**Personal Statement - 2020**

**Introduction**

Catch, Drive, Release, Repeat. The united rhythm of our 8 bodies greet the rising sun as my teammates and I pull our rowing shell along the Charles River. In my freshman year of college, with an excitement to learn and try new things, I found myself as a walk-on to the MIT Crew Team, where I have grown through the past 3.5 years, improving every day and even finding myself invited to train with the US National Team this summer. Some of my teammates resent the stereotype of the nerdy MIT rower who performs physics calculations in their head during a race, but I embrace it. In truth I cannot deny considering the angle of my blade as it enters the water, the torque I apply to my shaft, the fluid dynamics of our hull sliding through the water, and the transient forces resulting from our relative accelerations. How could anyone not be curious about the forces and principles that underlie our worldly experiences? I have always been curious and eager to learn and understand science. As a young child I drove my parents mad with incessant questions of “why” and “how.” One wall of my bedroom contained a floor-to-ceiling bookcase filled with encyclopedias, my parents’ favorite novels, and my favorite - “The Way Things Work” - which was full of descriptions and illustrations of mechanical and electrical mechanisms. In a way, gaining an understanding of these small corners of the universe felt comforting, providing a sense of order in a world that can otherwise seem ruled by chaos. As I have grown though, my quest for understanding has developed an outward facing motivation as well as I seek to contribute to the world around me. My passion has led me to pursue education and experiences to build my understanding, an unending quest, for my own benefit as well as that of society at large. I am eager to pursue a PhD, to push the frontiers of science and gain the tools to continue in my quest for scientific understanding and social impact.

I long to live a meaningful life by leaving the world better off than I found it. My long-term vision towards this end entails engaging my academic curiosity and passions to an impactful end by advancing the frontiers of medical understanding. I believe good health is a basic human right and so feel compelled to fight for equity and justice through the development of our fundamental scientific understanding – the fuel for innovation of more effective diagnostic and therapeutic technologies. I will pursue this impact through higher education and a career in biomedical engineering research. For this long-term effort, I’ve focused a great deal of my energies to date into building a solid educational foundation in bioengineering and mechanical engineering both through theoretical and practical coursework and through my research positions.

**Intellectual Merit**

I am grateful to have had the opportunity to attain a world-class undergraduate education through MIT. My coursework has combined instruction in theoretical principles as well as hands-on practical applications to produce a more intuitive grasp of engineering and scientific concepts. For instance, through building a confocal microscope and microfluidic apparatus and performing experiments with them I gained a deeper understanding of optics, microscopy, signals and systems, microfluidics, and data processing. I also had the opportunity to learn cell culture, high-throughput small molecule screening, and other modern wet-lab skills including the design and implementation of a CRISPRi system for metabolic engineering of bacteria. In another project, I applied engineering principles to design and manufacture a robot for an end-of-course competition. I was excited to see my invention advance to the quarter-finals and had the honor of receiving an end-of-course award for design and execution. The greatest satisfaction though was in how the practical experiences of the course had deepened my understanding and abilities in engineering. My coursework in this way has increased my capabilities and further stimulated my passion for science and engineering in practices such as research design, creative problem solving, and data analysis.

My extracurricular research activities have also had this effect. My first foray into academic research was one summer in high school through the Young Scholars Program at Florida State University where I treated cells with a chemical agent and mapped the resultant epigenetic changes. This experience inspired a fascination with epigenetics and ignited my passion for scientific exploration. In my eagerness to contribute to scientific research and discovery, I was then drawn to MIT’s Undergraduate Research Opportunities Program (UROP). I have engaged in UROP projects through the Biomechanics and Rehabilitation Lab, the Bioelectronics Group, and the Center for Biomedical Engineering. These projects have spanned a variety of academic departments but have been consistent in their focus on advancing health science - a testament to my desire for societal impact through contributions in research.

    In the Biomechanics Lab, I facilitated the investigation of feedback in fine motor control by making adaptations to physical and software components of a therapeutic robotic interface. In the Center for Biomedical Engineering, I explored the influence of ECMO circuit design on thrombotic complications as well as the potential for laryngoscope modification to enhance tissue manipulation - though these projects were cut short by the Covid-19 pandemic.

My project in the Bioelectronics Group was the most substantial, evolving over a couple years and involving a great host of subprojects. The overarching project investigated the potential for light to induce neuro-regeneration in rat models of spinal cord injury. This project was especially exciting to me for its enormous opportunities for increasing the understanding of neural relays in the spinal cord and nerve regeneration mechanisms. I was initially recruited to design and build a rat treadmill for assessing the recovery of locomotor function. I was responsible for the entire development process, from background research, to design, fabrication, and testing. I created CAD models and fabricated my designs with a laser cutter and lathe. I also sourced and tested motors and elastic belt materials to optimize cost and performance. I iterated on the treadmill multiple times based on testing results. For example, in one early version of the treadmill, the belt was prone to slipping off of its track. Through researching related fields, I was able to identify and implement a solution - creating a convex surface for the belt pulley to generate differential tensions resulting in a self-centering system. Through this experience I gained practice in experimental design and demonstrated my ability to plan and execute testing, analyze results, and generate solutions.

It was my good fortune to get to work with the incredible Dr. Polina Anikeeva and to have a most talented and thoughtful mentor, Dr. Dena Shahriari, who, recognizing my enthusiasm for learning, offered further involvement in the incredibly multidisciplinary project. In addition to engaging in mechanical engineering and design, I gained exposure to methods for developing implantable electronics and neural probes as well as for animal handling and testing. When tasked with generating a procedure for generating motion data from videos of the treadmill use, I took the initiative to teach myself computer vision methods and develop programs to conduct basic analysis. I ultimately identified a more advanced open-source platform, and through much trial and error figured out how to harness this tool for our application by training and implementing a cloud-based neural network to process the raw video data. Through this sub-project, I gained experience in the realms of bioinformatics and machine learning. In this way my experiences in the spinal cord injury project not only provided nearer term societal impacts, by advancing the field of neuro-regeneration, but also increased my capacity for future impact, as I added a vast host of new research tools to my toolbox.

In addition to technical skills, I learned more general truths about the research process. The focus and design of the project were adapted numerous times as a partner neurosurgeon had to leave the project (requiring a new partner be found and brought up to date) and the surgical procedures had to be repeatedly modified to reduce the rate of casualties. Surgical and unexpected casualties were especially catastrophic setbacks, as each new cohort of rats set us back by months, but I have learned patience and an appreciation for all the discovery that goes unpublished in the process of enabling that which is ultimately reported. The experiences I have had through this project have been a crucial lesson in persistence. I have gained a greater appreciation for the complexity of scientific research, learning to expect the unexpected and exhibit adaptability as obstacles arise.

Currently I am working with Professor Ellen Roche to develop a minimally invasive tool for the delivery of cardiac patches providing mechanical support of heart function after heart attacks. The research focus of Dr. Roche’s lab provides the exciting potential to expand our understanding of the mechanisms and optimization of various organ support techniques. I aim to become further involved in this research through my graduate studies, and to take advantage of the Roche Lab’s computational work to advance my own quantitative research skills.

**Broader Impacts**

I recognize that not everyone has or will have the opportunities for education that I have had and so fully believe in using my research and advantages to benefit others. I am incredibly grateful for all my mentors, who have blazed the trail ahead of me and turned around to lend a hand through the steeper parts of my ascent. In my eagerness to pass on this favor to those coming up the trail behind me, I have engaged in mentorship through both formal and informal positions. In my junior year, I served as a Resident Peer Mentor, a role established to provide freshmen with an upperclassman friend within their living community that they can turn to for advice, particularly in cases when they may feel more comfortable reaching out to a peer rather than faculty. I also act as a mentor through my involvement on the MIT Crew Team. One aspect of the team that I love is how it throws students from all class years together into one boat and demands mutual support and unification for mutual success. I am always delighted to share my experiences and advice with inquiring younger teammates, whether about rowing and training, choosing classes, reaching out to professors, acquiring a research position, or any other questions or issues on their minds. This year I am also excited to be taking on the position of Associate Advisor (AA). In this role, I will have the opportunity to support rising sophomores as they enter the Bioengineering major. It is my hope that, as an AA, I will be able to serve as a mentor and friend to foster a sense of community for these sophomores within the department and assuage any anxieties they may have, especially given the unique challenges of the pandemic situation and largely virtual upcoming semester. I am certain that I will continue to serve as a mentor and source of support for others throughout the rest of my life and in any role I may assume. When I am a graduate student, I plan to continue serving as a mentor and source of support by encouraging and assisting undergraduates as a Teaching Assistant and UROP Supervisor. I will also draw examples from my research and rowing experiences to lead workshops on physics, biology, and scientific concepts for local underprivileged and underrepresented youth through outreach programs such as DynaMIT and through the Society of Women Engineers.

**Looking Ahead**

While I have learned a tremendous amount from my coursework and research experiences to date, I recognize that there is still a vast wealth of knowledge I have yet to encounter. To be more effective in expanding scientific understanding and improving healthcare I need to immerse myself even further at the cutting edge of biomedical exploration and towards this end I intend to pursue a PhD. While there are multiple pioneering graduate programs in the US, the Health Sciences and Technology program at MIT is especially promising as a next step in achieving my long-term vision. It combines the strength of premier education and research centers - such as MIT, Harvard Medical School, Massachusetts General Hospital, and the Broad Institute - to provide an unparalleled education in medical engineering, merging clinical experience and technical curriculum. It also offers the opportunity to engage in pioneering research through the exploration of organ support systems with Dr. Roche.

Graduate studies would not only serve to deepen my understanding of specific technology at the cutting edge of healthcare, but also strengthen my communication skills in collaborative and professional research environments, and provide the opportunity to further explore and pursue scientific advancement for the benefit of society outside of the capitalistic focus of industry. Funding from the NSF Graduate Research Fellowship will help make my aspirations a reality by enabling me to join the program and the lab that foster my academic and outreach aspirations.