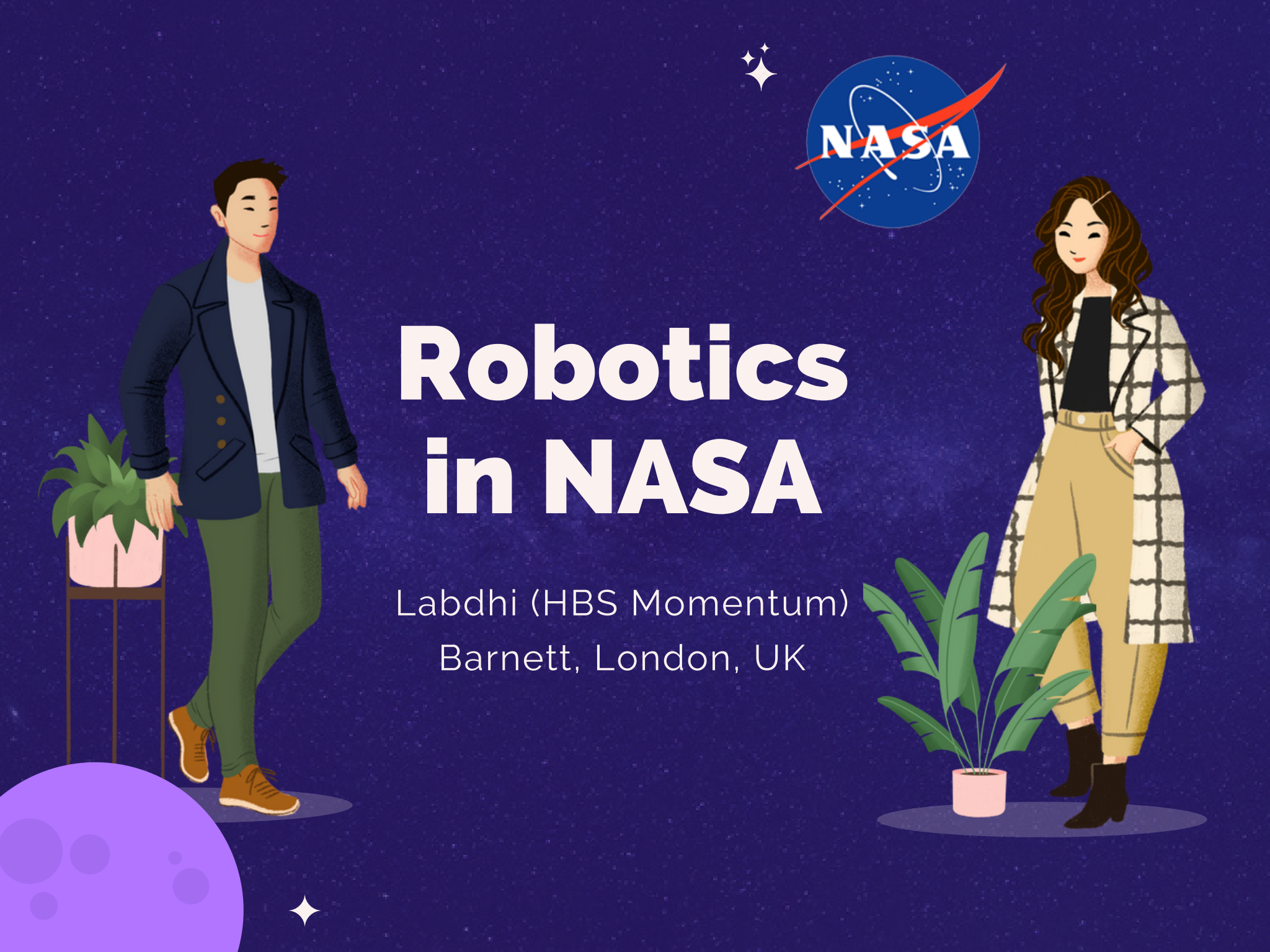


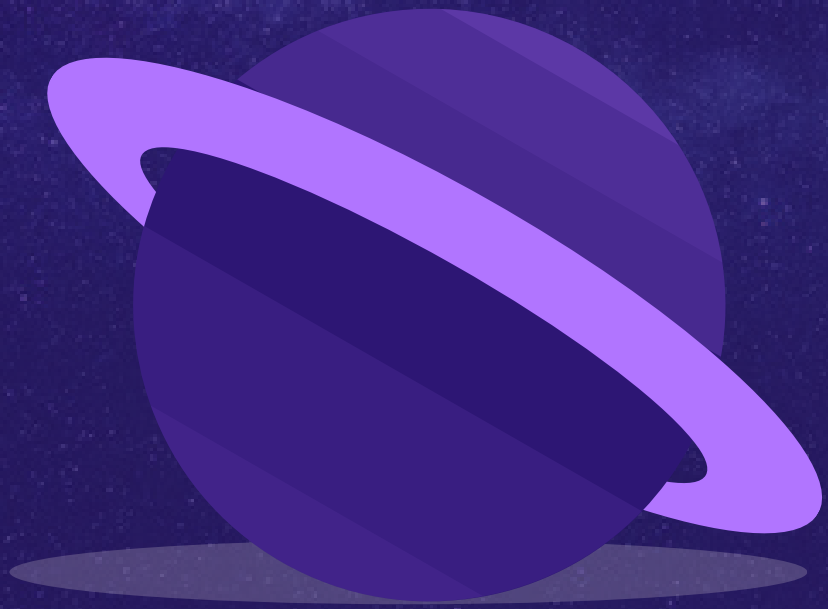
Robotics in NASA

Labdhi (HBS Momentum)
Barnett, London, UK

NASA.

NASA stands for National Aeronautics and Space Administration. NASA is a U.S. government agency that is responsible for science and technology related to air and space. The agency was created to oversee U.S. space exploration and aeronautics research.

We, team 10173C want to explore a possible future career in NASA, and discover the similarities and differences in how this prospective career and our own team use and learn from the process of engineering design.

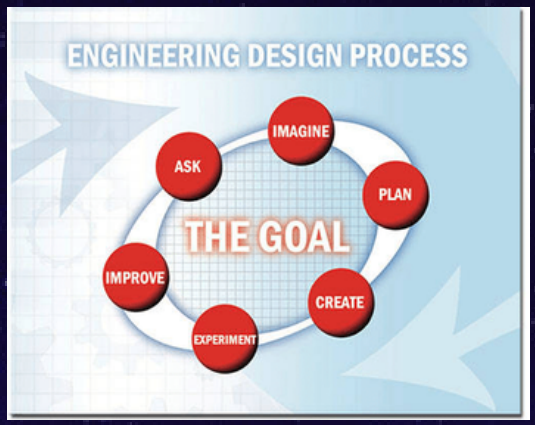


Why did we choose NASA?

For this online challenge, we decided to research a company's engineering design process to see if it can help improve our own. We had to chose NASA, (a US agency) as they revolutionized space exploration and tackled problems never imaginable to mankind. NASA funding also helps small businesses research new ideas and develop innovative aeronautics, human exploration, science, and space technology solutions, which effectively portrays NASA's major contributions and appearances in our world today, showing how our modern society is so influenced by their work.

By lowering cost and increasing innovations through their rapid iterative design process, NASA is among the greats of space travel. To this day, they have hundreds of successful launches and are working on continuing the exploration of Mars and developing new technology to make supersonic aircraft fly more quietly.

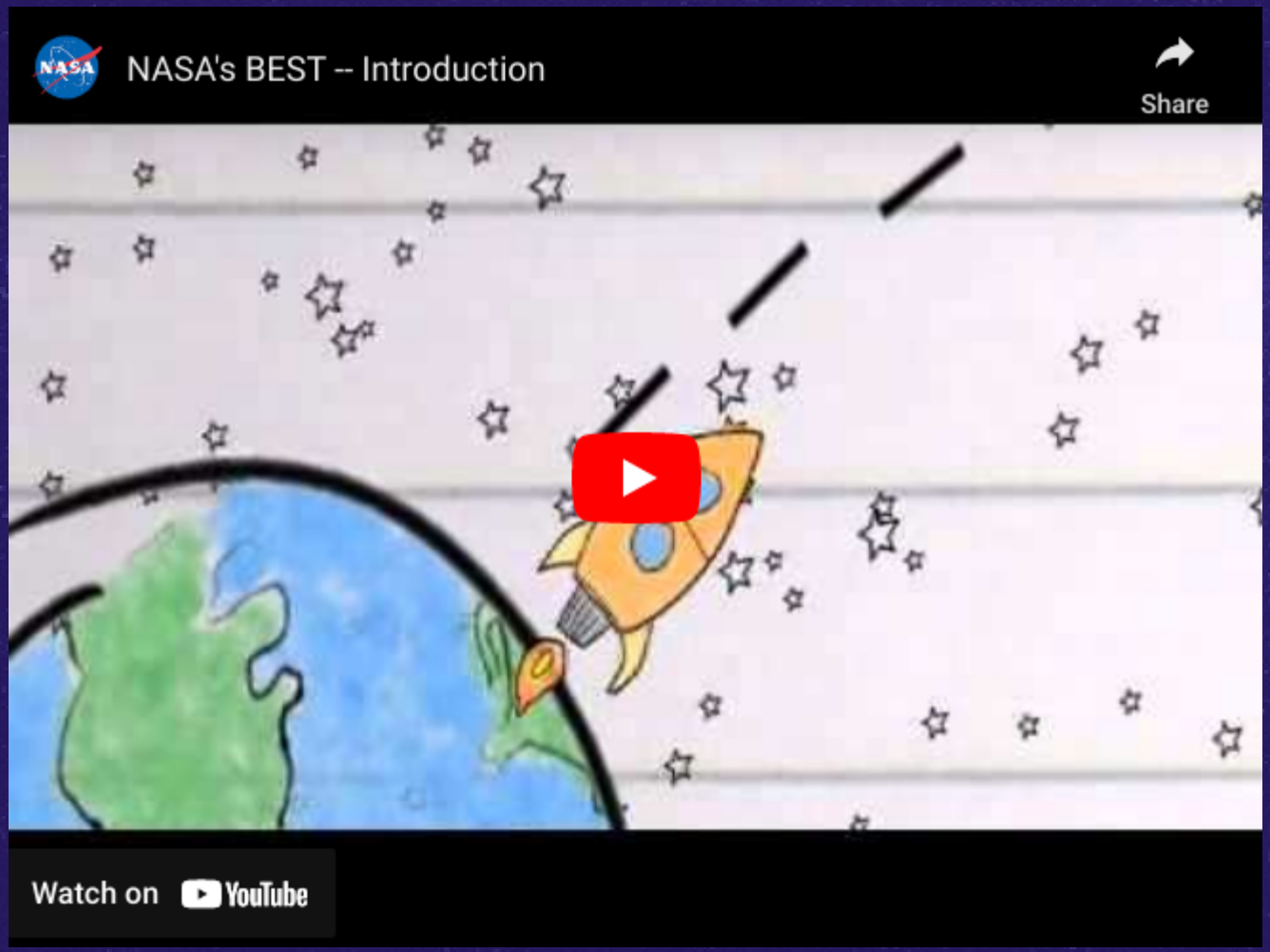
The NASA engineering design process



The NASA Engineering Design Model serves as a foundation for all activities. These Activity Guides were designed to teach students the Engineering Design Process (EDP) as an iterative process that engineers use to guide them in problem solving. NASA Engineers ask questions, imagine solutions, plan designs, create and test models, and then make improvements. These steps all contribute to mission success and may be described as follows:

ASK: NASA identify the problem, requirements that must be met, and constraints that must be considered.
IMAGINE: NASA brainstorm solutions and research ideas. They also identify what others have done.
PLAN: NASA choose two to three of the best ideas from their brainstormed list and sketch possible designs, ultimately choosing a single design to prototype.
CREATE: NASA build a working model, or prototype, that aligns with design requirements and that is within design constraints.
TEST: NASA evaluate the solution through testing; they collect and analyze data; they summarize strengths and weaknesses of their design that were revealed during testing.
IMPROVE: Based on the results of their tests, NASA make improvements on their design. They also identify changes they will make and justify their revisions.

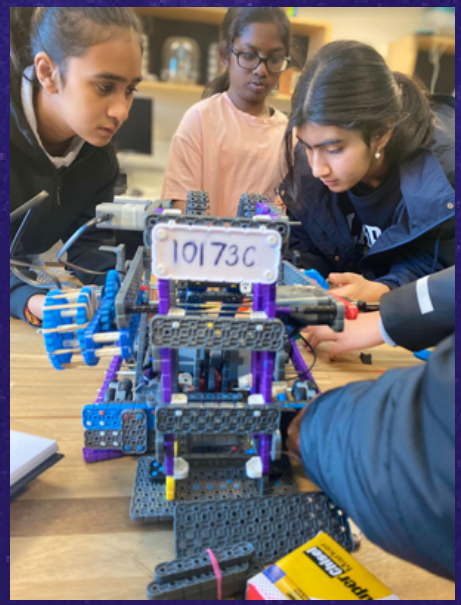
Ask, Imagine, Plan, Create, Experiment, Improve



https://www.youtube.com/watch?v=c0wh4GxoL28&list=PLTUZypZ67cdsM-asYGpX0L6NalPqhjljP&index=1

ASK

Just the way how NASA identifies the problem, finds the requirements that must be met, and constraints that must be considered, we, Team 10173C also have a team meeting to set our goals and deadlines. Before every game announced and before every competition, we all discuss and prepare solutions for the questions we have to ask. This is like the primary move in our engineering design process, just like NASA.




SETTING DEADLINES

Goal Revisions

After this tournament, we looked at our score consistency and average points, along with the goals we wanted to meet, and so we decided that something has to change if we want to be successful in this game. We need to change our robot to meet the goals that haven't been met.

ITERATIONS:

We also want to add a few more goals after seeing what the other teams have been doing and strategies we used!

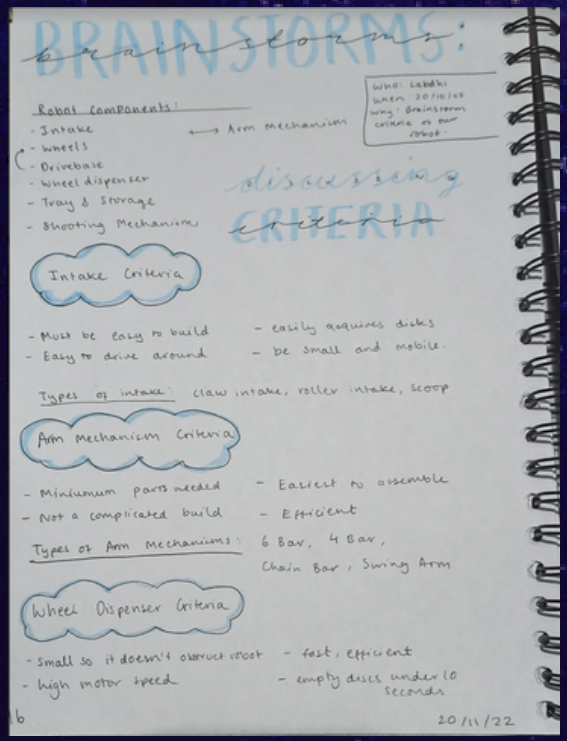
- Robot must be able to do blue dispenser quickly.
- Robot must be able to shoot in a timely manner.
- Robot can have two shooters instead of one.
- Robot must include a consistent driver and autonomous skills score.
- Robot must have an expansion arm to get into the expansion / contact zones for bonus points.
- Sketchbook must be to a good standard.

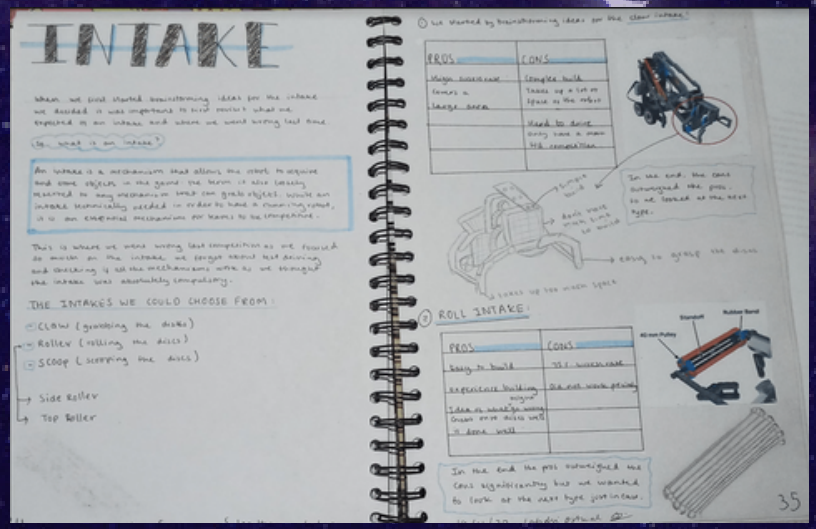
24

An example of us setting deadlines and assessing our situation through team meetings in our engineering notebook.

IMAGINE

Just like NASA brainstorm solutions and research ideas whilst also being able to identify what steps have been taken so far, our team also incorporates this brainstorming and research for every part of our robot to match with our design brief. We hold meetings to discuss the different options we have, and then compare the pros and cons for each of these options. In the very end, we make a decision matrix table to compare the various choices, so that in the end, we are ultimately left with the best option for us, our team and mainly our robot.

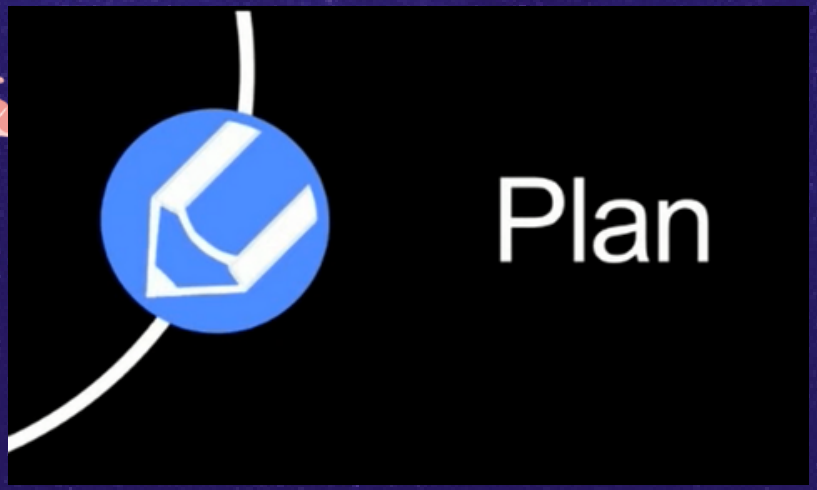


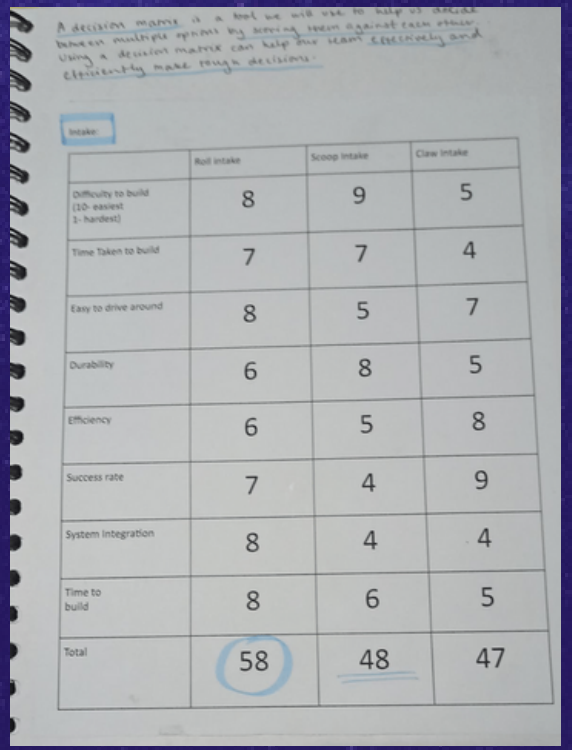


Here is a team meeting record where we discuss and brainstorm the different types of intakes, along with assessing their pros and cons so we know which one is best for us and our robot.

PLAN

Just like NASA choose two to three of the best ideas from their brainstormed list and sketch possible designs, ultimately choosing a single design to prototype, we use a decision matrix to ultimately select the best ideas and possible options for each part of the robot to build, which will be most beneficial and fitting with the design brief. A decision matrix is a tool we use to decide between multiple options by scoring them against different criteria. Using a decision matrix helps our team efficiently and effectively make touch decisions, just like NASA.



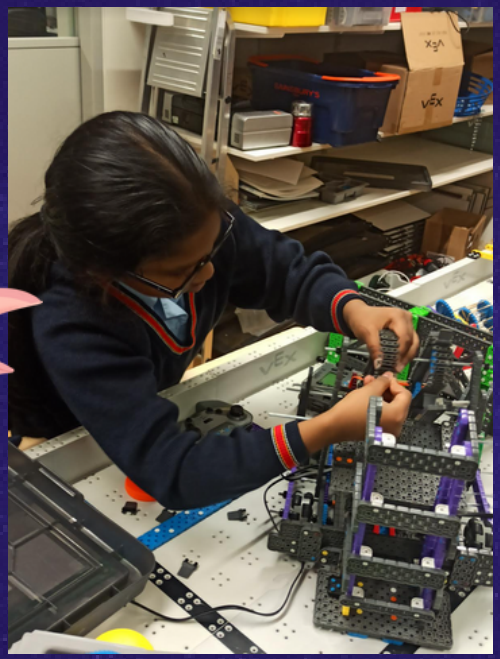


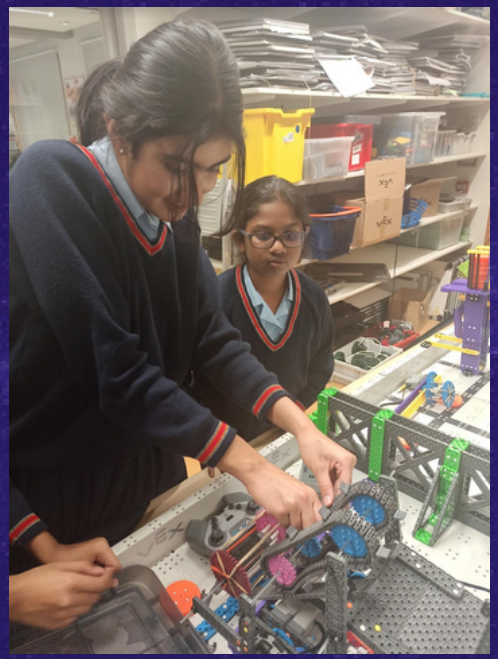
A decision matrix is a tool we will use to help us decide between multiple options by scoring them against each other. Using a decision matrix can help our team effectively and efficiently make tough decisions.

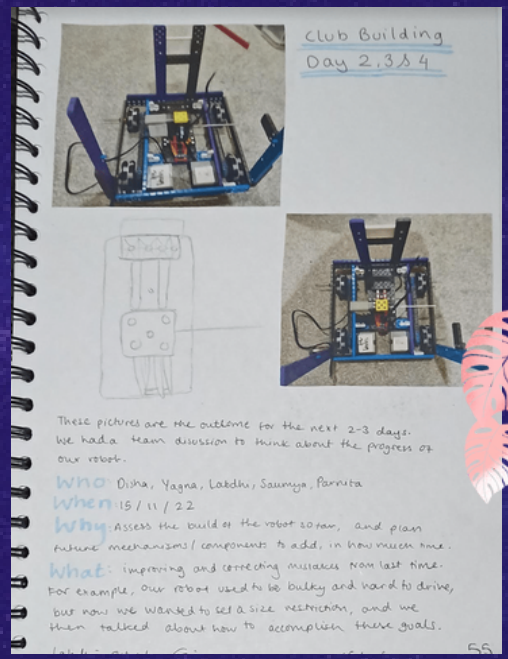
Intake:

	Roll intake	Scoop intake	Claw intake
Difficulty to build (10- easiest 1- hardest)	8	9	5
Time Taken to build	7	7	4
Easy to drive around	8	5	7
Durability	6	8	5
Efficiency	6	5	8
Success rate	7	4	9
System integration	8	4	4
Time to build	8	6	5
Total	58	48	47

The Create section of the NASA engineering design process is quite simple. All they have to do is build a working model, or prototype, that aligns with design requirements and that is within design constraints. This is exactly what we do as well. We also make sure to note down our Club Building Days in our VEX Engineering Notebook at the same time, along with adding team records and pictures of the robot for progress. We also make sure that every team member is involved in doing something, like NASA, and that we all are aware of what is going on in our robot.



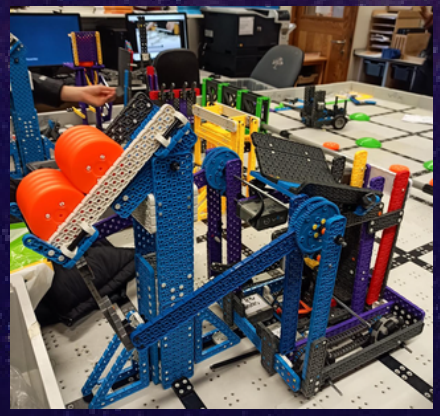




CREATE

TEST

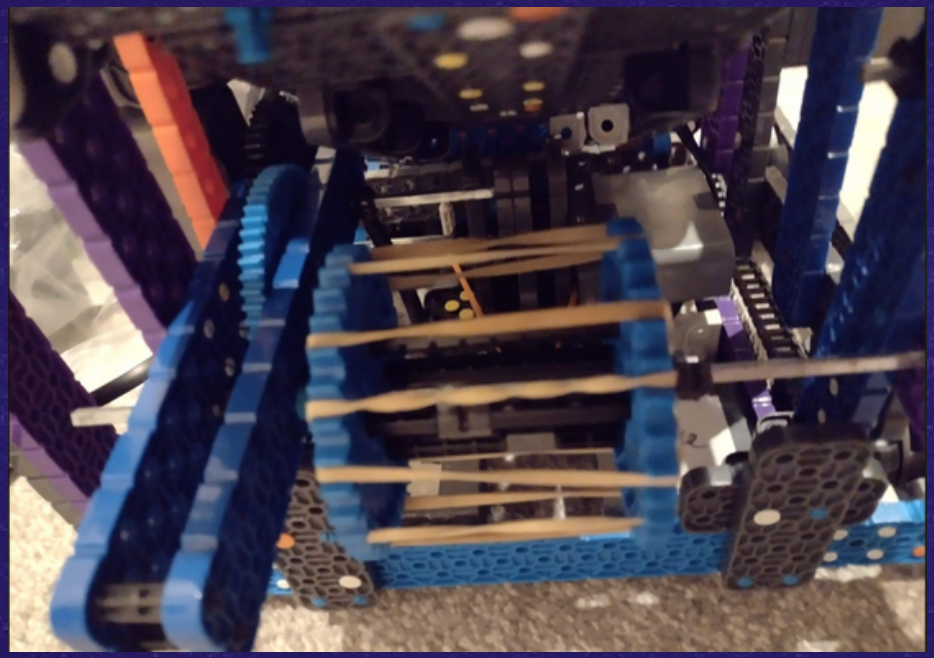
What NASA does to get through their testing phase of the engineering design process is to evaluate the solution through tests; they collect and analyse data; they summarize strengths and weaknesses of their design that were revealed during testing. This is exactly what we do for our robot as well. For example, in this Slapshot season we found that we needed to work on and test our robot on the purple and blue dispensers, which we later also recorded in our engineering notebook.



This is also posted on our Instagram account @hbs_momentum

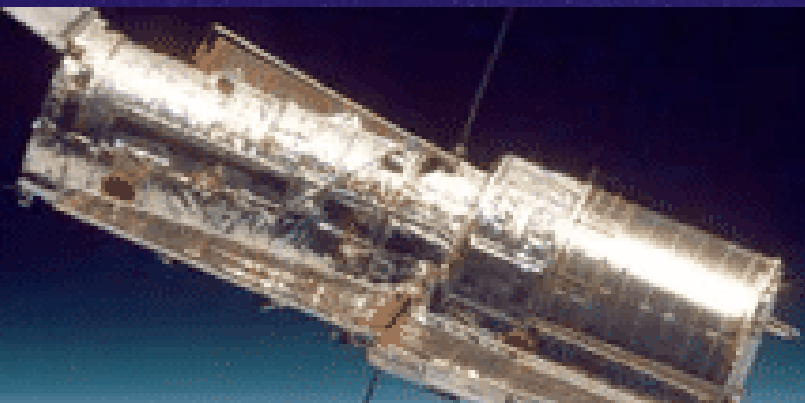
Follow us!

After all, our success for our next competition depends on our improvement from the previous competition. After observing this very final step from the NASA design process, we found our that based on the results of their tests, NASA make improvements on their design. They also identify changes they will make and justify their revisions, which is what we do after making a detailed analysis of our latest competition, assessing on potential spaces of improvements.



This is our discs dispenser mechanism to dispense the purple dispenser. Before it was too small so it took much longer for our drivers to successfully dispense all of the discs. Now, using improvement,
we have made it longer so that is is consequently much easier.

IMPROVE



PROFESSIONALS in this career

THIS IS DON HIGDON, A SENIOR INSTRUCTIONAL DESIGNER WITH THE UNIVERSITY MARYLAND BALTIMORE COUNTY, WORKING FOR NASA

Don Higdon applies steps of the NASA engineering design process to educate young engineers about NASA. He helps in the future STEM career jobs in NASA, by involving these young engineers in a varied range of activities, from rockets, robots and satellites. He works to make sure that STEM (Science, Technology, Engineering and Mathematics) are all integrated in the activities and thinking process of many young engineers, who will later apply this into the design process.

This professional also follows the Ask, Imagine, Plan, Create, Test and Improve NASA engineering design process, which is quite similar to our teams engineering design process. We follow the same basics when preparing for a VEX season, and we make sure to follow this design process in detail in our engineering notebooks as well.

How will VEX prepare us for our future career?

TEAMWORK SKILLS

PROBLEM SOLVING

CREATIVITY

LEADERSHIP

Teamwork & Problem solving

Two heads are better than one. As the saying says, a team is far more efficient and superior to a single person. Our VEX teams prepare us for the future by involving us and immersing us in the quality of teamwork, which plays a significant role in securing a career in NASA.

Furthermore, Problem-solving enables us to identify and exploit opportunities in the environment and exert (some level of) control over our future career. Problem solving skills and the problem-solving process are a critical part of daily life both in our team, and as our individual roles in the team. VEX prepares us for this through the challenges we face.

Creativity & Leadership

Creativity allows us to view and solve problems more openly and with innovation. It broadens our minds and helps us overcome the challenges we face with ease. This is extremely important in career experiences, and is a skill many workers in NASA have. Vex teaches us creativity as there are many teams that compete at a VEX Robotic Competition, so individual teams use creativity to stand out in the crowd. They create cool team names, costumes, and unique robot builds.

Leadership is able to bring out the best abilities in our team members and motivate all of our team to work together in achieving a shared goal. We perform this quite often, and the most recent occurrence is when we won the Excellence award at our last competition, where we all got the fruits of our success.

On Instagram account @hbs_momentum

How NASA uses Robotics

https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what_is_robotics_58.html

NASA uses robots in many different ways. Robotic arms on spacecraft are used to move very large objects in space. Spacecraft that visit other worlds are robots that can do work by themselves. People send them commands. The robots then follow those commands. This type of robot includes the rovers that explore the surface of Mars. Robotic airplanes can fly without a pilot aboard. NASA is researching new types of robots that will work with people and help them.

“That’s one small step for man, one giant leap for mankind.”

Neil Armstrong
1930 - 2012

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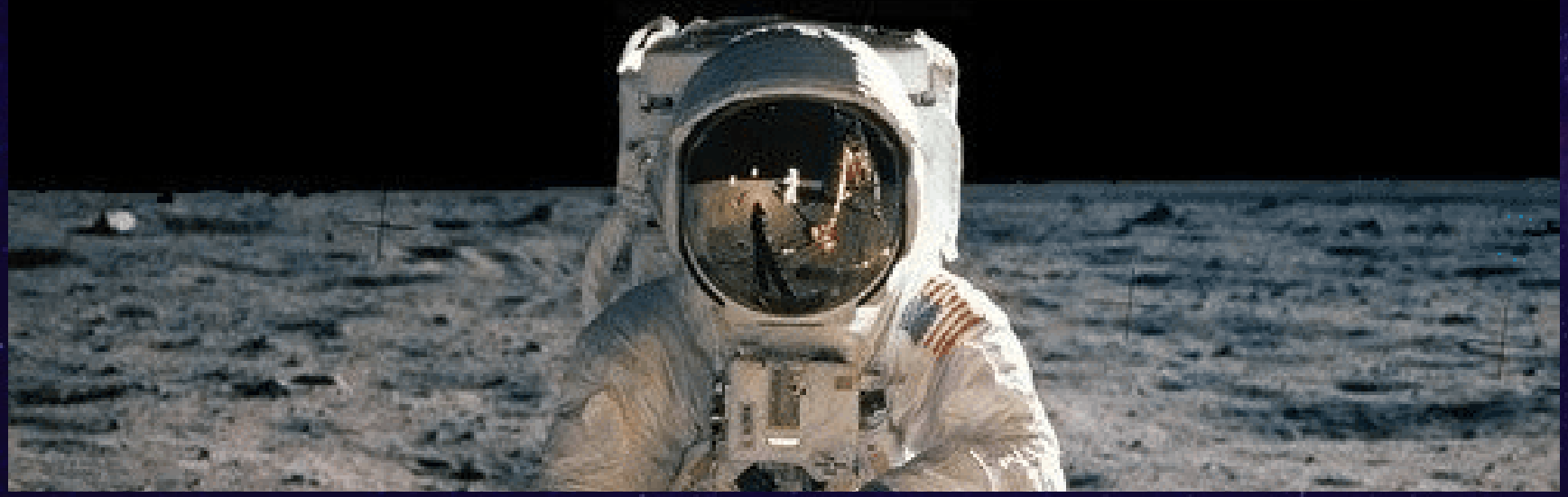

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10173C : ROBOTICS IN NASA

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