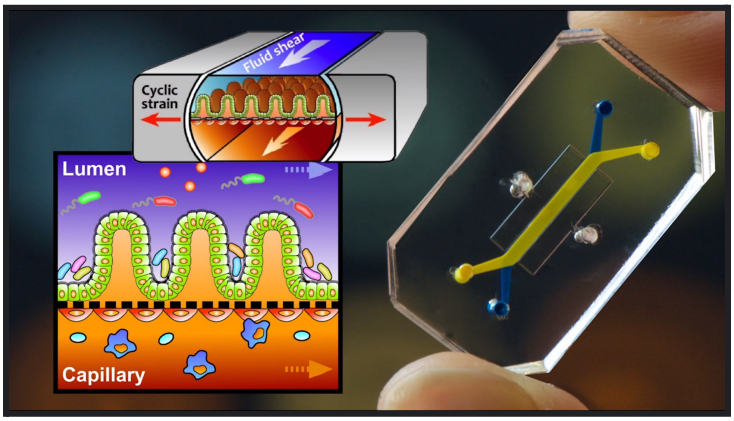
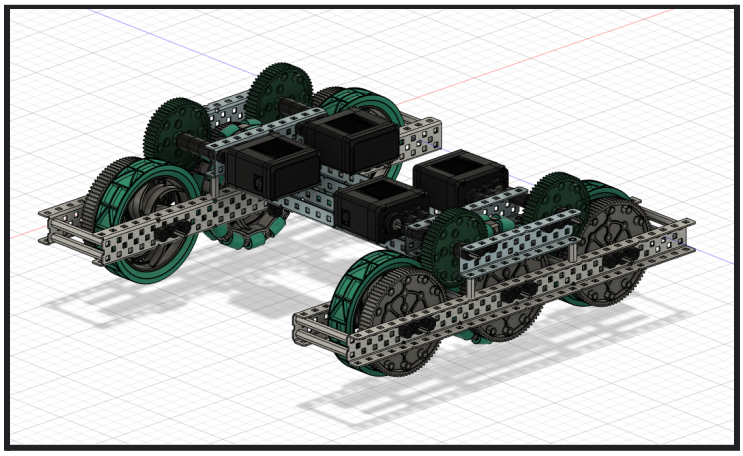
Throughout history, the use of the engineering process has led to unprecedented advances and development in areas of science, engineering, and math alike. Though simple, it is the basis behind every idea, invention, theorem, and more, marking it as the most efficient way to solve the problems of this world. It involves the following steps: Define the problem, Conduct research, brainstorm and conceptualize, Create a prototype, build and market your product, product analysis, and improve. Most often this design process is synonymous with mechanical engineering, but the innovative design process can be used in multiple different careers, namely the one that I am interested in, bioengineering.

What makes bioengineering so unique is that it applies the concepts and techniques commonly used in engineering for medical applications. It is a relatively new career and still pretty uncommon, with around 8,000 graduates per year compared to mechanical engineering's 47,000 graduates per year. Those who pursue this major and career are expected to understand fundamental physics and engineering in addition to the anatomy and physiology of the human body. Bioengineering has led to multiple revolutionary creations, such as the case of the human organ chips by the Wyss Institute. These innovative chips recreate certain human organs on microfluidic devices that contain living human cells, allowing for much more efficient drug-testing. These technologies are created through a modification of the engineering design process that they call the "innovation funnel". Their steps include Idea Generation, Concept Refinement, Technology Validation, Technology Optimization, and Commercialization. Idea Generation is much of the academic research that Wyss Institute provides. They first pick a certain problem and start the associated research and testing. Once they are able to see potential in the technology, their business and staff work on creating a marketing model for maximum exposure. Technology Validation starts to evaluate risks in the potential solution and works toward finalizing the concept and building the first few prototypes. After this point, they work to keep any risks at a minimum and build



market potential. Once this step is complete, a startup is created, and through the help of backers, the product is released into the market, ready to revolutionize the world. All these steps are just the engineering process just refined for the purpose of their solutions.

We use the engineering design process quite a lot when it came to designing and building our robot. We first started with understanding what our robot's objective is. For this year's event, the primary goal was to be able to pick up objects called mobile goals, pick and put rings on these mobile goals, and be able to place them on platforms that act like a seesaw. We take all these separate objectives and try to establish which ones will give us the most points in matches. Once we understood what we should be working toward, we headed on to creating our design statement, which outlined the problem we were solving. This helped us create a criterion for us to follow, which was later on used towards the design matrix that we used to rank and decide our final design. During this time, we also started to research some of the math and physics concepts that we could use to enhance our current solutions. All this work was done before we even started to work on the solutions, as all the different areas of research helped us visualize and design better solutions and subsystems for the robot. For the actual designing itself, we used whiteboards for initial concepts and transitioned into a 3-D modeling program called AutoFusion 360 so we could have increased precision and accuracy during designing. After we created a few different designs, we ranked them in a design matrix.



Once we evaluated which was the best design, our build team worked to create a tangible, real-life version of it, with build-checks and iterations along the way. As the build started to finish up, our code team worked to build a test code that could test the design out, and see what potential flaws it may have had. We tested using two different methods, a code test and then a competition test. The first test simply tests basic robot functionality, and the second test measures the effectiveness of the robot in a match-like environment, which also helps uncover any

design-based problems. A lot of these procedures derive from the design statement and goals for the subsystem.

Although the “Innovation Funnel” is specific towards the Wyss Institute’s research and Ethereal is not directly related to bioengineering, we both are able to find a common ground in the engineering design process. Their steps of idea generation, concept refinement, and technology are similar to our steps of research, build progress checks and code testing. Just like us, they define a problem and research and find potential solutions, and then work towards a concept and its refinement. However, one notable difference is the commercialization process. This launches the solution into a competitive market and starts the path of its integration of the solution in modern labs and research. We don’t really do this as our robot’s objective is built for competition purposes rather than real-world application.

The engineering design process is practical and allows for an efficient way for solutions to be created for modern-day engineering problems. Being an independent robotics team allowed us to extensively use these processes and see how they could apply to a competition setting. School teams have a coach or something guiding them towards a solution, but we had to create and research our own unique and creative solutions. More importantly, competing in VEX allows us to start our journey towards a career in engineering. VEX allows us to learn the basics of robotics and apply them in a competitive setting, which strengthens our general engineering and design skills. Every great engineer, mathematician, and scientist started somewhere, and hopefully, VEX will be the place where we start our journey and eventually revolutionize the world as we know it.

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