My curiosity for scientific research began in my sophomore organic chemistry lab, at the University of Toledo, when I was asked to be a part of the NSF-funded Ohio Research Experience to Enhance Learning (REEL) project, a program designed to teach concepts and techniques in organic synthesis. Using the skills I refined while in this program, I joined an organic chemistry research group where I synthesized, purified, and characterized 1,2,3-trizaole oxazolidinone analogs, a class of potentially novel antibiotics. In developing the experimental methods, we determined that microwave chemistry could be used to bypass the first refluxing step of this 3-step synthesis. All products were analyzed with IR and NMR spectroscopy, providing me with my first exposure to analytical instrumentation. I presented a poster on this research at the Central Meeting of the American Chemical Society (CERM-ACS) in May 2008.

In my next year at Toledo, I joined a bioanalytical chemistry lab where Dr. Wendell Griffith introduced me to his research regarding the physical and functional changes in red blood cells as they age or senesce. With his guidance, I carried a project of my own from topic selection to developing a working research question which then became the topic for my undergraduate honors thesis. The goal of my project was to sequence hemoglobin from the Cape Clawless Otter (*Aonyx capensis*) to further study the evolutionary role of hemoglobin in the underlying mechanisms involved with red blood cell aging. I used reversed-phase HPLC to purify and isolate the protein chains and then used MALDI-TOF/TOF MS and ESI-MS/MS to sequence the resultant peptides obtained from digestion. Using sequence homology and database searching using Mascot, I achieved 95% and 76% sequence coverage for the α- and β-chains, respectively. Although crystallography and x-ray diffraction could then be used to obtain electron density maps, which would differentiate between isomeric and isobaric residues resulting in 100% sequence coverage, x-ray quality crystals proved to be challenging to obtain. I funded this work by earning the merit-based Sullivan Research Fellowship from the Honors College at Toledo. In December 2010, I completed my oral thesis defense, and presented my research at the National Conference for Undergraduate Research (NCUR), as well as the ACS National Meeting, both in March 2011.

While preparing for my defense, I obtained a position in the Ecosystem and Soil Ecology lab at the University of Toledo under Dr. Michael Weintraub. As a technician and lab manager, I gained a deeper appreciation for how chemistry may be applied to environmental research, and was offered the opportunity to contribute intellectually to a multitude of projects, while simultaneously managing undergraduate and graduate student research activities. During my first year there, I used my previous knowledge and experience in analytical chemistry to make a unique contribution to the development of a fluorometric method for the quantitative determination of amino acids in soil extracts. With the growing demand in soil ecology for high-throughput analyses of amino acids and other small organic nitrogen compounds in soil, we adapted a fluorometric method based on the reaction of σ-phthaldialdehyde and β-mercaptoethanol (OPAME) for use in 96-well microplates. We made a critical change to an existing protocol and demonstrated that the OPAME reagent fluoresces in the presence of primary amines other than amino acids, an important distinction when examining a complex heterogeneous mixture such as soil. I co-authored a peer-reviewed paper on this work that was published in *Soil Biology and Biochemistry* in spring of 2013. The process of working on a manuscript provided valuable experience in scientific writing and data analysis, and taught me what is necessary to take a scientific project from idea generation to the final published product. The intellectual excitement and personal fulfillment I received during this process motivated me to pursue an advanced degree where I could direct my own research and learn the necessary skills to advance in a scientific field.

During my time as a lab technician, I also presented data from another project at the Ecological Society of America (ESA) meeting in August 2012. The objective of this work was to evaluate how elevated nitrogen affected litter decomposition at different stages of decay by monitoring microbial respiration, biomass, extracellular enzyme activities, and concentrations of inorganic nutrients throughout a 25-month laboratory incubation. In addition to becoming proficient with multiple infrared gas analyzers, this project introduced me to laboratory incubation studies, environmental modeling, and improved my abilities in ecological scientific inquiry and statistical analysis, all of which are central to my proposed research plan.

Two summers at the Toolik Lake LTER Field Station on the northern slope of the Alaskan Brooks Range gave me the opportunity to explore my research interests more intimately, by interacting with various research groups, in addition to our own field team. Our project focused on the large stores of carbon in Arctic soils, and how they may act as a significant source of greenhouse gases with warming. In particular, we were interested in how microbial activity influences the carbon and nitrogen cycles with changing seasonality. Working in a geographically remote location, I learned to be resourceful and flexible; important lessons that I have already noticed are essential for success in a graduate program and career in the sciences. Fieldwork introduced me to the complexity and unpredictability of the natural environment. In our final season, we sought to develop a procedure to collect root exudates *in situ*, which proved not to be a trivial task. It was essential that I not only fine-tune my analytical skills but also that I clearly communicate with team members back home, discussing possible areas of methodological improvement while always keeping the overall scientific goals in mind. Throughout the summers, I worked closely with undergraduate REU students, a PolarTREC high school teacher, graduate students, and post-doctoral fellows in addition to a team of principal investigators leading our project. I benefitted from engaging in regular scientific discussions, and quickly became determined to blend my interests in chemistry and the environment into a career in science. The nature of my proposed work relies heavily on my ability to collect and analyze samples and data in the field as well as in the lab.

During each of these research experiences, I learned more about how environmental scientific discoveries influence public policy and education, confirming my ambition to combine my research efforts with broader societal aims. Having earned a competitive and interdisciplinary fellowship to pursue a doctoral degree in Energy Science and Engineering through the Bredesen Center at the University of Tennessee, I have been able to start researching globally important issues with Dr. David Graham and Dr. Baohua Gu at Oak Ridge National Lab (ORNL) on the Next Generation Ecosystem Experiments (NGEE-Arctic) biogeochemistry team. I plan to make the most of this partnership by collaborating with governmental leaders to promote Arctic research and public education regarding climate change and energy issues. My goals are to combine 1) laboratory experiments for a deeper mechanistic understanding of the biogeochemical processes that impact global climate change, 2) field observations and *in situ* measurements necessary for a better appreciation of environmental systems chemistry, 3) and environmental modeling to better inform quantitative variables at local, regional, and global scale models. Additional paths I want to pursue during my tenure as a graduate student is to understand how policy-makers interpret scientific knowledge and find better ways to communicate my scientific findings to the public. I have recently taken steps to share my scientific research findings and outreach or education activities in a monthly blog targeting high school, undergraduate, and graduate students (see below).

Broader Impacts:

As an undergraduate and post-graduate at Toledo, I was closely involved with several scientific organizations, including the ACS, Alpha Chi Sigma Professional Chemistry Fraternity (AXΣ), Women in STEM Excelling (WISE), and the Association for Women in Science (AWIS), allowing me to broaden my impact on the local community. For example, I was part of a team of undergraduate students that developed the only pre-professional STEM Summer Camp for high school students in the area. I also have helped Girl Scouts and Boy Scouts of America earn chemistry merit badges by teaching them laboratory safety with hands-on chemistry demonstrations. Beginning my sophomore year, I mentored introductory chemistry students in a Peer-Led, Team-Learning (PLTL) course, and throughout the years I used the PLTL question-based techniques to tutor math and science students and teachers from underprivileged schools in the greater Toledo area. Each year, I lead groups of high school girls at Toledo's Annual Women in Science Day of Meetings (WISDOM). My fundamental objective in outreach and education is to get people as excited as I am about asking (and answering) scientific questions. This is the primary motivation for why I dedicate time away from studies and research to maintain my science blog and website, *Think Like a Postdoc* (www.malloryladd.com).

Intellectual Merit:

In addition to my honors classes, research, and extracurricular organizations, I was offered the opportunity to captain Toledo's Varsity Volleyball offense as setter on a Division I NCAA athletic scholarship. Through athletics, I learned how to balance a demanding course load with the physical and mental stresses of being a collegiate athlete. Although I was a freshman, and a scientist among athletes, I was called upon to lead our team on and off the court. I also enrolled in two minors that interested me: Forensic Investigation and Spanish. As a student in the Criminal Justice College, I gained additional valuable insight into what it will be like to be a woman pursuing a degree in a profession dominated by men. The honors curriculum and these additional fields of study allowed me to explore politics and literature, and further develop my versatility in research and communication.

With the guidance of my mentor, Dr. Nina McClelland (Dean Emeritus of the College of Arts and Science (UT) and Former Chair of the Board, ACS), and my ambition to succeed in science, I have focused my research interests on Arctic biogeochemistry. My previous experience with Arctic terrestrial research as a lab and field technician has provided me with a strong foundation for success in pursuing these research aims. Having presented multiple research projects, in addition to preparing a manuscript and following it through submission and revision, I am trained in effectively communicating the results of my research. I will share the results of my dissertation research via publications in peer-reviewed journals for general and specialized audiences, and presentations at both national and international conferences. The perspective I gained from refining my research interests via fieldwork and continuing my education beyond the classroom, in conjunction with my strong academic history and leadership skills, have prepared me well for a career in science. *Whether I pursue a leadership position in the governmental or industrial sector, or a career in academia, I will do everything within my ability to promote environmental research, represent the NSF fellowship program with distinction, and make a substantial contribution to science.*