SUMMER RESEARCH PROGRAM FOR UNDERGRADUATES

USC’s Graduate Initiative for Diversity, Inclusion, and Access (DIA) aims to increase the pool of diverse PhD applicants by providing academic and financial support and professional development opportunities.

DIA JumpStart works with USC 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.

PROGRAM BENEFITS
The Graduate School provides JumpStart students with a stipend and health coverage. Those who successfully complete the program will also have their application fees waived if they apply to USC PhD programs.

To complement their summer research experience, JumpStart students will participate in Graduate School-sponsored sessions on professional development and PhD funding, an end of summer research presentation, and an opportunity to network with current PhDs.

APPLICATIONS
Students completing their sophomore or junior year at outside institutions prior to the summer are encouraged to apply through JumpStart for available research opportunities.

Applications are evaluated by the research program, or faculty, and the Graduate School.

Applications for research positions through DIA JumpStart are available at websites.usc.edu/graduateschool/jumpstart.

As part of the application, students will be required to submit:

- Personal statement and research interests
- Short statement on academic and professional goals
- Resume or CV
- Current transcripts (unofficial or official)

- One (1) letter of recommendation should be submitted directly to brooksas@usc.edu before the JumpStart application deadline

FOR MORE INFORMATION
Questions about DIA JumpStart should be sent to Ashley Brooks at brooksas@usc.edu.
Additional information can also be found by visiting graduateschool.usc.edu/dia.

APPLICATION DEADLINE: January 18, 2019
WHAT DID LAST YEAR’S PARTICIPANTS SAY ABOUT THE PROGRAM?

“The most helpful aspect was the classroom setting. I had some self-doubt about my ability to perform in a USC program but my classroom experience and course work proved to me that my abilities are above what I may have gauged. I gained a self-confidence and reinvigorated passion, just in time for application season.”

“I would recommend the program to others because the mission is admirable in trying to help individuals from underrepresented backgrounds. Additionally, the program is great in providing collaborations with individuals who are currently in graduate school or have their PhD.”

“I believe it is a great opportunity for undergraduates to propel themselves into academia and research in a rather safe and consistent manner that comes with bountiful rewards and also allow for great networking and meeting and making new friends with people from many fields.”

“First, the program seemed like a good opportunity to gain insight as to how graduate school is, while also gaining new research experience to put on my resume. Second, the time span of the program worked well with my other summertime commitments. Finally, the stipend that was provided also was a great incentive.”

WHERE DID THEY COME FROM?

California State University, Northridge
California Polytechnic University, Pomona
California State University, Fullerton
Loyola Marymount University
California State University, Long Beach
2019 AVAILABLE RESEARCH OPPORTUNITIES

1. SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP
   School of Pharmacy
   Preferred Majors: Biology, Chemistry, Biochemistry, Microbiology, Biomedical Engineering, Economics

2. SCREENING AND SELECTION OF NANO-ABS TO TARGET PROTEIN-PROTEIN INTERACTIONS WITH PHARMACOLOGICAL VALUE
   Pharmacology and Pharmaceutical Sciences
   Preferred Majors: Chemistry and Biology

3. MANIPULATION OF THE GUT MICROBIOME: INFLUENCING ALCOHOL CONSUMPTION BEHAVIORS AND ALCOHOL-INDUCED IMMUNE ACTIVITY
   Titus Department of Clinical Pharmacy

4. SNAPSHOT OF CHEMISTRY
   Chemistry

5. NEUROSCIENCE EXPERIENCE UNDERGRADUATE RESEARCH AND LEARNING PROGRAM
   Neuroscience Graduate Program

6. BRAIN AND CREATIVITY INSTITUTE
   Psychology and Occupational Science
   Preferred Majors: Psychology, Neuroscience, Occupational Therapy, Computer Science, Human Biology or related fields

7. POPULATION, HEALTH, AND PLACE
   Spatial Sciences Institute and Population, Health, and Place PhD Program
   Preferred Majors: Open, but with some preference for the three cognate fields of the PHP program: sociology (demography), geography/spatial sciences, and health promotion (public health)

8. CENTER ON EDUCATION POLICY, EQUITY AND GOVERNANCE
   Rossier School of Education
   Preferred Majors: Social Sciences

9. SOCIAL SCIENCE AND INEQUALITY LAB
   Political Science and Public Policy
   Preferred Majors: Political Science, Public Policy, Economics, Statistics, Psychology, Math with Social Science Interests, or other Social Science majors

10. SECURITY AND POLITICAL ECONOMY (SPEC) LAB
    School of International Relations
    Preferred Majors: Social sciences (any), mathematics, computer science, communications, film production
2019 AVAILABLE RESEARCH OPPORTUNITIES (CONT.)

11 ROLE OF CLAUDIN-18
Medicine—Division of Pulmonary, Critical Care and Sleep Medicine
Preferred Majors: Biology, Molecular Biology

12 LUNG CANCER RESEARCH
Surgery, Biochemistry, and Molecular Medicine

13 NKT CELLS
Molecular Microbiology and Immunology
Preferred Majors: Biochemistry, Biology, Immunology, Microbiology

14 HORMONES ACROSS THE TRANSITION TO CHILDREARING (HATCH)
Clinical Science
Preferred Majors: Psychology, Neuroscience, Cognitive Science, Biology, Pre-medical

15 MEDICAL POPULATION GENETICS
Preventative Medicine, Center for Genetic Epidemiology
Preferred Majors: Genetics, Computer Science, or related major with some form of computational background

16 WHY PHYTOPLANKTON
Earth Sciences
Preferred Majors: Chemistry, Biochemistry, Oceanography, Geology, Environmental

17 MICROBIAL COMMUNITY BIOPHYSICS
Physics and Biology
Preferred Majors: Physics, Biophysics, Biochemistry, Bioengineering, Chemistry, Chemical Engineering

18 HELIOSEISMIC STUDIES OF SOLAR INTERNAL STRUCTURE AND DYNAMICS
Physics and Astronomy
Preferred Majors: Physics, Astronomy, Earth Sciences, Computer Science, Electrical Engineering, Astronautical Engineering, Aerospace Engineering

19 APPLICATIONS OF TOPOLOGY AND KNOT THEORY
Mathematics
Preferred Majors: Mathematics
SCHOOL OF PHARMACY SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

SCHOOL OF PHARMACY

MAY 20-JULY 26

USC School of Pharmacy’s Summer Undergraduate Research Fellowship (SURF) is geared towards increasing learning and networking opportunities for undergraduate students committed to pursuing either professional or academic research careers in pharmaceutical and translational sciences. Students will develop confidence and independence in conducting research and communicating scientific concepts under the guidance of faculty and other mentors. In addition to daily engagement in the lab, students will attend regularly scheduled entrepreneurship/professional development seminars and participate in a workshop on the graduate school application process so as to stimulate serious consideration of graduate study. At the end of the summer, students will give a presentation of their research to their peers and faculty.

PROGRAM REQUIREMENTS:

- Have a strong desire to pursue a PhD degree in one of the disciplines offered by the USC School of Pharmacy graduate programs in the Pharmaceutical & Translational Sciences and Health Economics (pharmgradprograms.usc.edu).
- Strong academic background (GPA of 3.5 or higher) in the fields related to biology, chemistry, biochemistry, microbiology, biomedical engineering, economics.
- Students should have a working knowledge of lab skills and concepts learned through college courses such as chemistry and biology.

APPLICATION INSTRUCTIONS:

- When applying, please indicate three (3) faculty from USC School of Pharmacy whose research is of interest to you.
- Housing may be provided on USC’s University Park Campus. Consideration will include a demonstrated financial need and availability of funding. Evidence of financial need can be demonstrated by emailing your most current FAFSA package directly to Ashley Brooks at brooksas@usc.edu.
SCREENING AND SELECTION OF NANO-ABS TO TARGET PROTEIN-PROTEIN INTERACTIONS WITH PHARMACOLOGICAL VALUE

DEPARTMENT OF PHARMACOLOGY AND PHARMACEUTICAL SCIENCES
MAY 28 - AUGUST 3

The JumpStart student will conduct research under the direction of Professor Julio A. Camarero, PhD.

The practical and conceptual opportunities made available by recent innovations in the emerging fields of synthetic protein chemistry and protein expression using modified protein splicing elements are providing a fertile source for innovative biotechnology tools to study the physico-chemical basis of protein function in vivo and in vitro.

The Camarero lab is focused in using chemistry-driven technologies for studying biological process involved in human disease such as cancer, autoimmune diseases and bacterial/viral pathogenicity. The student will be exposed to many techniques at the interface of chemistry/biology/physics. These include biomolecular separation and analytical techniques, cell culture and molecular cloning, among others.

SOME OF THE ACTUAL WORKING PROJECTS IN THE CAMARERO LAB INVOLVE:

1. Development of new methods for the biosynthesis and screening of biological libraries inside living cells for the rapid detection of small molecules able to inhibit or attenuate intracellular molecular recognition events. For example, the method can be used to find molecules that may disrupt the destructive mechanisms involved in cancer and neurodegenerative diseases such as mad cow and Alzheimer’s.

2. Development of molecular tools for the study of protein/protein interactions in real time and at single cell level. Key to this approach is the development of new molecular tools based on photomodulated protein trans-splicing that will allow the reconstitution and site-specific labeling of particular proteins inside the host cell with total temporal and spatial control. This approach is being used to study the pathogenicity of Yersinia pestis (the causative agent of plague) in real time and at single cell level to better understand the virulence mechanisms associated with this human pathogen.

3. Rapid production of protein microarrays to understand interactions in microbial pathogenicity and how to modulate them. This project involves interfacing the method of protein immobilization that we have developed based on protein trans-splicing with high-throughput cloning and expression methods, such as Gateway-like and cell-free expression systems. This approach is being used for the analysis of protein/protein interactions to study bacterial pathogenicity.
MANIPULATION OF THE GUT MICROBIOME: Influencing Alcohol Consumption Behaviors and Alcohol-induced Immune Activity

TITUS DEPARTMENT OF CLINICAL PHARMACY
MAY 28 - AUGUST 3

The JumpStart student will conduct research under the direction of Daryl L. Davies, PhD.

The bacteria that colonize the mammalian gastrointestinal system, known collectively as the gut microbiome, play critical roles in the development and function of multiple host activities throughout an organism's lifetime. The benefits include conferring protection from pathogens through resource and habitat competition, supplementing immune system maturation, and regulating nutrient absorption and metabolism. Building evidence suggests bi-directional communications between the central nervous system (CNS) and microbiome, and this communication plays a role in affecting the pathophysiology of CNS-related disorders, such as Alzheimer's disease, Parkinson's disease, autism, and depression. Recent findings suggest that patients diagnosed with alcohol use disorder (AUD) express altered gut microbiome compositions as compared to healthy individuals. These changes are thought to be attributed to prolonged exposure to alcohol and its ability to affect immune responses and enteric microbial ecosystems. However, there is limited mechanistic data to explain how the microbiome influences alcohol intake behaviors. To begin to investigate this potential, we administered broad-spectrum antibiotics to adult mice (using a binge model of alcohol drinking) and measured changes in alcohol intake. The preliminary findings found that the treated mice significantly increased their alcohol consumption compared to untreated mice. The present study is designed to begin to understand some of the mechanisms involved in propagating alcohol abuse and identifies potential targets for developing microbiome-directed therapeutics to augment the current psychology-based standards of AUD treatment.

Notably, this project is perfectly suited for an undergraduate student that can collaborate with other undergraduate students in my laboratory in that the project has multiple experiments running in parallel, so that each student can accomplish a research endeavor over the course of the summer.

The training of potential future scientists is critical to the long-term success of science. To this end, the project incorporates an introduction to all aspects of a career in research and critical thinking: conceptualizing the project, reading and understanding laboratory standard operating procedures (SOPs), designing and performing well-controlled experiments, collecting and analyzing data, and writing up the project. Notably, as this is a team driven project, the students learn responsibility to self and colleagues, problem-solving, proper laboratory technique, and ethical responsibility while working as a team to solve a complex problem. Part of this training includes taking both the appropriate lab safety training as well as the animal training as provided by our Department of Animal Resources.
SNAPSHOTS OF CHEMISTRY
DEPARTMENT OF CHEMISTRY
MAY 28 – AUGUST 3

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.

In our summer program, you will work one-on-one in a lab with a faculty advisor and graduate student mentor. We will have weekly seminars on scientific topics as well as graduate school applications and scientific ethics. Included will also be tours of local research facility such as the Loker Hydrocarbon Research Institute and other social activities. The summer will end with a poster session, where you will display your summer research and discuss it with Chemistry faculty and graduate students.

APPLICATION INSTRUCTIONS:
Established by the USC Neuroscience Graduate Program (NGP), the USC Neuroscience Experience Undergraduate Research and Learning Program (USC-NEURAL) is devoted to providing outstanding research experiences and professional development opportunities for underrepresented minority undergraduates who have a strong interest in pursuing an advanced degree in the neurosciences. The USC Neuroscience Graduate Program (NGP) established the program in 2017, working to provide an enriching on-campus experience for the visiting NEURAL scholars, who work in a laboratory for 8 weeks during the summer in Los Angeles.

Neuroscience is naturally interdisciplinary. We welcome undergraduates who major in a variety of fields, including various fields of biology, biochemistry, chemistry, computer science, economics engineering, genetics, mathematics, neuroscience, and psychology.

THE PROGRAM HAS THE FOLLOWING GOALS:

• Partnering NGP training faculty members with a visiting NEURAL scholar.

• Provide a roadmap for the scholar to learn about a specific area of neuroscience, read original literature, perform experiments and learn analytical strategies.

• Foster interactions with current NGP graduate students and other faculty to learn about advanced training in the neurosciences.

• To discover outstanding opportunities for career development in academic, private sector, education and policy arenas.

At the end of the summer program, each NEURAL scholar will have the opportunity to prepare and present a poster during a USC hosted research poster session.

APPLICATION INSTRUCTIONS:

Indicate in the application faculty and/or research interests, in that department, that you would like to work with. We will do our best, depending on availability, to match you with faculty that suit your research interests.
The JumpStart student will conduct research under the direction of Lisa Aziz-Zadeh, PhD.

Our lab uses neuroimaging techniques to explore sensory-motor skills, and their potential involvement in processing emotions, empathy, and social communication in Autism Spectrum Disorder and Developmental Coordination Disorder. The DIA scholar will be involved in a study funded by the NIH R01 mechanism on autism and dyspraxia where he or she will learn all aspects involved in conducting a brain imaging study. This will be a full immersion into Lisa Aziz-Zadeh’s laboratory at the Brain and Creativity Institute.

Specifically, this student will administer a mentalizing task to a pediatric population, and learn the skills necessary for professional interactions with children in clinical and typical populations. This task would require management and monitoring in the RedCap database for numerous participants and their assessment data. The student would also transcribe the task responses and score them using a coding protocol provided by the lab. This work will allow for direct contact with post-doctoral researchers, graduate students, and the Principal Investigator. The student would attend weekly lab meetings, and lectures and talks at the Brain and Creativity Institute around the topics of neuroscience and psychology. This will allow exposure to the type of work involved in getting a PhD and the research field.

The JumpStart student will assist in everyday functioning of a research lab, which uses neuroimaging techniques to explore questions of social cognitive neuroscience. The current project looks at sensory-motor skills and brain areas, and their potential involvement in processing emotions, empathy, and social communication in Autism Spectrum Disorder and Developmental Coordination Disorder. Research Assistants are required to maintain the RedCap data basing system, ensure data quality control, assist in recruiting, communicate with collaborators and participant families, and assist in acquisition of behavioral and neural data. This position requires excellent attention to detail, organization, and an understanding of the study protocols, measures, and reporting requirements. Working directly with participants and families from clinical populations to acquire paper and video data will require excellent communication and interpersonal skills.

**LEARNING OUTCOMES:**

- Deeper understanding of neuroscience, Autism Spectrum Disorders, behavioral and psychological testing, and MRI acquisition.
- Gain experience with the inner workings of and R01 level study in a research lab setting.
- Clarity on the process and information regarding potential next steps in higher education, and success within graduate programs.
This program will run concurrently with the SSCI 601ab research practicums scheduled for summer 2019. For the first 7-weeks of the summer session, with guidance from faculty including myself and participants from the cognate fields, we will conduct collaborative research projects with the Ph.D. students and the DIA fellows. There will be 8 Ph.D. students involved this summer. We would like to have up to three DIA fellows to serve as undergraduate research assistants.

There will be at 2-3 collaborative projects under way, and the undergraduate research assistants will have some choice as to which projects to work on. Past examples of projects include work on access of homeless populations to water for hygiene and drinking, exploration of spatial and temporal methods in interdisciplinary research, and research on the social and economic factors underlying the opioid abuse crisis. Potential projects for the upcoming summer include work on how proximity to cannabis retail locations may affect propensity for underage cannabis use and air pollution control modeling in China.

For the second 7-weeks of the summer, the Ph.D. students will work on preparing their dissertation proposals. At this time, DIA fellows may assist Ph.D. students with tasks related to their dissertation proposals, and will also work on crafting personal statements of their own research interests in anticipation of applying to Ph.D. programs.

DIA Jump start students would be expected to attend seminar discussions and team meetings, read articles alongside the Ph.D. students, and assist with various data gathering and processing tasks, including working with geographic information systems, depending on each student’s skill level and how rapidly they can be trained for these data-intensive tasks.
The JumpStart student will work under the direction of Patricia Burch.

ESTABLISHED IN 2017, CEPEG HAS A THREEFOLD MISSION TO:

1. Conduct rigorous mixed-methods research with consequence.
2. Design and implement new vehicles for scholarly engagement in policy and practice.
3. Train the next generation of researchers committed to furthering the vision of research designed to affect policy and practice.

The Center focuses on important policy issues in K-12 education, particularly policies designed to improve educational opportunities and outcomes for historically disadvantaged groups. CEPEG is a re-envisioning of the Center on Educational Governance (CEG).

THE JUMPSTART STUDENT WILL:

• Compile and synthesize feedback from education advocacy groups on the research agenda for equity-focused education policy that the Center has been developing this year.
• Assist Center-affiliated faculty and graduate students to develop and disseminate at least two briefs summarizing research to date on a priority that emerged from the aforementioned research agenda.
• Assist Center-affiliated faculty and graduate students to develop rapid-response policy briefs for the Association of California School Administrators (ACSA).
The JumpStart student will conduct research under the direction of Christian Grose, PhD.

JumpStart students in the Social Science and Inequality Lab will have the opportunity to work with some USC undergraduates as researchers on a project examining members of Congress, racial representation, and income representation in the United States.

The project’s learning outcomes for the students include assisting with the formulation of research questions, data analysis, data collection, social science analysis, and other outputs. Undergraduates working in this lab have assisted with field experiments where elected officials have been randomly contacted by constituents. Next summer, a similar experiment would be fielded with assistance needed from this Jumpstart student; The experiment is to test levels of discrimination by elected officials; and another project would involve an analysis of financial holdings by members of Congress and how that affect vote decisions by legislator that could harm income inequality.

There are also projects coming up soon involving American politics; race, ethnicity, and politics; and related topics.
SECURITY AND POLITICAL ECONOMY (SPEC) LAB
SCHOOL OF INTERNATIONAL RELATIONS
MAY 27 – AUGUST 9

The JumpStart student will work under the direction of Benjamin Graham and Megan Becker.

THE JUMPSTART STUDENT CAN CHOOSE WHICH PROJECT THEY MOST WOULD LIKE TO WORK.
THE TWO TEAMS AVAILABLE FOR SUMMER 2019 ARE DESCRIBED BELOW:

1. Inclusion, Dispersion and Constraint:
   How do power-sharing institutions achieve inclusivity of a wide range of political actors and constrain majority rule? What are the impacts of these institutions? This team will be working on coding country-year data on powersharing institutions and creating visualizations that describe that data. These data are an update an expansion to the Inclusion, Dispersion, and Constraints data. Updating the data through 2019 and adding new variables will allow me to write several new papers, one on democratization with Bryn Rosenfeld, Mike Miller, and Kaare Strom, and one on Federalism and educational attainment with Alix Ziff (our doctoral student), Mona Vakilifathi, and Kaare Strom.

2. Replicating and Re-Assessing the Resource Curse:
   What is the connection between natural resource wealth and civil war? We provide a model for qualitative replication using Michael Ross’ (2004) seminal paper on the connection between natural resources and civil war. The paper, which has been cited approximately 1000 times, uses information from thirteen cases to uncover the mechanisms that connect natural resource wealth to the onset, severity, and duration of civil wars. Preliminary findings from our replication, show that roughly twenty percent of the case observations are mis-coded in some way (conceptual issues, measurement issues, missing data), calling in to question the validity of Ross’ findings. During the summer of 2019, students will be supporting a large-scale collection of quantitative and qualitative data, allowing us assess Ross’ hypotheses with a larger set of cases. We anticipate that three journal articles will come out of this project.
DURING THE SUMMER, STUDENTS WILL BE WORKING ON AND SUPPORTING THE PREPARATION OF THE FOLLOWING COMPONENTS OF THE PROJECTS:

1. Primary and secondary source research on a defined set of cases.
2. Collection of quantitative data, including geo-referenced data.
3. Writing analytic vignettes about selected cases to assess causal mechanisms.
4. Statistical analysis of quantitative data to test hypotheses.
5. Creation of data visualizations for research products.
6. Preparation and editing of journal articles and supplementary materials for publication.
7. Creation of public outreach materials to disseminate results of the study (e.g. blog posts, white papers, explainer videos).

BY THE END OF THE SUMMER, STUDENTS SHOULD BE ABLE TO:

- Identify and demonstrate knowledge of appropriate research methodologies.
- Define, articulate and use terminology, concepts, and theory from social science.
- Apply problem solving skills to constructively address setbacks.
- Work collaboratively with other researchers.
- Work autonomously in an effective manner, setting and meeting deadlines.
- Explain their research to others in the field and to broader audiences.
- Articulate the relevance of their research to their coursework and professional future.
- Reflect constructively on their research experience in making decisions about their future.
ROLE OF CLAUDIN-18
MEDICINE—DIVISION OF PULMONARY, CRITICAL CARE AND SLEEP MEDICINE
MAY 27 – AUGUST 2

The JumpStart student will conduct research under the direction of Zea Borok, MD.

The JumpStart student will work on the role of Claudin-18 (a tight junction protein) in the response to lung injury. The student will learn histology techniques such as tissue embedding, sectioning and immunofluorescence. They will also learn how to isolate proteins from cells and tissues and run western blots. Finally, the student will learn how to plan and organize research experiments.
The JumpStart student will conduct research under the direction of Ite A. Offringa, PhD.

The student will participate in lung cancer research. The Offringa lab research involves studies of the genome (all the cell’s genes), the transcriptome (all genes that are expressed as RNA) and the “epi” genome, or the information layered on top of the genome (consisting of chemical modifications and bound proteins).

The student will participate in studying how normal lung cells change as they become lung cancer cells and how small differences between individuals affect lung cancer risk. Such small differences are called Single Nucleotide Polymorphisms or SNPs (pronounced “snips”), and these SNPs can affect how certain genes are regulated or how the gene products function. The Offringa lab also studies how exposure to tobacco smoke affects gene regulation. We do this by adding cigarette smoke concentrate to cells growing in petri dishes. Amazingly, this mimics what happens to lung cells in a smoker. Techniques a student might learn while in the lab could include: tissue culture (growing human cells in petri dishes), manipulating DNA and RNA, polymerase chain reaction (PCR), gel electrophoresis, luciferase assays, microscopy and using CRISPR/Cas9, a new approach to genome editing. The specific experiments are dependent on the status of research projects in May when the internship starts. The student will also attend our weekly lab meeting and present his/her experimental results there. Lab meetings are a great way to learn about research and experiments. The Offringa lab has a track record of training students, from the high school level through Master’s and PhD levels to postdoctoral and clinical fellows.
The JumpStart student will conduct research under the direction of Weiming Yuan, PhD.

NKT cells are a group of unconventional innate T cells with potent anti-tumor functions. The prototypical ligand for the major group of NKT cells, invariant NKT (iNKT) cells, α-Galactosylceramide (α-GalCer), exhibits very robust anti-tumor function in mouse models. However, α-GalCer does not work efficiently in human anti-tumor clinical trials. To solve this problem and harness the human iNKT cells for anti-tumor immunotherapies, we have generated novel humanized mouse models. We aim to utilize these new mouse models to develop new therapeutic regimes targeting different components of human CD1d and NKT cell antigen-presentation system to develop new immunotherapy approaches.
The JumpStart student will conduct research under the direction of Darby Saxbe, PhD.

We are currently conducting the National Science Foundation (NSF) funded HATCH (Hormones Across the Transition to Childrearing) study to explore couple and family dynamics during the transition to parenthood. We recruit couples in mid-pregnancy and follow them across the first year after the birth of their child. We are sampling hormones (cortisol, testosterone, oxytocin, and prolactin) and examining couple relationship functioning and psychological well-being over pregnancy and postpartum. We will also look at parenting, parent-child attachment, and early infant development. In a sub-study linked with the larger HATCH study, we will be scanning expectant and new fathers both before and after the birth of their child, using a combination of structural and functional imaging to examine the fathering brain and how it is correlated with hormones and parenting behavior.

Students who are placed on this project will have the opportunity to gain hands-on experience running laboratory visits as well as gain exposure to functional magnetic resonance imaging (fMRI) data. Students will collaborate with graduate students in the lab to complete a research poster where they will 1) ask their own research questions, 2) learn to run independent analyses with SPSS, and 3) create a final poster product.
The JumpStart student will conduct research under the direction of Charleston W. K. Chiang, PhD.

Given a decade of progress in modern human genetic studies, our understanding of the genetic underpinning of various human complex traits and diseases has advanced tremendously. The major result from hundreds of genome-wide association studies (GWAS) is that nearly every human trait and condition is highly polygenic, with hundreds (or more) of single nucleotide variants underlying the phenotypic presentation of these traits. Each of these variants have only a very small effect, but collectively, one can construct a polygenic risk score (PRS), which is the summation of all of these variants, properly weighted by their estimated effect, to perform much better risk predictions and assessments. In fact, there has been movement of including PRS for Breast Cancer or Cardiovascular diseases as part of the risk assessment, complementing the conventional mutational screening of relevant monogenic loci in a clinical setting. Despite these advances, however, most genetic studies are conducted in individuals of European-descents, and it has been demonstrated that PRS constructed based on findings from European-descent individuals do not translate well to other minority populations, resulting in disparity for the minority populations to benefit from the benefits of genetics research.

In this project, the student will first help curate a publicly available dataset of genetic associations found to date and implement a pipeline that will compute polygenic risk scores given any input genotype data, such as those from Directed-to-consumer services like 23andMe or other research dataset. The student will also take advantage of the existing genetic datasets of minority populations collected at the University of Southern California, and explore the best approaches to compute PRS in minority populations to perform risk assessment. Lastly, the student will then help compute PRS for a number of disease and complex traits of interest in these minority populations. Together, the student should acquire a strong foundation in modern human genetics research, statistical applications to human genetics, computer programming skills, and the medical genetic literature.
WHY PHYTOPLANKTON
EARTH SCIENCES
MAY 28 – AUGUST 3

The JumpStart student will conduct research under the direction of Dr. Seth John.

WHY PHYTOPLANKTON?
Half of the oxygen we breathe comes from tiny phytoplankton growing in the ocean. At the base of the marine food web, phytoplankton harvest sunlight to build biomass from inorganic nutrients and carbon dioxide (CO2) dissolved in seawater. Integrated across the global ocean, their photosynthetic conversion of CO2 to biomass is a major component of the carbon cycle, but how phytoplankton respond to climate change—present and past—is uncertain.

OUR APPROACH
In the same way you can grow plants in a garden, phytoplankton can be grown in bottles and studied in culture. Isolated in this way, we can quantify their nutrient and light requirements and relate them to conditions found in the open oceans. Students in the lab will carefully compose growth media and monitor changes in biomass frequently. When the time is right, biomass will be harvested, chemically digested, and nutrient contents will be measured. Students will also gain experience measuring seawater nutrient concentrations from samples collected on recent oceanographic expeditions.

AS A PROSPECTIVE CHEMICAL OCEANOGRAPHER, YOU WILL:
1. Appreciate the intricate links between seawater chemistry, ocean life, earth’s climate.
2. Grow phytoplankton in the lab and conduct experiments perturbing their chemical environment.
3. Analyze the response of phytoplankton cultures using cutting edge techniques in plasma mass spectrometry.
4. Gain experience in sterile and trace metal clean technique.
5. Never look at the ocean the same way again.
The JumpStart student will conduct research under the direction of James Boedicker, PhD.

When examined under the microscope, the behavior of individual bacteria are not uniform. Even microbes that are genetically identical will demonstrate variability in characteristics such as swimming speed, growth rate, gene expression, or enzymatic activity. The project will measure the variability of individual cells and analyze the consequences of single-cell heterogeneity on the collective activity of large populations. These measurements will focus on such “noise” in molecular communication, i.e. single-cell variability in the production, exchange, and response to small molecular signals bacteria use to communicate. These signals are known to coordinate group behaviors such as biofilm formation, DNA exchange, and collective migration, but the consequences or potential benefits of single-cell noise in information exchange remain unclear.

The project will involve fluorescent microscopy, molecular biology, genetic engineering, as well as isolation and characterization of bacterial strains from the wild. The project will be focused on experiments, but also could include work on biophysical models of cellular communication. Students will learn about the latest techniques in synthetic biology, microbiology, and biophysics while also experiencing hands on what it is like to work in a research lab.
The JumpStart student will conduct research under the direction of Edward Rhodes, PhD.

Ed Rhodes leads an active program in both ground- and space-based observational helioseismology. One of the pioneers in this field of solar physics he is a NASA-selected Co-Investigator on the Solar Oscillation Investigation (SOI). The SOI-Michelson Doppler Imager flies onboard the NASA-ESA Solar and Heliospheric Observatory spacecraft. Dr. Rhodes is the Principal-Investigator for the 60-Foot Solar Tower at Mt. Wilson Observatory and the High Degree Helioseismic Network (HiDHN). This network consists of a second station in Ukraine, at the Crimean Astrophysical Observatory. HiDHN provides nearly continuous observations of the sun during the summer months. Beginning in 1992 Ed Rhodes served as a Guest Computational Investigator in the NASA High Performance Computing and Communication Program. As part of this program he and his group employed several NASA-supported supercomputers located at Caltech and at JPL. These computers are still used in addition to a network of dedicated workstations located both at USC and the 60 Foot Solar Tower.

The student will participate in both observational and computations research in helioseismology. Will join an existing group of USC grad and undergraduate students and high school students in observing with the 60-Foot Solar Tower Telescope at Mount Wilson Observatory. Will also participate in computerized data processing of spacecraft data.
APPLICATIONS OF TOPOLOGY AND KNOT THEORY

MATHEMATICS

MAY 28 – AUGUST 3

The JumpStart student will conduct research under the direction of David Combecque.

This undergraduate research project will focus on the applications of Topology and Knot Theory, both subfields of Mathematics. The project goal is to use Knot theory and Tangle Calculus to study the action of special enzymes on DNA. Over the course of genetic processes in the human body, we observe in the DNA molecules topological structure characterized by the “knotting” of the molecule as it interacts with the enzyme. The way the DNA gets knotted is important as it will lead to different chemical reactions. The students will learn about Knot Theory and how to use it to predict the knotted structure of DNA specific to a certain enzyme.

No prerequisite knowledge of Knot Theory nor Biology is necessary. Students will first learn about Knot Theory and Topological Invariants, from classical results to more recent developments in the field. They will, in a second phase, learn how to use mathematical tools developed in Knot Theory to model chemistry and biology. The project can be tailored to be accessible to sophomore, junior or senior students.