Given my innate curiosity and educational experiences, my entrance to graduate school may have seemed inevitable, but it wasn't. Until 2 years ago, I didn't see myself in graduate school. But science was on my radar long before a doctorate. As a young student I kept asking "why" questions: why do people like this type of art? Why do some Iowan counties export more pork than others? Science offered a method to answer those questions, which delighted me. Excited to have classes devoted to science in middle school, I started to explore supplementary topics at home. While in class I learned the basics of statistics and biology, out of class I surfed the Internet looking for new tidbits of information. It sounds unbelievable that an 8th grader was excited about statistics, but I was a nerdy kid and I loved it. During my extracurricular browsing, I found the work of Dr. Griffith Buck and Dr. Norman Borlaug, both Iowan plant scientists. Dr. Buck worked on hardy roses, ensuring his roses were resilient enough for a harsh Iowa winter, and opened up the rose cultivation market. Dr. Borlaug was the father of the Green Revolution, and worked on developing high-yielding, highly resistant wheat varieties to address famine around the world. It was one of the first times I realized science wasn't all about figuring out how things worked, but could also address pressing needs of our communities. At the same time, I attended the "Taking the Road Less Traveled Conference" held by The Women in Science and Engineering at Iowa State University. At this conference I discovered ways plant science was pushing the boundaries of possibility and addressing societal needs. With those experiences and a growing awareness of global issues such as food security, I decided to become a plant scientist.

Statement of Purpose and Goals

I've witnessed and plan to take part in the rapid merging of data science and plant biology, which heralds leaps in our basic understanding of biology and opportunities to benefit our global community. My goal is to become a college professor so I can: **1) conduct research and advance human knowledge and 2) return communal investment in my education to both the next generation of scientists and the public through teaching and outreach.** This long-term goal will guide me through my doctoral education as I train as a researcher, hone my written and oral communication skills, and teach undergraduate students complex concepts. This fellowship will provide resources and opportunities–such as the GRIP and GROW internships–that will help me engage with researchers throughout the world with whom collaboration may otherwise be difficult. These opportunities will greatly enrich my educational experience and facilitate my career goal to work collaboratively within the scientific community at the frontiers of human knowledge.

Intellectual Merit

My first independent research project was a **Mentored Advanced Project (MAP) on campus sustainability** guided by Dr. Elizabeth Queathem during my undergraduate education at Grinnell College. The college was beginning a massive construction effort, the perfect opportunity to research landscape design, stormwater runoff, and local perceptions of these issues. My goal was to synthesize how current practices and designs could be improved to reflect the needs and values of the community. This work entailed substantial literature review, interviews with international landscape architects in Germany, and development of a questionnaire for qualitative analysis of community perceptions and values. My project culminated in a set of suggestions presented to the campus construction committee and architectural firm, poster presentations at academic conferences, and a public oral presentation and pamphlet distribution to the local community.

My other undergraduate research was with Dr. Jonathan Wendel's lab at Iowa State University. I conducted an experiment to identify nucleotypic effects occurring within different cell types of several accessions of cotton. Under the guidance of Plant Biology graduate student, Josef Jarezck,

and Dr. Wendel, I reviewed the literature on genome size variation, designed an experiment to test phenotypic effects of genome size on cell size, collected and analyzed microscopic images of leaf epidermis, **published the findings as my first scientific paper**, and gave several presentations. These two research opportunities were distinct in scope, purpose, and discipline, but both introduced me to the basic research process and different forms of science communication. Because of the interdisciplinary nature of my research, high performance in diverse coursework, and service to my department, I **graduated with honors** and was inducted into the **Phi Beta Kappa honor society**. I am incredibly fortunate to have had these opportunities as they played a major role in my eventual decision to pursue a graduate degree.

Despite these gratifying experiences, I found myself uncertain about my next steps after earning my bachelor's degree. In hindsight graduate school was an obvious choice, but at the time I thought I wasn't ready. So three days after graduating I drove to Alaska, where I **interned through the Chicago Botanic Garden's Conservation Land Management Program with the Bureau of Land Management** to investigate possible uses of my new degree in the public sector. I spent the five-month internship as a **botany technician** working on the **Seeds of Success program**, maintaining native seed resources, and the **Assessment, Inventory, and Monitoring (AIM) program**, monitoring mine-related restoration. The work consisted of field identification and collection of native plants, and explaining the findings to current mine operators whose businesses depended on the BLM's classification of restored land. I also assisted in public outreach with the **University of Alaska Anchorage program, ANSEP**, a STEM outreach program for rural and native Alaskan youth, in which I introduced the students to basic concepts of forestry and led a tree-coring activity. At the end of the five months, I had to decide my next steps. I loved using my scientific knowledge to better public lands and teach others about native ecosystems, but I also missed basic research–the opportunity to ask questions, methodically test, and find answers. Though I collated and managed reams of data collected throughout the field season from multiple groups, I would not get to analyze any of it. My inner statistics-lover craved data analysis. I decided to **serve the public through basic research and education as a college professor.**

During my first year at Iowa State University, I joined Dr. Matthew Hufford's lab and published a perspectives article in *Current Biology* and a book chapter on maize domestication. I also joined, by competitive invitation, the **NSF Research Traineeship program, Predictive Plant Phenomics** during fall of 2018. This program emphasizes interdisciplinary work across plant biology, data sciences, and engineering–all of which are needed in the budding field of phenomics. Additionally, I attended the University of Washington's **Summer Institute of Statistical Genetics** in July 2018 on scholarship where I learned about advanced statistical and computational methods specifically for population genetics. Both programs have strengthened my computational skills, allowed me to practice communicating across academic disciplines, and introduced me to recent advances in other disciplines that are useful in my research.

Broader Impacts

Research and education go hand in hand for broadly benefiting society through STEM activities. This has become particularly evident from my involvement in several mentoring and outreach programs at Grinnell College and with the Bureau of Land Management. At Iowa State University I have an on-going collaboration with **Science Bound**, a program which encourages students of color in central Iowa to enter STEM careers. The program collaborates with 19 separate middle and high schools, from which the program follows students and their families from 8th grade through college, providing guidance, field days, and free tuition at Iowa State University for par-

ticipants. Science Bound had over 160 students enrolled at Iowa State University as of 2016, and has previously graduated 135 students.

An important part of teaching is clear communication. My first holiday back from undergraduate I was asked the question "what are you doing at school". Instantly I jumped into the fascinating details of what I was learning, not noticing the slow glaze creeping over my family's faces. When the response to my explanation was "that sounds nice", I realized I needed to be able to explain my research to experts and non-experts alike. I looked for ways to practice science communication so my research not only advanced my field but also the knowledge of my communities. One way I practiced was as a **peer mentor**, a role I participated in for four semesters at Grinnell College. A mentor is similar to a teaching assistant (TA): I attended classes, created and led hour-long review sessions twice a week, and acted as liaison between students and professors. I had to translate abstract ideas into concrete examples in much the same way previous mentors and teachers had done for me. Because mentoring allowed me to return the support I had personally received to upcoming students, I found the hard work to be greatly rewarding and have pursued similar work.

After returning from Alaska, I worked as a **post-baccalaureate fellow** for an educational support program, **Partners in Education**, at Grinnell College. The program supports second semester students who may drop out without intervention. I advocated for students' access to institutional resources and support, helped students develop essential skills such as effective note-taking and time management, and assisted students in communicating with faculty and administrators. The program opened my eyes to inequities some students face within higher education, and how inequity can be mitigated through strategic support and authentic partnerships between students and teachers. Thus, in my future career as a scientist and educator, I will seek out and support programs that reach under-served communities within STEM, such as Science Bound.

I have also sought out and created peer learning and support networks at Iowa State University. During this past summer, I created and led an informal discussion group on the basics of population genetics, guided by my major professor Dr. Hufford. I organized the reading schedule and came prepared with notes and questions to lead discussion on a weekly basis for students from three different labs. This group has helped me gain a better understanding of the theory and create a sense of community with other students. Related to this peer community, I took on a leadership role within my program as the **vice president of the Interdepartmental Plant Biology student group**. As vice president, I schedule and run the weekly seminars for program students and faculty.

In the future, I plan to serve my field by participating in exchange programs with **CIMMYT (International Maize and Wheat Improvement Center)** in Mexico, a program designed to bring international researchers together to improve global grain resources. Access to the GROW program through NSF-GRFP would be helpful in supporting collaboration with researchers at CIMMYT. I will also assist with computational training at future **Annual Maize Genetics Conferences**. While I love statistics and am discovering a joy for coding, they have not been easy disciplines to learn. Sharing some of the hard learned lessons and guidance I have received to other researchers will be personally rewarding and help others utilize these powerful tools in their own work.

Conclusions

Data science offers powerful new tools for understanding plant biology. Together, these disciplines can tackle urgent global issues affecting us all. Not only will I participate in this scientific revolution, I will use my position to support under-served communities in STEM and disseminate findings to the broader community. The success of these goals will benefit greatly from the support and opportunities afforded by the NSF-GRFP.