LUMENS^3

FIRST TECH CHALLENGE

30393

DECODE™

PRESENTED BY RTX

2025-2026

Revised 5/16/26

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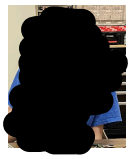
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About The Team

30393 Lumens³ is a passionate, rookie FTC team located in New London, Connecticut. Most of us are former Southeastern CT Robotics, Inc FLL team members from three different teams; we are joined by three Stonington team members. We're excited to share that this is our first year competing, making it a very special season for us. We know that we have a lot to learn.

Team Members

30393 Lumens³ has a total of 8 members, 2 coaches, and 2 mentors.

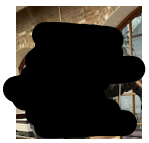


Levi [redacted] He is one of the 2 main programmers. He enjoys doing magic tricks, card manipulation, Playing and making video games, and going to math competitions.
DRIVE COACH, HEAD PROGRAMMER

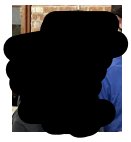


Shivam [redacted] and is the leader of the Building team. He enjoys playing lacrosse.

HEAD BUILDER

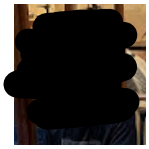


Declan [redacted] and is one of the 2 main builders. He enjoys mountain biking, and soccer.
DRIVER, BUILDER

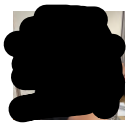


Daniel [redacted] and is our main CAD Designer. He enjoys playing the saxophone and skiing.

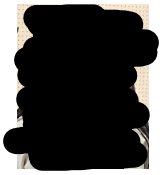
DRIVER, DESIGNER



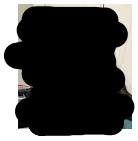
Kevin [redacted] and one of our two programmers. He enjoys programming, and is self-taught.
PROGRAMMER



Raffi [redacted], he is a scout and helps out with any other job as she enjoys playing the violin. SCOUT



Emma [redacted] and is one of the three scouts in the team. She enjoys gaming and baking.
HEAD SCOUT, JOURNALER



Victoria [redacted] and is one of the three scouts on the team. She enjoys drawing and playing games.
SCOUT



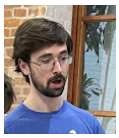
Brian McGlinchey is our Head Coach. He is an Electrical Engineer. He enjoys robots and gaming.

HEAD COACH



Ms. Fini is our assistant coach and administrator. She enjoys building with Legos and working on building robots with kids.

COACH



Connor Hall is one of our Mentors. He is also the coach for the FLL Aluminum Eyas and their new FTC team. He is a Mechanical Engineer and works at Electric Boat. MENTOR



Ethan Kerr is our second Mentor. He is a Mechanical Engineer and works at Electric Boat.

MENTOR

Meeting Format: Meetings are 6 pm-8 pm on Monday and Friday, and “as needed” on other weekdays

Review, Meeting Objectives, Announcements, Team Member Task Assignment -5 to 10 minutes
Members Work on Tasks - 50 minutes
Break - 5 Minutes
Finish Tasks, Evaluate and Set Goals for Next Meeting- 55 Minutes
Journal and Clean up - 10 minutes

Think Award

Our journey is documented in our Engineering Binder. Each day, team members enter and leave the Lab. They sign in and then document what they were working on, what they did, and what they need to work on next time. In this way, progress is tracked, and plans for improvements are documented. Our PORTFOLIO is a small overview of the Binder's documentation. We hope you take the time to look through our Binder.



We also make goals every week on Mondays for what we want to accomplish that week. Team members then come in on extra days during the week, depending on what needs to get done. This ensures we don't have too many people in the lab and that people aren't coming in for no reason.

The included image here is of the Engineering Design Process. The important thing to notice is that the process is iterative. A problem is identified, existing solutions researched and analyzed, new ideas brainstormed, a new idea built and tested. Repeat as necessary.

Required: Refer to pages 9-10 in this portfolio for Strategy Evolution to demonstrate specific examples of our team using the engineering design process

We used MoSCoW, a term we learned at our Rookie Training Camp at Wolcott, to organize our ideas:

M stands for Must have (Non-negotiable): Definition: These are critical, mandatory requirements that cannot be delivered without

. Impact: If left out, the project is considered a failure or not viable. Example: ball launching system, drive train for movement

S stands for Should have (Important but not vital): Definition: These are high-value, important, but not essential requirements.

Impact: They provide significant value but can be deferred to a later release without affecting the immediate launch. Example: field intake (could have human loading only), high-speed 3-ball launching system, fast drive motors, accurate shooting, odometry pods for distance tracking

C stands for Could Have. Examples: color sorting system and kick out, using Pedro Pathing and a color sensor for alignment on the April Tag to identify robot location, and a lift

W stands for Won't Have. Example: hanging system. Serves no purpose.

As you review our strategy, note that we moved from a robot that needed to shoot and move (MUST) to a robot that performed better as we added SHOULD and COULD items.

We used MoSCoW at the start of the season during the reveal and continued to use it throughout the season. We did a new MoSCoW after each competition to plan out what we would try to do before the next competition.

One example of our using mathematical analysis to make decisions is when we noticed a large drop and long recovery between when the first artifact was shot and the flywheel getting back up to its target speed, especially from far away. To compensate, we added a second 6000 RPM motor and an inertia wheel. We also programmed a custom PIDF controller to speed up the flywheel motors as needed. This has helped with the recovery times.

At the beginning of our season, we recorded what team members' goals were and what they wanted to learn, and made a chart. This is on our tri-fold. CHART OF TEAM GOALS found on page 15.

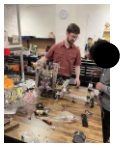
We have held one Open House where we recruited 2 new members. We will be holding another on April 11th.

Connect Award

Examples of developing in-person or virtual connections with individuals in the engineering, science, or technology community:

1. December 30, 2025. Mike Gentry, Engineer and CT FLL partner, came in and did a practice inspection of our robot.
2. November 2025 through March 2026. Continue working with Connor Hall, ME, from Electric Boat.
3. We invited Aidan Languedoc, Computer Science Engineer at Pfizer, to our lab to review our programs and provide feedback. He was very impressed with our code and how well it was "commented". We comment on the code because we have two programmers who don't always work on the code at the same time. This way they can share what they are working on.
4. January 13, 2026. Joe de la Cruz, Vice President of Hillery Company, helped our team by water jetting our inertia wheel and flywheel weights.
5. We have reached out to LeGrande Engineering, which has offered engineering assistance.
6. March 27, 2026, we met with John Scimone from Sonalyst and Chris Cooper from Covestro at Spark Makerspace
7. Our team members' goals and objectives, and how they changed over the season, are listed in a table on page 15.

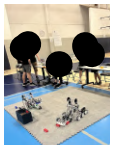
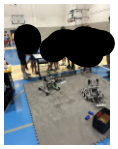




Reach Award: Outreach, Making an Impact

ASSISTANCE FROM:

- Rob Cormier and Wolcott Robotics, Max 1071, ran a week-long camp for Rookie teams, which we attended July 7-11.
- We received assistance from Bionic Tigers 10464, Ohio, who ran a coaches seminar on July 9th.
- Jay Spalding with Shoreline Robotics, Team 13181, has been a great assistance with parts advice.
- Ann Marie and Brian Hall with Aluminum Eyas provided feedback in November on the team's robot design.
- North Kingston FTC, Team 17847, The Velocity Raptors, gave us parts at the Tolland Scrimmage on December 20.
- Met with Armored Artemises, 16008, via Google Meet on January 27 to give us pointers on how to get our robot to perform better and how to make a better presentation.

HOSTED:

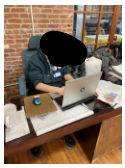
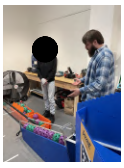
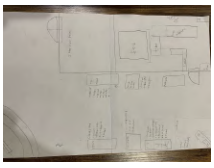
Our team has hosted an event that met ALL of the hosting requirements:

August 18, 2025: Southeastern CT Robotics FTC and FLL teams hosted an event at the Mystic YMCA. In total, we reached and introduced 168 kids between 9:30 AM and 2:30 PM to robotics and FIRST. Our FTC team alone achieved 23 hours of outreach in total for this event.



SUPPORTED:

- **January 10, 2026:** Southeastern CT Robotics, Inc FIRST Open House for New Members. The Southeastern CT Robotics FTC and FLL teams hosted an event at our Labs in New London to recruit new members. We helped organize and run the event. In total, we reached and introduced 37 kids between 4 PM and 6 PM to robotics and FIRST. We interviewed 3 potential new FTC Members. Our FLL Coaches and team members interviewed 34 potential new members. The FTC team designed a map layout of the games in the Atrium, made Event Manager and Staff Pins, helped set up the monitor system for check-in, helped set up the games and Atrium space for the FLL kids, ran a demo of our Lumens Cubed robot, and helped break down the Atrium space. Outreach = 15 hours

- **January:** Quantum Alphas, 32703, another rookie team, used our Lab and the advice of our members and coaches for several meetings throughout January. =60 outreach hours

- **February 1**: Rescheduled Farmington Festival -Supported the Festival by providing our robot for FLL teams to drive. 32 Explore kids, 63 Challenge kids, 6 FTC members for 4 hours = 24 outreach hours.




- **February 14:** Our neighborhood church suffered a flood. Our team pitched in to help them clean up. FIRST Robotics and our team were again seen as an organization that taught kids the importance of helping others. Its more than robots!
Six FTC members, 2 hours = 12 outreach hours.





- **February 13:** In addition to our SECTR website posts, we have Instagram and YouTube accounts where we post updates and videos sharing how we have fun during robotics. This is how we connected with a team from Israel 17056, and we joined them in a global trash cleanup. We also connected with another local rookie team from Norwich, Rose City Robotics 31639, and shared the challenges of being a new team. Six FTC members for one hour = 6 outreach hours.



- **March 28:** Tolland County Robotics Expo. Demonstrated our new robot and sold fidget toys and keychains. Eight FTC Members, 8 hours = 64 Outreach hours

- **April 17-18**: New England Premier. Volunteering to be field resetters. Estimating: 80 outreach hours

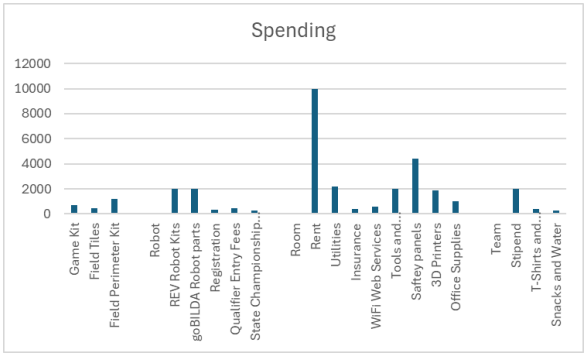
Total Outreach Hours: 284

Sustain Award: Program Longevity

Southeastern CT Robotics (SECTR) is an independent 501 (c) (3) program. They have been running FLL programs for six years and launched this High School FTC program once they had saved the funds. The FTC team started with an empty room and a dream. All expenses are paid for by **dues, fundraisers, and grants**. We would like to especially call out ReadyCT, which helped us with a rookie start-up grant and paid for our registration.

Grants and dues cover general operating expenses like rent, electricity, insurance, and supplies to more specific expenses like tools, workbenches, field set, game pieces, robot parts, entrance fees, t-shirts, and snacks.
Fundraisers allowed us to purchase more robot parts and to attend the FIRST Championship this year.

We have never started an FTC team before, so despite being careful, our original budget has been revised a few times. We have an Excel budget spreadsheet with specific expenses and revenue sources, but we are giving an overview here. Being part of a larger, more stable organization has helped us.



Spending:

Robot Game:
- Game kit: $695
- Fields Tiles: $460
- Field Perimeter Kit: $1200

Robot:
- REV Robots: $2000
- goBILDA Robot: $2000
- Registration for Decode Season: $325
- Qualifier Entry Fees: $150X3
- State Championship Entry Fee: $300

Room:
- Rent: $10,000
- Utilities: $2,200
- Insurance: $400
- Wi-Fi, Web Services, Accounting Fees: $600
- Tools and Workbenches: $2000
- Safety Wall Dividers: $4400
- Equipment - 3D Printers: $1900
- Office Supplies: $1000

Team:
- Stipend: $2000
- T-shirts and Sweatshirts: $400
- Snacks and Water: 300

Total: $32,630

Revenue:
- Grants:$26,630
- Dues: $6000

STEM Learning in New London WAS MADE POSSIBLE IN PART BY FUNDING FROM THE TEACHING WITH PRIMARY SOURCES EASTERN REGION PROGRAM

COMMUNITY FOUNDATION OF EASTERN Connecticut

The Frank Loomis Palmer Fund

GLENN W. BAILEY FOUNDATION

ReadyCT

T-Mobile

Dominion Energy

Double Good

Dime Bank

Pfizer

Pickles Foundation

Chelsea Groton

RTX

Mystic Glass

The Sweeney Family

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Chamber of Commerce Eastern Connecticut

The Manickam Family

THE BERTCHE FAMILY

Sustainability Plan

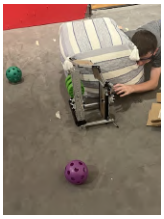
Member and Financial Plan	Event	Dates	Results
Member Recruitment	Ongoing - Feeder FLL SECTR Programs	January -December	Promising FLL Members are recruited onto the FTC Team
	Ongoing - FTC SECTR Members Visit FLL SECTR Meetings	January - December	FTC Members join FLL Meetings to help with lessons
	SECTR FLL/FTC Joint Open Houses	12/20/25 and 1/20/26	3 New FTC members - applied, 2 Accepted
	SECTR FTC Open House	4/11/2026	
	New Roster Decided for Next Season with FTC SECTR Member Input	5/6/2026	
	FLL Farmington Festival	1/27/2026	Showed 8 FLL Explore and Multiple FLL Challenge teams - allowed them to drive our robot.
Knowledge Transfer	Ongoing - Google drive shared document started	5/23/2025	All team members are able to find shared info at any time
	Ongoing - Engineering Binder Started	5/23/2025	All team members are able to find shared info at any time
	Ongoing - 30393 Discord Team Channel	7/30/2025	Members asked to join Discord to share ideas and photos
	Mystic YMCA	8/18/2025	Showed 169 kids our robot
	FLL Farmington Festival	1/27/2026	Showed FLL Explore teams the robot.
	Aerospace Adventure	3/28/2026	Showed FLL teams the robot. About 120 kids
	Ongoing - Work with SECTR FLL challenge teams	Multiple dates	Passing on programming knowledge, passing on building knowledge
Financial Planning			
Multi-year Funders	Library of Congress - Teaching with Primary Souces - Eastern Region	Ongoing - 2025-2026	Accepted - 2 years
	Communtiy Foundation of Eastern CT	Ongoing - 2025	Applied - 3 Years 2026- 29
	Frank Loomis Palmer	Ongoing - 2025	
	Department of Defense	In Process	
	National Science Foundations (NSF)	In Process	
Short-term Fundraising			
	Chipotle	9/9/2025	Percentage of sales goes back to team
	Double Good	3/23/26-3/31/26	50% of sales goes back to team
	3D Printing Fidget Sales	Sales Ongoing	Team members design and print fidgets to sell at outreach events

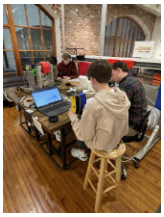
We would like to send a special thank you to our incredible families and community. Without your support we would not be here today!

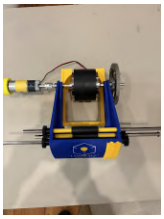
Innovate Award

When the challenge was released, and we saw that teams were using a turret to track the April tags, we deliberately decided not to add a turret and use what we had on hand to our best advantage. We had to think outside the box on most of our designs, and we 3D printed the majority of our most innovative parts. We had to redo many of our designs because, as we tested the function of the design, we found it needed to do more or do it better. For Innovate, we would like to point out our Hood, elevator system, and what we call our "cheese wedges" on our intake.

HOOD:



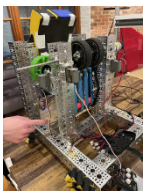
Hood Iterations- REV prototype. Shoots from midfield, didn't shoot well, not compatible with goBILDA

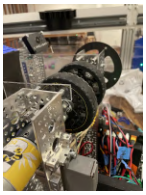
We 3D printed different angles which were tested because wanted a shallow "lob" and up close shooting. The second hole stops flex. Added what we call "horns" to center and guide the artifact past the flywheel making the shot more consistent. Our new adjustable hood will allow us to shoot from a distance.

Risks:

- Strategically, we took a risk not having a turret and reducing the accuracy of our long shots, so before States, we decided to be the best up close robot we could be.
- After States, we decided to add a custom 3D printed adjustable hood because we wanted to improve our far shooting for Worlds while reducing the risk of artifacts bouncing out.
- Because we were now shooting from mid to far field, having a rear intake didn't make as much sense, so we flipped our intake to the front.

ELEVATOR:





Our original servo-driven wide rubber band belt drive was very slow, so we replaced it with a 1150 RPM motor, chain drive sprocket, and rubber band system. All our sprocket and rubberband wheels use 3D printed sprockets and printed spacers on the shafts. Our teardown in February eliminated the elevator and went with central sprocket and rubberband wheels.

Risks:

- The upright design made it so the robot would have a difficult time parking under another robot. We have decided that we will instead use a "kickstand" mechanism that lifts part of our robot off the parking zone, leaving half for another kickstand or lifting robot.

CHEESE WEDGES:





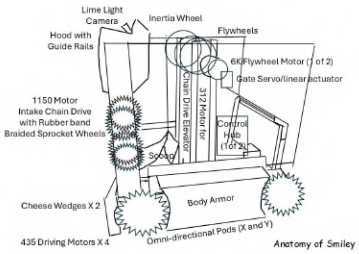


The Cheese Wedges guide artifacts into the intake and scoop. We had to reprint them 7 times to fix issues with rubbing, fitting into the U-channels of the chassis, and functionality. The fourth print had 100% infill because the original ones had taken damage. Later iterations were taller with rollers to allow us to use the wedges to open the gate. The latest iteration was incorporated into the redesign of the intake. It is shorter so that it can fit under the intake, keeps the rollers, and has a much deeper angle to guide artifacts into the center of the robot.

Risks:

- More pressure on the leading edge of the wedge when it runs into the perimeter may cause damage to the wedge. However, we have mitigated this with an extended intake.

Control Award



HARDWARE:

Gate: The purpose of the gate was to hold artifacts before feeding them into the flywheel, and bring artifacts up to the flywheel. Our first design: Two squishy Gecko wheels for grip. We found that artifacts would slip past the Gecko wheels, so we changed to using a servo-powered gate that would rotate in and out of the way. The issue with this design was that the Gobilda servo would break under too much pressure. We changed to using stronger, faster servos from Swyft; we also changed the gate mechanism to a linear slide. The linear slide used a string to move the drawer slide forward and backward. This solved the problem of our servo breaking because the pressure is on the drawer slide, not the servo. Our programming team found that programming this is significantly harder due to hardware limitations. There were also issues with our strings stretching, causing positions to change. To solve this and bring us to our current design, we put a gate into the flywheel mechanism. Additionally, to know when we have three artifacts, we can use the 3-beam break sensors and the current that the servo is drawing, because if it is drawing a higher current, then we know there are three artifacts.

Flywheel:
To launch our artifacts into the classifier, we use a flywheel that started as one 6K RPM Gobilda Yellow Jacket motor and had two hard wheels, but that changed on January 13th. On January 13th, we changed to using two 6K RPM Gobilda Yellow Jacket motors along with a steel inertia wheel. Because we had two motors, we had to create a custom PIDF controller (stated on the next page). This lets us keep the flywheel at an optimal RPM for launching artifacts. Our main problem with the first design was that the robot was using one motor, which meant that each time we could shoot an artifact, the flywheel motor would decelerate and not get back up to the set RPM fast enough. To solve this, we tested and documented the RPM fluctuations so we could compare them to an updated version.

Elevator: Our elevator was designed to bring the artifacts up to the indexers and flywheel, but it was slow. After the CT Tolland scrimmage, we changed from using a belt drive made out of rubber bands to using a sprocket wheel on a chain drive. Another improvement we made was switching from continuous-rotation servos to a 1500 RPM motor, which used a sprocket with rubber bands. . Using the 1500 RPM motor makes the elevator more efficient.

Scoop/Intake Ramp: The scoop/ ramp for intaking artifacts is designed to guide the artifacts up to the elevator system. Our prototype system was made from cardboard and then rubber band steps. We took what we learned from the cardboard prototype to create a polycarbonate scoop and side panels. We added side panels to help feed and keep artifacts in alignment. The issue with this design was that the artifacts jumped outside of the scoop, and they would slip. To counter this, we put duct tape on the polycarbonate, creating friction. We bent the polycarbonate to funnel the artifacts into the elevator. In our current iteration, the ramp rails have replaced the top of the scoop, and the smaller 3D printed scoop is incorporated into the intake system.

Intake Sprocket Rubberband system: The Intake pushes the artifacts into the scoop. One of the challenges was that the artifacts were not being centered to the middle of the scoop. To solve this, we braided our rubber bands into a double helix design with a sprocket wheel on either side. This naturally funnels the artifacts into the center and eliminates a deadzone. An issue with this design was that the intake was too close to the robot, and the artifacts needed to be perfectly aligned to shoot. Our solution to this was to extend our intake further forward and put rollers into our intake wedges to better guide artifacts into the scoop.

Hood: The hood is to guide artifacts at the correct angle from the flywheel to launch them into the goal. Our original design was a multi-distance shooter. The issue with this was that the REV Prototype did not work well and did not directly translate to the redesigned goBILDA robot. We had to determine the optimal angle for launching from up close to the goal, so we decided to 3D print a total of 6 different hoods with different angles. On January 15th, we added rails/"horns" to the fixed hood to center the artifacts through the hood. To shoot from different distances, we added a LimeLight 3A camera and odometry pods to find our distance from the goal, allowing us to set our flywheel to the correct speed to make the shot. While this worked, when we changed our strategy from a close shooter to a multi-distance shooter, our hood needed to adapt. We made our hood adjustable and added rollers to the hood to eliminate artifact backspin.

Chassis and Drive Train: Our chassis and drive train are the base for our robot to get around the field. We have only changed it once this year, and that was upgrading our drive motors from 312RPM Gobilda Yellow Jacket Motors to 435RPM Yellow Jacket Motors. This lets the robot move faster around the field. We also have a 4-bar odometry pod on the drive train to monitor our position on X and Y positions. Odometry pods are deadwheels with encoders on them.

Control Mechanism: Our robot uses a REV Control Hub and a REV Expansion Hub to control our robot. We use 2 X-Box 360 controllers, one for controlling the drivebase and one for controlling the elevator, intake, and shooting functions. Our issue was our drivers communicating; to fix this, we put the main controls on one of the controllers and limited controls on the second controller.

SOFTWARE

Programming: This year, programming came with many challenges. At the beginning of the season, our autonomous program was based on time. This means that an internal timer determines when it executes different functions. Using a time-based system had downsides of reliability, accuracy, along with speed changing based on battery voltage/power. Our solution to this was changing to a distance-based autonomous. We used the motors' built-in encoders and math to drive certain distances. We also added PIDF programming to optimize direction variations. At the New Haven event, we used Pedro Pathing and its custom movement library to control our autonomous. "Pedro Pathing uses Bézier curves, PIDF control, centripetal force correction, and more to provide smooth, fast, and accurate path". The issue was that our robot couldn't determine its location on the field, so we added a 4-bar odometry pod and an Inertial Measuring Unit to the chassis of the robot. We used Pedro Pathing to solve the robot's inefficiency during autonomous.

One of the issues we had was orienting toward the goal quickly, so we programmed a LimeLight 3A camera to read April Tags and use localization data to orient toward the goal.

SENSORS

4 Bar Odometry Pods and Pinpoint IMU - track X and Y on the field, better than internal motor encoders. Allows us to localize in Autonomous and TeleOp and automatically drive to points, get the target flywheel RPM, and turn towards the goal.

Limelight 3A Camera: to read April Tags on goals and get the goals' position. We tried the Logitech C-270 camera; the issue was that the field of view was too small, and it struggled to keep tracking the April Tags as the robot moved. To resolve this, we switched to using a Limelight 3A Camera. We use the camera with Pedro Pathing to keep the robot aligned during autonomous and recognize its position on the field during tele-op. Trying to reduce driver error so only minor corrections are needed.

Beam Break sensors: 3 Adafruit beam break sensors were placed in the ramp leading from our intake to our flywheel. See below.

Flywheel Testing Data

We tested our flywheel shooting at several different points so that we could automatically get our flywheel RPM from our Limelight 3A camera. We use the target Y, which is how far above or below the center of the camera the AprilTag on the goal is, and plug it into an equation to get our RPM. We were able to create the equation based on the test points, for which we set the RPM manually and tested to see what speed was most accurate. During our state competition, we were forced to make changes to the hood, which meant we had to redo our equation. Because we had practiced doing this equation multiple times, we were able to redo it quickly before the matches started and test that it worked properly.

A	B	C	D	E	F	G	H	I	J	K	L	M	N
inches to goal	setpoint			target "Y"	RPM		target "Y"	RPM		target "Y"	RPM	ty	rpm
47	500rpm	kf multiplier 2.49		2.67	1800		-1.65	2050		-7.2	2075	-6.7	1950
48.5				-2.6	2050		-6.7	2000		-11.4	2200	-13.2	2050
				-8.02	2150		-11.05	2200		-14.3	2350	-15.2	2300
				-11.59	2325		-14.75	2350		-15.5	2500	-16	2400
				-13.64	2700		-17.2	2650		-17	2750		
				-15.2	3250		-18.85	2850		-18.2	2900		
				-17	4250					-18.8	2950		
				HOOD V2			HOOD V4			HOOD V5		Competition	

PIDF Testing

To ensure that our flywheel RPM is accurate, we use a custom-built PIDF controller.

What is a PIDF Controller? PIDF stands for **P**roportional-**I**ntegral-**D**erivative-**F**eedforward. It is a method of getting a motor to the target speed as fast as possible while minimizing overshoot. It increases power above the target speed when the target speed is much higher than the actual speed, and reduces speed when it is over the target. The **P**roportional term is proportional to the difference between the target speed and the actual speed. The **I**ntegral term minimizes error when the motor comes near to its target speed consistently, and the **D**erivative term prevents the proportional from overshooting by predicting future error. Many systems only use the P, I, and D terms. However, for our flywheel, we use a fourth term: **F**eedforward. This accounts for preexisting forces and allows our motor to start getting back to speed right away.

Why use a custom one? Normally, you can use the built-in setVelocity() method in code, but we had to build our own PIDF controller because we use 2 motors on the flywheel. If both of them read encoder data to get the actual speed and not the target speed, then they might end up running at different speeds, causing issues because they are mechanically connected. Instead, we read encoder values from one of the motors and use that to adjust our power output.

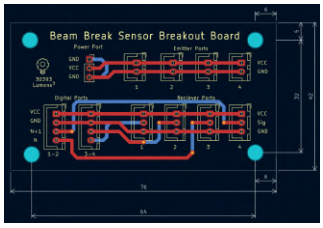
Tuning: To tune our PIDF controller, we fired artifacts through our flywheel and noted the drop in flywheel speed whenever a ball passed through. In order to reduce the amount of time between the drop and reaching the target speed, we made sure our controller was properly tuned to get back to the target speed quickly without significant overshoot.

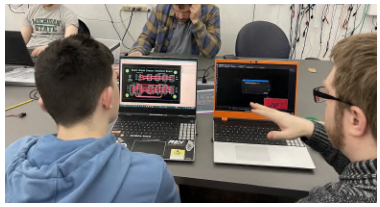
Automatic Aiming

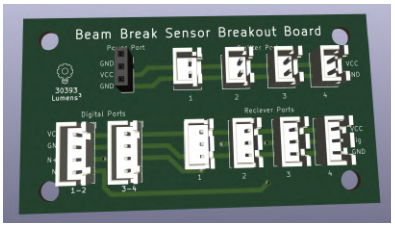
We use an automatic aiming program to make sure that we are always on target when we shoot. Initially, we just had the drivers do their best to eyeball the required rotation. In competitions, however, this was either slow, inaccurate, or both. To solve this problem, we installed the Limelight 3A camera. This allowed us to make sure we were actually on target by turning right if the goal's AprilTag was on the right of our vision and vice versa, using another PIDF controller. This was very useful and significantly increased accuracy. When the robot wasn't already facing the goal, though, the drivers couldn't use this feature. To solve this, we now use a combination of our odometry localization as well as the Limelight to know which direction the goal is at all times. This further improved speed, and we can now shoot 3 artifacts in even less time.

Beam Break Sensor (Control and Connect)

This year, we created a custom PCB (Printed Circuit Board) to let our Adafruit beam break sensors interact with the control hub using digital ports. We implemented the beam break sensors in order to detect how many artifacts are in the robot. We use this to help prevent the robot from getting penalties for containing more than three artifacts. We worked with engineers from Sonalyst and Covestro at Spark Makerspace, who helped us make design suggestions and offered manufacturing company suggestions for the PCB.







Design Award

“What Is Industrial Design? The professional practice of designing products, devices, objects, and services used by millions of people around the world every day... focuses on the physical appearance, functionality, and manufacturability of a product...extends to the overall lasting value and experience a product or service provides for end-users.”
https://www.idsa.org/about-idsa/advocacy/what-industrial-design/

Examples of using Industrial Design Principles: our CAD Drawings and functional, aesthetically pleasing builds used on the Robot:

This year, we used OnShape to create parts of our robot, specifically, our inertia wheel, side armor, Licence plates, intake, battery holder, and a full CAD model of the robot.

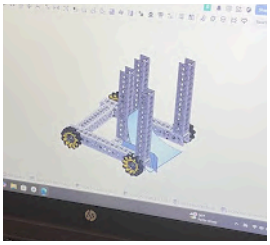
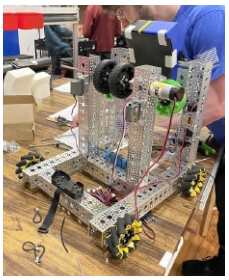
Cheese Wedge: One of the challenges with our robot was funnelling artifacts into the robot. To solve this, we added 2 solid 3D printed plastic cheese wedges which funnel and center artifacts into our intake. We made a total of 7 different design iterations. On our fourth design iteration, we changed our rollers to mini rollers on the inside of the wedges, which removed the friction between the artifacts and the plastic.

Intake: Our intake was designed to intake the artifacts into our robot. The robot's intake started with a piece of polycarbonate that we bent, this funnels the artifacts into the center of the robot. Our flywheel needs centered artifacts to consistently shoot at the same speed. Our final iteration was to change from a scoop to a lighter system of 2 rails to keep the artifacts lined up.

Inertia Wheel: The inertia wheel is used to help keep our flywheel at a constant RPM. Before we added the inertia wheel, our flywheel would spin down after each shot. To solve this, we added the steel inertia wheel to keep the flywheel at a constant speed.

Side Armor: The side armor was designed for strength and protection. We found that the wheels would get beaten up on the game field, so we put side armor on the robot.

CAD of Robot

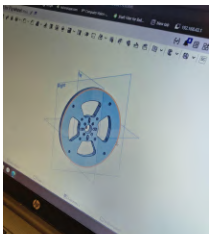
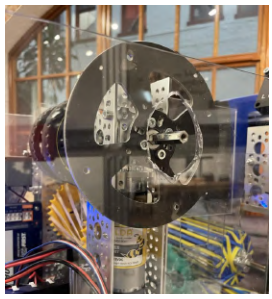



Side Armor

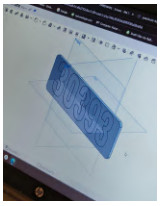


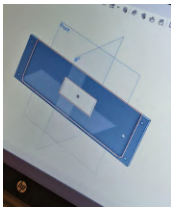


Inertia Wheel

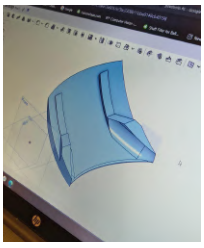



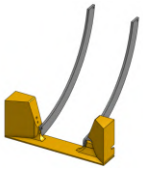
License Plate



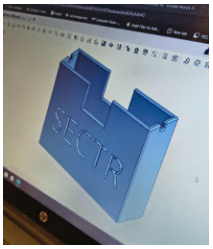



Intake



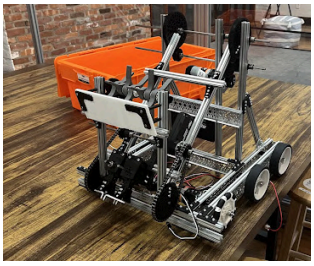

Battery Holder



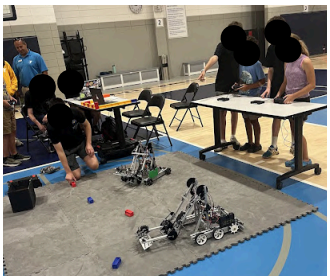


Strategy Evolution, Developing Robot (Think)

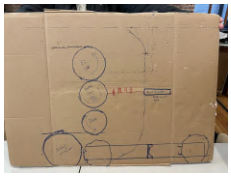
July Strategy:
All team members learn OnShape and design and 3D print their own name plates.
Build the REV Starter bot, practice driving and programming with the WPI XRP mini-bot. The idea was to get a robot built and programmed for the Outreach Event at the Mystic YMCA.

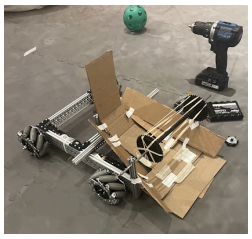
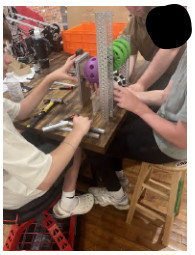
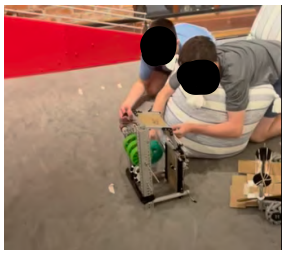



August Strategy:
Build and complete the second REV starter bot for our outreach event at the Mystic, CT YMCA on August 18, 2025. Continue to learn and practice skills for the season.



September Strategy:
Game Reveal. Prototyping intake and launcher using REV.

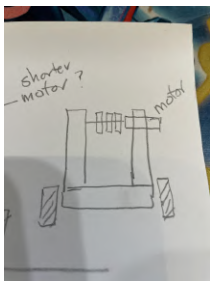


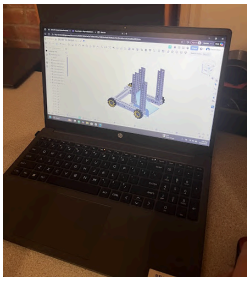
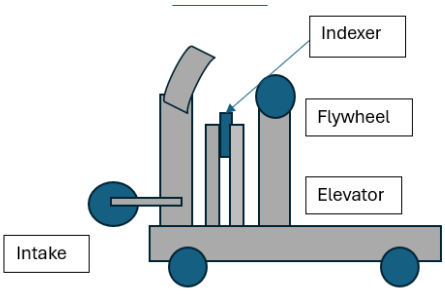




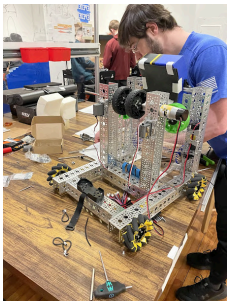
Front loading and launching design: Prototypes in REV

October Strategy: We switched to goBILDA and ordered a starter bot. Head Coach Andrew resigns, Mentor Connor Hall starts. We struggled because our other coach, Brian McGlinchey, was at college and unable to help us. The robot is not accurate. Connor helps the team come up with the new strategy, which is to be an up-close shooter. They use what they have already built and convert it to rear loading and front shooting. Tolland Scrimmage is the deadline. Start to work on autonomous programming, scrap the color sensor artifact kick out for now. Focus is on getting a robot working.

November Strategy: Radical Redesign progresses:
One of the Initial Sketches Chassis Design in OnShape Identifying "our" robot's terms Flywheel Motor Placed "As Planned"





Hood went through several iterations trying to get the right angle and get rid of the flex when an artifact is shot:



Hood 1: November 19, angle good, only one hole So flexes when doing test shooting.



Hood 2: December 4, angle good, two holes for better support, doesn't flex when shooting, but too tall, striped because the 3D printer is having issues. SECTR logo colors are cool.

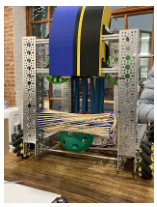


Hood 3: Red one. Angle is too great. Decide to go back to striped one and cut off excess height

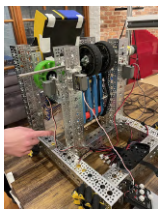


December 4: adding indexers and a new 2-hole hood.

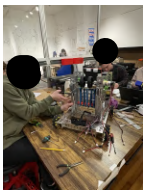
December Strategy: Prepare for our scrimmage and first qualifier soon after. Coach Brian McGlinchey finishes college in time for the scrimmage.



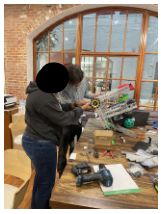
December 9 - redesigned intake with braided rubber band intake



a new rubberband elevator installed



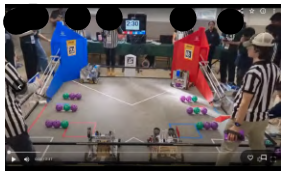
December 11. Adding tensioner to rubberband elevator with cut down hood, able to pick up artifacts and shoot

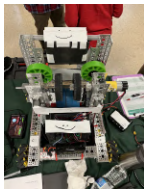


December 15. fitting a new rubberband scoop, so can practice before robot polycarb scoop designed and completed



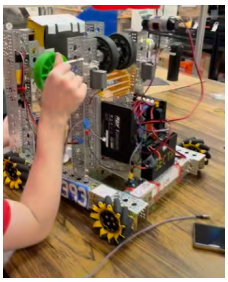
December 16. Test robot with cut-down hood
Shoots and picks up artifacts.
and keeps artifacts out of hubs





December 20. Go to the Tolland Scrimmage. Duct tape smiley faces lets drivers know which direction is facing them for autonomous and keeps artifacts out of Hubs. Robot name: Smiley

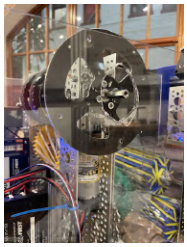
December 29. Testing a new elevator with a rubber band, a sprocket wheel, and a motor instead of a servo. Changed the autonomous program to distance from time. Tested: Shoots, 1,2,3 - during autonomous.
TESTING RESULTS:



Flywheel speed	Speed aimed	highest	lowest
low	1260	1300	740
medium	1900	2000	1520
high	2520	2600	2000

FLYWHEEL SPEEDS BEFORE INERTIA WHEEL(BLACK)
SLOWING DOWN SIGNIFICANTLY AS ARTIFACT PASSES THROUGH

January Strategy: Refine the robot from scrimmage, learn from our mistakes. Working on our MoSCoW "Shoulds". Increase the autonomous artifact collection number and accuracy. Increase driving speed and shooting speed. Add the ability to read April Tag and change position based on the field location. Add PedroPathing to programming. Clean up the image while embracing the Smiley face.



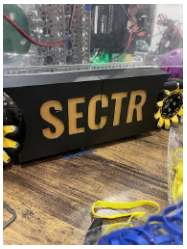
Weighted Flywheel and Second 6K Motor on flywheel Water Jet cut at Hillery Company



Add and Program Camera to read April Tags



Replace Indexer wheels with gate



Add armor for opening goal gates and protection



Clean up Appearance

February Strategy: Qualified for State Championship. Rebuilding the intake on the robot to pick up artifacts more quickly. Tried a 3D printed mecanum wheel on the side of a movable extended intake to widen the angle of the intake's ability to pick up artifacts and better guide artifacts into the scoop from the wider angle. Mecanum wheels are not working properly. Going to a longer rubber band and sprocket intake system.

Upgrading programming. Three different autonomous programs: a twelve-ball and leave from close, a twelve-ball with a gate release and leave from close, and a leave from the far zone. We wanted to program a simple back-of-the-field leave in case our alliance has a better autonomous, and we needed to let them score. We added Limelight automatic aiming and speed for better shooting accuracy. We also tuned our PIDF for better performance.

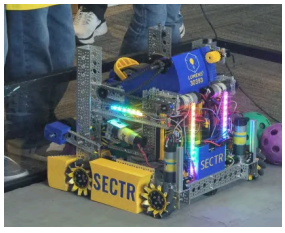
March Strategy: Qualified for the FIRST World Championship, decided to change our strategy. Our close shooter limited who we could partner with and where we could shoot artifacts from. We wanted to be a more generalized midrange robot for Worlds. This meant changing our intake from rear loading to front loading and adding an adjustable hood so we could shoot from anywhere. We ran a MoSCoW session and decided we (WON'T) wouldn't add a turret for time and economic reasons. We added a custom beam break sensor system to let the driver know when the intake has three artifacts and make driving easier.



March 6 - Tear down



New Hood



Beam Break System at Work

Season Overview (Think)

May

16 - Visit to Wolcott High School to meet with Rob Cormier and get advice on how to start the team, and equipment is needed
17 - Rent Atrium 101 - The new FTC room

June

24 - First team meeting, 9 members. Set season goals: Andrew Crouse and Brian McGlinchey coaches

July

7-11 Wolcott Rookie Training Camp. Learned what MoSCoW meant
Building the first REV Robot
20 - Team Building Field Trip - Bowling

August

Working on the second REV Robot for the YMCA event
11 - Practice driving and programming with WPI XRP mini-bot
18 - Outreach Event at Mystic YMCA
24 - Coach Brian is going back to school, and Ethan Kerr is taking his place

September

6 - Game Reveal - go to Wolcott for kick-off
9 - Chipotle - Taco Tuesday Fundraiser
11 - Received game field, set it up
23 - Prototyping intake, feeder, and launchers
Want to have a color sensor set up that activates the kick-out of wrong artifacts
The prototype launcher has this idea in mind
Learning to program the color sensor

October

14 - Decided to switch to the goBILDA robot
On Shape CAD designing of the competition goBILDA robot begins - front feeding and launching design
REV robots taken apart, one drive base saved for driver practice
Learning how to program the color sensor
New robot not progressing - goBILDA and REV parts not compatible - constantly out of parts we need for build

November

8 - FLL Mock Tournament - Team makes an unofficial presentation to Ann Marie Hall and Brian Hall from the Aluminum Falcons. They loved the CAD design
13 - Coach Andrew resigns
18 - Mentor, Connor Hall - steps in and helps the team refocus and redesign the robot. New strategy and get it done before scrimmage attitude. New strategy is a rear feeding, front launching robot. Upright angle to hood allows up close and accurate set up and shooting
Robot is held together with rubber bands, 3D printed parts and duct tape
Robot is slow but finally works.

December

19 - Coach Brian comes back - just in time to take team and robot to the scrimmage the next day
20 - Scrimmage at Tolland - learned a lot about penalties.
Made an autonomous, and used for the day, had to improve between matches but it worked
Robot is SLOW but worked
Robot scored highest score of the day (due to penalties)
Made it to finals as the second seed alliance!
21-30 - Robot's driving motors replaced with faster motors, elevator servo replaced with a motor, elevator redesigned to replace rubber band belt drive with rubber band sprocket wheels. Dead zone eliminated. Autonomous revamped to get 6 artifacts. Programmers switch from time to distance programming. Drivers still not able to practice much because of work being done.
New scouting sheet made.
30 - Mike Gentry came to the Lab and did a practice inspection on the robot in anticipation of the Wolcott Qualifier. Robot passed.

January

3 - Wolcott Qualifier - ranked 7th, 4th Seed Alliance Captain, alliance placed second in playoffs after making it to the finals. Innovate Award, Finalist Award
3-17 - Prep for New Haven: Indexer wheels replaced with gate, side armor designed and added, Limelight camera added, Metal Flywheel added, programmers implemented Pedro Pathing autonomous. Colored rubber bands added for looks.
10 - FLL STEM night - Helped run a SECTR open house/science night where the FLL teams were interviewing possible new members. Showed off the FTC competition robot to many kids interested in robotics. Also met and gave a tour to 3 potential new members.
17 - New Haven Qualifier - made it to finals. Wins 4, losses 1. Control Award, Second Seed Alliance Award
24 - Vernon Qualifier - Wins 4, Losses 1. Captain of Second Seed Alliance. Placed 10th in finals

February

21 - States

March

27 - Outreach with Tolland Robotics at the New England Air Museum. Our new robot needed to be ready to roll.

April

28- Worlds begins

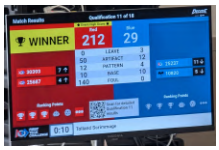
May

2-Worlds ends

Season Milestones

Tolland Scrimmage, December 20, 2025

On Alliance with the Highest Points for the Event
Joined the Second Seed Alliance.
Final Place: Second Place Alliance



Wolcott Qualifier Event, January 3, 2026

Qualification Rounds:
Wins: 3 Losses: 2
Rank for Alliance Selection: 7th.
Captain of 4th Seed Alliance.
Playoff matches:
Wins: 2 Losses: 2
Final Place: Second Place Alliance



Won: Innovate Award



Final Place: Second Place Alliance

New Haven Event, January 17, 2026

Qualification Rounds:
Wins: 4 Losses: 1
Rank for Alliance Selection: 7th.
Accepted Second Seed Alliance Selection.
Playoff matches: Wins: 3 Losses: 2
Final Place: Second Place Alliance



Won: Control Award



Final Place: Second Place Alliance

Vernon Event, January 31, 2026

Qualification Rounds:
Wins: 4 Losses: 1
Rank for Alliance Selection: 2nd.
Captain of Second Seed Alliance:
Playoff matches: Wins: 1 Losses: 2
Final Place: Did not place



FTC State Tournament, February 21, 2026

Qualification Rounds:
Wins: 5 Losses: 0
Rank for Alliance Selection: 2nd.
Captain of Second Seed Alliance:
Selected Robo Demons, 8th Seed.
Playoff matches: Wins: 3 Losses: 2
Final Place: Second Place Alliance



Won: Design Award



Final Place: Second Place Alliance

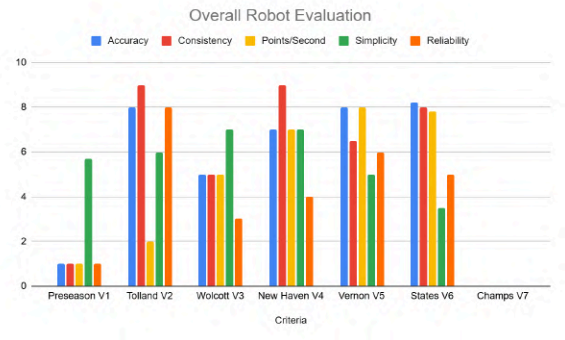
Tables and Chart

Robot Evolution Overview (Think and Control) See Poster in Pit for Close Up

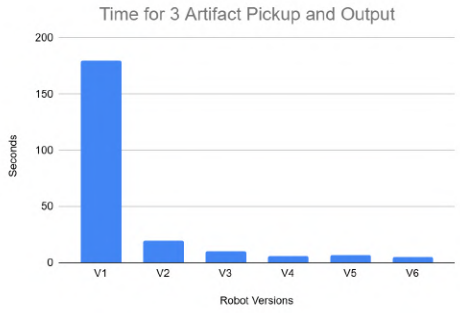
Robot Version History

Version Numbe	Intake	Elevator	Gate/Indexer Method	Hood Direction/Angle	Intake/Scoop	Motors	Servos	Sensors	Inertia Wheel	Code/Score	Drive Base	Lessons Learned
1 - Preseason	Front	Omni Wheel Transfer	Wheels - Geeko	Front/Fixed	Rubberband Roller	4 Drive -Core 20:1	2 REV	None	No	Auto	REV - Mechanum	Did not perform well
Date: 5/23-8/18/25		servo - REV	servo - REV smart	120 Degree	Motor	1 Flywheel				0	4 Core 20:1	shooting inconsistent
					Cardboard Scoop	REV - Core Hex 6k				Tele-op		
						1 Intake - 1150				2		
2 - Tolland	Rear	Rubber Band Roller	Wheels - Geeko	Front/Fixed	Helix Rubber band Roller	4 Drive -350	2 Indexer	None	No	Auto	goBilda - Mechanum	Robot worked and shot.
Date: 8/18-12/20/25		servo - torque	servo - torque	15 Degree	Motor 1150	1 Flywheel -6K				13	4 312	Close ONLY. Very slow
					Polycarb Scoop	1 Intake -1150				Tele-op		
										47		
3 - Wolcott	Rear	Rubberband Roller	Wheels - Geeko	Front/Fixed	Helix Rubberband Roller	4 Drive - 350	2 Indexer	Omni Pods	No	Auto	goBilda - Mechanum	faster shooter
Date: 12/20-1/3/26		312 Motor	servo - torque	15 Degree	Motor	1 Flywheel - 6K		Lime Light		13	4 435	close ONLY
					Polycard with Aluminum Extrusion and grip tape	1 Intake - 1150				Tele-op 22		
4 - New Haven	Rear	Rubberband Roller	Arm	Front/Fixed	Helix Rubberband	4 Drive - 435	1 Gate	Omni Pods	Yes	Auto	goBilda - Mechanum	faster shooter,
Date: 1/3-1/17/26		312 Motor	goBilda torque	15 Degree	Motor	2 Flywheel 6K				14	4 435	close ONLY
					Polycard with Aluminum Extrusion and grip tape	1 intake 1150				Tele-op 35		More consistent
5 - Vernon	Rear	Rubberband Roller	Arm	Front/Fixed	Helix Rubberband Roller	4 Drive - 435	1 Gate	Omni Pods	Yes	Auto	goBilda - Mechanum	faster shooter,
Date: 1/17-1/31/26		312 Motor	Swyft torque	15 Degrees	Motor	2 Flywheel 6K		Lime Light		11	4 435	speed drop reduced
					Polycard with Aluminum Extrusion and grip tape	1 Intake - 1150				Tele-op 45		
6 - States	Rear	Rubberband Roller	linear slides -	Front/Fixed	Helix Rubberband Roller	4 Drive - 435	1 Slide	Omni Pods	Yes	Auto	goBilda - Mechanum	fast shooter, close,
Date: 1/31-2/21/26		312 Motor	Swyft speed	26 Degrees	Flex	2 Flywheel 6K		Lime Light	+1 plate	0	4 435	tried to add distance
					Polycard with Aluminum Extrusion and grip tape	1 Intake 1150				Tele-op 43		shooting, inconsistent
7 - Worlds	Front	No Elevator	Arm	Front/Adjustable	Helix Rubberband Roller	4 Drive - 435	1 Gate	Omnipods	Yes	Auto	goBilda - Mechanum	fast shooter, far to mid
Date: 2/21-4/29/26			Swyft torque	26-40 Degree of Freedom	Flex	2 Flywheel 4,285		Lime Light	+2 plates		4 435	Very Consistent
								Beam Break		Tele-op		
					Rails and Small Scoop							

Robot Evaluation (Think)



Cycle Time (Control)



Team Member Goals (Connect)

Team Member Goals

Member Name	Goal 7/15/25	Progress	Goal 2/12/26	Progress	Goal For Worlds 4/28	Progress
Shivam Patoju	Coding	Changed goal	learn about building systems	learned srtinging, using chains; learned how to interface 3D printed things to metal	Learn how teams build custom robots at worlds, learn more about shooters	Learned how counter rollers work
Daniel Hyrn	CADing quicker	Practiced CADing	Same Goal	Praticed CADing; namely CADed an adjustable hood	Design Award	Made hood, did design for portfolio
Declan Bothur	CADing	Practiced CADing	Organize wiring for robot	Made wiring diagram	Learn from the best teams at worlds	N/A
Levi Stewart	Coding	Learned pedro pathing	12 ball auto	Finished auto	Learn about worlds so we can excel next year	N/A
Raffi Manley	Driving	Changed Goal	Learn to code	Coded basic Teleop	Finish comprehensive scouting sheet	Recently finished scouting sheet
Kevin Bergel	Coding	Distance and pedro-pathing code	Same Goal	Finished Pedro pathing auto but there was a glitch at states	Using beam brake sensors along with LED strips to help the drivers	Finished Learning how to use beam brake sensors.
Emma Sadja	Coding	Changed Goal	Learn about scouting	Learned how to scout and about budgets	Get sustain award	Working on improving presentation
Victoria Richards	Getting Involved	Learned how to scout	Make Scouting list	Finished list	Fnish scouting sheet	Recently finished scouting sheet