Vanessa YiRan Li

I fondly remember my efforts to recreate the lung-on-a-chip platform in the open hallways of my high school. The day prior, I had scraped the surface of pig lungs bought from the wet market and seeded them into growth media I had read about in literature. To my disappointment, the cell media had turned yellow from overheating and was swarmed with bacteria. Though disheartened at the time, I cherish these moments of "failure" as I conduct experiments in the laboratory today. The opportunity to ask questions, to fail, and to grow as well as to occasionally find something life-changing captivates me. I am not only enthralled to discover more but also determined to utilize these steps of scientific inquiry as my toolbox to advance healthcare. As such, I am determined to pursue a Ph.D. in Biomedical Engineering at Columbia University to become a research scientist — with the goal of driving sustainable change in the world around me.

As a first-year undergraduate student, I jumped at the opportunity to join the Weiss Lab at the Massachusetts Institute of Technology where I worked alongside a team of aspiring scientists to form cell swarms and *properly* learned to culture mammalian cells. Specifically, I genetically engineered human embryonic cells to release chemokine and characterized the movement of neutrophils toward these cells using transwell assays and fluorescent microscopy. I then moved from genetics to organs, working in the Zhang lab at Harvard Medical School to fabricate glomerulus-on-a-chip platforms with light-activated hydrogels and 3D bioprinters. The ability to engineer different pieces of the human body fascinates me as it redefines our definition of biology. It transforms today's medicine, which is based on drugs, into personalized cell-based therapies developed using the building blocks of the human body. As such, I want to be a part of this extraordinary shift in biomedicine to tackle urgent health challenges in the 21st century.

Vanessa YiRan Li

Amidst the crisis of COVID and the sudden pause to my research at the Zhang Lab, I was given the opportunity to spend more time with my extended family in Japan, specifically my uncle. I watched him struggle physically and financially with unexpected episodes of heart attacks. As such, I started reading into heart diseases and clinical trials to become better informed on the procedures and treatments he endured. As I delved deeper into literature, my interest in the heart grew more and more not only because of its significance as a modulator of the entire human body but also its symbolism as a bridge that connects people. My interest led to an opportunity at the Yoshida Lab at Kyoto University's Center for iPS Research and Application where I engineered heart organoids to study the effect of MAPK inhibitors and immunosuppressants on cardiac fibrosis. In the process, I was able to build upon skills I have previously used as well as learn new techniques, such as immunostaining and polymerase chain reaction, that I have come to use in my day-to-day life as a research assistant today.

When I joined Columbia in 2022, I continued my exploration of the heart and its diseases at Professor Vunjak-Novakovic's Laboratory For Stem Cells and Tissue Engineering. During my first two semesters, I conducted mitochondrial assays and analyzed surface proteins to contribute to an existing project exploring myocardial injury in systemic lupus erythematosus patients. Through this study, I was able to gain experience differentiating iPSC cells into cardiomyocytes and constructing bioreactors using PDMS, which I then combined to form 3D engineered cardiac tissues. Currently, I am pursuing my independent project embedding gold nanorods into engineered cardiac tissues with the hopes of stimulating electrical maturation in a way that more closely resembles the human myocardium. Through these studies, I have grown tremendously as a scientist with the incredible mentorship I have received and have learned to find joy in not only

the successful experiments but also the failures in between. Furthermore, I sincerely appreciate the sense of community in the lab from eating Serbian food in the East Village, building Christmas trees out of lab gloves, to summer picnics at Central Park. Being a part of this team has reaffirmed my interest in scientific research and most of all, the strong presence of female leadership has inspired me to set ambitious goals for myself.

As a Ph.D. student, I intend to continue the research I have started and to make use of the skillset I have garnered to ask deeper scientific questions. Under the guidance of Professor Vunjak-Novakovic and Professor Cheng, I plan on studying the role of exosomes in cardioprotection using heart-on-a-chip platforms. I am curious about the pathogenic function of exosomes released upon diseases and injury, like ischemia-reperfusion injury, and their trafficking between different cell types within the heart. Furthermore, how do factors such as age, sex, and race affect EV content? Can exosomes be used for personalized diagnostic markers and therapeutic approaches in cardiovascular diseases? The emerging role of exosomes has the potential to unveil unknown mechanisms and new therapies and is currently being explored in Professor Cheng's lab. Professor Vunjak-Novakovic's lab offers a heart-on-a-chip platform to model and study cardiovascular diseases in vitro. As such, this collaborative effort combines the strength of both labs to explore unventured avenues in biomedicine and I am honored to be able to be a part of and take the lead on this project.

In parallel to my research interests, I have always been passionate about the intersection of medicine, sociology, and advocacy. My upbringing in China, Japan, and the United States informed me of the immense privilege of having a voice in who I want to be knowing that this is not a global norm. As such, I seek for opportunities to advocate for equity in and out of the

laboratory. At Columbia, this has manifested in the form of being a student advocate as an ambassador for the BME department and the inter-school chair of the Engineering Graduate Student Council. I have organized events to foster interdisciplinary conversations on next-generation issues and offered support to students, especially those who are underrepresented in higher education, to find their place at Columbia Engineering. As a Ph.D. student, I hope to continue my advocacy efforts for the student body by stepping into leadership positions and taking an active role in community events. I intend to make a positive impact through both my lab work and community engagement efforts, working towards the goal of becoming a research scientist who will make a difference.

Upon completing my Ph.D., I plan on engaging in a career in research to redefine what is possible in cardiovascular care and to advocate for equity in healthcare. I can envision myself developing personalized tissue models that reflect sex differences in diseases or fighting for the safe use of new biotechnology such as stem cell therapy. Along the way, I intend to use my compassion, curiosity, and leadership skills to make a real impact on the world. At Columbia, I am excited to be in a space that curates the perfect environment for me to thrive, and am even more elated to have found my community within this space. As I continue to pursue research, I wish to encounter more moments of growth from using brightfield microscopy to find lung cells to operating high throughput imagers to characterize cardiac tissues. I look forward to encountering more moments of “failures” I can look back and laugh at in the future as I bring scientific research closer to the world.