

NSF-GRFP: PERSONAL STATEMENT

DAVID E. HUFNAGEL

It is August 2008, and there is a little blue house on an empty street speckled with houses and surrounded by forest. Just down the road farmers break the soil and their backs every year to turn sunlight into food for their families and the community, but this little blue house does not contain farmers, but rather a UPS driver, a stay-at-home-mom and their three boys, of which I was the middle child, then preparing to leave the countryside for Michigan State University (MSU), one of the largest universities in the United States.

Nobody in my family expected me to pursue higher education when I was growing up. Early in adolescence I was socially awkward, angry at the world and convinced I was stupid. In school I was attacked nearly every week, often by groups. I responded by fighting back, and became a short-fused explosive who would start brawls over any snide remark. At the same time, I was bored with my classes and rarely tried. Everyone around me soon accepted my ineptitude, but after years of inadequate grades and low self-esteem, I decided I would put all my efforts into school to see if I could prove everyone wrong. Before long I was getting along with my peers and insisting on being placed on the advanced track. I had found something I was good at, and it fueled me. Furthermore, in tenth grade I met a biology teacher who exposed me to concepts in biology for the first time since I started paying attention. I was so captivated that I regularly stayed after class with additional questions and stayed after school for his Microbiology Club.

After high school I decided to pursue my newfound thirst for biological inquiry at MSU. In my first year I had the opportunity to get involved in a genetics lab under the guidance of Dr. Cornelius Barry. In his lab, I worked with other lab members towards answering questions regarding what genetic factors cause certain fruit ripening and terpene production phenotypes in both *Solanum lycopersicum*, tomato, and its wild relatives. Our research on terpene production was published in The Plant Journal (Gonzales-Vigil 2012). While I enjoyed doing wet-lab genetics work with Dr. Barry, I was also interested in exploring computational biology, so I took three computer programming classes in python and C++, and one introductory bioinformatics class.

In addition to taking classes, I wanted to do computational research to further explore my interest. I earned a position in Dr. Shin-han Shiu's lab where I acquired more independent, computational experience including playing a significant role in a project studying how whole genome duplication has affected gene evolution in the family Brassicaceae. As part of this project, we assembled the *Raphanus raphanistrum*, wild radish, genome and transcriptome from next-gen sequencing data. This data was used, along with genomic data from *Arabidopsis thaliana*, *A. lyrata* and *Brassica rapa*, to answer questions regarding the evolution of genome structure, duplicate genes and pseudogenes in plants and was published in The Plant Cell (Moghe 2014). I was also the leader of a project involving the acquisition and comparison of genomic pseudogene datasets from 31 representative species across land plants in order to learn more about the nature of pseudogenes and their role in plant evolution. For this project, I planned to compare pseudogene length, distribution and rate

of evolution across land plants to see how these factors relate to species age, gene family size and timing since whole genome duplication. While significant progress was made, the project was unfinished when I left the Shiu lab. In addition to these projects I was able to use my experience with pseudogene analyses and other computational skills to help with three additional projects that led to publications, two of which are currently under review (Campbell 2014, Wu, Lehti-Shiu).

In addition to research and classes, at MSU I graduated in the Honors College with a 3.74 GPA while participating in other career building experiences. I tutored students in three science classes both with and without pay. I also gave three oral and four poster presentations on my research, excluding lab meetings. I also had the opportunity to be a part of a study abroad program where I traveled with a group of students to Nicaragua for nine days to learn about both tropical ecology and Nicaraguan culture. This experience allowed me to see the world from a different perspective and showed me that my own was quite limited. I also had practice in competing for funding: During my time at MSU I was regularly on the Dean's list and earned seven competitive awards and scholarships including the 2010 Plant Genomics at MSU Summer Internship. My experience at MSU, and my acquired taste for research inspired me to pursue graduate school and become the first in my family to do so.

Part of what made graduate school possible for me was earning the Plant Sciences Institute Fellowship and the Brown Fellowship which helped defray the costs of education and living at Iowa State University (ISU). In my first year at ISU have also earned a travel award for my presentation on my research during my second rotation with Matthew Hufford. I also gained leadership experience by accepting the role of Director of Outreach for the Bioinformatics and Computational Biology program's Graduate Student Organization (BCBGSO). As the Director of Outreach I felt a responsibility to assist the many students on campus who had difficulties understanding and utilizing the computational tools needed to carry out their research and coursework. I therefore led a team of student teachers and volunteers to design, advertise and implement two four-hour LINUX workshops in August 2014. The workshops were not only a great success in terms of learning outcomes for students but also in terms of my development as a leader who can organize people with different skills and viewpoints to accomplish a greater task. I intend to repeat these workshops in January of 2015 in addition to a Python workshop with more students and volunteers than in the previous workshops. In addition to developing workshops I had the opportunity to be a teaching assistant in an introductory biology lab course. This experience required me to be a leader in the classroom on a regular basis and was a catalyst in my development of emotional maturity in dealing with grading, cheaters and generally difficult personalities in a professional way.

Despite many great options, after research rotations I decided to work with Dr. Matthew Hufford as my major professor during my PhD. During my rotations I realized that after working in plant labs largely by coincidence I had fallen in love with plants. Furthermore, I have a fascination with maize not only because it is the world's number one food crop but also because there seem to be so many dramatically different varieties and landraces all across the world. I have also realized that maize is as diverse genetically as it is phenotypically with **X% of the genome structure varying between individuals within maize (cite)** In the Hufford lab I have already contributed to a project regarding the origin and evolution of maize in the American Southwest that was accepted in Nature Plants (DaFonseca 2014). Moreover, I decided I would do my first major project on admixture because it seems to

be a substantial yet underappreciated force in plant evolution. **impressive stats about admixture**

During my PhD I intend to continue to develop my independence and leadership skills through project development and teaching. I am also committed to developing research skills through experience and mentoring. At this time I consider it likely that I will work in Industry after my education, so in order to learn about the culture of industry research I plan to do an internship with one of the many seed companies that have major research branches in Iowa. This will also hopefully serve to facilitate future collaborations between the company I intern with and ISU through my colleagues and myself.

After my education I plan to do a post-doctorate in Europe, after which I plan to work for a large seed company. The purpose of doing a post-doctorate in Europe is to gain new perspectives on science and lifestyle. I also expect it would introduce me to collaborative opportunities that would otherwise be unavailable to me. After my post-doctorate I will make an effort to do more than keep up with my research. In larger companies like DuPont Pioneer and Syngenta there are research facilities all across the world under the tutelage of the company which would enable easy and efficient international collaboration. **[education and outreach in big companies]** My ultimate career goal is to significantly increase the carrying capacity of the world population to allow humans more time to develop a sustainable long-term relationship with planet Earth.

In conclusion, I believe I should receive this grant because I have the right experience, skills and personality to use this money to launch a career in science that will contribute significantly to international research, education and innovation. My education and research experience have and will continue to provide me the knowledge needed to be a great scientist. Because of the big data revolution, my programming classes and computational research experience have provide me with skills that are in high demand. Leadership experience in tutoring, teaching and developing workshops will allow me to lead team members with disparate backgrounds and points of view toward goals in research and education. My presentation experience has and will continue to develop my communication skills to share my research with other scientists and the greater community. I also have experience in competing for funding through award and scholarship competition which will help me provide funding for my future research. Additionally, I have started to acquire a global perspective through my study abroad experience and will continue to do so if I earn a post-doctorate in Europe. Funding me would also support my intention of bringing collaboration between industry and academia through my internship experiences. Finally, I believe I have the right personality to become a globally engaged scientist with significant contributions to science and society. I am driven and focused enough to pursue challenging questions, curious and happy enough to enjoy doing so for the long-term and confident and adventurous enough to keep pushing myself to do better science and learn more about this beautiful world we live in.

1: Campbell et al. (2014). *Plant Physiology*, 26(5):164(2):513-24. doi: 10.1104/pp.113.230144.
2: DaFonseca et al. (2014). *Nature Plants* **3: Gonzalez-Vigil et al. (2012). *The Plant Journal*, DOI: 10.1111/j.1365-313X.2012.05040.x** **4: Lehti-Shiu et al. Evidence for a decay-**
ing *Arabidopsis thaliana* transcription factor derived from whole genome duplication
 (Submitted) **5: Moghe et al. (2014). *The Plant Cell*, 26(5):1925-1937.** **6: Wu et al. Green al-**
gal retained duplicate genes tend to be stress response genes and experience frequent
response gains (Submitted)