2015 NSF Graduate Fellowship Personal Statement

Potions – most people think of Harry Potter and Disney villains, magical realms and witchcraft when they hear the word. Instead, I think of a childhood spent in my backyard, alongside my best friend, making our version of potions. We would combine anything and everything we could find to make fantastic materials and cures for imagined diseases. From then on, I took every afterschool science class that would allow me to continue my experimenting. In elementary school I learned how the neutralization reaction between vinegar and baking soda applied to cooking. Next, I split water with a 9-volt battery and learned how minute changes in the combination of protons, neutrons, and electrons created our universe. In middle school, I was sent around school with petri dishes to culture samples, surprised to see formerly clear plates alive and teeming with colonies. Along with other aspects of my childhood, these experiences offered the values and inspiration that will help me grow into the scientist I hope to be.

As I grew older, I combined my love of science with my drive to discover. In high school, I worked for two years as a research assistant in a stem cell research lab at Children's Hospital Los Angeles (CHLA). I was one of only four members of my junior class to be accepted into this selective program. This was my first true opportunity to exercise the scientific inquisitiveness I had developed over the years. My lab hypothesized that the ability of a cell to maintain stem cell phenotype and function may have been related to the activity of the DNA repair enzyme telomerase. We fluorescently marked telomerase positive cells to monitor them temporally and spatially using telomerase-controlled reporter protein constructs. We hoped to trace the fate of telomerase-positive lung epithelial cells in mice to identify a possible progenitor pool to repair damaged lung epithelium. At CHLA, I practiced scientific writing, produced a 24-page research paper on my findings, and independently worked on a project that was entirely my own. Twice, I designed and presented a poster at the annual, open-to-the-public CHLA poster conference among post-docs and principle investigators, communicating the broader impacts of my learning. My time at CHLA solidified my interest in pursuing a future in the scientific field.

During college, I worked on two projects in disparate fields of research: environmental geochemistry and bio-analytical chemistry. In researching a cyanide leach pit from the Mono Lake region of California, I learned valuable techniques, how to operate several new instruments, and observed first-hand the impact we have on our environment. As my advisor granted me more autonomy, I relied on the experience I had gained at CHLA and in lab courses. Quantifying the toxicity of cyanide and other heavy metals in these regions was very valuable, but I found myself drawn to how these toxins were affecting the miners and residents. This realization prompted me to pursue a more biochemically-oriented project. My senior thesis entailed identification of volatile organic compounds (VOCs) to use as biomarkers in diagnosing infectious diseases via a breath test. Working with the same advisor, Professor Charles Taylor, I continued to be awarded significant independence with this project. I examined the VOCs present in the air above growing cell cultures. Compounds or patterns in relative abundances can be used to identify the organism (biomarkers). My goal was to distinguish the fingerprints of *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, and *Mycobacterium bovis*, a model for tuberculosis. Initially, my approach to characterize these biomarkers failed. I then used a multilateral approach, comparing the four strains simultaneously rather than sequentially and was able to identify diagnostic combinations of biomarkers. These will be used to train a Raman spectrometer to identify the pattern associated with each bacterial strain to combat upper respiratory infections. Our breath test will expedite diagnosis and treatment, be useful in locations of greatest need due to the low cost of 50 cents per sample analyzed, and enable isolation of contagious individuals to prevent further spread of these diseases.

After graduation from Pomona College, my desire to pursue science let me my work in Professor Steven Clarke's lab in UCLA's Chemistry and Biochemistry department to study aging. I primarily studied the production of Vitamin C in *C. elegans*, possibly through a yet undiscovered pathway, and the role ethanol plays in lifespan extension with a graduate student and an undergraduate we mentored together. We identified that *C. elegans* can biosynthesize Vitamin C, likely by a novel pathway as the *C. elegans* genome does not encode all enzymes in either the plant or animal biosynthetic pathways. They use precursors obtained through their *E. coli* food source as starting materials for Vitamin C synthesis. Prior lab members discovered that low concentrations of ethanol double the average lifespan of starved first larval stage *C. elegans*. They use the ethanol as an energy source and incorporate it into amino and fatty acids. We analyzed changes in mRNA expression after exposure to ethanol and observed altered levels of enzymes involved in producing acetyl-CoA and glucose from ethanol or triglycerides. Modest alcohol consumption, antioxidants, and lack of damaged proteins increase lifespan in humans, therefore elucidating their mechanisms in *C. elegans* will shed light on human aging. My work at UCLA is described further in two second-author manuscripts. One has been accepted with minor revisions to the Journal of Biological Chemistry and the other is currently in review. I performed many of the experiments and participated heavily in the writing and editing of both manuscripts.

Upon entering graduate school at Yale, I tested activation of an unfolded protein response sensor, IRE1α, by imposed dimerization with Professor Craig Crews and I worked to understand the role of disorder of Troponin I in cardiomyopathies with Professor Elizabeth Rhoades. The summer after my first year I was fortunate to participate in the Yale-Bristol Myers Squibb Internship program and work with Dr. Neil Burford and Dr. Andrew Alt. I designed, troubleshot, and executed an assay to identify positive allosteric modulators (PAMs) of the κ-opioid receptor and screened over 60,000 compounds for PAM activity using this assay. In collaboration with another intern, I helped elucidate the structure-activity relationship of a known δ-opioid receptor modulator by screening nearly 100 new compounds for positive and negative modulator activity. The data we generated will be included in a manuscript currently being prepared by Dr. Burford.

After my time at BMS, I joined Professor Mark Hochstrasser's lab and began working on the assembly and localization of the proteasome in *Saccharomyces cerevisiae*. My work focuses on the mechanism by which the proteasome localizes to the nucleus, but I also plan to study the assembly of the proteasome lid and the formation of cytoplasmic proteasome storage granules under low glucose stress. I designed my main project independently, based on data collected by previous lab members and hypotheses I generated from unanswered questions in the literature. This project includes the work I propose in my Research Plan Statement. The breadth and nature of my research experiences, ranging from analytical geochemistry to biophysics, in addition to the expertise of Mark Hochstrasser and his lab regarding the subject matter I propose, attest to my qualifications to advance the knowledge of my field via my proposed plan of study.

Over the years, I have had incredible mentors who supported my desire to pursue science, but many young girls do not have the opportunity to attend college, let alone work in a research lab. Since high school, I have worked to ensure diversity in the academic environment. I firmly believe promising students come from all socioeconomic backgrounds and have worked for years to help spread opportunities for education. In high school, I helped found and served on the Board of Directors of the Marlborough Student Charitable Fund, a student initiated and run donor-advised charitable fund working to improve educational opportunities for underprivileged girls in Los Angeles. In two years, we raised over $30,000, provided grants to four organizations in LA, and joined the Women's Foundation. At Pomona College, I tutored with Upward Bound,

working with underserved students from the Los Angeles Unified School District. This program works to support potential first generation college students in the East San Gabriel Valley. High college tuition prices are also a significant obstacle to many qualified students. Working at the Pomona College Annual fund, I personally raised nearly $90,000 and our student calling team raised almost two and a half million dollars during my four years, for students struggling to afford college. Over sixty percent of this money was used for grant-based financial aid to ensure that students from all backgrounds have opportunities in higher education. In graduate school, I have continued my commitment to diversity and equal access to higher education. I participate in mentoring programs through Yale's Office for Diversity and Equal Opportunity (Many Mentors) and Women in Science at Yale (WISAY). Both organizations focus on ensuring students from all backgrounds receive the support they need to be successful in higher education. WISAY in particular supports mentoring female undergraduates with an interest in science. Outside of mentoring, I also volunteer to help AP Chemistry students at New Haven's Cooperative Arts and Humanities High School prepare for their AP exams and weekly at New Haven Reads, an organization that helps local students struggling with reading to improve their literacy.

In the future, I hope to pursue a career in teaching, and I firmly believe that my work both in lab and at Yale will impart the skills, independence, and training I will need. I have been appointed to the NIH CMB training grant, providing me the opportunity to present my research annually at poster sessions, including the annual departmental retreat, and conferences. For my qualifying exam later this month, I have prepared two dissimilar NIH-postdoctoral fellowship application style proposals using biochemical and biophysical techniques that I will defend to a panel of professors. In weekly lab meetings, I will present my experimental design, data and conclusions, defending the rationale and honing the clarity of my presentations. In pursuing a Ph.D. in Yale's department of Molecular Biophysics and Biochemistry, I will act as a TA and lead discussions to analyze primary literature. I am working to complete the Certificate of College Teaching Preparation, providing me the necessary skills and training to teach. These experiences, along with my community outreach, serve the 'broader impacts' goal, as I will learn to better communicate complex ideas and experimental design to those outside my field in addition to mentoring and supporting underrepresented students at various stages of education.

While I have been very fortunate in many regards, including my educational and research opportunities, I was born with a ventricular septal defect, a hole in my heart, the size of a dime. In my early childhood, things that came easily to other children were difficult for me. I had to work hard and be creative to compensate for my inefficient heart. My body lacked the energy to participate in typical toddler activities. I never learned to crawl as it required too high an input of energy, instead I would roll like a log across the floor. I learned there are many ways to achieve the same result and to work hard to reach my goals. I have carried these lessons with me all my life. My surgery was entirely successful and restored my heart to full function, but I will bear the resultant scars forever. These serve as a reminder each day that everything meaningful is worth the work. I recognize how few people in similar situations are fortunate enough to pursue higher education, and I have and will continue to help others from disadvantaged backgrounds. Due to the hole in my heart I continue to be efficient, determined, and hardworking in my research and other endeavors. As an NSF Fellow, I hope to blend pursuing my childhood passions and experiences with my desire to continue my scientific studies and service to others through these projects and activities at Yale.