

Engineering Notebook



The Ohio State University

osurobotics.org

Table of Contents

6	VEX Robotics Competition: Push Back	5/12/25
7	Scoring Breakdown	5/13/25
8	Initial Push Back Thoughts and Ideas	5/13/25
9	Brainstorming Initial Thoughts	5/14/25
10	Initial Intake Reviews	5/14/25
11	Roller Drawing	5/15/25
12	Ball Hoarding Ideas	5/15/25
13	Initial Game Strategy Analysis	5/16/25
14	Robot CAD Designs	5/18/25
15	Robot CAD Designs	5/18/25
16	Robot CAD Designs	5/18/25
17	Robot CAD Designs	5/18/25
18	Robot CAD Designs	5/18/25
19	Brainstorming Match Autonomous Routes	5/19/25
20	Drive Base Initial Build	6/6/25
21	Drive Base Initial Build	6/6/25
22	Drive Base Initial Build	6/6/25
23	Ramp	6/6/25
24	Entrance Jamming	6/14/25
25	Hollow Coil	6/15/25

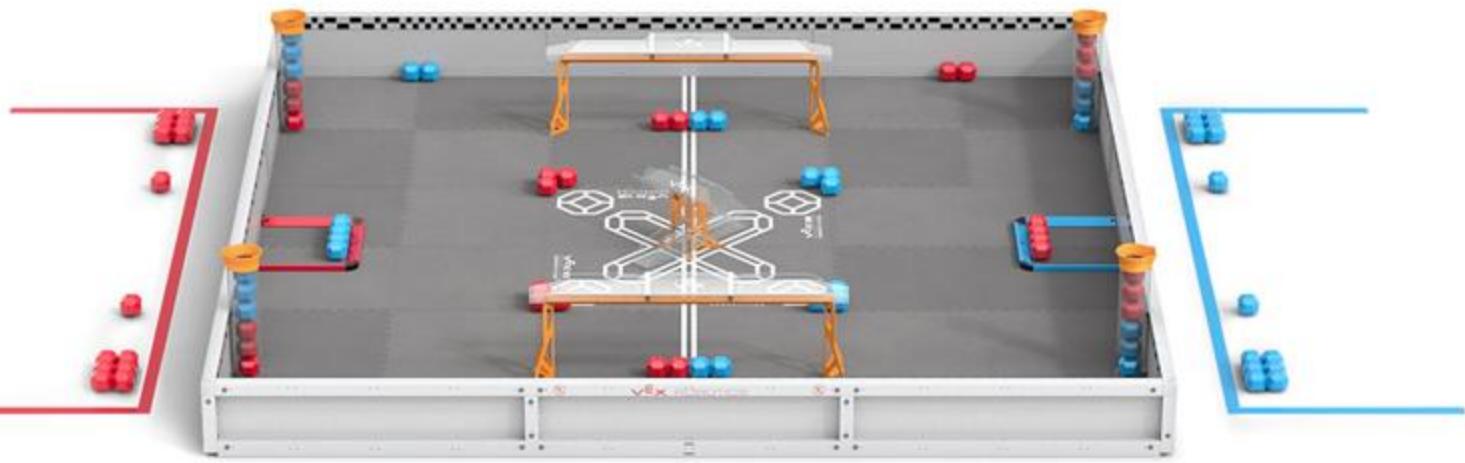
Table of Contents

26	Lexan Hood	6/15/25
27	Single Hopper	6/16/25
28	Sketches	6/16/25
29	Highest Capacity	6/16/25
30	Mono-hopper	6/17/25
31	Subsystem	6/18/25
32	Intake Wall	6/18/25
33	Hoarding	6/18/25
34	Hopper Capacity	6/18/25
35	Capacity	8/1/25
36	Expanded Intake	8/2/25
37	First Test Print	8/2/25
38	First Working Robot	9/6/25
39	Intake Designs	9/8/25
40	Intakes	9/10/25
41	Angled Flex Wheels Intake	9/11/25
42	Angles Flex Wheels Intake	9/11/25
43	Drop Down Intake CAD	9/13/25
44	Angled Flex Wheels	9/14/25
45	New Members!	9/14/25

Table of Contents

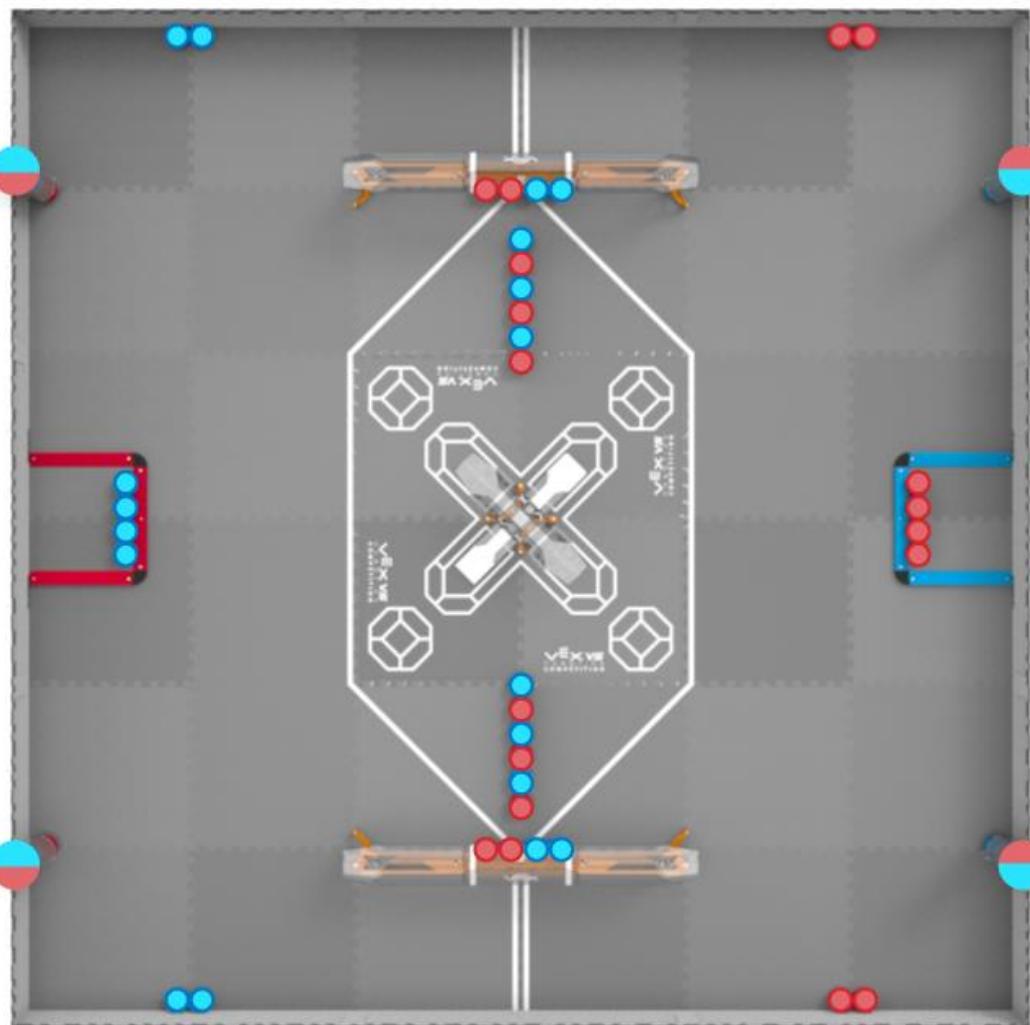
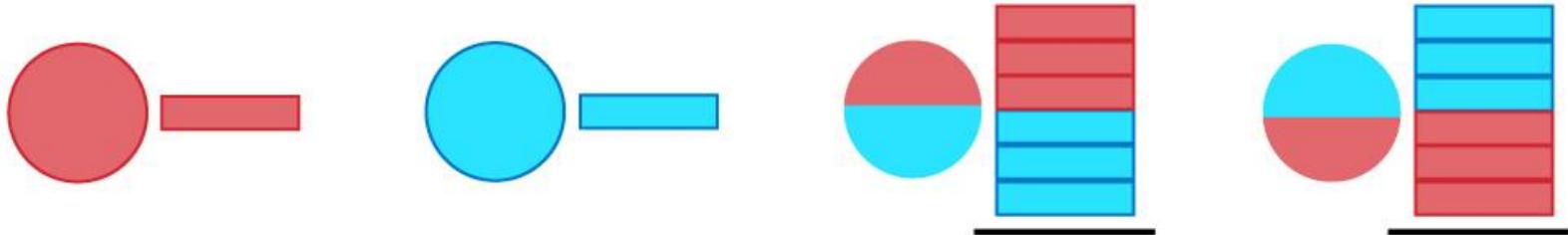
46	Scoring Middle Goal Video	9/16/25
47	Updated Robot Picture	9/19/25
48	Updated Hood Picture	9/20/25
49	Weekly Meeting Robot Video	9/21/25
50	Brainstorming	9/21/25
51	Robot CAD	9/25/25
52	Robot Update	10/9/25
53	To-Do for 2t bot	10/26/25
54	Roller Placement Plan	10/30/25
55	New Hood. Mounting the Score Box	11/3/25
56	CAD for Scorebox	11/4/25
57	Shortening the Gate	11/5/25
58	Intake Decision Matrix	11/9/25
59	First Autonomous Route	11/19/25
60	Driving Testing	11/24/25
61	Intake Jamming	12/1/25
62	Robot Question	12/1/25
63	Coding Routes	12/2/25
64	Intake Snapping	12/3/25
65	Wing Size	12/4/25

Table of Contents



The 2025-26 season's VEX V5 competition is called Push Back. This game consists of two alliances, one red and one blue with two teams each in one alliance. The game starts with a autonomous period which lasts 15 seconds. Whichever alliance scores the most points during this period is awarded with an additional 6 points. Additionally, each alliance has an opportunity to earn an additional Autonomous Win Point by completing a assignment that is given to them. After the autonomous period the driving commences and scoring is mainly obtained by placing the rings onto stakes. This part of the game lasts 1 minute and 45 seconds (1:45). Scoring can occur by placing blocks into goals, and robots parking at the end of the match.

Reference: https://www.vexrobotics.com/push-back-manual?srsltid=AfmBOopOEMstfID5eGHzeSc_DbB-8qk5TvO_jtR3ulA6GAsOjnec-iYP

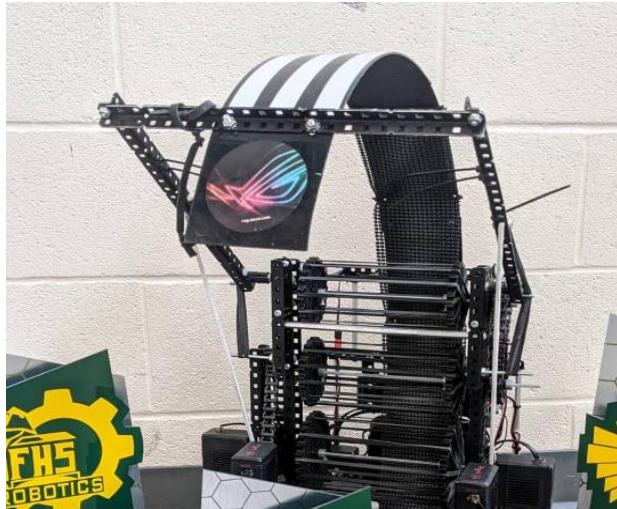


Autonomous Bonus	10 points
Each Block Scores	3 points
Each Controlled Zone in a Long Goal	10 points
Controlled Center Goal – Upper	8 points
Controlled Center Goal – Lower	6 points
1 Parked Alliance Robot	8 points
2 Parked Alliance Robots	30 points

5/13/2025

Initial Push Back Thoughts and Ideas

- We don't want change up style uptake because that would be heavier, have good cycle time, but may be bad at holding multiple balls at top while feeding more?
- Feed into a hopper.
- Cover on top of a hopper?
- Maybe plastic tubes, 3.5 inch diameter tube.
- Color sort the intake, 2 hoppers.
- Not a change up style hood for the 15 because it's slightly below.
- First bot should probably be simple with change up uptakes, lexan back piece



VEX Change Up hood.
Reference: 60883dougie
Instagram
<https://www.instagram.com/p/CNfYm-1BbSF/>

TODO:

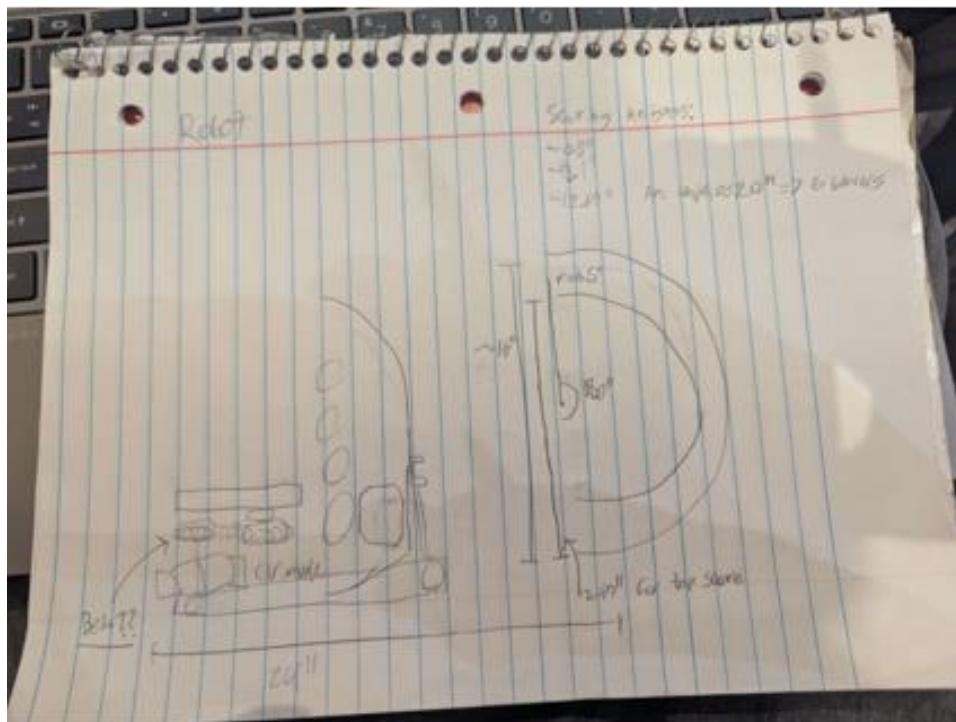
- We need to brainstorm different uptake methods
- Brainstorm single chain and sprocket system

5/14/2025

Brainstorming Initial Thoughts:

- Nate says we want a hopper that can hold 7-8 balls, therefore we can get all the way to the control zone.
- Need a track length of at least 23 inches.
- We want a motor to index rather than a piston.
- Other color hopper would be a holder with a way to dispose of the balls.
- We would score opponents robots if we are out or low on our color so we can swing the control zone by simultaneously scoring and de-scoring their blocks.
- Intake with 2 paths so we can hold 15 in each bot.

Initial Drawings:

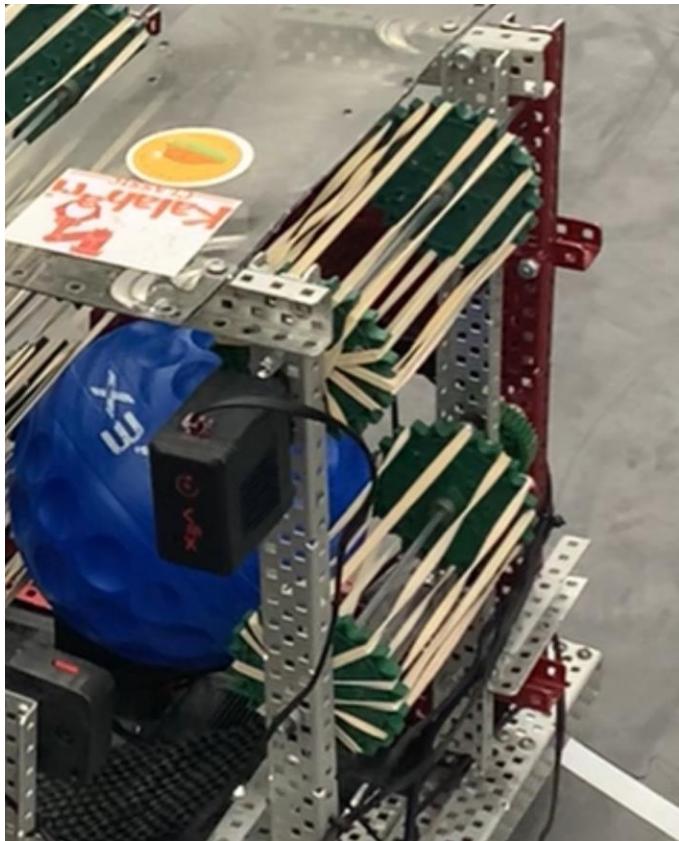


Simple snail should have room for 6 blocks

5/14/2025

Initial Intake Reviews:

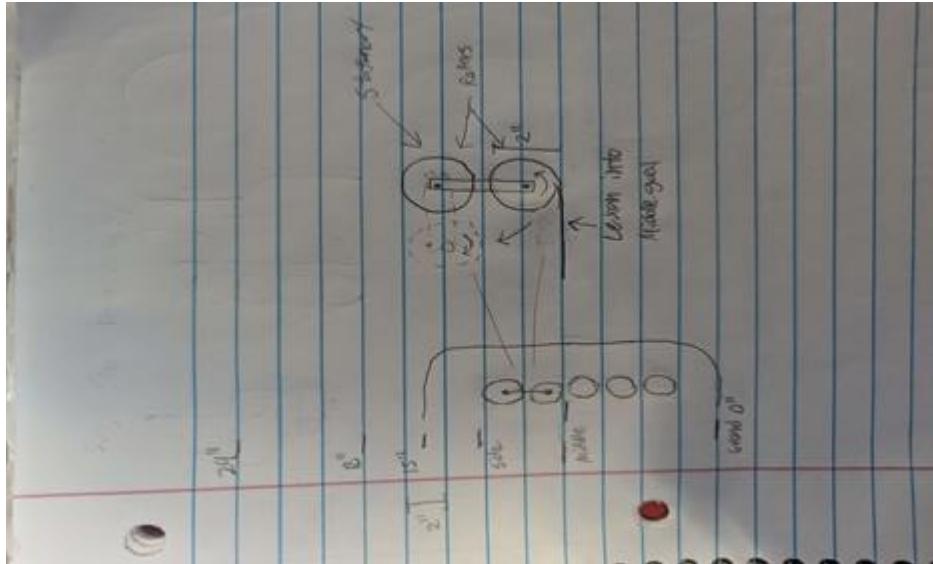
- Change up ball disposal to redirect to a different outtake for the middle top.
- Multiple snails side by side that are fed by the same intake to go to the same outtake.
- We can easily add more capacity by extending the snail horizontally at both the intake and outtake - maybe add 4 more blocks that way



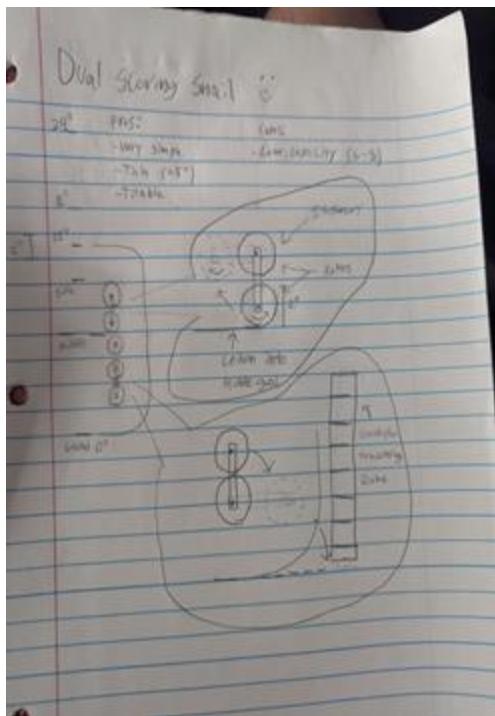
Old High School VEX
Change Up Ball disposer

5/15/2025

Roller Drawing:



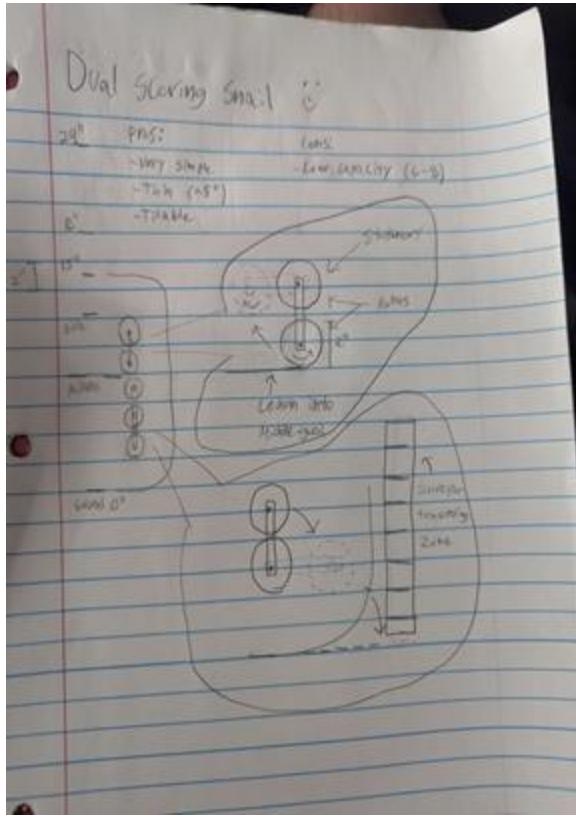
Second roller from the top rotates up by a piston or whatever, then it effectively becomes a change up ball disposer with the added benefit of the roller continuing to accelerate the block right until it goes into the goal.



- We could use a really similar design to make a redirect to a hoarding container
- Just a big volume that cubes get dropped into
- Don't love that you have to drop the ramp down
- Really like the redirect for top to middle goal

5/15/2025

Ball Hoarding Ideas:



- Could use a really similar design to make a redirect to a hoarding container.
- A big volume that cubes get dropped into.
- Negative, would have to drop the ramp down.
- Positive: the redirect for top to middle goal

Drive Base Initial Ideas:

- Smaller drive base, skinner and maybe shorter. Makes the bot more mobile
- A lot of the weight can be concentrated down low, so tipping shouldn't be a concern.
- Most power for roller will be done via chains, gears, timing belts so we can keep that weight very low.
- 1/4-3/8in aluminum side walls.
- Stack the intake motors on the drive pods and just using gears/timing belts to move the power upward.

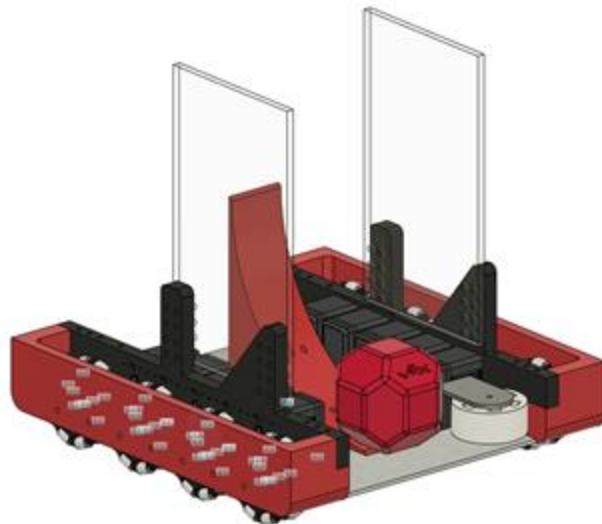
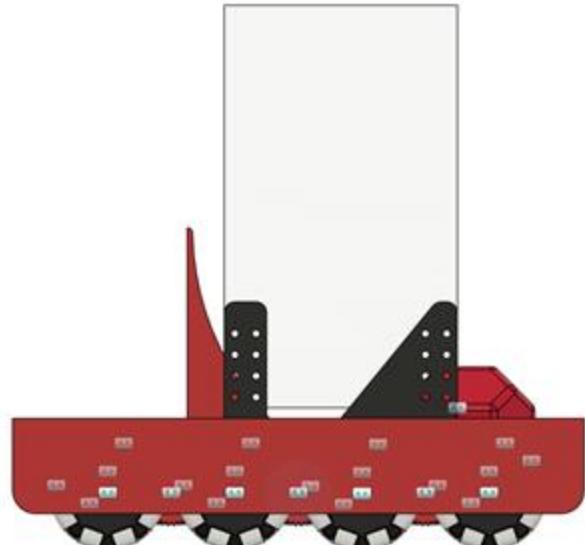
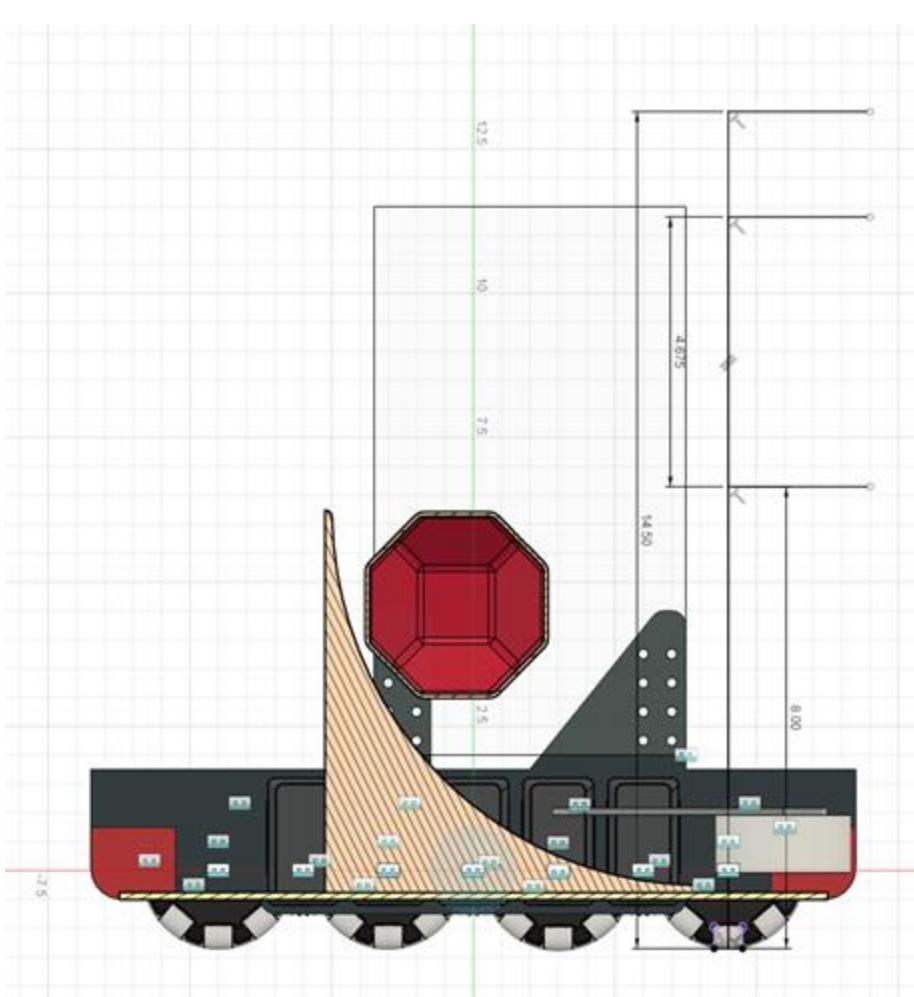
Initial Game Strategy Analysis:

- Rather than having a standard hoarding mechanism on the back of the robot, have a “plinko” type of mech.
- 4 in line tubes that hold 3-4 blocks each
- We load the blocks by sorting them, and then once loaded we line up with their parking space around 45 seconds and open up a back flap to dump them into the zone
- The parking zone is 14.86x 14.86 so a 4x4 grid of blocks essentially covers it completely
- So, they either have to spend the end of the match clearing out their zone to double park (worth 3 control zones) or they get denied 16/44 (over a 3rd) of their game elements
- Will be taking away $\frac{1}{3}$ of the balls for scoring

5/18/2025

Robot CAD Designs:

- 8' gpa; and 12.67' goal and 15' height limit

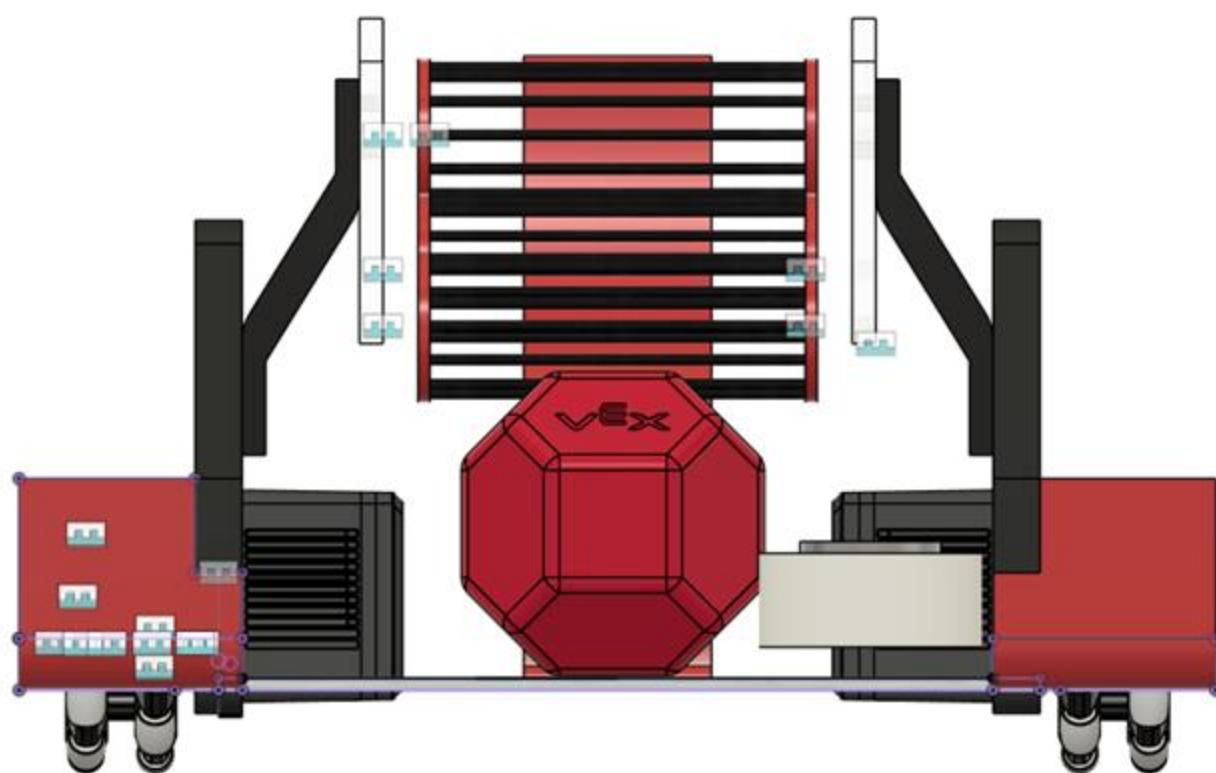
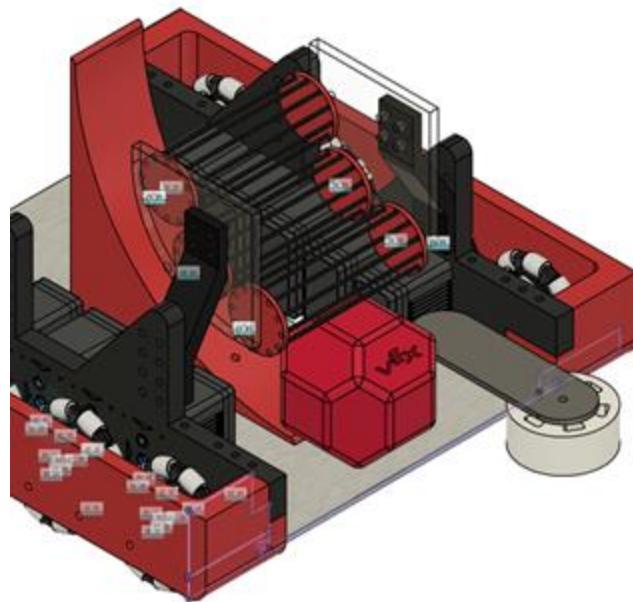
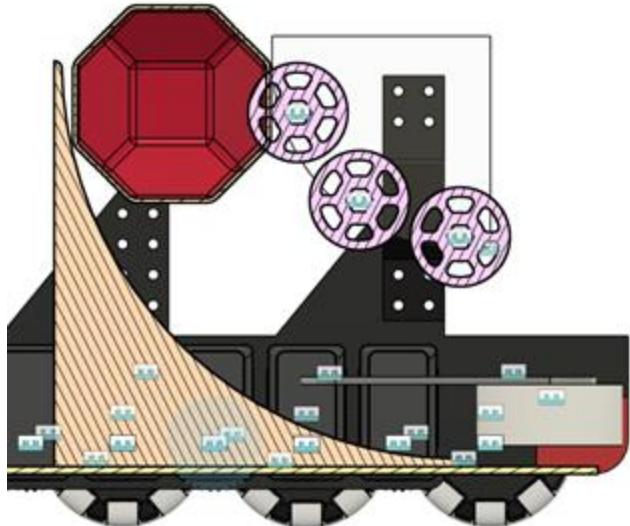


Biggest challenge is designing an uptake that maintains constant contact with the ball. While not blocking the potential path from the 8in goal

5/18/2025

Robot CAD Designs:

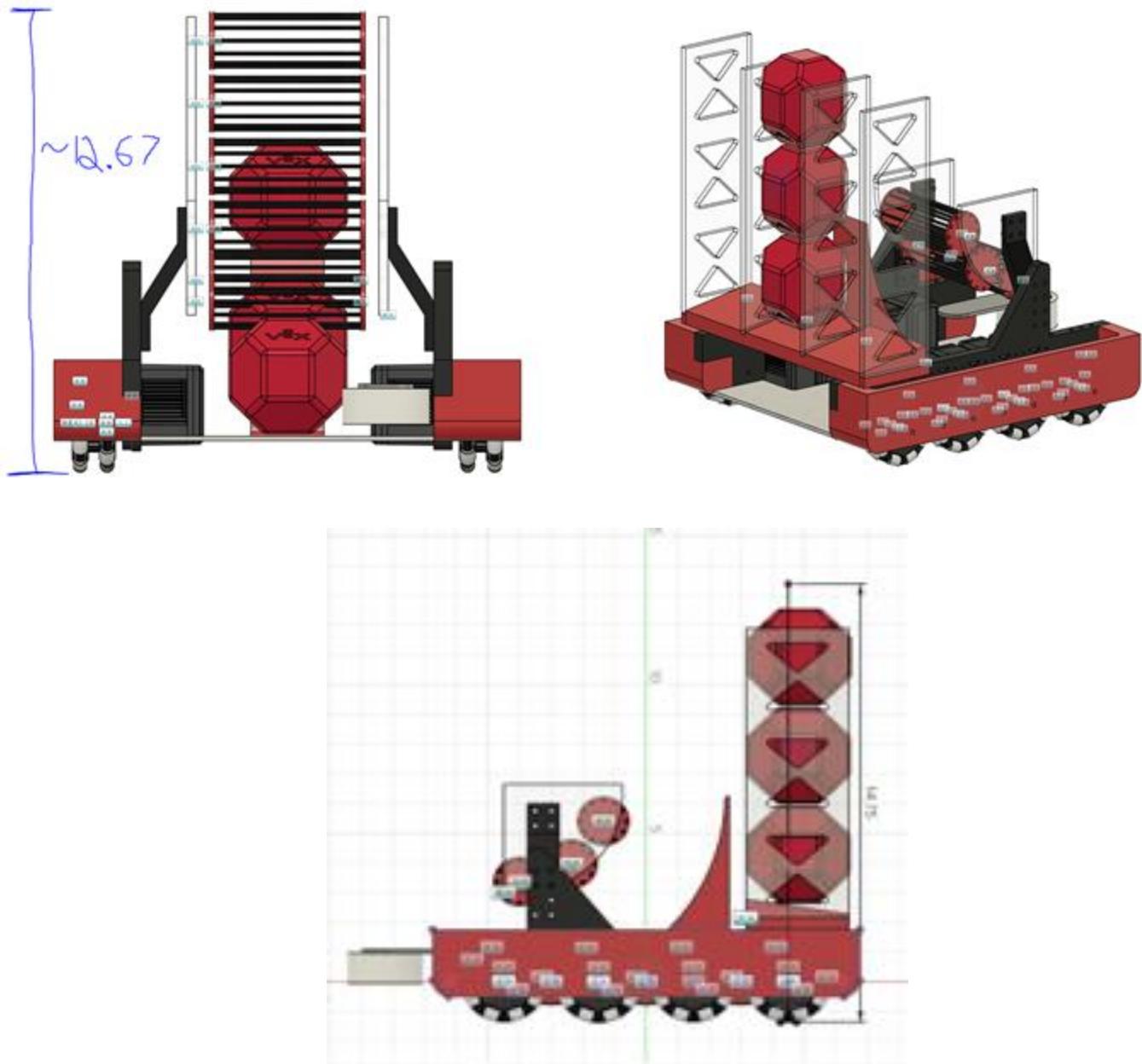
- Banded rollers will likely be better than flex wheels



5/18/2025

Robot CAD Designs:

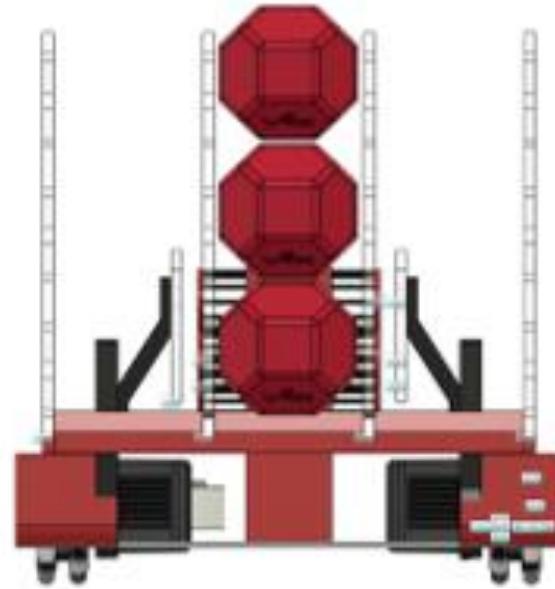
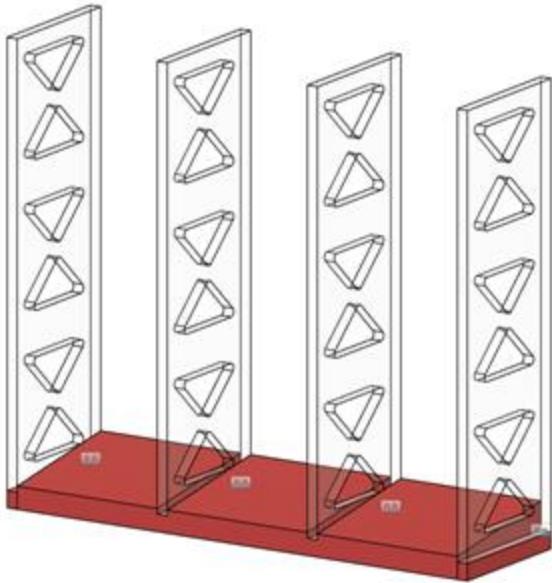
- Testing the concept of a dump. To achieve 3x high of elements, the mechanism is going to need to be recessed into the drive train



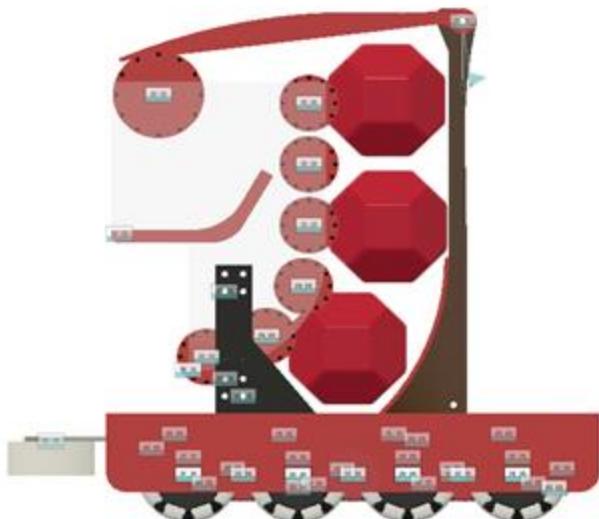
Images continued on next page.

5/18/2025

Robot CAD Designs:



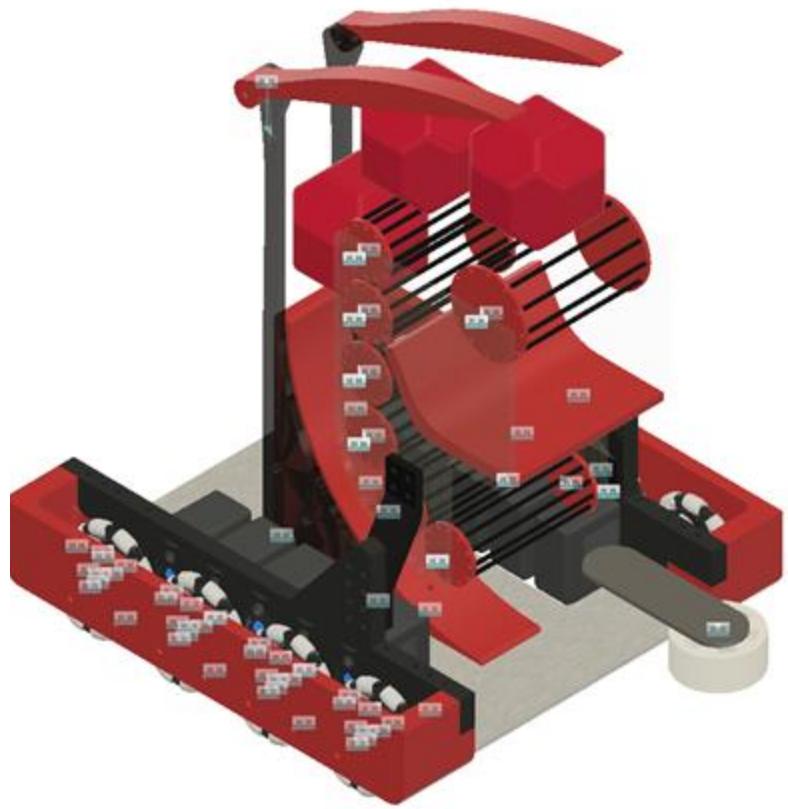
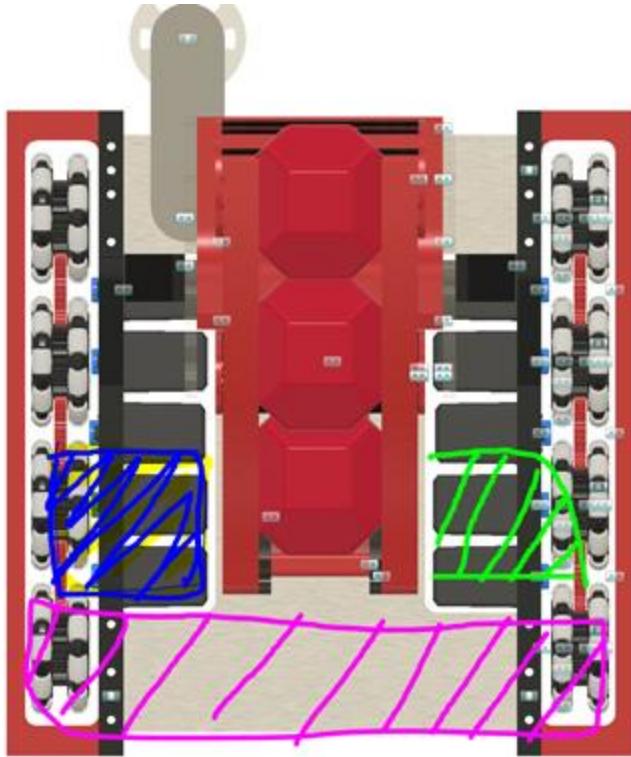
- Rough concept of a pop-up hood. This bot will be 13" x 13.5"



Images continued on next page.

5/18/2025

Robot CAD Designs:



From the top perspective

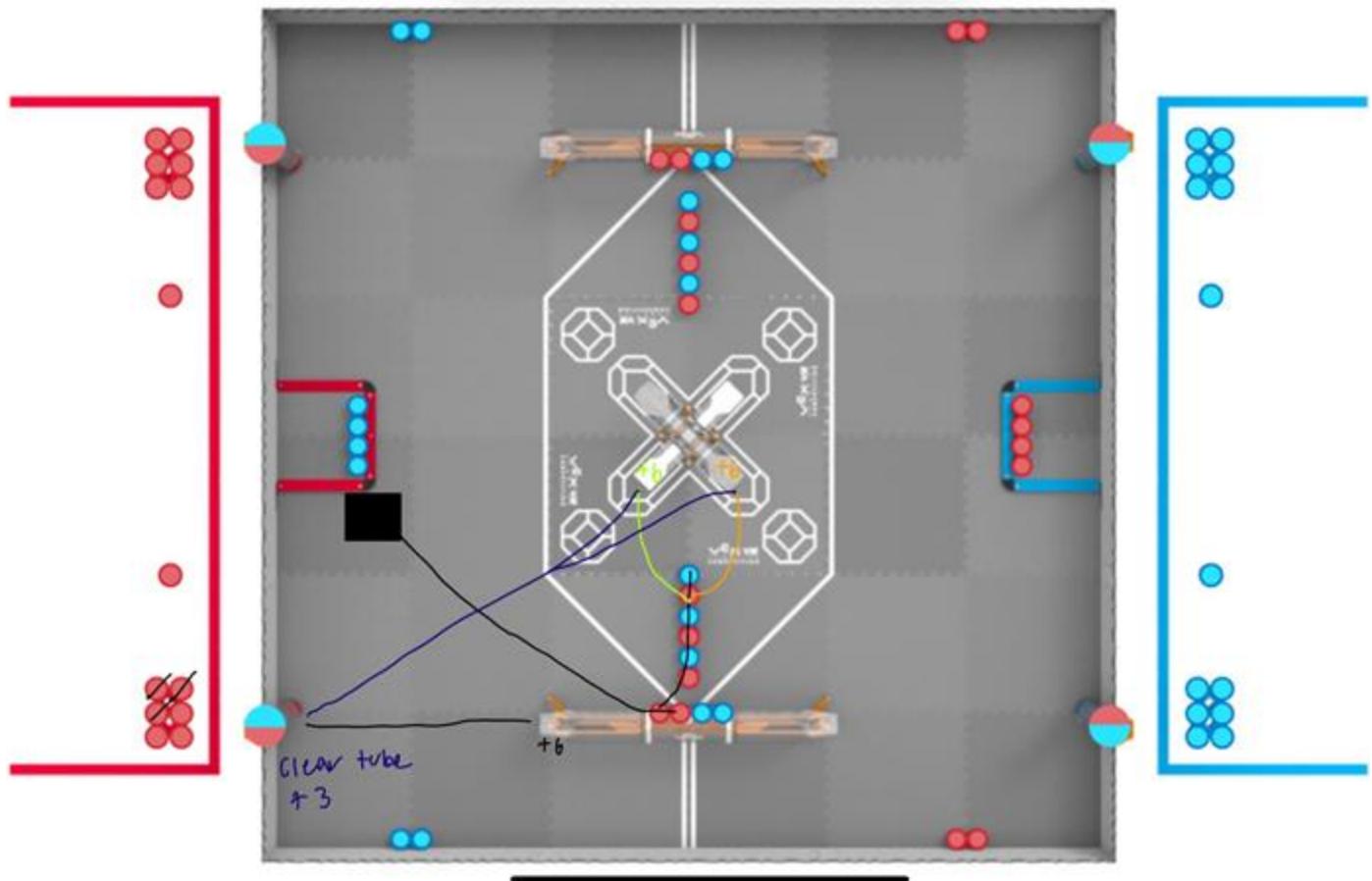
Blue is where the
slapper/puncer/piston will go

Green is where the
slide/ramp back will go

Pink is where the dumper
storage will be

5/19/2025

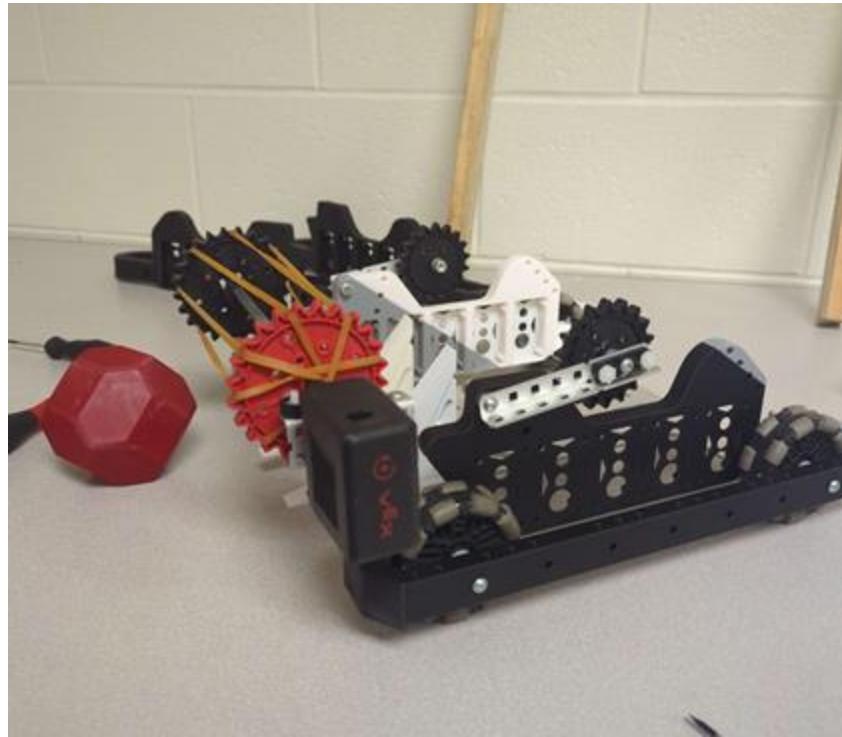
Brainstorming Match Autonomous Routes:



- With this route we will end up with 24 blocks. With the blocks we will be able to choose which tube is filled based on the opponent match autonomous programs.
- We will have a block-counter to determine how many we get from the middle rush and can go back to the match load tube before scoring in the middle goals if needed.
- Collusions will abound in the neutral zone.

6/6/2025

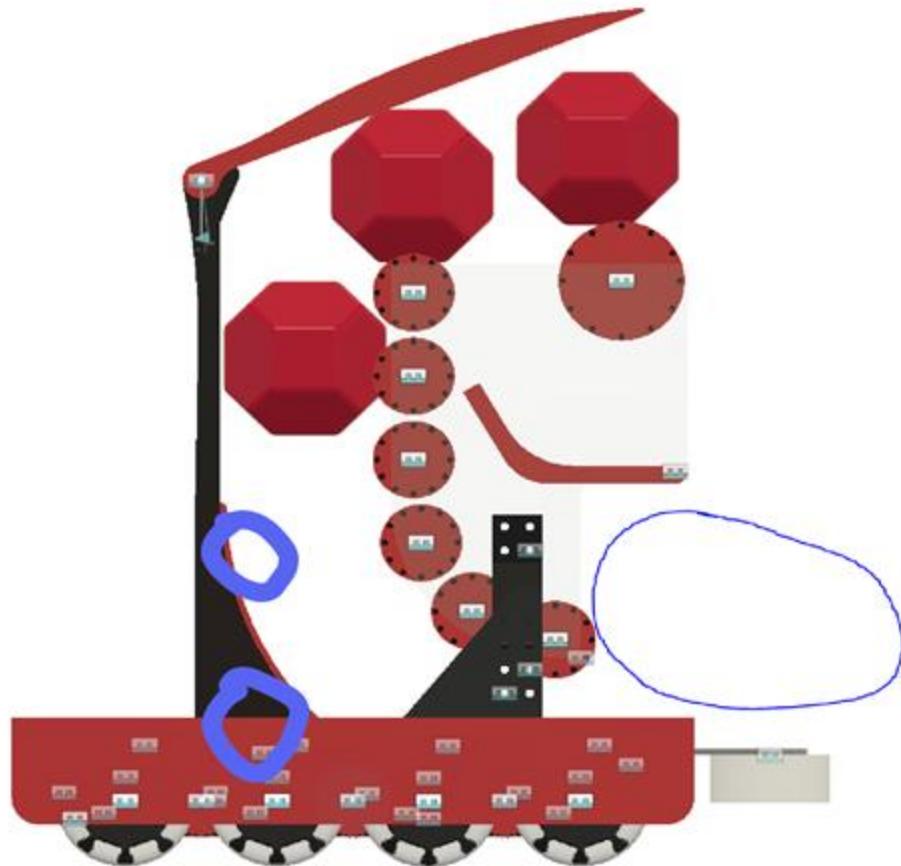
Drive Base Initial Build:



- How do we fill up a hopper from the main snail?
- Spindexer- We could have it in line with the intake (as close to the bottom of the uptake) might need something to slightly isolate the uptake from the hopper, to insure we don't pull unwanted elements back into our uptake
- Because it is the lower hopper, we need to apply a little force on the elements to load them

6/6/2025

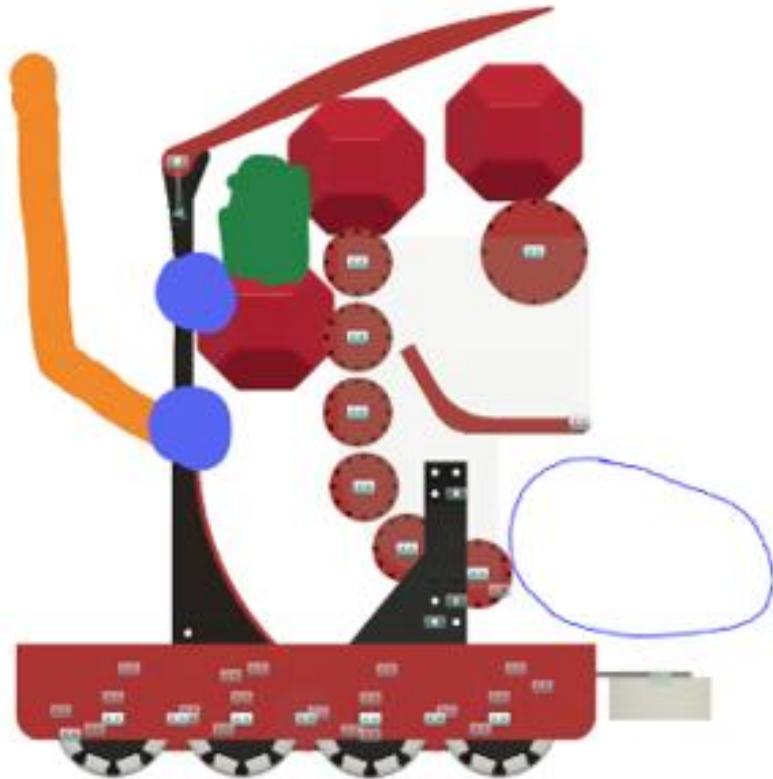
Drive Base Initial Build:



- At the same height as the bottom roller.
- We could have another set for our color to direct the balls upwards.
- Trap door to dump into the parking space.

6/6/2025

Drive Base Initial Build:



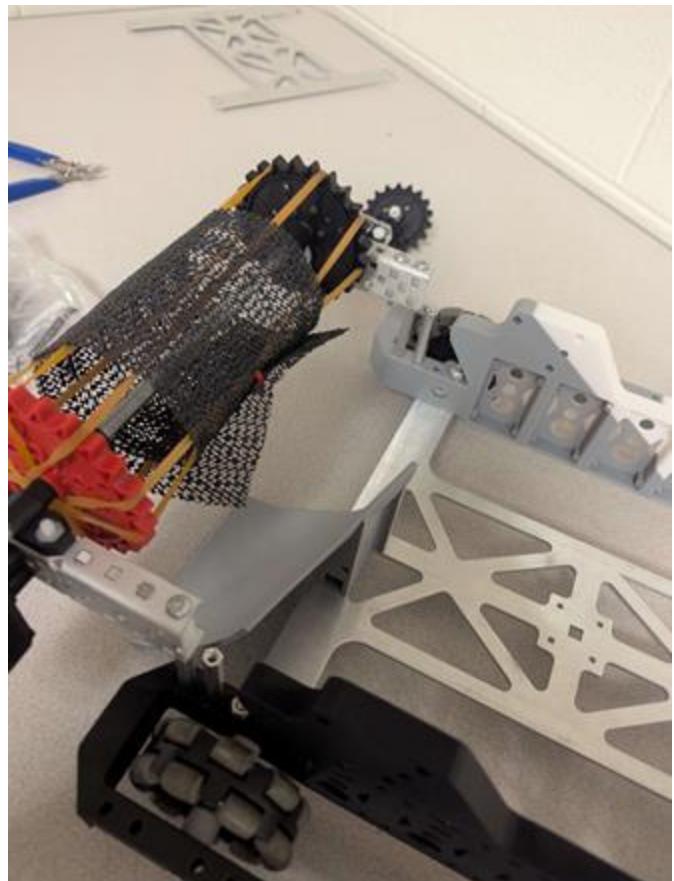
Green: diverter

Orange: hopper (with tapered floor)

Blue: rollers to reintroduce elements to snail

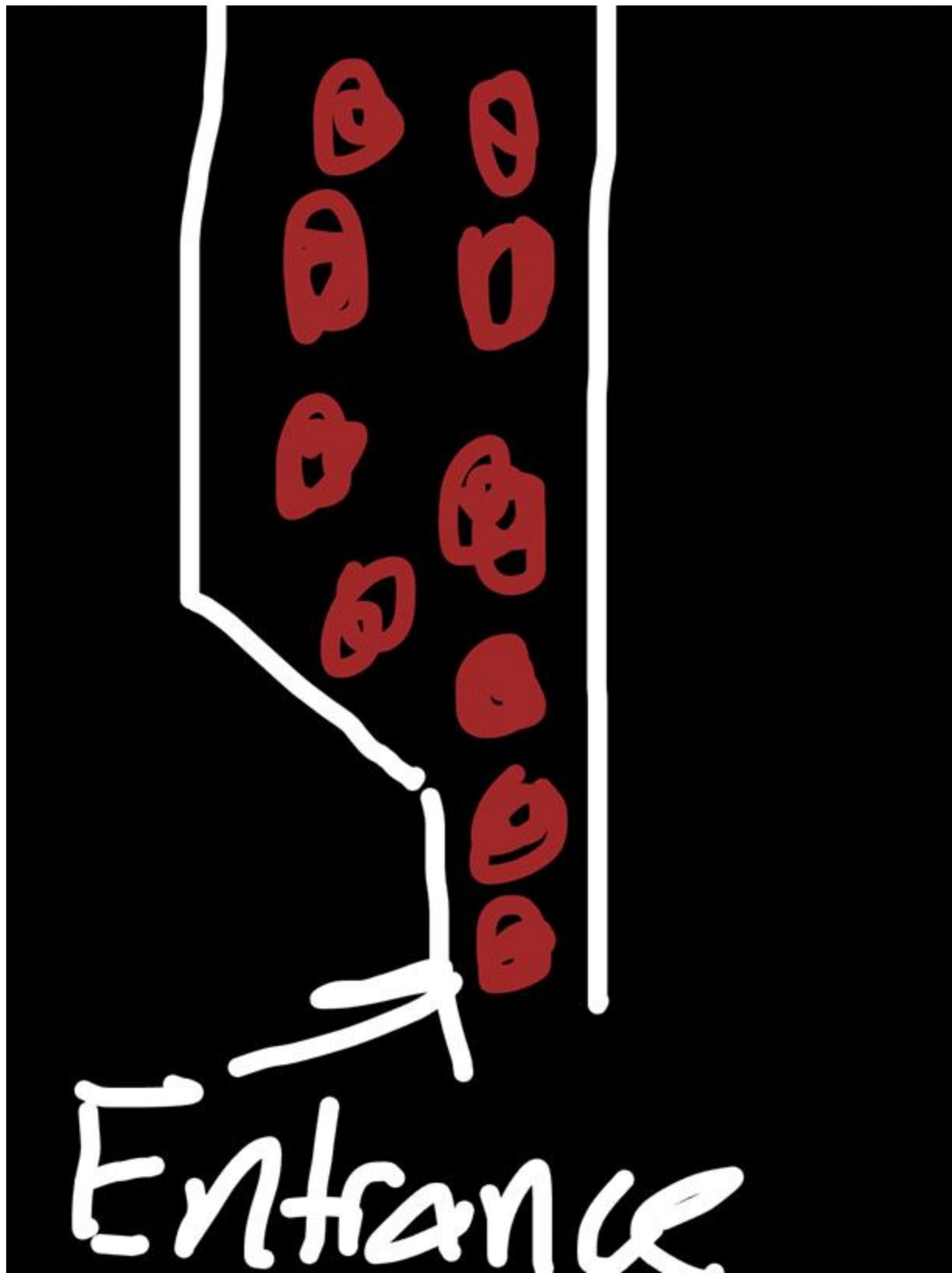
- 10 motor drive
- 1m intake, 1m bottom uptake, 1m mid/upper uptake, 1m back filter, 1m dougie mech
- Leaves 6 ports for everything else on a perfect brain, optical, coprocessor, radio

6/6/2025



Worked on a ramp that will allow us to funnel while we intake. Good centering

6/14/2025



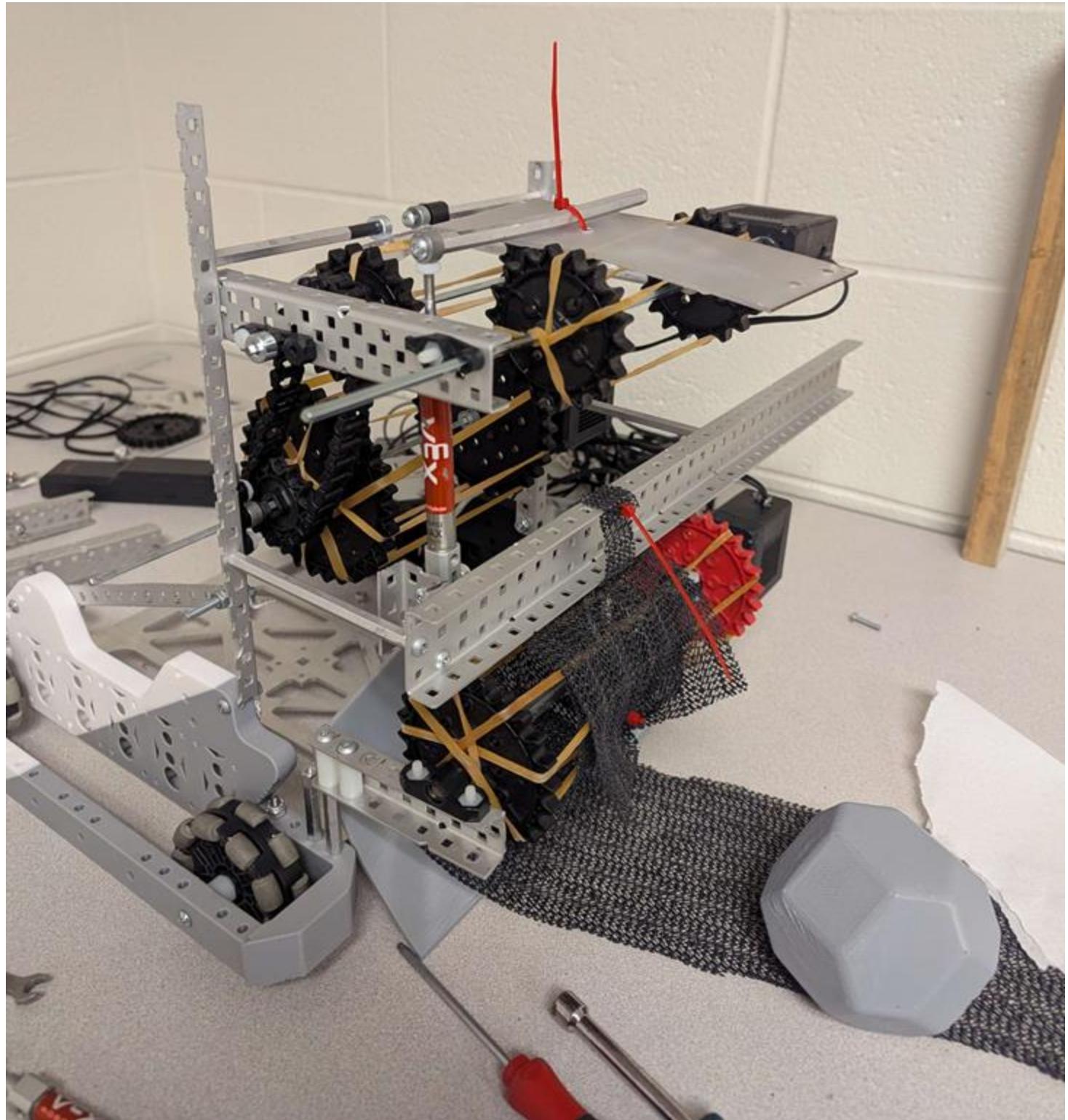
This won't jam

6/15/2025



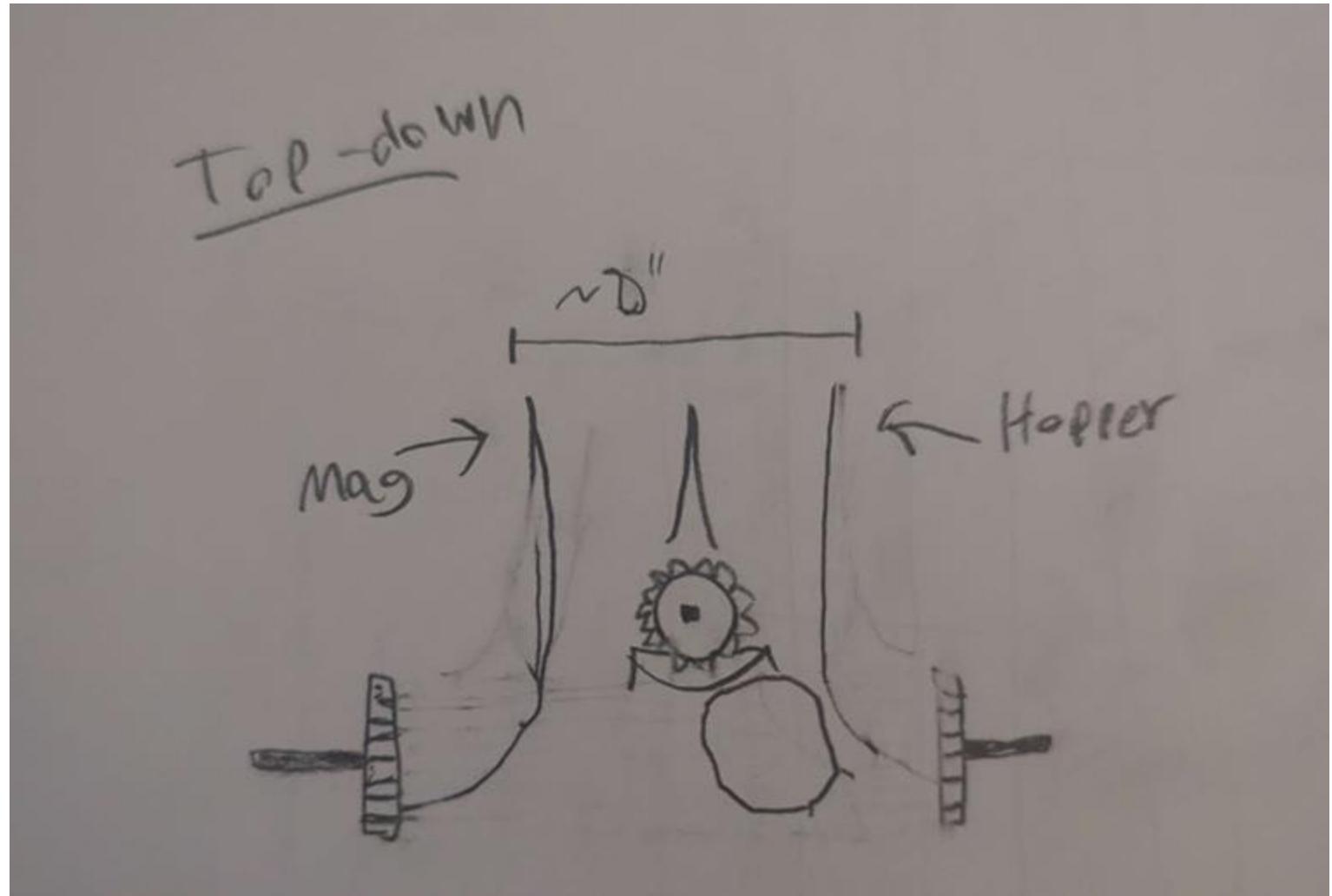
A hollow coil with an is big enough to store balls as the magazine design. Maiximizes capacity while giving us tremendous control over the track

6/15/2025



Lexan hood, a more rigid hood would also probably be better for consistency

6/16/2025



Thinking about a single huge hopper that spits opponent blocks out at the top of the hopper when they're outtakes into the snail. Talk about maximizing capacity. 15' isn't much

6/16/2025

-Albus arbitrary scoring configs given ammo

Establish:

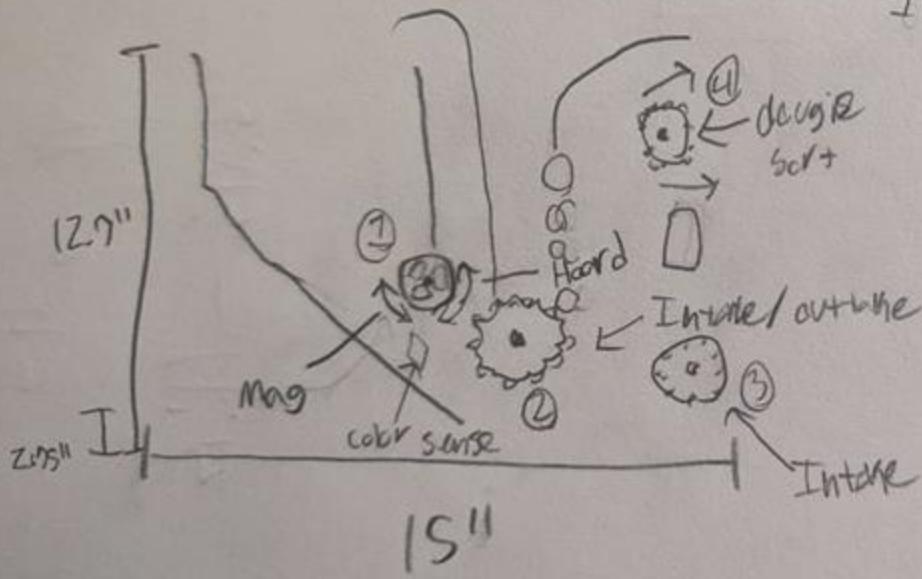
Red \Rightarrow Alliance
Blue \Rightarrow Opponent

Intake red: Sorter \nwarrow
Intake \nwarrow

Outtake red: Sorter \nearrow ?
Outtake \nearrow ?

Intake blue: Sorter \nearrow
Intake \nwarrow

Outtake blue: Sorter \nearrow ?
Outtake \nwarrow



Capacity estimation: 22 blocks

2.75" \times 12.7" \times 15"

Thought process on the next page.

6/16/2025

We need the highest capacity you could give a 15" without expansion. Estimating the capacity with hexagonal close packing, we could do 22 blocks with no expansion. We don't need anymore than that.

4 motors for the entire block system.

Bluc blocks get thrown up to the top of the hopper and red blocks are loaded in the bottom. Then when a blue block comes out while trying to unload a red, it just gets thrown back up to the top.

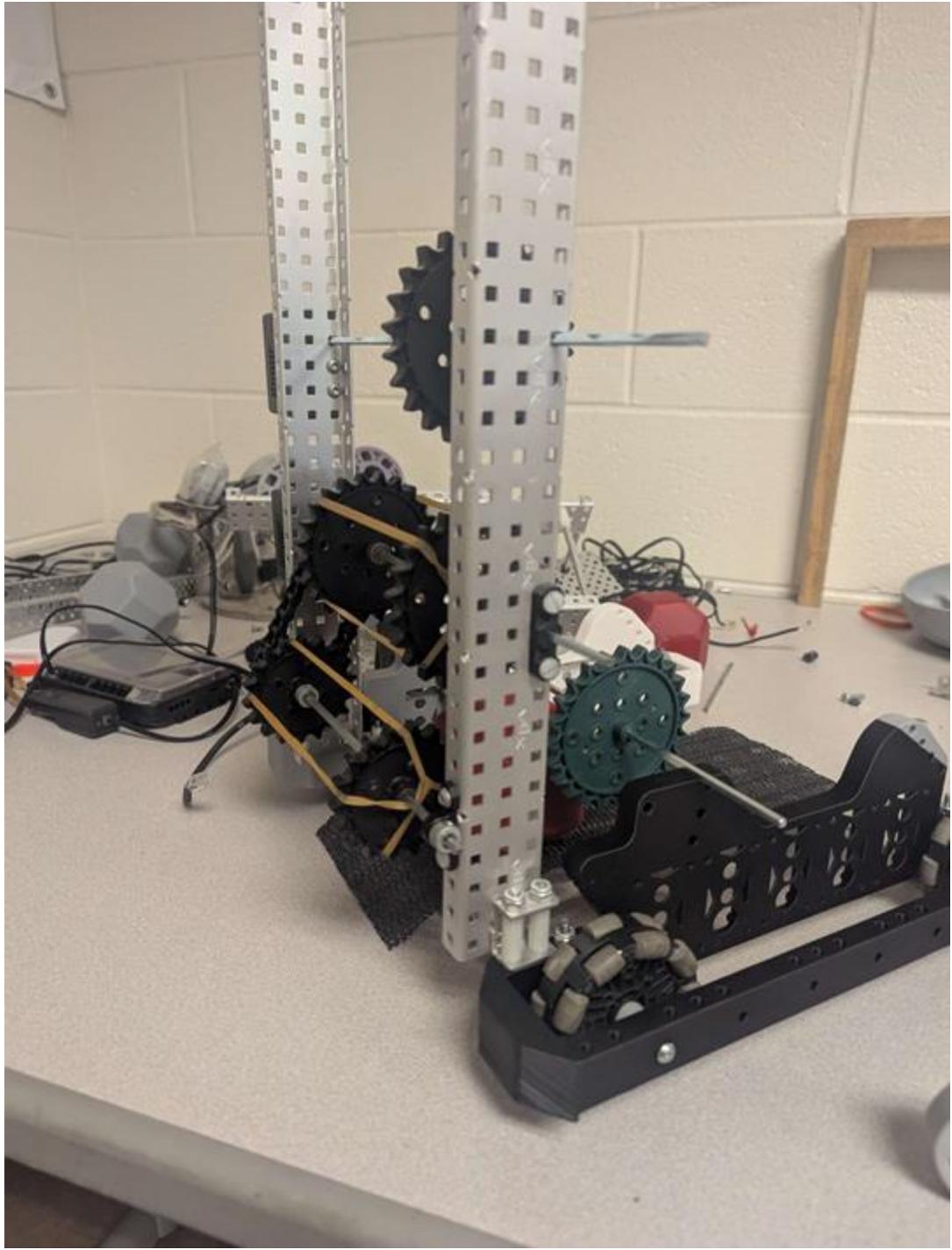
1 hopper seems the best.

You get to decide on the fly how much capacity you want to allocate to red and blue blocks, and both can be sorted so you can use a blue if you're short on reds to change a control zone.

We need color sort somewhere and this is a very functional and low profile way to do that.

Jams can be avoided by adding rollers above the sort rollers to stir up blocks.

6/17/2025



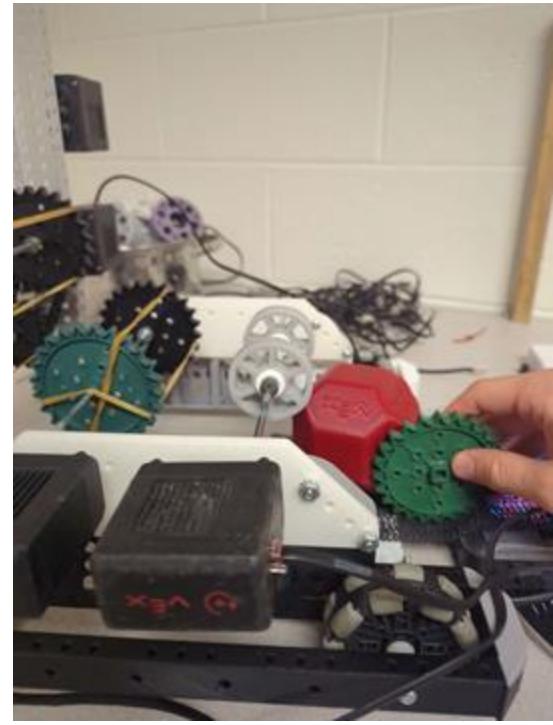
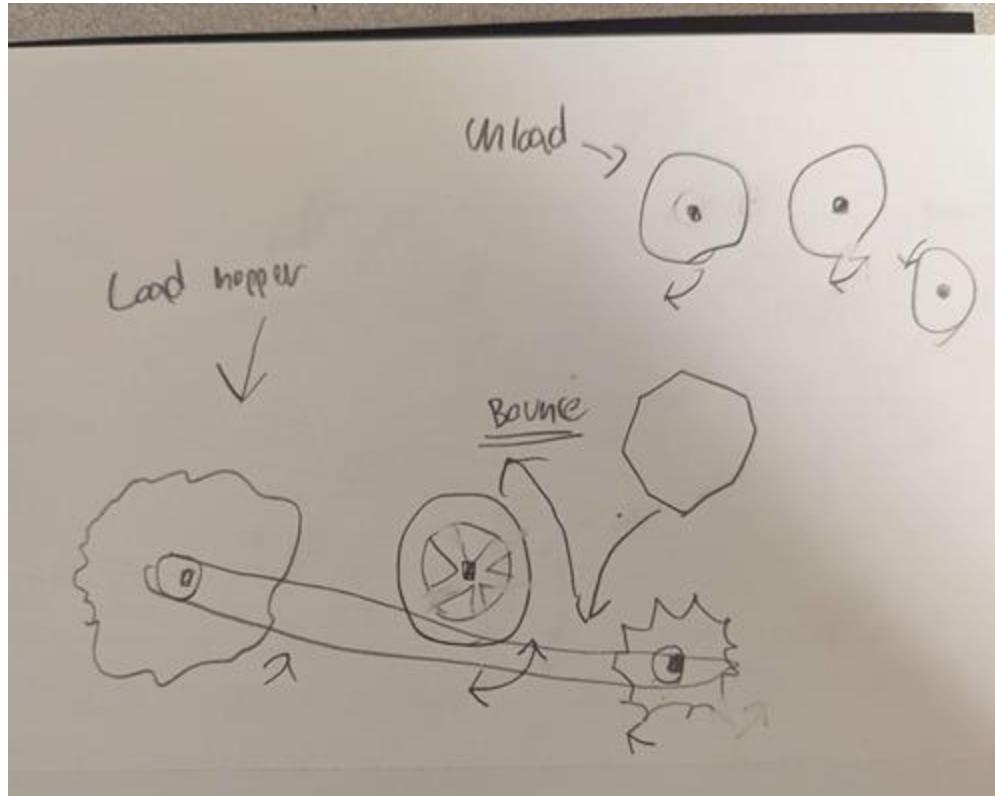
Mono-hopper

Block 1: sends into snail for scoring

Block 2: sends up to the top of hopper

Block 3: loads hopper from bottom

6/18/2025



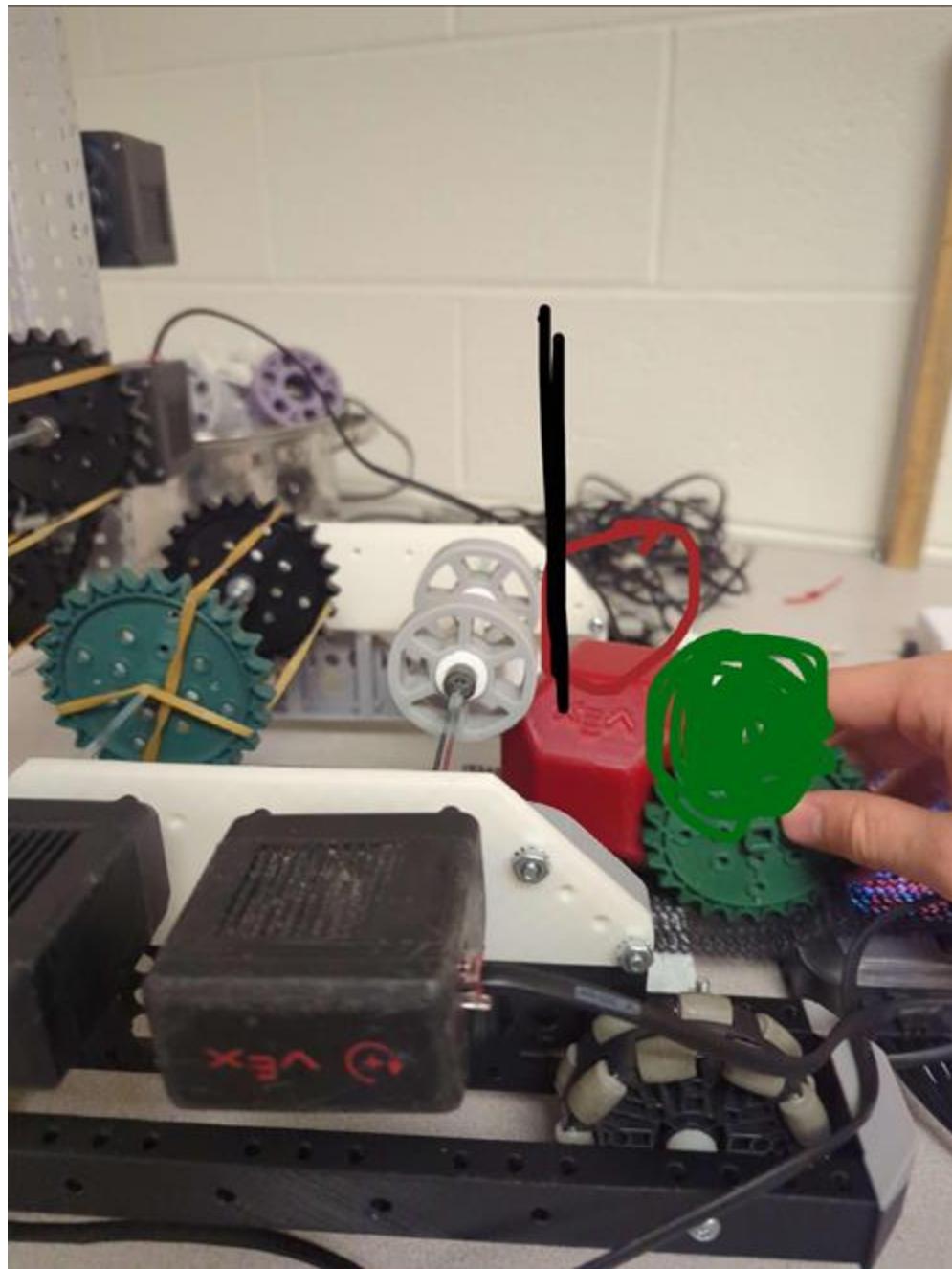
Subsystem

Allows us to shoot blocks back up to the top without unloading extra

Significantly reduces jam risks when unloading

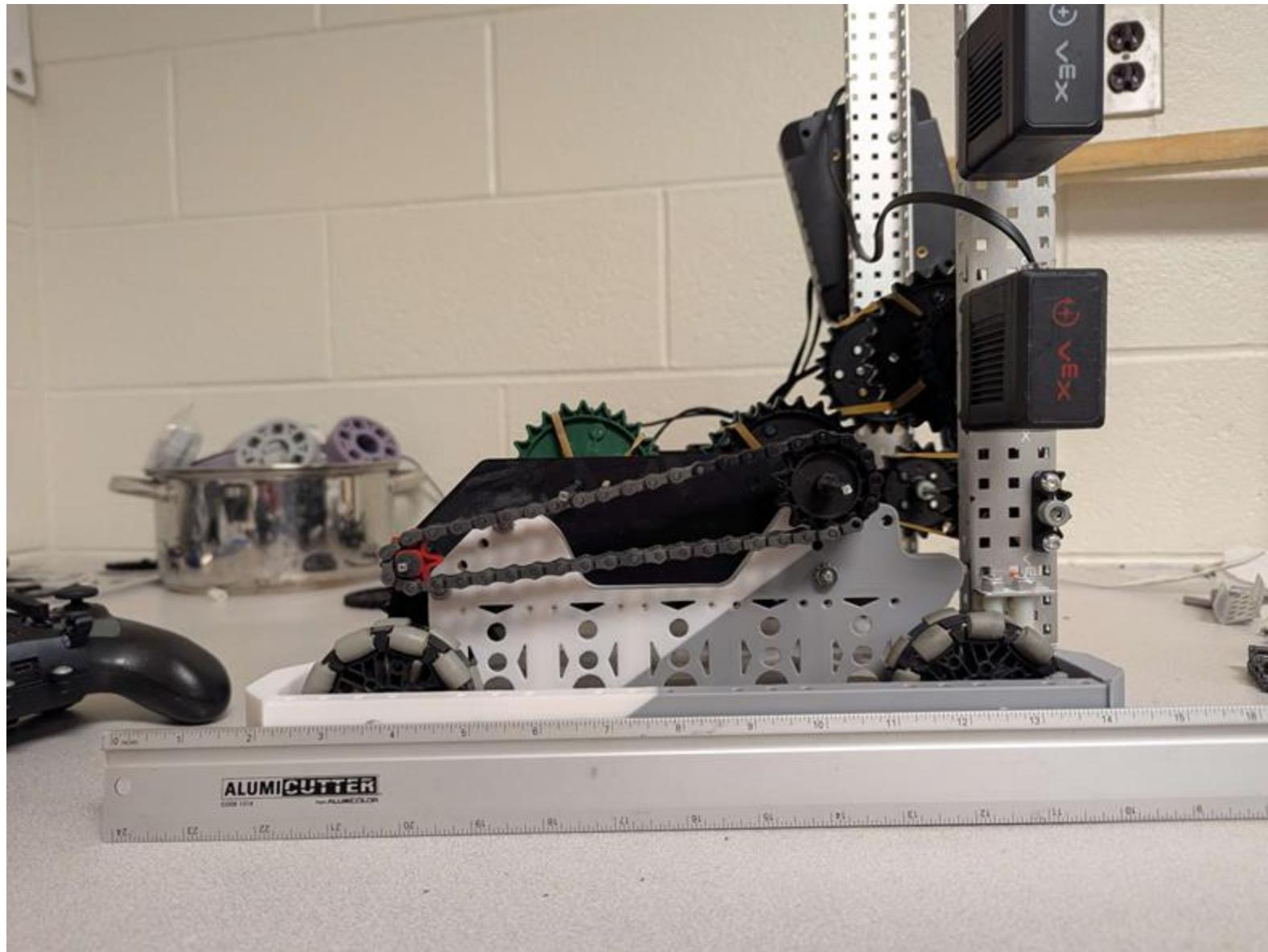
Back intake

6/18/2025



The wall blocks the balls from hitting the motors and rollers
Instead of a wall, arc around the flex wheel + more capacity.
Flex wheel is also going to become a sprocket

6/18/2025



7 inches in the back of the bot just for hoarding

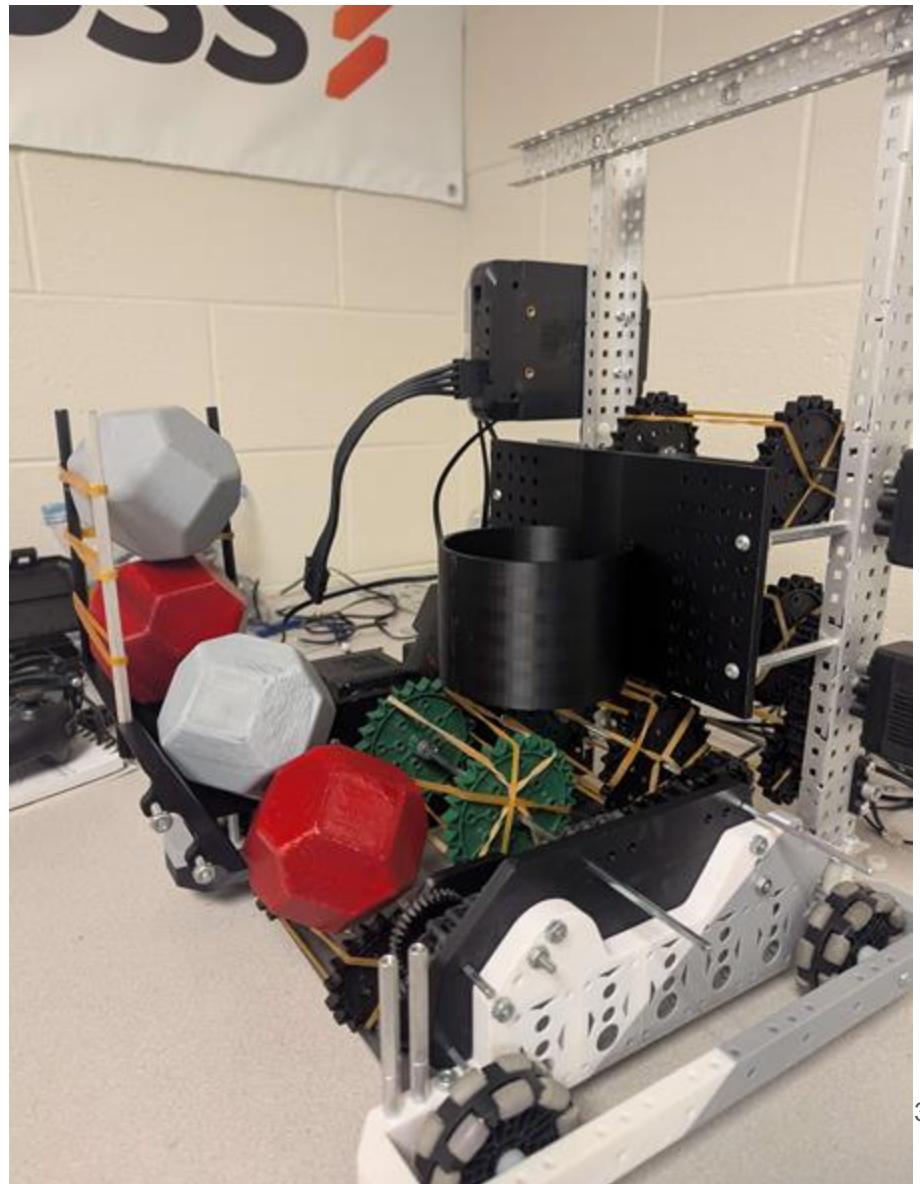
6/18/2025

Hopper capacity is 17

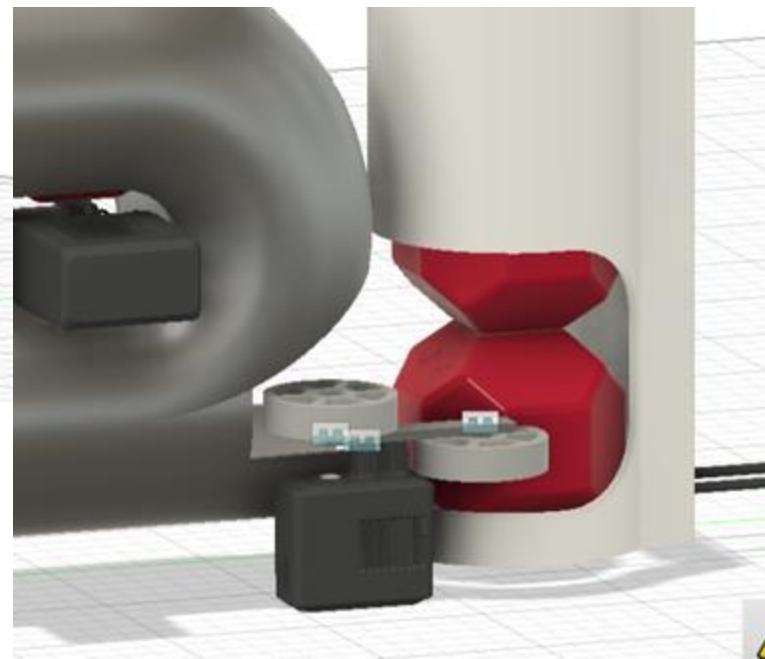
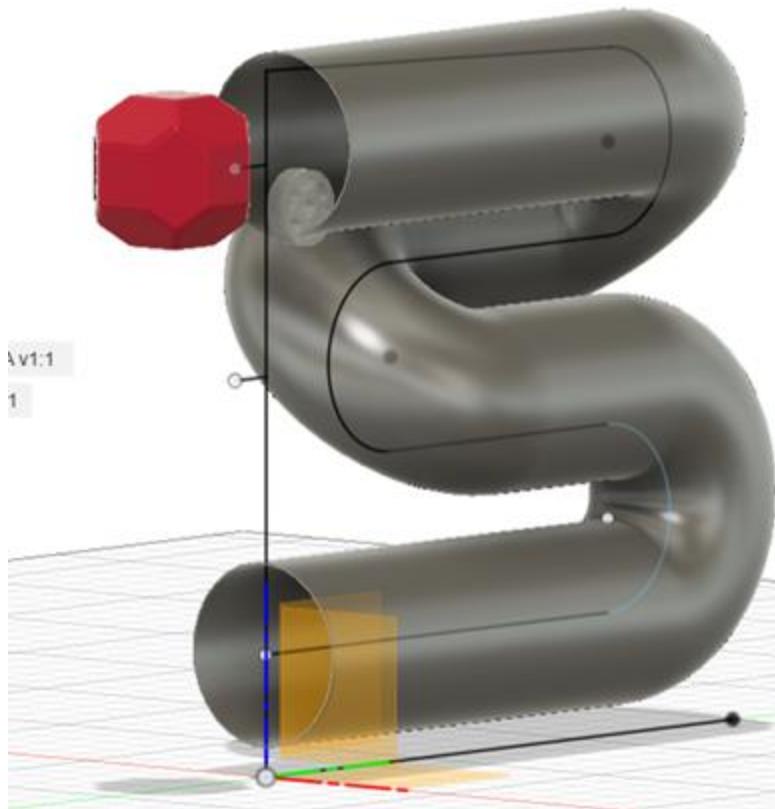
For the magazine, rather than a straight tube, make a sloped funnel (on the left and right side) like $\frac{1}{4}$ of the way up the current funnel. Could 3x the magazine capacity while still getting the elements out in a single file

Doing that would decrease the hopper capacity. That tube isn't primarily for storage, it is for redirecting blocks to the top of the hopper

Dump time is very fast right now, like 3 or 4 balls a second. But they might come out with too much force right now, we will have to tune it down. Otherwise, they might just shoot through an empty goal. Testing an improving cycle efficiency will be the name of the game if this design plays out how Noah will think

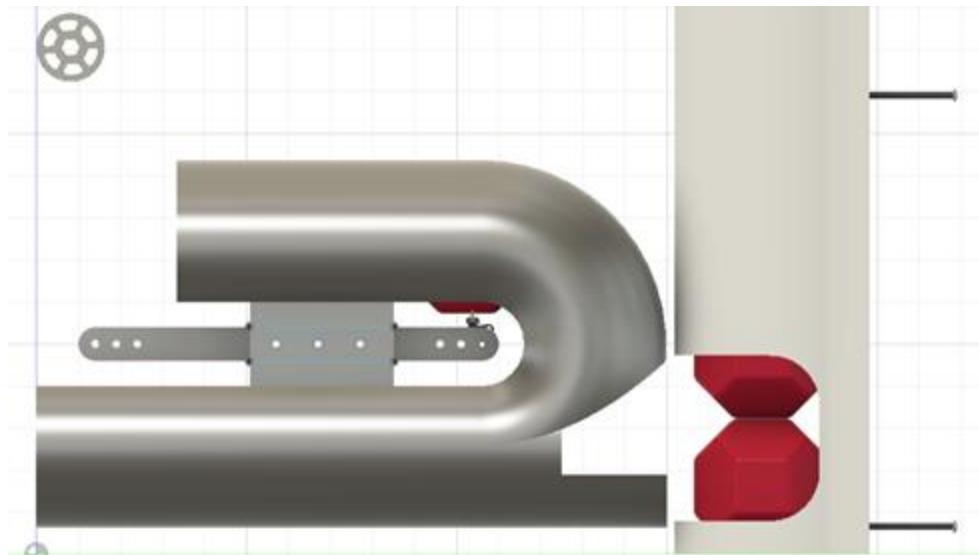


8/1/2025



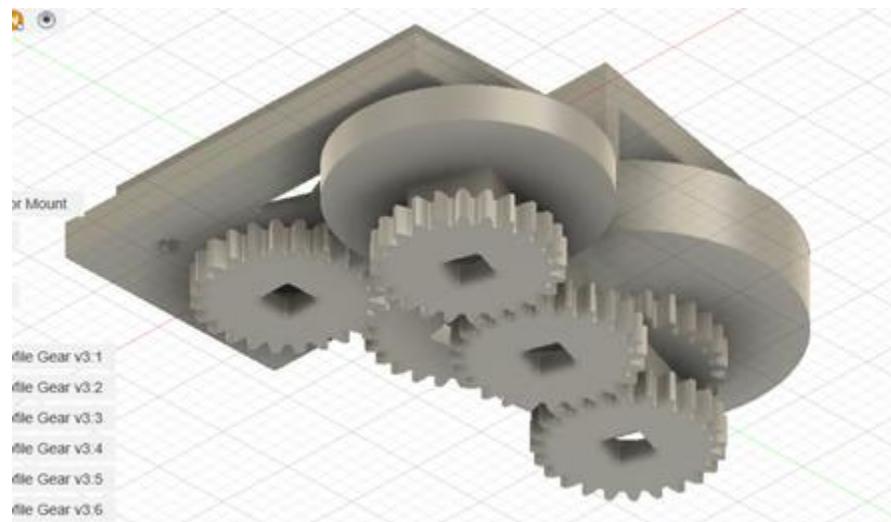
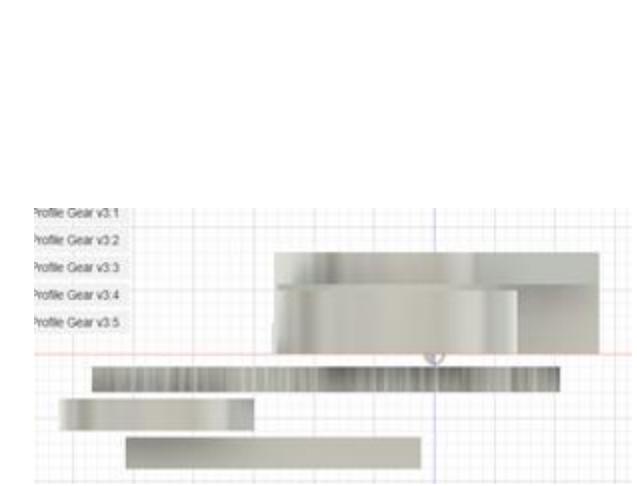
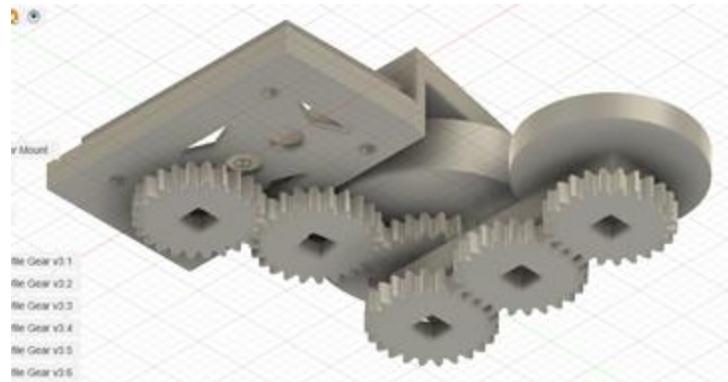
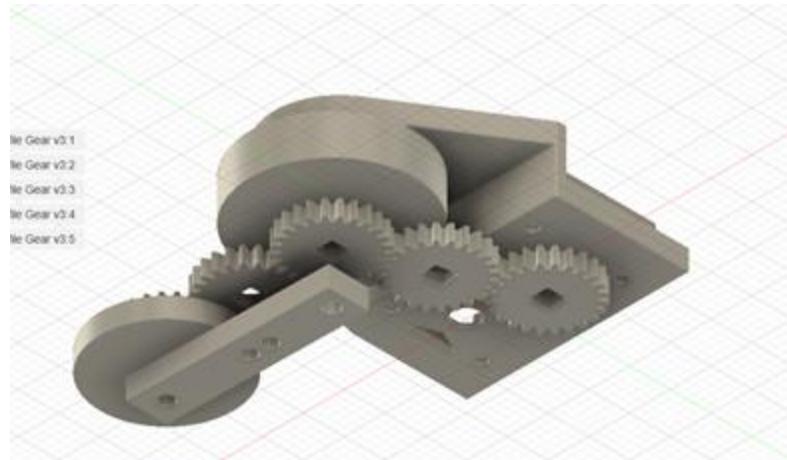
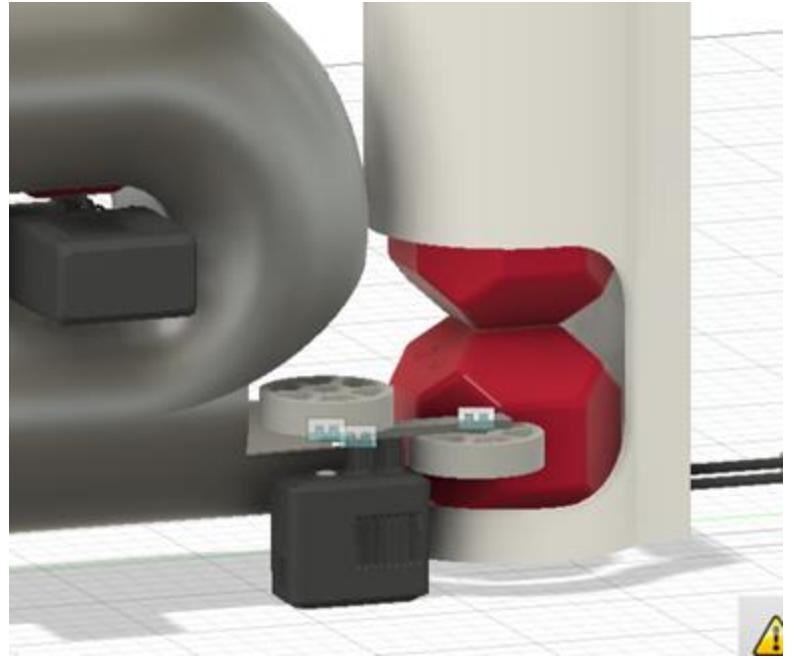
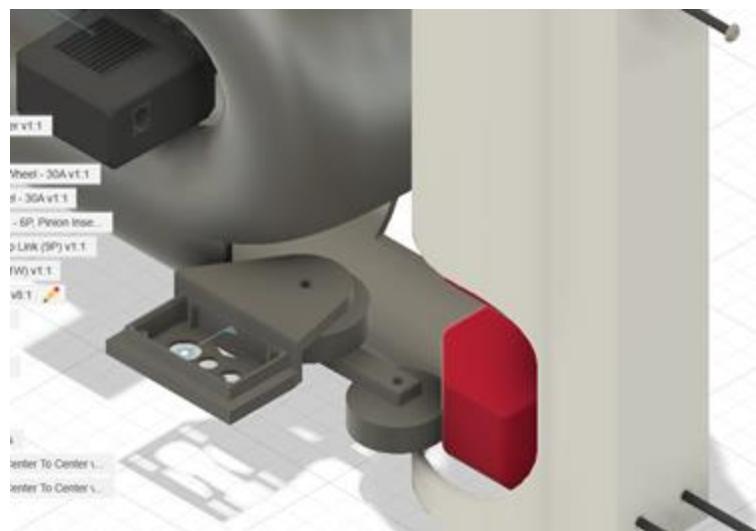
On the 15, 13.25 capacity with front scoring for all goals and rear intake for match loads.

That puts us at 15 motors with 10m drive. Motor sharing for the snake



8/2/2025

Will need to expand to this in order
to start in 15



8/2/2025



First test print, slightly lighter than predicted, too tight on the game elements though

9/6/2025



Robot built so we have something to show new members in our weekly club meetings

9/8/2025

Design questions:

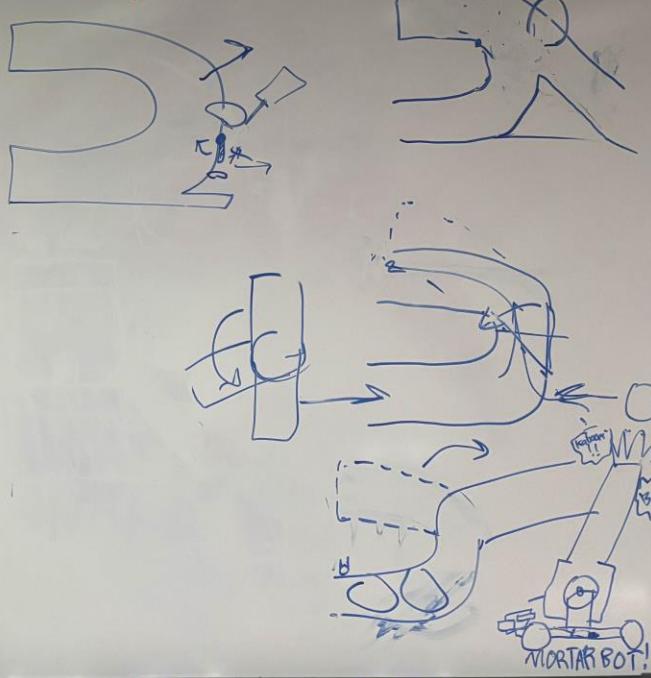
- Ramp or Koller? - How 2 surv?
- Extending intake?
- Maybe for match loads and own
- Make snail as thin as possible
- Goal aligners?
- Tongs!
- (VStam)



Wish list:

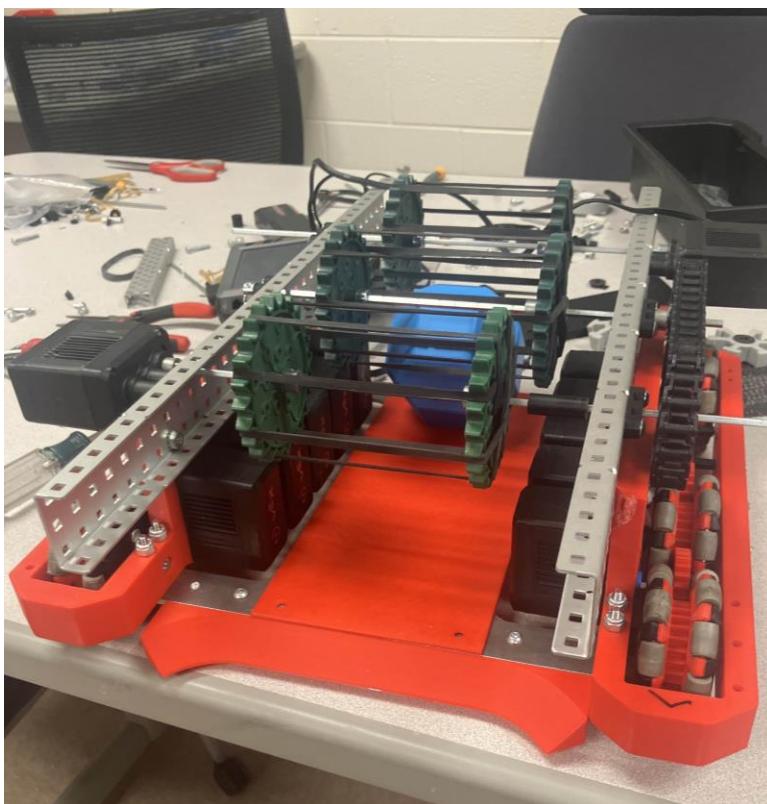
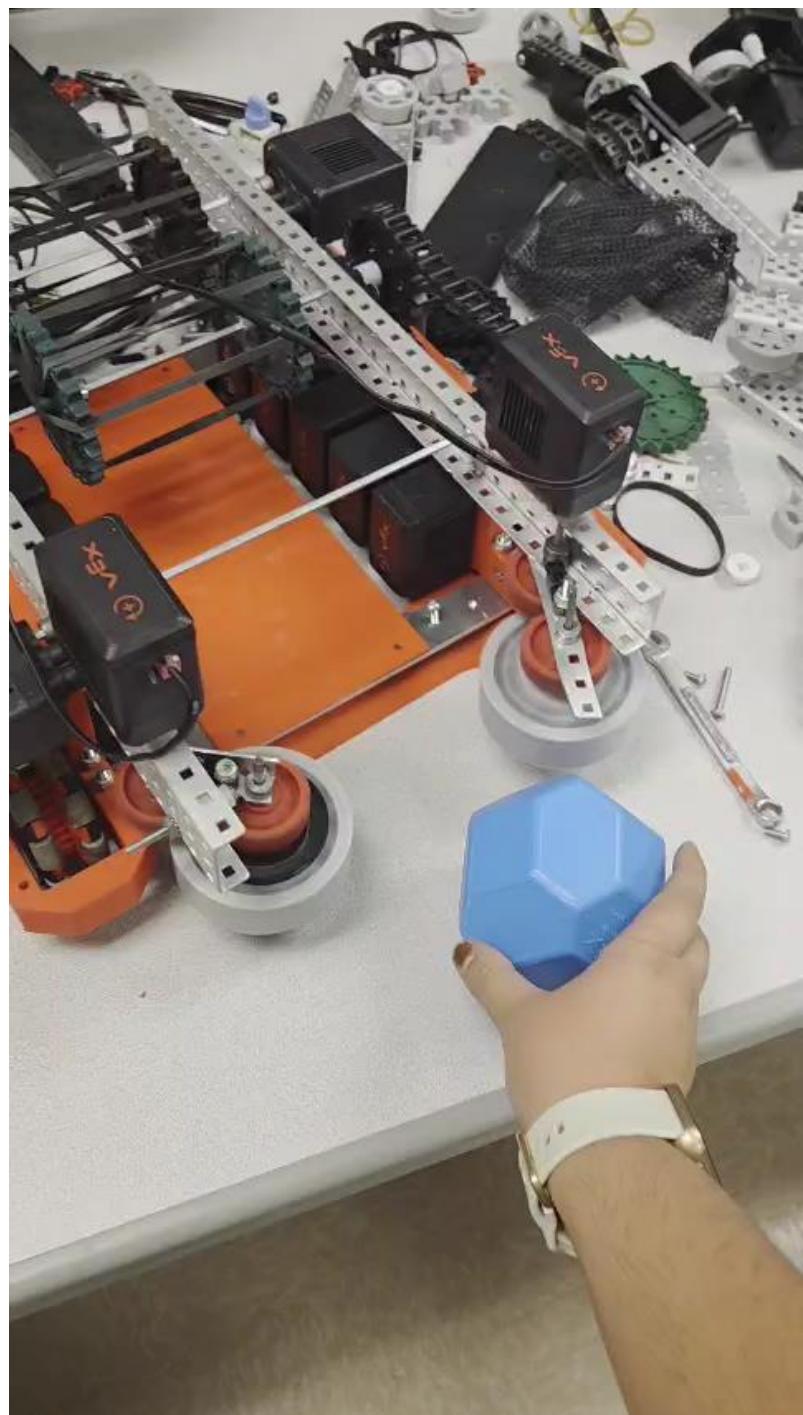
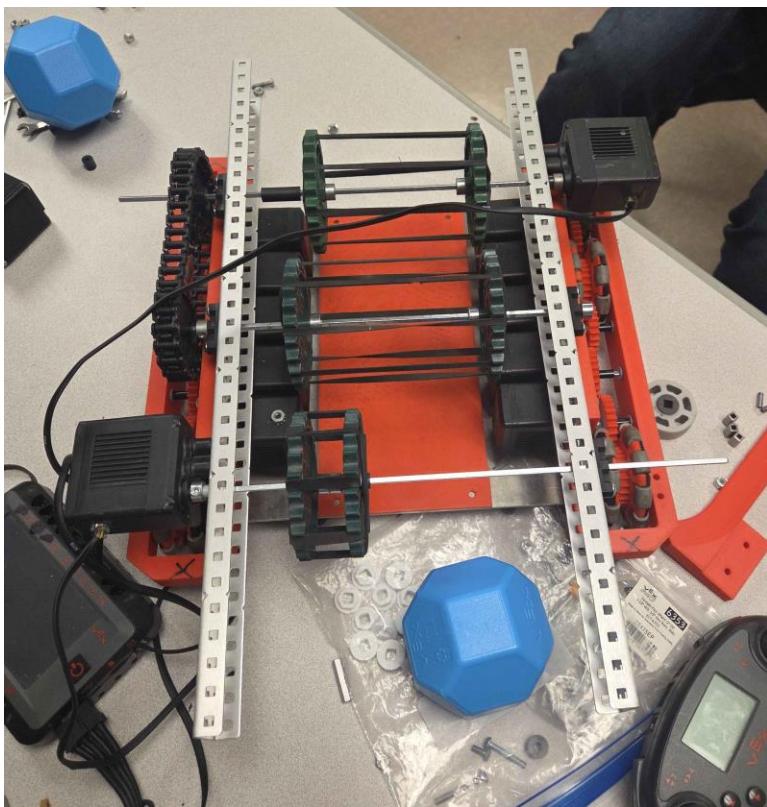
- Robot cart
- Tool organizer
- Nylon collars

BACK

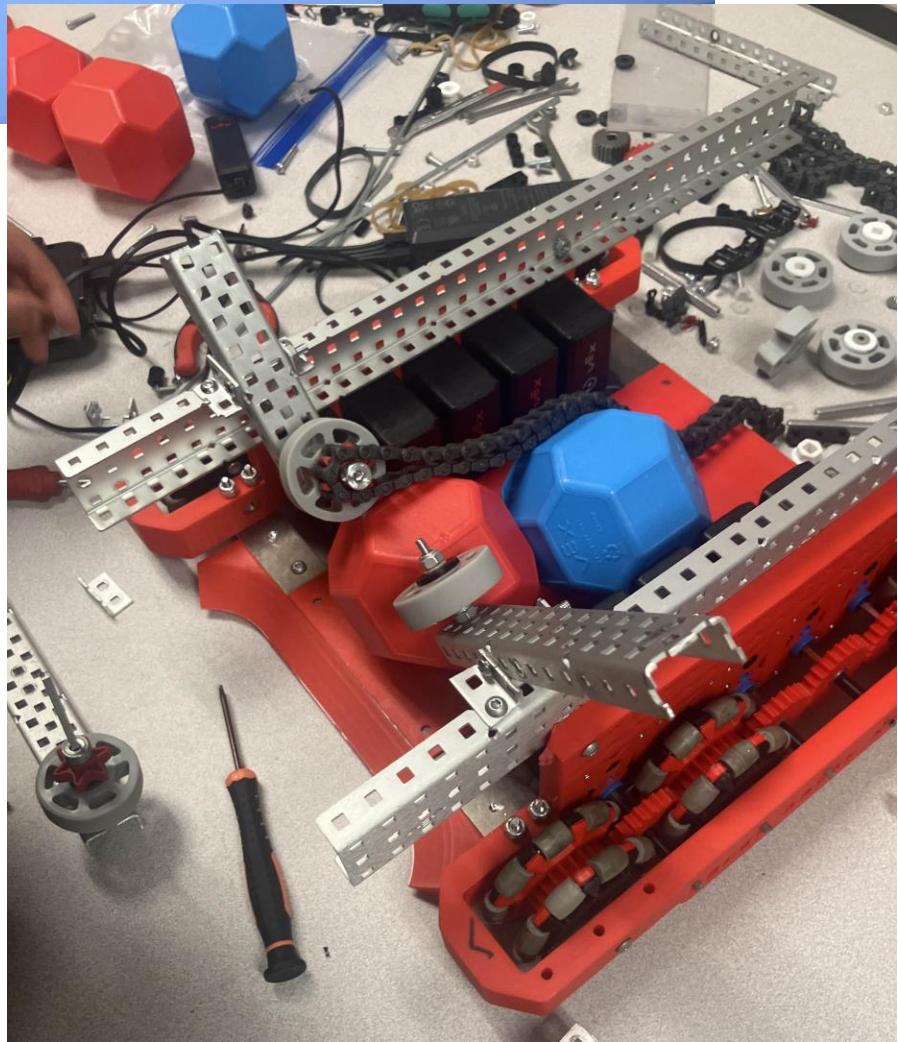
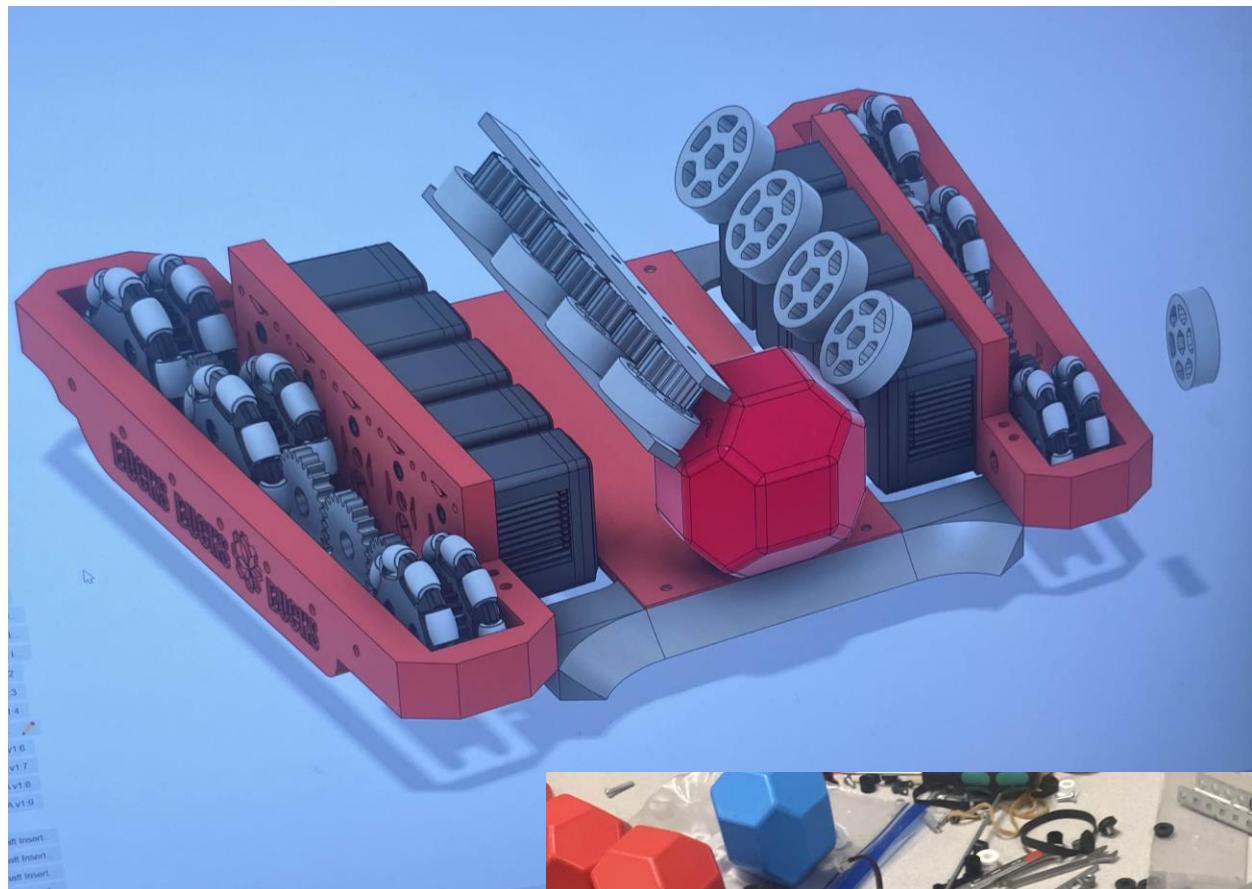


Intake designs. Designed by new member teams.

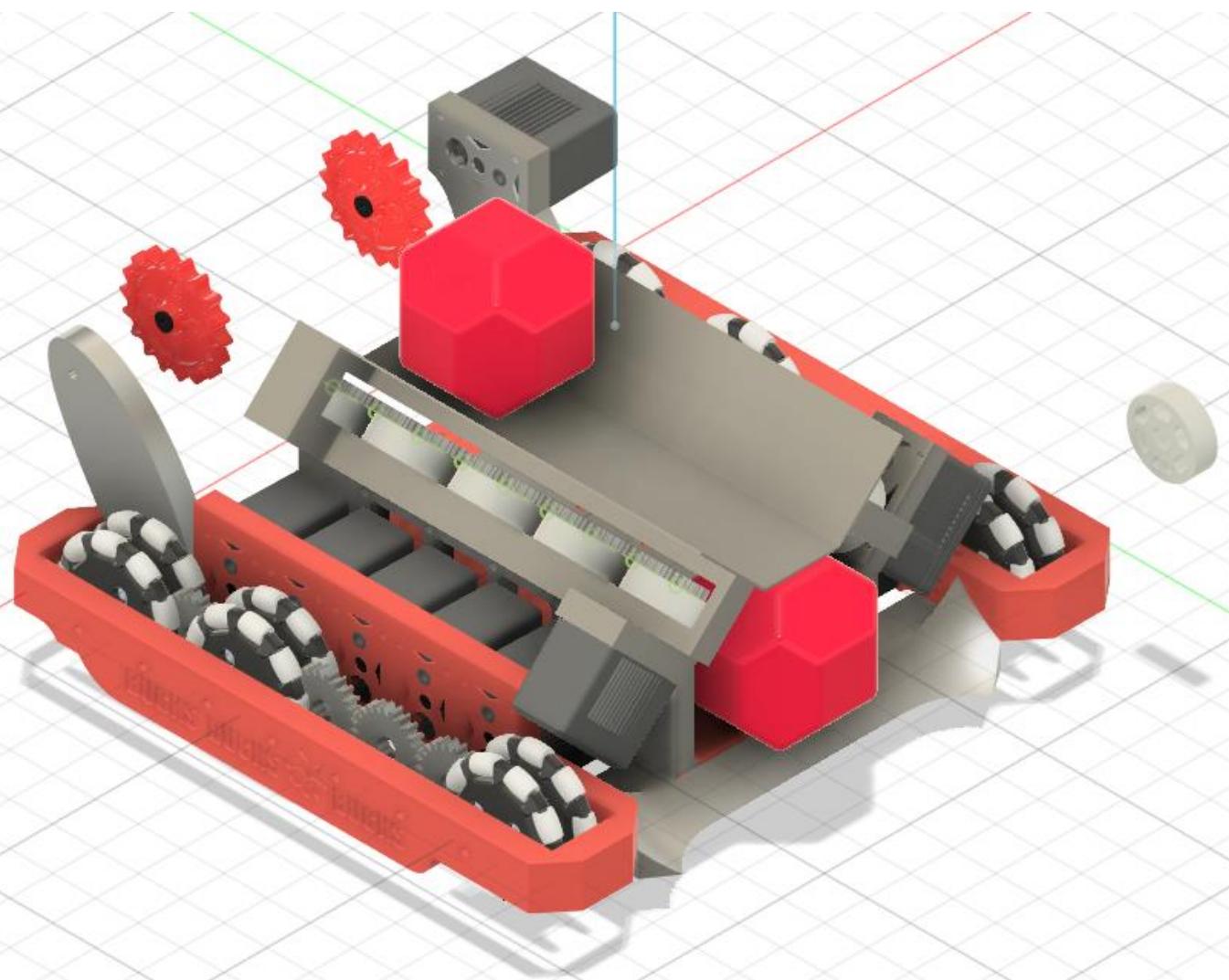
9/10/2025



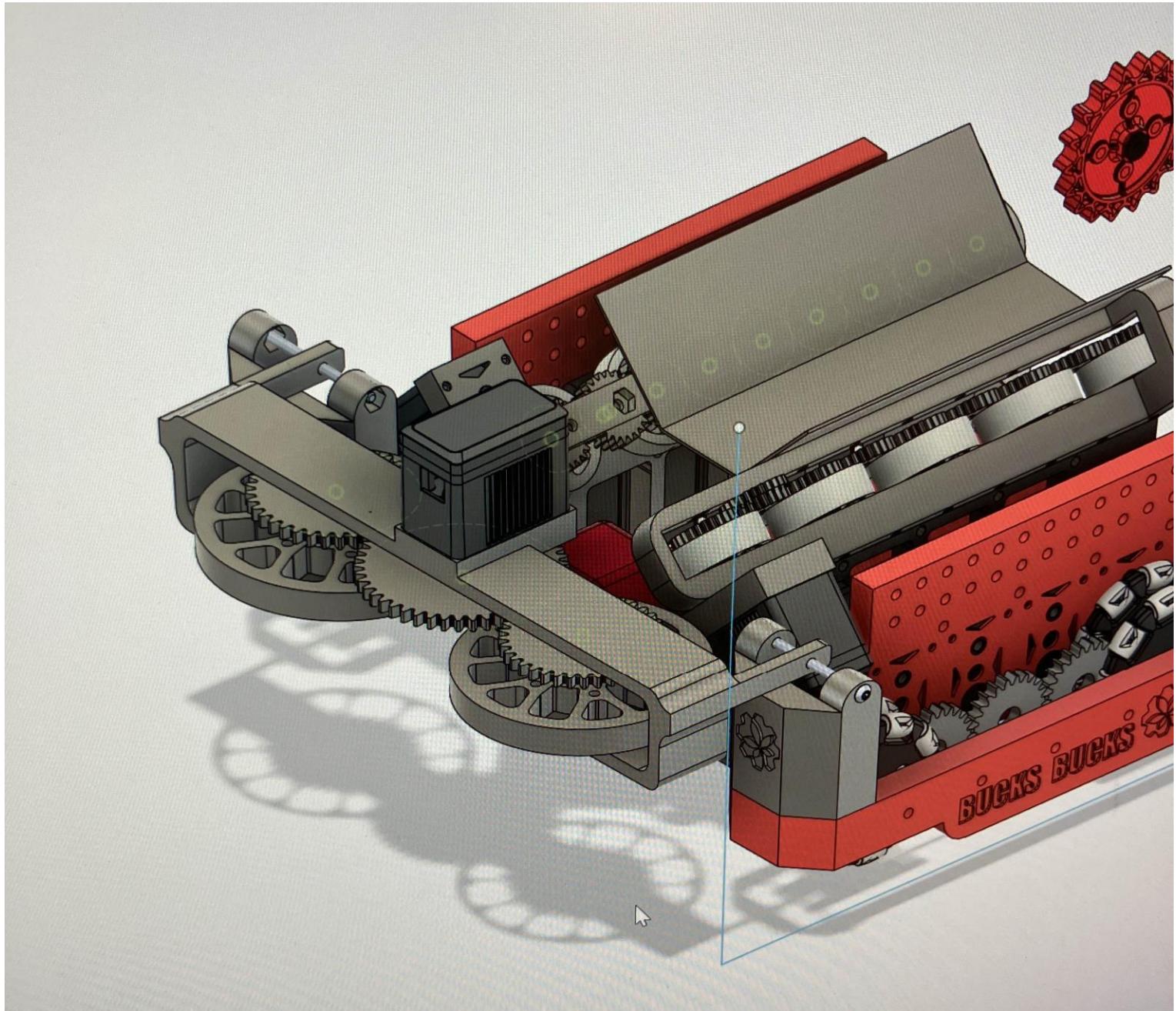
9/11/2025



9/12/2025

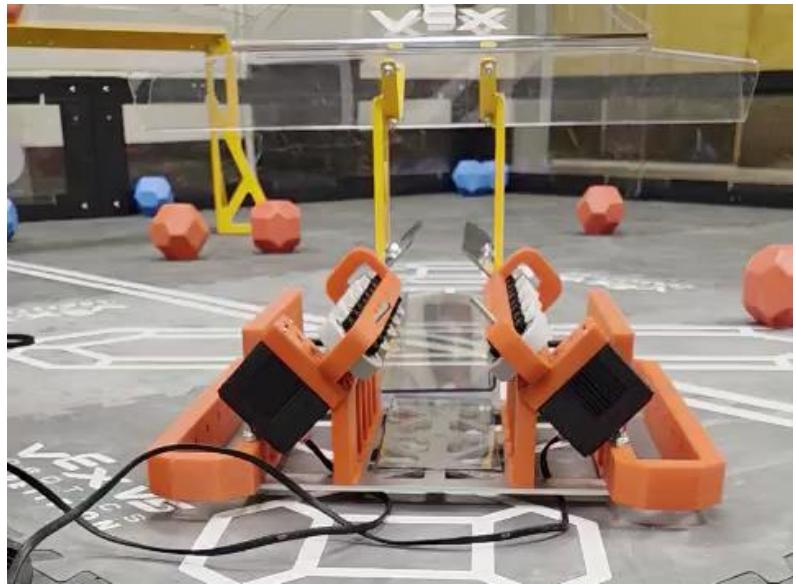
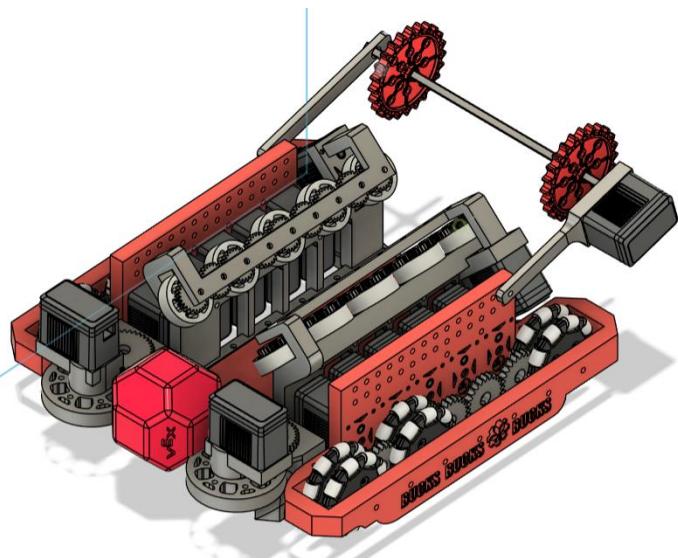


9/13/2025

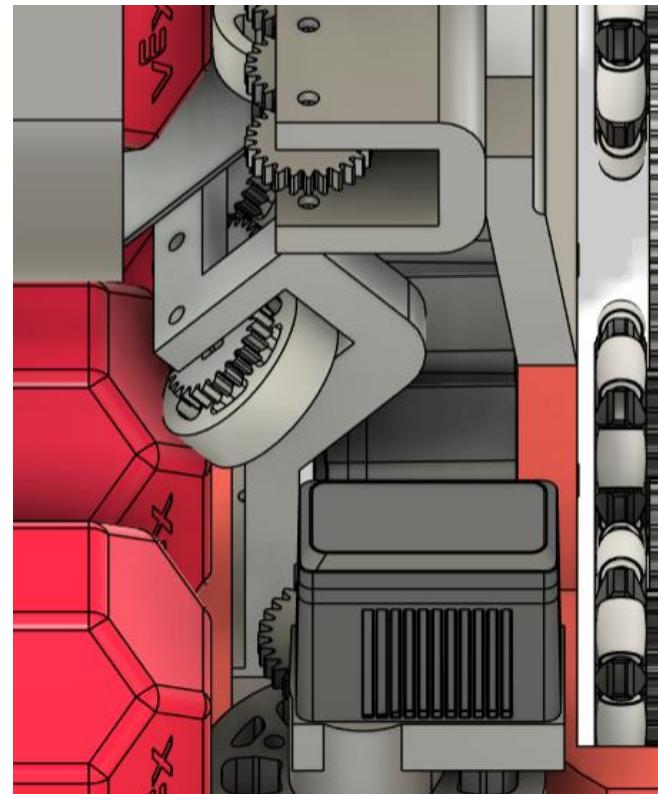
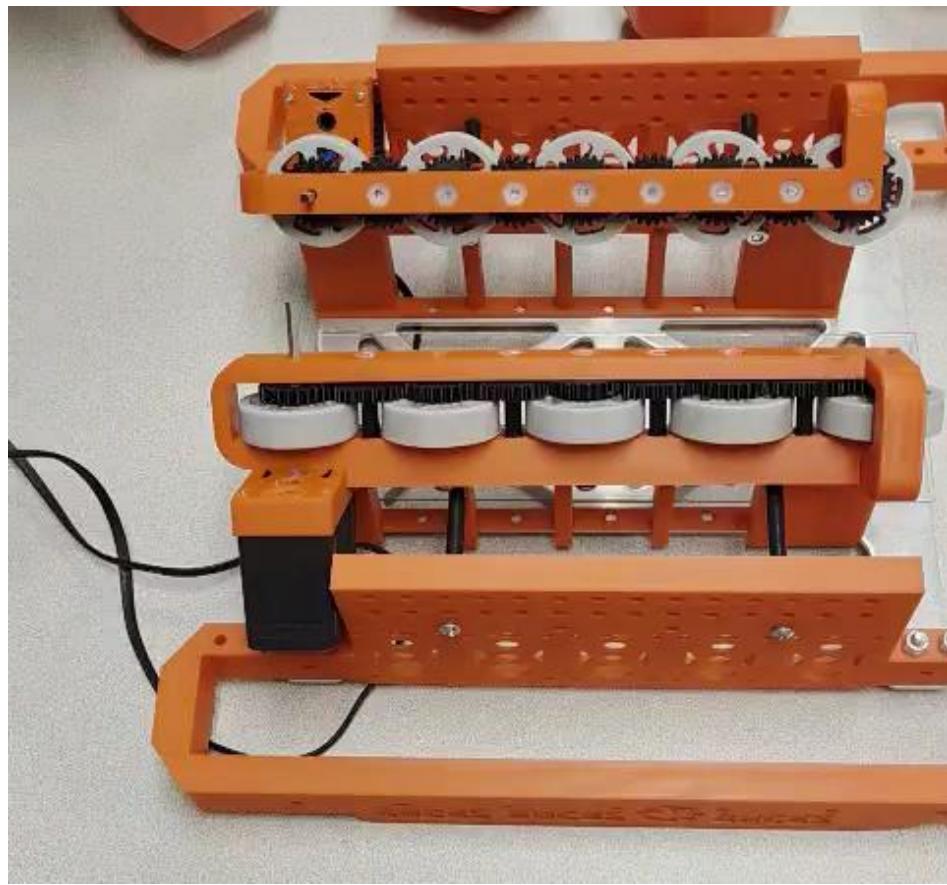


Drop down intake CAD

9/14/2025



Angeled flex wheels

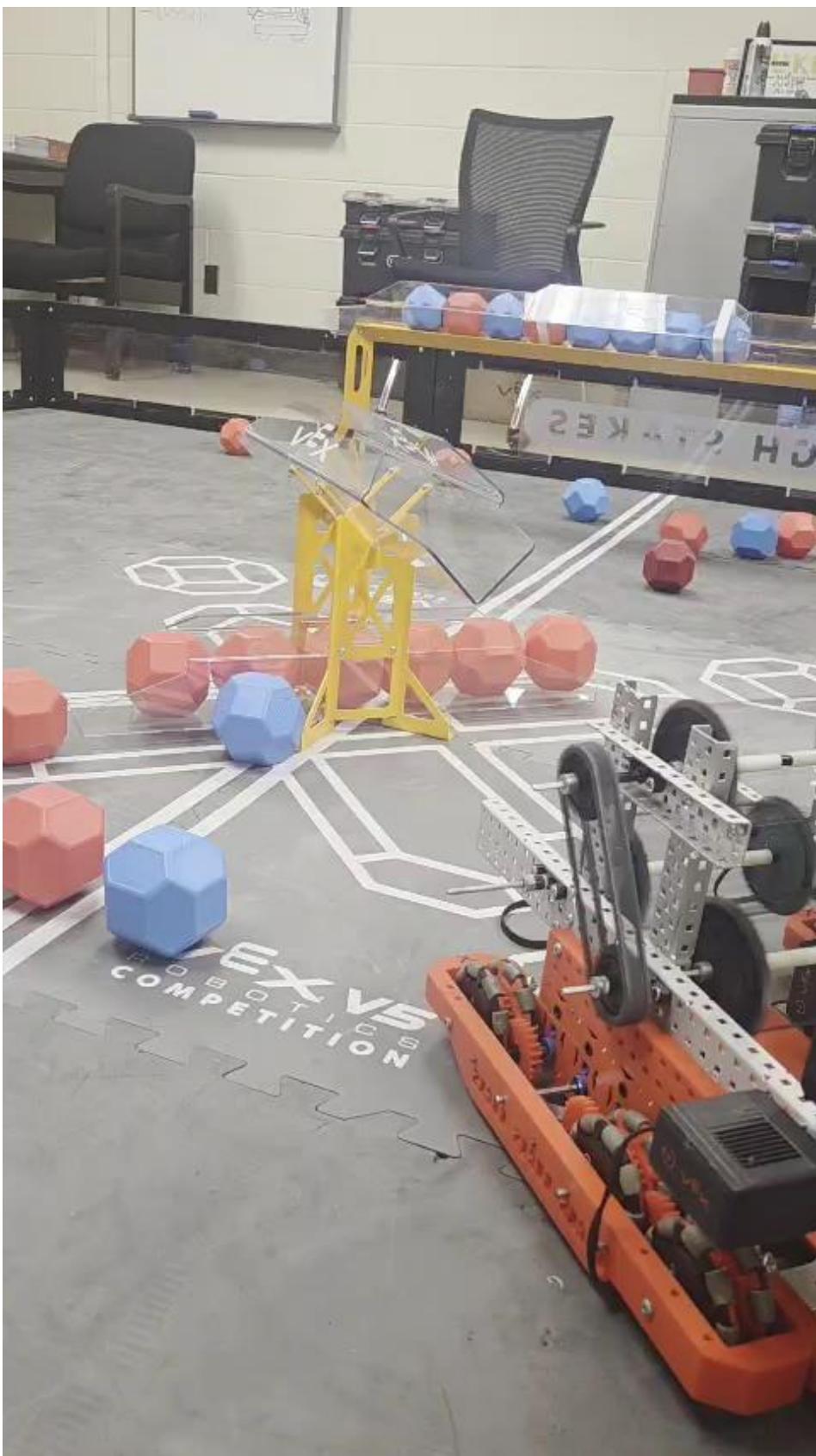


9/14/2025

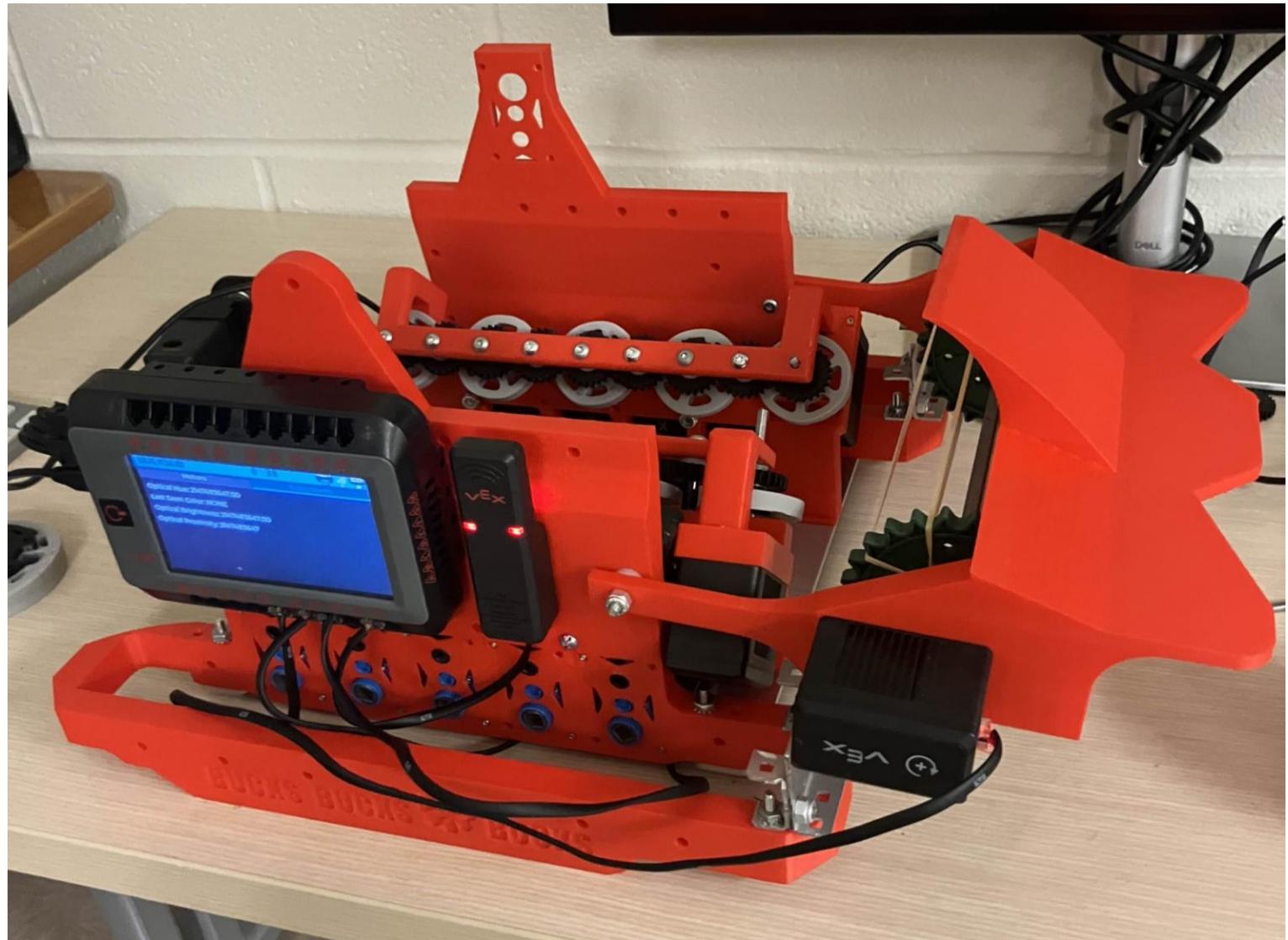
We had our first club weekly meeting today! We are excited to teach our new members.



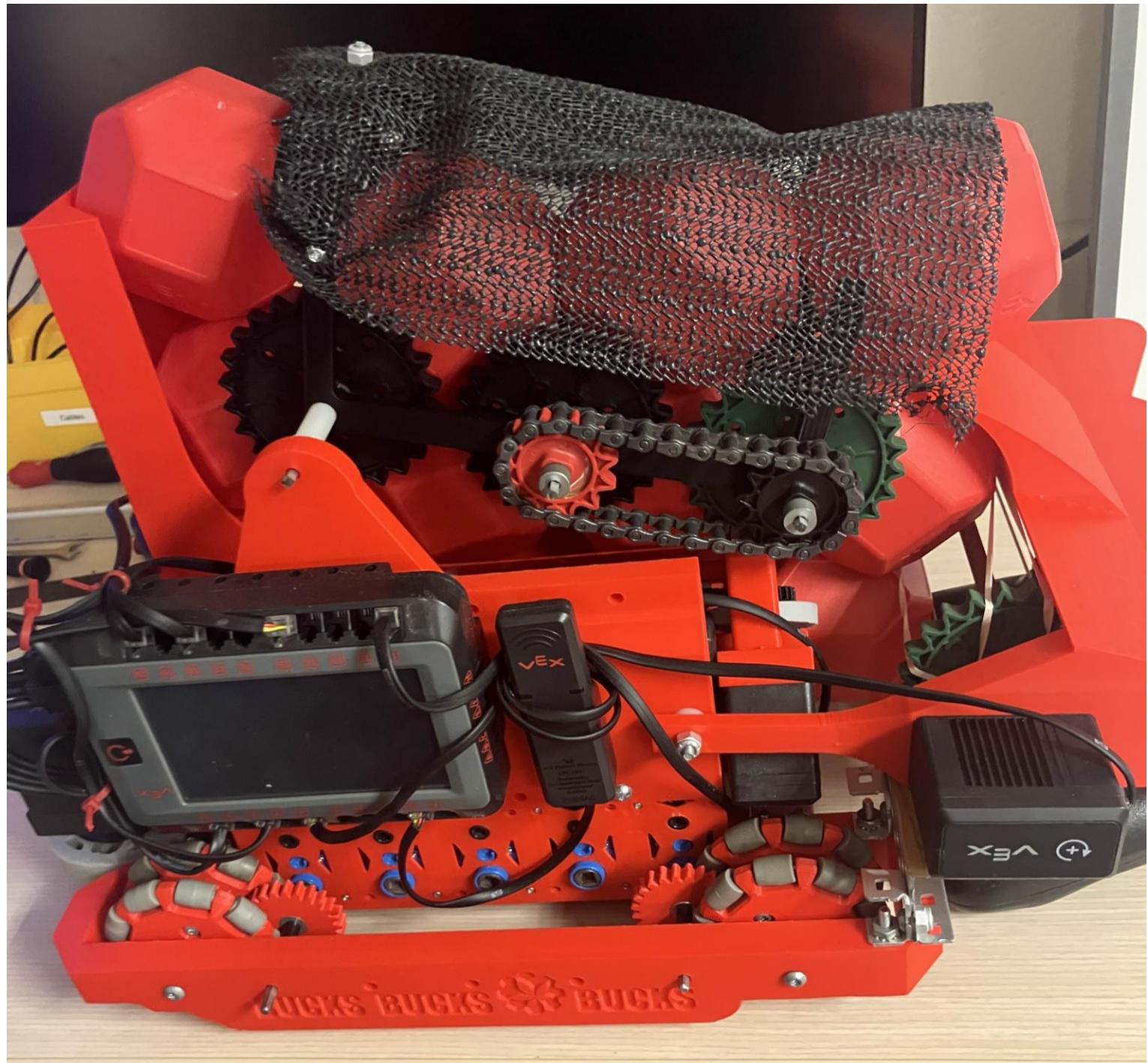
9/16/2025



9/19/2025

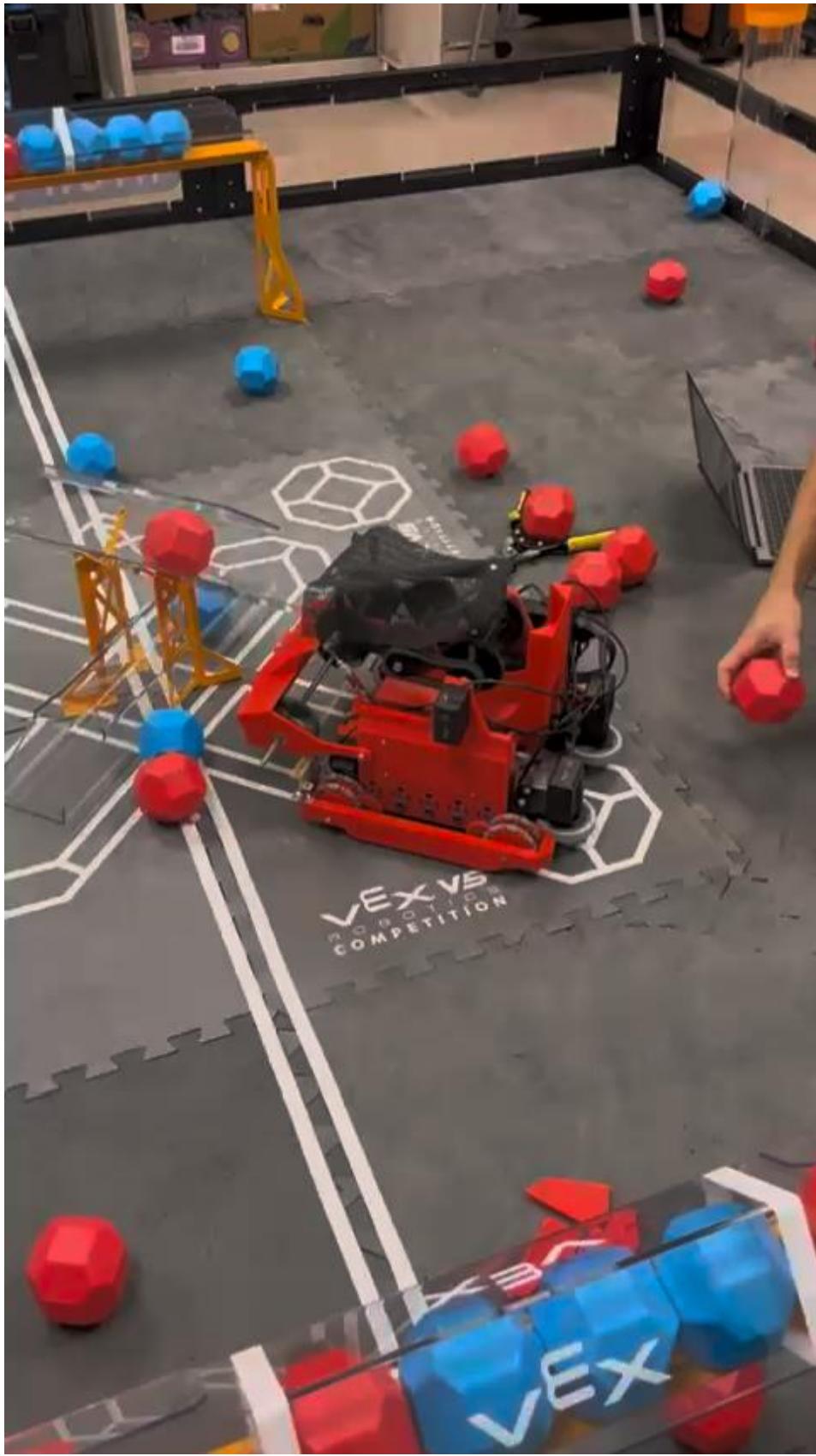


9/20/2025



9/21/2025

Weekly meeting: cleared the room, pistonized score arm. Seems like a 1.7 second cycle time.



9/21/2025

What was the reasoning behind lopping off the aligner?

- We were looking at how small we could make the footprint when expanded. Ideally we have a flip up gate (as opposed to flip down)

How does that make the footprint smaller if we can't align?

- And if we flip up it's not a bridge, and we can't make contact with the band roller.
- It would be much better if we could power blocks all the way through, but we'll have to see how much it harms us.

Its simplicity is a bonus

We could maybe cut back capacity to 10. We don't want lower than that. Put the roller further in.

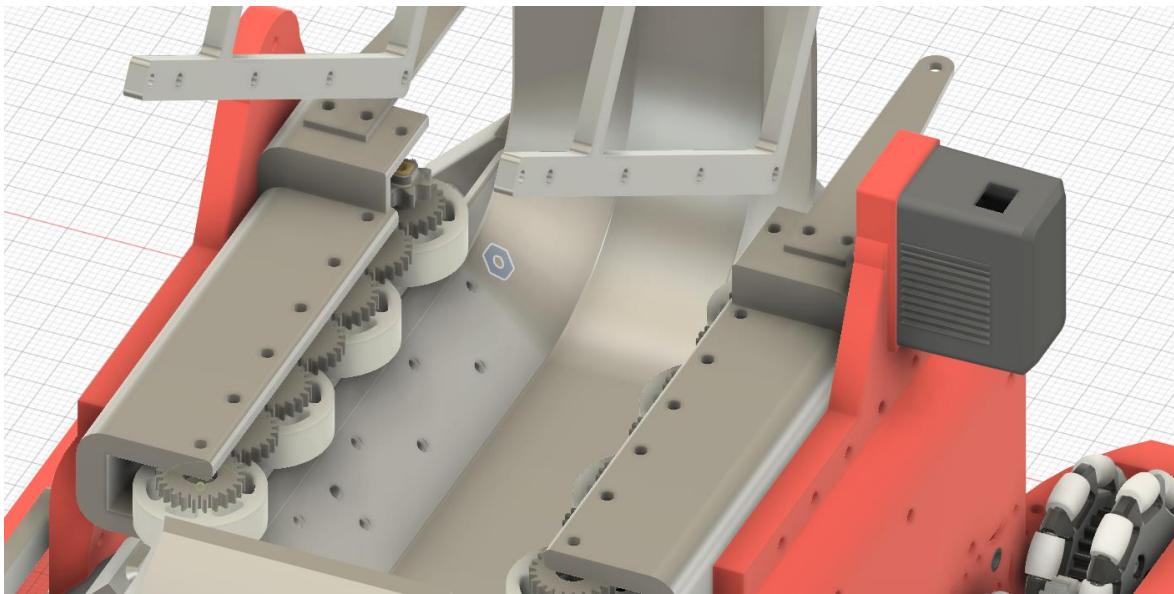
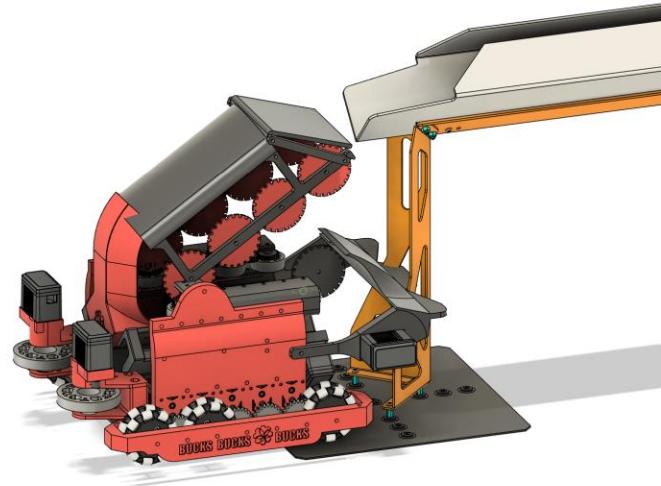
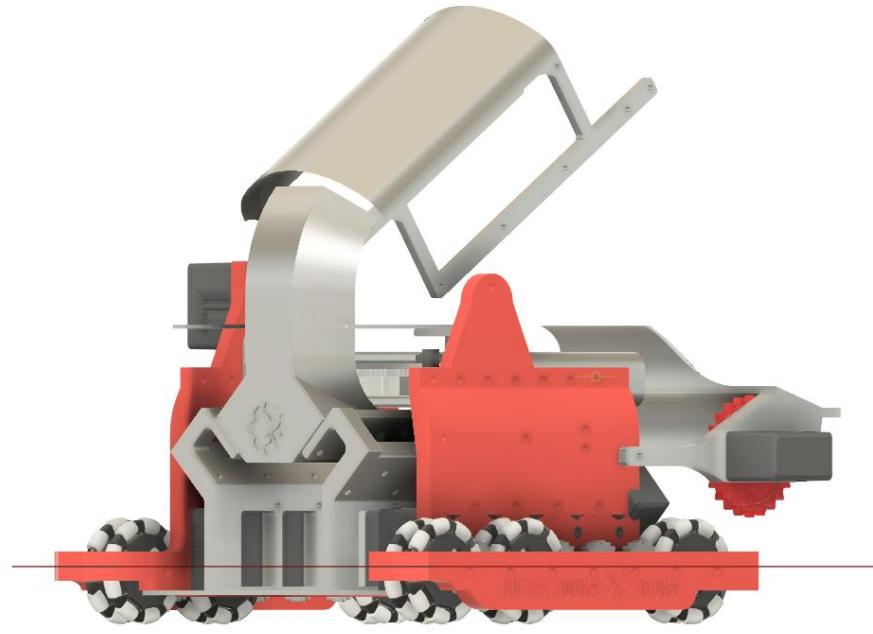
Although it would use a similar motor count and part of the benefit for more motors was actual high capacity.

9/25/2025

A change that we will likely want to change in our future

- One of the hex inserts on each flex pod is too close to the back of the track and we can't actually use it.

It might make sense to do it the other way around and have a nut holder in the track since it's quite thick back there.



10/9/2025

The bot is mechanically not perfect, but major flaws have been worked out besides the actual application of the t2 torque clutch and smaller tuning is very doable.

Software and Electronics is really what the robot needs right now to get in solid working order.

Currently we are examining the timeline for color sensors. Also need a drivetrain limiter.

Electronics timeline depends heavily on how much help the head coder has on getting BUCKShield updated. Software is going to be a lot simpler.

Our head coder has color sensors picked out, but they don't have integrated flashlights which will be a problem. We want them to have some sort of proximity reading as well.

Our OTOS codebase is going to remain the same though. Because of this, we'll have to spend very little time getting odometry working.

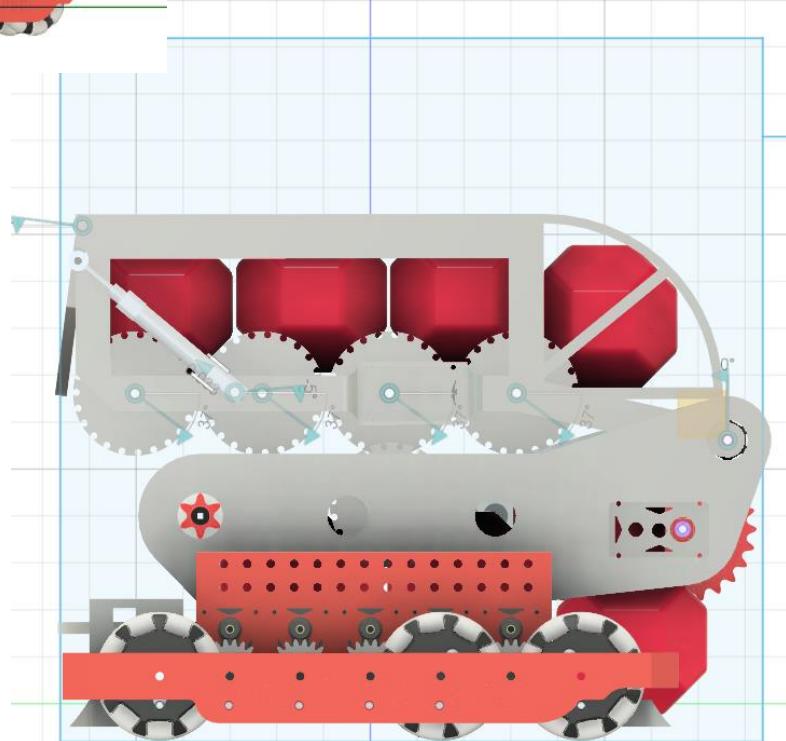
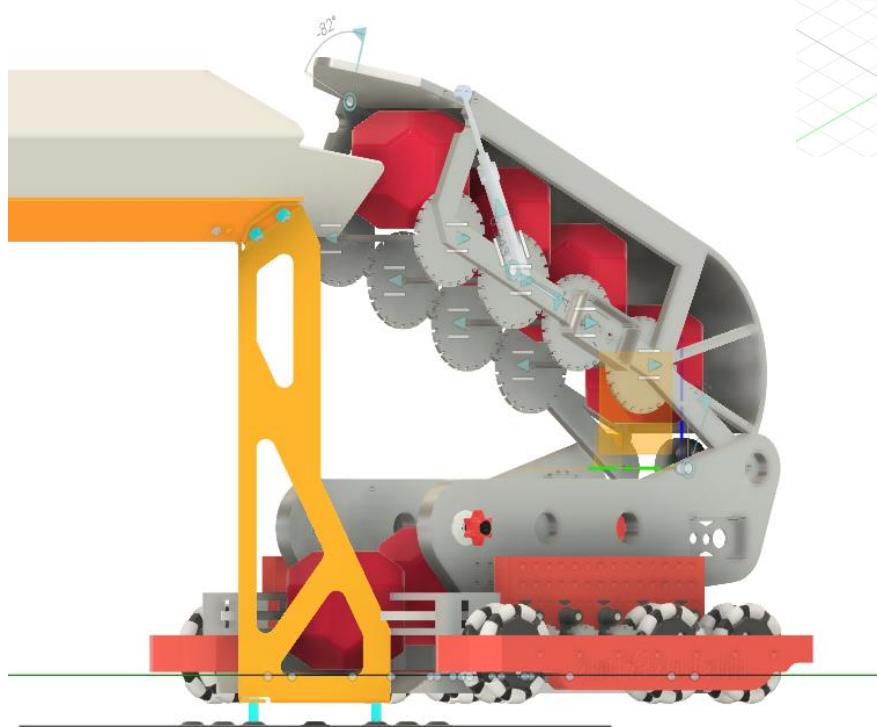
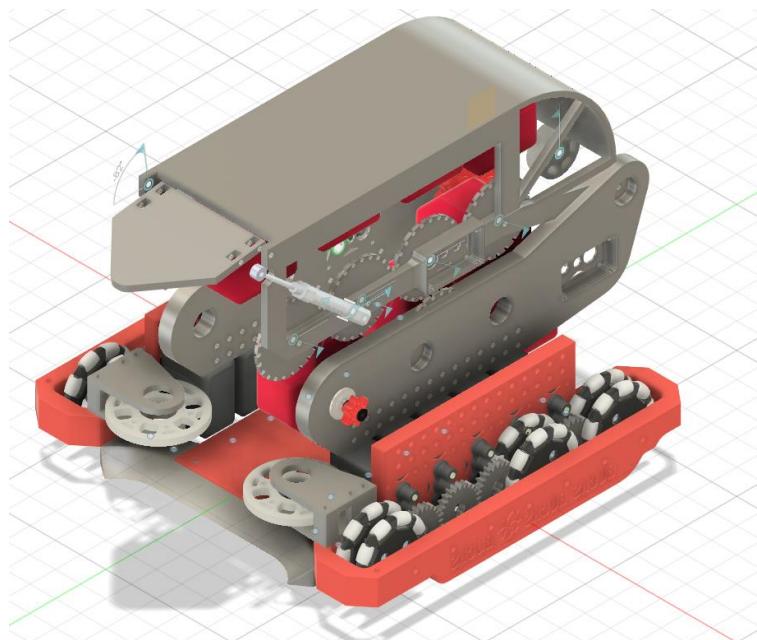
Lead coder can take an old shield and OTOS off of one of our bots from last season and mount it soon.

We need to find a quick mounting spot for the shield covers. OTOS screw holes should be accessible.

10/26/2025

To-Do for 2t bot:

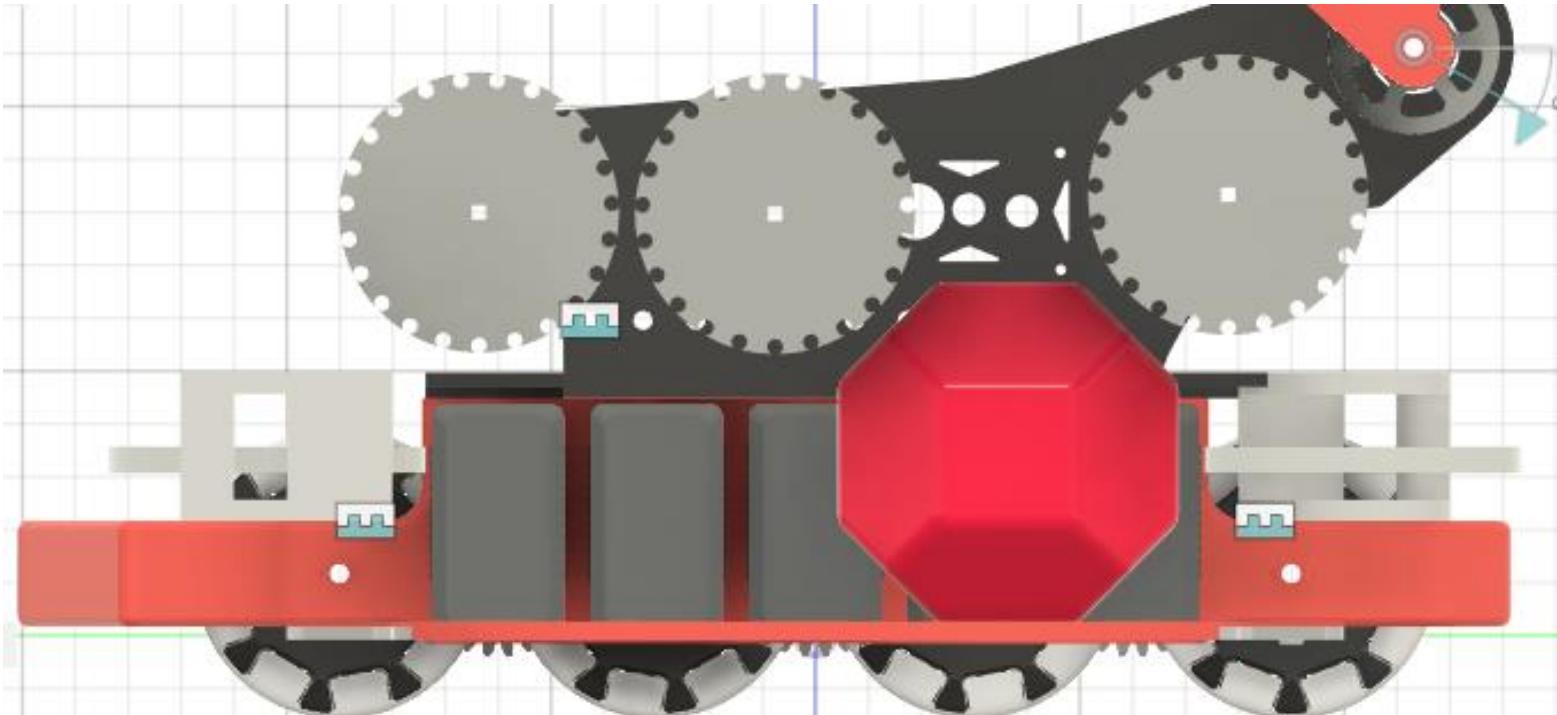
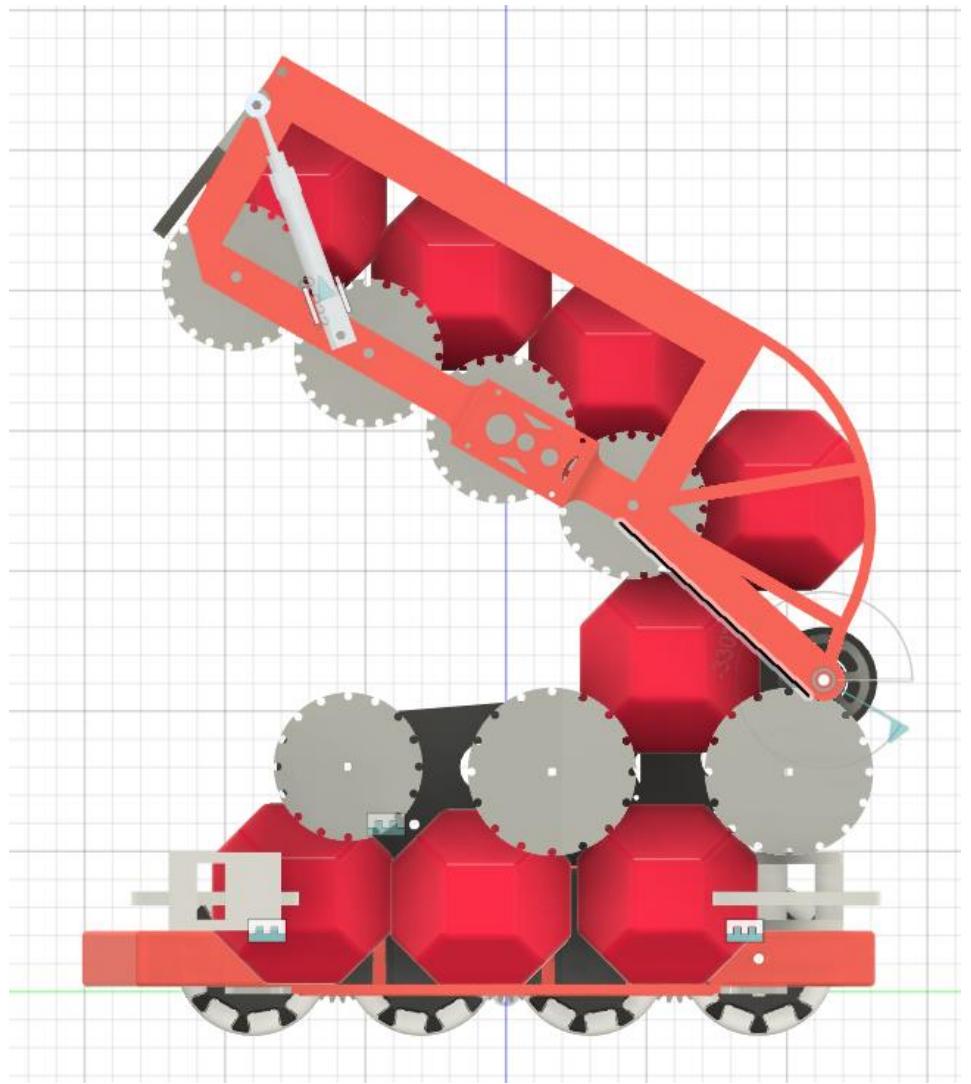
- Vertical front intake
- Color sort position and size
- Simple hood – add roller
- Shift tier 1 spacing and size



10/30/2025

With our roller placement, the flex sheath might be the direction we should take.

The rear roller is just too crowded and blocks would definitely be hitting the axle in our current setup. This would kill cycle and sort time.



11/3/2025

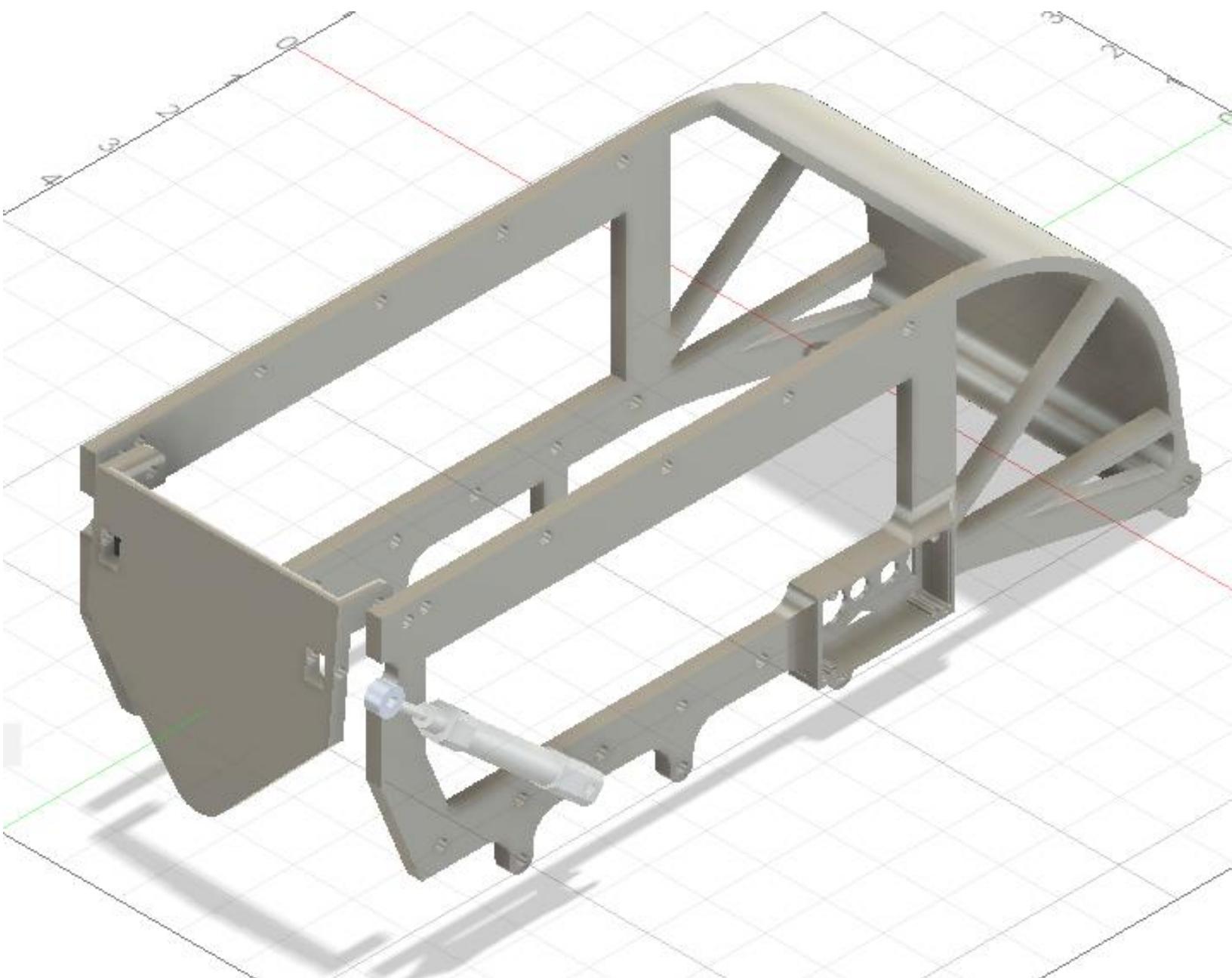
New Hood. Mounting the Score Box.

- Slight crack near motor mount on the scorebox
- Next time we do gear optimization, we need to make gears for the score arm.
- We should make insert holes for our low strength axel gears. That will keep them properly aligned.

In general, the score box is pretty much done, just needs hardware and tuning.

11/4/2025

CAD for Scorebox V3. Ready to print.



11/5/2025

We can probably shorten the gate. We need to power up and down.

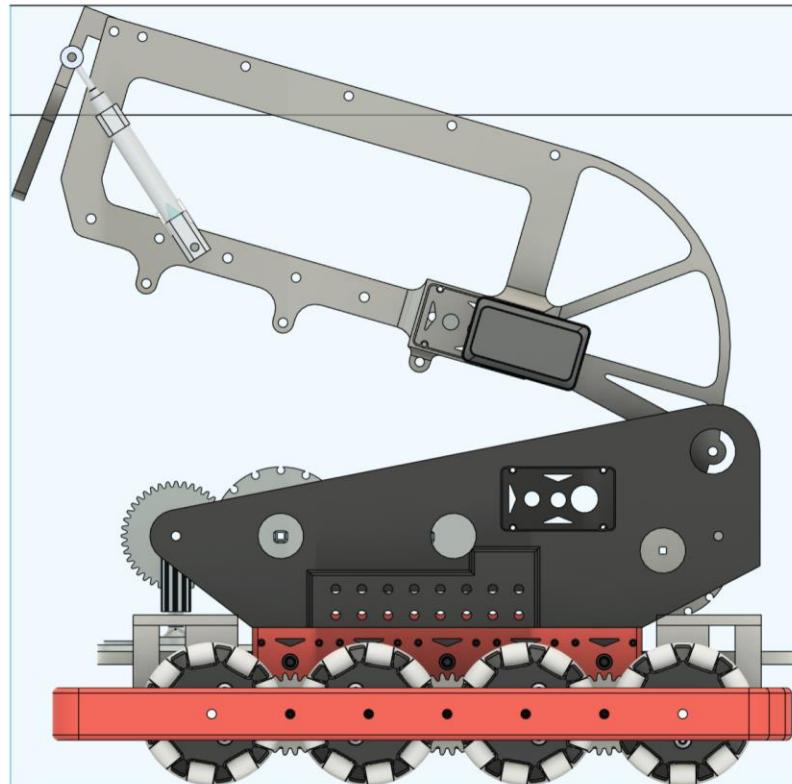
The box goes up and down substantially when blocks transfer. This can probably be tweaked.

- If tweaked, it might hurt our middle scoring only.

We should also put the front rollers on the box and check it compared to a long goal.

- We are pretty sure it can actually be shortened, and also moved forward maybe.

Can we shorten the scorebox without comprising long goal scoring? = probably



11/9/2025

Intake Decision Matrix

X/10

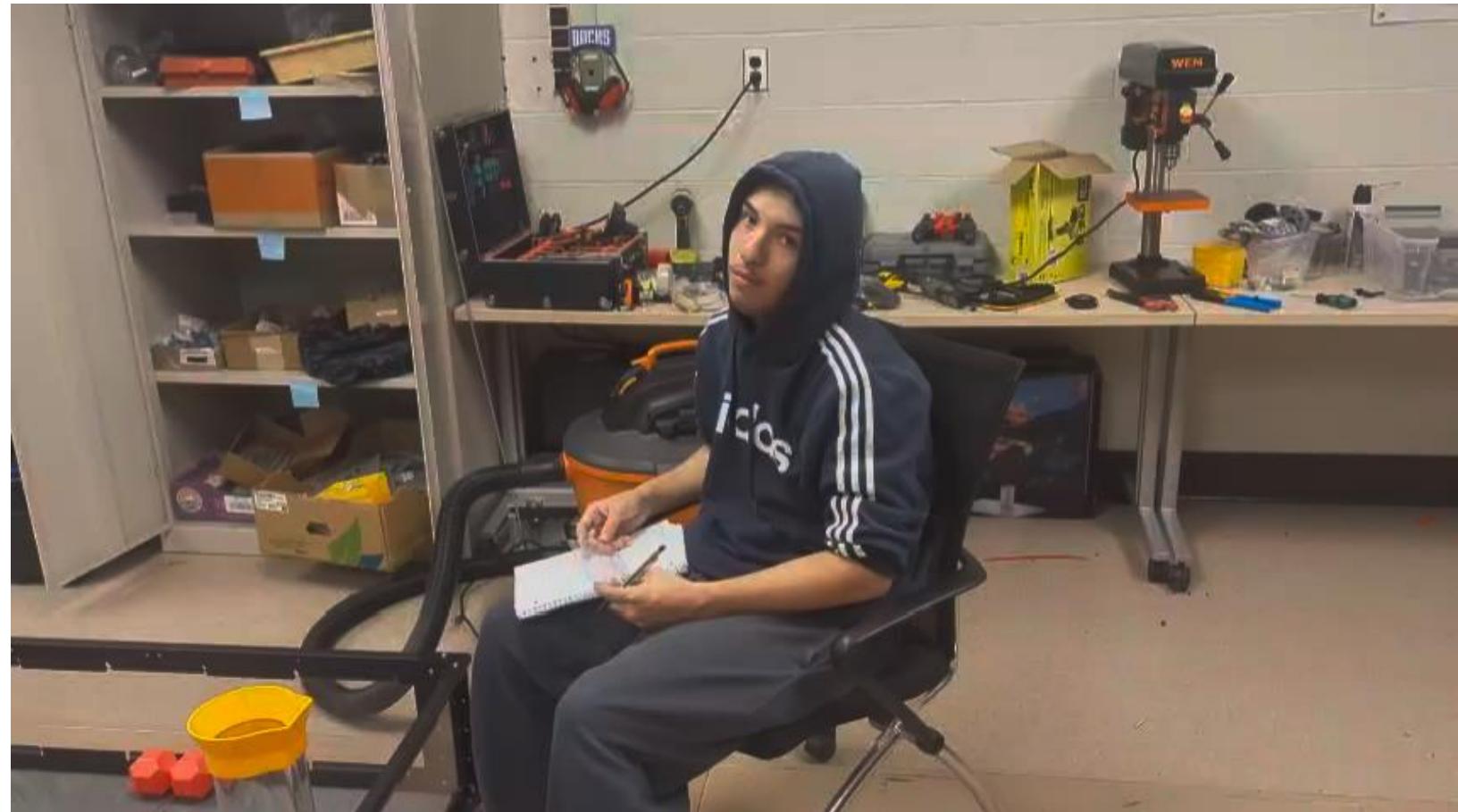
	Vector	Flex Drum	Bond Roller	Weight
Clump Fielding	8	6	5	8
Maintainence	7	9	5	4
Weight	10	6	8	4
On the move Fielding	5	8	9	10
Bottom Goal Scoring	8	9	7	7
Match loading	6	0	0	2
Resilience	8	10	4	9
Unweighted	52	48	38	
	32.2	34.1	26.9	

MAGNETIC Whiteboard
ERASER



11/19/2025

First autonomous route!



11/24/2025

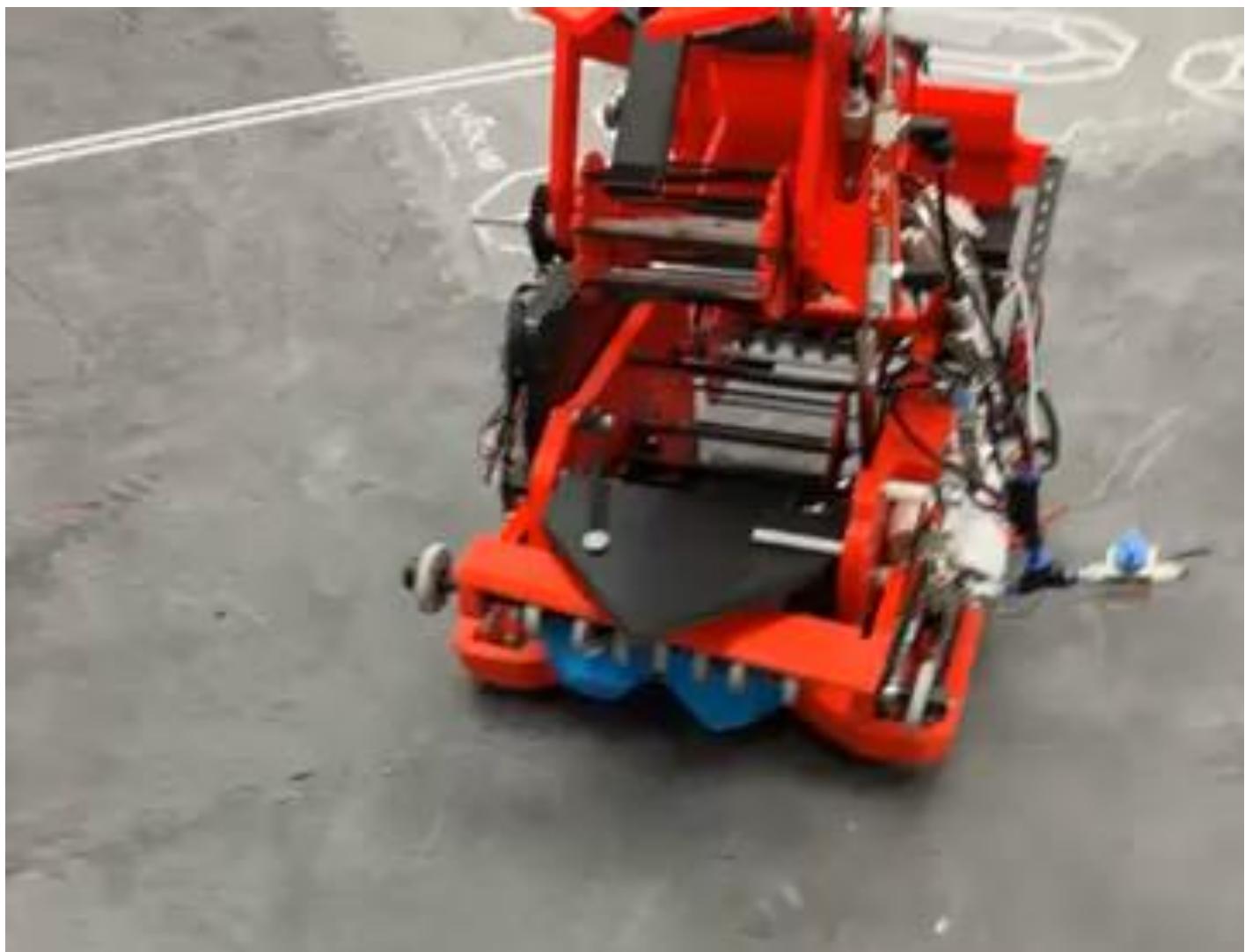
Driving testing



12/1/2025

Problem: blocks jam here and won't clear with out taking or in taking. Driver also tried running into field elements and other blocks and that didn't work to clear it either.

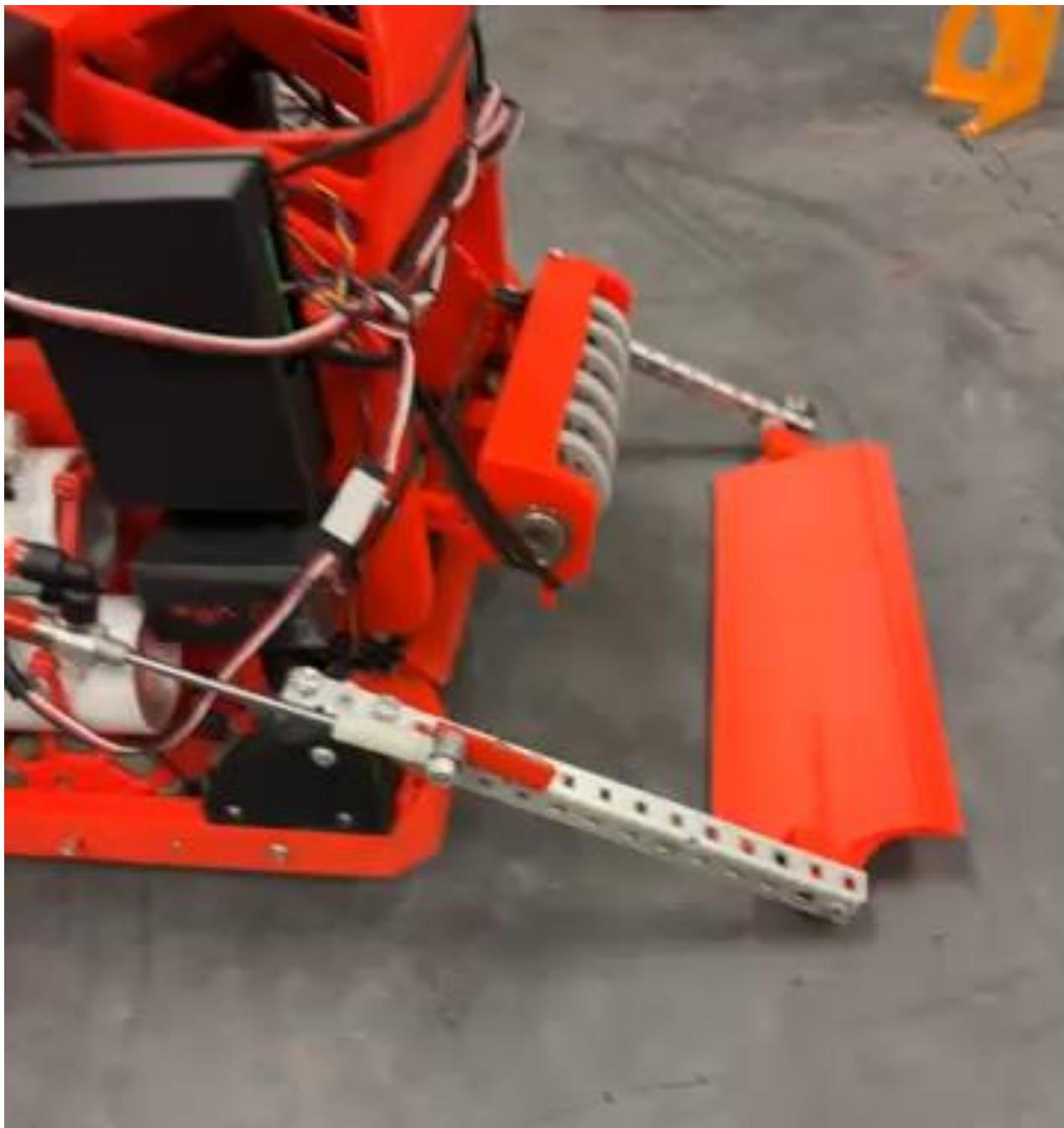
Solution: This is because the intake is too tight, so we need to adjust it.



12/1/2025

Question: Should we move the piece holding the shaft collar a few holes down on this?

We can't really move it that much for it to properly tuck in, but a rubber band on the piston will do the trick.



12/2/2025

Need to code routes in preparation for our competition on 12/13.

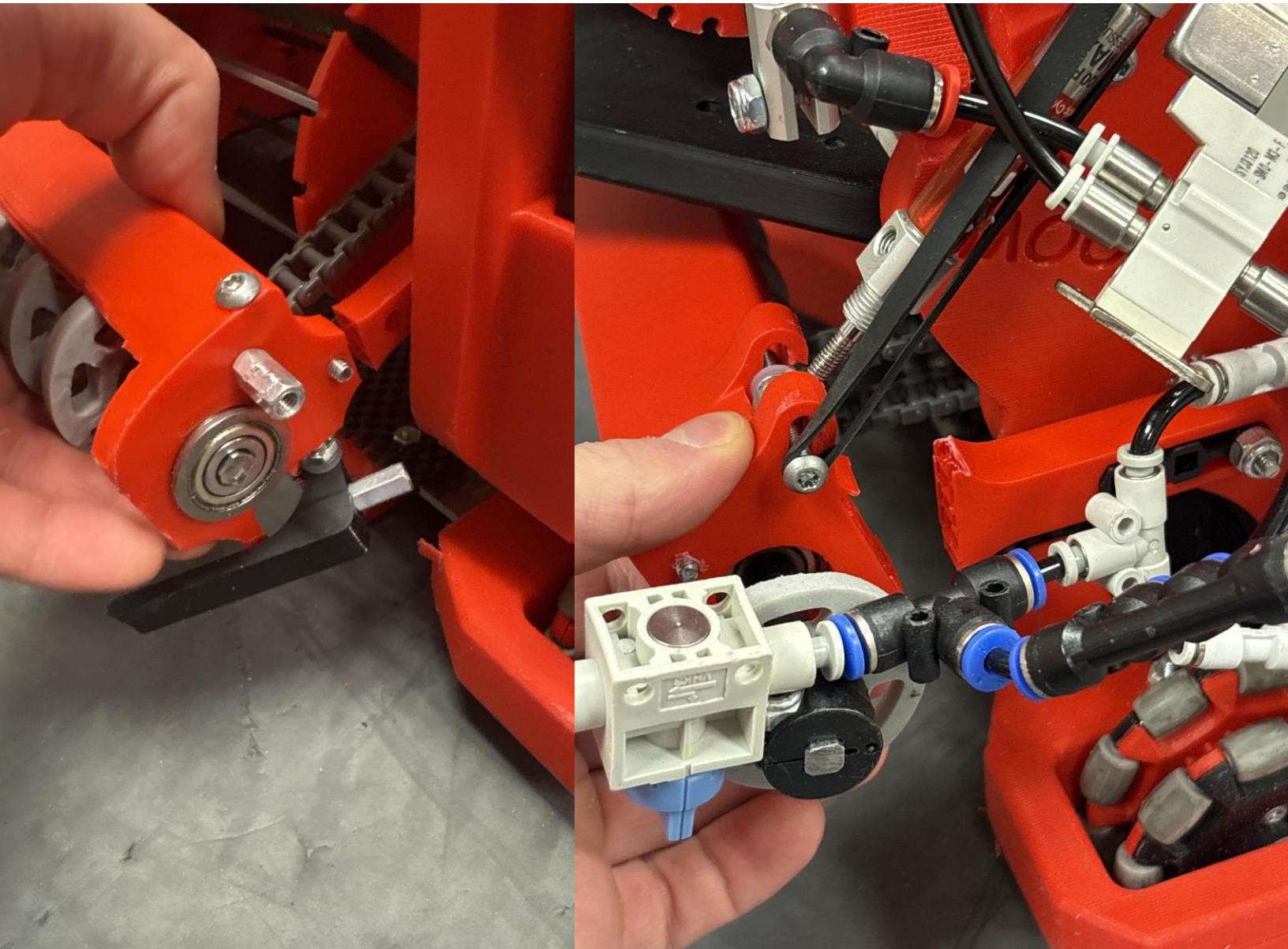
We have one bot almost complete – just the wings need finished development.
Other bot needs a bit of hardware and is being put together now.

The second bot is basically just waiting on hardware and intakes to be printed.

12/3/2025

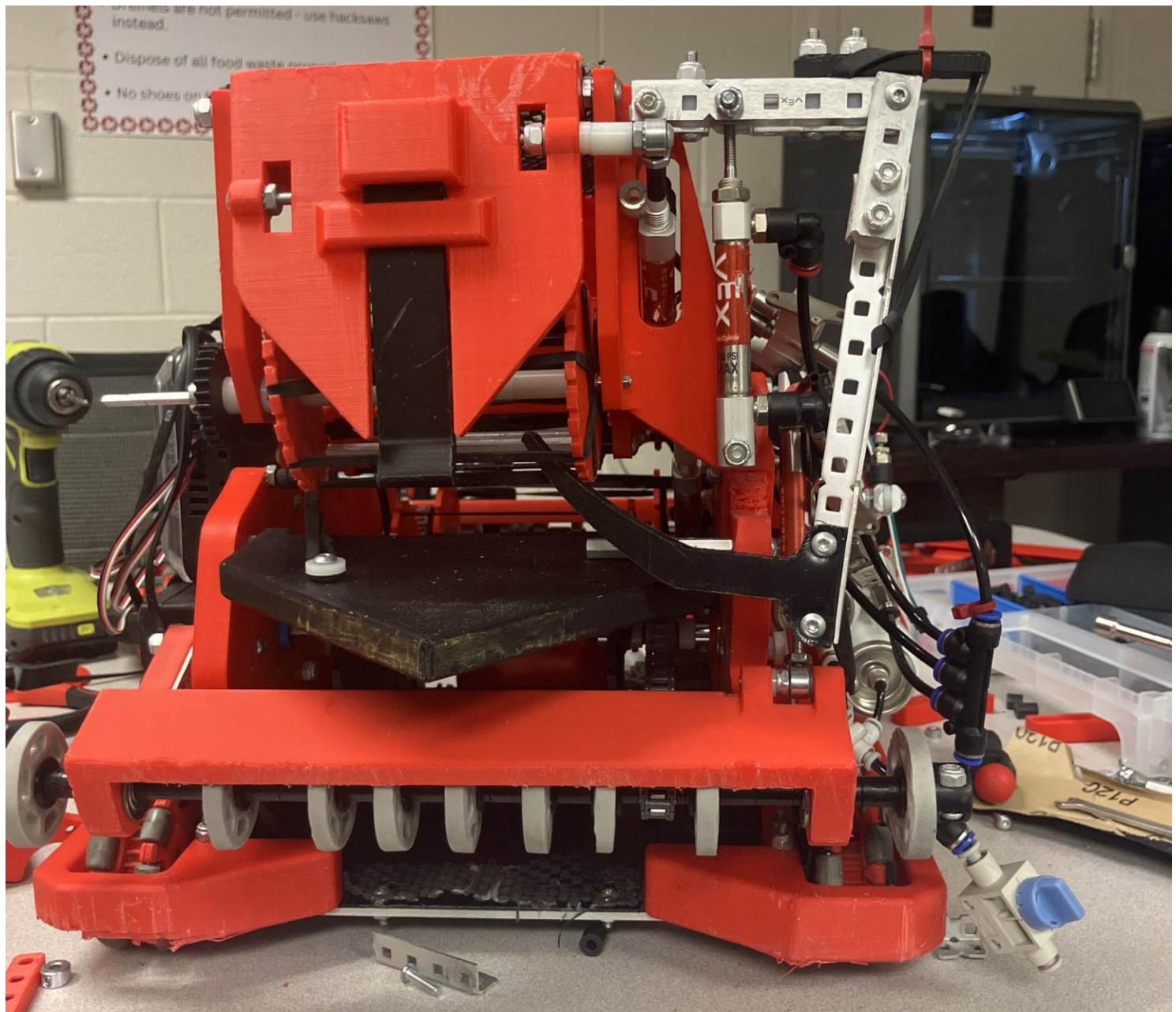
Problem: Intake snapping

Solution: Brace with a half cut. It would be slightly heavier but way more durable and way easier to replate if the half-cut breaks.



12/4/2025

The wings are in size under the long goal.



12/5/2025

Next Bot Design Considerations

Here's what we are thinking we should develop after our competition given what we've seen from high level matches so far. We will evaluate further after VEXU matches.

- **Control zones control zones control zones**
 - Our wings need to be rigid and reliable
 - We almost certainly want some kind of win aligner to make play easier
- Going under makes defending against good wing play very very difficult. We need to invest time into HS level wings that can go under. This might need to be independent of our scorebox so that it can go high enough.
- Capacity
 - 4-6 seems good for in-match play. We think we want some way to extend our capacity in auto, similar to our idea for 12 capacity on this bot but actually implemented. Going up to 8 in auto seems good
- Fewer Motors (PTO?)
 - Our current limiting is a bit of a nightmare right now; 15 motors is simply too many
 - Reducing our capacity will naturally reduce the number of motors we need
- **How important is color sorting?**
 - So many high school teams don't have it, and it doesn't really seem like that much of a downside.
 - Does no color sort mean we're only going to have one intake?
 - Ideally yes. It saves us a ton of motor complexity and allows us to do drive-base aligner.
 - Intakes on both sides seems really good at first, but fielding continues to seem less and less important as the meta progresses
 - Color sort is a very nice feature but not necessary at all, and probably not worth it due to the complexity it adds to the design
 - In the right situations, it saves time but from what we've seen, it doesn't seem like those situations are common
- Aligner
 - We want a drive base aligner
 - This becomes much simpler without color sort, we should probably just do back to front