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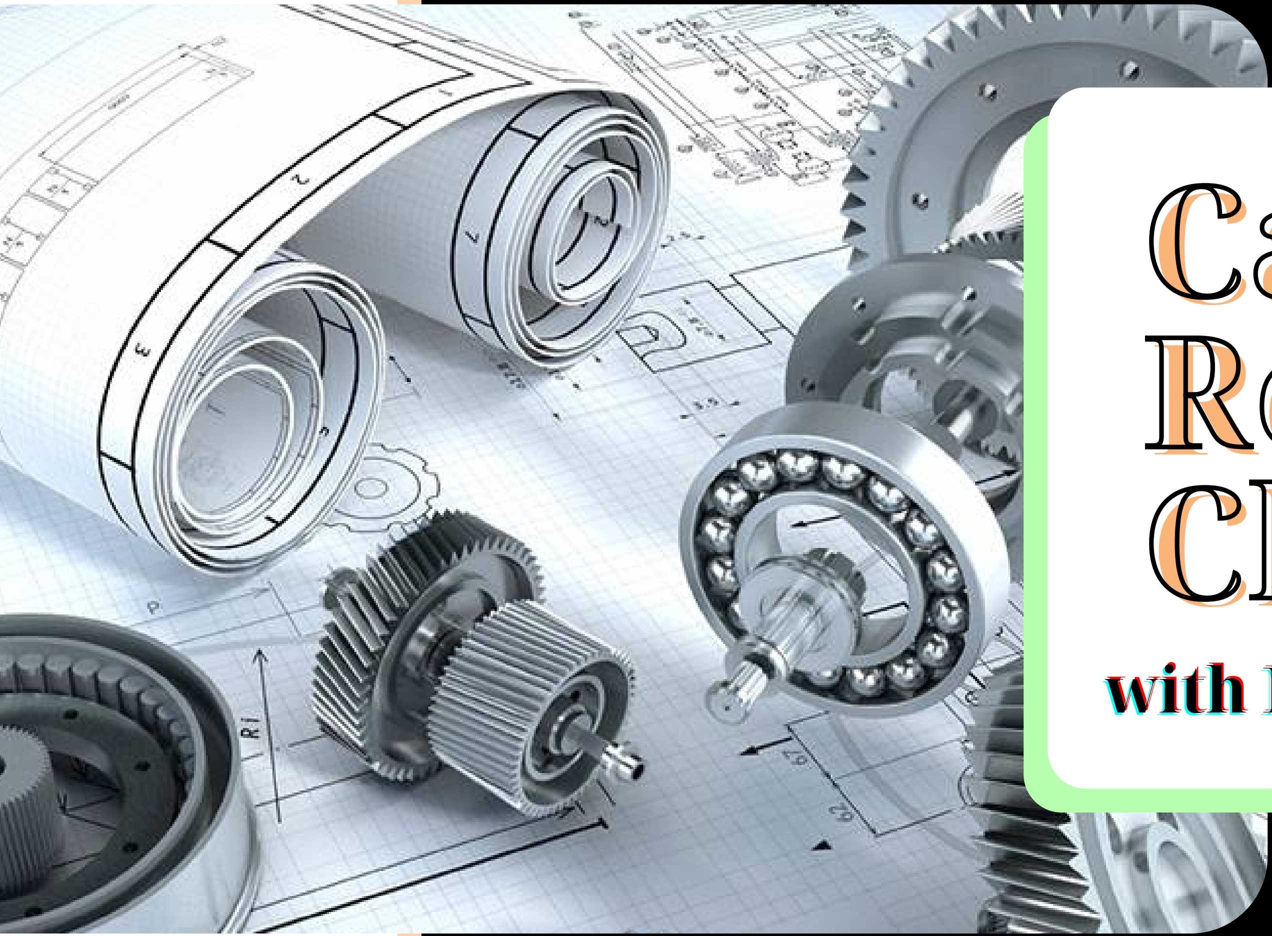


Career Readiness Challenge

with Mechanical Engineering

By Anupa, Anjani, Neha, and Sharika
of 1715H MindHackers;
Hopkinton, Massachusetts

1715 H
mind
Hackers

TOC

Big questions:

1. What career did we choose and why?
2. What are some similarities and differences?
3. Why is the career so important?
4. How does robotics prepare us for a future career?

Iterative design process

...the process we use to approach and find solutions to problems.

Define

...the task/problem, main constraints, and timeline.

Brainstorm/ Research

... multiple ideas, choose one and sketch the final plan.

Create

...your design according to the plan.

Test & Improve

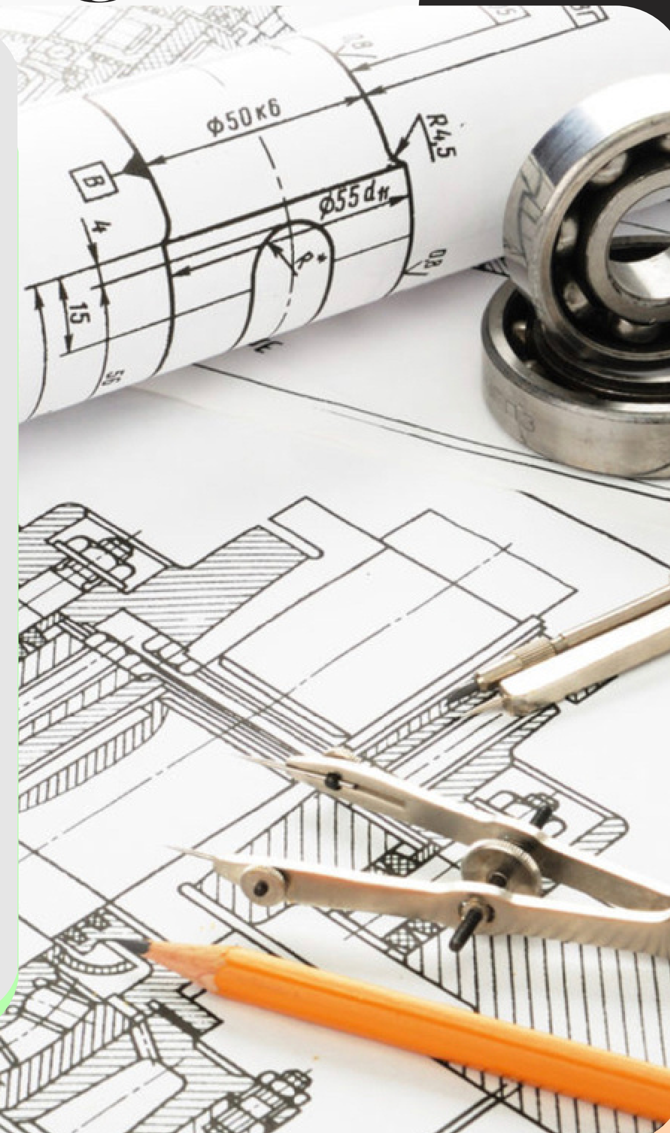
...by putting your design in a real-life situation. Carefully record results and possible changes.

Why we chose:

Mechanical Engineering

Last year, during the Slapshot season, we researched Software Engineering to further our coding skills. This year, we decided to focus on the building aspect of robotics by choosing Mechanical Engineering. Along the way, we hope our team learns building techniques to strengthen our construction skills (and robot).

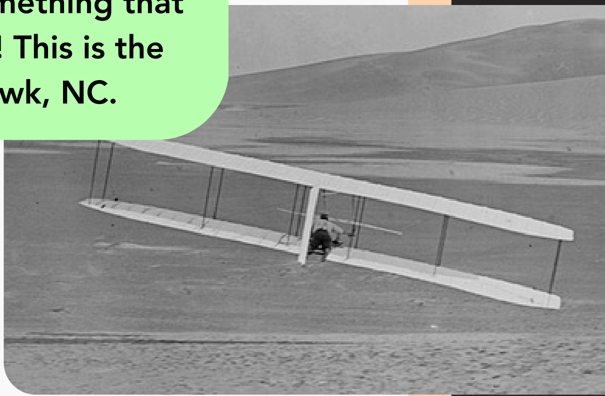
Mechanical Engineering plays a crucial role in our daily lives as it designs, develops, and maintains various mechanical systems. Mechanical Engineers are behind the creation of many essential products we use daily, from automobiles and airplanes to the device you’re reading this on. They are necessary for many prominent companies, such as NASA, Boeing Co., Apple Inc., Ford Motors, and more. Without them, even things as simple (on a large scale) as a smartwatch to as complex as spacecraft may be impossible to create efficiently.



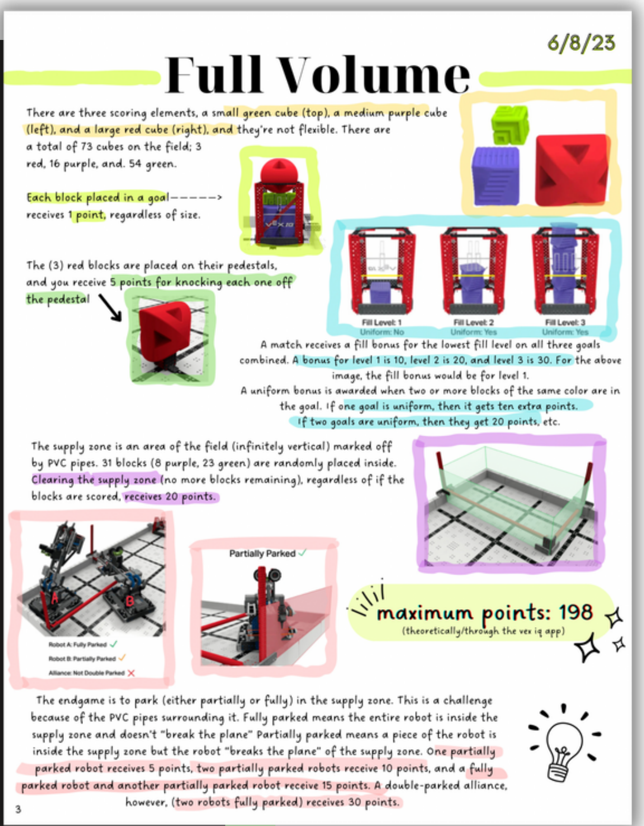
define

...the task/problem, main constraints, and timeline.

The "task" the Wright Brothers made for themselves was to create something that could fly. A stunning success! This is the first ever airplane in Kitty Hawk, NC.



A page in our notebook that we used to *define* this year's challenge.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Full Volume

There are three scoring elements, a small green cube (top), a medium purple cube (left), and a large red cube (right), and they're not flexible. There are a total of 73 cubes on the field; 3 red, 16 purple, and. 54 green.

Each block placed in a goal------> receives 1 point, regardless of size.

The (3) red blocks are placed on their pedestals, and you receive 5 points for knocking each one off the pedestal

Fill Level: 1 Uniform: No
Fill Level: 2 Uniform: Yes
Fill Level: 3 Uniform: Yes

A match receives a fill bonus for the lowest fill level on all three goals combined. A bonus for level 1 is 10, level 2 is 20, and level 3 is 30. For the above image, the fill bonus would be for level 1.
A uniform bonus is awarded when two or more blocks of the same color are in the goal. If one goal is uniform, then it gets ten extra points. If two goals are uniform, then they get 20 points, etc.

The supply zone is an area of the field (infinitely vertical) marked off by PVC pipes. 31 blocks (8 purple, 23 green) are randomly placed inside. Clearing the supply zone (no more blocks remaining), regardless of if the blocks are scored, receives 20 points.

Robot A: Fully Parked
Robot B: Partially Parked
Alliance: Not Double Parked

Partially Parked

maximum points: 198
(theoretically/through the vex iq app)

The endgame is to park (either partially or fully) in the supply zone. This is a challenge because of the PVC pipes surrounding it. Fully parked means the entire robot is inside the supply zone and doesn't "break the plane" Partially parked means a piece of the robot is inside the supply zone but the robot "breaks the plane" of the supply zone. One partially parked robot receives 5 points, two partially parked robots receive 10 points, and a fully parked robot and another partially parked robot receive 15 points. A double-parked alliance, however, (two robots fully parked) receives 30 points.

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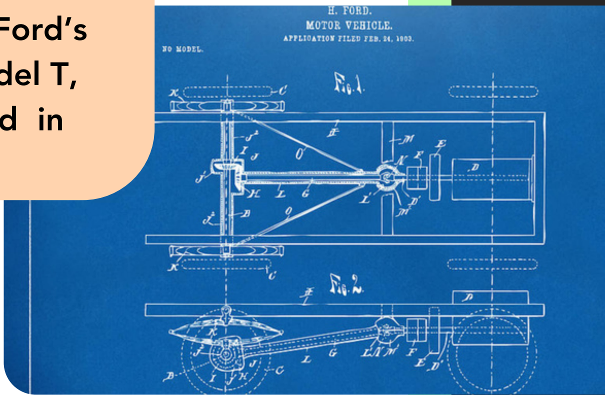
Mechanical Engineers work for companies that give them tasks and timelines, akin to many other engineers. The constraints are the timeline or deadline, customer requirements, cost, and regulations.

1715H's task is to build a robot. We also encounter smaller tasks along the way. We read the manual as a team to understand the set constraints. Additionally, we plan a timeline as a team, which helps us ensure we have enough time for practicing and programming. Finally, we create a countdown to our next competition.

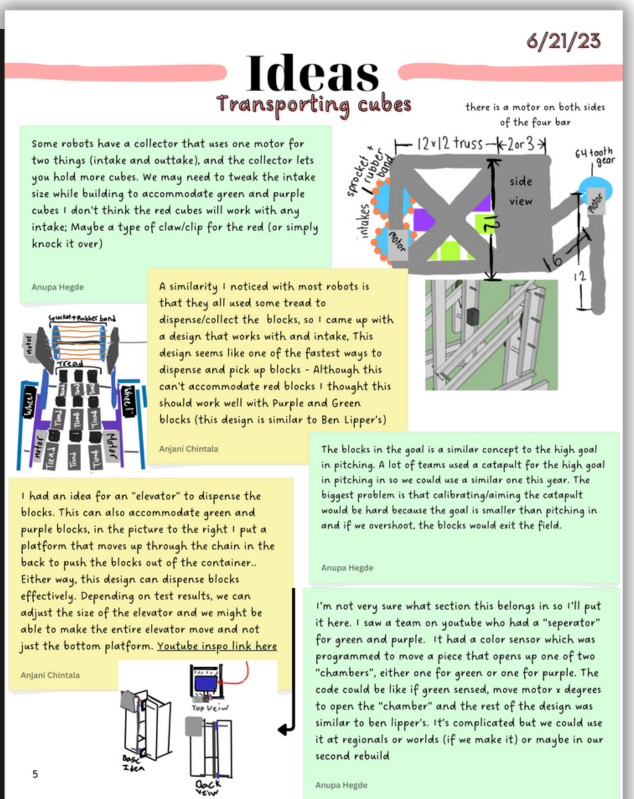
brainstorm/ research

... multiple ideas, choose one, and sketch the final plan.

One page of Nikki Marie Smith's digital rendering of Henry Ford's blueprints for the Ford Model T, originally submitted by Ford in 1903.



Part of our preliminary research for this year's challenge.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Ideas

Transporting cubes

Some robots have a collector that uses one motor for two things (intake and outtake), and the collector lets you hold more cubes. We may need to tweak the intake size while building to accommodate green and purple cubes I don't think the red cubes will work with any intake; Maybe a type of claw/clip for the red (or simply knock it over)

Anupa Hegde

there is a motor on both sides of the four bar

12×12 truss — 2 or 3

sprocket + rubber band / intakes

motor

side view

64 tooth gear

A similarity I noticed with most robots is that they all used some tread to dispense/collect the blocks, so I came up with a design that works with and intake, This design seems like one of the fastest ways to dispense and pick up blocks - Although this can't accommodate red blocks I thought this should work well with Purple and Green blocks (this design is similar to Ben Lipper's)

Anjani Chintala

Sprocket+Rubber band

Tread

Wheel

Motor

The blocks in the goal is a similar concept to the high goal in pitching. A lot of teams used a catapult for the high goal in pitching in so we could use a similar one this year. The biggest problem is that calibrating/aiming the catapult would be hard because the goal is smaller than pitching in and if we overshoot, the blocks would exit the field.

Anupa Hegde

I had an idea for an "elevator" to dispense the blocks. This can also accommodate green and purple blocks, in the picture to the right I put a platform that moves up through the chain in the back to push the blocks out of the container.. Either way, this design can dispense blocks effectively. Depending on test results, we can adjust the size of the elevator and we might be able to make the entire elevator move and not just the bottom platform. Youtube inspo link here

Anjani Chintala

Top Veiw

Basic Idea

Back Veiw

I'm not very sure what section this belongs in so I'll put it here. I saw a team on youtube who had a "seperator" for green and purple. It had a color sensor which was programmed to move a piece that opens up one of two "chambers", either one for green or one for purple. The code could be like if green sensed, move motor x degrees to open the "chamber" and the rest of the design was similar to ben lipper's. It's complicated but we could use it at regionals or worlds (if we make it) or maybe in our second rebuild

Anupa Hegde

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Mechanical Engineers take existing ideas (previous models, previous knowledge, etc.) and entwine them into their own. For example, the idea of building a car comes from Ford's first design. However, each modern car looks different, because developers have repeatedly built upon that first design, resulting in all the advanced models we see today. The same goes for many other fields. For their final sketch, Mechanical Engineers create technical plans and/or blueprints, a unique type of drawing meant to specify the dimensions in an organized manner to aid the constructor.

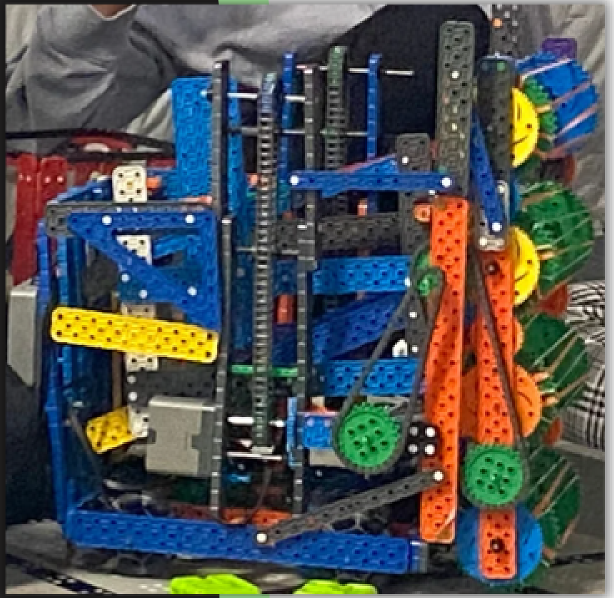
1715H makes a page in our notebook of sketches for possible solutions. Every team member has a chance to participate. We label everything so it is easy to revisit and build them. We select ideas based on their size, complexity, and ease of programming. Our final draft is a labeled technical sketch of each part (for more detail) and how they join together, or a series of pictures to build off of.

create

...your design
according to the plan.

<u>A look at the complex, global supply chain and dozens of minerals needed to build an iPhone</u> (CNBC)

Our create step is building our robot.



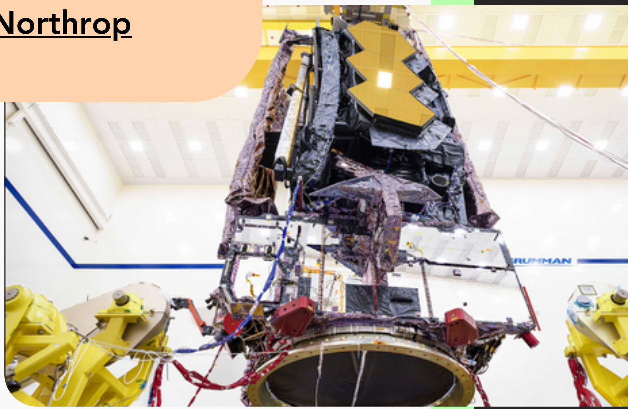
With countless trials (and errors), Mechanical Engineers build their product. Depending on the size and complexity, it can take weeks or years. When working on large constructions or buildings, Mechanical Engineers add *load-bearing beams* to the plan. These beams are parallel to the ground and perpendicular to other *joists,* or beams. It *helps prevent sagging* and is commonly used in basements or foundations to support the rest of the building. We use this technique with our chassis to support the weight of the robot (Our team calls this the waffle design).

We take about a month and a half to build a fully functioning robot, and sometimes we must re-build. 1715H devotes several pages in our notebook to the building process of our robot, making sure to address even the minute details. While building, we must pay attention to how the robot supports its weight and stability, as they are crucial factors in determining our success in competitions.

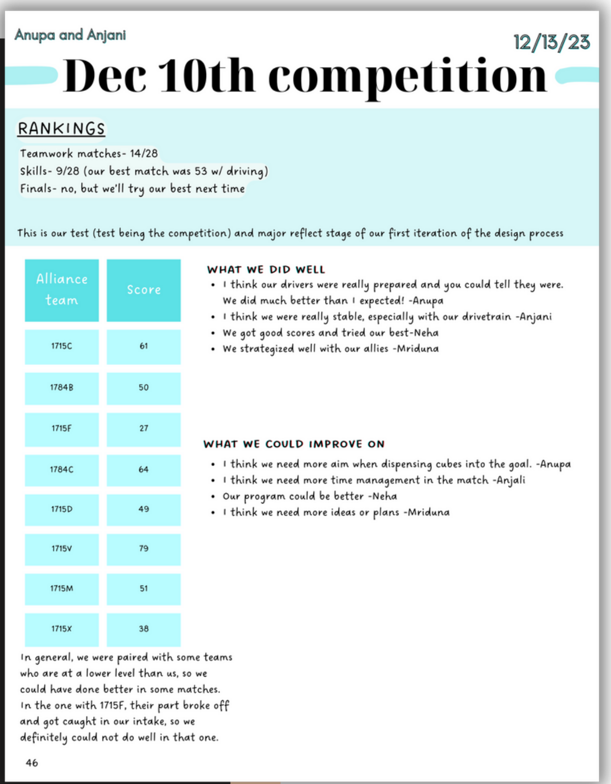
test & improve

...by putting your design in a real-life situation.

[Northrop Grumman and NASA Complete Environmental Testing on the James Webb Space Telescope | Northrop Grumman Newsroom]



Part of our first competition reflection of the season. We use it to improve for our next one.



Anupa and Anjani

12/13/23

Dec 10th competition

RANKINGS

Teamwork matches- 14/28
Skills- 9/28 (our best match was 53 w/ driving)
Finals- no, but we'll try our best next time

This is our test (test being the competition) and major reflect stage of our first iteration of the design process

Alliance team	Score
1715C	61
1784B	50
1715F	27
1784C	64
1715D	49
1715V	79
1715M	51
1715X	38

WHAT WE DID WELL

- I think our drivers were really prepared and you could tell they were. We did much better than I expected! -Anupa
- I think we were really stable, especially with our drivetrain -Anjani
- We got good scores and tried our best-Neha
- We strategized well with our allies -Mriduna

WHAT WE COULD IMPROVE ON

- I think we need more aim when dispensing cubes into the goal. -Anupa
- I think we need more time management in the match -Anjali
- Our program could be better -Neha
- I think we need more ideas or plans -Mriduna

In general, we were paired with some teams who are at a lower level than us, so we could have done better in some matches. In the one with 1715F, their part broke off and got caught in our intake, so we definitely could not do well in that one.

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After many small trials while building, Mechanical Engineers are ready to put their construction to the actual test. They want to ensure every piece of their creation functions flawlessly before releasing it. They often put their design in real-life scenarios. Recently, NASA engineers put their James Webb telescope in a zero-gravity vacuum environment similar to outer space to test their design. They use their test results and monitor their customers' reactions, product outputs, and more to improve their design or other designs in a later release.

1715H runs countless practice matches and mock scenarios to ensure our robot functions smoothly, and if something goes wrong, we can fix it efficiently. After a competition, we perform a reflection where we discuss the pros, cons, and new ideas. It helps us recognize the new tasks to work on and provides ideas for improving our performance.

similarities & differences

Mind Hackers vs Mechanical Engineers

The main similarity between Mechanical Engineers and 1715H mindHackers is what we do. We both work on building and refining systems. We both follow an engineering design process to facilitate our work. We both have competition, but for 1715H, our competition is other teams, and for Mechanical Engineers, the competition is other companies.

We have as many differences as we do similarities. Mechanical Engineers are far more advanced in engineering than we are. And while their projects can take months and even years because of their size and complexity, we only take about ten months for the entire season. Furthermore, Mechanical Engineers use tools superior to ours to create their structures, ranging from 3D printers to metal beams, while we only use materials like plastic beams and pins.

How does participating in Robotics prepare us for a future career?

Our team has learned many essential lessons just by partaking in VEX. Not only have we learned skills to help us in future STEM explorations, we learned skills that apply to any career. Be it a first, second, or fourth-year student, we all have something new to learn from robotics.

Perseverance

Things can and will go wrong. Participating in robotics fostered our ability to face those problems. We must demonstrate perseverance while debugging code, meeting criteria, fixing our build, and more, and we must do the same in future jobs when something goes awry.

Cooperation

Be it inside the team or alliances, cooperation is the key. Cooperation is the difference between a team and a random group of people. To perform well in robotics, we must cooperate. The same theory also applies to working on a team in a future career.

STEM Careers

While participating in VEX robotics, we learned many STEM skills used in various careers. We used an iterative design process similar to those of professional engineers, real-life coding and building techniques, and more.

Credits

Image credits:

- Title slide: UMass Lowell Online
- Slide 5: The Engineering Design
- Slide 6: Pheonix East Aviation
- Slide 7: Pixels
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- Slide 9: Northrop Grumman Newsroom
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Other credits:

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