Going into my undergraduate education, I never considered graduate school or research as an option for my career path. In my family, the mold is to go to college, get a degree, and then get a job. However, early into my education I discovered that in order to fulfill my career goals I would need to break tradition and open myself up to a new world of thought—to a world that would allow me to pursue advanced knowledge and make great societal impacts. This world I discovered is research.

The first research area I explored was space. At my second summer internship with NASA, I worked with a mentor to develop the acceptance criteria for the unbonded areas of the Ares I common bulkhead composite structure. The common bulkhead structure is made up of two curved aluminum plates bonded to either side of a curved honeycomb phenolic resin core. My task was to determine the maximum allowable size of the unbonded areas and the maximum allowable spacing between unbonded areas. To begin this process, I performed a literature review of all research involving curved composite structures and bonding theory. Once I gained a knowledge base, I set out to develop a mathematical model to determine the acceptance criteria. Throughout the summer, I collaborated with a group of materials researchers who were testing the composite structures as well as stress analysts who helped me develop computer simulations to validate my mathematical model. This experience helped me not only gain fundamental experience in the research process, but it also gave me confidence in my abilities to solve complicated problems.

Returning to school, I sought out professors to see if they had any undergraduate research opportunities. I knew that if I wanted to be successful in graduate school I would need to develop my skills with a more hands-on research project. Also, I wanted to spend time around graduate students to observe graduate school life and talk with them about their experiences. After speaking with several professors, I decided to work on a research project funded by NASA's Alabama Space Grant Consortium involving chaos theory applied to mesoscale solid rocket motors.

As the independent researcher on this project, I was tasked to design and build the experimental test apparatus, develop data acquisition techniques, and analyze the collected data. The purpose of this project was to characterize the behavior of mesoscale solid rocket motors using chaos theory, which is highly scalable. The data would then be used to present an analog to macroscale solid rocket motors. During the course of this effort, I designed and built test equipment that both coupled a rocket to a stationary load cell device and safely expelled exhaust gases. Also, I developed a data acquisition technique using principles I learned in my experimental instrumentation class, such as signal amplification from an op-amp circuit and programming with National Instrument's LabVIEW. Finally, I worked with my advisor to apply chaos theory techniques to analyze the collected thrust data.

I learned many valuable skills from this project such as research design, appropriate data collection, and data analysis. Also, I was able to strengthen my problem solving skills as I encountered minor setbacks during the project, but was able to think through them and successfully complete the task. This project was a great experience, but I didn't stop there. Once I had gained a taste of hands-on research, I was hooked and wanted more.

Upon developing my research skills and investigating the aerospace field, I decided it was time to explore my other interest — energy research. The energy field of study has the

potential for large-scale impact, as currently the United States' dependence on foreign oil has become a national security issue. Because energy research is broad, I understood I would need to narrow my focus to a specific area. It was not until I listened to a speaker at a Department of Energy symposium that I found my direction and passion in energy research. For my last summer internship, I turned my attention to Oak Ridge National Laboratory's National Transportation Research Center to study vehicle waste heat recovery.

At Oak Ridge, I worked with a team of researchers to recover low-grade waste heat from diesel engine exhaust using an organic Rankine cycle (ORC). Though regulations did not allow me to handle any tools, I spent countless hours in the engine test cell assisting various team members and learning specific aspects of the experimental setup. My major contribution to the team was a parametric analysis of the data collected from the ORC. The results from my study revealed the component in the cycle with the largest area for improvement and the component with the greatest sensitivity to increase in efficiency. This analysis was used to direct further improvement to the cycle, and at the end of the summer I submitted a paper to the Journal of Undergraduate Research.

Along with performing an analysis on the cycle, I was tasked to execute a literature survey of not only the ORC, but also other waste heat recovery techniques. Through my literature survey I found several techniques, but none as interesting or with as much potential as thermoelectrics. Each day I became more fascinated with the subject and began talking with researchers at the lab that work on thermoelectric waste heat recovery projects. Through these talks I learned about their experimental setups and the challenges that come with thermoelectric experiments. My time with these researchers helped me not only gain knowledge in a field of energy research that is potentially transformative, but it also fostered my passion to study thermoelectric waste heat recovery. Since returning to the University after the summer, I have taken a thermal instrumentations class in order to prepare myself to conduct my own thermoelectric waste heat recovery project.

The internship at Oak Ridge was my most beneficial research experience. Not only was I able to focus my research interests, but I was also able to witness and understand the benefits of a tremendous outreach program. Many times throughout the summer, tour groups would visit the lab facilities. At times I was able to help lead groups of middle school children through a tour and see their astonished looks as we explained some of the projects occurring in the lab. I was also able to give tours to some of my colleagues at the lab, whose questions helped provide new perspectives to the research process. I believe these tours did well to inspire the next generation of researchers and generate ideas about current research projects. Seeing these positive results, I will look to continue giving tours at my graduate institution's research facilities.

My experiences have prepared me to be successful in both the intellectual merit and broader impact areas of the research. For intellectual merit, they have focused my research interests and taught me technical aspects of the field. For broader impacts, they have revealed the importance of outreach, and shown me how to effectively communicate scientific findings (I have presented four posters and written four technical reports for my research projects). The skills I developed through my research experiences will not just help me become a successful experimentalist, but they will help me achieve my goal of making a significant societal impact.