TEAM 9717 ROBOT-A

St. Catharine Comets
St. Catharine Academy
Coach: Sheere Petrignani
Meet The Team!

Meet The Team!

Team Members!

Jasmine Carrion- Captain, Lead Programmer, Lead Skills Driver, Electrical (Robot A)
- This is my second year on the team and I am very excited to start up this new season for the VRC! In the future I'm interested in becoming a software engineer!!

Laura Nyguen- Lead Mechanical (Robot A)
-

Samia Rivera- Lead mechanical , Driver (Robot A)
-This is my second year on the team and I can't wait to compete against other teams for this 2023 season! When I grow up I want to become an aerospace engineer!

E'Manna Evans- Mechanical, Lead Driver (Robot A)
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Season 10:

Tentative Schedule (subject to change): In robotics team attire meet at SCA by 6-6:15am, on bus leaving at 6:30am!

Competition locations:

January 14th- Rye HS, Upstate NY
January 28th- Kennedy HS, Long Island, NY
February 4th- Kennedy HS, Upstate NY
February 11th- Vaughn College, Queens, NY
February 18th- Malvern HS/Adelphi U, Long Island, NY
March 4th- "States," Harvey School, Upstate NY

Inspection Checklist

Robot Inspection Checklist

Team Number: ____________ Division: ____________

Size Inspection

☐	Robot fits within starting size restrictions (18" x 18" x 18") with Team ID Plates installed.	<R5>
☐	All vertical Robot extensions or combinations of extensions that will expand above 18" **before Endgame** fit within a single vertical cylinder 2" in diameter and are below 24".	<SG5>

Overall Inspection

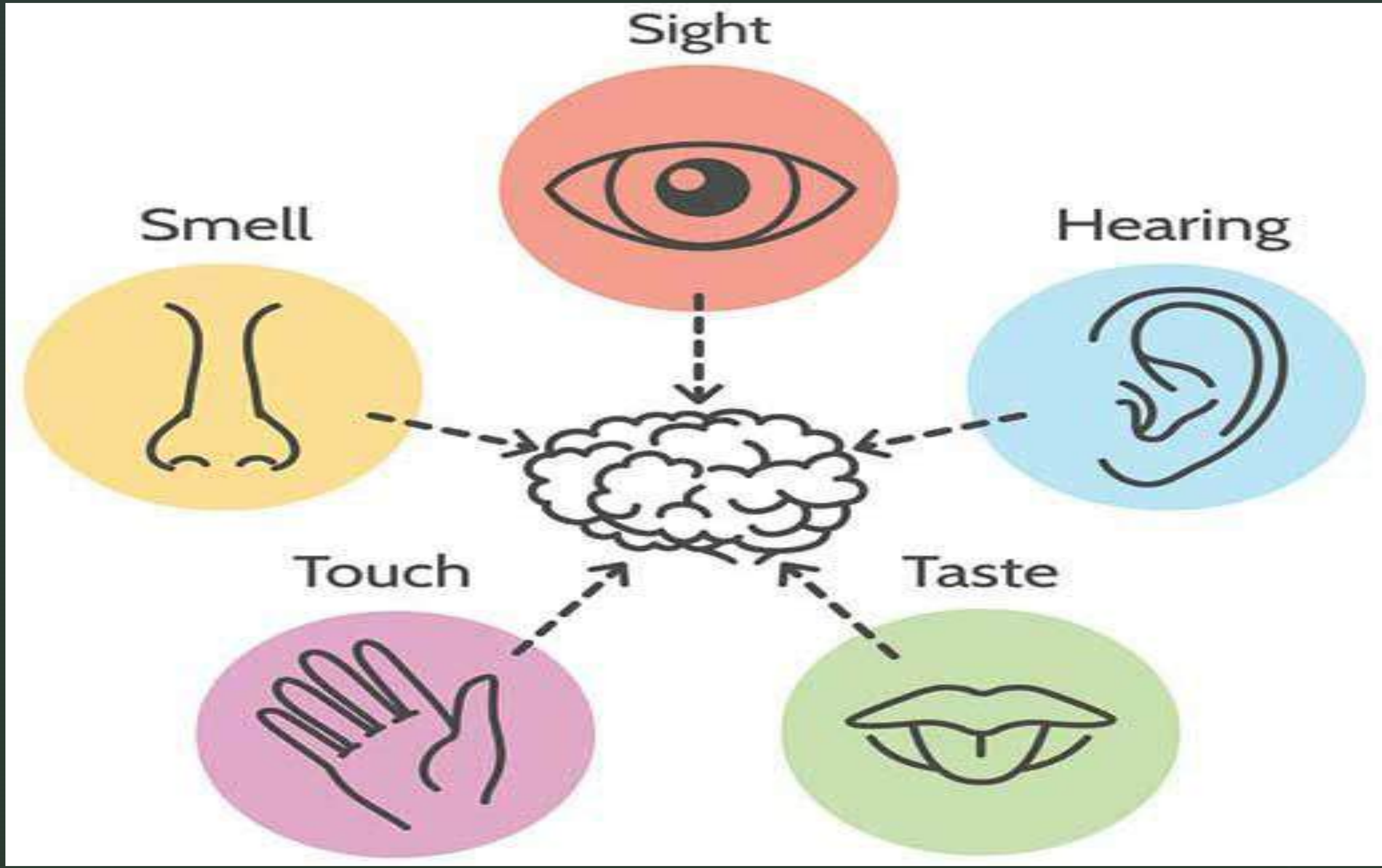
☐	Team is only competing with ONE robot. They have no spare or replacement robots. Multiples of subsystem 3 are permitted.	<R1>
☐	Robot displays colored VEX Team Identification plates on at least (2) opposing sides, with only (1) color visible and the team number displayed in white text.	<R24>
☐	Robot does NOT contain any components which will be intentionally detached on the playing field.	<G5 >
☐	Robot does NOT contain any components that could entangle or damage the playing field or other robots.	<R4>
☐	Robot does NOT contain any sharp edges or corners.	<R4>
☐	Robot Brain power button is accessible without moving or lifting the robot.	<R23>
☐	Team testifies that the designing, building, and programming of the robot was done only by the students on the team.	<R2>, <G2>, <G6>

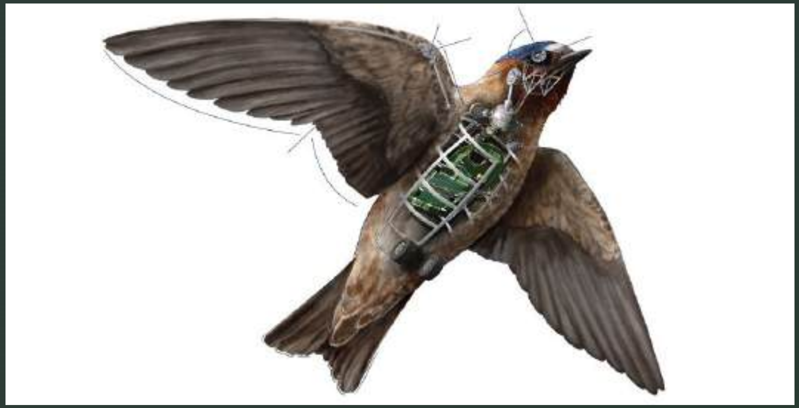
VEX Parts Inspection

☐	ALL robot components are OFFICIAL VEX V5 components as sold on VEXrobotics.com or materials used as color filters, minimal grease or lubricant, minimal anti-static compound, hot glue for cable connections, unlimited amount of rope/string, with a thickness/diameter between 1/8" (3.175mm) and 1/4" (6.35mm), rubber bands and zip ties that are identical to those included in the V5 product line, cable protection materials and tape for connections and labeling, and certain non-VEX screws, nuts and washers.	<R6>, <R7>, <R10>, <R11>, <R13>
☐	Robot does not use VEX products not intended for use as a robot component or any VEX packaging.	<R6>
☐	ALL components on the robot NOT meeting VRC inspection criteria are NON-FUNCTIONAL decorations.	<R12>
☐	Any non-shattering plastic (0.070" or thinner) on the robot fits within the space of a single sheet of material not larger than 12"x24".	<R9>
☐	Robot has only (1) VEX V5 Robot Brain and no additional microcontrollers.	<R14>
☐	Robot utilizes the VEXnet wireless communication system and no other wireless communication during matches.	<R15>
☐	None of the electronics are from the VEXplorer, VEXpro, VEX-RCR, VEX IQ, VEX Cortex, or VEX Robotics by Hexbug. This includes the EXP Brain, EXP Controller, and EXP battery.	<R6>
☐	Total number of V5 Smart Motors is not more than eight (8).	<R16>
☐	Robot contains no VEX 2-wire Motors and no 5.5W V5 Workcell motors.	<R16>
☐	Robot uses only one (1) V5 Robot Battery Li-Ion 1100mAh.	<R18>
☐	Robot is controlled by no more than two (2) V5 Controllers.	<R19>
☐	NO VEX electrical or pneumatic components have been modified from their original state.	<R20>
☐	NO method of attachment NOT provided by the VEX Design System is used (welding, gluing, etc.).	<R22>
☐	Robot uses a maximum of two (2) VEX pneumatic air reservoirs (maximum 100 psi per air reservoir) and the compressed air contained inside a pneumatic sub-system is only being used to actuate legal pneumatic devices.	<R17>
☐	Robot contains no components obtained from the V5 beta program.	<R6>
☐	If any custom cables are used, they are made only with official V5 Cable Stock.	<R21>
☐	Any NON-FUNCTIONAL decorations do not imitate game or field objects as a distraction for the V5 Vision Sensor.	<R12>
☐	Robot Brain has the latest firmware listed on VEX.com/firmware. If an event uses the Smart Field Control System, the latest firmware must be installed and the team number/letter (no spaces) must be on the brain.	<R20>

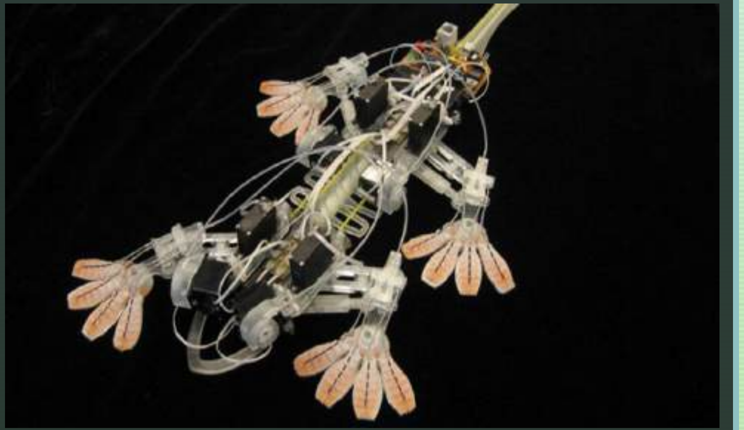
Final Inspection Pass **Inspector Signature:** ____________

Design Concept Nature:





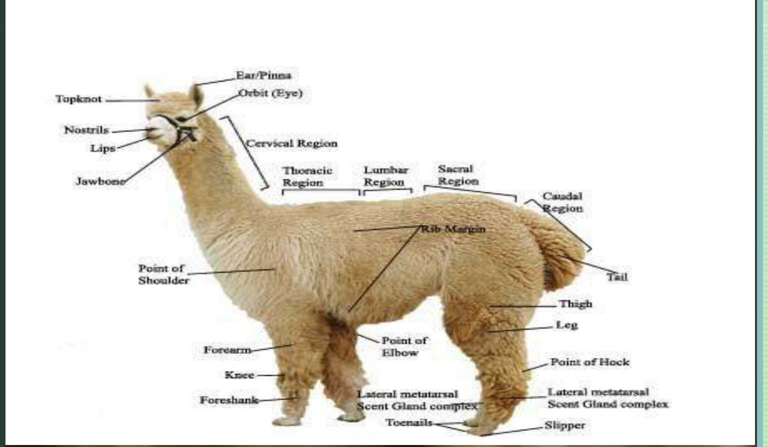
Biomimicry

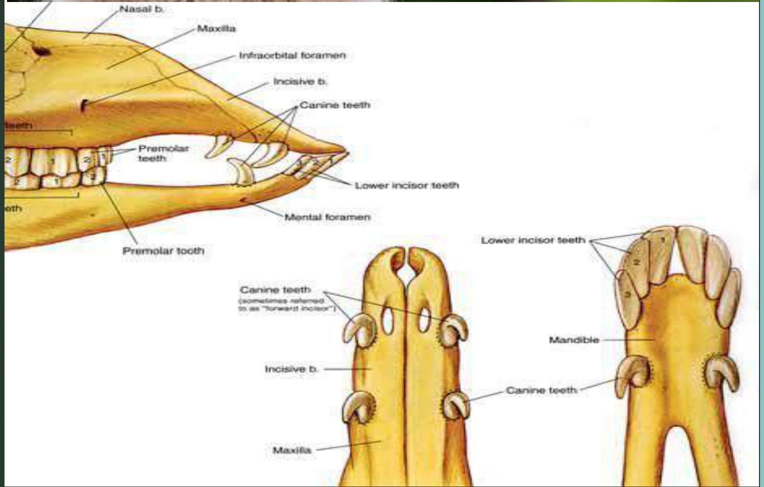


- The imitation of the models, systems, and elements of nature for the purpose of solving complex human problems.
- Nature is one of the most fundamental sources of inspiration for many Engineering projects, just look at a mouse on any computer!
- Nature is a self-sustaining system that has individual parts that work in unison. Similarly, the different components of our robot work in unison to be an efficient system.
- Looking into nature for design inspiration helps us fine tune our design to work more precisely and efficiently.
- Nature also has patterns that engineers can use to better predict behavior in their own projects.
- By using an animal for our design, we supply ourselves with a structural idea, movements, and functions. This solid foundation helps us progress much faster in building.

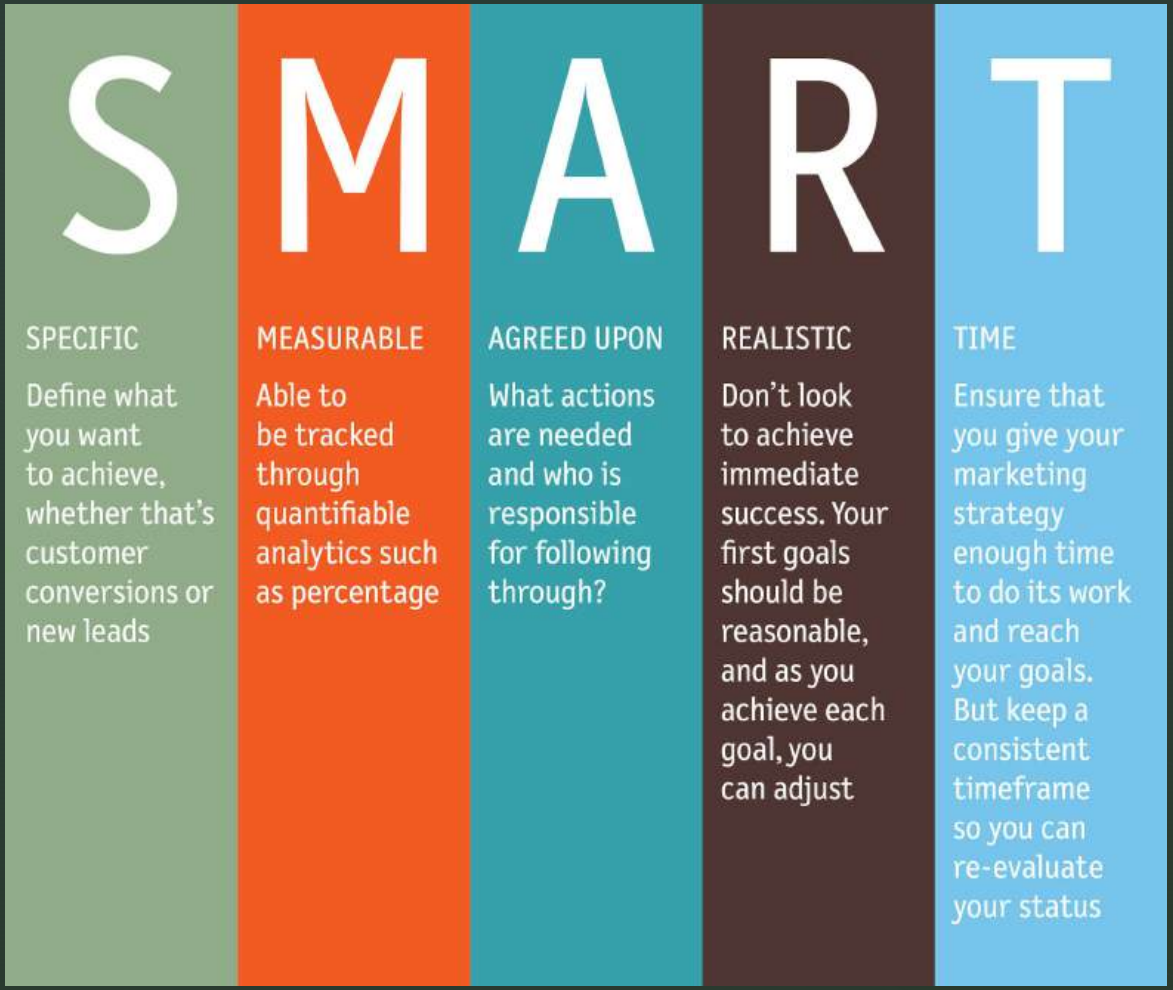
Overview of an Alpaca

- Alpacas are modified ruminants called pseudoruminants and only have three compartments to their stomachs, called the C-1, C-2, C-3
- The average height at the shoulder is 3 feet (91.4 centimeters or about 35 inches)
- Alpacas hum; they make a sound like "mmm," according to Alpaca Ventures.
- The baby alpaca, called a cria, weighs 18 to 20 lbs. (8 to 9 kg) when it is born.
- Alpacas don't have teeth in the top-front of their mouths. This gives them the appearance of having an underbite.





Game Overview



Initial Thoughts

- At first, my team pondered upon mechanisms we could use in order to execute an intake that will precisely and efficiently work to launch the disks into the high goal.
- We also explored about types of gear trains that will be able to have the most motion along with the perfect velocity in which the robot can move
- Of course, we had to think of the perfect biomimicry animal that will mimic to the robots purpose as closely as possible.
- The team brainstormed in order to get the most points while containing a robot that isn't too excessive
- We spent numerous amounts of trial and error developing a strategy based on the game in order to play offense, and defense
- Both teams took the rollers into consideration and pondered what we could use to make it rotate

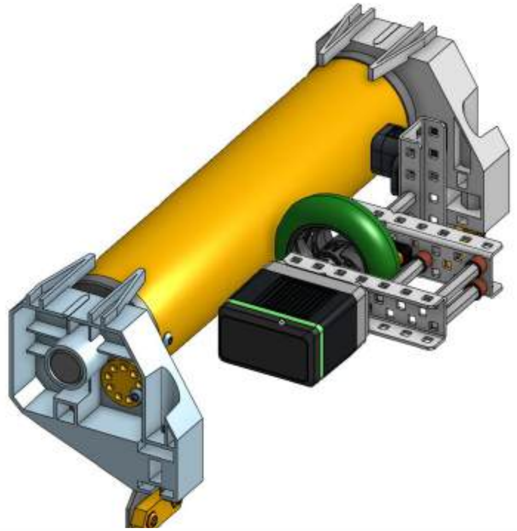
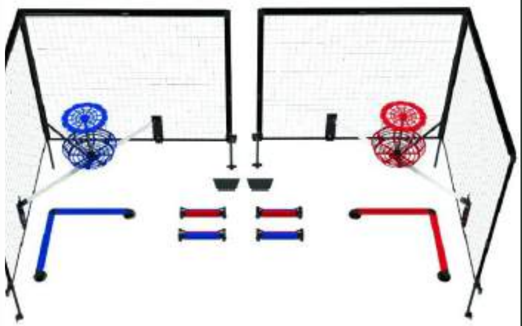


Figure 20: Vertical dimensions of the High Goal



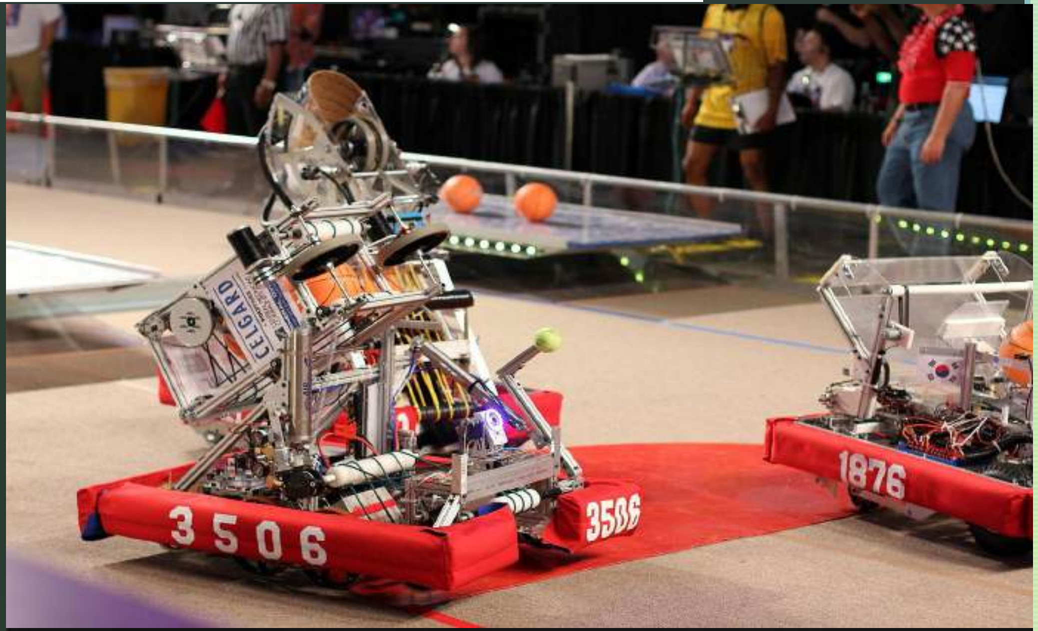
Game Point System

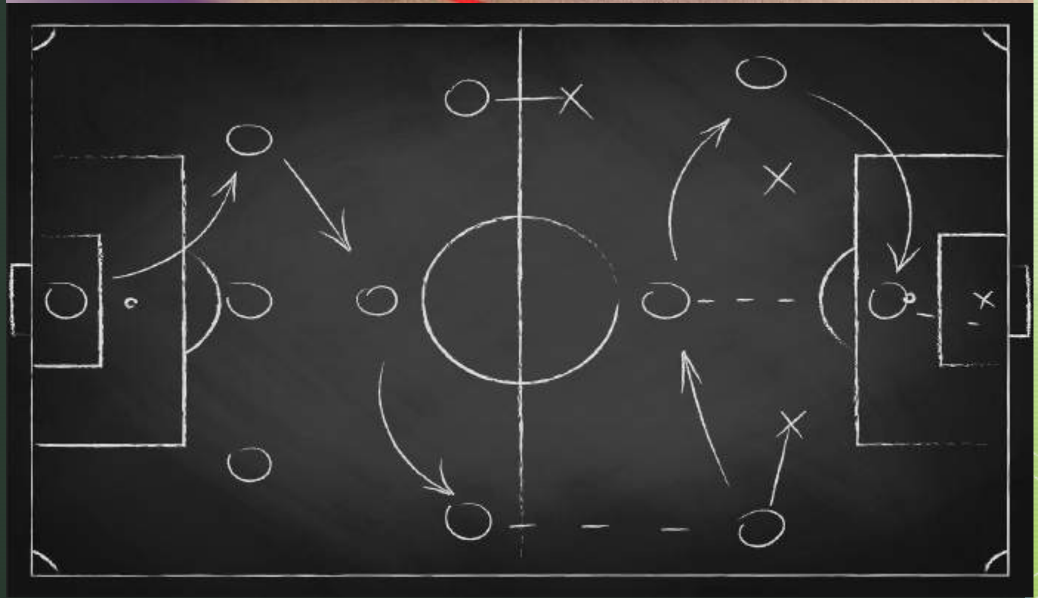
Each Disc Scored in a High Goal	5 Points
Each Disc Scored in a Low Goal	1 Point
Each Owned Roller	10 Points
Each Covered Field Tile	3 Points
Winner of the Autonomous Bonus	10 Points

By keeping this information in mind, our plan is to win the autonomous bonus as well as owning rollers, and retrieving and releasing many disks into the high goal, considering they are worth the most points.

Game Strategies: Offensive

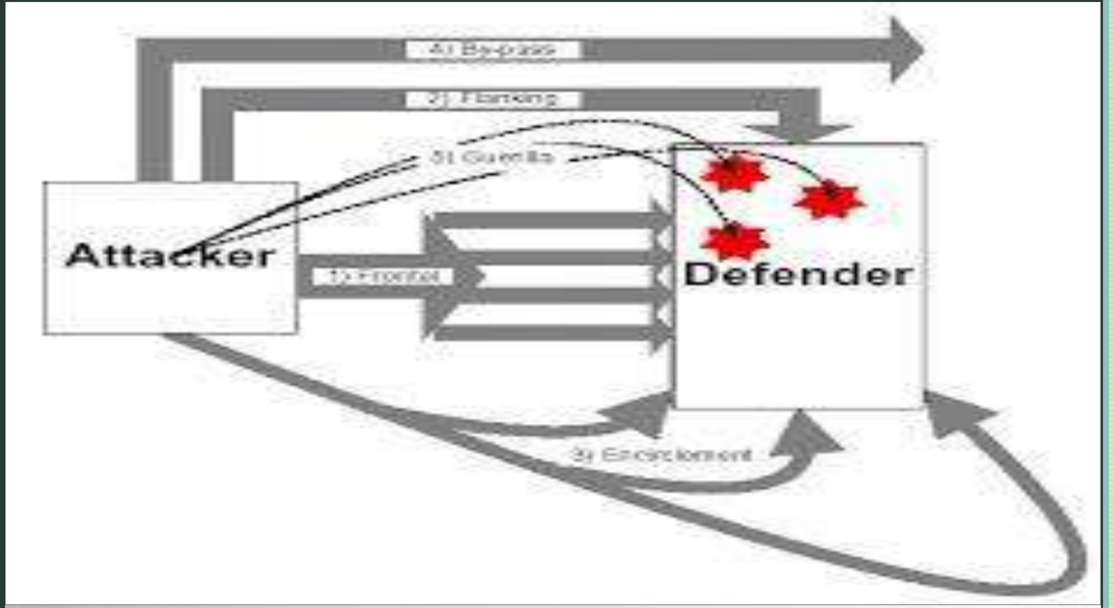
- To play offense during the matches, my team plans to pick up the discs using our intake, and shooting them into the high goal.
- We also plan to collect discs and put them into the low goal almost before the time runs out in order to collect the most amount of points possible



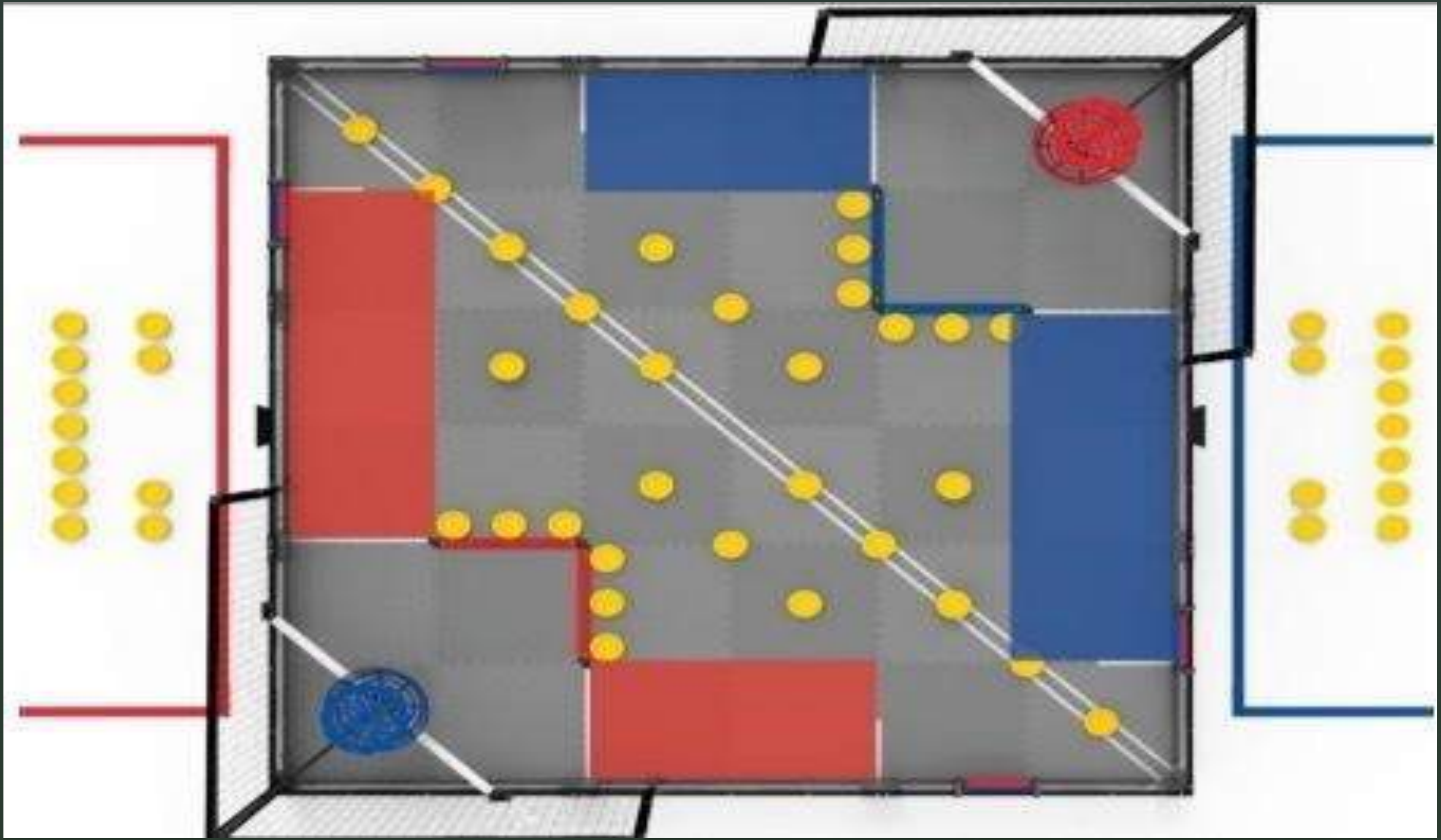


Game Strategies: Defensive

- In the case we have to play defense, our process will remain relatively the same as our offensive strategy.
- We will collect discs from the other team's low goal and put them into our own low goal. We will also use the discs we collect to both shoot with our own robot and for our Alliance to shoot with theirs.
- During the Endgame, we plan to park next to robot so as to limit how much they can expand as well as using a mechanism (almost resembling a slingshot) to shoot out the string for



Autonomous Plan:



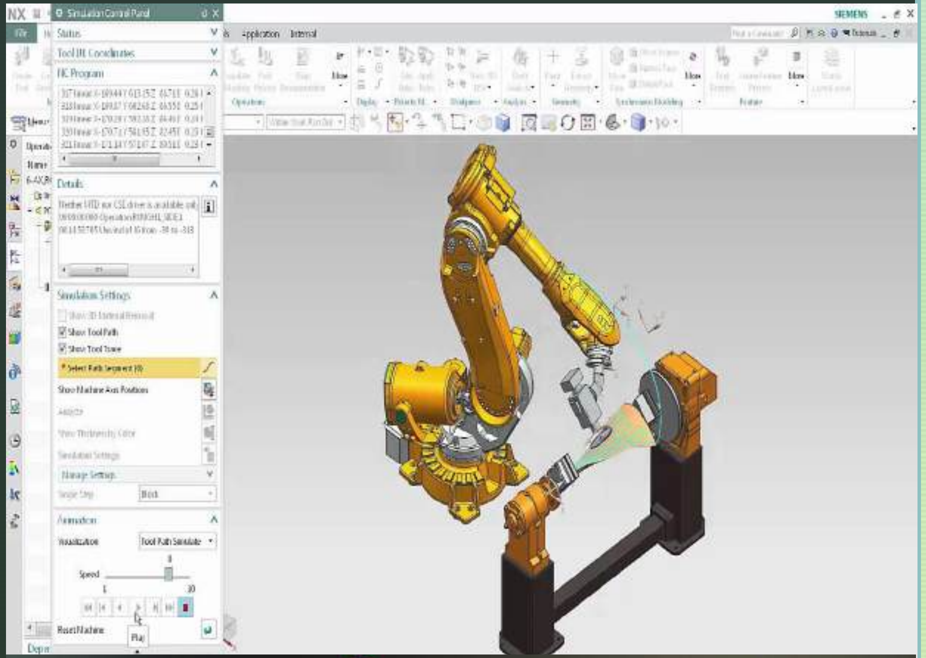
CAD/CAM Overview!

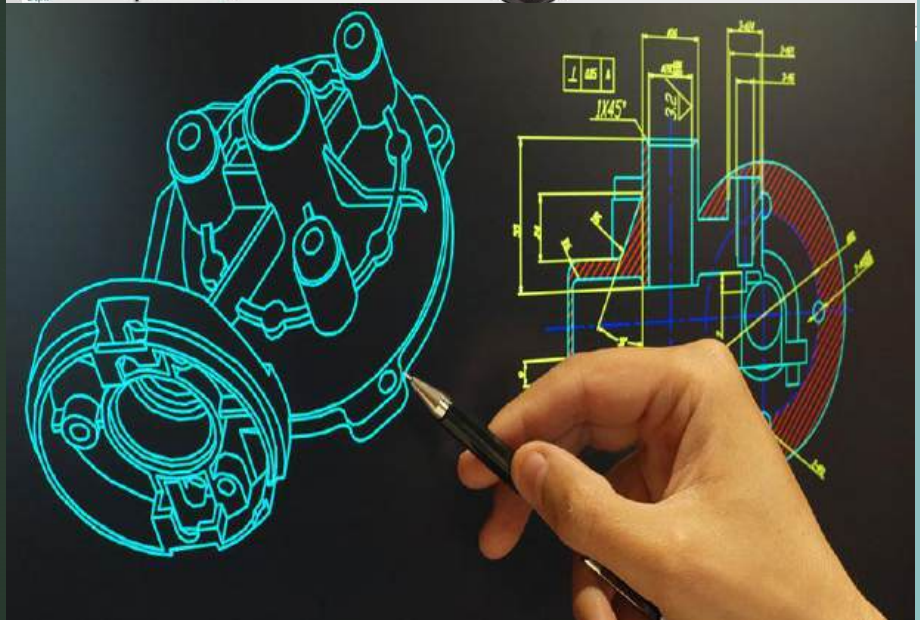
- While thinking of a design, we decided to start building on software such as Tinker CAD, Robot Mesh Studio & OnShape. It helped us to brainstorm and made sure that the performance of the robot is optimal.

- CAD stands for Computer Aided Design, while CAM stands for Computer Aided Manufacturing.

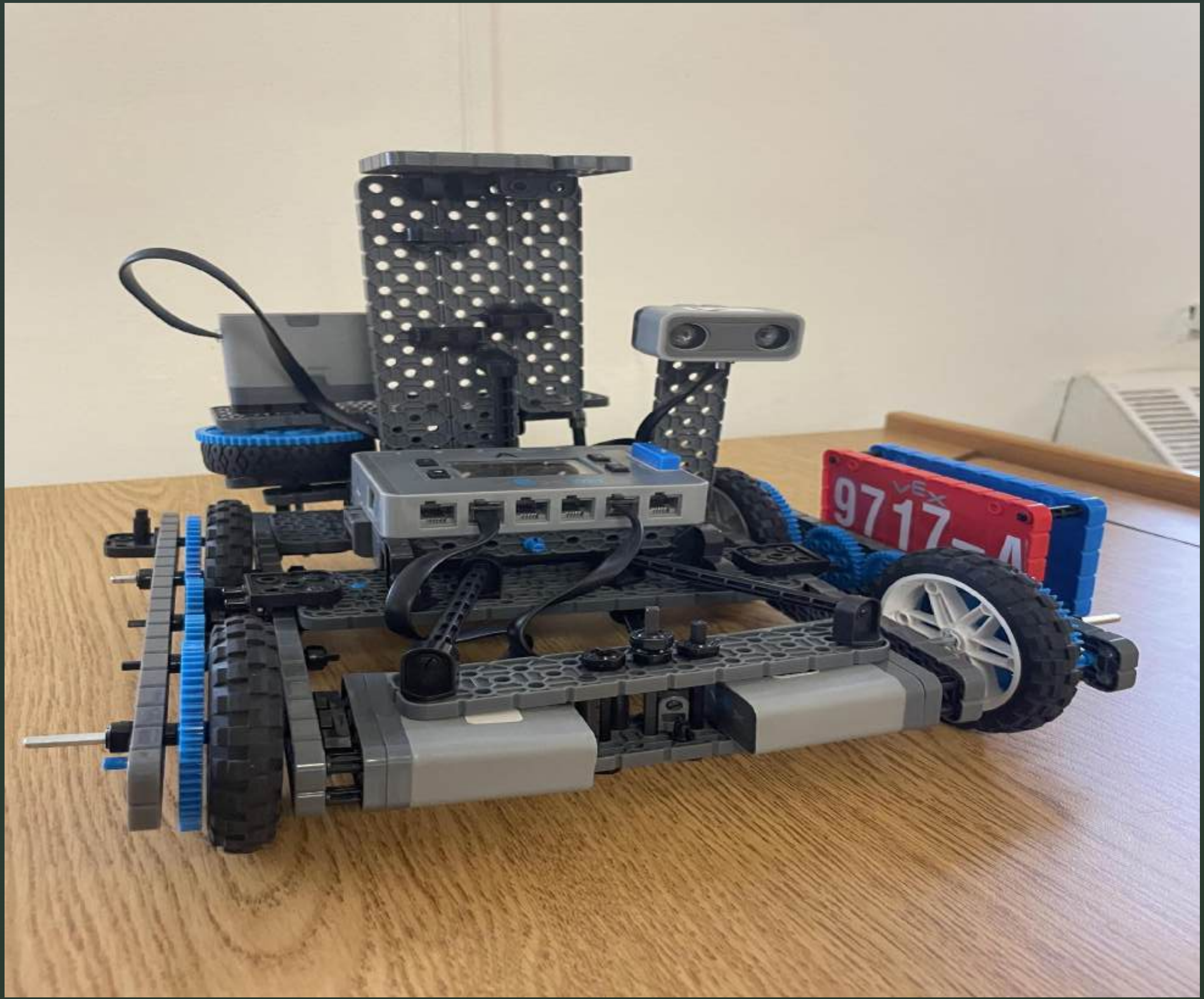
- The most important advantage of an online prototype is that it simulates the real and future product of the robot. It can help the builders plan out the final product before allocating any resources needed for implementation. You can test the design's correctness before it comes into production and you can discover design errors.

- As a whole, this saves much time needed for other tasks, while also getting a better idea (or better ideas) of what the builders are planning.

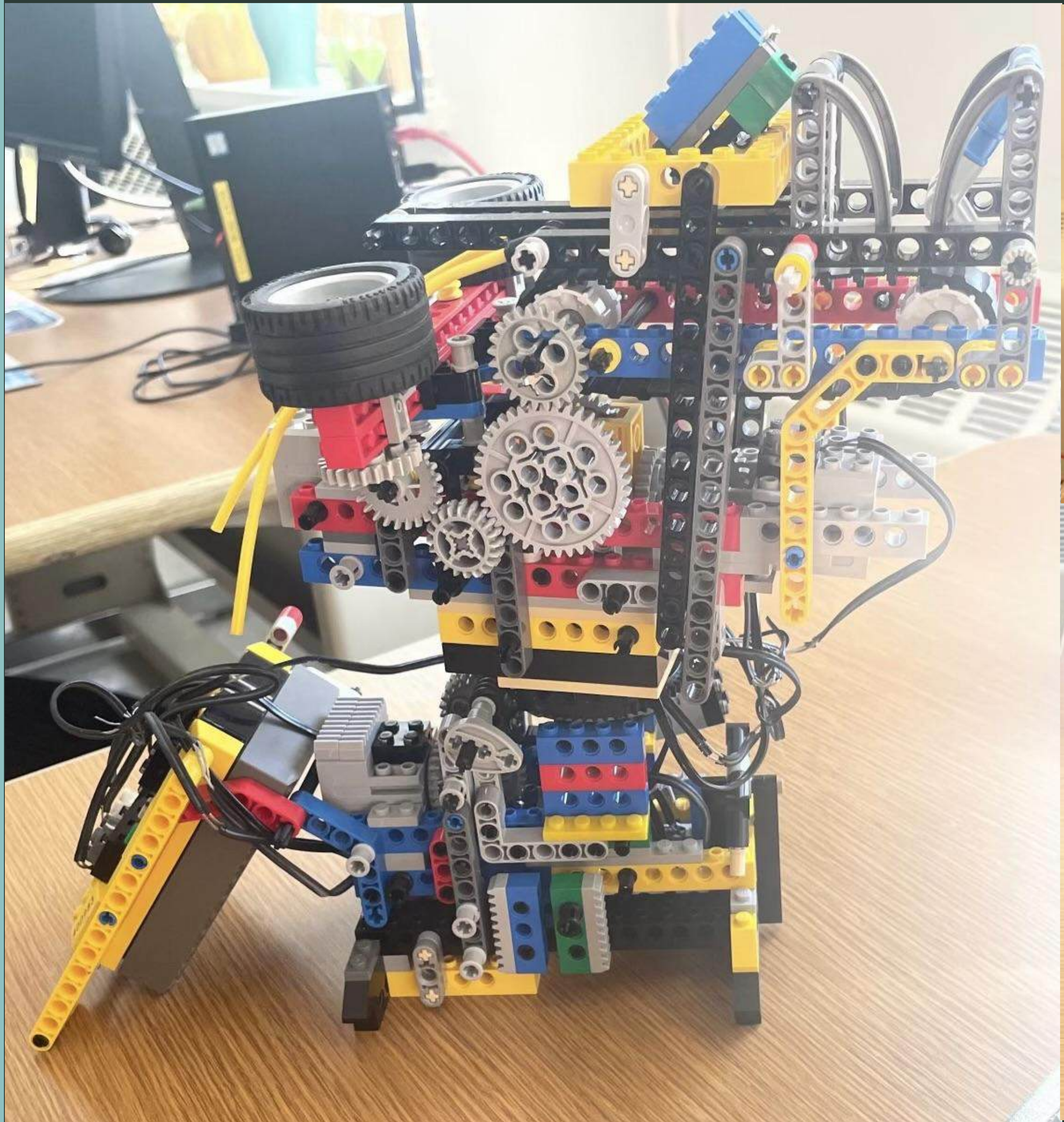


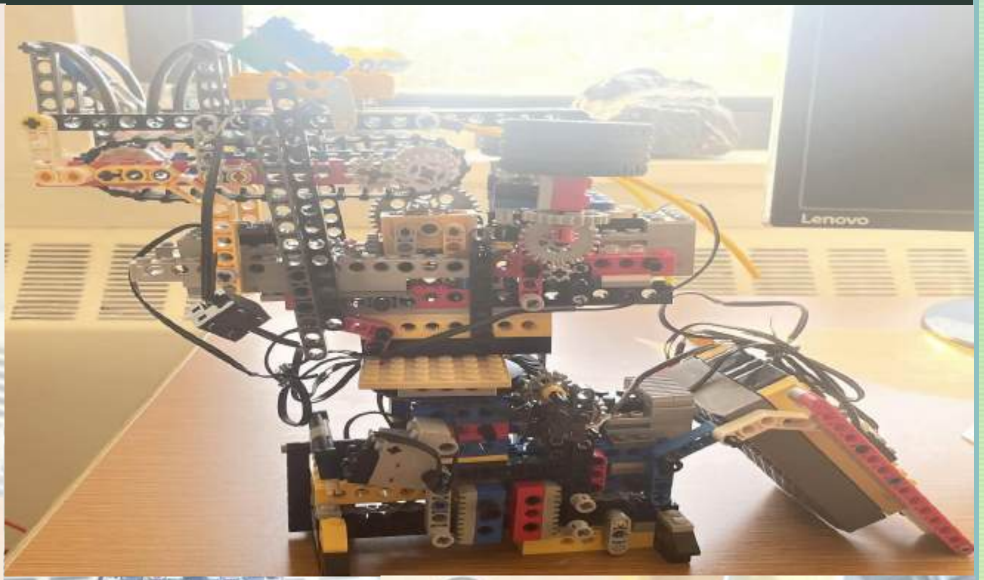


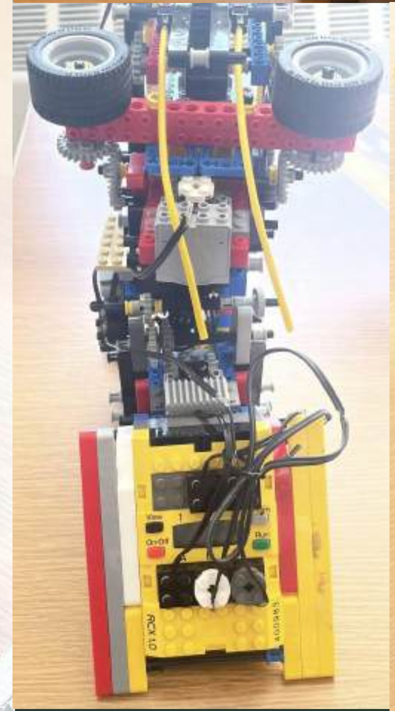
Prototype Vex IQ- Robot A



Prototype for Intake Release







Purpose of This Prototype

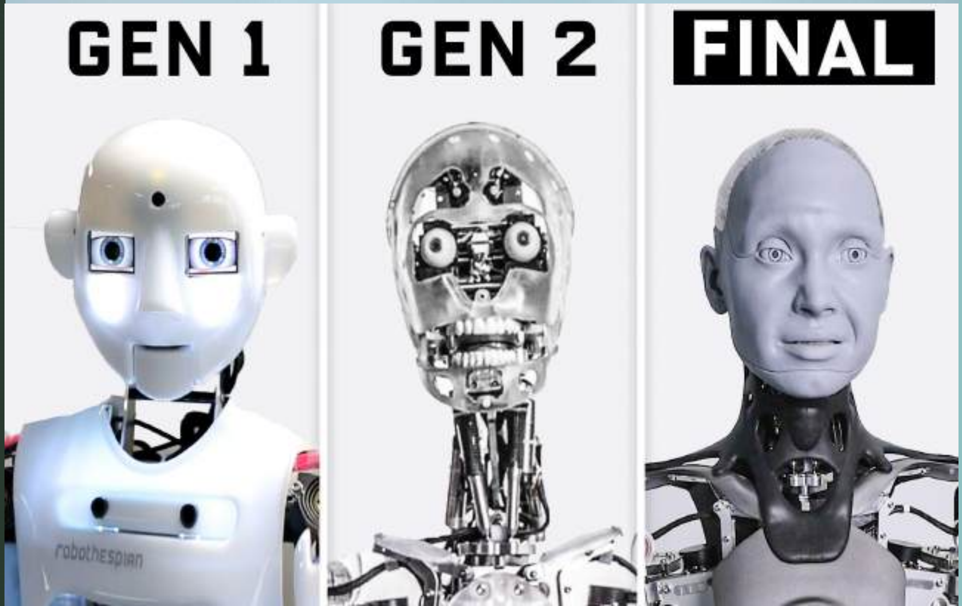
The prototype is essentially our initial tester robot where we can experiment with different design ideas and function.

We can test different gear trains and see how our motors will operate with each mechanism.

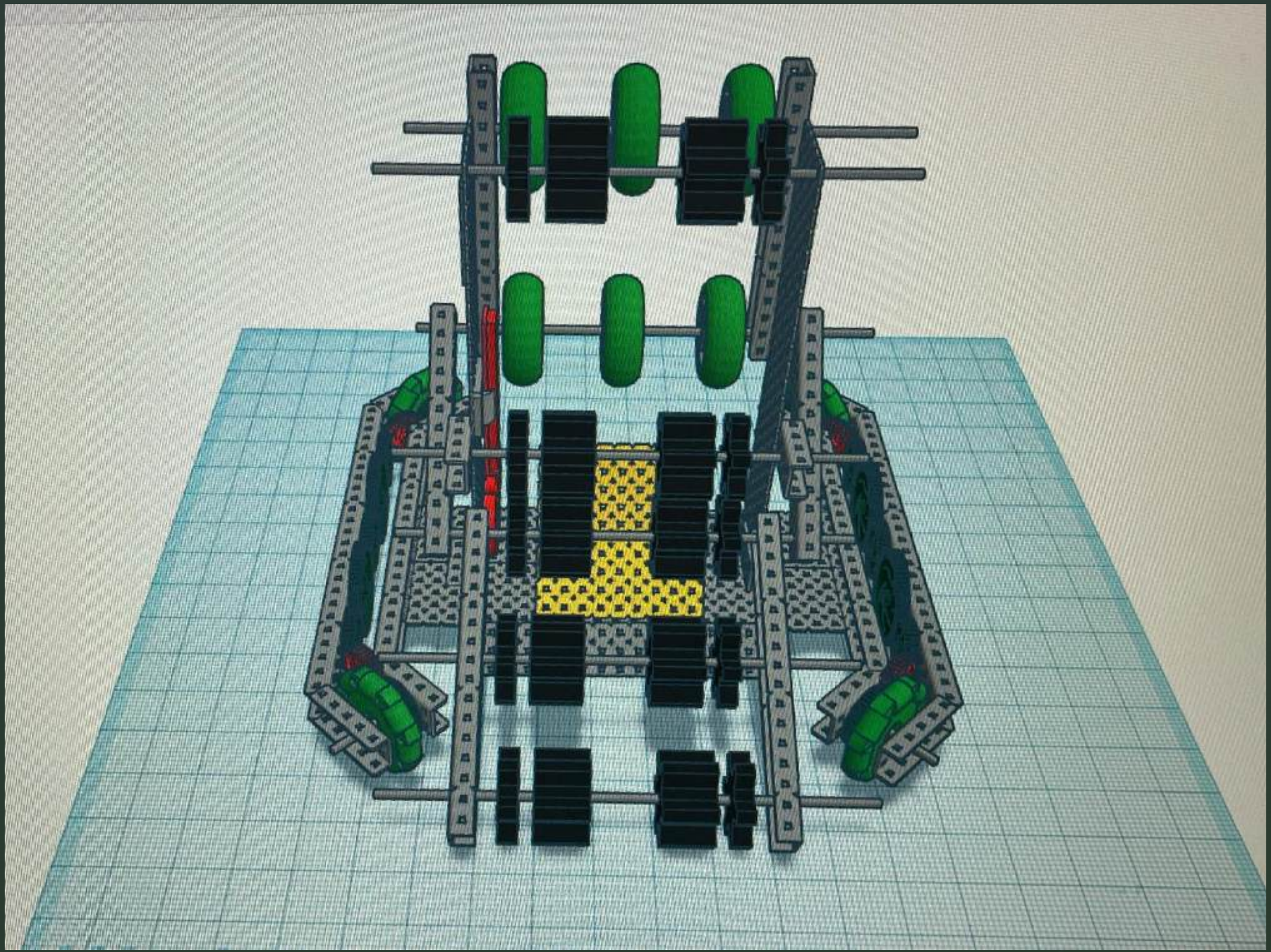
We can also quickly edit and change our design on the prototype before we build the final Version.

Programming: we can program different autonomous programs and test the basic movements of our program before transferring to the official bot.

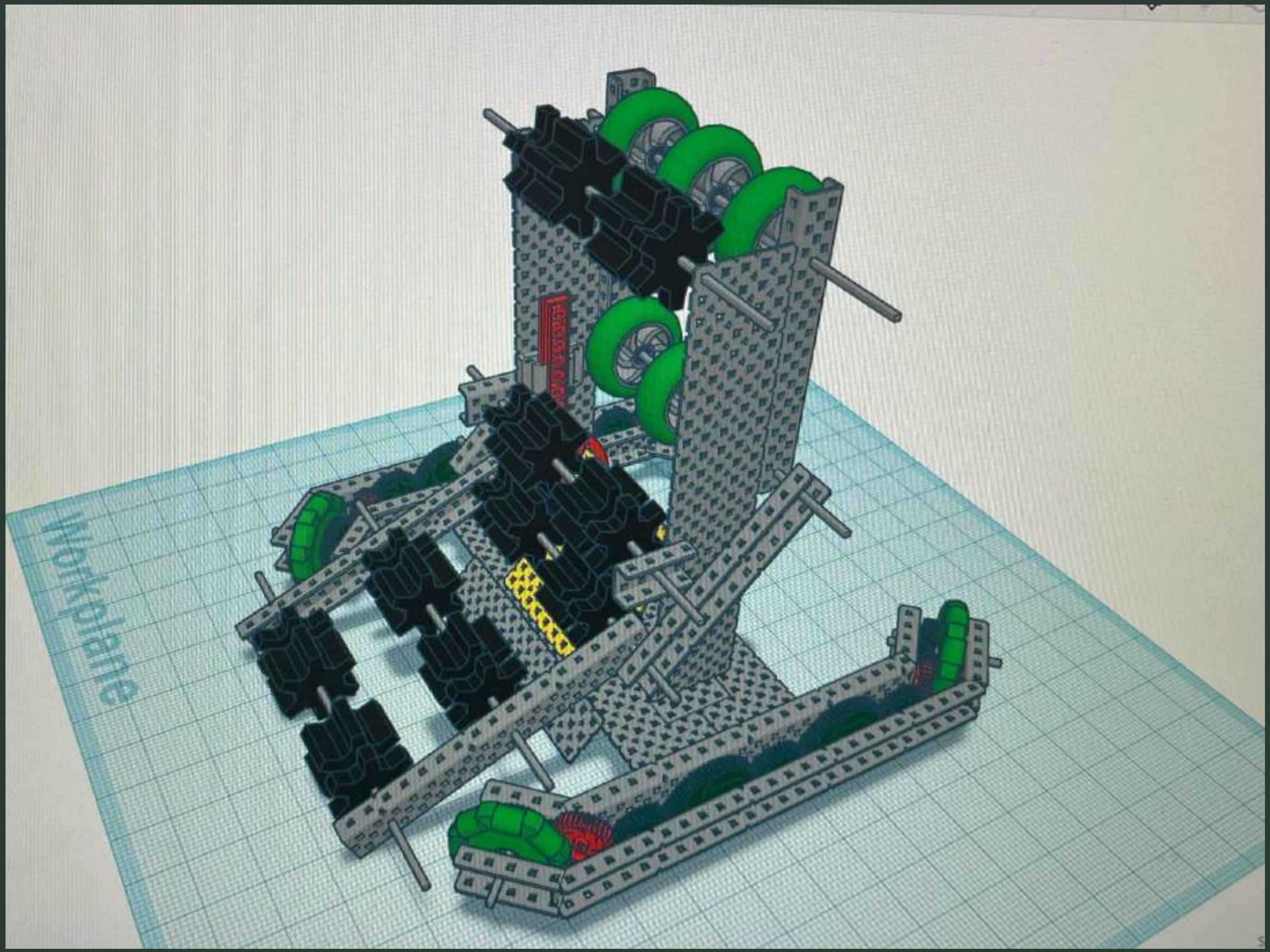
Overall: gives a gauge of performance



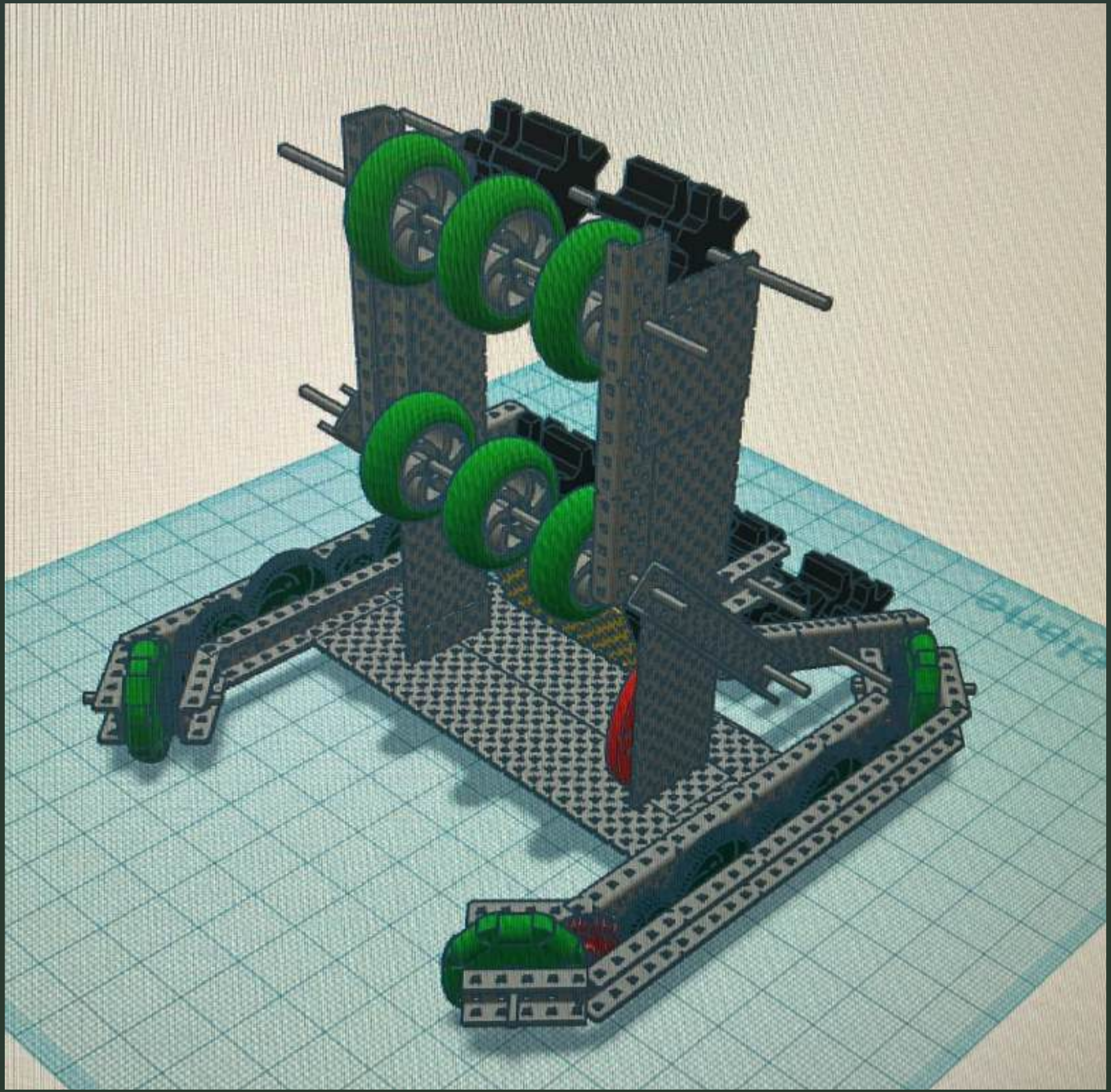
CAD/CAM Reveal (1/7)



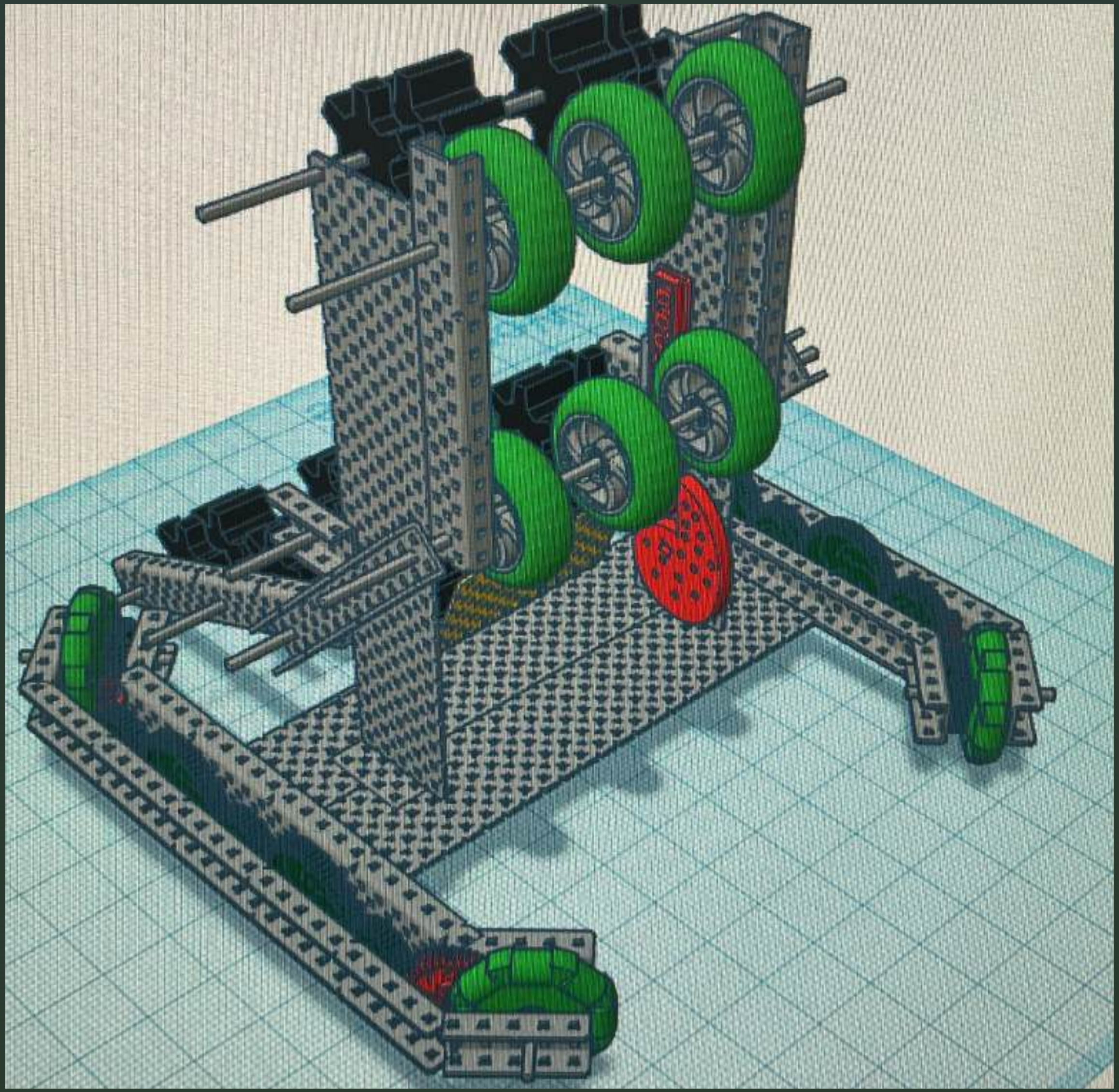
CAD/CAM Reveal (2/7)



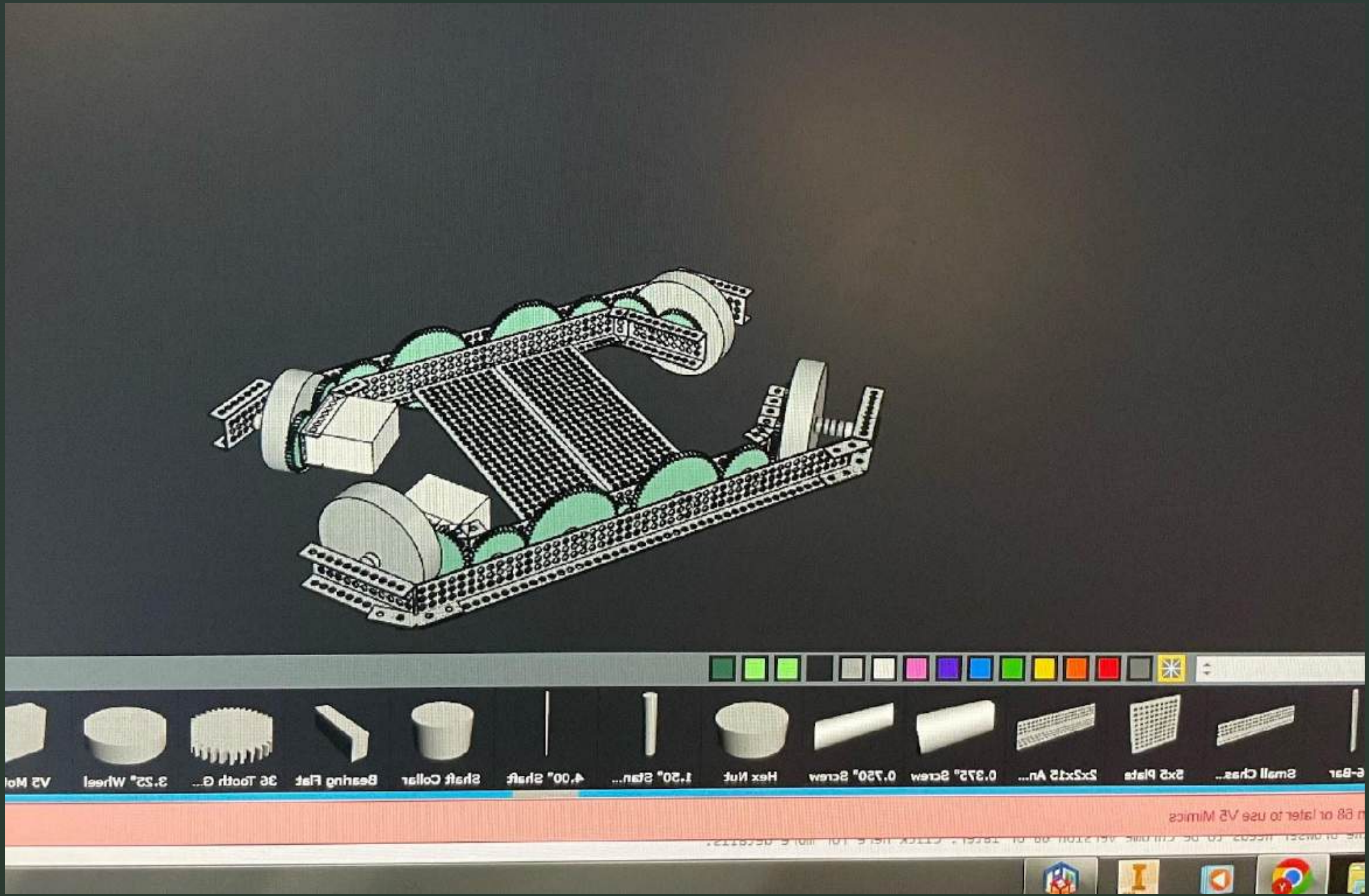
CAD/CAM Reveal (3/7)



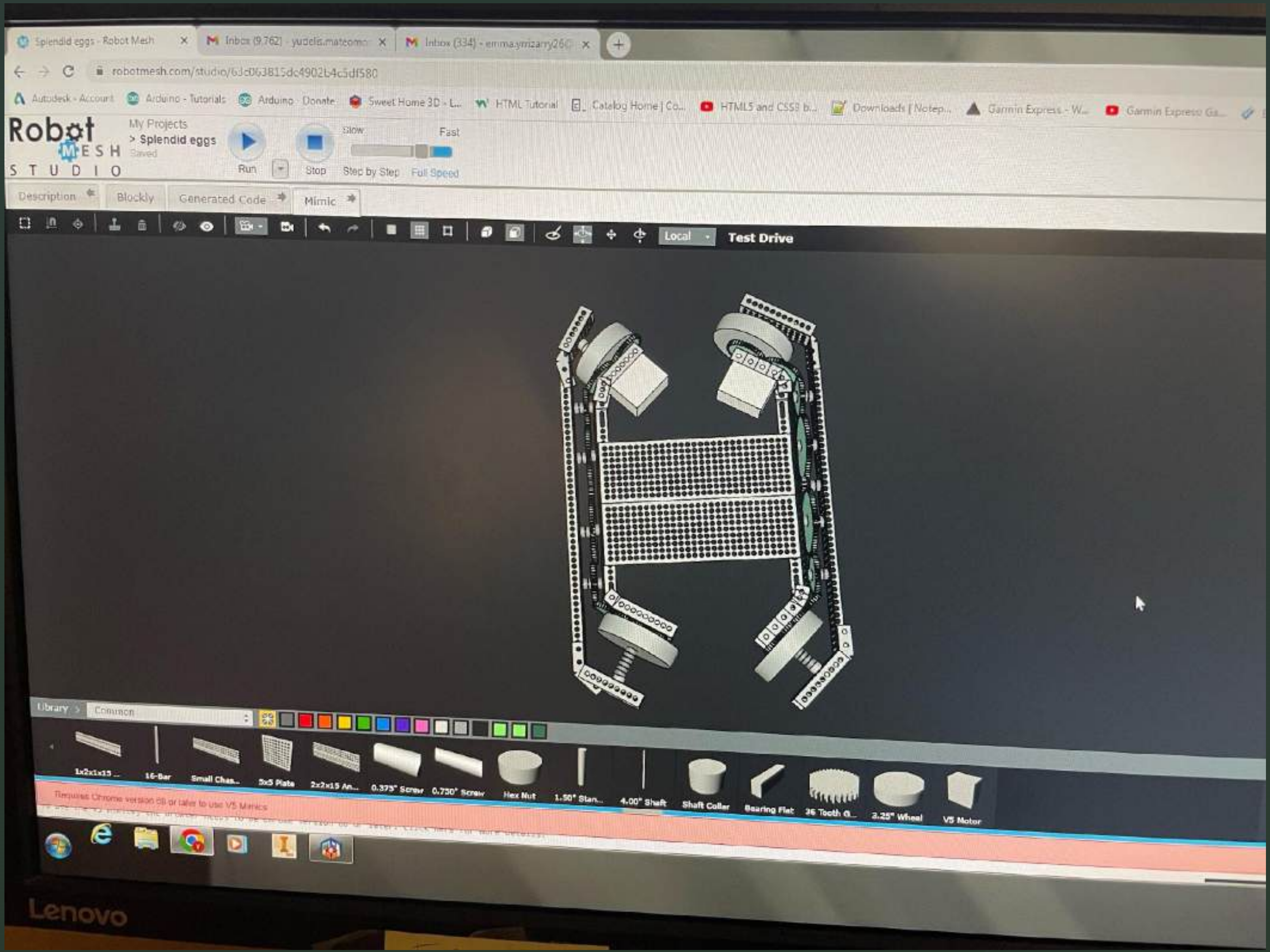
CAD/CAM Reveal (4/7)



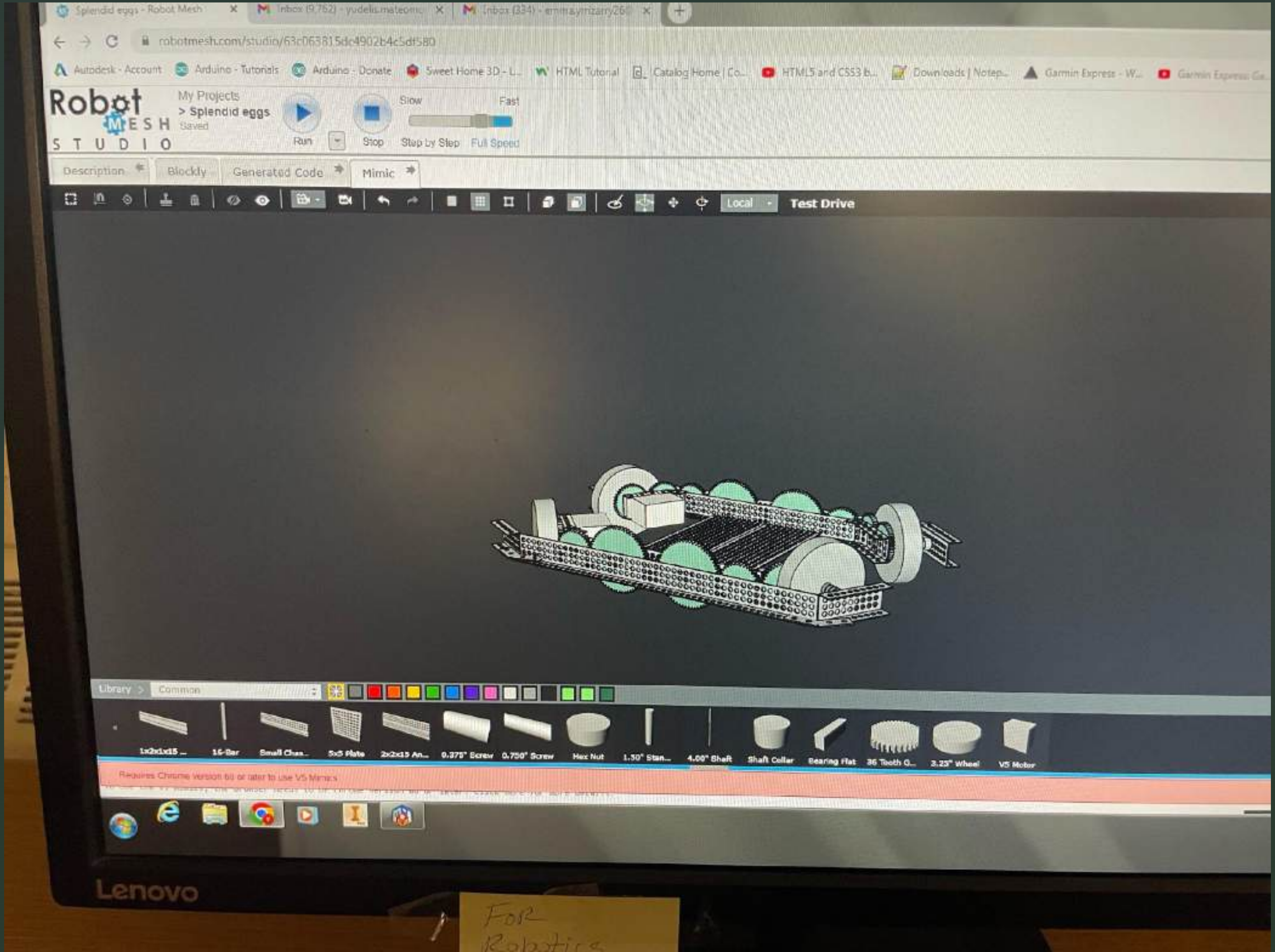
CAD/CAM Reveal (5/7)



CAD/CAM Reveal (6/7)



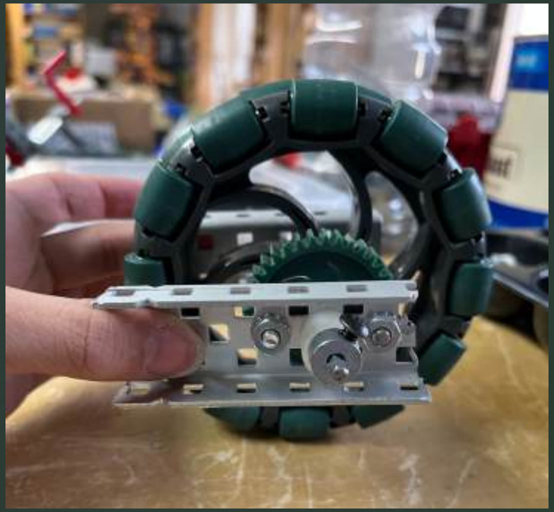
CAD/CAM Reveal (7/7)

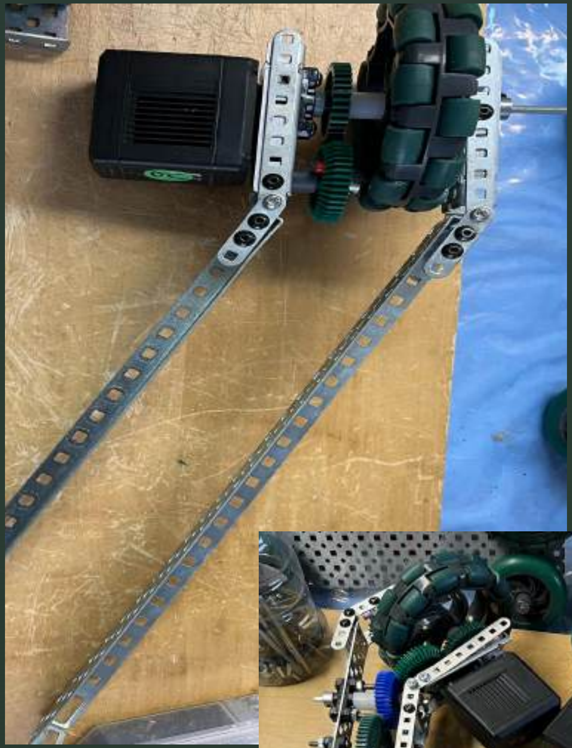


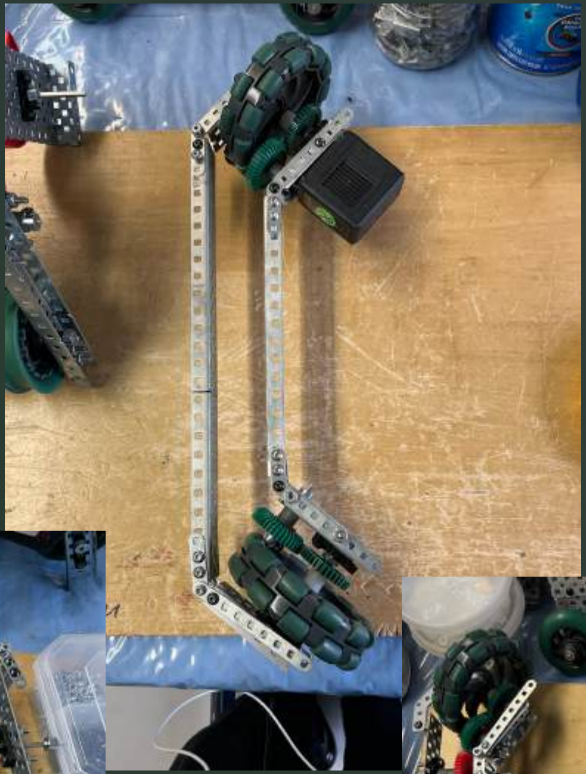
QR Codes- Watch and Enjoy!

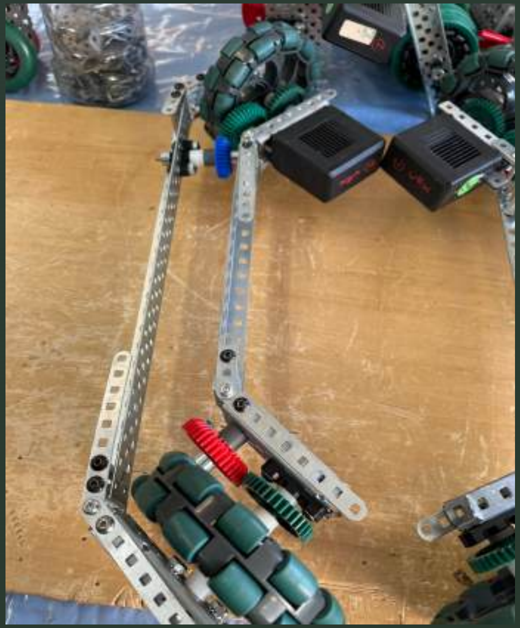
This is a video demonstrating the function of our string catapult expansion. There is one launcher on each side of the robot which will double our points when it is time for the non-limited expansion in the last 15 seconds of the VRC match!

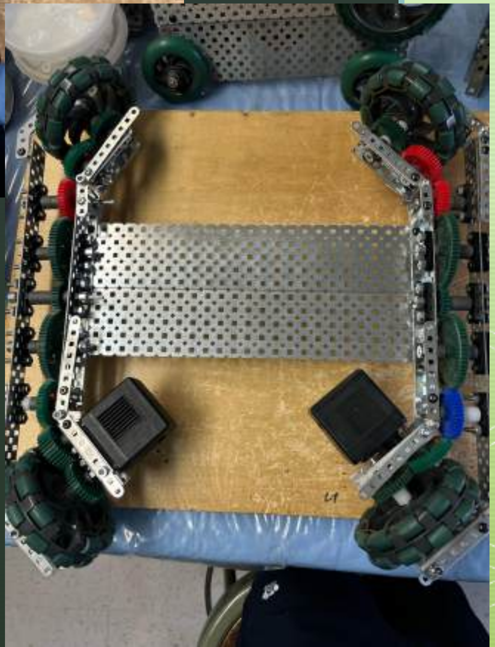
Building Log- Robot A: The Base



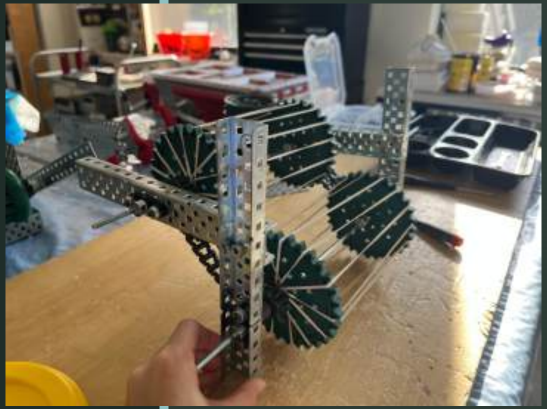
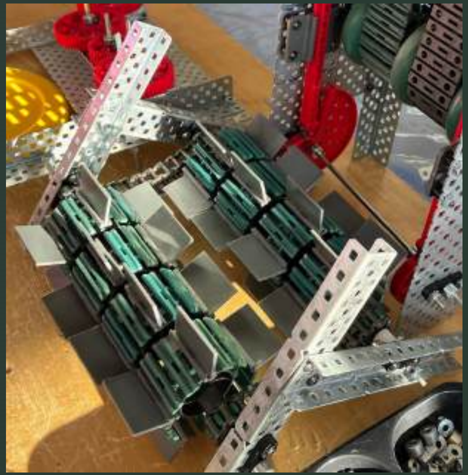
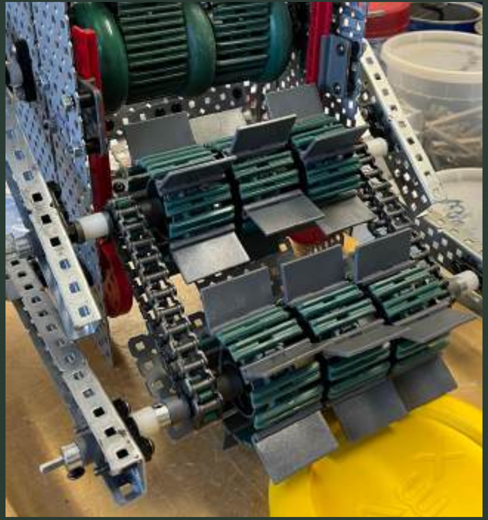
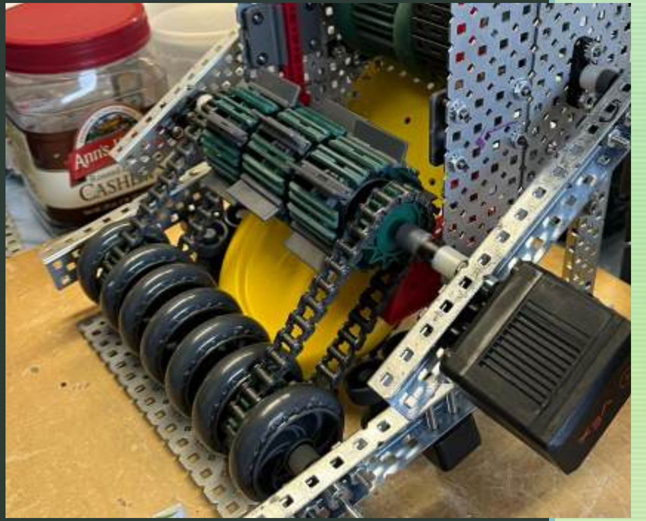
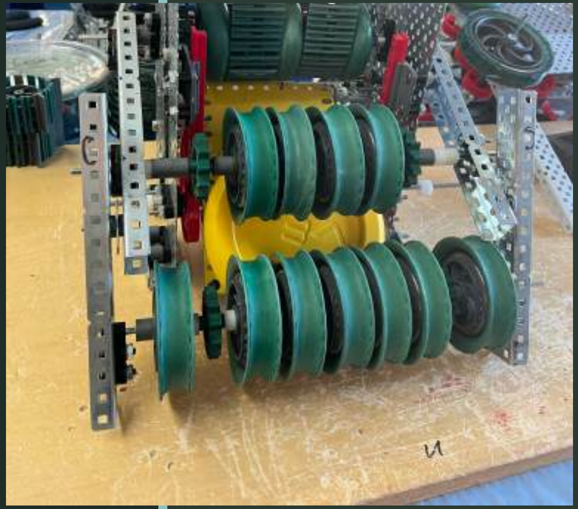
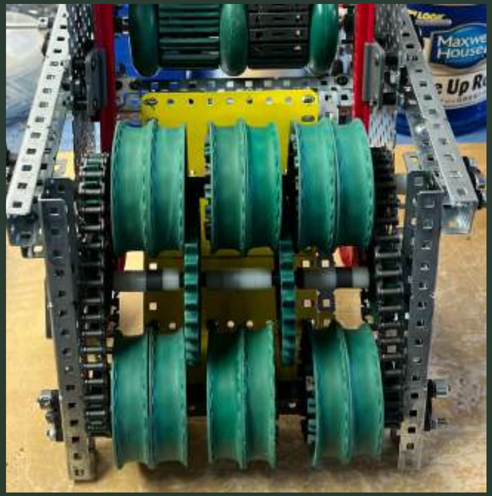
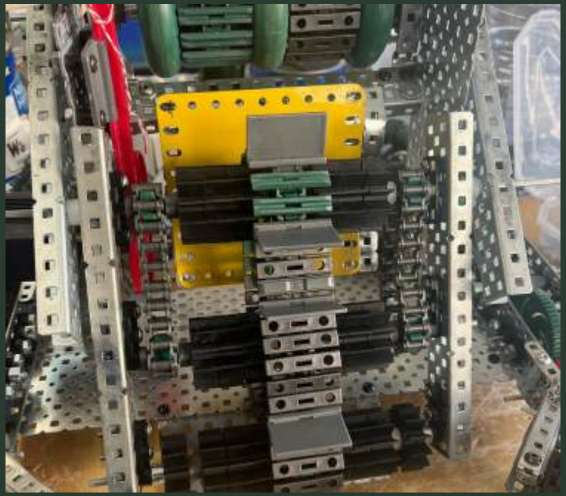
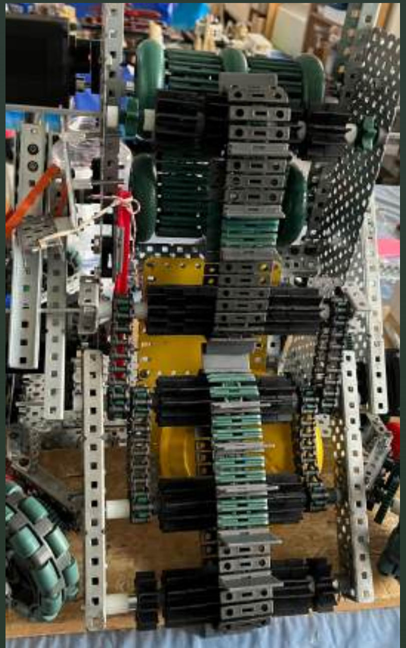




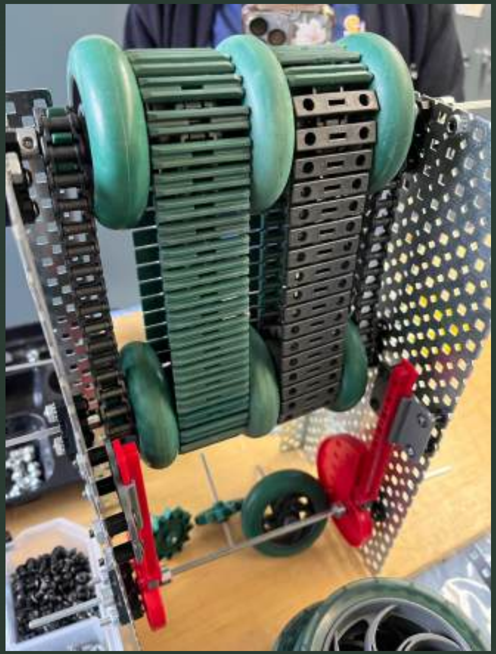


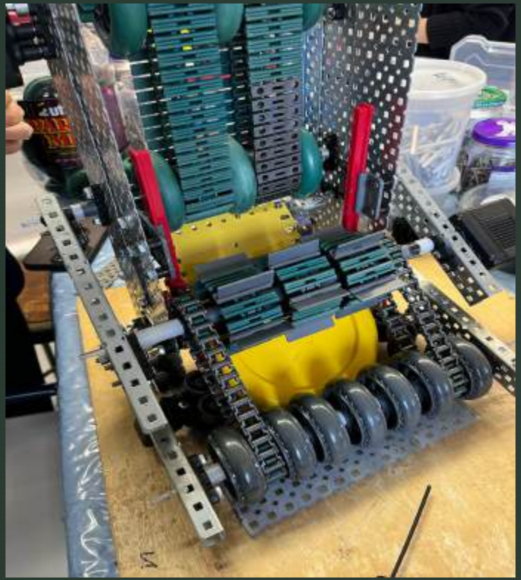


Building Log- Robot A: The Intake

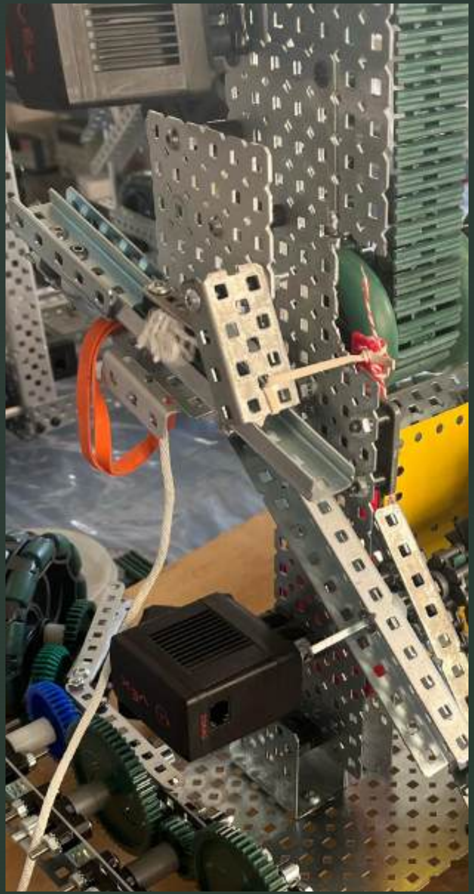









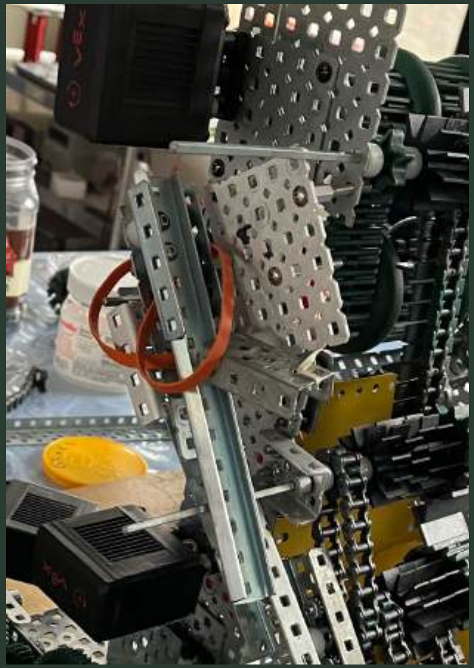
Building Log- Robot A: Cam and follower





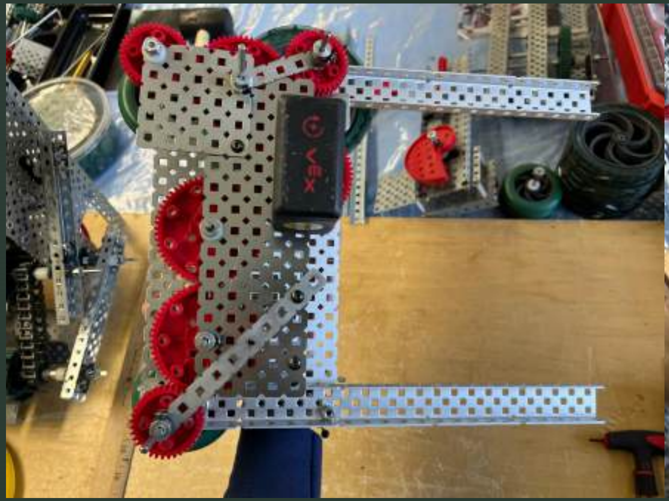
Building Log- Robot A: Expansion

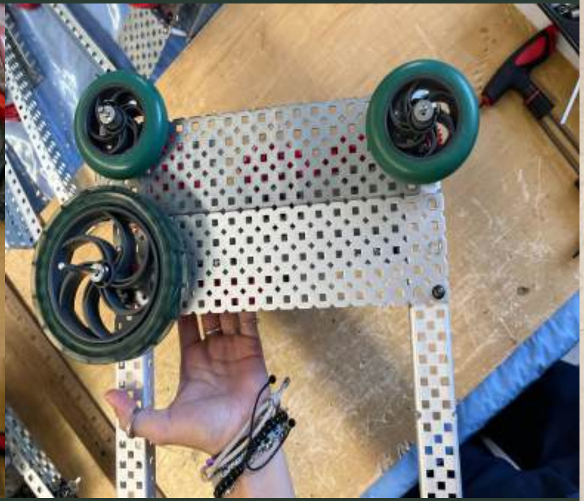


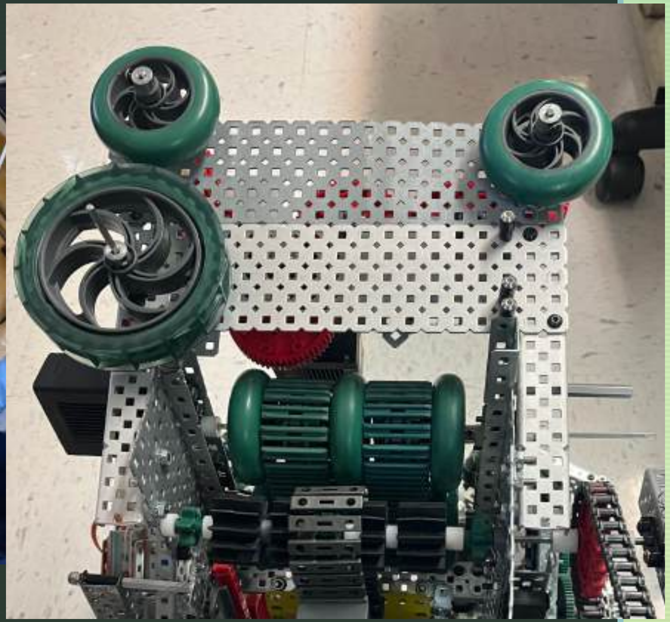


Building Log- Robot A: Roller

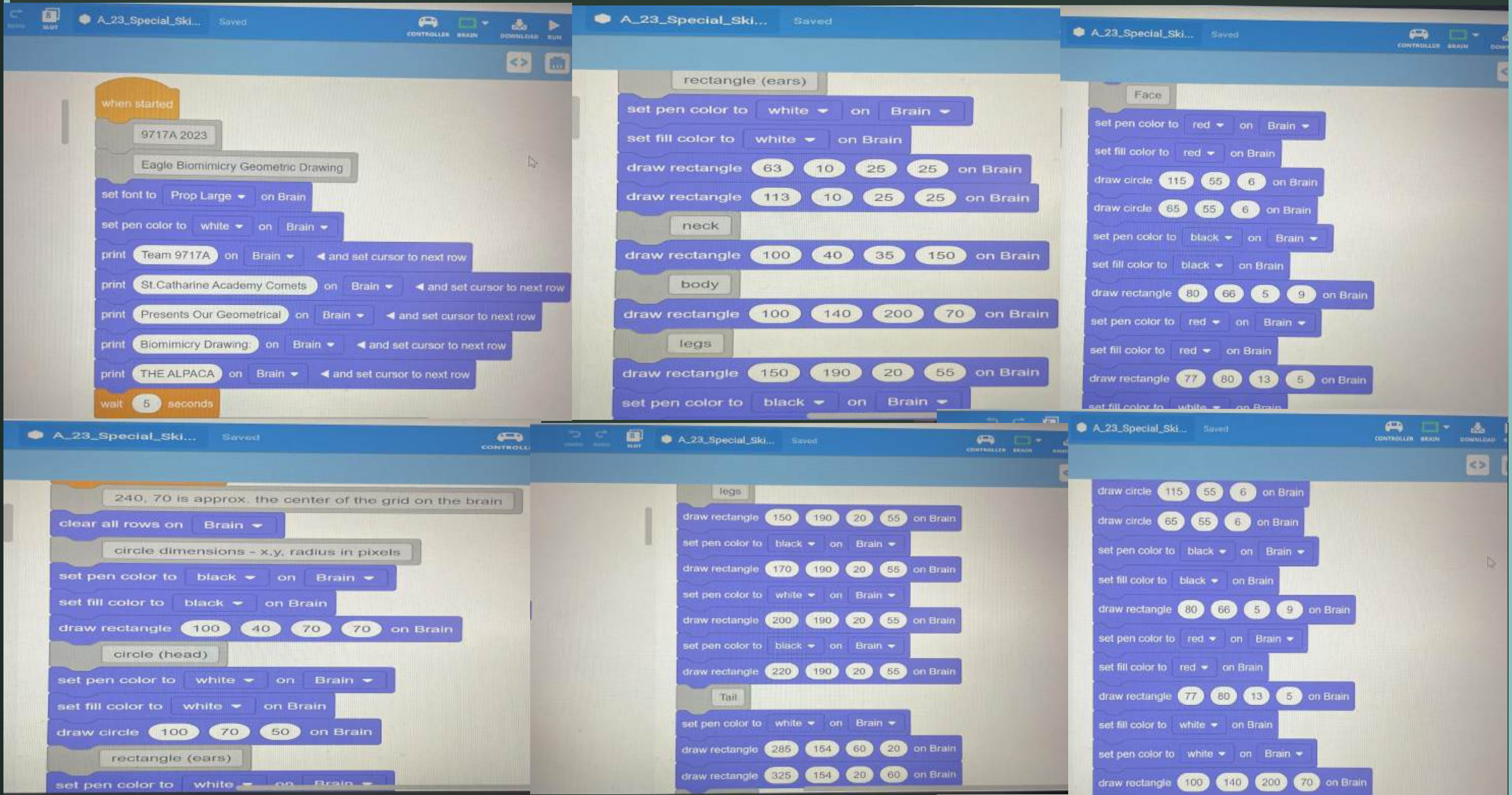
Building Log- Robot A: Fly wheel



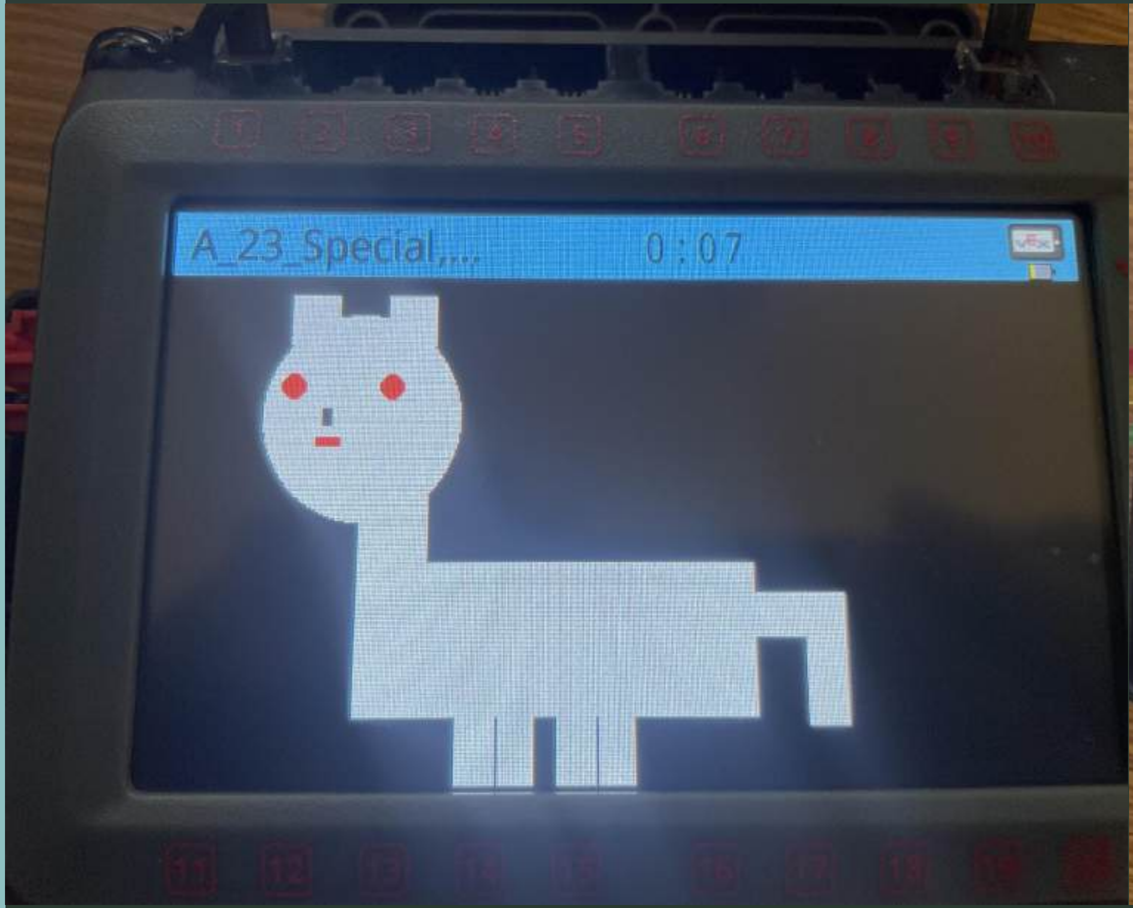


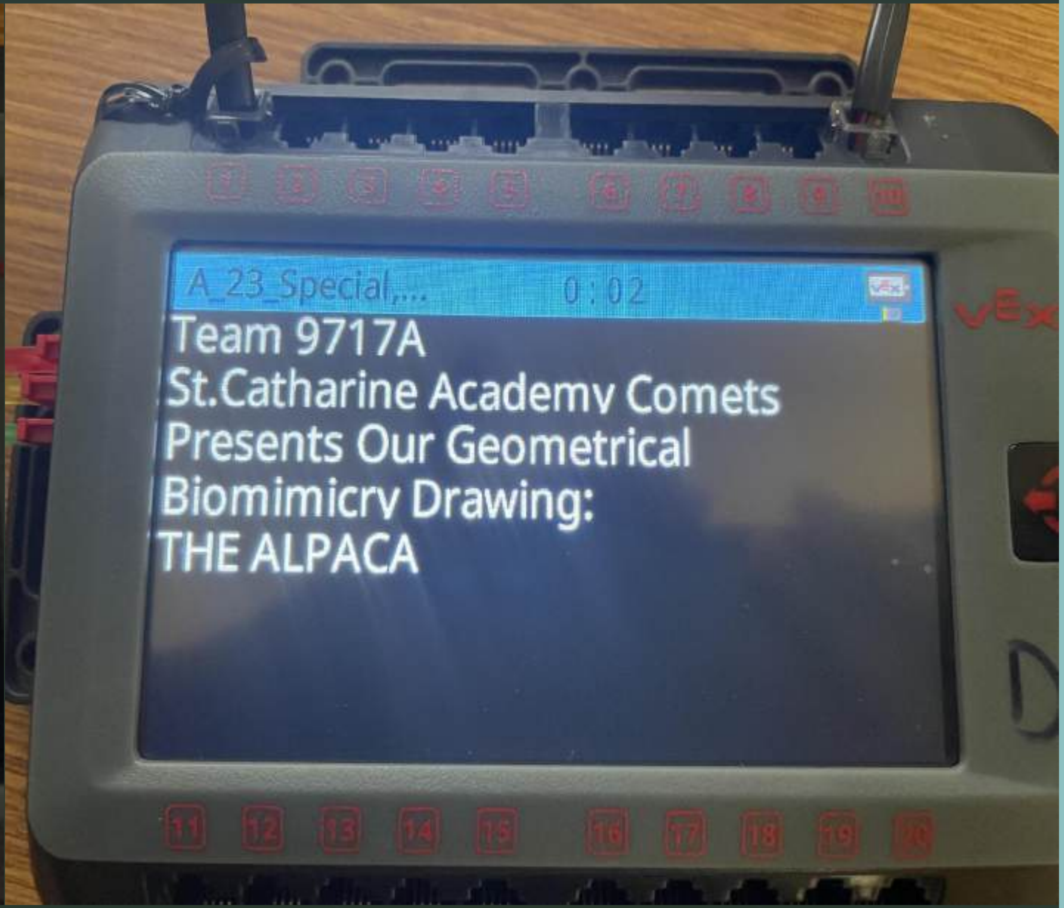


Programming Special Skills: Geometric Drawing of Biomimicry



Special Skills Code of Alpaca!



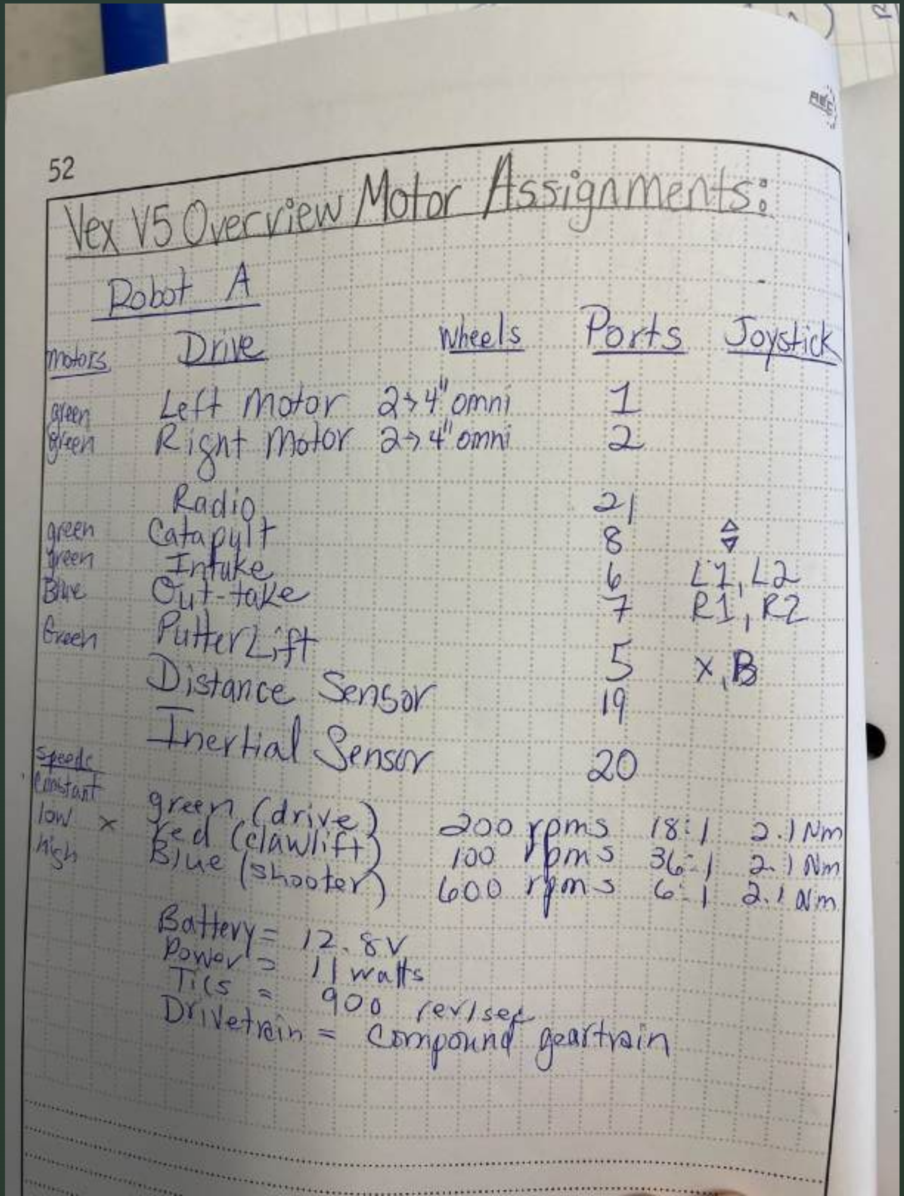


Sensors Used for Robot 9717-A:

- - inertial and distance sensor
  -inertial- a combination of a 3-axis (X,Y, and Z) accelerometer and a 3-axis gyroscope . helps because it measures linear acceleration of the robot (including gravity)

- - distance- can detect how many inches in front for programming , helps for programming displacement. Measuring a street length for example

Motor Assignments for Robot 9717-A:



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Vex V5 Overview Motor Assignments:

Robot A

Motors	Drive	Wheels	Ports	Joystick
green	Left Motor	2→4" omni	1	
green	Right Motor	2→4" omni	2	
	Radio		21	
green	Catapult		8	⇕
green	Intake		6	L1, L2
Blue	Out-take		7	R1, R2
Green	PutterLift		5	X, B
	Distance Sensor		19	
	Inertial Sensor		20	

Speeds constant				
low ×	green (drive)	200 rpms	18:1	2.1 Nm
	Red (clawlift)	100 rpms	36:1	2.1 Nm
high	Blue (shooter)	600 rpms	6:1	2.1 Nm

Battery = 12.8V
Power = 11 watts
Tics = 900 rev/sec
Drivetrain = Compound geartrain

Math For Base (RPMS & Gear Ratios)

Gear ratios:

Starting from motor

40/36= 10:9
Gearing up

40/40=1:1
Constant

60/40=3:2
Gearing down

60/24=5:2
Gearing down

60/24=5:2
Gearing up

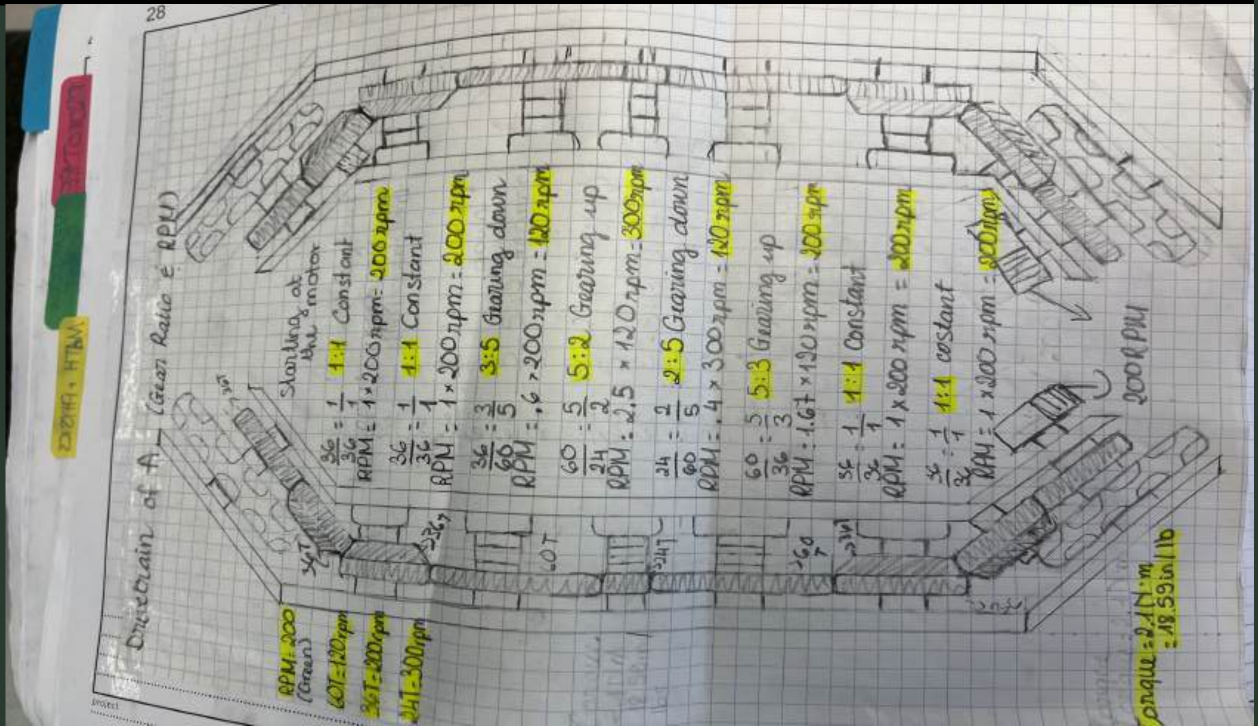
60/40=3:2
Gearing up

40/40=1:1
Constant

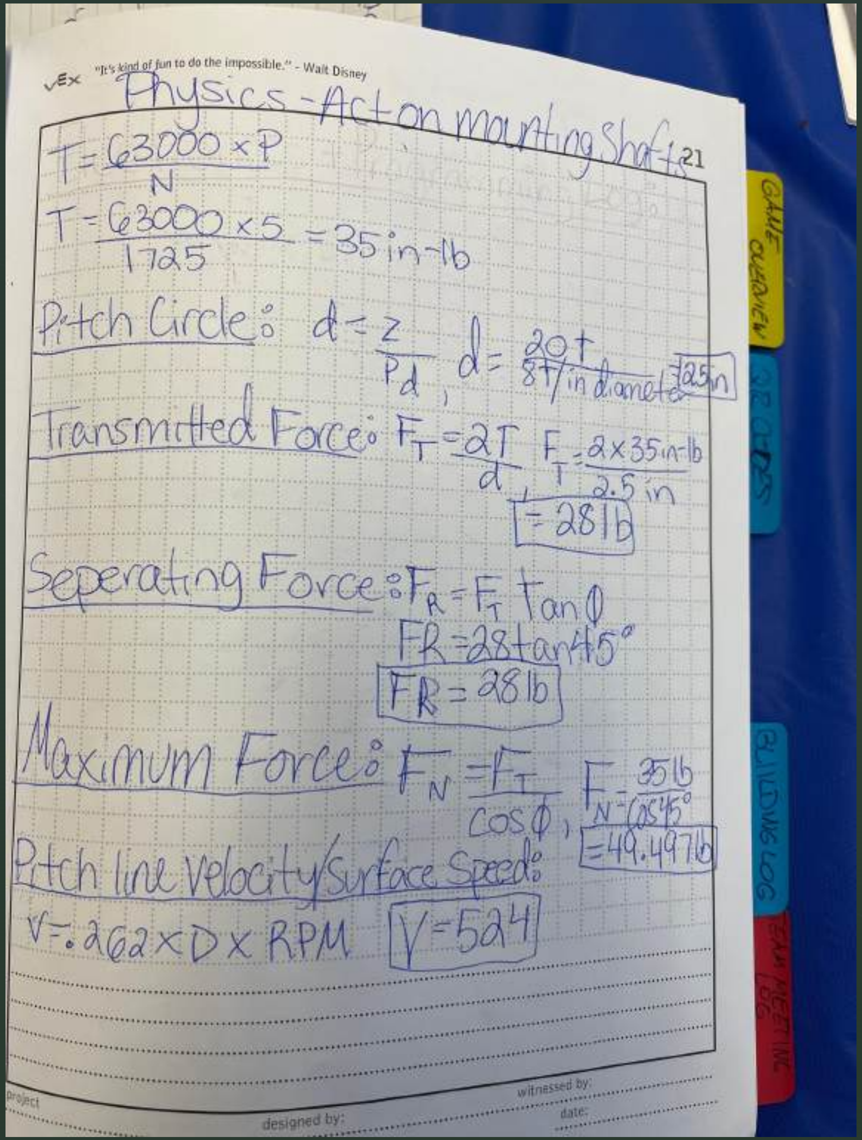
40/36=10:9
Gearing up

RPM: green motor (200rpm)

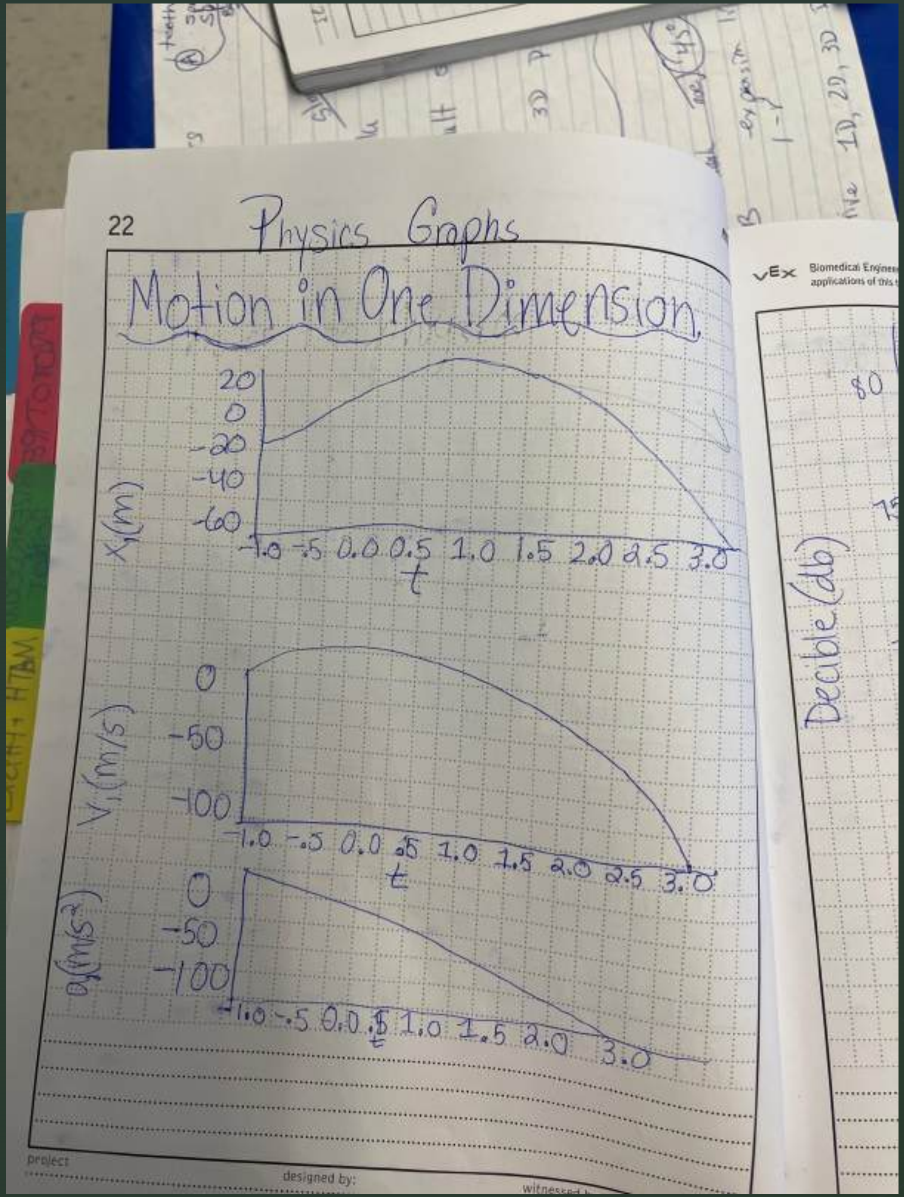
Big/Small= 40/36= 1.11 x 200rpm= 222rpm
Big/Small= 40/40= 1/1 X 222RPM == 222rpm
Big/Small= 60/40= 222/ 1.5= 145rpm
Big/Small= 60/24 = 145/2.5= 58 rpm
Big/Small= 60/24= 58x2.5= 145rpm
Big/Small= 60/40= 145x1.5= 217.5 rpm
Big/Small=40/40= 1/1= 217.5rpm
Big/Small= 40/36= 1.11x 241.43rpm



Physics

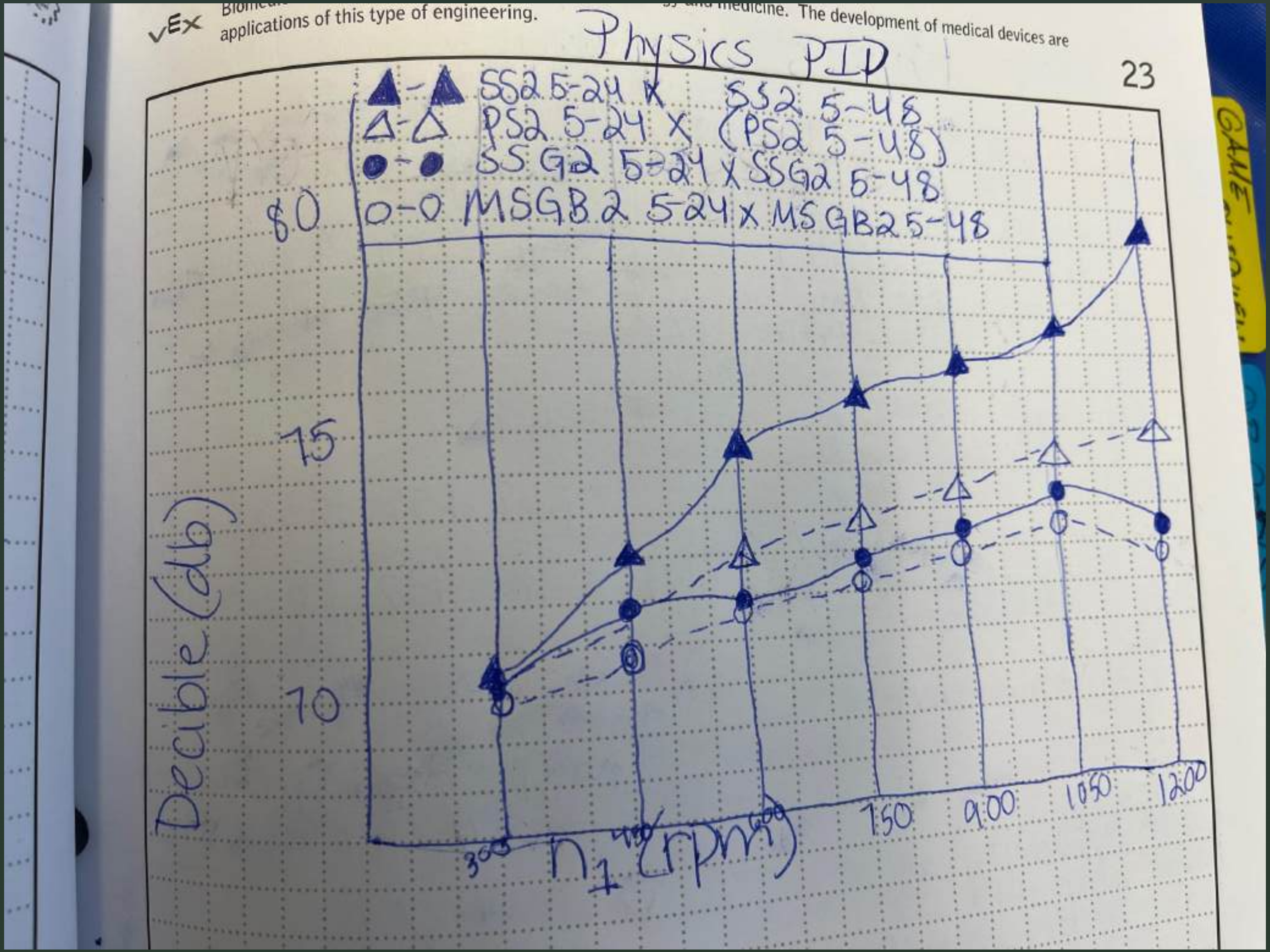

"It's kind of fun to do the impossible." - Walt Disney
Physics - Act on mounting Shafts
21
T = 63000 × P / N
T = 63000 × 5 / 1725 = 35 in-lb
Pitch Circle: d = Z / Pd , d = 20 t / 8 t/in diameter = 2.5 in
Transmitted Force: FT = 2T / d , FT = 2 × 35 in-lb / 2.5 in
= 28 lb
Seperating Force: FR = FT tan ϕ
FR = 28 tan 45°
FR = 28 lb
Maximum Force: FN = FT / cos ϕ , FN = 35 lb / cos 45°
= 49.497 lb
Pitch line Velocity/Surface Speed:
V = .262 × D × RPM
V = 524
GAME OVERVIEW
BUILDING LOG
TEAM MEETING LOG
project
designed by:
witnessed by:
date:

Physics

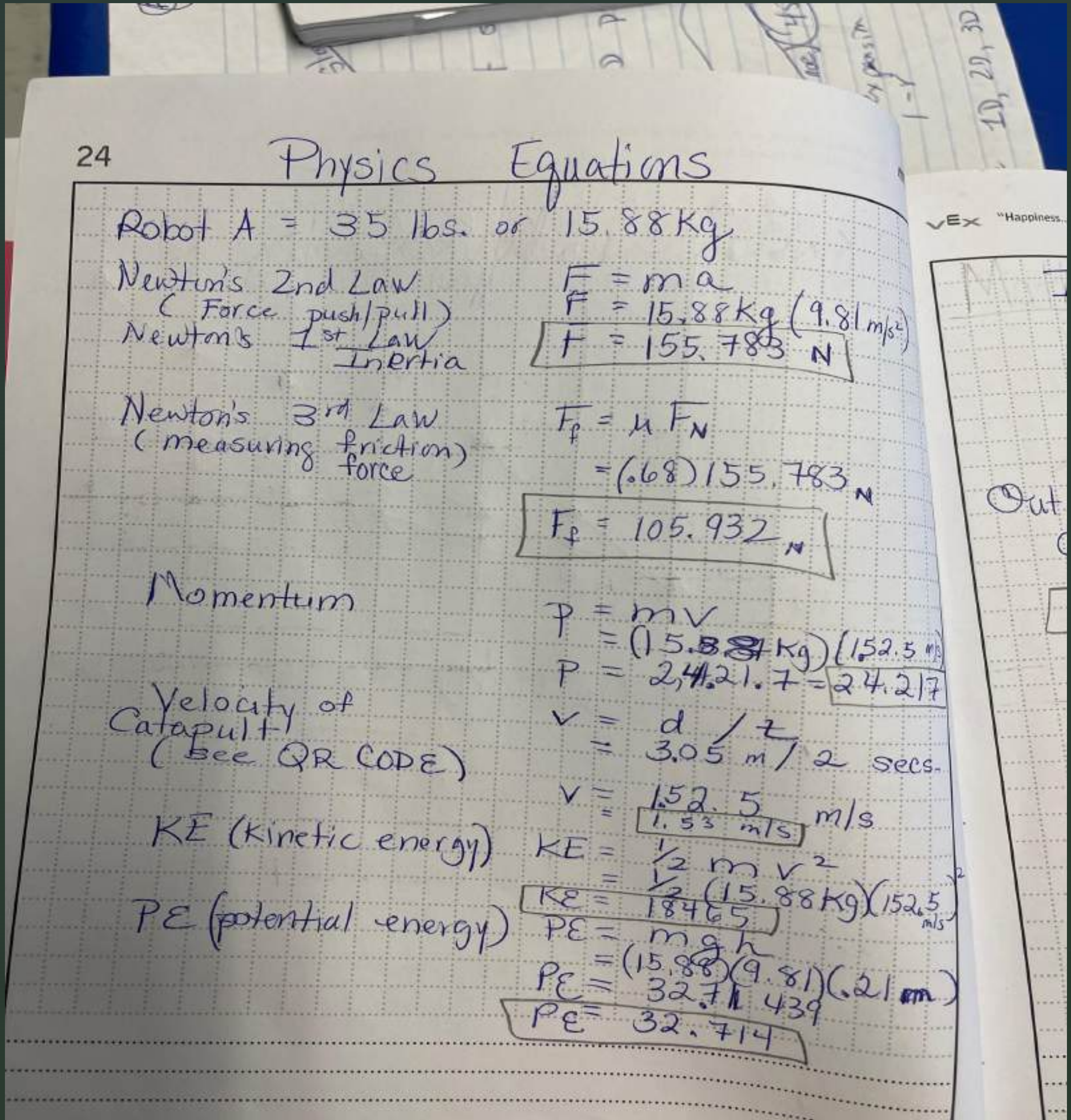


22
Physics Graphs
Motion in One Dimension
x_1(m)
20
0
-20
-40
-60
-1.0 -.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0
t
V_1(m/s)
0
-50
-100
-1.0 -.5 0.0 .5 1.0 1.5 2.0 2.5 3.0
t
a_1(m/s²)
0
-50
-100
-1.0 -.5 0.0 .5 1.0 1.5 2.0 3.0
t
project
designed by:
Decible (db)
80

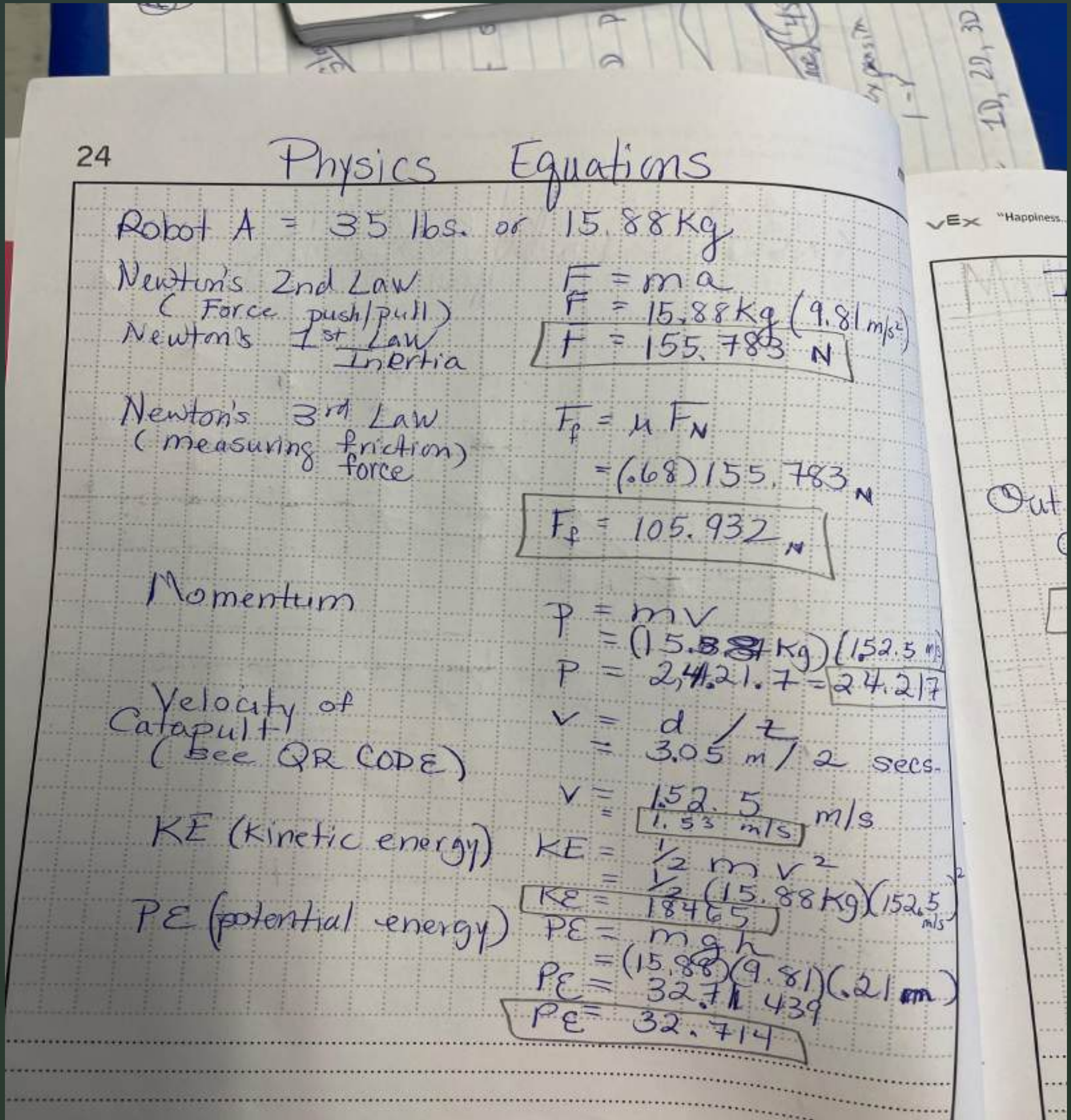
Physics


applications of this type of engineering.
The development of medical devices are
23
Physics PID
SS2 5-24 X SS2 5-48
PS2 5-24 X (PS2 5-48)
SSG2 5-24 X SSG2 5-48
MSGB2 5-24 X MSGB2 5-48
80
75
70
Decible (db)
750
900
1050
1200
n_1 (rpm)

Physics


24
Physics Equations
Robot A = 35 lbs. or 15.88 Kg
Newton's 2nd Law
(Force push/pull)
Newton's 1st Law
Inertia
F = m a
F = 15.88 Kg (9.81 m/s²)
F = 155.783 N
Newton's 3rd Law
(measuring friction force)
Ff = μ FN
= (.68) 155.783 N
Ff = 105.932 N
Momentum
P = mv
= (15.88 Kg)(152.5 m/s)
P = 2,421.7 = 24.217
Velocity of Catapult
(See QR CODE)
v = d / t
= 3.05 m / 2 secs.
v = 152.5 m/s
= 1.53 m/s
KE (kinetic energy)
KE = ½ m v²
= ½ (15.88 Kg)(152.5 m/s)²
KE = 18465
PE (potential energy)
PE = m g h
= (15.88)(9.81)(.21 m)
PE = 32.71439
PE = 32.714
VEX "Happiness...
Out

Physics



24 Physics Equations

Robot A = 35 lbs. or 15.88 Kg

Newton's 2nd Law
(Force push/pull)
Newton's 1st Law
Inertia

$F = ma$
$F = 15.88\,Kg\,(9.81\,m/s^2)$
$\boxed{F = 155.783\ N}$

Newton's 3rd Law
(measuring friction)
force

$F_f = \mu F_N$
$= (.68)\,155.783\,N$
$\boxed{F_f = 105.932\ N}$

Momentum

$P = mv$
$= (15.88\,kg)(152.5\,m/s)$
$P = 2,421.7 = \boxed{24.217}$

Velocity of Catapult
(See QR CODE)

$v = d / t$
$= 3.05\,m / 2\,secs.$
$v = 152.5\,m/s$
$= \boxed{1.53\ m/s}$

KE (kinetic energy)

$KE = \frac{1}{2} m v^2$
$= \frac{1}{2}(15.88\,kg)(152.5\,m/s)^2$
$\boxed{KE = 18465}$

PE (potential energy)

$PE = mgh$
$= (15.88)(9.81)(.21\,m)$
$PE = 32.71439$
$\boxed{PE = 32.714}$

Physics

"Happiness... it lies in the joy of achievement, in the thrill of creative effort." - Franklin D. Roosevelt

Intake

$$a_c = \frac{V^2}{r} = \frac{(1.525)^2}{.05}$$

$$\boxed{a_c = 46.513 \ \text{m/s}^2}$$

$$V_c = \frac{2\pi r}{T} = \frac{2(\pi)(.05)}{2 \text{ secs.}} = .157$$

$$\boxed{V_c = .157 \ \text{m/s}}$$

Out-take

$$a_c = \frac{(1.525)^2}{.025}$$

$$\boxed{a_c = 93.025 \ \text{m/s}^2}$$

$$V_c = \frac{2\pi(.025)}{2 \text{ secs}} = \boxed{.079 \ \text{m/s} = V_c}$$

Power

$$P = (\text{torque})\left(\overset{\text{velocity}}{\text{speed}}\right)$$

$$\boxed{P = 11 \text{ watts}}$$

Electrical

$$P = VI$$

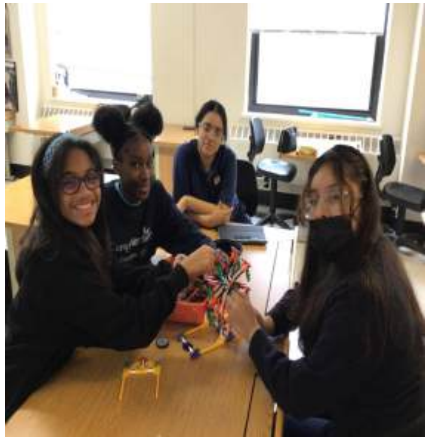
$$\frac{11}{12.8} = \frac{(12.8\text{v})\, I}{12.8}$$

Current

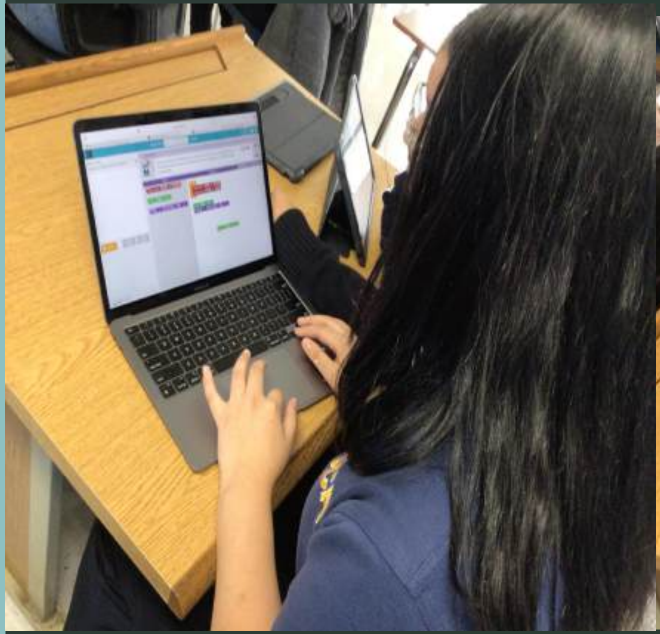
$$\boxed{.859 \ \text{A} = I \ \text{(Amps)}}$$

Our Robotics Team's Community Service!

Even during the summer, the robotics team spent their time in the lab introducing incoming high school students to first-hand engineering. Most of what they build consisted of a type of Lego, KNEX, which in turn helped them learn that engineering is mostly math, symmetry is key, and that engineering can be used to create anything you imagine!

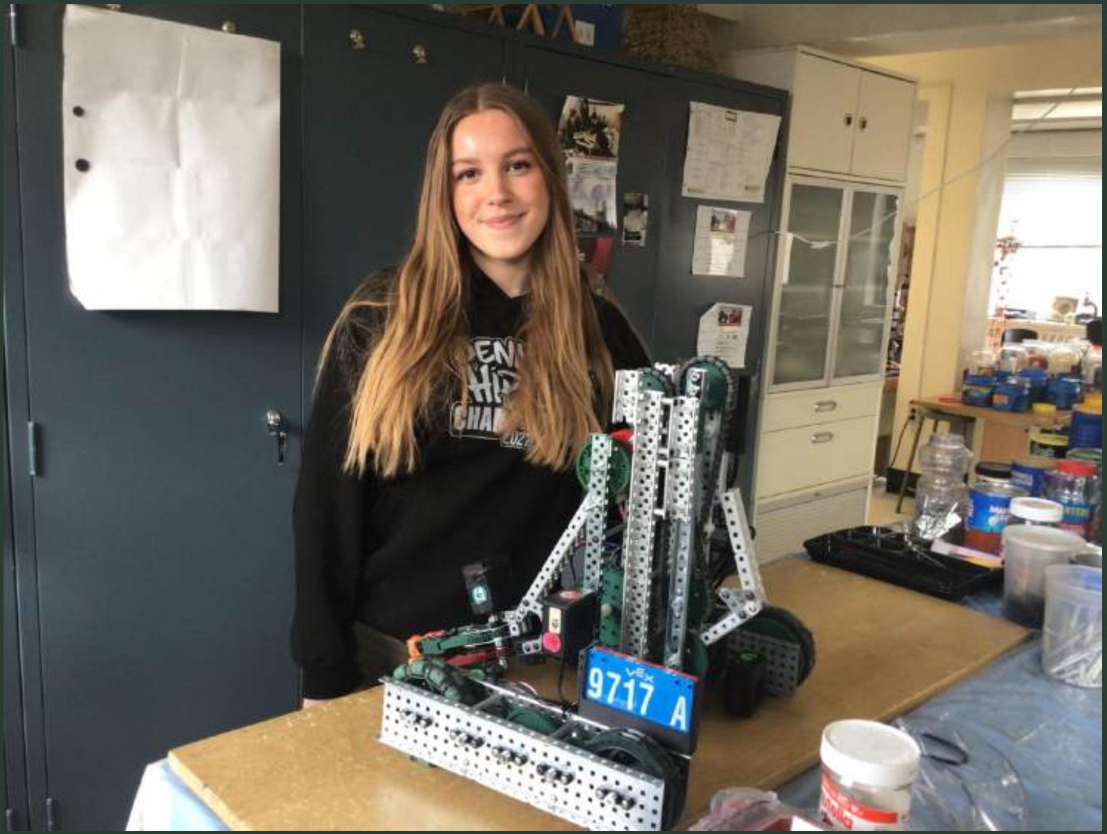


Our Robotics Team's Community Service!



On December 5th, the programmers of the robotics team celebrated "National Hour of code day" by gathering a group of interested students in our school and taught them how to code. Specifically partnering up with girls who code, we were able to program exciting things such as this dance party theme. With this, a lot of kids were very excited and wanted to learn more advanced coding!

Our Robotics Team's Community Service!



A group of students from the Netherlands took a flight to visit our school and learn more about engineering, considering we are the only girls team in our state which peaked their interest. When they arrived, we showed them how our robot from last year was built, were able to build KNEX Legos, and even got to drive the robot!

Revisions for Kennedy HS Competition 1/28/23

- Problems:
- String shooter activated catapult prematurely
- Drivetrain got stuck on our chassis sub base
- Roller by outtake positioned not centered, lacked good friction of roller
- Autonomous or turn commands were not working during drives

- Solution:
- Enlarged the catapult trigger
- Cut the corners and put gussetts instead
- Replaced traction wheels for omni wheels with rubber bands, then positioned them increase torque
- Modified both commands with repeating forever loops

Revisions from Rye HS Competition 1/14/23

- Problems:
- Weight distribution interrupted all robot functions
- Field Measurements for autonomous mode were incorrect
- Catapult string kept getting jammed

- Solutions:
- Redesigned a lighter weight fly wheel
- Remeasured field and fixed measurements
- Added spacers and lifted catapult