Plant Breeding and Genetics

I love answering questions. The process satiates my curiosity and causes my brain to fire on all cylinders, as I often explore creative solutions and draw from diverse intellectual fields to tackle difficult problems. I dream of having a career where I investigate question after question – the harder and more complicated the better. As a young child I fortuitously came upon what I believe to be the most interesting question in the world. I was born with a congenital heart defect, which, while having a relatively insignificant effect on my short and long-term health, brought my attention to the puzzle at the root of modern genetics. After reading a book about genetics at the age of twelve I realized the question at the core of my condition and the field of genetics were one and the same: "How do phenotypes arise from genotypes?" I strove to answer this question as an undergraduate, and I hope to keep answering it as a graduate student and eventually a researcher and teacher.

My journey to understand the relationship between genotypes and phenotypes made me an F_1 hybrid of the sciences and the humanities. I majored in both biology and philosophy to understand the techniques and theories of biology at a practical and conceptual level. To effectively communicate my research, I combined my passion for science with my previous experience in speech and debate to synthesize these skills into science communication that advocates for science to politicians and the public. Recognizing the importance of balancing the rigor and structure of science, I regularly performed improvisational comedy which fostered creativity and inspired dynamic communication and pedagogical techniques when I taught in the classroom. My experience beyond the sciences provided hybrid vigor in scientific environments and I believe have made me a stronger candidate for the section of Plant Breeding and Genetics at [redacted].

As an undergraduate at [redacted] I crafted collaborations with university, private sector, and government researchers to conduct interdisciplinary work in the fields of phylogenetics, molecular evolution, and quantitative genetics. These projects challenged preconceptions in the field of phylogenetics, provided new information about metabolites in Brassicacae, and characterized molecular and phenotypic diversity in *Brassica rapa* at an unprecedented resolution. My work resulted in six manuscripts at various stages of publication and shows my ability to learn and integrate new fields into a focused research question. Furthermore, through these experiences I attained proficiency in a variety of research techniques that I will draw upon to complete my doctoral studies.

In May 2013, I began working in Dr. [redacted] at [redacted] Over the following year I trained in bioinformatics and contributed to two phylogenetic projects. My contributions to those projects resulted in a published co-authored paper in PLOS ONE, and another co-authored manuscript in preparation. One of the most valuable parts of my first year was diving into the world of "big data." Before beginning research, I had little knowledge of genomes and only basic computational skills. Dr. [redacted] lab opened up a new field of study and a new set of skills for me to master. I was enthralled by genomics and wanted to absorb all I could to apply these skills to my future investigations. I worked with a post-doctoral associate to assemble and analyze reference-based transcriptomes and taught myself basic programming skills with Perl, Python, and Bash. I have continually used the methods and conceptual framework of the genomics paradigm in my independent projects.

During Fall 2014, a new field, metabolomics, captured my fascination. I collaborated

closely with a researcher from [redacted] on his project to analyze Brassicaceae species for anti-microbial and anti-carcinogenic metabolites. I was exposed to the new world of high-throughput analytical chemistry and witnessed the potential it held when combined with genomic methods. When my collaborator visited [redacted], we performed transcriptome and metabolome sampling. He identified novel compounds and found evidence of a metabolite in a lineage it had never been seen in before. This pilot study is being refined and the results are being prepared in a co-authored manuscript (in prep). During our weekly SKYPE meetings, I learned about the theory and application of analytical chemistry techniques and was excited about potential integrative and collaborative projects using these methods. Metabolic phenotypes presented the opportunity to tackle my deep conceptual questions about complex genotype-phenotype relationships, and the answers to my questions could be translated into useful antibiotics and nutritionally improved crops that could benefit society. I was motivated by this collaboration to combine genomics and metabolomics into a framework for answering questions in genetics.

In spring 2014 I found the perfect combination of my fervor for genomics and metabolomics by performing a quantitative genetics field trial for *Brassica rapa* nutritional traits. This experience motivated me to get a PhD in plant breeding and genetics from [redacted]. I acted as the primary researcher on a collaboration between [redacted], Dr. [redacted] at [redacted], and the [redacted]. Working with Dr. [redacted], who has a focus on crop biofortification, was a first-hand exposure to the societal benefits of integrating plant metabolomics, genomics, and breeding. I spent the summer of 2015 at [redacted] funded by the American Society of Plant Biologists Summer Undergraduate Research Fellowship and began a field trial for a genome-wide association study (GWAS) of nutritional traits in Brassica vegetables. While at [redacted], I gained field experience and expanded my genomics toolkit to include SNP calling and quantitative genetic techniques. This experiment was my first foray out of the greenhouse. Fieldwork excited me since I knew the results would be more representative of the real world compared to the controlled condition of the greenhouse. I crafted collaborations with researchers at [redacted] and the [redacted] Plant Science Center to produce leaf metabolomic and ionomic data. Currently, I am performing population genetic analysis on the sequence data and will complete a GWAS after receiving the nutritional trait data. These projects will result in two first author papers (in prep).

At [redacted], I want to work amongst world class faculty like [redacted] and others to gain further experience in quantitative genetics and use the techniques and framework of computational biology and genomics to enhance the results of quantitative genetic studies of economically important plant species. I want to capitalize off of [redacted] activity with international entities to foster global activity that allow my research to have impact to farmers world-wide. I also want to mentor undergraduate students in my graduate school lab to contribute to their education in the same way graduate student mentors contributed to my development.

I aspire to become a professor at a major research university, and continue to use a combination of genetics and systems biology to investigate the complex processes underlying the genotype-to-phenotype map. My research will serve as the foundation for my undergraduate and graduate level courses. I also want to expand upon my graduate student mentoring by building a lab that focuses on graduate and undergraduate student research development.