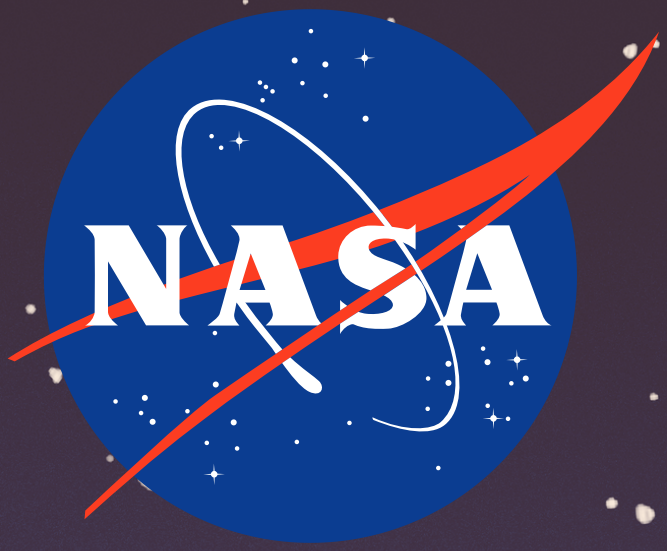
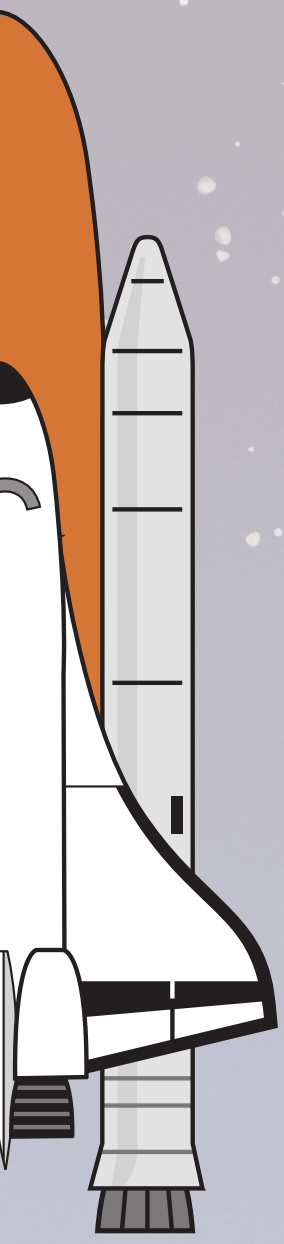


NASA

ENGINEERING DESIGN PROCESS

3118B Astrobots
Friendswood, TX
Misbah, Ben, Jonathan, Jath, Sumi



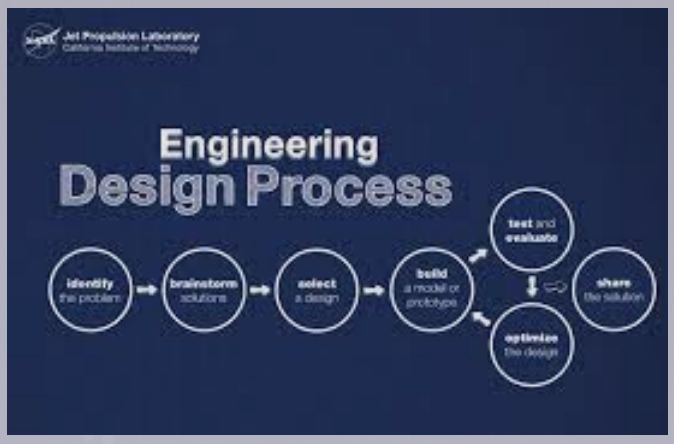
WHY NASA?

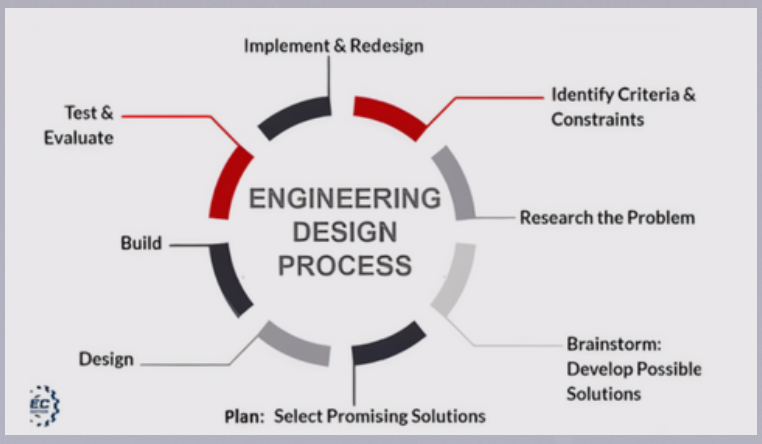
The National Aeronautics and Space Administration is a leader in space exploration and has been since its founding in 1958. NASA is a United States Government Agency that has facilities and centers across the country, and a laboratory in space. In addition to cutting-edge space technology and research to help the well-being of the Earth and its inhabitants, NASA has programs to work with the young innovators of the future. Through programs such as the Robotics Alliance Project (RAP), NASA works to encourage students to pursue careers in STEM by supporting programs like VEX Robotics. Growing up in Houston, the "Space City" NASA has had a lot of influence on our team over the years, and all of our members are currently members of a NASA-housed FIRST robotics team.

Our team conducted research on NASA's engineering design process by reviewing several resources found on their website, analyzing the VEX and RECF design processes, and speaking with NASA employees.

THE DESIGN PROCESSES

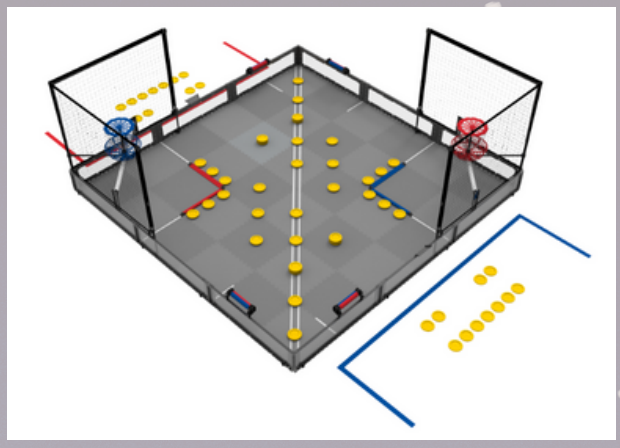
The Engineering Design Process is a series of steps a person or group can follow to create or improve an existing design. By using the steps in the Engineering Design Process, developing an effective solution is straightforward. A design process is an approach for breaking down a large project into something manageable. NASA engineerings working on all types of projects use this process. In the applicable robotics program (VRC), the Engineering Design Process can be used to create an effective robot and refine the existing features of the robot for competition. Our team uses using the Engineering Design Process inspired by RECF (shown below) throughout the season. While NASA also uses an engineering design process the steps differ slightly in name. The primary difference between the two is that the process our team uses is displayed as a cycle, as throughout the season we often find ourselves back at the beginning of the design process as we reevaluate designs.





IDENTIFY THE PROBLEM

This stage is the most crucial in the engineering design process. In the VRC competition, the problem is identified through the game that is revealed each year. Each team must identify the requirements of the game and limitations in their design to create a successful competition robot. This stage can include reviewing the Game Manual, studying the field design, and researching previously created solutions to the problem. For NASA, identifying the problem differs based on the mission and the goals of the mission. In this stage of the process, NASA also considers factors such as the stakeholders, cost, and project timelines.

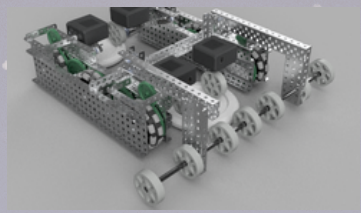


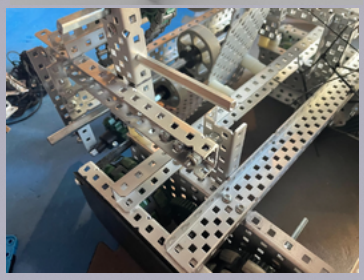
Both NASA and VRC teams brainstorm during this stage through sketches, CAD designs, prototyping, and other forms of proof of concept such as high-fidelity models. After brainstorming solutions, the best design is chosen to utilize specific criteria. Our solutions will be selected with design matrixes which are also commonly used in STEM careers.

PROTOTYPE & BUILD

The images on the left are examples of prototypes created by NASA for their projects using materials such as 3D printed parts. The images below show a prototype first designed in CAD and then built out of VRC parts for our team this year.

Using the selected solution to the problem, a design is created with the research and brainstorming done in the previous phases. For the Astrobots, this phase often includes CAD design of the robot's various subsystems to develop an integration plan. After designing the robot in CAD, the separate subsystems are built and assembled. Similarly, for a NASA project such as a rover, the design is split into different subsystems with different teams working on individual parts that are eventually integrated together. Prototyping, testing, evaluation, and even brainstorming are done separately for different parts of a project with a common end goal in mind.



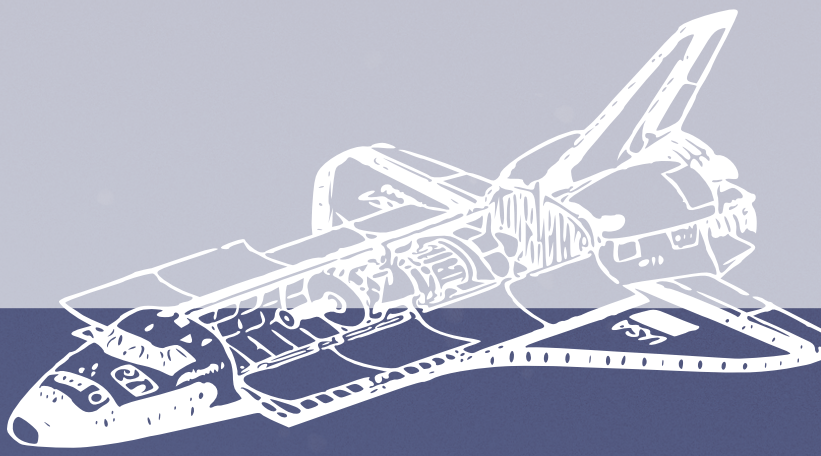


EVALUATE & OPTIMIZE

After the design has been constructed, the product will then be evaluated based on the criteria set and the problem identified. In the case of VRC, robot designs are often tested at competitions and evaluated based on performance as shown in the images below. While a VEX robot might compete at a competition as its end goal, a NASA project might be launched into orbit or sent on a mission to another planet.

SHARE THE SOLUTION

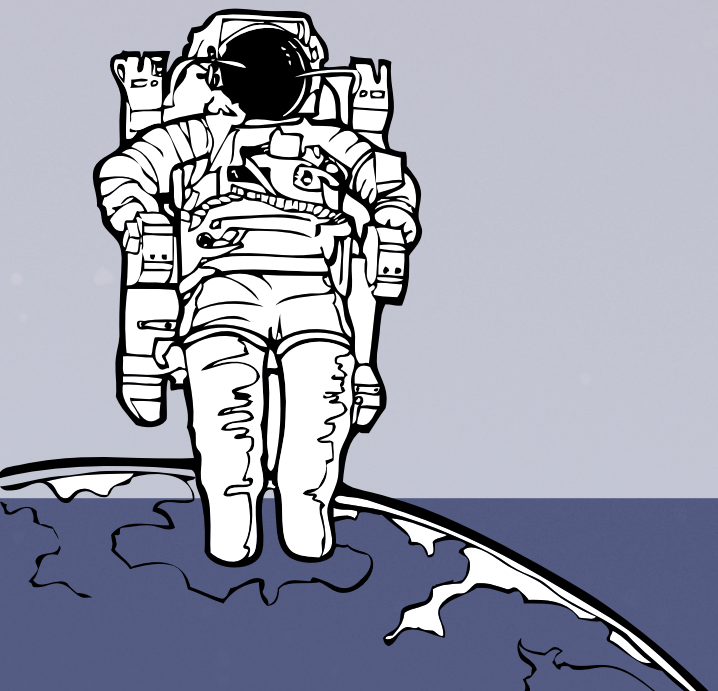
At the end of the engineering design process, both NASA and our team, the Astrobots, share our solutions. For our team, this means posting on our website, social media accounts, and Youtube channel. Toward the end of our competition seasons, we create reveal videos to share our robot design with a large audience. NASA uses similar methods to share its projects with the world upon completion, and sometimes even throughout the process of design. The images to the left are from the nasa.gov website and the Astrobots website which can be found at https://3118astrobots.netlify.app.



CAREER IMPLICATIONS

As our team researched the engineering design process used by NASA engineers, we learned a lot of valuable information about how our experiences participating in VEX robotics competitions are similar to the experiences of professionals in STEM careers. Through VEX robotics, as students we gain a lot of essential skills that will be beneficial to us in the future. Some of these skills include learning to operate machinery, designing through CAD software, coding a robot to perform tasks autonomously, and communicating our design process. By researching NASA's engineering design process, we also learned a lot about the important step of sharing your solutions. Though this means different things for a government agency and a student-led robotics team, there are similarities in our outreach methods as a team. Similar to NASA our team runs a website, and social media accounts, and keeps detailed records of our progress, some of which is made public after the completion of projects.

Through VEX, the Astrobots have been able to gain vital tools and experiences that prepare us for future careers in STEM and are essential to developing future problem solvers and change makers.



WORKS CITED

Figliozzi, G. (2022, July 26). NASA's Viper Prototype Motors through moon-like obstacle course. NASA. Retrieved December 30, 2022, from https://www.nasa.gov/feature/ames/nasas-viper-prototype-motors-through-moon-like-obstacle-course

Hoover, R. (2021, October 18). Full-scale Artemis Rover prototype takes shape. NASA. Retrieved December 30, 2022, from https://www.nasa.gov/feature/ames/full-scale-artemis-rover-prototype-takes-shape

NASA. (n.d.). NGSS Engineering in the Classroom. NASA. Retrieved December 30, 2022, from https://www.jpl.nasa.gov/edu/teach/resources/engineering-in-the-classroom.php

Saenz, S. (n.d.). Astrobots 3118. Astrobots 3118. Retrieved December 30, 2022, from https://3118astrobots.netlify.app/