USC’s Graduate Initiative for Diversity, Inclusion, and Access (DIA) aims to provide a pathway to PhD programs for undergraduate students by providing academic and financial support and professional development opportunities. DIA JumpStart works with schools and programs to invite diverse candidates from outside institutions to apply for 10-week summer research opportunities in various PhD disciplines. Available opportunities range from lab-based research to mentored participation in other types of faculty projects.

JUMPSTART PROGRAM OVERVIEW

DEADLINE TO APPLY
11:59 PM TUESDAY 2/22/22

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**PROGRAM BENEFITS**

- JumpStart scholars will receive a $5,000 stipend
- Health insurance for the duration of the program if needed (on campus program)
- Parking passes, bus or train passes (on campus program)
- USC email address and iVIP access to standard USC resources
- Fee waivers for PhD admission applications
- Graduate School sponsored professional development sessions
- JumpStart scholar’s research will be featured in an end of summer poster symposium

**Program Dates:** June 3 through August 8

**APPLICATION REQUIREMENTS**

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

**WHO SHOULD APPLY?**

Underrepresented, undergraduate students from outside USC who will be rising juniors or seniors and are interested in pursuing a PhD program.

**QUESTIONS? EMAIL: GRADDIA@USC.EDU**

COVID-19 Considerations: We are planning for an in-person summer experience, but JumpStart will follow USC, City and County of Los Angeles public health COVID guidelines.

**APPLY:**
https://provost.sma.usc.edu/prog/jumpstart2022
Opportunities by Field

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

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44  Bo-Kyung Elizabeth Kim

Business

28  Andrew Daw
29  Matteo Sesia
A NOVEL COMPREHENSIVE APPROACH TO POST-STROKE GAIT REHABILITATION

FACULTY: KRISTAN LEECH

This project seeks to determine the feasibility and optimal parameters of a novel approach to gait rehabilitation post-stroke that combines biofeedback- and aerobic intensity-based gait training. The chosen experimental design integrates biomechanical analyses and physiological assessments to determine how the aerobic intensity of walking influences the capacity for stroke survivors to make biofeedback-driven changes to their walking patterns. Ultimately, this work may lead to a more efficient, comprehensive treatment approach to improve walking dysfunction post-stroke.

Preferred majors: Neuroscience, Biomedical Engineering, Data Science

STUDENT LEARNING OUTCOMES

Students will learn:

- Human movement data collection procedures
- Clinical research policies and procedures
- Human movement data processing
Stroke is a leading cause of disability worldwide. Importantly, motor impairments, one of the most common impairments post-stroke, limit a stroke survivors’ ability to perform daily activities, contributing to reduced community participation and quality of life. Despite rehabilitation efforts, one of the most impenetrable problems challenging full recovery after stroke is the gap between what a stroke survivor can do and their choice to engage in home and community activities. Advances in wearable technologies (i.e., sensors such as FitBit or AppleWatch) can enable continuous monitoring of functional movement behavior and deliver a context-relevant intervention to encourage stroke survivors to be more active in their everyday life. We partnered with a small business in the development of a novel multi-sensor activity tracker system specifically designed for stroke survivors. The unique features of the wearable sensor system are the ability to capture and deliver feedback on both arm activity and mobility of stroke survivors outside clinical or laboratory settings.

Aims: This study will help to establish the feasibility and usability of the wearable sensor system to monitor functional movement behaviors at home in stroke survivors across a broad range of motor impairments seen in this population. We also aim to identify feedback preferences for driving behavior change.

Methods: Specifically, 30 individuals expressing a range (i.e., mild-severe) of motor impairment chronically after stroke will be recruited to participate in this project. Participation will include 2 lab visits and 1 week of monitoring with the wearable sensor system in the home and community. During the first lab visit, we will perform a battery of assessments to identify factors that may explain daily arm and hand performance, and physical mobility. Participants will be familiarized and trained on how to wear and charge the wearable sensors. After the first lab visit, participants will don the wearable sensors during waking hours for 7 days, while continuing their daily activities as usual. Adherence, occurrence of adverse events, and satisfaction with the wearable sensors will be recorded. During the second lab visit, data from the monitoring period will be used to present participants with a ‘Movement report’. The ‘Movement report’ will include visual displays of their performance (e.g. bar plots, line plots, gauges, rings or numerical values, etc.). Using qualitative semi-structured interviews and surveys, we will identify the components of feedback that users find most meaningful to encourage stroke survivors to move more and drive lasting behavior change.
Approximately 4 million women give birth in the United States each year. About half of these individuals have lower extremity pain of the knee, hip, or ankle, and about half have low back pain or pelvic girdle pain during their pregnancy. During the months after birth, mothers face large changes in their musculoskeletal, hormonal and psychological states, and for many, pain continues. In order to effectively inform treatment interventions for pain reduction in this postpartum population, we must first understand the physical demands of motherhood, including transporting, lifting, and feeding baby.

The Perinatal Health Research Group aims to characterize the biomechanics of postpartum mothers during common infant care tasks. The DIA Jumpstart scholar will be introduced to all aspects of a career in research and critical thinking during their tenure. The scholar will be able to explore options of ongoing projects to work on, depending on the ability to actively collect laboratory data given the COVID-19 pandemic. Examples of projects include:

1) Contribute to a systematic review of literature on the topics of pelvic girdle pain, low back pain, and current physical therapy interventions in the postpartum population
2) Collect biomechanical motion capture data on postpartum mother and her infant in the Jacquelin Perry Musculoskeletal Biomechanics Research Laboratory
3) Create a data processing pipeline to analyze previously collected pilot kinematic and electromyographic data in innovative and streamlined ways
4) Design motion characterization methods for analyzing publically available videos of mothers interacting with their infants
5) Establish scientific writing skills by contributing to written work on a project

The Jumpstart scholar will work closely with a faculty mentor and will be expected to report weekly on the progress of the project during lab meetings. Scholars will function as part of the Perinatal Health Research team and will learn the responsibility of themselves and colleagues, ethical standards in laboratory research, problem solving, and laboratory procedures. They may have the opportunity to present their research at internal, regional, or national conferences.

STUDENT LEARNING OUTCOMES

CONTINUE
This project aims to assess the effect of positioning on learning opportunities for infants at risk for cerebral palsy (CP). Previous work has shown that posture changes how typically developing infants explore objects and interact with caregivers; in particular, infants demonstrate improved object manipulation and increased social attention while in an upright sitting position. Children with CP often have delays in postural development and learn to sit much later than their typically developing peers, but little is known about how these postural delays affect learning and development.

In this study, we will examine object exploration during a structured object play task, and social attention during an unstructured social play task, in 8-14-month-old infants at risk for CP in three different positioning contexts: supine (lying on their backs), sitting with support from an adult, and sitting in a supportive infant seat. Object manipulation will be quantified using video behavioral coding; infants will wear head-mounted eye trackers to measure their eye gaze during play. Standardized clinical assessments of development and neurological function will be performed to assess gross and fine motor development and CP risk. The results of this study will be used to inform seating and positioning interventions for pediatric clinicians, to support the design of seating devices that maximize early learning opportunities, and to guide future work assessing the long-term impact of positioning on learning and development in CP.

Research assistants will contribute to infant recruitment, data collection, video processing, behavioral coding, data analysis, literature review, and may contribute to abstract submission for a national conference. They will have opportunities to interact with research participants (infants and their families) as well as researchers at all levels (graduate students, postdoctoral researchers, and faculty). They will have opportunities to learn how to collect and process eye gaze data using head-mounted eye trackers and to score standardized clinical assessments of development and motor function. Students will also attend a biweekly seminar hosted by the Division of Biokinesiology and Physical Therapy covering topics including career development, research methods, data management, and current research in the division. Students will complete an original research project during the internship and present a poster presentation at the end of the session.

STUDENT LEARNING OUTCOMES
The SIT-PT clinical trial is a National Institute of Health funded multi-site clinical trial led by Stacey Dusing in Biokinesiology and Physical Therapy. Infants 7-24 months of age with motor disabilities are enrolled and randomized to one of two interventions, MORE-PT or START-Play. Both interventions are based on well defined principles and are video recorded for regular monitoring of the accuracy of the intervention provided or fidelity. Each participant is also assessed 5 times over 12 months to quantify changes in motor, cognitive, and language development.

Undergraduate researchers are instrumental in videotaping these intervention and assessment sessions when completed by the research team. The visits are either completed in a research lab on the HSC campus or in the family home. As the student skills progress they may be trained to help administer questionnaires and prep equipment for the visits. Students gain valuable skills in interacting with parents and children engaged in research, observing intervention and assessment methods, managing video data, and in some cases completing basic methodological assessments with one to one supervision. Students will also have an opportunity to learn how to do behavioral coding, video editing, basic programming, data management or entry.

Each student will attend a weekly seminar with other undergraduate researches or new graduate students in our division. The seminar provides an introduction to career planning. A readings and data presentation seminar called Developmental Discussion Group is held bi-monthly with 4 faculty members specialist in pediatric physical therapy research providing opportunities to interact with DPT, PhD students, and post doctoral fellows in 3 different research labs. Students will complete a research project based on a current behavioral coding research questions going on in the lab. This will give the student an opportunity to go from data collection, to analysis, and into presentations. Students will practice presenting at a lab meeting and present a poster or presentation on their role in the research at the end of the session. This program will give some insight into pediatric physical therapy, but is focused on research related to the field and not clinical training.

STUDENT LEARNING OUTCOMES

CONTINUE
We have recently identified that men without a history of pelvic pain are able to relax their pelvic floor back to baseline after performing voluntary pelvic floor contractions. In contrast, men with CP/CPPS, particularly those with ejaculation-related pain, have an impaired ability to relax their pelvic floor muscles.

Brain markers of these observations are yet to be identified. Electroencephalogram (EEG) data collected from the same participants under the same experimental conditions is available to analyze. We hypothesize observing cohort-differences in the beta band that resemble the above-mentioned cohort-differences in muscle activation.

**STUDENT LEARNING OUTCOMES**

The learning outcomes for the summer interns:

- Understand symptoms of Chronic Prostatitis/Chronic Pelvic Pain Syndrome (CPPS)
- Understand associated sensorimotor dysfunction in CP/CPPS.
- Understand principles of motor control.
- Understand principles of neuroimaging, in particular EEG and its analysis pipelines.
- Understand how to perform structured literature review to support the different phases of research from study design to publication.
- Gain skills in working in a research environments to support ongoing research and identifying possible independent research projects.
Work in the Cnidarian Evolutionary Ecology Lab centers around the main question of what causes variation in the characteristics of organisms like coral and anemone. We want to know how ecology, or organism-environment interactions, induce or select for different traits and how these ecological interactions influence and are influenced by the evolutionary trajectories of populations and species. We use a variety of methods to address these questions, ranging from field experiments to ecophysiology to genomic analyses. We also have a strong interest in “translational ecology”: turning scientific findings into tools for conservation management.

Possible summer projects include processing and analyzing samples from a temperature stress experiment to understand how aspects of coral host physiology influence thermal tolerance, determining functional characteristics of bacterial associates of coral and anemones, and investigating differences in the physiology of dinoflagellate algal symbionts. A final project will be selected based on the individual interest of the prospective participant.

**STUDENT LEARNING OUTCOMES**

Students will learn:

- Students will learn methods in ecophysiology, animal care and microbial culturing techniques, statistical analyses and gain a general understanding of coral biology and ecology through participation in regular lab meetings.
RNA interference (RNAi) is an important mechanism through which cells regulate gene expression and protect the genome against aberrant gene expression, transposons, and viruses through evolutionarily conserved small RNA pathways. Integral components of small RNA pathways are RNA-induced silencing complexes (RISC), made up of an Argonaute protein family member and its associated small RNA, which induce silencing through sequence recognition of specific transcripts through a variety of different mechanisms including post-transcriptional or co-transcriptional silencing. In recent studies, it has been shown that some Argonaute proteins are dimethylated on arginine residues in arginine/glycine-rich regions (RG/RGG motifs), and that these motifs can be recognized and bound Tudor domain proteins.

We are currently focusing on the role of Tudor domain proteins in small RNA pathway in the nematode C. elegans. To this end, we will assess small RNA phenotypes associate with depletion of the Tudor domain proteins via RNA interference, determine localization of Tudor domain proteins by fluorescently microscopy, and assess interaction with known small RNA pathway components by colocalization and coimmunoprecipitation.

**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.
FLY MODELS OF NEUROLOGICAL DISEASE

The primary research goal of my lab is to study the fundamental mechanisms of post-transcriptional regulation of gene expression with an emphasis on RNA processing factors mutated in human disease. Specifically, we are interested in the post-transcriptional activities of the RNA-regulatory RNA exosome complex in human neurological disease. In my lab, we have taken the strategy of coupling in vitro molecular/biochemical studies with in vivo Drosophila genetics and multi-omic approaches to understand the different aspects of post-transcriptional regulation of RNA. Our focus ranges from defining tissue-specific roles of RNA processing, surveillance, and decay machinery to how defects in essential and ubiquitous RNA processing factors cause neurological disease.

STUDENT LEARNING OUTCOMES

• To determine the functional consequences of the specific amino acid substitutions in the RNA exosome that cause disease in humans, we will utilize a CRISPR/Cas9 system to generate fly mutants in the respective endogenous genes.
• The knowledge required to design, execute, and analyze the results of genetic experimentation in Drosophila
• The ability to recognize the experimental rationale of genetic studies as they are described in peer-reviewed research articles
• The ability to evaluate conclusions that are based on genetic data
• Insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets
Our laboratory at USC studies the structure of membrane proteins involved in synaptic transmission, to understand how neurons communicate. We are using a spectrum of biophysical and biochemical methods. Most notably, we are studying these proteins with the powerful technique of cryo-electron microscopy, which allows us to observe these proteins at atomic detail. With the results of our studies, we help to understand how these proteins work on the molecular level, while also guiding drug discovery to help with the treatment of neurological disorders.

Preferred majors: Biology, Chemistry

STUDENT LEARNING OUTCOMES

- The potential student will be fully immersed in the laboratory and get exposed to basic skills of molecular biology and biochemistry, as well as be able to observe imaging the produced samples with an electron microscope. If interested, the potential student could also be involved in computational aspects and data analysis.
SNAPSHOTS OF CHEMISTRY: VISUALIZATION AT THE MOLECULAR LEVEL

FACULTY: CHEMISTRY FACULTY

Preferred majors: Chemistry, Biochemistry

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. Research projects will cover a broad range of topics, spanning from femtosecond time-resolved observations of transient events to synthesis of novel drugs, development of nanostructures and catalysis in energy research, biochemical and structural investigations of proteins and nucleic acids, and theoretical investigations using advanced algorithm and state-of-the-art computer graphics and multimedia capabilities.

We offer 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 lab with a faculty advisor and graduate student mentor. We integrate student research activities with 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, 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.

STUDENT LEARNING OUTCOMES

- We provide comprehensive research opportunities, individualized 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.
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.

The DIA scholar will be involved in all aspects of data collection and data management, working with child participants and researchers. Students will be exposed to EEG, MRI, and behavioral data collection techniques and will be responsible for learning protocol and good research habits. The student will be responsible for collecting and maintaining high quality data. The DIA scholar will attend biweekly lab meetings, where they will learn the logistical aspects of managing a longitudinal research study. The student will also attend lectures and talks at the Brain and Creativity Institute centered around the topics of psychology, neuroscience, and music.

**STUDENT LEARNING OUTCOMES**

- Learning the day-to-day aspects of running a longitudinal research project
- Gain understanding of topics related 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
We are interested in understanding autism from a whole body perspective: the brain, behavior, and gut microbiome functioning. We analyze fMRI data, behavioral measures, and stool and saliva samples.

Preferred majors: Psychology, Occupational Therapy, Neuroscience

STUDENT LEARNING OUTCOMES

- Understanding of the biological basis of autism, understanding how to conduct research studies, analyze data, and participate in writing papers.
The NICU Therapy Lab investigates factors associated with cerebral alterations and adverse neurodevelopmental outcome in high risk newborn infants, specifically infants born prematurely. Early factors that can impede function and are being investigated include the environment (low stimulation environments as well as higher stimulation environments), stress, pain, medical complications and interventions, parenting, brain injury and prenatal exposures. The NICU Therapy Lab has developed a sensory intervention, The Supporting and Enhancing NICU Sensory Experiences (SENSE) program, which is supported by current evidence and aims to engage parents in providing age-appropriate, positive sensory exposures to their infants each day of NICU hospitalization. This program is being implemented in hundreds of NICUs across the United States and abroad. The NICU Therapy Lab has also developed the Neonatal Eating Outcome Assessment, which assesses feeding skills in preterm and high-risk infants. Other research interests include neurobehavioral assessment of preterm infants and early identification of developmental challenges, neonatal feeding, neurodevelopmental outcomes, empowering parents and early intervention services.

The NICU Therapy Lab is a new addition to USC, after being at Washington University for 12+ years. Through longitudinal data that has been collected over a long period of time, there are multiple opportunities for student-driven inquiry that aligns with this topic area and available cohort data. Along with other students in the NICU lab, DIA Jumpstart students will engage in active learning about OT and medical practice in the NICU setting, learn skills related to being a research scientist, and participate in identifying and answering research questions that can advance science. There may be opportunities for engaging in data collection with families, but it is uncertain if this will align with the timing of this year’s DIA JumpStart program.
RESEARCH IN CRANIOFACIAL BIRTH DEFECTS AND TISSUE REGENERATION

FACULTY: YANG CHAI

The human face represents the unique identity each of us present to the world. What’s more, the face and skull house many of our important sensory organs, our brain, and the entry points to the systems by which we breathe, eat, and speak. 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. The USC Center for Craniofacial Molecular Biology (ccmb.usc.edu) on the Health Sciences Campus is consistently recognized as one of the world’s top centers in the field, led by Director and University Professor Yang Chai.

The Chai Lab (chailab.usc.edu) has a strong track record of pioneering research investigating the molecular and cellular regulatory mechanisms of craniofacial development, with particular emphasis on congenital birth defects such as cleft palate and skull malformations. Lab members also conduct basic and translational research involving mesenchymal stem cells from in vitro studies to large animal models, necessary steps in the development of stem cell-based regenerative therapies for both soft and hard tissues. Dr. Chai is also currently Co-PI of the 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.

STUDENT LEARNING OUTCOMES

- The Center for Craniofacial Molecular Biology is a cutting-edge research center with a full suite of state-of-the-art equipment shared by all of our affiliated researchers. It provides a rich academic environment with weekly seminars, monthly journal club, and numerous venues through which to learn from each other and our colleagues at research institutions across the globe.
- Our JumpStart Scholar will hone their skills in important molecular and cellular biology techniques that will provide a strong foundation for future graduate studies or laboratory-based positions.
- Additionally, the JumpStart Scholar will gain confidence in visualization and communication of scientific concepts in a variety of settings, working directly with experienced postdoctoral fellows and highly trained professional laboratory staff.
- To culminate the summer, our JumpStart Scholar will give a presentation of their research to colleagues and faculty at the Center for Craniofacial Molecular Biology.
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 chitosan-amelogenin peptide. Amelogenin is a protein that animals and human use to build dental enamel. The Oldak lab has made significant contributions to fundamental research on biological mineralization and they are translating these finding into the clinic.

The JumpStart scholar working on this project 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. Students 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.

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

STUDENT LEARNING OUTCOMES

- Students will collaborate with graduate students and postdoctoral fellows in the lab to complete a research poster, and present their findings to colleagues and faculty at the end of the summer.
- An understanding of the general biologic principles that apply to the formation of tooth enamel and fabrication of enamel-like materials.
- Experience with the inner workings of NIH grant R01 level study in a research setting.
- Clarity on the process and information regarding potential next steps in higher education, and success within graduate programs.
- Learning laboratory techniques and the principals behind them students in the lab to complete a research
In this opportunity the student will work on two different applied microeconomics projects, under the direction of two faculty mentors.

The first research project involves the evaluation of a school greening program. The program involved the creation of green areas in a public-school playground. The study includes a treated school and a control school and has followed up participating students over several years. The objective of the research is to measure the impacts of the program on physical activity and short run and long run academic performance. The student would examine academic, health and behavioral data collected before and after a school greening project. The student tasks will include writing a literature review, data cleaning, data formatting, and data analysis.

The second research project aims to evaluate the changes in the psychological well-being and cognitive function of a large cohort of seniors across the US during the COVID-19 Pandemic. The project uses data from an ongoing online study by the research team. Previous analyses using these data has shown significant but temporary worsening of psychological variables, such as depression and stress, but no comparable changes in cognitive functioning. The student will help the team confirm these preliminary results with more recently collected data, examine possible hypothesis and implications for the relationship between mental health and cognition. Tasks will include helping with questionnaire design and testing for ongoing data collection, as well data cleaning, formatting and analysis; writing a literature review; and producing tables and graphs for presentations, papers and grant submissions.

**STUDENT LEARNING OUTCOMES**

- The student will learn empirical strategies used in economics to measure the impact of a program, using both cross section and longitudinal data.
- The student will also learn programming skills used for data analysis under the supervision of Profs. Paulina Oliva, Silvia Barcellos and postdoc Hao Yin, including how to construct outcomes of interest and to produce tables and figures that describe data and results.
- Most importantly, the student will learn to identify threats to identification of a causal impact and the empirical techniques and data analysis tools that economists use to overcome them.
- Finally, the student will learn academic writing and presentation skills.
NEUROMOBOTS

FACULTY: FRANCISCO VALERO-CUEVAS

Create robots with artificial nervous systems. Will be working with PhD students and post doctoral fellows to contribute to the design and construction of robots and hand prosthetics that use simulated neural circuits for control.

Preferred majors: Engineering or Neuroscience

STUDENT LEARNING OUTCOMES

- Working knowledge of Neuroscience
- Robotics
- Mechatronics
- Rapid prototyping
MODELING AND MACHINE LEARNING FOR INFECTIONOUS DISEASE FORECASTING

FACULTY: AJITESH SRIVASTAVA

After more than a year, COVID-19 continues to disrupt our lives. It has shown us that the state of infectious disease forecasting needs to address significant challenges to improve forecasting. Understanding the epidemiological situation and generating short-term forecasts and long-term scenario projections are important to drive public health decisions. For epidemics of interest, collaborative efforts take place worldwide between experts, government agencies, and stakeholders and have generated a vast amount of data that can be leveraged to evaluate forecasts. In this project, the candidate will conduct research to address how to improve epidemic forecasting by developing better data pre-processing techniques, fast regression models, exposing dynamics of competing variants, and learning the imperfect vaccines.

Preferred majors: Computer Science, Statistics, Computer Engineering, Mathematics

STUDENT LEARNING OUTCOMES

1) Understanding challenges in infectious disease forecasting.
2) Understanding epidemic dynamics.
3) Building the experience of applying machine learning and statistical tools to real-world problems.
4) Dealing with missing, noisy, and multiple sources of data.
Investigate ways to limit/eliminate defects in composite manufacturing by tailoring component format, modifying cure cycle, and developing resin formulations.

Preferred majors: Mechanical or Chemical Engineering

STUDENT LEARNING OUTCOMES

Tools for characterizing polymer matrix material by thermal analysis and rheology, incorporating data into models for cure kinetics and viscosity profiles, synthesis methods for producing polymer and ceramic composites.
Los Angeles’s Chinatown has been a city within a city for over 150 years, a destination for residents and tourists and a neighborhood vulnerable to the destructive acts of the dominant culture. The multifaceted Chinatown History Project utilizes digital humanities to access a reconstructed version of this historic place and encounter the life and labor histories of people who shaped a city, state, and nation – and invites further thought on contemporary understanding of a modern, pluralistic society.

Following the 1869 completion of the transcontinental railroad, Chinese rail workers and immigrants established businesses and residences in central Los Angeles near the historic Los Angeles Plaza. By the 1880s, the Chinatown community had expanded east of Alameda Street to land bordered by Macy Street (later renamed Cesar E. Chavez Avenue). In the 1910s, property that encompassed much of Chinatown and adjacent industrial land was identified as a site for a union passenger terminal to be shared by the three transcontinental carriers of the era. By the early 1930s, following decades of litigation, officials finalized plans to build the terminal in Chinatown. That decision required the acquisition of land, relocation of residents, and razing of all structures. Demolition of Chinatown began in December 1933. The grand opening of the Los Angeles Union Passenger Terminal took place in May of 1939.

This project is devoted to recalling, memorializing, and analyzing that environment and those who moved and created new neighborhoods so that the last major metropolitan rail depot constructed in the nation could rise from the neighborhood that was once theirs. This is one moment in the city’s long history of racial antagonism toward people and communities of Asian descent. While well known in the Chinese and Chinese American community (especially in nearby “New Chinatown,” constructed as the first Chinatown fell), the history of this destruction, displacement, and rebirth is not widely known by broader public or scholarly audiences. This project springs from our team’s devotion to study, remember, and in a sense recover that earlier landscape and the people within it (and to share that recovery as widely as possible).
Small cell lung cancer (SCLC) is the second most aggressive cancer type in humans, with a 5-year survival of only 8%. SCLC kills over 20,000 Americans per year. Therapy for this disease has improved only marginally in the last 30 years, with the addition of prophylactic cranial irradiation (irradiation of the skull, because the disease commonly spreads to the brain) and recently the combination of standard cytotoxic therapy with immune checkpoint inhibition, which prevents the cancer cells from “hiding” from the immune system. Adding immune checkpoint inhibition therapy created much excitement despite only increasing the median overall survival from 10.3 months to 12.3 months. This shows just how dire the need is for improved SCLC therapies. Previous studies of SCLC patients exhibiting a naturally-occurring immune response called “anti-Hu” showed that those SCLC patients respond better to standard therapy and live longer. This observation inspired Dr. Offringa to identify the antigen (the cause of the immune response). We found that ELAVL4, a protein expressed in pulmonary neuroendocrine cells (the cells of origin of SCLC) is the immune target. In addition, we found that in the context of SCLC, ELAVL4 undergoes a type of damage called isoaspartylation. This “kinks” the protein and makes it antigenic. Our hypothesis is that this immune response can be leveraged to develop new therapies for SCLC patients. Our preclinical aims leverage a powerful SCLC mouse model available in the Offringa lab by testing immunization with isoaspartylated ELAVL4 as well as developing monoclonal antibodies against isoaspartylated ELAVL4.

STUDENT LEARNING OUTCOMES

By the end of the program the student should be able to:

- Describe what small cell lung cancer is, including the cell of origin and clinical characteristics
- Explain what monoclonal antibodies and how they are made
- Explain how the mouse SCLC model works
- Be able to handle mice confidently (after having undergone training)
- Apply the rotarod instrument to test for neurological defects in mice
- Analyze rotarod data
- Interpret rotarod data
- Apply the Paster score sheet to mouse health
- Interpret data from the Paster score sheet
- Create a powerpoint presentation or poster about the project
- Explain the whole project to a variety of audiences
Rejection continues to be an important cause of graft loss and failure post-liver transplant (LT). The diagnosis of rejection is not predicted by changes in liver function tests and thus requires an invasive biopsy. Meaningful examination of alloreactive lymphocyte populations has been limited by the amount of tissue in a core biopsy and the constraints of immunohistochemistry. The Emamaullee Lab is developing novel, high resolution single cell multiomic techniques to understand which lymphocytes are involved in allogenicity post-LT.

The project for this undergraduate program application involves characterizing lymphocyte subpopulations during known episodes of acute cellular rejection post-LT. Imaging mass cytometry, CyTOF, and single cell RNA sequencing techniques will be used to study patients with known acute cellular rejection to characterize lymphocyte populations associated with this phase of rejection. The role of the undergraduate students will be to learn about single cell and computational biology approaches required to analyze these data. Under the supervision of the PI, students will gain expertise in these techniques, and also participate in various educational activities related to clinical liver transplantation and experimental immunology.

Preferred majors: Bioinformatics, Biomedical engineering, Biochemistry, Immunology, Biology

STUDENT LEARNING OUTCOMES

- Gain experience in working with clinical data
- Develop expertise in computational biology techniques including R programming, Seurat, Histocat, Ilastik, etc
- Build knowledge in immunology and transplant immunology
- Learn about manuscript and abstract preparation
- Work within a highly diverse team of undergraduate, graduate, postdoctoral, and clinical trainees
The ease and speed at which information can be shared online has become one of the most important and consequential components of modern life. This has democratized the documentation and discussion of major events, but it has also created vulnerabilities in the accuracy of information. This is particularly true when the information is being reported quickly or in real time, as it can be hard to verify what is being said until reality can be observed.

Consider the following simplified example. Suppose you are watching real time streams of posts regarding the same situation, but the posts disagree about what is occurring. Some posts say that Outcome A happened, whereas some say that Outcome A did not happen. Outcome A either happened or it didn’t, so not all of these posts can be true. From an outsider’s perspective, though, it can be hard to tell what is true and what isn’t. In particular, some people may share or repeat information without actually knowing what truly happened, accidentally or even antagonistically lending credence to what may be eventually revealed to be false. Simply because a piece of information has been shared recently can make it more likely to be shared again, and this makes it challenging to identify the truth.

In this project, we will create probability models of the information sharing process and its underlying virality. Through these models, we will propose and analyze policies for determining when and why an outside observer should believe a real time story within an information stream. Our goal will be to evaluate these models and policies both through careful mathematic analysis and through simulation study. Furthermore, given the plethora of relevant examples in social networks, we will also collect and analyze data so that we can apply our models to reality, evaluating their fit and their usefulness in practice.
Machine learning algorithms are widely applied in many scientific fields, across businesses, and in several public sectors, for their ability to identify hidden patterns in large data sets. The predictions made by machine learning models often inform high-stakes decisions, such as whether to invest resources in specific follow-up studies, which assets to purchase or products to advertise, which credit or job applications to accept, or which defendants to grant bail. Unfortunately, machine learning models can be quite obscure and difficult to explain, are sometimes unreliable, and they are based on data which are not always representative of the population of interest. Consequently, their output may be difficult to trust and often underestimates the true difficulty of predicting complex phenomena accurately. Further, without proper checks and balances, sampling biases or other limitations of the data risk getting automatically absorbed into these models and propagating into the final decisions, raising safety and fairness concerns.

In this project, students will acquire hands-on-experience on how to properly use state-of-the-art machine learning techniques for uncertainty estimation. They will learn about different notions of algorithmic fairness and their relative advantages/limitations. They will implement these highly impactful machine learning algorithms in modern computational facilities and will have the opportunity to observe their usefulness by conducting large-scale numerical experiments using simulated and real data.

The details of this project can be tailored to the student’s specific interest and background. The core of this project is in statistical programming, machine learning modeling, and data analysis, but the relative focus on each component can shifted to best suit the individual needs of each student. Typically, research of this style is most natural for students majoring in statistics, computer science, data science, math, engineering, or other quantitative disciplines, but motivated applicants from other majors will also be given full consideration. Some prior programming experience, ideally in Python, is desired but not required.
Bacterial cells are capable of producing and taking up tiny pieces of cells called vesicles. These vesicles, which are surrounded by cell membrane, contain many biomolecules, including DNA. When DNA is packaged within a vesicle and the vesicle is taken up by another cell, the DNA inside is exchanged between two cells. Such horizontal gene transfer is important in the ecology and evolution of bacteria in the wild. DNA exchange within vesicles also enables different species of bacteria to exchange genes. Little is known about the kinetics of gene exchange within vesicles, and this project is designed to measure the rate of vesicle-mediated gene transfer and determine how this rate is influenced by the bacterial species involved and helper proteins and molecules that may facilitate vesicle production and uptake.

**STUDENT LEARNING OUTCOMES**

- As part of this research, students will isolate bacteria from the wild and measure the ability of these wild strains to take up and express genes contained within bacterial vesicles. The rates of gene transfer in vesicles will be compared for different bacterial species and strains under a variety of environmental conditions.
- The project will teach basic skills for the isolation and culture of bacteria as well as molecular biology techniques to measure vesicle production and gene transfer. There is a possibility of learning genetic engineering techniques to design bacterial strains to better quantify rates of gene transfer.
- Students will also learn how to plan and execute scientific experiments and analyze data. Data analysis may include basics in automated image analysis.
- Students will gain experience in thinking critically about scientific data and presenting their results to others.
Cannabis is the most commonly used substance during pregnancy. Due to a lack of evidence on efficacy and safety, women are advised not to use cannabis in pregnancy. Yet these recommendations are being made in a context in which policies and perceptions about cannabis use are becoming increasingly acceptable. Community perceptions of maternal cannabis use and risk, and its impact on maternal health disparities remain largely unexplored. Yet these data are urgently needed given expanding legalization, incomplete information about the safety of cannabis during pregnancy, and recent increases in prenatal cannabis use.

For the proposed pilot study, we posit that expanding legalization and increasing social acceptability and accessibility of cannabis may worsen existing maternal health disparities. This study will examine how maternal health stakeholders, cannabis retailers, and pregnant women perceive cannabis use and its impact on maternal health disparities in Black, Indigenous, and/or People of Color (BIPOC) communities in Los Angeles, California, where adult cannabis use is legal.

Using semi-structured qualitative interviews, the proposed study will be one of the first to identify community-level perceptions of cannabis risk, social and structural level influences impacting health disparities, and cannabis use patterns during pregnancy. This study advances the scope of Dr. Ceasar’s ongoing research on maternal cannabis use perceptions among pregnant Latinx women in Los Angeles. Findings will provide preliminary data for a larger study (R01) on assessing the efficacy of an implementation strategy designed to promote cannabis education for maternal health stakeholders, cannabis retailers, and pregnant women.

Preferred majors: Social Sciences (Anthropology, Sociology), Public Health

STUDENT LEARNING OUTCOMES
There is little doubt that housing insecurity and homelessness among college students disrupt learning and threaten student retention and success. To address this urgent basic need, more housing units are needed in California especially for low income students. There is a severe shortage of housing units throughout the state. From 1980-2010, housing construction nationally grew by 54%, while California’s housing stock grew by only 32%; as a comparison, housing construction in California from 1940-1970 grew by 200%. To make matters worse, the California Legislative Analyst’s Office (LAO) estimated that 70,000-110,000 new housing units would have been needed per year to keep housing prices from rising faster than the national average.

The proposed project, the Los Angeles Community College District Housing Strategy for Student Success (LACCD-HSSS) addresses options for meeting this basic need. The LACCD is the largest community college district in the US, enrolling over 230,000 students across nine campuses on almost 900 square miles of land in Los Angeles County. The LACCD serves a wide range of students including those seeking to transfer to four year universities (48%), those completing two-year workforce degrees and certificates, and adult learners seeking credentials for upward mobility or who are life-long learners (32%). Almost 60% of LACCD’s student body is Hispanic/Latino/a/x, 57% are female, 56% are first generation students, and 53% are living in poverty; a 2016 LACCD student survey indicated that 55% were housing insecure and 19% were homeless.

LACCD has worked with local nonprofits to provide housing for students experiencing homelessness, with about 75 students placed in housing over the past year. The basic need for housing however requires a scaling strategy to meet LACCD students’ basic need for stable and affordable housing.

Preferred majors: Economics, Sociology, Geography, Ethnic Studies, Public Affairs

CONTINUE
BEYOND CONQUEST

FACULTY:
BENJAMIN GRAHAM

Does military power still pay? The conventional wisdom is that conquest has become unprofitable and thus military power is largely obsolete as a means for seeking wealth in a globalized world. The conventional wisdom is wrong. There remain valuable pathways beyond conquest through which states continue to use military power for economic gain. We introduce a comprehensive typology of these pathways and develop and test theory regarding the conditions under which different types of states pursue wealth via different pathways.

Preferred majors: Any is fine, though Computer Science, Political Science, and Economics are all useful.

STUDENT LEARNING OUTCOMES

The DIA student will have an opportunity to participate alongside a cohort of NSF-funded summer research fellows in the Security and Political Economy Lab Research Experience for Undergraduates (see uscspec.org for details). The student will participate in a slate of formal trainings in applied data science using R as well as research design trainings and professionalization workshops aimed at helping prepare students for doctoral study and careers in social science research.
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 early 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. Thus, 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, Computer Science

Student Learning Outcomes

Students are expected to work on a team of graduate students and research assistants to help us collect, clean/process, and analyze these data. Thus, 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.
The CAR lab examines cognitive and affective processes involved in the regulation of negative affect, in an effort to identify vulnerability factors for mood disorders.

We take a multi-method approach to examining individual differences in styles of thinking and regulating negative affect. This work involves laboratory-based measures of brain activity (using fMRI and event-related potentials), autonomic nervous system functioning (heart rate and respiration), and behavior (computer tasks and questionnaires). In addition, to understand behavior outside of the lab, we utilize ambulatory assessment to measure person-centered variability in autonomic functioning (with wearables), sleep quality (with actigraphy), affect and regulation strategies (using ecological momentary assessment), and digital phenotyping approaches to measuring behavior.

Preferred majors or minors: Psychology, Neuroscience, or related discipline with relevant experience

STUDENT LEARNING OUTCOMES

1) Scoring and analyzing physiological data, such as heart rate and respiration

2) Learning to administer psychology experiments, including executive functioning tasks and psychophysiological assessment

3) Opportunities to generate, test, and present independent research questions
BIG DATA ANALYSIS TECHNIQUES (BDAT) FOR SCIENTIFIC REPRODUCIBILITY

FACULTY:
SERGHEI MANGUL

THE MANGUL LAB AT USC

The Mangul Lab designs, develops, and applies novel data-driven, computational approaches that accelerate the diffusion of genomics and biomedical data into translational research and education. The undergraduate and graduate students, postdocs, and PI at the Mangul Lab create novel bioinformatics methods and apply these tools to big data, perform benchmarking studies to assess genomics methods and help researchers select the right tools for a project, and work to increase the installation ability and archival stability of bioinformatics software.

We aim to provide Fellows a realistic experience, at the level of a typical first-year graduate student, in collaborative scientific research and scholarly communication. We will provide hands-on training to help Fellows gain competency in using computational tools for big data analytic techniques (BDAT) and scientific replicability. With our guidance, the Fellow will leverage acquired skill sets to conduct a benchmarking project that assesses the accuracy and usability of computational tools developed for genomics and biomedical data.

Our proposed activities for the fellows support recent demand for integration of computational skills and scientific reproducibility in biomedical curricula and inquiry-based learning in research universities (Boyer Commission Report). During the last 15 years, the amount of available high throughput (“big”) data has doubled every few months; this exponential growth has made computational tools a key driver of life science research. In order to analyze today’s big data, biomedical researchers now rely on analytical and data visualization computational tools produced by bioinformatics scholars—tools that often lack a graphical user interface. As data sets and analysis techniques become larger and more complex, reproducibility becomes a larger issue: published results often contain analyses that cannot be replicated. Ideally, an undergraduate student would be exposed to computational tools for BDAT and scientific reproducibility while they contemplate career and graduate school options.
Alcohol use disorder (AUD) ranks third on the list of preventable causes of morbidity and mortality in the United States, having a major national impact affecting over 18 million people and causing over 100,000 deaths annually. Approximately 25% of those individuals suffering AUD develop Alcohol Liver Disease (ALD). Unfortunately, high rates of alcohol (ethanol/EtOH) abuse, including binge-drinking, is increasing, and these unhealthy drinking patterns are contributing to higher incidents of ALD, including an increase in the number of young adults diagnosed with ALD. Current FDA-approved AUD medications are minimally effective in reducing AUD and there are no approved therapies for ameliorating ALD beyond the administration of corticosteroids as anti-inflammatory agents or in worse case scenarios, a liver transplant. The lack of therapies for ALD is due, in part to the multifactorial systemic responses that are associated with heavy EtOH intake and the way EtOH affects individuals. Overall, the lack of effective therapeutics illustrates the necessity for innovative methods and/or the identification of novel targets for the development of useful medications for the treatment of AUD and/or the consequential damage associated with alcohol abuse (e.g., ALD).

The Davies laboratory has been investigating ivermectin (IVM) and other members of the avermectin family as a new class of pharmacotherapeutics to prevent and/or treat AUD. IVM is already approved for human use therefore, repurposing of IVM for AUD represents a fast and effective translational strategy. Moreover, the lab’s extensive preclinical discoveries showing that IVM can reduce EtOH intake in mice sets the stage for a repurposing strategy. Unfortunately, IVM’s lipophilic profile and substrate binding to the P-glycoprotein (Pgp/ABCB1) efflux transporter affects its pharmacokinetic (PK) profile, limiting its CNS bioavailability. Recently, preliminary investigations suggest that dihydromyricetin (DHM), a flavonoid derived from Hovenia dulcis, can be used to significantly improve IVM’s ability to reduce EtOH intake in rodents which may be via reduction of Pgp activity. In that DHM has been recently demonstrated to have liver-protective properties, the pairing of IVM/DHM sets the stage for a conceptually novel combinational therapy that can be used to reduce the severity of AUD symptoms, meanwhile, providing benefits to prevent ALD for the patient.

Preferred majors: Biology, Pharmacology, Chemistry, Biochemistry
TRNA MODIFICATIONS AS THE “YIN-YANG” SWITCH OF INNATE IMMUNITY

FACULTY: ZHIPENG LU

The discrimination of “us vs. them” by the innate immune system is critical for fighting pathogens without self-damage. RNA sensors, such as RIG-I-like and Toll-like receptors (RLRs & TLRs) have evolved to recognize self vs. foreign RNA from bacteria and viruses. While pathogen RNAs usually lack modifications and activate these sensors, animal RNAs are highly modified to suppress them. Failure to sense foreign RNA leads to pathogen escape, whereas overactivation of RLR/TLR signaling and overreaction to self RNA underlies many autoimmune diseases that affect >7% of world population. In particular, the highly abundant tRNAs and their fragments (tRFs) in circulation play critical roles in immune activation. Despite the importance of balancing RNA immunity, mechanisms of host tRNA modifications and their roles in autoimmunity remain poorly understood.

Small nucleolar (sno)RNAs are a large family of ncRNA that guide RNA modifications. While a small subset of snoRNAs recruit the 2’-O-methyltransferase FBL and pseudouridine (Ψ) synthase DKCl to rRNAs and snRNAs, most have no known targets and called “orphans”. Recently we developed a new method, PARIS, for de novo discovery of RNA interactions using crosslinking and sequencing and found that snoRNAs guide modifications on more than 90% of all tRNAs, suggesting a new mechanism in regulating RNA innate immunity and autoimmune diseases. We hypothesize that snoRNA-guided tRNA modifications suppress self-activation, disruption of which contributes to autoimmune diseases. In this project we set out to determine the mechanisms that regulate tRNA modifications and their processing into tRFs (Aim 1), identify the specific modifications, tRNA/tRF species, and cellular receptors that mediate tRNA immune stimulation/suppression (Aim 2), and determine the role of tRNA/tRF modifications in autoimmune diseases in mouse models and human patients (Aim 3).

This project is part of our long-term goal to understand the basic biology and clinical applications of RNA interactions and modifications. In recent years, RNA modifications and their related signaling pathways have been exploited to develop COVID19 mRNA vaccines and cancer immunotherapies. The proposed studies on the fundamental mechanisms of tRNA and tRF modifications will lay a solid foundation for further vaccine and drug development targeting infectious diseases, autoimmune disorders, and cancers.

CONTINUE
When the COVID-19 pandemic swept across the globe in early 2020, scholars, journalists, and activists alike described the pandemic as a “perfect recipe,” a “perfect storm for rebellion” where “[social] unrest was inevitable.” The sociology of social disasters leads us to expect that a global pandemic will generate a pronounced contextual shift, a shock that unsettles both the political system and day-to-day life. Social movements scholarship leads us to expect the shock of the pandemic to generate an opportunity for deeper social change, especially among young activists. Yet these studies also show that social disasters amplify existing social inequalities across intersections of race, class, and gender, where effects are unequally distributed across groups with varied levels of precarity. COVID-19, for example, was conceptualized as a “racial time bomb” for its disproportionate threat to Black and Brown communities, manifesting through deeper systems of inequality. Widespread reports warned of learning loss and an exacerbated achievement gap for Black and Brown students who found their life trajectories interrupted, their lives increasingly constrained under COVID-19 lockdowns, increased familial responsibilities, and widespread death and bereavement.

Understanding specifically how the ongoing pandemic impacts activism among minoritized youth is essential as a wide range of studies show that collective action is a critical mode of civic and political incorporation for youth. Participating in youth social movement organizations, deliberating and strategizing in a group, learning the ropes of the political system, are all forms of political education that are also linked to educational and economic advancement. This study examines this puzzle through the case of youth movements for racial justice and their strategic recalibration during the ongoing pandemic. How do youth activists reconcile competing existential threats – systemic racism and a pandemic – through the political opportunity of an “unsettled time”? How does a social disaster shift mobilization strategies for racial justice movements more broadly? Students will help collect data examining how youth activists themselves make sense of the movement for racial justice in this unsettled time. The study will conduct semi-structured interviews with student activists and participant observation of Los Angeles youth activist organizations during summer 2022.
Impacts of climate change exacerbate the strain disproportionately on different sociodemographic groups, limiting social mobility and threatening public health. California is at the forefront of experiencing the modern impacts of climate change with the increased frequency of wildfires, intensifying heat waves, scant water resources, and increased air pollution and allergens. This study utilizes NOAA’s Climate Forecast System (CFS), and NASA’s Suomi NPP vegetation data to derive climatic, ecological and public health indices based on climate variables, airborne pollutant concentrations and vegetation indices. Unlike previous studies that derive empirical indices, this study is aimed at utilizing computer vision techniques to define climate and public health indices of extremes in terms of spatio-temporal evolution of new microclimates that threaten public health. Change in microclimates over time will be quantified by data-driven classification of spatio-temporal evolution patterns.

The second part of the proposed study will focus on modeling geographic associations between different microclimates and sociodemographics. The sociodemographic data will be derived from the latest American Community Survey (ACS) data and Supplemental Nutrition Assistance Program (SNAP) database. A statistical collocation analysis will be performed on time-varying climate stressors grouped into microclimates and sociodemographic variables to quantify disproportionately exposed populations in California. The space-time associations between the health-threatening microclimates and the sociodemographics will be defined via a spatio-temporal colocation test, that indicates sociodemographic groups that are at risk with high statistical significance. The disproportionality of the climate risk is quantified with a modified Area Deprivation Index and other niche indices that can be defined as a result of the project. All data sources will be represented inside a Geographic Information System (GIS) and analysis results will be served to public in a digital story-telling format.

Preferred majors: Statistics, Computer Science, Geography, Social Sciences
In the nascent field of synthetic morphogenesis, we strive to identify and implement artificial genetic circuits to drive user-defined processes of morphogenesis. One area of focus for the group is growing axially elongated structures starting from spherically symmetric aggregates; we have identified initial candidates circuits and we want to explore their features of robustness, and capacity to modulate outcome to obtain branched structures. The student will work with computational software to explore the different circuits features, as well as contribute to their implementation in cellular systems in the lab via genetic engineering of mammalian cells grown in the lab.

Preferred majors: Computer Science, Biology, Engineering, Pre-med

STUDENT LEARNING OUTCOMES

Students will learn basics of synthetic biology research including: molecular cloning of DNA plasmids, use of fluorescent microscope for imaging of cellular phenotypes, use of software for computational simulations of developmental trajectories
While most cells in our body maintain their identity, a few cells exhibit plasticity by changing their identity. Cell Plasticity allows continuous stem cell differentiation, organ maintenance, and tissues regeneration after stem cell damage through fate reversal of mature cells. However, such plasticity is detrimental in diseases such as cancer, where abnormal cells can regenerate by evading therapies designed to eliminate them. Why certain cells possess plasticity and what controls the cell fate change remains unclear; my laboratory studies the mechanistic regulation of cellular plasticity in light of tissue regeneration and disease.

We have shown that epigenetic regulation - the control of gene action through chemical and structural modification of DNA - is a major determinant of cell plasticity. Our studies have revealed principles of epigenetic control of cell identity and how plasticity of chromatin allows reversion of mature cells into stem cells. Building on this conceptual foundation and gastrointestinal tissue as a model, we ask:

1) What are the epigenetic barriers to tissue regeneration and cancer formation, and conversely,
2) What epigenetic states allow intestinal regeneration, and tumor initiation, growth, and relapse.

Preferred majors: Biology, Computational Sciences, or related fields

STUDENT LEARNING OUTCOMES

Learning opportunities and outcome for students:
- Conceptual and hands-on experience in: Mouse biology, tissue handling, microscopy, epigenetics, single-cell biology, cancer biology
- Exposure to: public genomic data resources such as the GEO database, The Cancer Genome Atlas (TCGA), ENCODE database.
- Computational biology and bioinformatics exposure: computational languages: Unix, Python, R, Perl,
- Sequencing data analysis: data alignment and pre-processing using pipelines, quality control, visualization, and interpretation
At the Center for Homelessness, Housing and Health Equity Research we have several ongoing projects that could support a student intern. These include: 1) a randomized control trial comparing social support versus universal basic income (UBI) plus social support for people experiencing homelessness; 2) a phone based longitudinal study of Los Angeles unsheltered population; 3) comparison study of different housing models on COVID-19 related outcomes for people who have experience homelessness. Data collection for all 3 projects are expected to be ongoing during the summer of 2022.

No preference; person needs to be willing to work with vulnerable populations.

**STUDENT LEARNING OUTCOMES**

We expect the following learning outcomes:

1) Understanding the impact of institutional racism on the problem of homelessness.
2) Learn about the research process (data collection, human subjects training).
3) Work effectively as part of multidisciplinary research team.
Juvenile court school is a byproduct of racial and ethnic inequality in the school-to-prison pipeline (STTP). The STTP is an empirically-tested concept that highlights how minoritized racial and ethnic youth are impacted by school and community-based practices and policies that lead to incarceration. While juvenile court schools are criticized for poor education quality, juvenile court school is the last educational opportunity for incarcerated youth to re-engage in education systems – a turning point for many. In this study, we examine educational challenges and needs of incarcerated youth within the context of racial inequity through the lens of educational advocates and the youth themselves. Phase 1 will include interviews of LA county education attorneys that will illuminate barriers and challenges to education, especially in the era of COVID-19 and possible solutions to change the system. Phase 2 will include surveys of youth attending juvenile court schools in the LA County Office of Education (LACOE). In this Phase, we examine the extent to which the current school policy and practice of SEL address racial inequity and promote social-emotional learning (SEL) towards the goal of ensuring equitable learning opportunities and improving outcomes. There is strong empirical evidence to suggest that SEL can foster resilience among marginalized youth. The youth survey, one of the first to examine racial identity and injustice in juvenile court schools, will leverage and adapt existing instrumentation. This work comes at a critical moment given the likely impact of the pandemic (e.g., frequent lockdown and solitary confinement for quarantining purposes) and police violence against Black Americans, on the education as well as social-emotional well-being of incarcerated youth.
Conclusion: The resulting technology will integrate engineering and patient-centered rehabilitation approaches to promote fuller participation in meaningful life activities outside clinical settings in a less structured environment—one where stroke survivors live their lives. The long-term goal for this project and the MiGo technology is to develop a data-driven and clinically informed behavioral intervention strategy that uses actionable feedback to maximize physical function after stroke.

STUDENT LEARNING OUTCOMES

The Motor Behavior and Neurorehabilitation Laboratory hosts an interdisciplinary research program focused on understanding control, rehabilitation and recovery of goal-directed movements that emerge from a dynamic brain-behavior system in brain-damaged conditions. The student will gain a greater understanding of how research methods can be used to answer clinically relevant questions at the intersection of neuroscience and rehabilitation. The student will also familiarize themselves with the different steps involved in conducting clinical research in rehabilitation. They will be involved in the recruitment of participants, the data collection and analysis, and the presentation of the results for scientific communication. The student will gain more exposure about various projects ongoing in the laboratory, interact with other lab members and work in teams. By the end of the program, we anticipate the student to improve the following research knowledge and skills:

- Learn and understand the methods involved in rehabilitation research.
- Develop the skills to read and understand simple research papers.
- Develop the verbal, non-verbal and written communication skills needed to effectively communicate with stroke survivors.
- Gain exposure to scientific writing and results dissemination.
- Take responsibilities in coordinating portions of a clinical experiment.
- Understand the methods to analyze quantitative and qualitative data.
- Work collaboratively in a team with researchers, clinicians, and engineers.
- Learn about the ethics and regulations pertaining to human subjects research.
STUDENT LEARNING OUTCOMES

1) Critically analyze research evidence, including determining risk of bias, understanding basic principles of common statistical methods used in relevant literature, and interpreting key findings.

2) Contribute to all aspects of human motion data collection: setting up motion markers and electromyographic and acceleration sensors, calibrating cameras, placing equipment on participants, running software programs and timers during collection, assuring data quality, and completing equipment protocols.

3) Understand current data analysis processing techniques and software, including learning Qualisys motion tracking and/or Visual 3D. Creatively conceptualize ways to streamline these processes using data reduction, coding, or other techniques.

4) Identify sources of publicly available videos and keyword search procedures to identify usable videos for mother-infant physical activities, and identify analysis methods or software to quantitatively describe movements.

5) Disseminate findings of their project by writing and presenting updates at lab meetings, and contributing to abstracts or manuscripts to present their findings at regional or national conferences.
OBJECT EXPLORATION AND SOCIAL ATTENTION IN INFANTS AT RISK FOR CEREBRAL PALSY

FACULTY:
KARI KRETCH

STUDENT LEARNING OUTCOMES

At the completion of the internship, students will:

1) Understand the ethical and safety considerations needed to participate in research and demonstrate the ability to integrate these values during interactions with participants and their families.

2) Demonstrate proficiency in reading and summarizing research articles.

3) Gain basic understanding of data collection and data processing methods for infant behavioral data, including head-mounted eye tracking data.

4) Demonstrate proficiency in behavioral coding of video data including eye gaze data.

5) Gain basic understanding of clinical measures typically used to assess motor skills in infants and children.

6) Develop research dissemination skills culminating in a presentation of an original research project.

In addition to these general learning objectives, each student will complete an Individualized Development Plan to self-reflect on their knowledge, preferences, strengths and areas for growth. Based on this assessment, a plan will be established to increase opportunities in specific areas as is safe and ethical.
STUDENT LEARNING OUTCOMES

1) Learn the ethical and safety considerations needed to participate in research and demonstrate the ability to integrate these values during interactions with participants and their families.

2) Gain an understanding of the multiple steps and roles of different researchers involved in a clinical trial.

3) Develop their skills in reading and discussing literature.

4) Demonstrate skills with behavioral coding to ask and answer a specific research question.

In addition to these general learning objectives each student will complete an Individualized Development Plan to help self reflect on their knowledge, preferences, strengths and areas for growth. Based on this assessment a plan will be established to increase opportunities in specific areas as is safe and ethical. A mentoring contract between the PI, students, and another senior lab staff that will engage with the student is completed the first week of the experience.
NEONATAL INTENSIVE CARE UNIT (NICU) THERAPY RESEARCH LABORATORY

FACULTY:
ROBERTA (BOBBI) PINEDA

STUDENT LEARNING OUTCOMES

1) Demonstrate skills related to doing a literature review of current evidence on a topic related to the NICU, early human development or high-risk families

2) Understand how to operationalize variables for research

3) Identify a research question that can be answered from longitudinal data collected on high-risk infants and their families

4) Learn about medical factors related to NICU care; learn about parenting a high risk infant in the NICU; learn about the early sensory environment in the NICU and how it can impact brain development; learn about therapeutic strategies used to improve outcomes of high-risk infants and families

5) Learn research skills: conducting literature reviews, operationalizing, data collection and management, using SPSS and analyzing data, conducting professional presentations, reporting research results; ethics and conduct in research

6) Explore interests related to obtaining a PhD and becoming a research scientist
The project has its origin in our encounter with nearly 150 historic photographs taken just before demolition and displacement took place in the early years of the Great Depression. Utilizing those images (which are meticulously addressed so as to allow GIS work), our Chinatown History Project brings humanities research – collected in the database described below – together with new techniques and technologies in digital humanities and augmented reality to display research findings and to invite anyone to pursue additional humanities research through the assembled historical data.

Student researchers will join a broad and diverse research team made up of more than a dozen participants. We cannot visit the neighborhood as it was but its history is buried in archives, public documents, journalistic sources, other photographic images, and within human memories. The Chinatown History Project proceeds on two major inquiries of humanities research, analysis and outreach. A team of historians, archivists, curators, and student researchers is at work adding data to the historic images and sites which they depict. Who lived in this apartment building before it was knocked down? Who worked at this stable? Who owned or was employed by this grocery store, that auto body shop, this herbalist? Using conventional historical sources – census and immigration records, scholarly monographs and articles, extant oral histories, newspaper sources, legal records, even the demolition permits – we are building a searchable database rich with social history variables (name, race/ethnicity/date and place of birth, occupation; business type, etc.).

Students will immerse themselves into the lost neighborhood and its history – analyzing and inputting social historical variables (name, occupation, citizenship status, family information, residence, etc.) and visual sources into the original database. Students will learn digital humanities tools, techniques, and the ways in which historical data and interpretations can then be brought to wider public dissemination and dialogue. Student researchers will be part of the team’s commitment to memorializing the lost Chinatown of Los Angeles, a facet of the project that will bring us all into conversation with civic leaders, members of the Los Angeles Mayor’s Civic Memory Working Group, our partners at the Chinese Historical Society of Southern California, and Los Angeles Metro (the owner of Union Station), with whom we expect to work closely in installing new commemorative features atop where Chinatown once stood.

We expect greater access to archives this coming summer and students would be invited to conduct in-person research at the various locations, including Seaver Center, Los Angeles Metro, and CHSSC – as schedules and access permits.
FAKE NEWS IN REAL TIME: PROBABILITY MODELS OF (MIS)INFORMATION STREAMS

FACULTY:
ANDREW DAW

STUDENT LEARNING OUTCOMES

The goals of this project are to model, simulate, and analyze the contagious spread of information in real time through probabilistic representations of reality. Hence, the learning outcomes for this project include knowing how to:

- Construct and evaluate probability models, particularly stochastic processes such as the Hawkes self-exciting point process
- Simulate probability models through developing and deploying Monte Carlo experiments and algorithms
- Collect, analyze, and apply data from social networks such as Twitter

The particular details of the project can be tailored to the student(s) and their interests in background. The core of this project is in mathematical modeling, code, and data, but the relative focus on each component can shifted to best suit the student. Typically, research of this style is most natural for students majoring in math, statistics, engineering, data science, or other mathematical sciences, but enthusiasm and excitement for the research are the most accurate predictors of a student’s success in research. If you’re excited about the problem but not too familiar with the topics, please don’t hesitate to apply!
STUDENT LEARNING OUTCOMES

- By the end of this program, students will be able to:
- Import, manipulate, analyze, and summarize data using the Python programming language
- Implement and apply different types of machine learning algorithms in Python
- Identify and explain possible limitations of machine learning models, such as overconfidence, bias, and different notions of unfairness.
- Explain, implement, and deploy mitigation methods for the aforementioned issues, including state-of-the-art techniques based on conformal inference.
- Present their results in a clear and articulate manner, for both technical and non-technical audiences. Produce professional reports combining nicely formatted text and neat visual elements (e.g., charts and tables) using Jupyter notebooks.
EXAMINING THE IMPACT OF CANNABIS LEGALIZATION ON MATERNAL HEALTH DISPARITIES

FACULTY:
RACHEL CARMEN CEASAR

STUDENT LEARNING OUTCOMES

This research broadly examines harm reduction approaches to substance use, including how expanding cannabis legalization may worsen existing maternal health disparities. At the end of this research collaboration, JumpStart Scholars will gain experience in:

1) Data collection. Conducting one-on-one interviews and focus groups with vulnerable study participants on sensitive or taboo topics (e.g., women who use cannabis during pregnancy);

2) Data analysis. Conducting data analysis (e.g., thematic analysis, grounded theory using ATLAS.ti);

3) Project management. Managing study-related project and data management and related project management programs (e.g., Institutional Review Board submissions and related protocols, research ethics, managing and storing data according to HIPAA, managing transcription of data; use of EndNote, Calendly.com Slack, Monday.com, MURAL and Notion to facilitate research and study communication)).

4) Dissemination of research. Writing up and taking part in the process of writing manuscripts, conference abstracts, presentations, and peer-reviewed publications.

5) Academic professionalization. Developing teamwork and collaboration skills, including utilizing effective communication, interpersonal problem solving, and graduate school materials (e.g., CV, letters of recommendation, how to identify potential graduate programs and mentors).
LACCD-HSSS is a partnership among USC and UCLA researchers and the LACCD Chancellor and his team to develop a scaling strategy to meet the basic need of housing for homeless and housing insecure LACCD students. A recent bill signed by Governor Newsom (SB 330 - LACCD Affordable Housing Pilot Program) enables new innovations in LACCD property development. The initial phases of the project (supported through a private gift) will begin in early 2022, and will include a literature review, assessment of LACCD property assets, and informational interviews with developers, planners, and other stakeholders to (1) identify best practices for higher education institutions that engage in housing production and management; (2) develop a preliminary assessment of the appropriateness of LACCD properties for housing production or other development options; and (3) identify a preliminary set of critical questions and metrics in support of a future strategic plan for housing production, management, or other options to increase available and affordable housing for LACCD students. We expect that in summer 2022, we will be conducting qualitative analysis of the interviews and mapping of the property strategies.

STUDENT LEARNING OUTCOMES

The undergraduate student researcher will work with a multi-campus team on an applied research project that aims to investigate and assess the possible housing (or other) development strategies for LACCD. Specific learning outcomes include:

- understand statewide policy (SB 330)
- learn basic elements of a study design (literature review, research questions, data collection and analysis)
- practice data collection (secondary data including census data and primary data including archival data)
- demonstrate basic qualitative analysis (deductive and inductive coding) using coding software
- work collaboratively on a multi-campus research team
We propose a research project that is well-suited to model for the Fellow how scientific methods, data, and ideas translate in real time. The benchmarking study will require the Fellow to select performance metrics relevant to their research questions; document their work as they install, run, and debug each computational tool; generate summary statistics using open-source tools for BDAT; interpret results in the context of major scientific questions; and present project materials on an open-source data sharing platform. The fellow will perform the benchmarking of Structural Variant (SV) callers, computational tools designed to detect SVs in genomic data. SV are genomic regions that have an altered DNA sequence due to deletion, duplication, insertion, or inversion, and some SVs may indicate disease status.
This project has the opportunity to attract one or multiple undergraduate students that will work alongside Dr. Davies and a PhD student in his lab whereas the student will be able to identify a facet of the ongoing research that meets their interest (e.g., animal behavior, in vitro testing, regulatory hurdles, etc). The project will utilize animal models, behavioral and biochemical pharmacology, and liquid chromatography-mass spectrometry (LC-MS) to demonstrate the utility of the dual therapy with improved CNS bioavailability and PK properties that include, improved onset of activity and greater tissue retention while monitoring for signs of organ toxicities. Collectively, the project will provide strong evidence behaviorally and mechanistically, that will set the stage for advancing IVM + DHM to the clinic. Importantly, the research experience will provide a fertile research environment that will result in significant growth in pharmacology/drug discovery methods utilizing a multitude of experimental tools in the quest to reduce the consequences of excess EtOH use.

**STUDENT LEARNING OUTCOMES**

**Objective 1:** Technical skill development. Student will be provided research training and technical skill development in alcohol research to accomplish their scientific goals. Students will design, develop, and apply methodology to the AUD-related research project as described above. The project is well developed, as such we are confident that the student will have a productive research experience while at USC.

**Measurable Outcome 01:** Student will become knowledgeable regarding substance use and addiction over the course of the summer research experience.

**Measurable Outcome 02:** Student will develop a general understanding of the research programs ongoing in my laboratory and this will help advance their scientific knowledge curated for their topic of interest including a final presentation of their work.

**Objective 2:** Professional development. Student will receive training and education to develop independent substance use research project under the mentorship of the PI (Davies) and a URM PhD graduate student with a focus on AUD related projects. As a result, the student will be exposed to academic or industry research careers, professional mentorship, and scientific communication opportunities related to AUD research.
DEVELOPING A NOVEL, DUAL THERAPY APPROACH TO TREAT ALCOHOL USE DISORDER AND ALCOHOL INDUCED LIVER INJURY

FACULTY:
DARYL DAVIES

Measurable Outcome 03: Student will be guided in exploring a range of substance use and addiction science careers and graduate programs available to PhD-level research scientists; measured by student survey responses that gauge student exposure to careers and completion of graduate school applications.

Measurable Outcome 04: Student will participate in scientific inquiry and information dissemination to peers and colleagues; measured by presentations in a public forum and/or co-authorship on publications/abstracts.

Objective 3: Interdisciplinary collaboration. Student will participate in interdepartmental and inter-school scientific projects via Dr. Davies interactions with the Institute of Addiction Science at USC. This will help the student to develop their creative approach to questions or problems, in which all program faculty of diverse fields will be available to the student for engagement and project development.

Measurable Outcome 05: Student interactions with interdepartmental collaborating research groups will promote creativity and knowledge outside of their research scope; measured by journal club/cross-disciplinary seminar meeting engagement and self-reported student surveys.

Measurable Outcome 06: Student will collaborate to develop their unique research project by engaging with departmental and interdepartmental mentors; measured by self-reported surveys from students and mentors.

Objective 4: Scientific and community engagement. Student engagement with faculty, research groups, and communities within and around Los Angeles will build a sense of belonging and self-identification as a researcher engaged in the public and scientific community.

Measurable Outcome 07: Student will participate in community engagement opportunities measured by active participation in community events and self-reported survey responses.

Objective 5: Scientific: A major goal for the 10 week experience is to develop a solid research opportunity that will result in the student being able to engage in local and national/international scientific conference by presenting a oral/poster presentation and networking with experts in the field; measured by active participation at conferences and self-reported surveys.
Our lab develops and applies new chemical and computational tools to understand RNA structures, interactions, and modifications. We then apply this knowledge to determine the roles of RNA in human diseases and develop new RNA-targeting therapeutics. The ultimate goal of training in our lab is to enable students and postdoctoral fellows to carry out innovative and impactful research. To achieve this goal, we have formulated strategies that promote learning in multiple aspects of scientific investigations that lay the foundation for their future success. In particular, we focus on these following areas.

First, students are constantly reminded that there is one single most critical question in any research, that is, the importance of the problem. This is especially relevant for undergraduates aspiring to become scientists in the future, since very often they expect to focus on the basics during the first lab experience. We would like to cultivate this habit of asking “why” in lab meetings, in one-to-one discussions, and in every step of the research process. Without a keen eye on the big picture, students are often lost in their everyday experiments and wear off their interest in research.

Second, students will be trained in reading original literature, making oral presentations and writing research reports. Such skills are critical for them to master in order to take charge of a project. The students will learn to analyze published data, formulate new ideas, justify their significance, and come up with feasible plans to achieve the goals. Even though undergraduate students often lack the experience and confidence in these tasks, we believe that early exposure to such activities are essential for their long term growth.

Third, students will be trained in both experimental and computational research skills. Our lab is quite unique since we have strong expertise in combining these two different types of tools in research. While basic experimental techniques are necessary and standard in every lab, our work requires the development and application of bioinformatic methods. Therefore, we provide a perfect environment to learn these skills. As research in biology and related fields are getting more and more interdisciplinary. This training will be essential for the success of the next generation researchers.

In summary, we provide a environment to promote the well-rounded development of students' research skills beyond "pipetting". These training plans will help them learn how to ask the best questions, develop the most effective strategies and execute the research plans with high rigor and efficiency.
TRACING YOUTH RACIAL JUSTICE ACTIVISM IN LOS ANGELES IN THE AGE OF COVID-19

FACULTY:
HAJAR YAZDIHA

STUDENT LEARNING OUTCOMES

Students will collaborate closely with me as I train them in qualitative methodologies, specifically ethnographic fieldwork and interviews. Students will learn how to compose jottings, field notes, and research memos, and how to systematize their data collection in a larger dataset. Additionally, students will learn to collaborate as a research team and will learn new cutting-edge research tools like Atlas.TI cloud.

I intentionally train students in multiple methods to both engage a variety of learning styles and to build their expertise in a range of modes of social scientific research. As a result, we expect that this research experience will give students an understanding of research design and familiarity with qualitative data collection and data analysis. They will be able to articulate research questions, preliminary coding, and tentative conclusions.
CLIMATE GHETTOS OF CALIFORNIA: SPACE-TIME ANALYSIS OF CLIMATE STRESSORS ON VULNERABLE COMMUNITIES

FACULTY:
ORHUN AYDIN

1) Learn to perform research pertinent to Earth system – human intersection within an environmental justice theme.

2) Gain working experience with R, Python, and GIS.

3) Gain working knowledge of geographic information (GIS) technologies.

4) Identify and work with spatial machine learning methods and their applications to environmental justice.

5) Perform analysis with a variety of satellite-based, remotely sensed data sources and their numerical representations.

6) Explore direct and indirect measurements of sociodemographic variables through state-wide programs serving data via GIS portals.

7) Gain experience with digital story-telling about research findings in the form of a Story Map, a digital story-telling software.

8) Distill sophisticated research ideas to easily understandable descriptions that is accessible to general public.
EPIGENETIC CONTROL OF TISSUE REGENERATION AND TUMORIGENESIS

FACULTY:
UNMESH JADHAV

Project 1: Epigenetic control of intestinal regeneration:

Intestinal epithelium, the inner lining of mammalian gut, self-renews by producing billions of cells every day. This extensive tissue turnover is driven by intestinal stem cells that divide each day; however, radiation or toxin damage can eliminate the stem cells completely. Remarkably, the intestine regenerates by restoring the millions of stem cells in a matter of a few days. We discovered that this regeneration happens by a cell fate change that allows mature cells to revert back into stem cells and this cellular plasticity is linked to rapid chromatin changes in cells. Details of what mechanisms initiate such fate reversal and how different types of cells reach stem cell state are unknown.

Experimental system: Our lab has established mouse models to eliminate intestinal stem cells by radiation or toxin damage. We purify epithelial cells during stem cell recovery and study the chronology of molecular events that allow cellular de-differentiation to regenerate stem cells. Using cutting-edge genomics and epigenomic methods including single-cell RNAseq (scRNAseq) and chromatin accessibility (scATACseq) assays, we intend to unlock the principles of tissue regeneration.

Specific goals:
A) Identify transition cell states unique to regenerating tissue.
B) Identify molecular regulators of epigenetic transitions from mature cells to stem cells.
C) Characterize the epigenetic barriers to cellular transitions during regeneration.

Project 2: Epigenetic modulation in gastrointestinal tumorigenesis:

Colorectal cancer (CRC) is the second largest cause of cancer-related deaths in the US. Large percentages of CRC cases show epigenetic changes, particularly in DNA-methylation, in addition to a well-defined chronology of mutations in genes such as APC, KRAS, and p53. However, detailed knowledge of how the epigenetic changes occur and influence various steps in tumor progression is lacking.

Experimental system: We have established mouse models in which intestinal stem cell (ISC) specific induction of CRC mutations causes tumorigenesis. We purify stem cells from normal and tumorigenic mouse intestines and characterize the gene expression and epigenetic change in cancer stem cells. This includes Histone modifications (ChIP-seq), DNA methylation (Whole genome bisulfite sequencing - WGBS), and mRNAseq (including single-cell scRNAseq).

Specific goals:
A) Establish chronology of epigenetic changes in stem cells during cancer development.
B) Correlate chromatin modulation to gene expression changes to predict causal genes, signaling pathways, and regulatory regions in tumorigenesis.
TOWARDS JUST AND EQUITABLE SCHOOLS: INTEGRATING YOUTH VOICE AND ADVOCATES TO EXAMINE INEQUITY IN JUVENILE COURT SCHOOLS WITH A RACIAL JUSTICE LENS

FACULTY:
BO-KYUNG ELIZABETH KIM

STUDENT LEARNING OUTCOMES

1) Student will learn institutional inequalities embedded in school and justice systems. Activities will involve reading theoretical and empirical articles that provide a knowledge base for understanding the mechanisms by which these inequalities affect youth of color.

2) Student will be introduced to qualitative research. Activities will involve assisting in the recruitment and interviews with education attorneys across LA county; Review transcripts and identify emerging themes.

3) Student will be introduced to quantitative research. Activities will involve reviewing the summary of survey data analysis and learn to interpret basic findings; Create tables, charts, and graphs as needed.

4) Student will participate in the dissemination of the findings. Activities will involve preparing powerpoint presentations for stakeholders; Engage in the process of writing a policy brief; Conduct literature reviews for peer-reviewed publication.