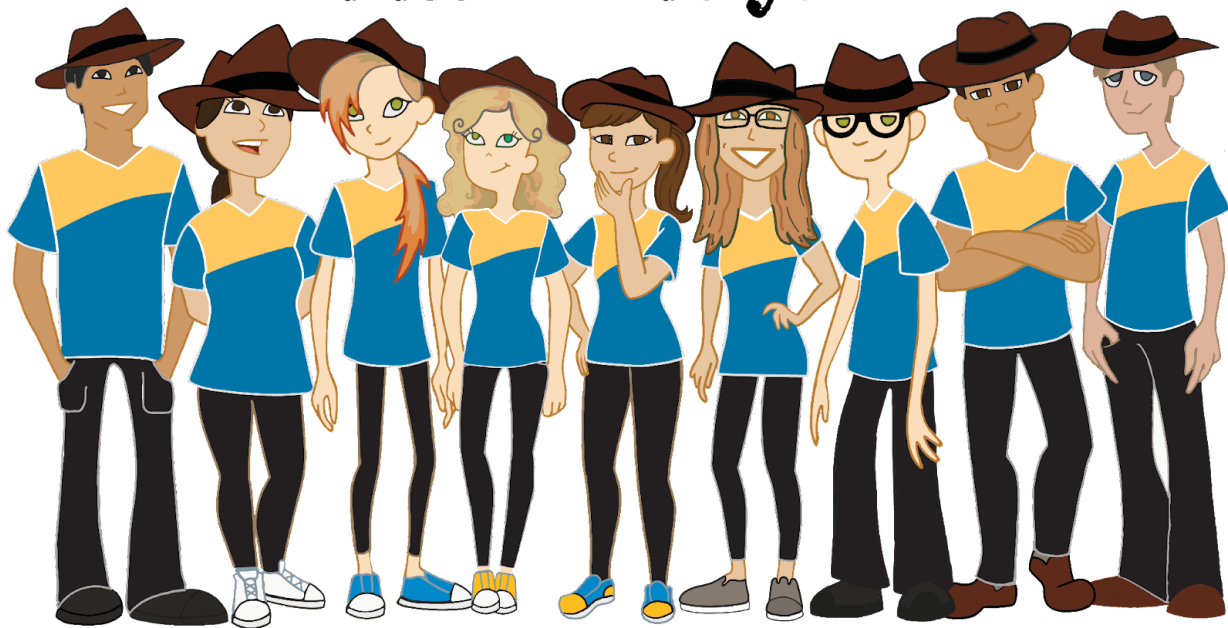


# Team Without a Cool Acronym



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Washington County 4H - Hurricane, Utah

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Freight Frenzy Engineering Portfolio  
2021-2022



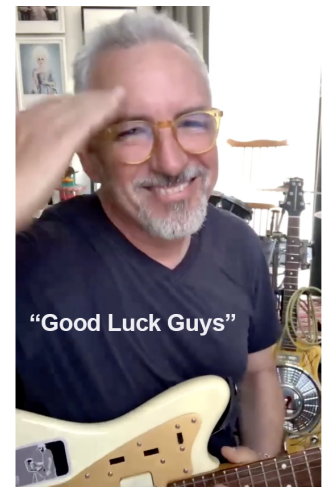
## Meet the Team!

Team Without a Cool Acronym [or TWCA for short], is a 3rd year FTC team organized with Washington County 4-H in Hurricane, Utah. FIRST experience on our team ranges from 7-year veterans to 1st-year newbies.

A unique thing about our team is that it is **based on the animated television show Phineas and Ferb**. The show is about above-average inventive children, [brilliant with mechanical engineering]... and their pet platypus, Perry. Perry is a secret agent for the Organization Without a Cool Acronym [or OWCA for short].



Jeff "Swampy" Marsh, co-creator of Phineas and Ferb, is a huge fan of our team and has been in constant contact with us over the last 3 years. This season, he sent us signed posters, and a video message wishing us luck in the Freight Frenzy season [screenshot to the right]. He gave us some advice on pushing through failure and not giving up and has posted on his Instagram account many times about how proud he is of our team. Team members Kate, Calvin, and Tess took the robot to meet him in person in March!



Jeff "Swampy" Marsh - Co-creator of Phineas and Ferb.

All of our team members pay tribute to the show with

our team name, the styling of our shirts, and the fedoras we wear!

















## Motivate

### About our Members and Their Team Roles:

Kate	Alex	Madi	Brooke	Gerrod
				
<ul style="list-style-type: none"> <li>-Team Founder</li> <li>-Senior/Captain</li> <li>-Mechanical</li> <li>-Programming</li> <li>-Outreach</li> <li>-Driver</li> <li>-Experience: 7yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Senior</li> <li>-Co/Captain</li> <li>-CAD</li> <li>-Mechanical</li> <li>-Outreach</li> <li>-Drive Coach</li> <li>-Experience: 3yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Senior</li> <li>-Mechanical</li> <li>-Outreach</li> <li>-Creative</li> <li>-Experience: 2yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Senior</li> <li>-Engineering NB</li> <li>-Outreach</li> <li>-Experience: 2yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Senior</li> <li>-Programming</li> <li>-Outreach</li> <li>-Experience: 5yrs</li> </ul>
Calvin	Codi	Teslyn	Jed	Perry-inator
				
<ul style="list-style-type: none"> <li>-Sophomore</li> <li>-Mechanical</li> <li>-Outreach</li> <li>-Driver</li> <li>-Experience: 6yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Freshman</li> <li>-Programming</li> <li>-Graphic Design</li> <li>-Outreach</li> <li>-Experience: 3yrs [FTC Rookie]</li> </ul>	<ul style="list-style-type: none"> <li>-8th Grade</li> <li>-Programming</li> <li>-Graphic Design</li> <li>-Outreach</li> <li>-Experience: 4yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Junior</li> <li>-CAD</li> <li>-Mechanical</li> <li>-Experience: 4yrs</li> </ul>	<ul style="list-style-type: none"> <li>-Robot</li> <li>-Earns Points</li> <li>-High Maintenance</li> </ul>

### Outreach, Community Service & Fundraising Goals

- Recruit new members.
- Perform over 1,000 hours of outreach
- Fundraise \$18,400.
- Reach 1,000 followers on Instagram by end of the season.
- Teach people of all ages.
- Volunteer at non-tech events.
- Befriend new FIRST teams all over the world!



We raised over \$1,200 fundraising at Peach Days in Hurricane City.

**How We Made & Reached Our Goals:**

We made our goals by **discussing what we wanted to accomplish** at planning meetings throughout the season and **writing those goals down**. We reached our goals by keeping our eyes and ears open, watching for every opportunity to volunteer or fundraise. A big way we found volunteer/outreach opportunities was by watching what events were coming up at local schools and then contacting the organizers to see if they were looking for volunteers. This is how we got involved in multiple STEM camps/clubs and school carnivals!

**Check out just a few of the fun things we did this season!**

FTC Showcase 2021

#omgrobots #FTC #firsttechchallenge 🏆 #WolfCorp



We presented at an international virtual FTC showcase with teams from Australia, Netherlands, South Africa, and Mexico!



We volunteered to serve dinner to 3000 people at a city-wide dinner & free concert.



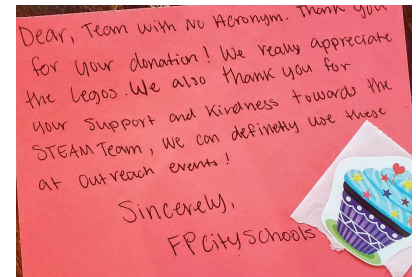
We represented Utah FIRST at the Craft Lake City, DIY fest. For 2 days, we presented FIRST programs in the Google Fiber building.



At local schools, we volunteered at 2 summer STEM camps, 2 Code Camps



We volunteered at the the STEM Outreach Center at Dixie State University.



We provided a product grant of LEGO Technic pieces benefiting 8+ FLL teams all over the US.



We volunteered at multiple FLL scrimmages and qualifiers.



Locally we mentor 1 FLL Explore and 4 FLL Challenge teams.

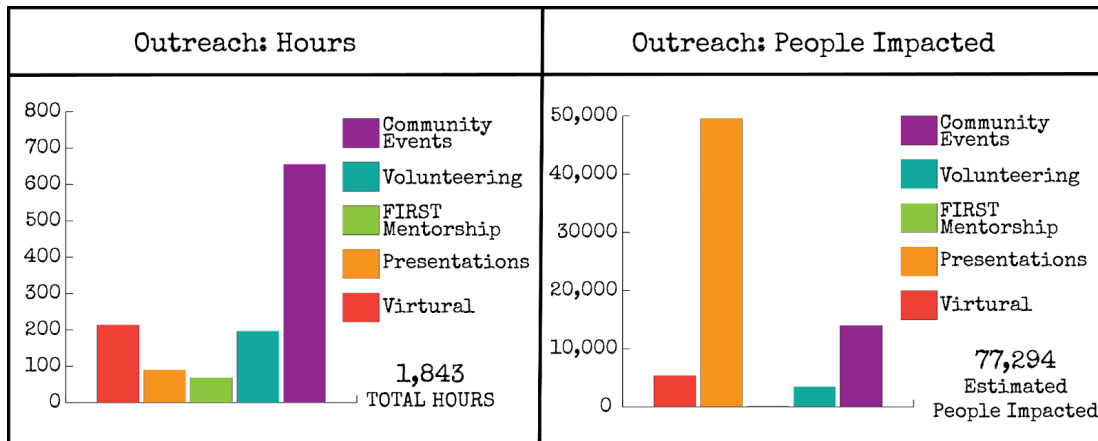


We taught the creator of Phineas and Ferb about FIRST.

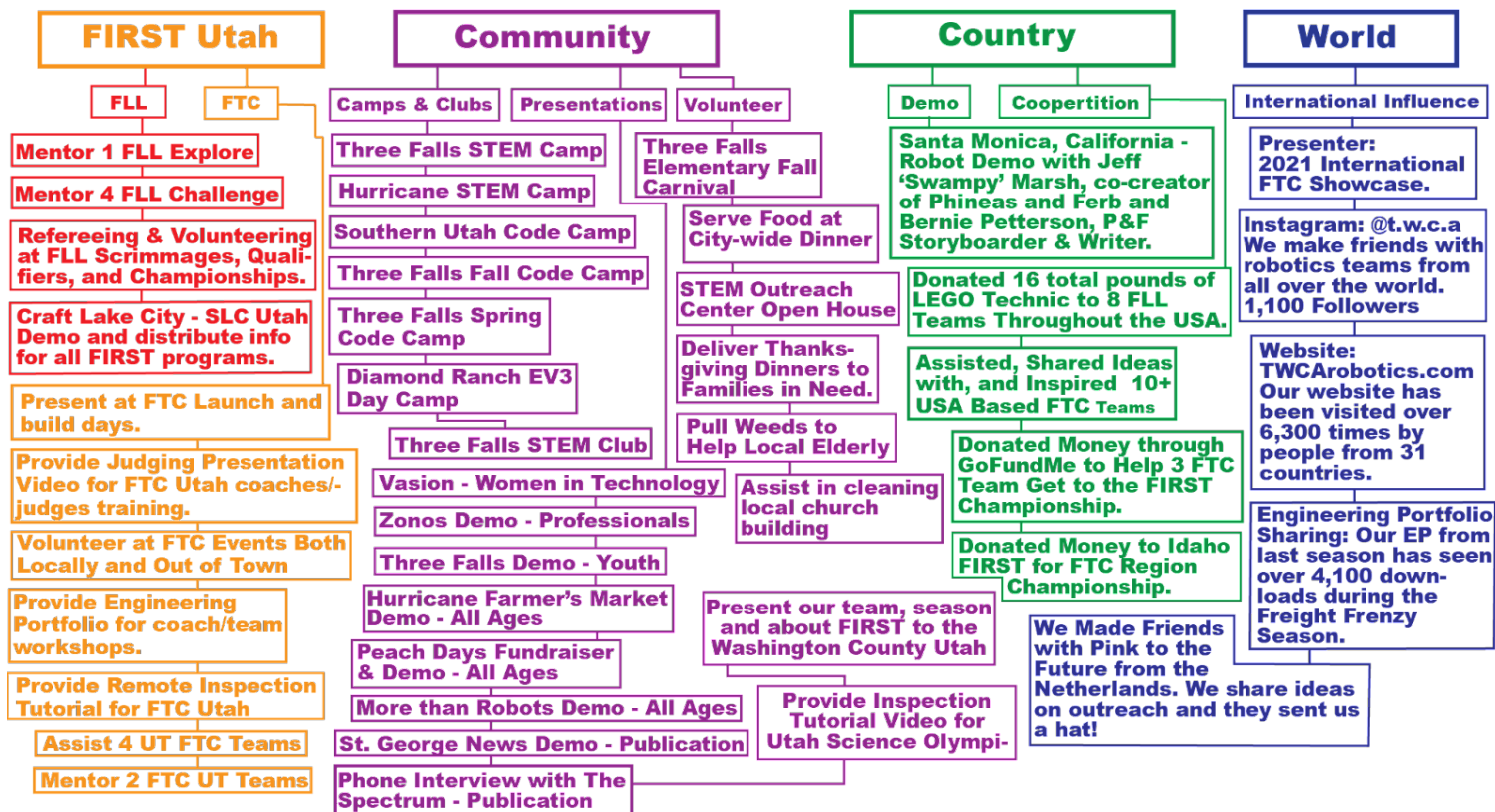




## We EXCEEDED our original goal of 1,000 volunteer/outreach hours



We spent our season teaching and mentoring many local and remote FLL and FTC teams. We connected with other teams from around the world through social media and email.



We shared our engineering portfolio with local teams and also with the world and have had thousands of downloads

Website Stats Year	Website Views	EP Downloads
All of 2021	1, 988	1, 093
Jan - April 2022	3, 445	2, 995

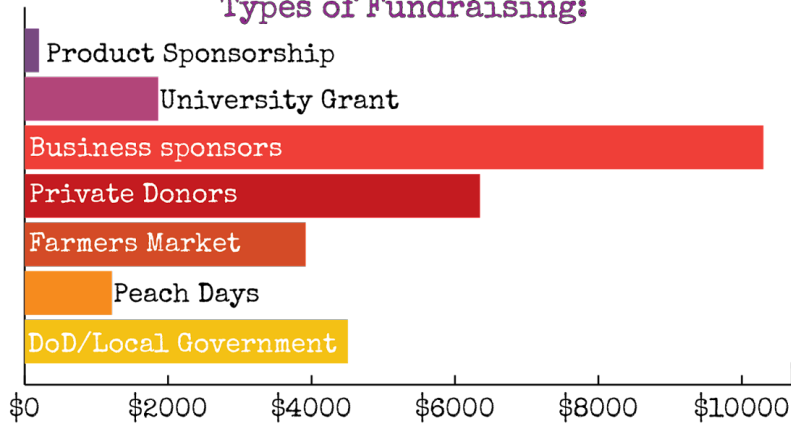
## Sustainability Plan:

We actively recruit for our team through neighborhood friends, social media, and outreach events. We added two new members this year and already have 3 new



members for next season that have started attending meetings so they can learn from our 5 outgoing seniors.

### Types of Fundraising:



Team members were tasked with raising \$6,400 for our regular-season goal. We contacted previous sponsors, cold-called potential sponsors, talked to relatives and worked at local markets to fundraise. We saw the return of 16 sponsors, 12 new sponsors, and almost **doubled our original fundraising goal!**

Regular Season Goal: \$6,400	FIRST Championship Goal: \$12,000	Total Freight Frenzy Goal: \$18,400
Amount Raised \$12,079.66	Amount Raised \$18,004.34	Total Amount Raised \$30,084

Check out some of our non-technical sponsors:



## CONNECT

### University & Business Partners/Sponsors

2019-20 Skystone	2020-21 Ultimate Goal	2021-22 Freight Frenzy
10	17	28

We had 16 returning and 12 new partners/sponsors for the 2021-2022 Freight Frenzy season!

We aggressively seek professionals and politicians of various backgrounds to help us achieve our goals. We do this by using mutual friend networking connections, sending emails, making phone calls, and showing up at local tech events to participate or

volunteer! The following are some of the technical sponsors that have given us financial support and/or mentorship!







## Professional Connections and How They Helped Us

We aggressively seek professionals and politicians of various backgrounds to help us achieve our goals



**Amy Hummel:** Head Coach Amy help us manage our team and teaches us organization and graphic design.



**Jared Hummel:** Assistant Coach. Jared is an electrical engineer and helps with programming and sensors.



**Gregg Robison:** CEO RAM-asd. He helped secure funding for the team & assigned James to work with us.



**James Wigton:** Sr. Design Engineer. James mentors us through the engineering process on our designs.



**Clint Reid:** CEO Zonos Clint helped us by getting us in contact with people that could help us brainstorm.



**Josh Aikens:** Zonos Chief of Staff. Josh has networked with us at several local tech events and helps us brainstorm.



**Dave Mead:** Zonos Sr. Soft. Eng. Dave is really into off-road vehicles and helped us brainstorm suspension ideas.



**Zach Richards:** Zonos Soft. Eng. Brainstormed ideas with us for autonomous operations using our webcam.



**Hallie Bonfonti:** CEO d.B Systems. Provided us with machining equipment and access to employees.

**Sydnee Thornburg:** d.B Systems, Draftsman. Sydnee reviewed our CAD drawings and gave us advice on how to use Autodesk Inventor.



**Paul Hill PhD:** USU Ext. Director, recruited our team to 4H program and provides innovation equipment.



**Diana Escobar:** USU Ext. Assistant. Diana helps us manage sponsor funds that come through our 4H Index.



**Becky Newman:** USU Ext. Assistant. She helps us submit travel requests and reimbursements from our 4H Index.



**Ed Larson:** USU 4H Coordinator, helps with our club charter renewal each year and team member registration.



**Sabrina Cox -** USU Staff Assistant, works with us to promote our team through press releases.



**Nick Tankersley -** DoD Mentor Nick acts as a liaison between our team and the DoD to help us secure grants.



**Ammon Teare -** Journalist worked with our team to produce a video on St. George News to help solicit funding.



**Darryl Zitting -** Bio-medical Engineer, works with us on project management and managing expectations.



**Andrea Wittwer -** Hurricane Recreation, mentors us through fundraising at the Hurricane Farmers Market.



**Bailee Allen -** Interaction Designer & FIRST Alumna who mentors us on our Eng Portfolio, promote video, and helps us prepare for competitions.



**Jeff 'Swampy' Marsh:** Co-Creator of Disney's Phineas and Ferb is an avid follower of our team.



**Bernie Petterson:** Writer and Story-board artist for Phineas and Ferb. He helped us think through designs.



**Dan Moore:** Tesla - Senior Software Engineer. Dan gave us insight on assigning chaos agents & programming.



**Kate Copperund:** Vasion Corporate Counsel, organized us to meet with the WIT group at Vasion.



**Christie Jensen:** Vasion Product Manager. Christie gave us a tour of Vasion & showed future career options.



**Victor Iverson:** Washington Co Commission - Chair. Visited with us to help our exposure in our community.



**Adam Snow:** Washington Co Commission. Adam worked with Victor and Gil to secure funding from the county.



**Gil Almquist:** Washington Co Commission. Gil worked to get us to the FIRST Championship.



**Nicholle Feldshaw:** Washington Co Admin. Nicholle reviewing our budget and found funding.



**Cari Heizer:** DSU STEM Outreach Center - Gives us volunteer opportunities with youth.



**Tanya Hales:** Local Artist, Tanya worked with us to update our team illustration to include new team members Codi and Jed.



We are thankful for the tech community that is growing in Southern Utah. We have met with many technical professionals and politicians that are excited about our team and are **helping us prepare for our future in tech.**



**CEO Gregg Robison and Engineering Manager James Wigton** gave us a tour of what they were working on for SpaceX.



We invited **Dan Moore, senior software engineer** at **Tesla** to teach us about unit testing & adding chaos agents.



We presented about FIRST and our season at a Washington County Utah Commission Meeting.



**Sydney Thornberg** of d.B Systems reviews our CAD and helps us learn new techniques.

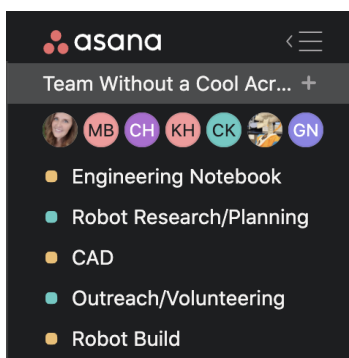


**Dave Mead and Josh Aikens** of Zonos brainstorm suspension design with us.



**Women in Tech** at Vasion were inspired by our team and invited us to a special lunch.

## Team Plan, Management & Scheduling:



From our mentors at d.B Systems, we learned about management software that they use to keep track of tasks. Last season we felt like task management was an area that we lacked in, so we started using the software. **ASANA** is used by many tech companies like NASA and we have found it to be very useful in assigning and completing tasks!

We also made a weekly schedule so that team members always know what was going on.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Volunteer 4pm FLL Explore ----- Volunteer 7pm FLL Challenge @ USU Ext.	Regular Team Meeting: ----- 6-9pm	Volunteer STEM Club @ TFES 3: 30-4: 30pm ----- Volunteer w/ FLL Challenge @ Coral Canyon 3: 30pm	Regular Team Meeting: ----- 6-9pm	Regular Team Meeting ----- 3-6pm	Fundraising @ Farmer Market ----- 8am-12pm





## Team Plan & Development of Skills:

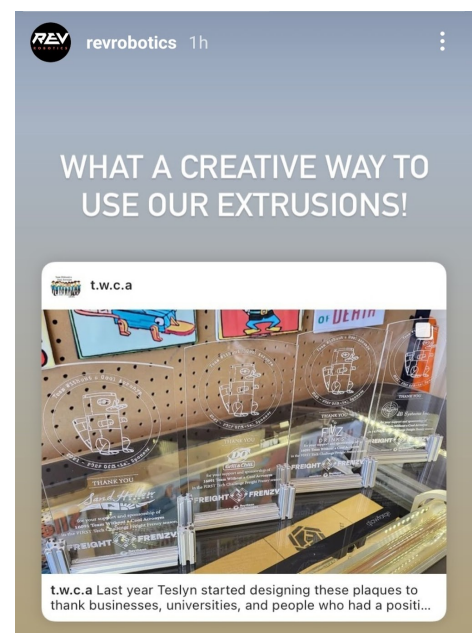
Kate	Alex	Brooke	Madi	Gerrod
<b>Developing:</b> CAD, Design principles, management --- <b>How:</b> Taking classes, watching videos, meeting with professionals, going to workshops.	<b>Developing:</b> CAD, Design --- <b>How:</b> Taking classes, watching tutorials, meeting with professionals.	<b>Developing:</b> More attention to detail in EN/EP. --- <b>How:</b> Attend EP training and workshops. View the other team's EP and discuss ideas.	<b>Developing:</b> Communication, Reliability. --- <b>How:</b> Making time for team meetings, being on task during meetings, asking how to help.	<b>Developing:</b> Communication, vision programming, teaching skills. --- <b>How:</b> Responding to team chat, watching tutorials, asking for help
Calvin	Teslyn	Codi	Jed	Perry-inator
<b>Developing:</b> Mechanical skills, listening skills. --- <b>How:</b> Asking what he can do to help and making an effort.	<b>Developing:</b> Graphic Design --- <b>How:</b> Asking for help from Coach Amy, watching tutorials, designing in spare time to sharpen skills.	<b>Developing:</b> Understanding of FTC --- <b>How:</b> Attending meetings, events and asking questions.	<b>Developing:</b> Understanding of team culture, CAD. --- <b>How:</b> Attending team social events, asking questions to professionals.	<b>Developing:</b> Figure out how to not disconnect all the time --- <b>How:</b> Research ferrite beads and grounding straps.

## Honoring our Mentors & Sponsors:

Our youngest member, Teslyn, designed these plaques to thank our sponsors and cut them from acrylic using a Glowforge!



Jeff "Swampy" Marsh, Creator of Phineas and Ferb and voice actor of Major Monogram.



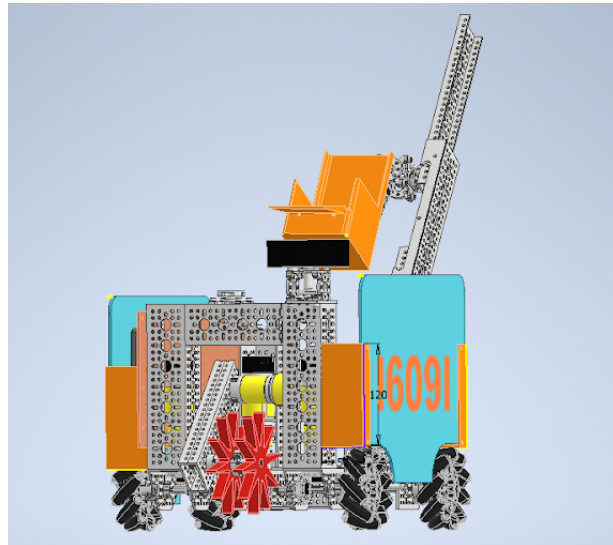


## Design

### Meet our Robot: The Perry-inator

#### Design Features:

- Colorful, visually pleasing
- 13x15" wheelbase, mecanum drive.
- Motors mounted vertically to allow room for lift and freight holder.
- Wood mounted electronics to prevent ESD & reduce weight.
- Low profile to prevent tipping.
- LED visual indication system designed as interior "underglow."
- Intake design allows for all kinds of freight.
- The freight holder can only hold one ball or block. Extras can be reversed out.
- Easy removal of side panels for quick modification of electronics.



Problem Statement	Design Statement	Research
The robot needs to go over and/or around barriers.	Robot design needs to have enough clearance to go over the barriers and be "mini" in size, having a wheelbase of about 13" wide maximum.	Our team looked at product insights from different robot manufacturers, brainstormed with professionals, talked to other FTC teams, thought about past designs, and viewed "robot in 3 days" videos to see what solutions were already out there. We also turned to non-traditional resources like <b>studying toy remote-control cars for inspiration.</b>
The robot needs to carry 3 different kinds of freight.	A holding system needs to be designed that can intake or grip & store 3 kinds of freight all differing in size.	
The robot needs to place freight on hubs of different heights.	The robot needs a multistage lift mounted at an angle that complements delivery on different levels, but most easily accesses the top for max score.	
The robot needs to spin the carousel to deliver 9 ducks in 30 seconds.	The robot needs to use a motor or servo to contact and rotate the rim only of the carousel. Speed needs to be fast enough to deliver ducks without launching them off.	







## Perry-inator (aka E-Bot) Design Process:

After all of that planning, we ran into major supply issues and couldn't get the materials we needed. Despite attempting to **manufacture our own pieces**, time ran short and we built a backup "Emergency Bot," [or E-Bot for short]. We competed with the E-Bot at 2 qualifiers and quickly realized it was very capable after setting several records & ranking 4th in Utah at the region championship.

**[Sketches for our Emergency Bot, or E-Bot for short]** - We started designing the E-Bot in sketches to brainstorm how we wanted the robot to come together. Sketches were translated to CAD to aid in the design of 3D-printed parts.

Chassis	Powered Intake	Freight Holder

Above: We modeled out of cardboard to feel out our element holder design.

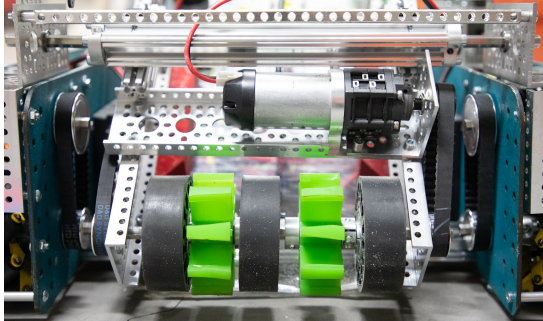
Freight Holder Problems & Solutions	Panel Mount Problems & Solutions
<p>We designed the holder based on our <b>cardboard design</b> above. The photograph is of our V2 holder which we broke in practice. We performed stress tests found in our EN and updated our CAD to prevent future breakage.</p>	<p>We made 3 versions of this panel mount photographed [broken]. We realized we needed to strengthen the corner and change our printer settings to use more infill. CAD render is of V2. V2 is mounted on the battery side of our robot and V3 is mounted on the electronics side of our robot.</p>



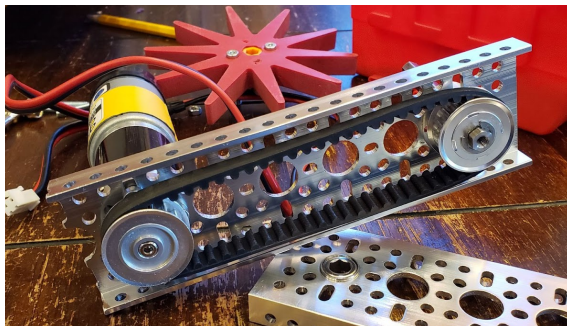
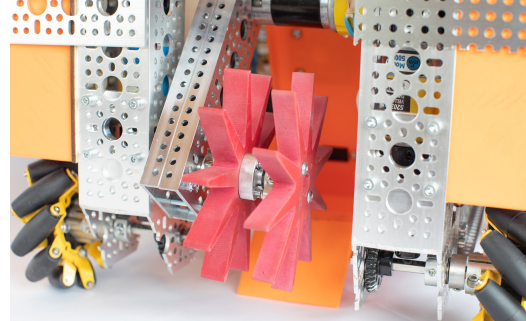


## Intake

Inspiration: Ultimate Goal Intake



Current: Freight Frenzy Intake

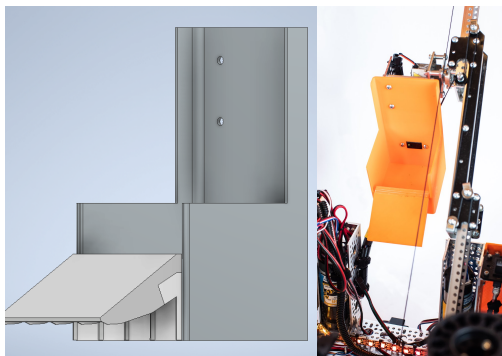
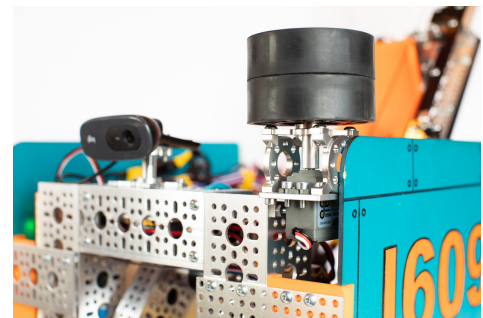


The E-Bot's intake design was inspired by the intake we designed last season. Both are driven by an overhead motor run by a system of timing belts and pulleys. One major difference is the intake wheels which are called "**entrapption stars.**" They are made of silicone, and the spokes easily bend to accommodate the different sizes of elements. The other difference is the use of rubber bands attaching the motor to the top frame of the robot. This rotates the

entrapption stars toward the ground and allows the intake to spring up to conform to the different sized elements.

## Carousel Spinner

Our carousel spinner is a 96mm rhino wheel mounted on a servo block that protects a goBILDA Superspeed Servo that can turn 290 RPM. This spins fast enough that we can **deliver all of the ducks** within the 30-second end-game, but not so fast that the ducks fly off the carousel.



## Element Holder V4

Our element holder can hold **all 3 types of freight.** The holder sits on the ground while the intake is on. When the distance sensor, designed into the holder, detects freight, the holder automatically lifts **to avoid intaking too many elements.** The holder is mounted on a servo which is, in turn, mounted to a 2 stage lift. The servo rotates and easily deposits freight onto all levels of the

alliance shipping hub and onto the shared shipping hub.

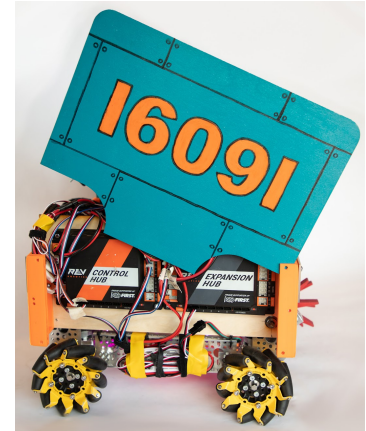


## Innovate

...but still sort of design, and a little control.

### Innovative Features:

- LED Underglow gives a visual cue for if the robot is holding freight.
- Distance sensor mounted inside freight holder detects freight of all sizes.
- Removable side panels give easy access to electronics for modification or repair.
- Wooden exterior and electronics mounting panel to prevent ESD (shown right).
- Retractable dead wheel encoders [odometry].
- Webcam mounted on Servo for a full field of vision.



### LED Underglow/Distance Sensor INSIDE Freight Holder:

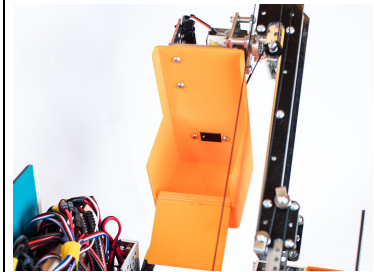
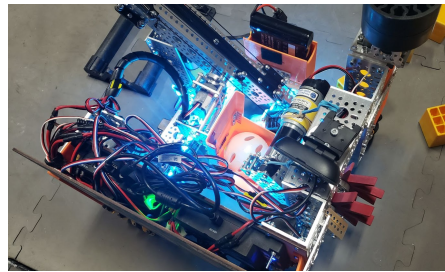
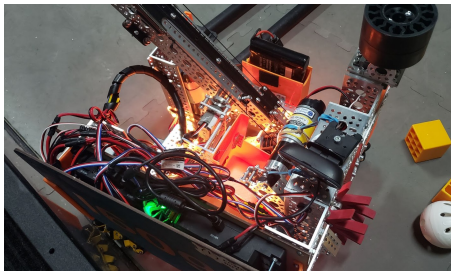
**Challenges:** It's difficult from the driver's perspective to see if the robot holds freight.

**Solutions:** Mount a distance sensor that can detect freight and give a **visual indication**.

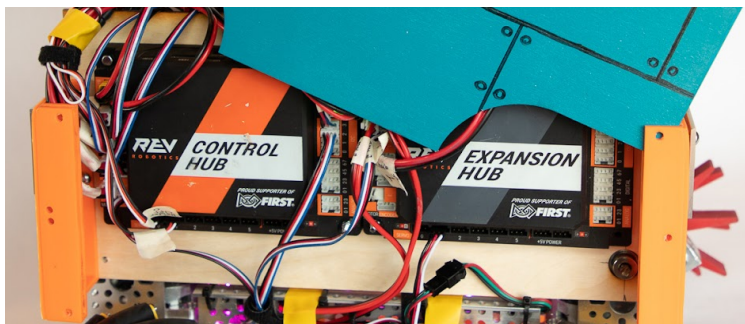
Orange underglow means that the element holder is empty.

Blue underglow means that the element holder is carrying freight.

Distance sensor inside freight holder helps with control features.



### Electronics encased in easily removable wooden panels:



**Challenges:** Electronics mounted to metal are subject to malfunction due to static build-up. Internal mounting makes electronics modification difficult.

**Solutions:** Wood helps to insulate against the flow of electricity. External mounting of hubs with removable cover **eases access**.



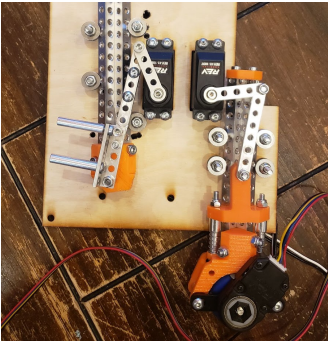
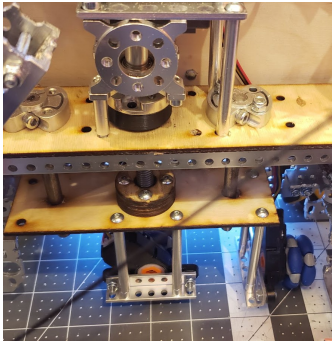
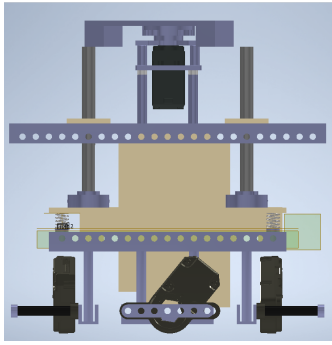
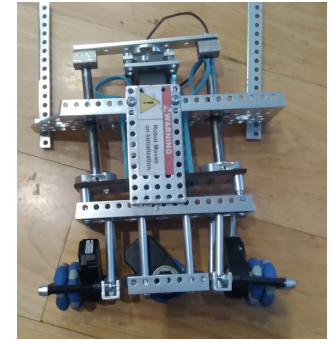


Mounting electronics to wood has become a traditional mounting method for our team. We learned that it is effective in **preventing disconnections** due to Electrostatic Discharge and haven't experienced any disconnections this season. We mounted the electronics on the outside of our robot to **create more room inside** for moving parts. We invented a mounting system that allows us to add a protective cover plate while also allowing us to easily remove the plate for electronics modification.

### Retractable Odometry Encoder Wall:

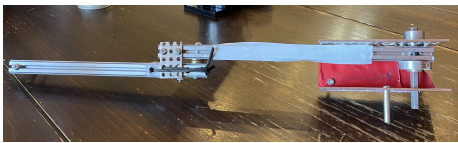

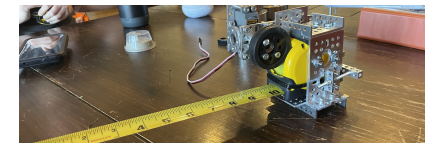
**Challenges:** Going over barriers makes it impossible to use dead wheel encoders in a traditional way.

**Solutions:** Create a system of **encoders that retract** into the chassis for protection.

Features:			
<ul style="list-style-type: none"><li>Rev encoders paired with Rotacaster 35mm omniwheels make contact with soft tiles when lowered position.</li><li>When a servo is rotated after autonomous, the odometry system springs up into the robot allowing the robot to drive over the warehouse barriers.</li></ul>			
Design Prototype 2	Design Prototype 3	Design CAD 6	Working Design
			

### Team Shipping Element [TSE] Capping Arm - Failures and lessons learned:

When we originally designed our robot, we did not plan on capping our TSE to prioritize other aspects of the game. Late in the season we decided to retrofit a capping arm as an afterthought. After several weeks and about \$60 spent on this project, we ended up not using any of it because we couldn't get it to fit well.

Capping Arm Prototype V1	Capping Arm Prototype V2	Capping Arm Prototype V4
		

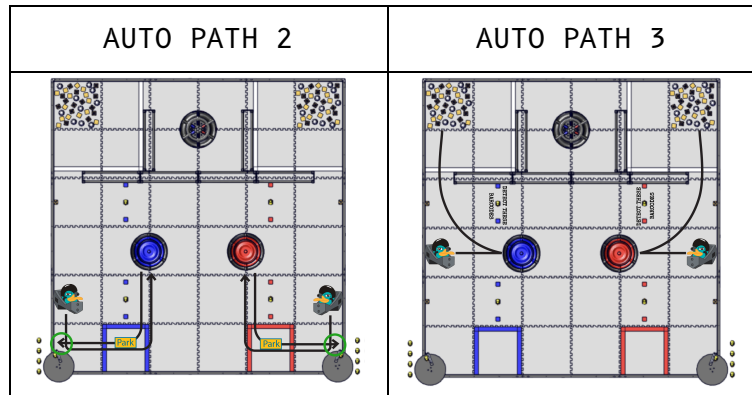
Through this process, we learned how to identify if our ideas are worth exploring further after identifying and running into further problems. It took us a while to be comfortable with it, but we eventually learned not to marry ourselves to an idea that just doesn't work.



# Control

## Autonomous Goals:

- Detect which barcode the team shipping element is on and place freight on the correct level of the alliance shipping hub.
- Detect barcode, Spin duck off carousel, deliver freight, locate duck and intake, deliver duck, park in the storage unit.



## Autonomous Summary:

We have 4 paths per alliance side. **Auto path 2** Detects barcode, stores value, and aligns on the carousel spinning the duck off. Preloaded freight is placed on the shipping hub [correct level]. We then use the camera to detect where the duck is, picking it up. The duck is placed on the hub and we park in the storage unit.

**Auto Path 3** deposits preloaded freight and then cycles in and out of the warehouse, depositing on the middle level while checking time to determine whether to park.

## Sensors

### Used:

- |                           |                          |
|---------------------------|--------------------------|
| • 4 drive motor encoders. | • 5 Distance sensors.    |
| • 1 lift motor encoder.   | • External webcam        |
| • In hub gyro sensor      | • 3 Dead Wheel encoders. |

**Tele-Op Goals:** Quickly and **reliably** pick up freight, cargo, and ducks and place them in either the alliance shipping hub or shared shipping hub based on alliance partner strengths.

**Automated Freight Loading Sequence:** The distance sensor located in the element holder will determine if there is freight loaded and will: Change LED from orange to blue > turn off intake > raise lift above the “danger zone” of barrier height to **prevent damage** when going over barriers.

**Inverse Control:** The base controller has an **inverse controlled trigger** that when held down will reverse the front and back of the robot to help with intaking and dropping cargo off.

**Double Speed Button:** The base controller also has a double speed button that when held down will double the robots speed allowing us to do slow and controlled movements and be able to speed up in open spaces or allow for some extra power to clear the barrier.

**Manual Lift-Encoder Reset: Problem:** If the lift encoder gets off because of disconnections, we can't pick up freight anymore. **Solution:** By pressing a combination of buttons on the “gunner controls,” we can manually lower the element holder to touch the ground, resetting what is read as zero. The extensive steps **allow us a safety** against accidentally resetting the encoder in the heat of competition.