Biomedical Engineering and The Robotic Engineering Design Process Used in Project Warp Speed

By 1715G, Gigabytes From Hopkinton, MA, USA

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VEX IQ CHALLENGE

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Why We Chose This

After researching the vast field of STEM careers and the impact of robotics on these careers, our team has decided to focus on Biomedical Engineering. We will highlight similarities between the world of vex and bioengineering. We have chosen bioengineering since people on our team share many different interests. We have people who would like to be engineers, doctors, teachers, and even pursue business in the future. Bioengineering applies to robotics because, in robotics, we need to create a sustainable, usable, and prosperous bot. Bioengineers are given the task of applying engineering concepts to medicine. We have decided to conduct our research on Pfizer and Project Lightspeed, the race against time for a vaccine.

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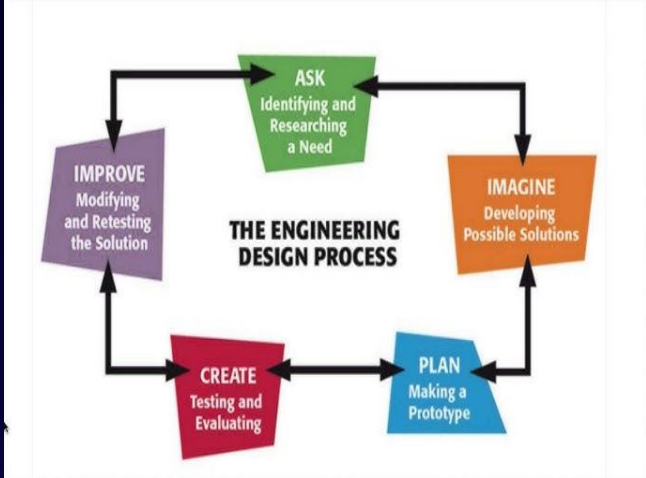
Engineering Design Process



Bioengineers have to identify problems in their area, and find ways to fix them. They must combine the Engineering Design Process with the principles of science. They are tasked with asking questions to find out about a phenomenon, and then engineering a design which can solve these problems. This presentation will detail how these engineers have to use the engineering design process, and the ways they have applied it in the Pfizer Covid-19 Vaccine.

How We Use The Engineering Design Process

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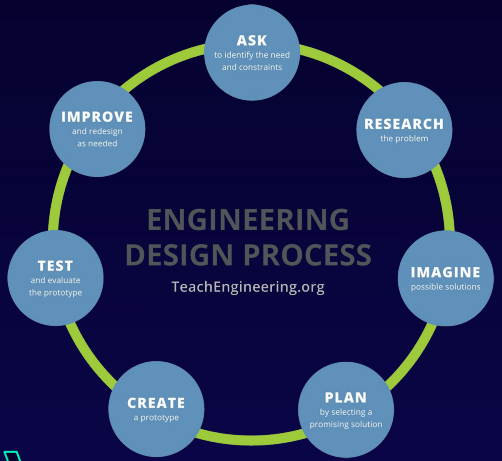
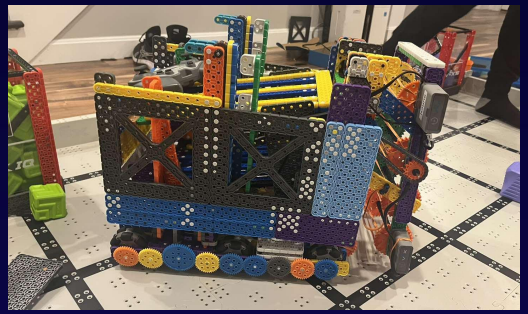
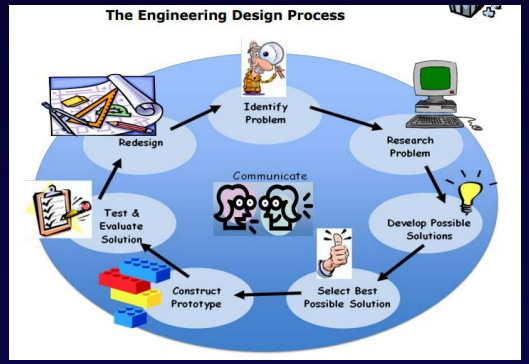
We apply the Engineering Design Process in VEX robotics, starting with defining objectives. Competitions serve as testing grounds, allowing us to enjoy the challenges and refine our designs for continuous improvement.

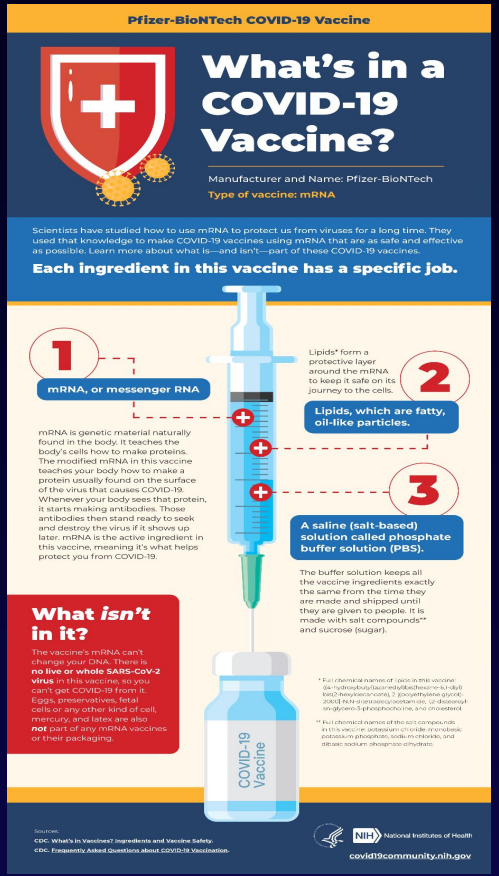


Applications

In March 2020, as COVID-19 spread globally, Pfizer applied the engineering design process in Project Warp Speed, a joint government and Pfizer initiative. The challenge was to create a vaccine within ten months. This endeavor, completed by the end of 2021, aimed to solve the pandemic that had confined people to their homes. Similar to Pfizer's impact, VEX students also have the potential to change the world through innovative solutions. These students can use the creativity they harness in VEX to do anything they dream of.



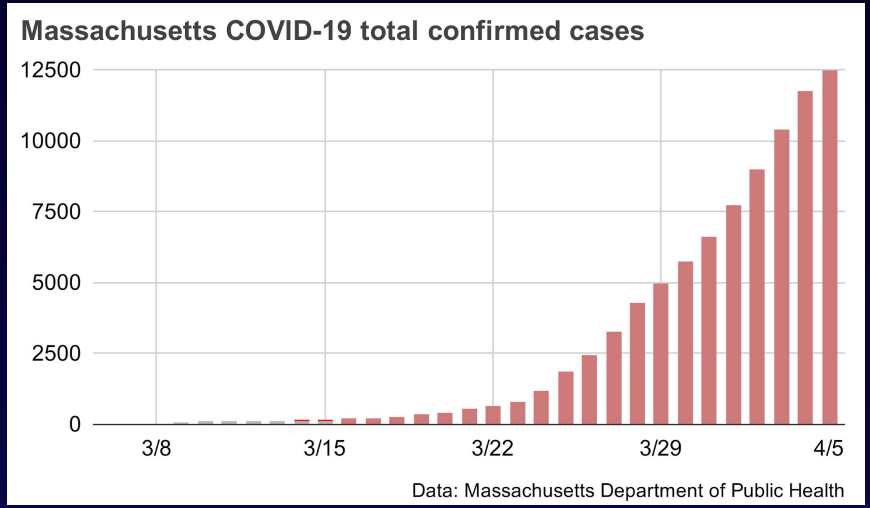




Identifying the Problem

In March of 2020, citizens of the world went through a frenzy of problems. The reason for these problems was the COVID - 19 pandemic. This pandemic caused 7 million deaths in the world. This pandemic also caused 1.16 million total deaths in the US alone. Once the pandemic was announced, Pfizer and BioNtech began developing the vaccine. These two major tech companies began to create a vaccine in the face of the strongest virus seen in the last 100 years. This problem was immediately identified by health officials across the world.

This chart shows daily deaths rapidly increasing in our state, Massachusetts. One can view the case counts go from a few hundred to 12,500 in less than a month

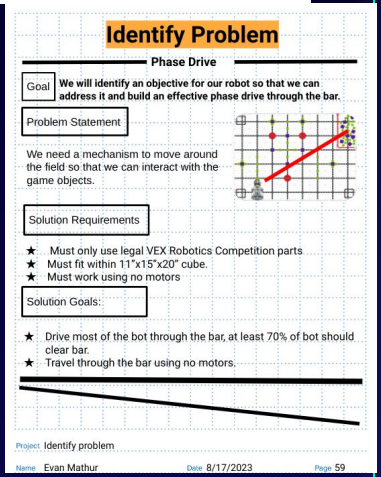


Robotics Similarities - Identify Problem

These pages from our notebook illustrate our team's problem-solving, and resourceful approach in the Engineering Design Process. When initially introduced to the game, we prioritize identifying tasks our ideas must address. For instance, to navigate the supply zone, we designed a phase drive for our robot, identifying constraints and requirements promptly. This concept, employed in Project Warp Speed, served as inspiration for healthcare professionals combating the COVID-19 pandemic.

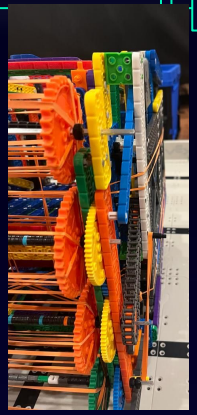
How did Covid - 19 cause a problem?

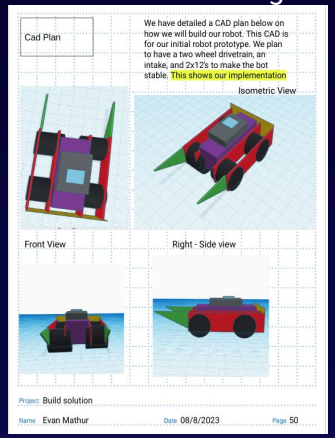
A page about dumper from our notebook.

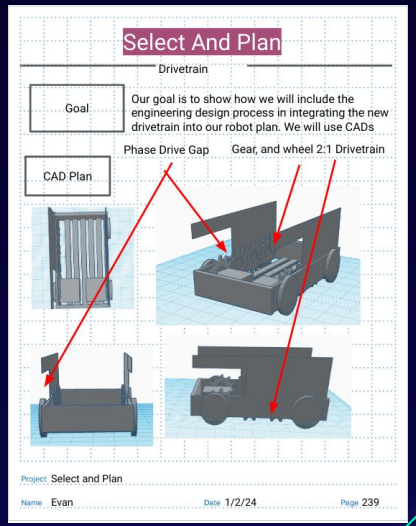


Brainstorming Solutions

During the COVID-19 pandemic, Pfizer innovatively developed the mRNA vaccine using AR cameras, skilled engineers, and remote facilities. Similarly, in robotics, resource constraints led us to use a compound gear ratio for our intake due to a chain scarcity, overcoming it with 1x8 beams, rubber bands, and CADs. Efficiency matters in our robot design, such as opting for a roller-based intake system over a slower claw. Pfizer applied a similar mindset, emphasizing speed and quality in creating their highly effective vaccine within a tight

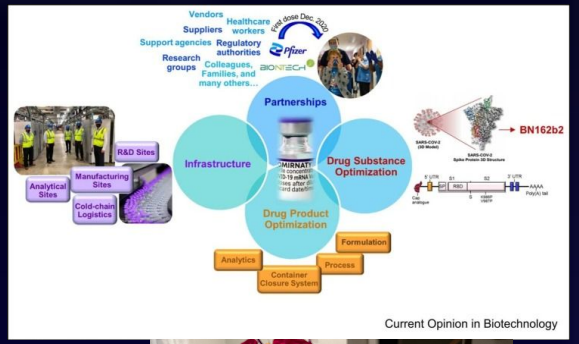






Building and Creating Our Solutions

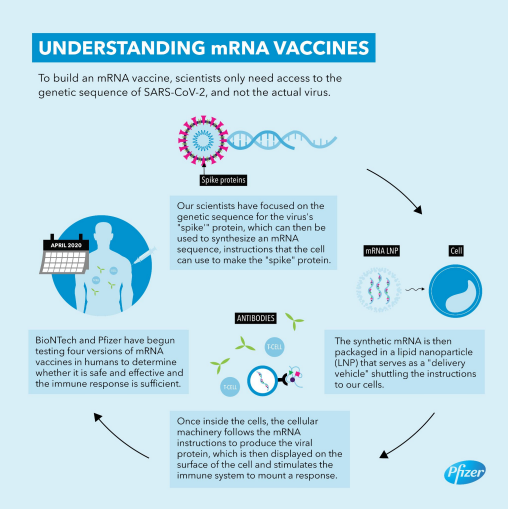
Pfizer and BioNTech's engineers and scientists faced the challenge of creating a vaccine, contributing significantly to global health. The vaccine utilizes a lipid nanoparticle containing messenger RNA to trigger antibody production. In VEX robotics, we apply similar problem-solving by using our given resources to build intricate mechanisms, employing fundamental engineering mechanics, such as harnessing potential and kinetic energy in our dumper for efficient cube deployment.

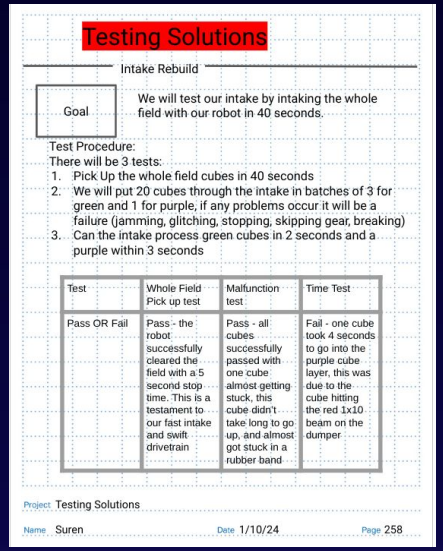


We use slope to find the optimal dumper slope. Our current slope is y=23/60 x+41/2. This helps us to learn more about slope, and math principles.

Testing Solutions

In robotics, testing solutions is a crucial step, achieved through competitive testing. Pfizer used a similar approach, initially developed a vaccine but identified suboptimal efficiency through numerous tests. By using a phased strategy, they innovated quickly to create an effective vaccine.





Sources:

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[Pfizer Article]

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[CNN Article On mRNA Vaccine]

[Pfizer and BioNtech testing]

[How Are Vaccines Developed? by Pfizer]

[The People Behind Your Vaccine]

[CDC Article]

[Vaccine Technology]

Our Team (referenced from our notebook)

First Meeting

1715G Team Biography

We are team 1715G Gigabytes from Hopkinton Middle School, Hopkinton, Massachusetts. Our Student-centered and hands-on team strives for excellence in everything we do. Together we have 2 years of participation in the VEX Robotics Competition program, We are excited to learn new skills and apply those new skills in this season: VEX Robotics Competition "VIQRC" Full Volume

Suren Sahakyan

I am Suren, I am in 8th grade, and I take part in coding, building, and notebooking for our robotics team. I am our Team Captain, and my strengths are problem solving, and building creative designs.

Divit Vallandas

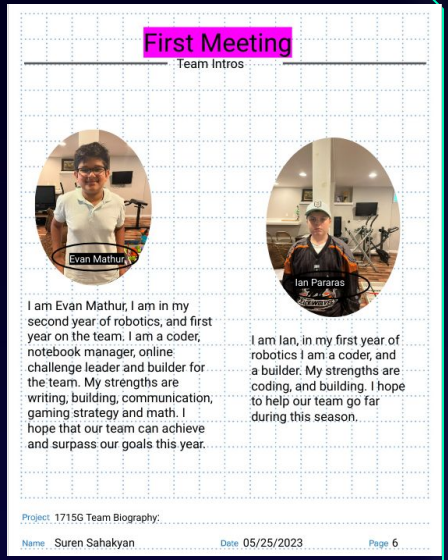
I am Divit, an 8th grader in my second year on the team, and third year in robotics. I am a driver, builder, and online challenger for our team. My strengths are driving, strategy, building, and writing. I am excited to achieve our goals during this VEX IQ season.

Mission Statement

Throughout Challenges and Successes we will always innovate and improve.

Project 1715G Team Biography

Name Evan Mathur Date 05/24/2023 Page 5



First Meeting

Team Intros

Evan Mathur

I am Evan Mathur, I am in my second year of robotics, and first year on the team. I am a coder, notebook manager, online challenge leader and builder for the team. My strengths are writing, building, communication, gaming strategy and math. I hope that our team can achieve and surpass our goals this year.

Ian Pararas

I am Ian, in my first year of robotics I am a coder, and a builder. My strengths are coding, and building. I hope to help our team go far during this season.

Project 1715G Team Biography:

Name Suren Sahakyan Date 05/25/2023 Page 6

Word Count: 970