Personal Journey: Growing up as an economically-disadvantaged, young Puerto Rican, the idea of pursuing graduate studies at [redacted] struck me as an unrealistic future. The great recession during the early 2000s introduced socioeconomic challenges in Puerto Rico that rendered many hardships for my family to the extent of almost becoming homeless. Despite financial instability, my parents overcame budgetary barriers to provide my sister and me with the best education available given our limited resources. Witnessing my parents struggle to support us, I value my education as the product of my family's perseverance and the only everlasting resource capable of securing one's future aspirations. **Motivation for graduate studies**: During my undergraduate career at the University of [redacted], I became genuinely fascinated towards the application of engineering mechanics across different scenarios in the human body (e.g. mechanical stresses during bone fracture, fluid dynamics of blood flow, mechanical properties of cells). As a result, this interdisciplinary approach, coupled with my curiosity for understanding complex systems, fueled my current passion for deconstructing the mechanical environment of biological systems in order to elucidate the role of mechanical stimuli in the progression of diseases and tissue regulation. Thereby, shifting traditional means in understanding physiological phenomena towards the infusion of engineering perspectives to develop novel therapeutics for terminal and degenerative diseases; this idea drives my avidity to pursue an advanced degree in mechanical engineering. Although research became my primary motivation to pursue graduate studies, educational outreach activities, including mentoring and tutoring other students, have also played critical role in this decision. Inspired by my previous struggles to achieve my academic goals, I am committed to alleviate social and financial barriers for motivated students and directly improve their educational opportunities. Under this effort, I will continue to engage and inspire our next generation of scientist and engineers while encouraging the inclusion of students in STEM from diverse social and cultural backgrounds like myself. **Intellectual Merit:** During the Fall of 2013, my academic achievements and research enthusiasm provided the opportunity to join [redacted] Program at the University [redacted] under the mentorship of [redacted] (letter writer). Through this research program for minority students, I tackled a graduate-level project addressing current limitations in tissue engineering techniques to reconstitute the cellular architecture of native tissue. Based on my literature review, I noticed that numerous research efforts were limited to one degree of mechanical input to induce cellular alignment, overlooking the multiple driving forces present in the cellular microenvironment. To address this issue, I implemented a mechanical bioreactor that induced cyclic tensional strain to osteoblasts seeded on a series of substrates of varying elastic modulus. After experimentation, I analyzed alterations in the cell's morphology and adhesion sites, using immunofluorescent imaging, as a response to simultaneous mechanical stimuli. This analysis validated the reliability of our technique to achieve controlled cellular alignment for over 70% of the cell population under the synergistic effects of inducing cyclic strain (1%, at 0.5Hz) to osteoblastic cells seeded on a substrate, with an elastic modulus of 2.04 MPa. Thus, providing a novel technique to reproduce highly organized tissue scaffolds for regenerative medicine, resulting in a first-author publication that is currently under review in [redacted]. In parallel to the previous project, my interdisciplinary effort drove my curiosity to another biological scenario, cancer metastasis. Although current research indicates that metastasis is highly orchestrated by numerous biochemical signals, we currently have limited knowledge with respect to the role of mechanical signals during this phenomenon. Therefore, to address this question, I implemented a mechanical bioreactor to determine how cyclic strain, in the tumor microenvironment, influences the metastatic behavior of cancer cells. The immunofluorescent images of the experiment revealed that cyclic stimulus enhanced metastatic characteristics such as higher proliferation rates and lower focal adhesion expression in adenocarcinomas, a glandular-based cancer, thereby enhancing their metastatic efficiency. To which, I hypothesize that mechanical perturbations, induced by remodeling events, in the tumor microenvironment enhance invasive traits in cancer cells. I'm currently compiling our latest results of this work to submit for publication, tentatively to the journal of [redacted]. In the summer of 2014, I conducted research in microbial biophysical systems through the [redacted] Program at [redacted]University with Prof. [redacted] (letter writer). As a part of his research team, I developed a microfluidic approach to measure the rheological properties of bacterial biofilms and probe the influence of structural mechanics on biofilm-microbial behavior. During the course of the summer, I designed and characterized a micro-membrane rheometer capable of measuring the elastic modulus of various strains of bacterial biofilms. In the design of the device, stress was imposed on the test specimen by pressurizing a microfluidic channel located directly under a flexible polydimethylsiloxane (PDMS) membrane in contact with the biofilm. The elastic deformation resulting from the applied stress was quantified by measuring the deflection with confocal microscopy. In order to obtain the modulus of elasticity of the biofilm from the resulting deformation, I undertook a computational approach and developed a COMSOL software based finite element model, allowing us to characterize the relative contributions of the elastic modulus from the PDMS membrane and the biofilm. The research potential of the microfluidic based rheometer lies in its ability to quantify the effectiveness of new drug treatments against biofilm infections by evaluating the detrimental effects of the drug in the mechanical resilience of the biofilm itself. During the summer of 2015, I participated in my second [redacted] program at [redacted] with Prof. [redacted]. To better understand how endothelial cells sense and response to hemodynamic forces, I developed a fluorescent-cellular sensor activated by distinct flow patterns (laminar flow vs. disturbed flow) known to regulate endothelial cell phenotype. I achieved this activation by introducing into the endothelial cells a genetic construct that consisted of a green fluorescent protein linked to a KLF2 promoter, a transcriptional factor that has been well characterized to be proportionally upregulated by laminar flow. Over the course of the summer, I successfully implemented and characterized the transcriptionally activated cellular sensor capable of exhibiting a quantitative fluorescent response when the cells were exposed to distinctive fluid shear stress. This genetically engineered cell-based sensor is currently used at the [redacted]'s lab as a novel platform for evaluating the effects of flow-based shear stress on cell physiology in real time. Overall, these research experiences have strengthened my scientific proficiency for my proposed graduate research by providing me with a broad set of skills and knowledge in the areas of cell mechanics, tissue engineering, and microfluidics. Additionally, I presented my research findings in numerous conferences, including the [redacted] Symposium, [redacted] Annual Conference, and [redacted] Meeting, which has taught me how to effectively communicate a broad understanding of my research to a diverse community of people. **Broader Impacts**: In addition to my research experience, my motivations for an academia driven career is also rooted to a variety of extracurricular activities from mentoring peers to outreach at foster homes, confirming my aptitude and passion as an educator. Since becoming a tutor in high school, I discovered my enthusiasm for explaining mathematical and scientific concepts to others in a vivid and intuitive manner. I continued this teaching interest to college, where I tutored for 3 years, calculus and engineering courses including Engineering Statics and Mechanics of Materials. My teaching experience provided me with a strong foundation to build my pedagogical abilities by inspiring students to use science in transformative ways like integrating it to real life applications. In addition, my devotion as an educator extended to tutoring-visits at the hospital for a student that underwent surgery during the academic semester. In the Fall

2014, I challenged my professional character a step further to better develop my leadership abilities by accepting the position of [redacted] Director within the robotics association known at my university as [redacted]. During my involvement in this association, I directly managed the design process of each [redacted] project, including [redacted] robotics, ensuring that the design phase of each project resulted in the innovation and improvement needed to keep us a step ahead of the competition. The result of our design efforts allowed our Vex robotics team to win the 2015 [redacted] Championships in [redacted] and our [redacted] team to reach higher ranks in the [redacted] 2015 National Championships than in previous years. In addition to our robotics projects, I organized and participated in numerous educational outreach activities, including encouraging young students towards engineering by visiting two foster homes with our robotics projects and hosting a robotics preview seminar for over 100 middle school students. During my senior year as an undergraduate, I realized that there was an overwhelming amount of encouragement and support, in my institution, oriented towards industry opportunities. Conversely, in terms of undergraduate research, there was little to no help offered to students. As an initiative to address this imbalance in opportunities, I founded and organized the [redacted] Program. In our launch event, there was more than 200 student attendees, as well as the participation of the dean of diversity initiatives from [redacted] and the director of diversity outreach from the [redacted]. Within this program, other senior students and I served as mentors to encourage students to pursue innovative research projects by networking with research professors, guiding them through the process of preparing a competitive application for summer REUs, and being a constant source of support for any struggles during their research experience. **Future Aspirations**: In addition to my enduring efforts pursuing academic excellence, my parents provided me the opportunity to break from my financial constraints and strive towards a greater educational future ultimately achieving graduate studies at [redacted]. I will continue my graduate education towards a Ph.D. at [redacted] as an overriding component to achieve a career in academia, gaining the technical expertise to become a faculty leading my own research lab dedicated to the nexus of novel engineering approaches to explore the underlying role of mechanics in human physiology. Furthermore, my involvement in academia will extend beyond contributing to the advancement of the field, but also to the academic development of others. Under this commitment, I have frequently met with the dean of diversity initiatives, to extend my mentoring skills towards diversity efforts at [redacted] including research-mentoring undergraduates during the [redacted] Summer Research Undergraduate Program and as panelist in graduate school info sessions for minority outreach. By obtaining the prestigious NSF-GRF, I will have the financial flexibility to fully pursue my proposed graduate research while undertaking my social motivations to encourage and facilitate scientific literacy to underprivileged students. Moreover, this fellowship will confirm my efforts to exemplify that restless academic endeavors can dismantle socioeconomic impediments on a young Puerto Rican pursuing a higher education.