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Personal, Background, and Future Goals Statement

Personal background. I was raised to believe that the best way to thank someone for helping you achieve your goals is to help someone else reach theirs. You can show your greatest level of appreciation when you have taken the advice of someone else into your own hands, and you are able to apply it to your life and that of those around you. This philosophy has been the driving force throughout my undergraduate education as I want to make the numerous mentors I've had proud of my growth, progress, and work ethic. The various research, tutoring, and mentoring opportunities I've been lucky to have up until now have helped me grow as a person and scientist.

Research background and achievements. Starting college, I was interested in science and had a strong desire to conduct research, so I sought opportunities to become involved in research and to challenge myself, as ways of growing as a scientist. My research experiences came from involvement in three types of activities: (1) studies of plant-fungal associations in the deep fossil record; (2) participation in the NSF-REU Sustainable Land and Water Resources at the University of Minnesota; and (3) work in the collection of the Humboldt State University (HSU) Dennis K. Walker Greenhouse.

Studies of fossil plant-fungal associations. Starting my freshman year, upon taking Introductory Botany at Humboldt State University, I became interested in the subject and enlisted in Dr. Mihai Tomescu's paleobotany lab. The independent project I was assigned was a multifaceted study of Early Devonian (400 million-year old) plants and their fungal and microbial associates. I would spend any time I had outside of my classes and of several jobs to (1) learn and apply the laboratory techniques for sectioning fossils; (2) survey the scientific literature on plant-fungal associations; and (3) investigate and characterize the plant and fungal fossils, and assess their evolutionary implications. All along this project I received support through the California State University Louis Stokes Alliance for Minority Participation (LSAMP) Student Research Scholar Program and the HSU Siering-Wilson Undergraduate Research Endowment.

Fungi and microbial organisms are often too delicate or small to be preserved in the fossilization process and as a result their fossil record is sparse. Any addition to the fossil record of microorganisms is important to understanding the history of their interactions with plants. In my study, I documented and characterized multiple fungal and microbial morphotypes associated with the plant fossils, some of which had never been described before. Together, these revealed a new occurrence of exceptional preservation of plant-microbial interactions in the Early Devonian, the second only to be described from rocks of this age and, therefore, an important reference point in studying the history of these interactions. My study also broadened the search image for plant-microbial interactions in the fossil record. I presented these results at the 2019 meeting of the Botanical Society of America and then published them as first author in the *International Journal of Plant Sciences* (doi: 10.1086/713441).

NSF-REU Sustainable Land and Water Resources. This REU program at the University of Minnesota, which took place virtually, allowed me to continue my undergraduate research on fossils while also being introduced to new concepts. Following my interest in plant anatomy and evolutionary biology, I delved deeper into plant-fungal interactions in deep time. Specifically, I focused on a particular type of Early Devonian fungus that I had identified in my previous studies. The majority of land plants have some type of intimate relationship with fungi. One of these essential interactions, called mycorrhizal associations, has its first occurrence in the fossil record around 410 million years ago. Adding to my knowledge of extant fungi and their roles in ecosystems, which I had accumulated through my coursework, I conducted an in depth literature review of the fossil record of fungi, that would later be synthesized as a table in my second manuscript (currently in review at *Review of Palaeobotany and Palynology*). This information provided the context for placing the fossil fungi I had been studying in a taxonomic framework, assessing their relationships with the host plants, and justifying the erection of a new mycorrhizal species. I

presented this research at four conferences – the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) 2020 conference (where I was awarded Best Student Presentation), the Botanical Society of America 2021 meeting, the Midcontinental Paleobotanical Colloquium 2021, and the Progressive Palaeontology 2021 meeting (Palaeontological Association, UK).

As part of the REU program, I also participated in a series of seminars on the importance of community based research and traditional ecological knowledge. We met with graduate students, faculty members, and tribal professionals who taught us the importance of conducting research ethically and respectfully, especially in regards to indigenous cultures and lands. This experience taught me numerous things that I can now apply to my own research, as well as to the way I perceive science as a whole. Additionally, I became acquainted with underlying philosophies of research that I had not considered before, such as the importance of being meaningful and purposeful in the way you communicate and write science. I got to present my research to these communities in two symposia held by the HSU Indian Natural Resources Science & Engineering Program (INRSEP) and the REU organizers at the University of Minnesota, where I was also awarded Best Writer.

Greenhouse database. One of my on-campus jobs was at HSU's Dennis K. Walker Greenhouse, which has the largest living botanical collection in the California State University (CSU) system. There, I was responsible for assembling a digital database on the maintenance of plant specimens, the first one ever made for this collection. I photographed each plant and recorded the health problems or nutrient deficiencies it had. I also collected data about each plant's native region, distribution, pest issues, care instructions, monetary value, conservation status, etc. This required extensive research and consultation of numerous primary sources for finding the most up-to-date information on each species to make the database cohesive and consistent. Added to my fossil research experiences, the greenhouse database experience emphasized for me the importance of detail in scientific work. For my contributions to this database, I was awarded HSU's Sterling J Sam Botany Award and CSU-LSAMP'S award for Outstanding Research in STEM.

Teaching and mentoring experiences. One opportunity to apply my credo of 'helping others to honor those who helped me' presented itself early on, during my sophomore year, when I was selected to work as an Instructional Student Assistant (ISA) at the Humboldt State University Learning Center, based on recommendations from the faculty. There, I tutored various STEM subjects, such as introductory botany, biology, and chemistry. Aside from helping students better understand difficult topics, what I found most rewarding about this work was assisting them in building and cultivating skills for success in college. Most of the people that I tutored were either freshmen or first-time science students, so aside from course materials we would work on time management, study habits, and active learning skills. This experience allowed me to help students of diverse backgrounds, get acquainted with different learning styles, and taught me the importance of patience and effective communication.

In addition to my tutoring work, I currently work as a LSAMP Student Leader. There, I serve as a mentor to undergraduates affiliated with INRSEP, which is a program built specifically to provide resources and guidance for groups traditionally underrepresented in STEM fields. I help these students in various ways relevant to their professional development, with tasks such as building their CV/resume, revising personal statements, finding and applying for research opportunities/grants, creating plans and goals for their future semesters, and applying for graduate school programs. My contributions to INRSEP undergraduate students earned me the CSU-LSAMP Outstanding Service and Leadership Award.

All these experiences have greatly increased my awareness of the obstacles that STEM students, especially those belonging to underrepresented groups, have to face every day and try to overcome. As a woman of Asian and Pacific Islander descent, I know firsthand how challenging it is to succeed in obtaining a college education, especially in a university setting with a strong white demographic. I am able to relate to and empathize with students who experience similar prejudices and treatment. Thus, I try my best to provide resources and help these students in any way I can, and I feel grateful for the multiple outlets I've been offered to do so.

Intellectual merit of an NSF Fellowship. My ultimate career goal is to become a professor at the university level. I will work to reach a position where I can teach and facilitate research for undergraduates and graduate students. In doing this, I want to prioritize helping those that belong to traditionally underrepresented groups in STEM, as a teacher and mentor. I plan to achieve these goals by (1) pursuing a master's and later a doctoral degree; (2) taking advantage of any teaching and mentoring opportunities throughout those training years; and (3) continuing to grow my research skills all along.

An NSF Graduate Research Fellowship would be essential for my success because it would allow me to be financially stable while pursuing my graduate education. Currently, having just started working toward my Master's degree in Dr. Tomescu's lab at HSU, I have three part time jobs that take away from the time I am able to dedicate to my studies and research, and make it challenging to continue my strong research output. This is because HSU, as a part of the CSU system, is a primarily undergraduate teaching institution. Without this NSF fellowship, I don't have any other outstanding means of funding. Currently, I self fund my own supplies, conference/travel expenses, tuition fees, etc. The NSF fellowship would go very far toward improving my overall productivity and would help me expand my horizons beyond what I am able to achieve currently. Some of these possible opportunities that I would have otherwise no access to due to lack of funding, could include: fieldwork, visiting fossil museum collections, or visiting scientists in other labs that are studying the topics relevant to my research, in the US and abroad. All in all, the NSF fellowship would allow me to relieve financial burdens, so I can focus all my energy on furthering my research and honing my teaching skills.

Broader Impacts. Overall, graduate school will help me reach my goals of becoming a scientist, teacher, and mentor. On a personal level, an NSF fellowship would be symbolic for me and my success in reaching these goals, and would solidify my sense of belonging to the scientific community. I will be the first of my immediate and extended family to receive a graduate degree, as well as the first to go beyond an associate's degree. Additionally, I am the only one in my family to pursue an education in any science-related field. This family history made me realize what kind of scientist I want to become, in terms of ethics and creativity: I want to promote more inclusive environments that not only communicate science in an effective way, but also are accessible to various audiences.

For this reason, I want to conduct meaningful and purposeful research that prioritizes inclusiveness towards underrepresented groups in STEM. I see my continuation of a career in STEM crucial because of the unequal balance of women and men who have successful positions in academia. According to the UNESCO Institute for Statistics, less than 30% of the world's researchers in STEM are women [1]. This statistic is disheartening but this gender gap has been a recurring phenomenon for centuries in science. I want to change this continuous cycle of what has been called a 'leaky pipeline' [2], in reference to the stark discrepancy in the number of women who obtain degrees in STEM but end up falling out of the scientific community. I will not let myself accompany those who did not persevere past the opposition and setbacks of being a woman who wants to advance science and society. I hope that I can be a leading example for other women in my field, as well as to people belonging to underrepresented groups, who choose to challenge an academic system that has historically been male dominated.

If I was awarded an NSF fellowship, that would speak loudly on what kind of people a big national organization is choosing to support and invest in. Such an award would make progress in the right direction, towards supporting the advancement of those who perceive and learn science through different lenses as compared to the mainstream scientific establishment. Furthermore, an NSF fellowship will boost both my capacity and my motivation to make significant contributions to science during graduate school and in my future career.

[1] UNESCO Institute for Statistics. 2019. Women in science. Fact Sheet 55, June 2019; FS/2019/SCI/55.

[2] Ysseldyk R. et al. 2019. A leak in the academic pipeline: identity and health among postdoctoral women. *Frontiers in Psychology* 10: 1297