Personal and Educational Experiences

When I was in elementary school, my great-grandmother was slowly dying from cancer. On one of her last days, I ran around her blowing bubbles hoping that my magic soap bubbles could cure her. Experiencing loss at that early age prompted my desire to cure disease. As I grew up, I learned that there is a lot more to finding the "cure". As I got older, my curiosity grew and was satiated by taking more science classes in high school. The science courses allowed me to test what I read in a textbook through hands-on experiments, where I could see and interpret the results. This was exhilarating! I recognized that I enjoy making discoveries: a realization that guided my decision to pursue a college degree in science.

Undergraduate Research and Education: I hold a Bachelor of Science degree in both chemistry and molecular biology from [redacted], a small liberal arts college in [redacted] I sought out all available options at my home institution, serving as an organic chemistry lab assistant during my freshman and sophomore years, but still wanted to seek out additional opportunities. During the summers, I took every opportunity possible to gain research experience, culminating three unique research internship experiences. For my first summer research experience, I was accepted into the **NSF Research Experience for Undergraduates Program** in Chemistry at [redacted] for two consecutive summers (2011 and 2012), where I worked under the direction of Dr. [redacted] (**Ref. 3**). My project aimed to characterize the role of Methylthioadenosine/S-adenosylhomocysteine nucleosidase (MTN) in bacterial growth and biofilm formation. I studied the nutrient growth requirements of an *Escherichia coli* mutant lacking the MTN enzyme and investigated the effects of deleting the MTN gene on bacterial biofilm formation. I had the opportunity to present my research findings at the [redacted] **Conference**. In my second summer at [redacted], I also mentored a first-year researcher, which gave me experience in **leadership and teaching in a laboratory setting**. In the summer of 2013, I had two very different research experiences: (1) an academic internship under the co-direction of Dr. [redacted] and Dr. [redacted], and (2) an internship in industry at [redacted]. In my academic internship, I worked closely with a team of three additional undergraduate researchers from other institutions using bioinformatics techniques to identify gene targets that may regulate the differentiation process of mouse pluripotent stem cells into neuronal and endodermal cells. The industrial internship at [redacted] was an excellent experience that opened my eyes to the differences between academic and industrial research. As an intern, I was unable to conduct independent research, so I observed many analytical techniques and assisted with tasks like sample preparation for contract-based agricultural chemistry research projects. The ability to communicate research and be a part of the scientific community thrilled me, as my undergraduate research experiences afforded me the opportunity to present several posters and oral presentations at 11 conferences, including the **244th National American Chemical Society Meeting and Exposition** in Philadelphia in 2012. I also qualified to earn **Departmental Honors in both in Chemistry and Molecular Biology**, which involved a two-year program culminating in a formal research paper for each major. These experiences solidified my interest in biomedical research as a career.

Graduate Research and Education: I entered the [redacted]e Program [redacted] in August 2014. I was attracted to [redacted] because of the opportunity to take a yearlong course encompassing several different disciplines of biology including cell

biology, biochemistry, and genetics. While taking the first-year [redacted] course, I also rotated through four different research labs. At [redacted] rotation labs can be selected from eleven different departments, which allowed me to explore chemistry, biochemistry and microbiology. Surprisingly, due to my chemistry-heavy background, my time in a microbiology lab stood out from my other experiences, as it combined biochemistry and bacterial pathogenesis research. During my rotation in Dr. [redacted] (**Ref. 1**) lab, I was tasked with validating the spatial localization of proteins during biofilm growth using uropathogenic *Escherichia coli* as a model. My rotation work resulted in middle authorship on a manuscript now published in **PLoS Pathogens** ([redacted]). My rotation project in Dr. [redacted] lab sparked my interest, especially when it came to oxygen-dependent control of where proteins- and corresponding bacterial subpopulations- end up in biofilms. I joined the [redacted] lab (May 2015) to delve deeper into oxygen-dependent modulation of biofilm formation in *E. coli*. In addition, I am investigating the impacts of bacterial respiration on biofilm formation by studying alternative terminal electron acceptors. I will incorporate microbial and biochemical methods with molecular genetics to determine the connecting factors transducing changes in energy production to the expression of adhesive fibers that contribute to the formation of biofilms. This integrated training will give me tools for leading a team in research development in the future.

Intellectual Merit: Educational, Career Development and Future Goals

My short-term educational goals include developing, writing, and defending a dissertation towards a doctoral degree in [redacted] from [redacted]. Upon completion of my studies, I aspire to work for a biotechnology company leading a research team focused on developing better or novel disease diagnostics. Currently, many diseases, especially in developing countries, are under-/mis-diagnosed due to the lack of more accessible diagnostic tools. As a scientist, I want to continue to bridging this gap and applying my knowledge to improve quality of life for others. In the case of bacteria, understanding the physiology of each infectious agent can uncover potential biomarkers for infection. Combining this understanding with an advanced technology to make biomarker testing tractable and affordable will greatly impact the speed and location of which diagnostic tests be transported and used. My graduate education will provide me with in-depth knowledge about bacterial physiology. In order to gain more project development experience, I plan to apply for post-doctoral training in an academic lab, focusing on the development of global health technologies. Such a post-doctoral fellowship will help prepare me for a successful career in leading a research and development team.

At [redacted] I have excellent opportunities for career development. Weekly meetings with my mentor, Dr. [redacted] help me to keep track of my progress and troubleshoot my project when problems arise. In addition, I am gaining experience in grant and manuscript writing through my mentor and coursework. Furthermore, I present my science often, in the form of lab meetings and departmental seminars, as well as at local, national, and international conferences. For example, I presented my research at the 2015 [redacted] student symposium and won a poster presentation award. The office of [redacted] at [redacted] also offers several resources, including career workshops, lecture series, and job placement resources that I have and plan to utilize frequently. Finally, my mentor has launched a trans-institutional collaboration initiative towards better understanding the progression of infection during urinary tract infections, the disease caused by uropathogenic *E. coli*. This group is focused on identifying early infection biomarkers and

evaluating their potential for disease diagnostics in specialized populations. I participate in these monthly meetings and I interface with several scientists from broad research backgrounds, such as Dr. [redacted] (biomarker development) and Dr. [redacted] (chemical engineering) and Dr. [redacted] (the Director of the Center for Translational Immunology and Infectious Diseases).Through these new connections, I am confident that I will develop my communication skills to effectively present my research across disciplines and will have strong guidance that will help me identify an appropriate post-doctoral opportunity.

Broader Impacts: Outreach, Leadership and Mentoring

To date, I have had multiple opportunities to mentor undergraduates and a post-baccalaureate researcher during my graduate career. One undergraduate researcher was a visiting student in the **Leadership Alliance Summer Research Early Identification Program**. As a rising sophomore minority student from a small liberal arts university, this student had very limited exposure to research when he entered the lab. After eight weeks, he learned the basic microbiology and molecular biology techniques typically practiced in our lab. At the end of his program, he presented his findings with a poster and an oral presentation. It was extremely rewarding to see the progress that he made over the summer and his confidence become boosted as his scientific and communication skills improved. Currently, I am working with two student researchers in our lab: a sophomore undergraduate [redacted] student and a post-baccalaureate researcher. Together, we study metabolite sensing and biofilm under varying oxygen conditions in uropathogenic *E. coli*. I am responsible for helping them design experiments, answer their scientific questions, interpret their results, and present them in a PowerPoint and research report format. Overall, my mentoring experiences in the [redacted] lab are helping to shape my confidence as well as my communication skills.

In addition to training junior researchers, I also recognize the importance of extending my efforts to the community, both within the science realm and beyond. During my undergraduate career, I co-founded a **Chemistry Club** with two fellow classmates and served as the president for two years. Many of our club members spanned both science and non-science. Interspersed with our other activities, we introduced volunteer opportunities and organized educational and social events. One event included a question and answer session for students with panel of professional scientists from a variety of fields that included an academic professor, an academic research scientist, and an industrial worker. A volunteer opportunity that was especially memorable was a biannual event sponsored by the American Chemical Society called [redacted] **Girls Enjoying Science (PAGES).** The goal of this program is to promote women in science by introducing science to girls at an early age. We organized fun experiments for middle school aged girls, including making silly putty and liquid nitrogen ice cream, while explaining the science behind it. I volunteered for four of these events while at CHC. In [redacted] I am involved with **Girls, Inc.** This program, similar to PAGES, is focused around teaching girls to reach their full potential and encourages the exploration of STEM fields. In February 2016, a lab mate and I will be hosting a session on exploring the microbes around us through interactive experiments with the girls. Outside of the science world, I volunteer at my church to coach the middle school girl's volleyball team, emphasizing the importance of teamwork- a necessary skill in many aspects of life. I feel that there is a strong need for effective communication among scientists and improved dialogue between scientists and the broader/lay audience. I believe my training at [redacted] will afford me these skills and mold me into a well-rounded scientist with the ability to reach and support the community.