

2025 SURF at Caltech Reflection

Peiyu Kao

Reflection on My SURF Experience at Caltech

When I look back at the summer I spent participating in the Summer Undergraduate Research Fellowship program at Caltech, the first phrase that comes to my mind is: it truly takes a whole village to make this summer possible. The program was not only about conducting research in a laboratory; it was an immersive experience that combined science, community, personal growth, and cultural exchange. From the very first day, I realized how carefully planned and well-supported the program was. Behind the scenes, there were countless administrators, mentors, and staff who ensured that everything ran smoothly. Their efforts allowed us, the students, to focus on exploration, discovery, and learning in an environment that was both academically challenging and socially engaging.

The richness of this summer experience came from the many opportunities outside of the laboratory. Every Saturday, there were tours to explore different areas of Los Angeles, which helped me not only to discover the diverse culture of California but also to bond with students from all around the world. On Wednesdays, the program organized seminars where leading scientists presented their groundbreaking research. These sessions opened a window into the frontiers of scientific inquiry and exposed me to areas of science I had never encountered before. Mondays and Tuesdays were reserved for workshops on topics ranging from academic writing to professional networking. These workshops provided practical skills that I know will benefit me far beyond this program. And then, of course, there were countless informal social gatherings—many of them initially attracting students with the promise of free food, but eventually serving as platforms to build friendships and connections across cultures.

My Research Project

My project for the summer was “The Role of Neural Crest Cells in Jaw Regeneration.” This research placed me at the intersection of developmental biology and regenerative medicine, two fields that have fascinated me since my early years in medical school. Working on this project introduced me to a wide variety of techniques that I had never previously used. Among them were cryostat sectioning, *in situ* hybridization chain reaction (HCR), microinjection, and live imaging. Each of these methods required patience, precision, and practice. At the beginning, the steep learning curve seemed daunting. However, over time, I gradually gained confidence, not only in executing technical procedures but also in designing experiments with clear goals and strategies. From the very first day I joined the laboratory, I was struck by its scale. Both in terms

of physical space and the number of people involved, the lab far exceeded anything I had previously experienced in Taiwan. I shared this environment with three other undergraduate students from California, all of whom were biology majors with significant prior laboratory experience. Compared to them, I initially felt like a novice. Nevertheless, I was extremely grateful that my PI gave me the opportunity to join the lab and learn. My postdoctoral mentor, who came from Japan, guided me closely at the beginning. Although there was a slight language barrier at first, we quickly adapted to each other's communication style, and after about a week everything flowed smoothly.

One of the most valuable lessons I learned was how to conduct research independently. My mentor gave me substantial freedom. Rather than walking me through every step, she encouraged me to plan my daily schedule and make decisions about which experiments to pursue. This level of autonomy was new to me. On some days, I chose to go into the lab in the afternoon if I wanted to rest in the morning. On other days, I spent long hours immersed in experiments, sometimes not even seeing my mentor face-to-face for several days. In many ways, this independence instilled in me a sense of responsibility—I came to realize that no one else was accountable for my experiments except myself. This experience helped me to grow, not only technically but also intellectually, as I began to think critically about experimental design and the direction of the project.

Life at Caltech

Outside the laboratory, life revolved around the campus community. One of the most important aspects of daily life was, of course, food. All students who lived in the dormitories were required to load a minimum dining balance onto their student cards. This meant that a considerable portion of our meals came from Caltech's dining facilities. The main dining hall offered a wide range of options typical of American cuisine: hamburgers, tacos, sandwiches, pizza, salad bars, and desserts. Occasionally, there were more international options such as Mediterranean dishes or Mongolian barbecue. On average, a meal cost between 10 and 15 dollars. In the first half of the program, many of us sometimes cooked together in small groups, preparing simple Taiwanese dishes that reminded us of home. Off-campus restaurants were also an option, though meals were more expensive, averaging 15 to 20 dollars per person. Walking to the nearest restaurant district took around 20 minutes, which meant eating out was not always convenient.

Housing was another essential part of the experience. Most participants were assigned to campus dormitories, with the cost of about 4,000 dollars for ten weeks—an amount that consumed more than half of the stipend provided. Students could choose between

single, double, or triple rooms. I was fortunate to receive a single room, which gave me both privacy and space to rest after long days in the lab. Interestingly, it seemed that most students from Taiwan who requested single rooms as their first choice were granted them, so future participants should not worry too much about this. Each dormitory had its own “summer ambassador,” a Caltech student responsible for organizing social activities. These included fun gatherings like yogurt or acai bowl nights, small parties for national holidays, and outings such as trips to the Hollywood Bowl or rock climbing sessions. I would strongly recommend joining these events whenever possible. They not only offered enjoyable breaks from research but also provided a great opportunity to meet peers from all over the world.

Transportation was another huge part of life at Caltech. A fellow student from Taiwan once joked that the thing he “spent the most time on” during the program was walking. The description was humorous but accurate. Distances in Pasadena often felt long, especially under the California sun. A simple dinner outing could involve a 20-minute walk, while the nearest Trader Joe’s supermarket was 20–30 minutes away, and the gym was about 10–15 minutes by foot. Bicycles were not commonly used, so walking was the default option. For longer trips, such as visiting Old Pasadena, we sometimes took the bus. The area had a much greater variety of food and drinks, along with beautiful buildings and scenery. Traveling into Los Angeles itself often required ride-sharing. During the weekends, groups of students sometimes explored the city together by public transportation, but riding alone was not recommended due to safety concerns.

Activities and Cultural Exchange

The SURF program was carefully designed to enrich our academic and cultural experiences. The Wednesday seminars were among the highlights. Each week, a leading scientist gave a talk about their cutting-edge research. These talks ranged across disciplines—from physics and astronomy to chemistry and biology, from engineering to social sciences. They showed us how interconnected different areas of knowledge are and how creativity drives innovation at the boundaries of science. Listening to these talks often sparked new ideas about my own project and inspired me to think more broadly about the applications of research.

The Monday and Tuesday workshops also played an important role. These sessions were practical and interactive. For example, we learned how to write effective scientific papers, how to design scientific posters, and how to network with professionals in academia and industry. These skills are crucial for anyone considering a research career, and I am thankful that the program emphasized them alongside laboratory work.

The social aspect of SURF was equally rewarding. I made friends with students from across the United States as well as from countries such as India, the UK, and Iceland. We bonded over shared meals, late-night conversations, and weekend adventures. Cultural exchange happened naturally in this environment. I learned about different traditions, perspectives, and ways of thinking, all of which enriched my worldview. These friendships are among the most valuable takeaways from my summer at Caltech.

Reflections and Takeaways

Looking back, I see SURF not only as a research program but as a life-changing journey. It was the first time I lived abroad for an extended period, managing my own schedule, finances, and responsibilities. I grew in confidence, independence, and adaptability. The laboratory experience trained me in advanced scientific techniques and taught me to think critically about experiments. The independence I gained from designing my own research schedule will be invaluable as I continue my medical training and eventually pursue research as part of my career.

Equally important were the lessons I learned outside the laboratory. I discovered the importance of balance—between work and leisure, between solitude and community. I learned how to connect with people from diverse backgrounds and how to find common ground despite differences. I also came to appreciate the value of stepping out of my comfort zone, whether it was trying new food, participating in unfamiliar activities, or navigating a foreign city.

In conclusion, my SURF experience at Caltech was extraordinary in every sense. It combined rigorous academic training with cultural exchange and personal growth. It taught me responsibility, independence, and resilience, while also offering me friendships and memories that I will cherish for years to come. I am genuinely grateful to my advisors and PIs from NTU that encouraged me through the application process, to people at Caltech, including the program organizers, my PI, my mentor, and my peers, for making this summer possible, and to Dr. Oyang for all the financial and daily support from the very first day. This was definitely a dream come true for me, and I believe that the lessons I learned will continue to shape me as I move forward in both my academic and personal life.

