By May 2012, I had garnered over three year's collective research experience between four groups at three different institutions across the United States. My tenure at each lab was relatively brief, but each experience provided a new perspective on, and an enhanced understanding of the field of chemistry. By contrast, in May 2013, I was making plans, after a year away from the field, to relocate from [redacted] to [redacted] to commence my graduate studies at the University of [redacted]. My in-between year was an unanticipated shift in direction that has proven to be beneficial for my development as a scientist. Direction, as it turns out, often comes from the most unexpected places. As famously stated by Mr. Ralph Waldo Emerson, "All life is an experiment. The more you make, the better."

My first substantial role in a group began in June 2009 after returning from an exchange year at the University of [redacted]. I joined a solid-state chemistry lab for my Honors thesis work. My focus was to synthesize phase-pure, kinetically-favored tantalum sulfides by employing low temperature, non-hydrolytic sol-gel (NHSG) chemistry. I worked in a glove box for all sample preparation, handling, and storage, and learned to design experiments that rigorously exclude oxygen at all stages. Thermal treatment of the amorphous material resulted in the preparation of phase-pure, nanocrystalline TaS_2 polymorphs, and structural characterization was carried out utilizing Powder X-Ray Diffraction (PXRD). The most intriguing result of the project was to learn that a high S:Ta ratio in synthetic conditions tended to reduce crystallite size in thermally treated samples. I presented my findings at three regional conferences, the 2011 Conference on [redacted] in [redacted], to state politicians at the [redacted] State Capitol Building, and at colloquium for the Department of Chemistry at the University of [redacted]. I completed my thesis in Spring 2011, entitled "Non-Hydrolytic Sol-Gel Synthesis of Tantalum Sulfide." I will be published as a co-author for my early contributions to the project in a manuscript that is currently under preparation.

My final semester [redacted] was spent in [redacted] as an intern at [redacted] laboratory. I was hired by Dr. [redacted]. I worked closely with her, her former student, Dr. [redacted], and Dr. [redacted] of the [redacted] division, in the kinetic study of methane-clathrate hydrate decomposition. Naturally occurring methane hydrates are estimated to contain the largest hydrocarbon[1] reserve on the planet. They have received considerable attention for potential to replace depleting petroleum reserves. With changing climate and their limited pressure-temperature stability zones, methane hydrates pose a potential environmental risk if they were to decompose. Intriguingly, methane hydrates demonstrate the ability to self-preserve well beyond their stability boundaries. This well-documented phenomenon termed 'anomalous preservation' is considered to be critical to understanding how to harness this potential source of carbon.

At [redacted], we prepared samples of methane hydrate through a facile high-pressure process, and structurally characterized the decomposition regime using Low Temperature (LT) PXRD. The kinetics were studied by the change in hydrate and ice phase fractions as a function of time, over several temperatures ranging from 140 to 273 K. I performed much of the sample preparation and characterization, and learned how to refine diffraction data using the General Structure Analysis System. The Avrami model of nucleation and crystal growth was used to determine dimensionality of crystal growth for ice from the initial hydrate sample. The activation energy of hydrate transformation was calculated for two temperature regions; because higher activation energy of transformation was calculated for the lower temperature region, it was reasoned that the phase of the ice transformed (i.e., post-hydrate) plays a role in decomposition. My contribution to the project earned me co-authorship on a paper published this year[1].

Beyond the invaluable research experience and outstanding facilities at [redacted], I was exposed for the first time to the realities of scientific funding in the US. I was initially hired by to

work on a different project, but the funding was cut early in 2011 at the onset of the budget crisis that continues still today. Budgetary constraints are an important concern for all publicly-funded scientist and engineers; unfortunately, stagnant economic recovery could exacerbate this dilemma despite the clear benefits of funding scientific research and development.

The following September, I relocated [redacted] to work for Professor [redacted] at [redacted]. I was assigned to continue work on the then recently-published multivariate-MOF (MTV-MOF) project.[2] Working closely with a post-doctoral researcher, I spent months on the synthesis and scale up of ligands, and prepared preliminary MOF samples for our project. It was during this time that I became aware of my strengths and weaknesses as a chemist. This was an integral step toward my development as a researcher: I reassessed my habits and methods, and made the necessary changes to grow professionally. By April 2012, however, Professor [redacted] moved his group from [redacted] to [redacted]. At the time, I was uncertain if a career in science was what I truly desired. Rather than continue on in his group or enroll in different program, I chose to relocate to [redacted] to be closer to friends and family, and explore a world beyond the academic bubble to which I became accustomed.

I spent July and August 2012 working on a voter registration drive in the low-income neighborhoods of [redacted]. Organized by the [redacted] Foundation, the initiative was part of a national campaign sponsored by [redacted]. Our goal was to increase civic engagement in a vastly underrepresented community, and we faced two huge obstacles: educational disparities and general mistrust of outsiders. One of the objectives was to hire people from the neighborhoods we canvassed, and as the only person in the office with a college degree, I rapidly took on significant responsibility. I met men, women, and teenagers who led lives of instability, transience, drugs, and alcohol. The rampant poverty and inequality I saw each day stood in striking contrast to the large amounts of wealth concentrated near [redacted]. From my time at [redacted] that I grew to understand the complex scope of initiating social and economic change in impoverished and underrepresented communities.

Due to the inherent, temporary nature of the job, I accepted an offer for a technician position at a pharmacy in one of our target neighborhoods. By September, I no longer roamed the streets to register eligible citizens to vote, but I continued to see many of the same issues on a day-to-day basis. Most strikingly was the poor quality of education among the residents of the surrounding community. The principles of basic science and medicine were poorly understood, and I received daily recommendation requests for the best "over-the-counter antibiotic for a cold." Educational disparities were visible everywhere, and they were continually underscored by the cyclical nature of poverty and the overall low quality of life in that neighborhood. Having grown up in a working class family from a rural community in an economically desolate part of [redacted] a part of me could identify with their condition. My hometown of less than 3,000 people more often than not served as a trap for its youth to get lost in a sea of drug addiction and instability. In both instances a combination of few economic opportunities and poor education serves as the barrier to building a better life. Inner-city and rural schools often leave the least equipped and most vulnerable members of our society at the greatest disadvantage. To rectify this beyond federal laws and test scores, voluntary engagement of the most educated and creative minds of our society should form the basis of any initiative; however, cultural differences can form a sometimes insoluble barrier.

The differences in education between my patients, coworkers, and me were obvious. Despite this clear barrier, I formed mutual understanding and connections with the people I encountered at both [redacted] and my pharmacy. Helping an individual to understand a problem,

medication, or even the importance of civic participation was most rewarding. As a college educated, Latino-American who has actively engaged people of all ages, ethnicities, cultures, and socioeconomic backgrounds through outreach and public discourse, I believe I possess significant potential to bridge gaps between the scientific community and the greater public. This was part of my decision to apply to graduate school once more.

Since starting in Dr. [redacted] group at [redacted] this summer, I worked independently on two separate projects, and was able to successfully prepare and scale up ligands. I am currently using these ligands to prepare porous covalent organic frameworks in work that is similar to that outlined in my Graduate Research Statement, though not nearly as comprehensive.. Receiving the National Science Foundation (NSF) Graduate Research Fellowship would give me greater room to grow as a scientist. Without designated teaching responsibilities, I would have more time to dedicate to both research and desired community outreach initiatives.

As a minority in science, I will encourage other students of underprivileged backgrounds to pursue science and engineering research, and help ensure pathways to success. Though there are several initiatives like Research Experience for Undergraduates and Project SEED, I hope to explore a program like urban gardening. Urban gardens are considered a central tenant to sustainable urban development as they utilize otherwise abandoned land in low-income neighborhoods. Gardens like these provide fresh fruits and vegetables to community members, and function as place of socialization and relaxation. By recruiting other graduate students from science and engineering disciplines to maintain the garden, an academic presence in these areas would facilitate direct engagement of community members who may otherwise remain unaware of the scientific world beyond. Additionally, urban gardens present a unique opportunity to create a natural, interdisciplinary laboratory for hands-on teaching of subjects like botany, agro-ecology, and environmental chemistry, underscoring a central goal of the NSF. This type of exposure is invaluable to young and old alike, and will enrich the lives of both the mentors and mentees – I say this from experience.

Life experience thus far has taught that the best results are sometimes the most unexpected; a little experimentation is required. I do not know what to anticipate after graduate school, but I aspire to lend my talents to the development of a sustainable civilization through scientific advancement. Before returning to academia, I made a personal commitment to remain active in the communities where I reside, and have a track record that precedes [redacted]. I possess the creative mind, relevant experience, and global awareness that define an NSF Fellow. If awarded this fellowship, it will be an outstanding honor.

References

[1] *J. Phys. Chem. A* **2013,** *117* (17), 3593-3598.
[2] [redacted]