
Team #6417

Ultimate Goal | 2021-2022

# Engineering Portfolio

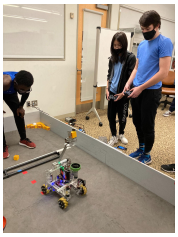
# About the Blu Cru

The Blu Cru is part of the **Explorer Post 1010 organization**, based in **Rockville, Maryland** and founded by our mentor, Bob. Explorer Post 1010 is dedicated to offering students exciting hands-on opportunities to learn about engineering and STEM.

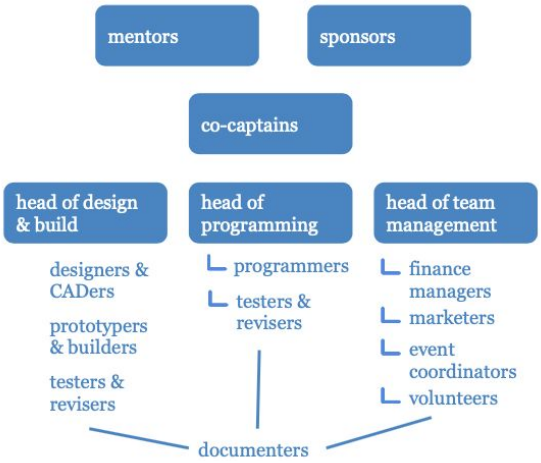
The Blu Cru made its debut in the FIRST Tech Challenge in 2012. The team has returned every year since, advancing to the state level of competition in a significant number of its past seasons.

*Why "Blu Cru"?*

Gratitude and teamwork. We wear "blu" as a show of thanks to our sponsors, the Explorer Post 1010 & IBM. We embody our value of teamwork in every activity that our "cru" does together, working together respectfully and inclusively to achieve our goals.



We come together to make important, group-scale decisions, like when we decide on autonomous strategy and robot design. This season we've also decided that notebook should be done by the whole team, so that everyone informed of group activities and achievements.




# Team Structure

To keep our team running efficiently every season, we elect a captain or two co-captains, a head of design & build, a head of programming, and a head of team management to oversee all sub-crus' activities and events. During the season, we divide into "sub-crus" to increase efficiency. Our main sub-crus are each focused on programming, building, and team management.

*"We are the Blu Cru, and we stick together like Glu!"*

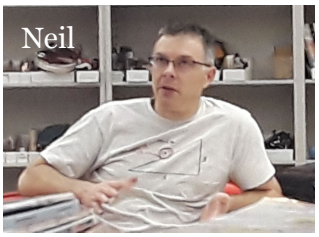
# Team Relationships

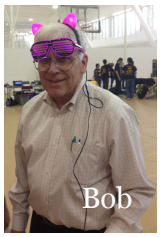
**Community:** Our outreach is primarily focused on reaching out to the youth in the community because we want to inspire the next generation of FIRST, and future STEM workers and leaders. Over the seasons, we have also become heavily involved with the local libraries, middle and elementary schools, and FLL teams, even hosting scrimmages and tournaments.

**Other FIRST Teams:** The Blu Cru embodies the spirit of coopertition as we interact with other teams. Our relationships with other teams are friendly rivalries, but off-the-gameboard-alliances first.

**Sponsors:** We are sponsored through the umbrella organization of the Explorer Post 1010 by the Rockville Science Center (RSC) and IBM. This year, we have maintained a strong relationship with our sponsors, but in a distanced setting. We keep our sponsors aware of our activities to maintain a personal connection with the organizations. We also host outreach and volunteer under the RSC as a show of our appreciation.

Thank you to our mentors and our sponsors!




Explorer Post 1010 Future Engineers

IBM

Rockville Science Center

# Engineering Design Process

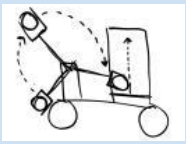
Though it will be outlined in chronological order, our engineering design process is anything but linear:

## 1. Define Problem(s)

- Discuss as a team
- Develop game strategy, considering point values, time constraints, feasibility, available resources
- Break down problems into parts
- Develop a coherent timeline and strategy
- Revisit constraints for robot and game field.

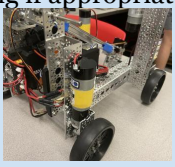
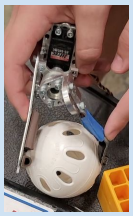
## 2. Brainstorm

- Collaboration! (a whole group effort)
- Combination of our own knowledge and research
- Ideas grounded in physics and math
- Make decisions as a group through pros and cons analysis, combining and improving solutions
- Sub-crus keep other sub-crus in check

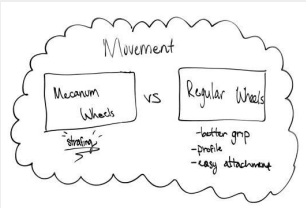

## 3. Plan Solutions & Prototype

- More focus on details of design
- Hand-drawn diagrams at meetings → CAD at home through Discord
  - determine if feasible
  - better visualize ideas and proposed solutions.
  - allow all members to easily provide input
  - maximize efficiency and results.
  - Blueprint/framework for prototyping and construction
- Prototype to test a simplified model of our
- design in a physical setting if appropriate

## 4. Build (& Implement)

- Using our CAD design and prototype, our Cru constructs the design solution
- Ideas for improvement and decisions made by whole team
- Areas of improvement learned from prototyping implemented
- Usually opt to test solution before implementing entirely, repeating prototyping and testing until a much improved robot is completed




## 5. Test

- Test in the order of:
  - Functionality (does it work?)
  - Accuracy (is it providing accurate results?)
  - Consistency (is it providing consistent results?)
  - Efficiency (could it work faster? using fewer parts? using simpler mechanisms? rely less on the human driver? etc.)
- Prefer quantifiable (objective, concrete, easily comparable) testing data
- Further improvements can be made, steps repeated
- Not only improvements engineering-wise will be made (ex. through testing, we realized a coded preset arm height would increase accuracy and consistency)

## 6. Evaluate & Get Feedback

- Consider improvements to robot in key areas of accuracy, consistency/precision, efficiency
- Typically use outreach events to test robot "health"
- Also consider alternative design solutions
- Get feedback from all team members and mentors
- If no feasible alternative solutions → move forward, else back to the brainstorming phase
- Essentially the brainstorming phase take 2!

## 7. Improve

- Implement brainstormed solutions
- Quantitatively and qualitatively evaluate improve compared to original solution
- Continuously get feedback

## 8. Finalize & Communicate

- Always room for improvement, but finalize robot ~2 weeks before competition for practice
- Drivers practice tele-op period
- Coders improve autonomous code
- Document final robot in notebook
- Display robot to other Explorer Post teams

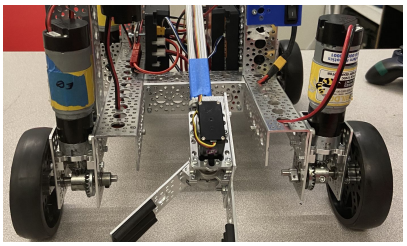
# Game Strategy

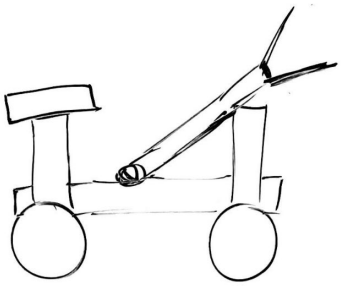
Below details our analysis of the points and our justifications for why or why not we don't plan to pursue them at competition. Point-scoring functions we're pursuing are indicated with a "✓" and those we're not with a "✗ ".

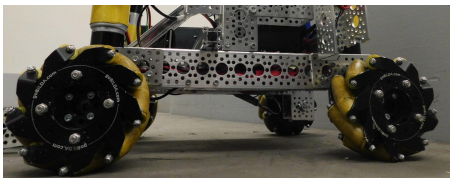
| Activity | Pts | What we can do | What we can't |
|---|---|---|---|
| **Autonomous** | | | |
| Duck Delivered via Carousel | 10 | ✓The carousel is in a very easy spot to reach on the field from the close spectator side of the field. It also takes a small amount of time, and is easy to do. That made this something that we had to do whenever it would be possible, as we can see no real downsides. | |
| Preloaded box to shipping hub | 6- | ✓We put our preloaded block onto the top level during autonomous. We do this because of how our robot is made, it is easiest to deposit on the top level. | ✗We do not use TensorFlow to detect the level that the block should be deposited on. We have a rookie coder, and did not want to put too much stress on him. We also do not see our robot being reliable enough to do that every time. |
| Parking | 3-10 | ✓Parking on both sides is a very useful and easy scoring opportunity for every team. We have the ability to park on both sides, and use this to our advantage to be able to meld better with potential teammates. We do this by parking on the side that we start on, while also leaving room for more advanced teams to complete multiple cycles during autonomous. | |
| **Driver-Controlled** | | | |
| Freight in alliance shipping hub<br>Level 1<br>Level 2<br>Level 3 | <br>2<br>4<br>6 | ✓This is the main source of points during the tele-op period. Our team designed the arm to be able to pick up any freight and place it on any level of the team shipping hub, as well as being able to place blocks on the shared team shipping hub. They are both great sources of both normal and bonus points. | ✗We decided against putting the freight into the alliance storage unit because it did not provide us with sufficient points for the amount of time and effort, leaving the shipping hub being the main strategy to maximize our score. |
| **End Game** | | | |
| Duck Delivered via Carousel | 6 per | ✓Being able to get a total of 4 points just from offloading all of the ducks during end game is insane in our opinions. Our robot can do this incredibly easy, and it still leaves time to accomplish other tasks. This task is a must do, and something that our robot was designed around. | |
| Alliance Shipping Hub Stable | 10 | ✗This is something that we would like to accomplish if possible, however it isn't one of our priorities as our robot isn't well-designed for this particular task. | |
| Shared Shipping Hub Tipped | 20 | ✓We recognize that 20 points is a lot of points to get for putting heavier blocks on our side. This is a must do, and something that we need to be looking out for the entire match, regardless of the side we are on. | |
| Parking in a Warehouse | 3-6 | ✓This is a simple task and we will try to save a sufficient amount of time during the countdown in order to gain the full 6 points for completely parking in the designated area. | |
| Alliance Shipping Hub Capped | 15 | ✓This task earns a significant amount of points for a relatively easy task, as we chose to design a cone for our team cap to allow for it to be easily placed on the shipping hub, as well as for our alliance to easily place their cap on ours. | |

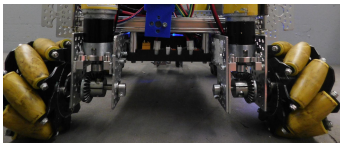
# Robot Evolution: The Beginning of the Season to Qualifier 1

Our chassis has a higher center of mass than in previous years. We used CAD to ensure that the arm would have proper clearance to swing through the robot. We used normal channels because we did not see a benefit to using x-rails at the time. The motors are sticking straight upward, and use bevel gears because we wanted to have a high clearance, and room in the front to put a grabber.

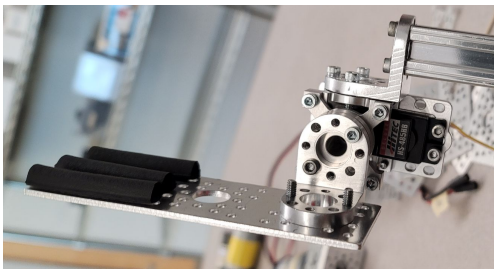


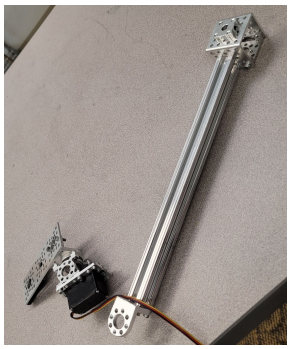


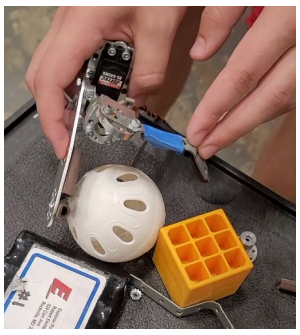


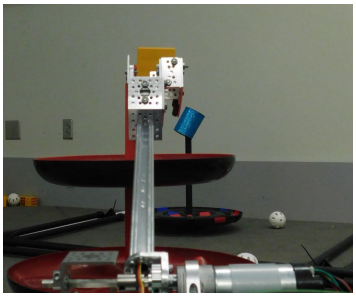


We planned to have our arm be long, and be able to swing over the entire robot. This was because we thought that an arm would be the most efficient system for something of this competition, because of being allowed to hold just one block at a time. We ended up putting our grabber on the robot parallel to the ground, that way we would have a very easy pickup, that was flat and in line with the blocks.

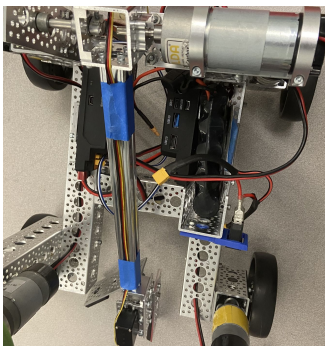


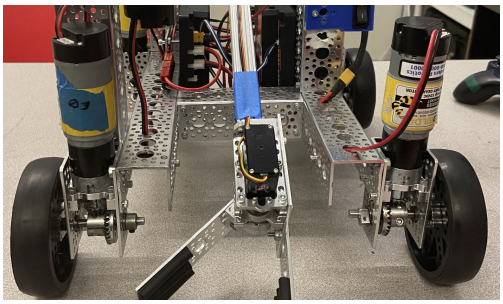


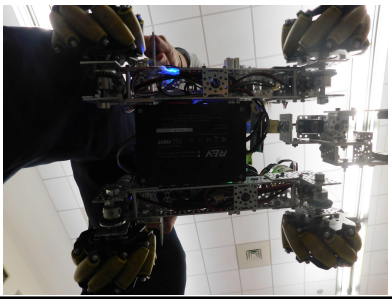


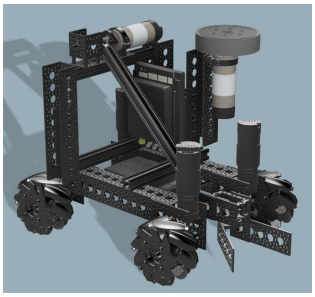


Our change from normal wheels to mecanum wheels was made somewhat challenging by not being able to find the right mounting hubs for the wheels, but was all worth it in the end. The ease of use of mecanum wheels will never be forgotten, no matter how long it has been since we have used them. We also attached a plate that the arm rests on when in is in the intake position. This allows a consistent position and intake every single time.









# Plans for Next Qualifier

Between each competition is the prime time for improvement. With mistakes and areas of improvement discovered from the previous competition, our robot often skyrockets with enhancements and new ideas to better our performance. Last year, between our first and second qualifiers, we implemented new, much needed revisions, almost doubling our score from the first qualifier. With this being said, the team has high hopes and much excitement for not only this qualifier but the ones following and the improvements that will be made in between!

| Aspect | This qualifier | Improvements in mind for next qualifier |
|---|---|---|
| Drivetrain | | |
| Shared Shipping Hub | Our robot is not the most ideal for going for the shared shipping hub, as there is a high risk of pushing the shipping hub. | Improve drivetrain to gain more control, and precision. This combined with our versatile arm would ensure high chance of winning the shared shipping hub aspect. |
| Autonomous | | |
| Detection | With our previous coder graduating, our new coder had some time to get comfortable with coding and learn many new things. Unfortunately, this means we were not able to detect and react to the different positions of the duck. | Get detection working well and consistently, ensuring we are able to deliver the box to the correct height every time. |
| Increasing Score | This qualifier, we are able to deliver one freight to the shipping hub. | We aim to improve our ability to score in autonomous by traveling to the storage unit to pick up more freight and delivering it to the shipping hubs. |
| Arm/Intake | | |
| Braking | The brakes do not seem to be strong enough to completely hold the arm in place. Unless the arm is pointed relatively perpendicular to the ground, it slowly falls back down. | Find a way to fix this issue, making it much easier, more consistent, and faster to deliver freight. |
| Other improvements | We believe our current arm design will be successful in this competition. | More time for drivers to practice will allow us to become more experienced with our robot, and will make us faster and more efficient. Along with this more problems will be made visible, which we are determined to find the best possible solutions to. We are considering a faster way to pick up freight, although this will naturally come with small refinements and more practice. |

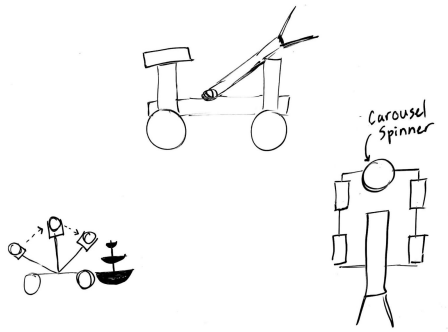
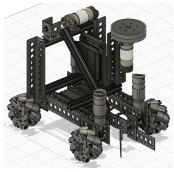
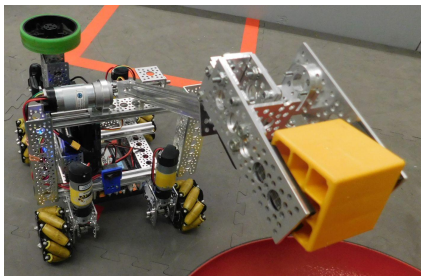
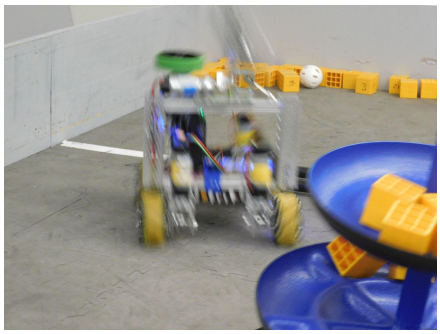
# Robot Evolution: Qualifier 1 to Qualifier 2

| Improving the Arm and Grabber for Qualifier 2 | |
|---|---|
| Brainstorming<br>• More stable<br>• A method method of ramping up the power for the arm's movement<br>• Keep the grabber as is<br>• New foam material on the grabber and the position holding bar<br>• Potential second carousel motor on other side | No images yet as we wanted to focus on the first qualifier right now |
| Planning Designs & Prototyping<br>• Create a schedule to have changes done<br>• Buy a second compliant wheel for the second carousel motor<br>• CAD the minor changes in how the arm may be held | No images yet as we wanted to focus on the first qualifier right now |
| Building<br>• Find a better way to mount the arm motor that is more secure<br>• 2nd Carousel motor and wheel, potentially could be on the back of the arm motor mount apparatus | No images yet as we wanted to focus on the first qualifier right now |
| Improving<br>• Ensure all motors are turning at the same rate<br>• Tighten all moving parts before and after each practice (mainly arm set screw) to avoid them becoming disconnected<br>• Replace grabber foam after each practice | No images yet as we wanted to focus on the first qualifier right now |
| Final Design<br>• ?<br>• ?<br>• ? | No images yet as we wanted to focus on the first qualifier right now |

# Robot Evolution: Qualifier 1 to Qualifier 2

| Robot Comparison: Coding | |
|---|---|
| Qualifier 1 | Qualifier 2 goals |
| Robot can take one piece of freight at a time, to any level, in about 10 seconds. | Robot can take one piece of freight at a time, to any level, in about 8 seconds. |
| Grabber is just the one moving servo, with the grey foam on it to provide adequate grip. | Better, stronger, more often replaced foam. |
| No stopper to stop arm from extending too far backwards. | Physical stop on back side of robot to stop arm from moving too far and breaking. |
| Potentially putting a second carousel motor on the other side to not have to turn around to get the right side. | |

# Engineering Meeting Extracts

| Meeting # | Objective | Reflections | Pictures |
|---|---|---|---|
| Meeting #2 | Draw out rudi-mentary chassis design | - A member of our team began to draw out a concept and a scaled model of our robot. It was helpful to be able to visualize the chassis as a team.<br>- Because this item was completed during the meeting with restricted time, the hand-drawn model developed is basic and does not include all the parts necessary. It will serve as a concept design for when the team CADs remotely—it's helpful to have the model so that even separated, we can CAD effectively, in an organized fashion, and with a focused design in mind. |  |
| Meeting #5 | Finalize CAD model of chassis | - At home, we used Fusion 360 to finish the CAD model of our robot<br>- Next week, we will begin building the rest of the robot |  |
| Meeting #16 | Test consistency of arm position | - The arm was finalized during the last practice, so we need to move on to coding it to get the right position<br>- The encoder plugged into the arm was working really well at first, but we have run into some small problems with the small consistency of it<br>- The arm will fall right back down after being set to go to a position, something that we are going to have to fix very soon, or use a different design otherwise<br>- Overall a successful arm design, but a solution to the arm falling down will need to be found |  |
| Meeting #22 | Replacing arm motor, much more practice | - Going to use a high torque servo instead of a dual mode servo for the grabber. No use for it not being more powerful could be found<br>- The arm being the length that it is makes perfect sense right now, so it is not going to be changed like was thought in the last practice |  |

# Science & Math

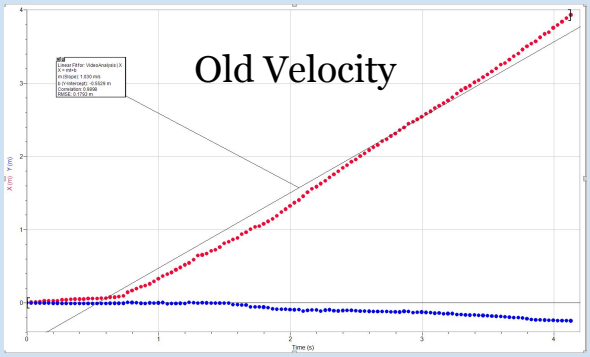
We use what we've learned from our science & math classes to improve the engineering process of our robot. Typically, we employ science & math concepts when designing our robot and when testing it or suggesting how to improve it. We take measurements to compare versions of our robot components in an objective, qualitative way.

## Velocity Comparison

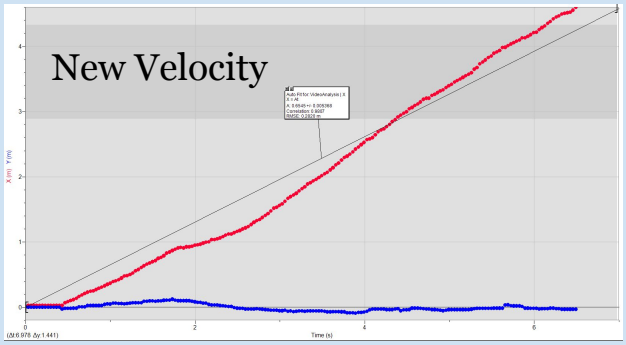
After qualifiers 1, our drivers requested for our robot to go faster to score more points.

This calculation used video analysis of Logger Pro

Not only is the robot at a more consistent velocity(as indicated from the $r^2$ value), our robot is moving quicker making it easier for our drivers to score more points in tele-op



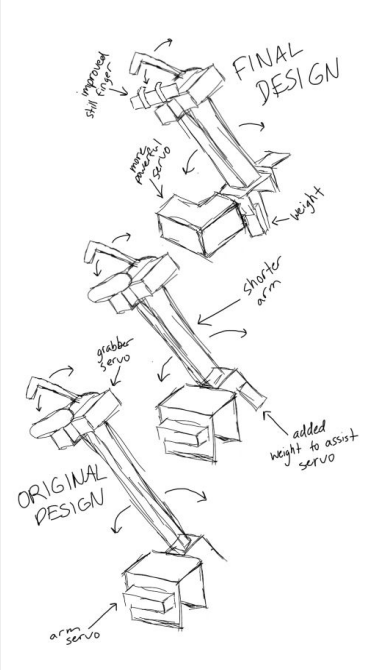

Auto Fit for: VideoAnalysis | X
X = At
A: 0.6545 +/- 0.005368
Correlation: 0.9807
RMSE: 0.2820 m




Linear Fit for: VideoAnalysis | X
X = mt+b
m (Slope): 1.030 +/- 0.01335 m/s
b (Y-Intercept): -0.5529 +/- 0.03188 m
Correlation: 0.9898
RMSE: 0.1793 m

Our Process:

Plan
↓
Experiment
↓
Record
↓
Calculate




## Torque Comparison

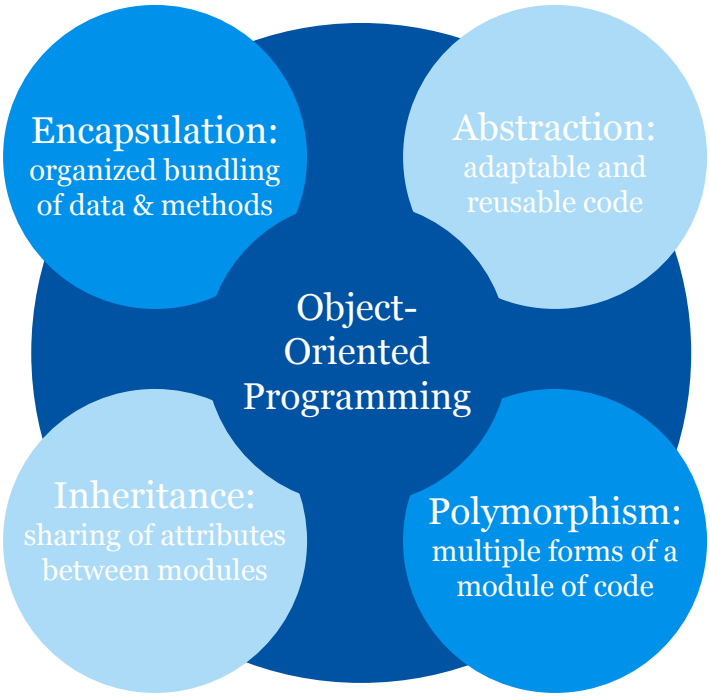
Torque is an important calculation because this is a quantifiable measurement of the strain put on our motor from moving the arm up and down but also lifting the block.

To calculate this we used the equation $\tau = r*f$.
Where $\tau$ is torque, r is the lever arm, and f is the force from the arm's weight & the weight of the block

The old torque value was $\tau = 3.53 \pm 0.32$ N*m
The new torque value is $\tau = 4.74 \pm 0.32$ N*m

Although the strain put on the motor is now larger than it used to be, it is by a miniscule amount and since the motor has been handling this strain consistently through practices, the team doesn't have to worry too much about the longevity of the motor.

# Code & Autonomous Development




We program our robot using Java in Android Studio. Through Java, we are able to take advantage of this **Object-Oriented Programming** (OOP) language and its four basic principles: **Encapsulation, Inheritance, Abstraction,** and **Polymorphism.**

- **Encapsulation**: in our code, the Hardware Map contains all of the variables representing our robot's physical hardware and the methods that operate on these variables, for instance, methods to drive, strafe, rotate, shoot rings, and move servos.
- **Abstraction**: In the autonomous phase, a single function that can carries out all three possible navigation paths using a matrix of distances to avoid repetitive code.
- **Inheritance:** Each OpMode module (Autonomous and TeleOp) inherits from the tempalate class LinearOpMode, which provides a basic framework for both modules.
- **Polymorphism:** Our software treats all versions of our autonomous code as multiple "forms" of the same module, so that our Hardware Map is always compatible with them. This is very helpful during debugging.

**Sensing**

The three main sensing techniques we use are:

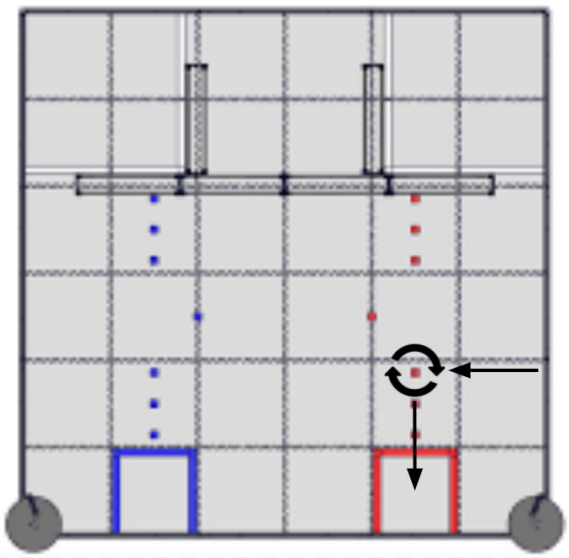
- **Encoders:** Sensing devices that detect the status of a motor based on electrical pulses. We can convert these pulses into revolutions of the wheel for our robot to travel specific distances on our field.
- **Inertial Measurement Unit (IMU):** An internal gyroscope built into the robot's Control Hubs. We use the IMU to detect the current orientation of the robot and rotate specific distances.
- **TensorFlow Object Detection:** A machine learning library that uses a pre-trained image recognition model to recognize objects through the webcam. We attempted use this library to detect the position of the duck.

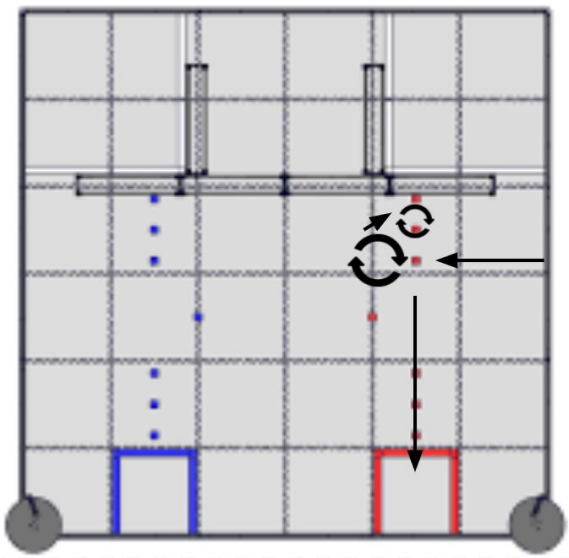
We've also experimented with **Vuforia Localization** to approximate the distances and angles of objects with respect to the webcam during testing, and **REV Color Sensor** to detect luminosity and sense the boxes.

**Autonomous Objectives:**

1. Determine position of duck
2. Place block on right level
3. Complete the carousel if on spectator side
4. Park in the closer box

**Autonomous Program Diagrams**

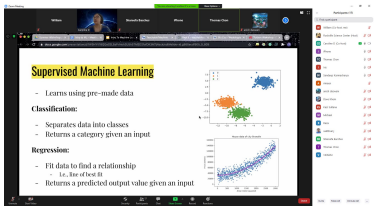


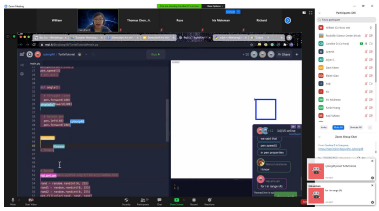


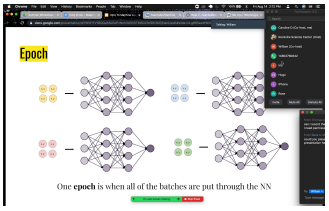
# Outreach

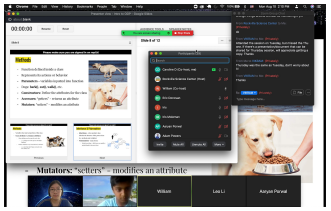
## Remote Java Programming Workshop Series

Our team recently conducted a series of Python programming workshops, led by our lead programmer Caroline. We virtually met with over 150 students over the course of five days, and our curriculum ranged from the basics of programming to complex interactive projects. Our cru was able to strike a balance between fun and informative by incorporating games and graphics as well as vocabulary and complex concepts. We made sure to guide our attendees through follow-up questions and helpful suggestions, rather than simply tell them what to do. We wanted to model our coaches' teaching style, as it has been very effective with us. Overall, we believe we achieved our goal of spreading the wealth of computer science throughout our community with the limited time that we had.



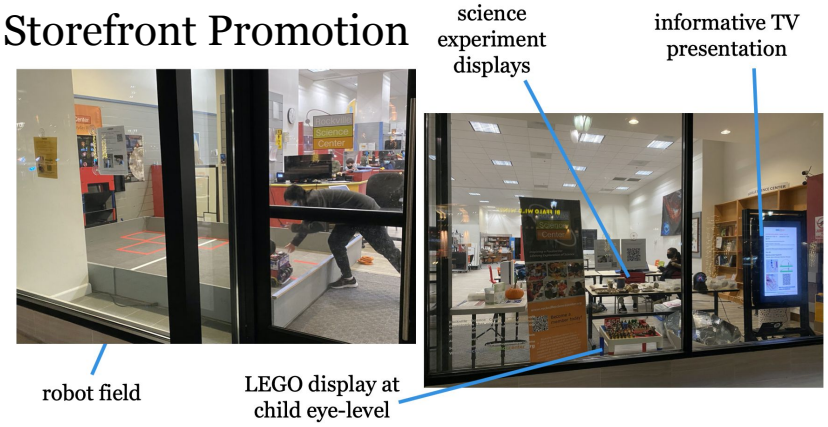



## Rockville Science Center Activities

The Blu Cru has also been helping out with our sponsor, the Rockville Science Center, in setting up for virtual workshops and volunteering to help out at them. This is our way of saying thank you for their continued support.

## Storefront Promotion

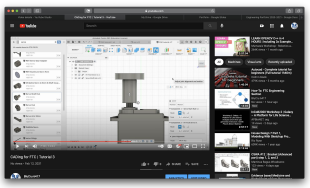



## Remote STEM Interview Series

One thing some of our senior members pointed out about their high school experience was a lack of career-specific guidance. There are so many professions, particularly in STEM, that people either don't know about or only know about on a stereotypical surface-level. So, the team had the idea to host a series of remote interviews with local professionals in STEM. We plan to host these seminars during the second semester, when career day is scheduled in schools. We will invite local professionals to talk about what they do for a living, as well as why they like it and how they prepared themselves to take on the job. We have set up this outreach activity (see the interview questions), and we plan to recruit professionals soon.

## Youtube Tutorial Series

We created a tutorial series covering all things FTC. Our goal in doing this was to a) create a resource for new members & future Blu Cru leaders to learn about how to run the team, and b) help new FTC teams, new members on other teams, and anyone looking for guidance on running a team. We published videos on the engineering and team plan-related activities teams need to complete during the year. We also created CAD tutorial with specifically cover creating FTC robot designs. We plan to create tutorial on building and code to expand our resource library in the future.



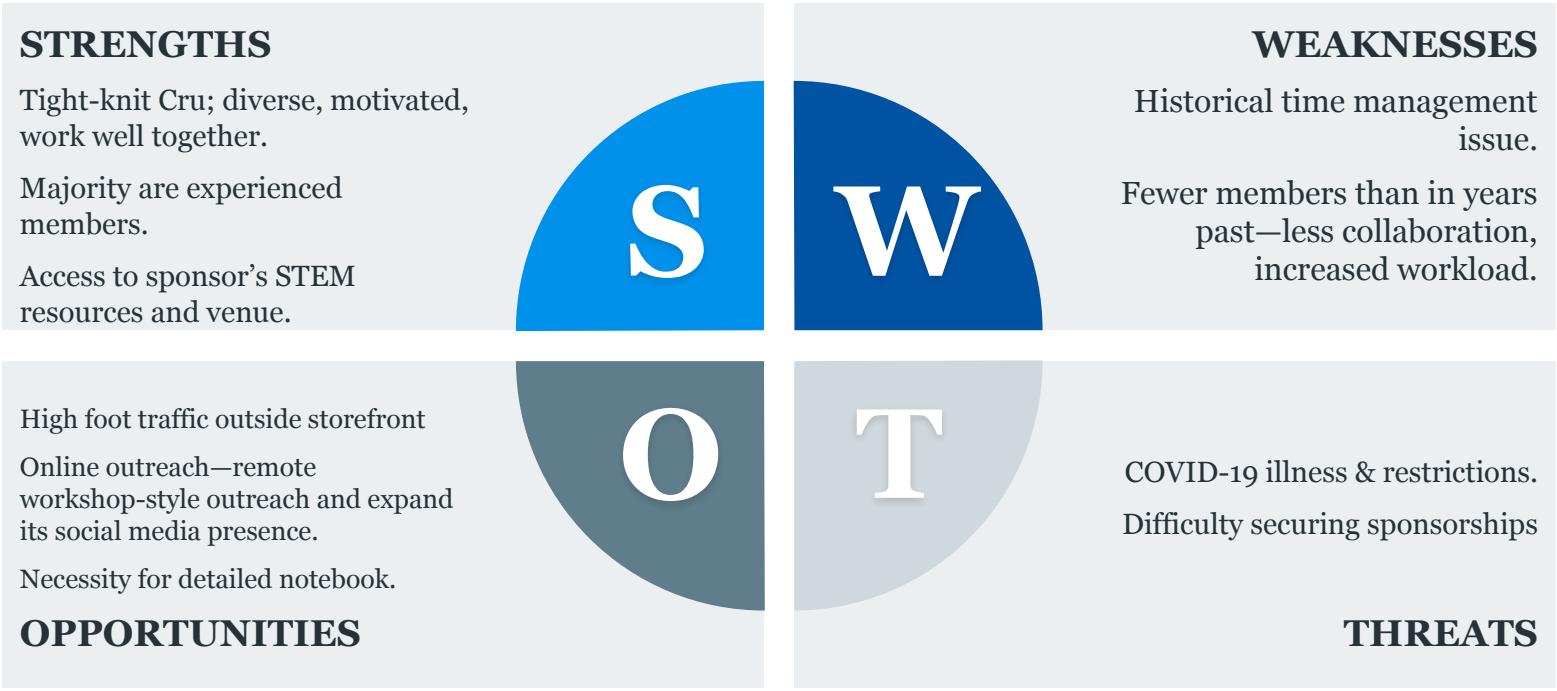

*"Because someone has to inspire the next generation of engineers."*

— Bob, our mentor, when asked *why outreach?*

# Business & Sustainability Plan

## Overview

At the beginning of every season, the Cru gets together to conduct a SWOT analysis (see below) and define our goals for the season. We aim to make these goals as coherent and well-defined as possible, as we believe that specific, clear goals are most conducive to success.




Every month, the Cru has a meeting to discuss our business agenda for the season. This meeting is attended by all team members and mentors. During the meetings, we...

- review our performance at past outreach activities, prepare for upcoming outreach activities, and canvass for new outreach opportunities.
- update team finance spreadsheets and approve purchases like robot parts and team competition expenses.
- discuss our fundraising opportunities and our sponsors.
- check in with our overall team progress, and each individual sub-cru.

Dually, these meetings teach our members to be more well-rounded; we aim to not only be technically skilled in robotics, but also to be business savvy, financially aware, and conscientious for our community.

The Blu Cru is committed to building long-lasting relationships with sponsors and mentors and maintaining positive connections to our community. Through efforts related to these goals, the Blu Cru has been able to sustain itself since its inception in 2012, and will hopefully be able to sustain itself in the future.

Our team actively engages with our sponsors during the season to keep them involved in our activities on a personal level. In a more typical year, we would attend multiple outreach events hosted by sponsors to showcase our progress and offer our services as volunteers as a thank-you. This year, we have hosted our online activities through our sponsor, the Rockville Science Center as a form of outreach to our community and our sponsor.

In this unprecedented time, we decided not to actively recruit new sponsors—not only are many businesses not in a financially stable enough situation to begin a relationship with our team, but we have managed to keep our expenses low so as to not require new sponsorships as a source of income. We plan to renew our plans to build connections with local businesses next season, or whenever circumstances become more appropriate to do so. In the meantime, we are using our STEM seminar outreach event as a way to canvass for new mentors. We are particularly looking for mentors with experience in coding and business, as our current mentors have experience with engineering.

# Business & Sustainability Plan

## Overview (cont.)

Because of our dedication to being positively engaged in our community, the Blu Cru has been able to grow and gain recognition. In the past, we have advertised our team activities in nearby schools, like in Rockville and Richard Montgomery High School, and promoted ourselves at local STEM fairs and events and in public spaces, like the library. This helped us gain community support and also attract new members to our team.

Without being able to interact with the public in a physical space, our location and the internet have become key in helping us reach our sustainability goals. We recently transitioned from the Makerspace in the Rockville Memorial Library to a property owned by the Rockville Science Center. This change allowed us to utilize the property's entirely glass storefront as a method of public-outreach.

The Blu Cru maintains its legacy through a coordinated effort to train new members. Our senior members usually transfer their knowledge and tips to the new members in training sessions. Our captains train our experienced members in learning how to coordinate all of the sub-crus on our team. In addition, our team mentors are a mix of alumni and community volunteers. This allows us to ensure continuity from year to year.

## Goals & Actions | General Timeline

AUGUST / SEPTEMBER
Start meeting
Begin orientation for new members
Plan finances
Brainstorm ideas and plan
Build chassis
Create part list
Brainstorm outreach

OCTOBER/ NOVEMBER
Design & prototype intake and arm
Work on autonomous code

DECEMBER/ JANUARY
Plan outreach
Train members
Finalize robot
Practice!

### Business

- Build sense of team comradery
- Keep all team members updated and aware of responsibilities
- Organize at least 2 online outreach events
- Coordinate volunteering positions at Rockville Science Center events
- Use storefront as form of team and STEM promotion
- Conserve and reuse robot parts to limit expenses

### Sustainability

- Promote STEM and advertise Explorer Post 1010 Activities in the storefront
- Maintain strong relationship with our sponsor, the Rockville Science Center
- Increase presence on team social media accounts; increase number of teams that we are following to at least 40
- Gain a minimum of 1 new mentor through seminar outreach
- Gain a minimum of 2-3 new members
- Train new members in CAD, building, programming
- Prepare current members for passing-on of leadership roles for the next season

### Robot & Competition

- Effectively use CAD software
- Improve approaches and strategies for solution testing (science & math)
- Document progress and details of design process thoroughly and extensively
- Outline comprehensive game strategy at beginning of season
- Allott drivers at least two weeks to practice for competition; score consistently

### General

- Spread the spirit of FIRST and encourage involvement in STEM to community
- Inspire the next generation of FIRST members
- Improve teamwork and cooperation™ skills
- Demonstrate gracious professionalism at all times during competitions and events
- Maintain a fierce and lively competition spirit, but understand the greater goals for innovation, teamwork, and encouraging involvement in STEM

| Goal | Action(s) |
|---|---|
| Build sense of comradery | • We have engaged in remote meetings over Discord, thus increasing the frequency of our meetings.<br>• We developed a game to play using this year's theme where we try to toss rings onto the wobble goals—it's a source of competitive fun for the team! |

# Business & Sustainability Plan

| Goal | Action(s) |
|---|---|
| Keep all members updated on progress & responsibilities | • We have held regularly-scheduled business meetings for every member of our team to check in on the Cru's progress as a whole and the individual sub-crus.<br>• We have used our Discord server as a way to recap each meeting at its conclusion for those who weren't there. Absent members check our notebook for a more detailed account of each meeting's happenings. |
| Organize at least 2 online outreach events | • We hosted a series of Python programming workshops for beginners over the summer. Through the Rockville Science Center online seminar platform, we engaged over 50 attendees in how to program at a beginner level, and even guided them on creating their own games!<br>• We are currently organizing a series of seminars with local STEM professionals. Not only will we use this event to canvas for new mentors or sponsors, but we will post the seminars on our social media pages to educate our followers on different STEM fields. |
| Coordinate volunteering positions at RSC events | • A series of Arduino circuit workshops takes place every Saturday at our meeting venue. We have been rotating members to help out at this seminar.<br>• This task falls on any member with experience in circuit building and Arduino. It is an ongoing effort. |
| Use storefront as form of team and STEM promotion | • We set up our playing field in front of the windows to invite interested passersby to look into the store.<br>• We have lego displays, block towers, and STEM posters (including informative COVID-19 posters) in front of our store. We loop a presentation with upcoming STEM events on a TV. |
| Increase presence on team social media accounts | • We have created a team Twitter account.<br>• We have created a team TikTok account, promoting STEM and the FTC competition.<br>• We have followed 53 teams on Instagram, which have in turn followed us back. We have direct-messaged several teams to keep each other updated on our teams.<br>• We have learned about the activities of other teams, and they in turn have learned about ours.<br>• We've created a team Youtube channel to post our matches and FTC tutorials for new members/teams |
| Gain a minimum of 1 new mentor through seminar outreach | • For the speakers whose professions line up with the FTC competition, we inquire about the possibility of a mentorship.<br>• The idea is to suggest a flexible arrangement that can accommodate the availability of the potential mentor, as everyone has different circumstances during the COVID-19 pandemic. |
| Gain a minimum of 2-3 new members | • We believe 5 members is a good minimum number of experienced members for a team to successfully handle all the tasks that need to be completed.<br>• We advertised FTC, the Cru, and our open team positions using the TV in the storefront to passersby.<br>• We used an online "word-of-mouth" recruitment policy, in which our members informed people about our position openings using their social media accounts, like Instagram.<br>• We used the Explorer Post 1010 and RSC email chains to inform people about the openings on the team.<br>• We successfully recruited 2 new members! |
| Train new members in CAD, building, programming | • We took our new members on a "tour" around each of our sub crus, giving them an overview of each.<br>• We held a CAD tutorial lesson for our new members using the Youtube tutorial developed by a Blu Cru alumnus. The new members learned the functions of CAD they would need for FTC, namely importing and using FIRST-specific parts and combining parts together to create an animated model for the robot.<br>• We involved new members in each of our brainstorming, designing, and braining activities, encouraging them to give their input during these stages.<br>• We created a series of tutorial videos to guide our new members on the FTC operations of a strong team.<br>• We showed our new members our test robot, and allowed them to tinker around with the bot to get familiar with the tools and the FTC-specific parts. |
| Prepare current members for passing-on of leadership roles for the next season | • The heads of our sub-crus have allowed our members to take the initiative on specific tasks. For example, the design of our wobble-grabbing arm was coordinated by our less-experienced members, who collaborated to build, attach, and test the arm. It was a success!<br>• Our captains prepare experienced members to learn how to manage the various sub-crus. These members learn about what the other Crus are doing by "swapping" jobs for a few meetings.<br>• Our tutorial videos offer guidance from our older members on how to run a team; to be consulted in the future. |

# Finances

This year we spent a much smaller amount than normal. We did not have to buy nearly as many parts as we normally do, as we reused all of ours. However, we were still not able to rely on our usual sources of income for this year. We were unable to carry out our typical fundraising initiatives, which involve in-person activities, such as the annual Explorer Post Laser Tag game and Post 1010 picnic. It is very apparent that this season is not an appropriate time to inquire about sponsorships from local business, most of which are in no financial position to divert resources to a sponsorship. We also know that our fundraising activities, which in previous years were entirely in person, would not be possible this year. In addition, IBM has changed the way it allocates grants for this year, meaning our grant will be of a smaller amount than usual.

## 2020-2021 Projected Income

| Source | 2020-2021 Amount | 2021-2022 Projected Amount | Change from 2020-2021 season |
|---|---|---|---|
| Member dues | $1800 | $1800 | — |
| Fundraisers/Community Donations<br>• All-night laser tag<br>• Post 1010 picnic<br>• Bake sales at science events | $0 | $0 | — |
| Sponsors | $1500 | $1500 | — |
| IBM Grant | $125 | $125 | — |
| Total | $3425 | $3425 | — |

## Expenses

| Category of Expense | Amount | Notes |
|---|---|---|
| FTC registration | $275 | This is a required expense |
| FIRST Chesapeake Competition Fee | $300 | This is a required expense |
| Field Costs | $450 | This is a required expense |
| Robot parts | $0 | We reused parts from last year, so no new parts were necessary! |
| Additional competition expenses | $0 | We do not have to print our notebook or provide other materials to present at competition (all online). |
| Rental of venue & other Explorer Post 1010 umbrella costs | — | These are covered by a portion of our membership dues. |
| Total | $1050 | We are happy to have stayed on track with our budget! |

As a result, we paid extra attention to being deliberate and sustainably-minded when it came to making purchases. In some ways, this unusual season prompted us to become more aware financial decision-makers.