Personal, Background, and Future Goals Statement

Background: I entered my undergraduate institution with a strong interest in astronomy, but every step along the way pulled me back towards Earth. I guess I missed and landed on Mars. After a long walk through our local universe, I found the field of planetary science and became enamored with what is happening on the surfaces of our nearby neighbors. No matter where I was in our universe, I loved the process of figuring out why astronomical objects do what they do. The primary reason I chose to attend Macalester College for my bachelor's degree was that I was excited by the research focus present within this liberal arts community. I was able to discover and nurture my love for research through classes and an environment that fosters curiosity, and sought out research opportunities both at Macalester and elsewhere. It is also because of my experiences while at this institution that I have been inspired to develop outreach initiatives, which has become something I am passionate about folding into a future career in research.

Intellectual Merit: My introduction to research came in the spring semester of my first year at Macalester, when I worked in Professor John Cannon's lab using radio data from the Very Large Array to analyze the neutral Hydrogen content and bulk kinematics of nearby dwarf galaxies. This experience was a great introduction to astronomy research and computational skills, as I became familiar with data analysis methods in Python and IDL. This opportunity also gave me experience with the publication process as this research resulted in two co-authored publications in the Astrophysical Journal Letters (Bralts-Kelly et al., 2017; Cannon et al., 2018). It also enabled me to better identify what I like and dislike about a research project. Although I enjoyed this research, I decided that the questions I was most interested in answering were related to smaller objects that I could analyze in more detail, which, for me, meant looking closer to Earth.

Since Macalester is a very small school, galaxy research was the only space science research available there at the time, so I took this as an opportunity to look for research elsewhere. This led me to an NSF-funded REU (Research Experiences for Undergraduates) program in heliophysics at the University of Alabama in Huntsville/NASA Marshall Space Flight Center in the Summer of 2017. Here, I studied the origins of small-scale plasma eruptions in the Solar corona. I loved the opportunity to work with a wealth of high-resolution data and was excited by the ability to analyze smaller-scale features. I thoroughly enjoyed this research and decided to continue it even after leaving Alabama, which I did until August of 2019 when I published my results as a first-author paper in the Astrophysical Journal (McGlasson et al., 2019b). This REU also gave me the opportunity to present a poster at my first ever academic conference, the American Geophysical Union meeting in December 2017 (McGlasson et al., 2017). As much as I enjoyed this work, I still didn't feel like I was answering the questions that really excited me. These solar features were almost at the limit of what our telescopes could resolve, and they were still about the same diameter as the Earth. I also wasn't keen on the idea of being limited to one object (the Sun) for my entire career, so I decided to broaden my research topics to planetary bodies.

Through the Arecibo Observatory REU in the Summer of 2018, I was able to gain experience in the field of planetary science working with Dr. Sean Marshall to study asteroids using planetary radar. At Arecibo, I used the S-band radar to observe near-Earth and potentially hazardous asteroids. In addition to performing observations of near-Earth asteroids, I developed a 3-dimensional shape model of the potentially hazardous asteroid Midas by combining radar observations from Arecibo and NASA's Goldstone Solar System Radar with archival optical lightcurve observations. This research became my senior undergraduate honors thesis, which I defended in the spring of 2020. I presented preliminary results of this work as a poster at the 233rd meeting of the American Astronomical Society in January 2019 (McGlasson et al., 2019a), and was awarded the Chambliss Astronomy Achievement Award Student Prize for my research. This work is in the very final stages of editing, and I will submit it as a first-author paper to the Planetary Science Journal within the next month. Through this research experience, I discovered my love for radar observations. Radar provides a unique suite of data that can not only provide information about the shape of a surface, but can also be used to look beneath the surface and analyze the geologic processes at work on another planet. Finally, I felt that I had found a way to ask, and work to answer, the questions that I was really interested in about our solar system.

This work with planetary radar is what inspired me to apply to the PhD programs to pursue a career in research. In the winter of 2020, I accepted an offer to work with Professor Ali Bramson in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue University. Here, I am using radar observations to understand the properties of stable ice deposits on the surface of Mars in an attempt to constrain the processes that created them. I am especially excited about the ability to build my geology background through the geology-heavy planetary science curriculum here at Purdue. More on the research I would carry out here as an NSF GRFP fellow can be found in my research statement.

Past Outreach Initiatives: In addition to research, I anticipate outreach being an important part of my future career. In my undergraduate institution, I was involved in and developed many outreach events to bring science to the surrounding community. My favorite outreach initiatives were hosting public observing nights at the Macalester observatory, hosting an astronomy talk show on Macalester's college radio station, and working as an astronomy ranger intern at Bryce Canyon National Park. For me, it can be easy to get lost in the minutiae of research, but these outreach events help me get back to why I do science in the first place: to answer the fundamental questions about the nature of our universe.

As a host of Macalester public observing nights, I taught visitors about astronomical objects using our 16-inch telescope. My favorite moments of these nights were when families from the surrounding neighborhood would bring their young children to look through a telescope for the first time. Last year, we also participated in a state-wide observing night where we not only opened up the telescope for viewing, but additionally planned physics and astronomy activities that demonstrated concepts such as how we detect exoplanets, spectroscopy, and where ice forms on planets in a manner suitable for all ages.

The astronomy talk show was a really exciting event to plan each week. I developed the show with two other students in my second year at Macalester and hosted it for 5 semesters until I graduated and handed it down to a new generation of hosts, who still continue it today. Each week my two co-hosts and I picked a topic related to space sciences and distilled it down to its fundamental ideas in a way that could be interesting to a general audience with minimal scientific background. For example, we once spent a show discussing astronomical distances from the size of the Earth to the size of the observable universe using the height of my 6-foot tall co-host as a measuring tool. This format also allowed us to explore topics like unsung scientists and ancient astronomy throughout the world.

The most impactful outreach initiative I have participated in was in the Summer of 2019 when I was an astronomy ranger intern at Bryce Canyon National Park. As an astronomy ranger intern, I worked 40 hours per week planning astronomy-related programming, doing telescope maintenance, showing visitors the Sun through a solar telescope in front of the visitor center, presenting astronomy evening talks, and holding 5 observing nights per week both at the visitor center and at the edge of the canyon. Each month I also led guided full-moon hikes, in which I guided visitors down a 2-mile hike into the canyon by the light of the full moon while providing scientific and cultural information connecting our moon to the landscape around us. I also helped plan and operate the annual astronomy festival, which involved organizing approximately 50 volunteer telescope operators and brought thousands of additional visitors to the park. This whole experience taught me a lot about how to present scientific information in a way that is understandable and accessible to a wide audience, as many national park visitors don't go to a national park with the intent of getting a science lesson. I also learned the valuable skill of writing scientific programs in a way where they can be preserved and taught by others in the future. This internship has greatly influenced how I plan to develop outreach opportunities for broad audiences during my PhD at Purdue University.

Broader Impacts: Through my experience at Bryce Canyon, I learned the benefits of teaching science in nontraditional educational setting. Teaching science at a national park is a great way to learn about the environment that surrounds you, which provides a very immersive experience. It also attracts people who may not seek out traditional science learning experiences like museums or planetariums. Attending Purdue University means I am located about two hours away from the newest national park: Indiana Dunes National Park. Indiana Dunes spans 15 miles of Lake Michigan shoreline, and covers 15,000 acres of a diverse set of natural resources including 200-foot-tall sand dunes. This national park contains the geologic record of 3 ancient dune complexes as well as remnants of ancient shorelines that were formed by glacial recession at the end of the last Ice Age. An important part about Indiana dunes that makes it well

suited for this work is that it was one of the first park sites created specifically to bring national parks closer to our country's urban areas. This is well-aligned with my mission to develop a planetary science educational program aimed at communities that are traditionally underserved by science outreach.

When Indiana Dunes was given national park status in February of 2019, a set of fundamental resources and values were identified, along with five interpretive themes which describe the key concepts that visitors should understand after visiting a park. One of these fundamental values was providing "regionally rare educational programs and experiences to millions of people in the Chicago metropolitan area" (National Park Service, 2016), which the program I would carry out as an NSF GRFP fellow will help accomplish. My program will also tie together two of the key interpretive themes identified by the park: provide a "natural setting for millions of people" and reflect a "national struggle to balance urbanization, industry, and conservation". I will address these by emphasizing both the natural settings of the park's geology and night sky visibility as well as the struggle to balance dark sky preservation with growing industry. Within the educational directive, goals and opportunities for improvement were identified. Some of these included increasing visitor participation in programs, increasing educational programming on the beach (this is where the largest visitation is), and creating new Science, Technology, Engineering, and Mathematics (STEM) programs for students.

I will work with the chief education/interpretation rangers at Indiana Dunes, Bruce Rowe and Kim Swift, to develop an educational program that connects the park's geology to the planetary surfaces on other planets in our solar system. This night sky program will focus on the role of water and sand dunes on shaping the landscape, both in the park and throughout the solar system (especially Mars). I will start with an indoor presentation at the Paul H. Douglas Center for Environmental Education that will introduce sand dune and lake geology using mostly photos captured by Mars rovers along with images of dunes in the park. I will also discuss dunes and bodies of liquid present on other planetary bodies. This presentation will be aimed at an all-ages audience that has no geology background but has an interest in learning more about planets, and the picture-heavy format will appeal to even younger audiences. Weather permitting, the indoor presentation will be followed by an opportunity to look at planets through telescopes set up by volunteers on the nearby beach. The necessary telescopes will be acquired with the help of Steven Smith at the Purdue Earth, Atmospheric, and Planetary Science (EAPS) department outreach office and volunteers will be organized with the help of the EAPS graduate student association outreach committee. This program will expand the educational programming of Indiana Dunes National Park, inform visitors about the connection between their surroundings and our solar system, and serve the nearby urban communities.

Future Goals: My professional goals encapsulate a desire to pursue research on the forefront of planetary science and to educate general audiences about our solar system neighbors. First, I would like to become an expert in the use of planetary radar observations to characterize the near-surface properties of our solar system, with a specific focus on ice. I would like to apply this expertise to a career at a university that values undergraduate research, as this is something that shaped me as a young scientist at my undergraduate institution. My second goal is to be able to volunteer a portion of my time with the National Park Service to develop night sky programs. With my experience in research and outreach settings, I am confident in both my decision to pursue these goals and in my preparation for pursuing them. The NSF Graduate Research Fellowship will give me the necessary resources to pursue this research and to build my night sky program at Indiana Dunes National Park. Overall, I feel the variety of research projects I have been involved with, my experiences presenting my findings at professional conferences and as publications, and the unique outreach programs I have developed make me an excellent candidate for this fellowship.

References:

Bralts-Kelly, L., et al., **including R.A. McGlasson** (2017), *ApJL,* 848, L10.

Cannon, J. M., et al., **including R.A. McGlasson** (2018), *ApJL*, 864, L14.

McGlasson, R. A., Marshall, S. E., et al. (2019a), abstract #255.03, *AAS 233rd Meeting*.

McGlasson, R. A., Panesar, N. K., et al. (2017), abstract #SH43A-2796, *AGU 2017 Fall Meeting*.

McGlasson, R. A., Panesar, N. K., et al. (2019b). *ApJ,* 882, 16.

National Park Service. (2016) Indiana Dunes National Park Foundation Document.