FRESHMAN SUMMER RESEARCH INSTITUTE

2019

CALTECH CENTER FOR DIVERSITY
Dear Friends,

During the Summer of 2019, the Freshman Summer Research Institute hosted 22 students - our largest and most diverse cohort of students to date! This included 10 women, nine Latinx students, and eight African-American students. This program year, students participated in cutting edge research in areas including astrophysics, chemistry, engineering, and neurobiology.

FSRI’s comprehensive program is designed to introduce incoming underrepresented and/or underserved first-year students to Caltech's research and math curriculum, culture, academic and student support services. The integration of orientation and academic support ensure a smoother transition from high school to college while building a strong research foundation.

The Freshman Summer Research works collaboratively with our community and institute partners to create an innovative academic and research-based program that supports underrepresented students from diverse backgrounds are successful in their academic and personal endeavors.

We thank you for your continued interest and support of this vital program.

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Caltech Center for Diversity

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The Freshman Summer Research Institute (FSRI) is designed to introduce incoming underrepresented and/or underserved freshmen students to Caltech’s research and math curriculum, culture and college life, and academic and student support services. The objective of the program is to create a "learning community" for students where they can develop the academic and social skills necessary to achieve academic excellence during their freshman year.

This fully-funded program offers each participant:

- A 5-week summer research assignment
- A 4-week math-intensive course
- Room and board on Caltech’s campus
- Group field trips, excursions, and activities
- Opportunities to learn and engage in first-year student programing and Caltech culture
- A service learning/volunteerism experience

The FSRI five-week residential program attracts highly motivated students from populations traditionally underrepresented in science and mathematics. The program looks at various identities including: race/ethnicity, socioeconomic status, and gender identity to determine eligibility. We also consider the students’ high school preparation and their previous exposure to math and research.

The 2019 FSRI program had record number of twenty-two student participants:

- 10 Female students
- 8 Black/African-American students
- 9 Latinx and/or Hispanic students
- 1 American Indian or Alaska Native student
- 4 Asian students
- 11 First-generation students
- 7 Pell Eligible students
- 4 Questbridge students
Each FSRI participant is carefully matched with a research mentor. Participants have the opportunity to work on engaging research projects with their mentors, and connect with other postdoctoral fellows, graduate students, and undergraduate students who work in Caltech/JPL laboratories during the summer. As a member of the Caltech research community, FSRI participants attend group meetings, present their findings, and learn about the ongoing work of their assigned research group. In addition to technical skill building, the FSRI participants learn important skills on how to collaborate in a lab setting and present their research to colleagues and peers.

The 2019 FSRI cohort had a team of twenty-two faculty, postdoctoral scholar, and graduate student research mentors.

- Aaron Ames, Professor of Mechanical and Civil Engineering and Control and Dynamical Systems
- Dinakar Ramakrishnan, Professor of Mathematics
- Robert Tanner, Visiting Associate in Chemical Engineering
- Arpita Roy, Postdoctoral Scholar in Astronomy
- Muhammad (Arslan) Ahmed, Postdoctoral Scholar in Aerospace
- Anqi (Angie) Liu, Postdoctoral Scholar in Computing and Mathematical Sciences
- Michael Kuhn, Postdoctoral Scholar in Astronomy
- Amruta Jaodand, Postdoctoral Scholar in Physics
- Mauro Rodriguez Jr, Postdoctoral Scholar in Mechanical and Civil Engineering
- Quanying Liu, Postdoctoral Scholar in Computing and Mathematical Sciences
- Stephen Appert, Mechanical Engineer – LIGO Caltech
- Christopher Barnes, Postdoctoral Scholar in Biology and Biological Engineering
- Sahil Shah, Postdoctoral Scholar in Electrical Engineering
- Maegan Tucker - Graduate Student, Mechanical Engineering
- Claudia Kann, Graduate Student – Mechanical Engineering
- Leah Ginsberg, Graduate Student – Mechanical Engineering
- Kyle Virgil, Graduate Student – Chemistry
- Karli Holman, Graduate Student – Chemistry
- Sarah Sam, Graduate Student – Neurobiology
- Caitlin Lacker, Graduate Student – Chemistry
- Silken Jones, Graduate Student – Aerospace
- Newton Nguyen, Graduate Student – Environmental Science & Engineering
The students enjoyed collaborating with their mentors and lab groups to learn new skills and techniques in the lab environment. Many of the students found that in the process of research, things do not always go as planned, and they learned to develop new strategies for problem solving and new ways for addressing challenges. Others found a clearer sense of direction in the academic fields they may want to pursue. The students had the opportunity to present their findings and share their experiences in lab, while building their presentation skills and answering questions in front of the Caltech community. As a collective, the FSRI participants learned computer programming skills, lab techniques, and contributed to research discussions with mentors and lab groups.

In addition to working in a laboratory, FSRI participants attend weekly research seminars given by faculty or staff from the Jet Propulsion Laboratory (JPL). Speakers prepare their talks for students at all levels and in all disciplines to provide a full scope of the work carried out at the Institute and NASA’s JPL. FSRI participants also have an opportunity to interact with faculty in a more informal space at summer faculty-student lunches. Many of these faculty members will be teaching core-curriculum courses, thus these interactions are important and beneficial.

"Before this, I did not understand the nature of research and how one goes about conducting it. I feel that I now have a much better perception of what it actually is. For this reason, I am grateful for the opportunity that FSRI gave to me."
2019 RESEARCH PROJECTS

- An Inverse Analysis: Characterizing Mechanical Properties of Biofilms through Single-Cell Indentation / Evan Dicker
- Assistive Technology / Diana Frias-Franco & Annabel Gomez
- Characterization of Cylinders for Thermal Ignition Tests / Esmir Mesic
- Creating a Mask for G-Type Stars / Elsa Palumbo
- Exploring Self-Healing of Passivated Perovskite Solar Cells / Ismail Elmengad
- Human Driving Behavior and Brain Signal Analysis / Sandra Chea & Makena Rodriguez
- Measuring Methane, CO2, and NO2 from Space / Aubrey Stevens
- My LIGO Experience / Daniel Contaldi
- Neural Decoding with Linear Filtering / Joshua Rosenberg
- Ni-catalyzed Reductive Cross Coupling Using Triflates / Robin McDonald
- On the Effects of Near-Field Compressibility and Elasticity on Bubble Oscillations / Chase Blagden
- Pd-catalyzed Cyclization Reactions to Synthesize Noraugustamine / Mahideremariyam Gessesse
- Pulsar Exploration with NuSTAR / Tea Freedman-Susskind
- Spiking in Enzyme Kinetic Systems / Erik Imathiu-Jones & Nathan Lopez
- Structural Characterization of a Broadly Neutralizing Antibody Targeting HIV-1 Env / Aaron Dubin
- The Habits of Cortexless Mice / Aanica Gonzales-Rogers & Owen Jenkins
- Visualizing Stratified Resolvent Modes in 3-D / Gabriel Aguiar
- Young Stellar Objects / Angel Rodrigo Avelar Menendez
The FSRI participants attend daily math classes and evening math workshops that have been aligned with Caltech’s first-year math program. The FSRI Mathematics curriculum is specifically designed to take advantage of an intensive summer setting while preparing the FSRI student for research and the transition into the Caltech’s math curriculum. The four week-long modules for the FSRI Math course are: Set Theory & Logic; Differential & Integral Calculus; Linear Algebra; and Ordinary Differential Equations.

These topics were chosen to prepare students for the mathematics they may see in their summer research experiences and to prepare them for much of the rigorous topics taught in the first two years of Caltech’s required mathematics sequence. Based on previous assessments, statistically FSRI students perform significantly better than their matched counterparts in first year math scores. This success can be directly attributed to the preparation, exposure, and training they receive during their intensive summer course. Instructionally, the course is designed as a hybrid lecture/workshop model.

Basic definitions and concepts are presented in lecture, and students work in small group settings to complete their homework assignments and problem sets. Students have a mix of computational and proof-based assignments, exposing them to the type of coursework they will be engaging in during their first quarter at Caltech. Beyond merely constructive correct solutions, students are required to present their solutions orally in a way that demonstrates their content knowledge.

The FSRI participants have direct exposure to the expectations of how Caltech defines academic rigor and math readiness. Students get their first glimpse of college midterms and finals, as well as receiving test scores and feedback from a college professor and teaching assistants. The students learn how to better communicate and ask clarifying questions to the lecturer, in addition to seeing the value of proof-based math through collaboration. Throughout the summer, these students found themselves learning math skills and concepts that they did not learn in high school in group settings instead of independently solving problems.

“It was great being exposed to so many new topics like stochastic matrices, Fourier series, and non-separable differential equations. I loved the emphasis on proofs, and really enjoyed workshop.”
The Freshman Summer Research Institute creates an engaging and intellectually rich residential experience for students that extends student learning beyond the classroom and into the everyday lives of our students. The FSRI Residential Life staff, composed of FSRI alums and graduate students, plans and implements weekly programming to help students transition into college life and learn about campus-wide and local resources.

During the program, FSRI participants are paired with roommates, establish community normative and expectations, and develop skills in communication and conflict resolution. The students learn independent living skills and are better prepared to manage living away from home and balancing college life.

The 2019 residential experience was exciting and eventful, as students learned how to balance research, math, and their personal lives while beginning the transition to college life. The students enjoyed the Resident Mentors evening events that helped them form bonds and learn about each other and Caltech’s culture. In particular, the group enjoyed the excursions off campus and exploring the Los Angeles area, as well the social opportunities and time making friends.

"I’ve never been with such an incredible group of people. Everyone was kind and interesting and exciting and just in general wonderful to be around. The research component and student life component were immersive and amazing. I’m so grateful to have spent time with some great people."
“I think this is one of the, if not the most, beneficial and fun experiences of my academic career and definitely a great introduction to life at Caltech. There is nothing else I wish I would’ve done with the past five weeks and I know for a fact that I would have done basically none of this if it wasn’t for FSRI. This has truly been an incredible experience.”

As part of the program, the FSRI participants attend group excursions highlighting Pasadena and the Los Angeles-area during the weekends of the program. From hiking and biking to trips to the beach and museums, the five-week residential experience provides meaningful, and fun activities to engage the diverse interests of the students. These excursions give FSRI participants an opportunity to become familiar with public transportation, cultural events, service-learning opportunities, and community resources. The 2019 FSRI Excursions included:

- Exploration at Huntington Library
- Service-Learning Experience with Habitat for Humanity
- Stargazing at Griffith Observatory
- Venice and Santa Monica Beach Trip
- Getty Villa
- Los Angeles County Museum of Art (LACMA)
- Pantages Theater Experience - Rent
- Jet Propulsion Laboratory Tour
- Disneyland/California Adventure Trip
This year’s program featured an experience working with the San Gabriel Valley Habitat for Humanity. Students had an opportunity to participate in activities ranging from structural framing and hanging side paneling, to painting and managing materials and supplies. While being equipped to have a successful first year at Caltech with the necessary math, research, and independent living skills required, the opportunity to build a cohort amongst a diverse group of students has directly translated into an increased sense of self, confidence, and belonging for these students.

"I’ve actually always wanted to try to contribute to some kind of building of a house, but never had the opportunity to. Being able to service the community and do something that I’ve never done before for a good cause was the most rewarding part."

Upon completion of FSRI, these students are situated to "hit the ground running" when their first quarter begins and thus, display more self-confidence, leadership, and perseverance than their peers. Many FSRI alumni hold student leadership positions, aspire to attain a graduate degree, and maximize the opportunities offered to them at Caltech.
Support the Freshman Summer Research Institute!

Your gift will go far to ensure that we continue to develop a more diverse and inclusive community. Contributions from individuals help us meet the evolving needs of Caltech’s students, researchers, faculty, and staff.

To make a contribution, please contact:
Checks should be made out to:
“Caltech” with “Center for Diversity - FSRI” in the memo line

Gifts can also be made online by visiting:
- [www.caltech.edu/content/annual-giving](http://www.caltech.edu/content/annual-giving)
- Click the “Give Now” button
- Write-In: “Center for Diversity - FSRI” in the “Other Designation” field
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