My research is driven by the desire to understand why the surfaces of planets look the way they do. This leads me to investigating the interactions between subsurface, geomorphological, atmospheric, and oceanic processes with respect to geology. This motto has motivated me to gain insights into a wide range of processes that occur on many planets and moons in our solar system, from Mars and Venus to Titan and Ceres. My main interest is to take a broad look at how geological processes operate on planets. Due to the ever-increasing amount of planetary image and topographic data available, I aim to characterize these processes across the Solar System, leading to more insights than by only using Earth as a laboratory. My work utilizes remotely sensed data, analog field work, and laboratory analog modelling to investigate tectonic processes, aeolian processes, and the geomorphology of surfaces. I think that this three-pronged approach allows for me to be stringent in my hypothesis testing. Each approach alone may not provide a comprehensive solution to my science questions, however when combined, they can provide a unique perspective in which to view or answer the questions.

My tectonic research is focused on investigating fault architecture on Mars and Earth as well as defining the influence of faulting on the geomorphology. I have been characterizing how faults can influence subsurface collapse (e.g. pit cratering) and subsurface volatile loss (e.g. breached groundwater or ice deposits on Mars causing further collapse of materials). Specifically, I used these concepts to determine that normal faulting, pit cratering, and breached groundwater or volatile deposits have significantly influenced formation of the massive chasms in Noctis Labyrinthus, Mars. This work has been supplemented by investigating these structures in the field at three different locations: Craters of the Moon National Monument and Preserve in Idaho, Hawai'i Volcanoes National Park, and Canyonlands National Park in Utah. I detected pit crater formation in response to the 2018 Kilauea eruption on Hawaii and I pinpointed the possible earthquakes and fault planes that could have promoted the pit formation. Both accomplishments were completed by analyzing time-series lidar data after field work at the pit crater location before and after its formation.

My aeolian research has been an ongoing project for the past 6 years working with Bob Craddock from the National Air and Space Museum in Washington, D.C. We have been examining the formation and preservation of linear sand dunes in the Simpson Desert of South Australia. Our work supports investigating linear dunes on other planetary bodies in the Solar System, specifically, it will be essential support to the newly selected NASA Dragonfly Mission, which will be landing in a linear dune field on Titan. My roles in this work have been the following: develop our uncrewed aerial system monitoring campaign to support and replace our previous dGPS monitoring campaign; aid in the planning and execution of the desert crossings each time we go to the field; and assist in auger core collection and planning. This work has been instrumental in characterizing how linear dune fields are maintained through time and how the sediment is emplaced/moved across the dune field.

Moving forward, I will continue to test questions about tectonics and geomorphology on Earth and other bodies in the Solar System. I intend to use the following general science questions to guide my research:

1. What are the differences in fault populations across the Solar System and what causes those variations?
2. How are linear dunes sourced, what are the controls on their geomorphology over time, and what differences do we expect for linear dunes on other bodies in our Solar System (Titan especially)?
3. How can technologies be leveraged (e.g. uncrewed aerial systems) to improve the geosciences, including data collection? How can these technologies contribute to geoscience education and data visualization?

I anticipate writing proposals to fund my research through NASA programs, such as Solar Systems Workings (SSW), to support field and remotely sensed research questions. I have had the opportunity to assist in writing of two SSW grant proposals and, although not selected, I gained the valuable experience of grant-writing and working with co-investigators as well as collaborators. I have also had the valuable experience of sitting on multiple grant review panels and a Participating Scientist panel for NASA programs to serve the research community. Another benefit of my service is the substantial insight I gained into the grant-writing process. Additionally, a funding option I anticipate pursuing is NSF Earth Science programs to fund Earth based projects. I was successful in obtaining a NASA Earth and Space Science Fellowship during my graduate school career, and I expect my future students to be actively pursuing these types of NASA (and NSF) fellowships and small grants to support their research and education. As a mentor, it is important to encourage my students to obtain this type of funding to provide them more concentrated time to work on research and discover what aspects of science are important to them. The process of writing grants also is helpful to their growth as a scientist, explaining their research in a concise and efficient manner is a great skill. I am always working to improve my skills in those areas as well either through writing or assisting in writing grants, reviewing grants, and reviewing articles for journals.

I expect to build and develop an active lab group that will be diverse in all aspects; it is essential that my group have different perspectives gained from not only research areas but also on a broader perspective of life experience. My second year during my Ph.D. I served as the president of our Marine, Earth, and Atmospheric Sciences Department Graduate Student Association, providing me the opportunity to represent the students during faculty meetings and offering our point of view on topics of graduate student interest. This position also allowed me to organize social/outreach events and help brand the department through social media initiatives and logo design. This position gave me insight into how the faculty make decisions regarding the department and how the operational side of a department is handled. I have the honor of being the first student for both my M.S. and Ph.D. advisors, allowing me to experience and assist in building lab spaces, recruiting, and assisting new graduate and undergraduate students in our groups as well as assisting new professors in their early years of growing a research group. This has been a unique and incredibly valuable experience for me to learn successful ways to advise my students as a mentor and hardships students in young lab groups may face as a result of a growing and changing atmosphere.