LigerBots

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A Guide to the LigerBots, 2022 FIRST Robotics Team 2877

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FIRST Robotics Team 2877

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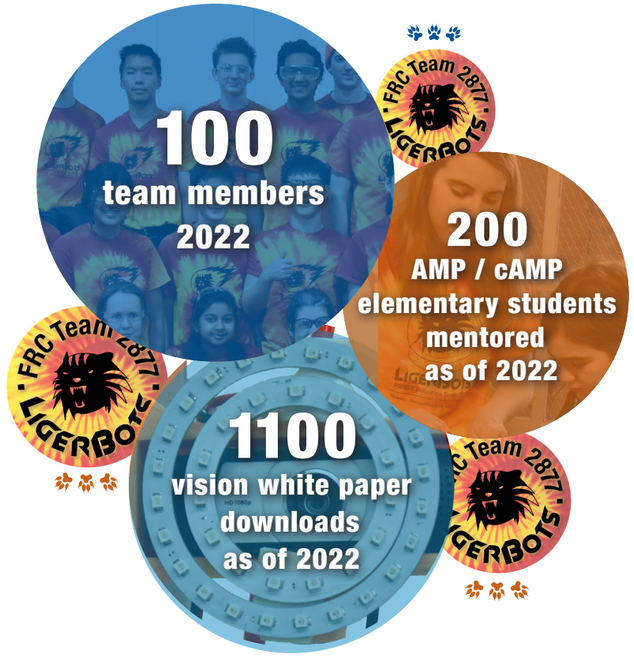

The LigerBots, 2022.

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LigerBots Lead in Project-Based Learning

"Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results."

— John Dewey, nineteenth-century education reformer

Little girls scramble for position around a small table, frantically grabbing at pieces of colorful origami paper. Settling in, they look up at the LigerBot instructor, papers in their outstretched hands. They quickly follow the first few instructions, but then things go awry. One little girl shoves her paper at the instructor, pleading for help. Others crease the papers in random places. During this commotion, one girl scrunches up her face in thought. She clearly does not understand all the steps and even has to take a new sheet to start over. She patiently goes step by step, folding with great care, and finally completing the project. Then, she turns to her friends to help them. By the end of the session, all of the girls hold up their creations in triumph. From a single piece of paper, they learned the process of engineering.

As a team, we do more than build robots; we strive to encourage students to become the next generation of leaders and thinkers. We seek to change the way students learn; our vision is to transform education through project-based learning.

Our goal is to become the recognized leader of project-based learning in Newton, Mass. To do that, we have created a system that uses hands-on projects to help team members build a strong and diverse set of skills. We then leverage those skills to advocate for project-based learning in the community by building a strong core of sponsors, educating the community, and establishing a sustainable FIRST LEGO League pipeline into our team. We share what we do in order to build and maintain the long-term strength of our team, foster a love for STEM and encourage project-based learning at home.

Carolyn helps Girl Scouts do origami at the FLL Eastern MA Championship maker fair.

Row 1: STEM advocacy—LigerBot delivers a TEDxBeaconStreet talk about FIRST as project based learning; STEM training—electrical mentor and CTO solder an electrical test bench. Row 2: sponsor relations—LigerBots outside Fowler High Precision after a successful sponsorship pitch; team outreach—LigerBot talks about the team to middle school students. Row 3: FIRST leadership— the participants at the FLL Eastern MA Championship.

2022 Chairman's Award Submission Executive Summary

Q: Describe the impact of the FIRST program on team participants within the last 3 years. This can include but is not limited to percentages of those graduating high school, attending college, in STEM careers, and in FIRST programs as mentors/sponsors.

A: The LigerBots builds on the FIRST program to inspire our team and our community. Of our 73 members, an average of 70% attend every meeting. While many join with an interest in mind, like CAD or graphics, all students gain experiences in many aspects of the team. Tech-focused members gain non-technical skills like writing and management, while non-technical students assist with mechanical brainstorms and prototyping. We have a 100% graduation rate with a majority pursuing fields in STEAM.

Q: Describe your community along with how your team addresses its unique opportunities and circumstances.

A: The LigerBots thrives on the innovation that surrounds Boston. Despite fierce competition, we stand out through an intensive outreach campaign. Prior to the pandemic the team would attend or host 30 to 40 local and regional events each year. With fewer in-person events available, the team adapted its educational programs by creating an online mentorship program and summer camp, and modifying events to fit safety guidelines. The team's message reached more than 100,000 people in 2021.

Q: Describe the team's methods, with emphasis on the past 3 years, for spreading the FIRST message in ways that are effective, scalable, sustainable, and creative. How does your team measure results?

A: Education and family relationships are core parts of Newton's identity, so the LigerBots use these as catalysts for spreading the FIRST message. Our online mentorship program and summer cAMP, STEAM Fairs and FLL competitions all allow us to engage with our community in ways that foster innovation while remaining engaging and sustainable. Online polls and emails show positive feedback and community organizations, including our mayor, who regularly invites us back to be part of their programs.

Q: Please provide specific examples of how your team members act as role models within the FIRST community with an emphasis on the past 3 years.

A: The LigerBots aided team 8567 during the 2020 season, hosted virtual FLL info nights for parents and created the New England Strategy Alliance with teams 246, 172, and 1100. We joined the Open Alliance, sharing our work and processes with the FRC community at large. We have written 4 white papers in the last 3 years, with our paper on distance education having over 1,100 downloads and 8,000 views. We invite other teams to take part in our distance education initiative and our STEAM fairs.

Q: Beyond starting teams, what initiatives have you done to help inspire young people to be science and technology leaders and innovators? What results have you seen from your efforts in the past 3 years?

A: We host an annual STEAM fair at our FLL competitions, where everyone can engage in hands-on STEAM activities, and local Girl Scouts can earn STEM badges. Additionally, our AMP and cAMP programs have helped engage K-5 kids in STEM education virtually while having fun. Last year, we reached over 180 kids and received $2560 in donations and positive feedback in emails and surveys despite offering cAMP as a free program. All of our STEM activity fliers are available on our website for download.

Q: Describe your team's initiatives to Assist, Mentor, and/or Start other FIRST teams with emphasis on activities within the past 3 years.

A: The LigerBots creates a pipeline for young students to engage in FIRST. We host an annual FLL Info Night targeted towards expanding FIRST opportunities in Newton, organize two FLL competitions every year, and have helped launch an FLL team with Newton's Boys & Girls Club. We've also held STEAM fairs where vendors run STEAM-related booths and demonstrate some of our own STEAM activities. We provide FRC teams operational advice, post our white-papers online, and are active in FRC forums.

Q: Describe the partnerships you've created with other organizations (teams, sponsors, educational institutions, philanthropic entities, etc.) and what you have accomplished together with an emphasis on the past 3 years.

A: We joined the Open Alliance, publishing our work on our robot to the FRC community for the benefit of other teams. We were interviewed by a local television program for our work with STEAM education for younger children during lockdown. We mentor our local Boys & Girls Club and helped them create a club FLL team. We've been invited by our mayor to discuss STEM with a local company, Barrett Technology, whose CEO then delivered a talk to the team about robotics as a career.

Q: Describe your team's efforts in the past 3 years to promote equity, diversity, and inclusion within your team, FIRST, and your communities.

A: We strive to promote equity, diversity, and inclusion within our community and our team. Our FLL events have seen an increase of Girl Scouts who come to attend our STEAM Fair. Thanks to changes in how we market to students, we have seen an increase in non-male members and this year have more non-male technical leaders than ever. Our goal is to encourage students who otherwise would not be interested in STEM find their way into the workshop and become engineers along the way.

Q: Explain how you ensure your team and the initiatives you have created will continue to run effectively for the foreseeable future.

A: Our team created a pipeline that brings families through FLL into FRC. Through this process, we've gained several members who continue to be involved with FLL. Our team's model encourages veteran members to form strong connections with rookies to teach them skills such as CAD, manufacturing, public speaking, marketing and more. AMP has also proven successful in recruitment; plus, the team created tools that build a repeatable process for promoting the program and matching mentors and mentees.

Q: Describe your team's innovative strategies to recruit, retain, and engage your sponsors within the past 3 years.

A: Recruiting and strengthening sponsor relations is a core part of our team's culture, with training including how to talk to a potential sponsor and handwritten thank you cards being written by all team members. We engage our sponsors by sending them updates with detailed descriptions of team activities. Sponsors attend our programming and speak to our team about careers in engineering. Several new sponsors have been attracted by our work with AMP and cAMP.

Q: Highlight one area in which your team needs to improve and describe the steps actively being taken to make those improvements.

A: While the Ligerbots strives to be a role model team within our community and within FIRST, we still have many areas where we can improve. Our relationships with our sponsors can always improve, especially as our senior marketing members begin to graduate. Our team training has been shifted primarily to online training, which has given our team the unique opportunity to explore more opportunities, which now

require more training than prior to the pandemic.

Q: Describe your team's goals to fulfill the mission of FIRST and the progress you have made towards those goals.

A: The LigerBots work to cultivate leaders that can innovate using project based education and community engagement. Regardless of position, veteran members help to educate rookie students on every topic and aspect of our team, both technical and non-technical. Students can take on leadership roles like managing outreach events and leading build groups. Within our community, we work towards inspiring younger generations through our FLL competitions, FLL info nights, STEAM fairs, and more.

Q: Briefly describe other matters of interest to the FIRST Judges, including items that may not fit into the above topics. The judges are interested in learning about aspects of your team that may be unique or particularly noteworthy.

A: The team uses surplus funds to create mini-grants, which offer opportunities for students to fund projects that they're passionate about. Students have written grants to help visualize their projects for the team. Recent grants include prizes for the hack-a-thon, solar kits, and even for the filing fee to patent the device that resulted from the FIRST Innovation Challenge. Coaches judge the grants based on whether the students clearly explained the benefit or value to the team or community.

LigerBots at the Boston GreenFest.

2022 Chairman's Award Submission Essay

Introduction

The LigerBots strive to build a community around project-based teaching and learning at all grade levels, from elementary through high school. Robots may be at the heart of FIRST, but our team does so much more, drawing people in with STEM opportunities, then teaching broader skill sets to mold future leaders and thinkers.

Past years: Building the LigerBots Community

Hosting STEAM fairs, mentoring and assisting FLL teams, and working with schools have been vital parts of the LigerBots' involvement in our community.

For the past 4 years we have developed hands-on STEAM activities designed to teach younger students various STEM concepts, and paired the activities with instructional flyers that are researched, photographed, and designed by our graphics students. As soon as we had a few activities ready, we began to take them to community events along with our demo robot, and to host STEAM fairs for elementary schools, libraries, and other organizations. We eventually received such an overwhelming number of requests for STEAM outreach events that we decided to make our flyers downloadable from our website, providing more accessibility. Currently we have 15 activities available.

Our flyers have not only helped us organize our STEAM outreach, but also have been a key part of our FLL involvement. Every June we host an "FLL Info Night" to encourage the creation of new FLL teams in our area. During the info night we set up STEAM activities for students while parents listen to our presentation about FIRST. In 2019 we facilitated the creation of 3 teams and an FLL Jr. team, bringing 20+ families into the FIRST pipeline. The skills gained from hosting small-scale outreach events like these helped LigerBots members build skills to work together and host much larger events, like entire FLL competitions.

We have organized, hosted, and staffed the Newton Qualifier since 2015 and the Massachusetts East Championship since 2016. In 2019 we had 34 FLL teams at the Newton Qualifier and 48 at the Massachusetts East Championship. The event included presentations from 10 FLL Jr. teams, attracted 1600 people, and earned $6,000 for the LigerBots from food sales and registrations. During these events, we hosted a STEAM fair that showcased LigerBots STEAM activities, and sponsor demonstrations. Newton South High School's science team, Newton North High School's computer programming club, Students for a Greener World, and other clubs have helped us staff these large-scale events. Since 2018, the Newton Girl Scouts have used this STEAM fair to replace their own STEM event in which they earn a STEM patch. (The challenges of the past two years have forced us to creatively adjust our competitions. More on this below.)

In addition to providing STEAM opportunities to the Girl Scouts at competitions, we strive to ensure that girls who enter FIRST continue to pursue STEM-related opportunities through high school. Past members of Newton FLL teams (Roaming Rovers, the Day Dragons, and the Snowy Owls) have gone on to join the LigerBots. Female FLL alumni have been part of a LigerBots trend toward more female involvement. In 2022, 30% of students regularly in our shop are girls. We have girls leading our ball storage, shooter, climber, and bumpers groups, as well as our graphics, strategy and awards groups.

The LigerBots' mission to share STEM knowledge to all of our communities extends beyond FLL, to our work with other FRC teams. We share information through white papers, creating scouting alliances, and collaborating on outreach events. We share our projects with the FIRST community on Chief Delphi,

including our code and white papers outlining projects such as our vision system and our electrical test bench. We formed a strategy council that analyzes FRC game strategies and builds scouting alliances with other New England teams. We coordinate efforts with these teams to increase scouting efficiency and work around the common problem of having too few scouts per team. Our council does data analysis using programs such as R and Tableau to create data visualizations. All of our work is posted to GitHub and Chief Delphi, and sent directly to the other teams in the scouting alliance.

Changing What We Do, Not Who We Are

As Covid-19 closed businesses, shut down schools, and brought life to a sudden halt in March of 2020, the LigerBots quickly realized that our community needed help. Kids sat bored at home, and parents were facing unbelievable amounts of stress. As a team, we didn't just hear or read about these issues, we lived them. Our solution: The Awesome Mentorship Project. AMP addressed problems faced by the LigerBots, students, and parents by creating a program that matched high school students with elementary school kids to tutor, teach, or simply hang out over an online platform. AMP continues today. Over the last 12 months 184 pairs have participated in our program.

While AMP is a success, we haven't stopped there; in the summer of 2020, we expanded AMP and launched an online summer camp—cAMP. We reached more than 55 schools over 8 weeks, with about 40 high-school-aged teachers and 250 elementary-aged kids. Classes were taught by LigerBots, students from high schools, clubs, and other FRC teams such as Mechanical Advantage (#6328), Inverse Polarity (#1100), and TJ2 (#88). LigerBots organized logistics and trained teachers to create a curriculum on any topic they were passionate about. These included not only core subjects such as math and reading, but also art, programming, Greek mythology, dance, thematic mapmaking, and more. Even though cAMP was free to all, parents voluntarily donated $2600 to the LigerBots.

Our online experience with the AMP program also helped us create an online hackathon, in which students from grades 4-7 used Scratch to create a game and present it to a panel of judges. In addition to teaching code, LigerBots student mentors ran online escape rooms to keep the kids entertained while judges deliberated. LigerBots coaches distributed awards at an awards ceremony. The entire event was even planned and run by two LigerBots freshmen.

AMP and cAMP were built using skills we've spent years mastering: engaging students, reaching out to the community, interacting with other FIRST teams, and teaching STEAM techniques—skills that have allowed us to build something with impact. Our work over the past few years building strong connections with outside organizations and the media has helped us advance AMP from a one-time project to an ongoing program. Marketing and community-building skills our members have gained helped us not only bring students of all ages together, but create a lasting community that values education. Our relationships with news outlets like the Boston Globe, the Newton schools, our city's STEM newsletters, and social media platforms, enabled us to help educate hundreds of students.

Growing Stronger Together

When we completed the cAMP program, we wrote a whitepaper about distance learning, sharing steps we took towards planning, marketing, and managing our virtual programs. Creating AMP offered learning experiences within our team that we could share with others outside of it. It gave us a way to use the planning, organization, and teaching skills we gained in past years to help us evolve as a team and community. After cAMP, LigerBots and the student teachers discussed activities and strategies that worked best in order to improve our ability to provide for students in the future.

Several new STEAM activities grew out of cAMP, which turned out to be a solution to another problem: finding a way to host safe FLL competitions. We wanted to continue to host while ensuring the safety of everyone competing, attending, and volunteering. To do this, we restricted who could attend, expanded the pits to allow ventilation, and adapted our STEAM fair. Rather than having our usual tables full of activities in the main hall at Newton North High School, which would have attracted unsafe crowds, we created STEAM kits for every FLL student attending the event, to be brought back to their pits or taken home.

Furthermore, we work directly with specific FLL teams. In addition to continuing to run FLL info nights online, our team worked with the John M. Barry Boys and Girls Club to start a STEM program and an FLL team. We hosted a demo day, where kids could get exposure to FLL by playing around with an FLL robot and code we provided. We continue to communicate with the club about how to engage students and create a permanent Boys and Girls Club FLL team, allowing waves of new students joining the club to keep the team running.

A Community Ever Growing

Our team has grown during the past several years. Despite the difficulties of Covid-19, this year's team is bigger than ever, with 73 active members. Even though 75% of LigerBots have never experienced an in-person build season, we have grown and changed to make sure our technical and institutional knowledge is preserved and passed on to our new members. Although we could only meet online last year, our virtual meetings greatly increased the cross-pollination of engineering knowledge and non-technical savvy, bringing our technical and non-technical students together. In 2021 our marketing, strategy, and graphics students worked intensively with our engineering students to create submissions for the FIRST Game Design, Infinite Recharge at Home, and Innovation challenges. This increased collaboration carried over into the 2022 season. We now have electrical students doing photography, graphics students participating in mechanical brainstorms, and rookies alternating from learning how machines in the shop work to writing sponsor letters. While robotics may be at the heart of FIRST, the wide-range of experiences the LigerBots provide to our team members allow them to prepare themselves for the future while creating long-lasting educational opportunities for everyone we touch.

LigerBot assists child with binary beads STEAM activity at Newton's Pumkin Smash.

LigerBot constructs robot bumpers.

LigerBots Do Hands-On Training

Our commitment to project-based learning starts as soon as students join the team. We spend our preseason teaching rookies core skills through hands-on activities. As a rookie, one of our recent chief technical officers had trouble learning how to put together an FRC control system. To help, a mentor trained her with a virtual, magnetic electrical system. “We did it every day until I understood how to do it,” she said. “Once I had nailed that, he let me play with the wiring on a previous year’s robot.” After her training, the CTO was able to use the same techniques to teach other students, and could help her parents with small electrical projects.

We start training each year by breaking rookies into groups; then, using previous FIRST games as a guide, we have students create game strategies and designs to teach them the engineering process. Each group then presents its designs to the rest of the team, which helps build presentation skills, as well as exposing the team to diverse engineering approaches.

Our broad preseason training has also resulted in team members understanding the wide variety of ways they can contribute to the team. For instance, a recent CMO learned to bend and mold polycarbonate to make a hinge, and our students who usually concentrate on technical projects regularly help with team fundraising and blog posts.

As a result of our training projects we have published four white papers on Chief Delphi that have received thousands of views and downloads: on robot vision, on the measurement of display latency, on making an electrical test bench, and on distance learning and teaching. Another paper, in progress, is about making reversible bumper covers. We share our robot code on GitHub, maintain a robot build blog as part of the Open Alliance on Chief Delphi, and publish our CAD on Onshape.

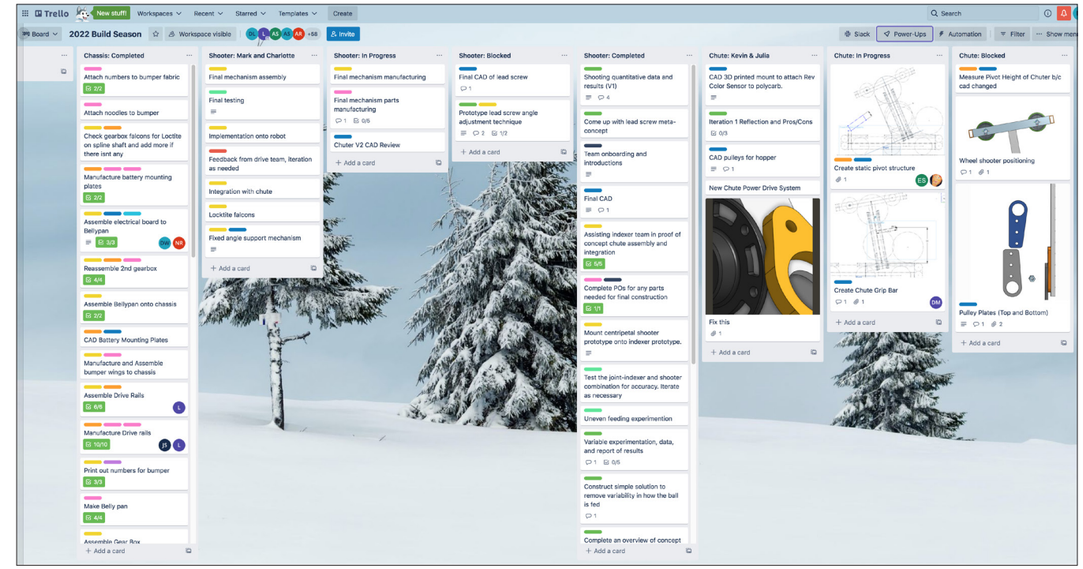
Rookies learn to disassemble a motor.

Row 1: LigerBot jeweling a piece of metal; watching previous years’ games to learn strategy. Row 2: explaining types of drive trains; wiring up the control system for a demo robot; setting up the computer numerically controlled (CNC) router. Row 3: assembling an intake arm prototype; showing rookies how to wire the brushless motor test bench. Row 4: improving public speaking; lerning how intakes work; practicing the bending of metal sheets using heat.

LigerBots Acquire Many Skill Sets

- ***Shop safety.*** Keeping our fingers and eyes intact as we work on the robot
- ***Basic training.*** Learning the functioning of basic mechanisms, motors, sensors, electrical and pneumatic components, and use of CAD software
- ***Use of machines.*** Using the band saw, hand drill, mill, drill press, and lathe
- ***Precision manufacturing.*** Improving our ability to cut and mill pieces of metal precisely into specific parts using a CNC router
- ***Outreach robot,*** Building a new West Coast Drive train and prototyping mechanisms to assemble a custom outreach robot
- ***Programming.*** Coding with last year's code, Arduinos and a simulator as well as the basics of vision tracking
- ***Electrical.*** Soldering, crimping, building prototype boards, CADing electrical layouts, and learning electrical physics principles.
- ***Swerve Drive Train:*** Building and experimenting with a new differential swerve gearbox and drivetrain
- ***Custom gearboxes.*** Creating custom gearboxes in order to practice use of the band saw, machining on the CNC, and assembling parts.
- ***Game Strategy.*** Watching robot games online and at live events prior to our own competitions to learn how to evaluate robots for their potential as alliance partners when we compete
- ***Technical writing***. Writing white papers, using LaTeX, that convey technical information about LigerBots projects in a concise, informative, and persuasive manner
- ***Elevator pitches.*** Constructing spontaneous, 60-second speeches about the LigerBots and FIRST, to use whenever someone asks us about the team. Practicing it in pairs and presenting to the team
- ***Public speaking.*** Creating a narrative and visuals and presenting them effectively to FIRST Robotics judges, sponsors, and the public
- ***Grant writing and sponsorship.*** Writing formal grant proposals to potential sponsors and approaching sponsors that don't have a formal grant process
- ***Writing for publicity.*** Writing for different formats: blog posts, sponsor relations, media relations, social media, government relations, and FIRST awards applications. Using tools such as MailChimp
- ***Leading an outreach event.*** Organizing the logistics for a LigerBots robot demonstration and outreach table
- ***Photography.*** Composing photographs and using the "exposure triangle," as an aid to documenting team projects. Using Flickr to keep all of our photos organized
- ***Video editing:*** Shooting and editing video for FIRST award submissions, robot videos and other special projects
- ***Graphic design.*** Creating graphical documents for team marketing and publicity, using Adobe Creative Suite and Creative Cloud.
- ***Sewing.*** Cutting and sewing soft materials to prepare for making bags and robot bumpers in build season

LigerBots Manage Our Projects



A Trello board showing the state of various robot mechanisms in late February 2022.

Alex marks a task as "blocked" on the team taskboard.

LigerBots use detailed project management for all of our tasks. We create Trello boards for all of our non-technical and technical projects. We use the KanBan process to track and control our business projects and robot manufacturing progress during the robot build season. In addition, team members contribute to a taskboard that employs sticky notes on a white board in our work area. Students sign up for individual tasks on the taskboard and follow them through from "not started," to "in progress" to "done," moving the sticky notes for their tasks to different columns on the board as they progress. A column for "blocked" projects helps us clear our bottlenecks. This system helps us finish our robot quickly, so that we can go on to testing it before competition. LigerBots students transfer their sophistication in planning projects to their academic work and other extracurricular activities, and by teaching it to others.

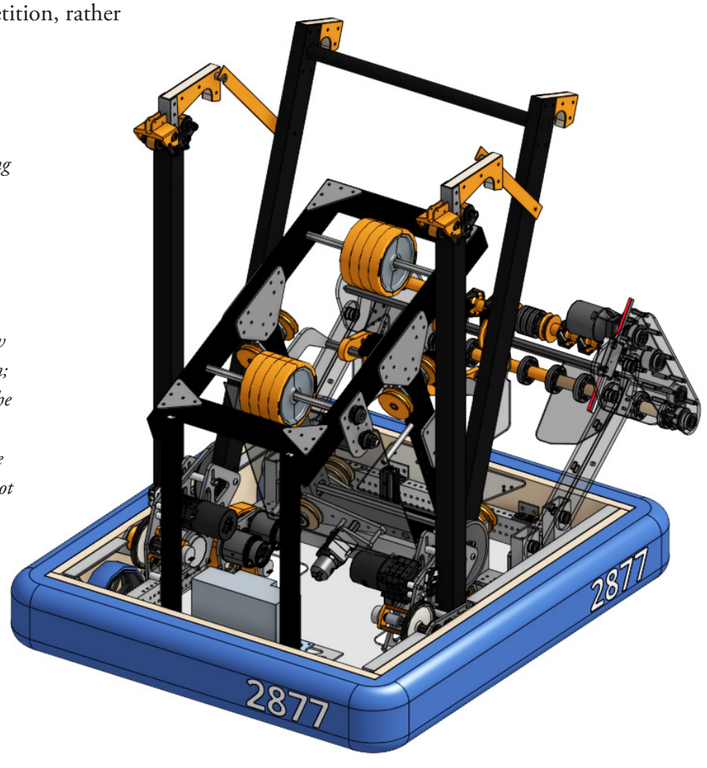
We Build a New 120-Pound Robot Every Year

All of the LigerBots fall training in engineering and marketing skills pays off during the most exciting and demanding part of our year, the winter robot build season.

Immediately after the new FIRST Robotics game is released in early January, the entire team splits into groups for our "three-day design" process. Engineering concepts and game strategy that emerge from our three-day design groups are reconciled by leaders of our mechanical, electrical, and software build groups and a final product is designed using CAD. After the design phase, we begin prototyping robot mechanisms and constructing mockups of the game field elements. We order our wood, metal, plastic, and cloth materials and set to work building in the shop at Newton South High School.

Current rules from FIRST allow us to work on our robot right up until the day of competition, rather than having to stop after six weeks and put the robot into a giant plastic bag, as before. This new rule has allowed us to save the money and time necessary to build a second robot for continued testing after the first robot was "in the bag." This gives us more time and money to spend on improving our competition robot.

During build season our marketing and awards groups are just as busy as the engineers. We finalize sponsor acquisition for the competition season and write and design website pages and printed materials, including this booklet, that recognize our sponsors. Outreach also continues. Our awards group prepares a written submission and an oral presentation to compete for the Chairman's Award, which goes to the team at each competition that best exemplifies the principles of FIRST Robotics.



This page: the LigerBots 2022 robot, "Prometheus." Opposite page, row 1: attaching the first intake prototype to a mock bumper to test the geometry; testing a catapult on the 2016 robot; cutting aluminum plates on the CNC. Row 2: testing a rudimentary version of the shooter; checking the dimensions of the chassis; assembling the climber gearboxes. Row 3: drilling mounting holes into a climber arm; troubleshooting the linkage arms; attaching the first version of the intake to the chassis. Row 4: wiring the chassis; testing a prototype of the climber on an old robot; testing the 2022 robot with a mockup "Hub" field element goal.

LigerBots Have a Robot Design Process

PRESEASON TRAINING AND IMPROVEMENTS

Hands-on Projects

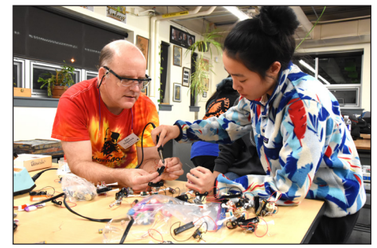
- LigerBots preseason training starts with projects that get new members working hands-on in the shop, with robot components, as fast as possible. In the fall, LigerBots run training sessions in many of our 20 team skill areas, including ten in technical areas. Examples from 2021 include:
  - Manufacturing, building, and wiring a custom chassis to serve as the basis for an outreach robot
  - Prototyping new mechanisms to handle an array of game pieces
  - Using simulations of mechanisms to write training software for Arduinos, and then testing it on the previous year's robot

Game Analysis

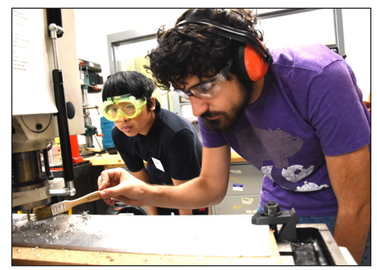
- Veteran LigerBots choose videos of matches from the previous several seasons of robot games. Team members, especially rookies, are invited to watch these videos in a group and think about robot design and game strategy before the new build season.

Improvements to Manufacturing Processes

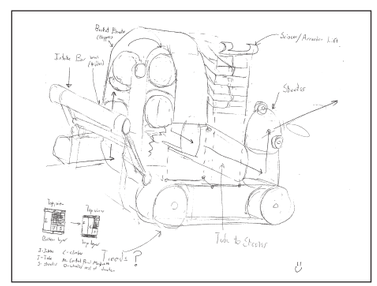
- Installing a digital readout on one of our school's manual mills, to improve the precision of manufactured parts
- Investing in a new, more versatile chuck for our manual mills to speed up and streamline our manufacturing process
- Rebuilding one of our lathes to restore it to a reusable condition
- Upgrading the current CNC router in one of our schools, creating the capability to make higher-precision metal, polycarbonate, and wood parts faster
- Using 3D printing to manufacture complex parts suitable for solving many robot design problems
- Learning how to accurately bend and heat treat aluminum so that it does not lose its strength
- Learning how to machine box tubing on a CNC router for more lightweight and compact robot construction
- Using team-built electrical and pneumatic test benches to help us prototype electrical wiring and pneumatic mechanisms



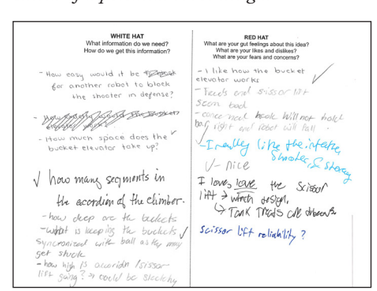
LigerBots coach teaches a rookie to solder.



LigerBots veteran teaches a rookie to use the CNC mill to precisely drill a hole.



Sketch of a potential robot design.



White and red hat critiques of above sketch.

ITERATIVE ROBOT DESIGN

Design Week

- ***Day 0:*** Right after the game kickoff, the team's build leaders and strategy group meet to discuss potential robot capabilities and advantages. They compile a list that is released to the rest of the team.
- ***Days 1 and 2:*** We break into small groups to brainstorm potential robot mechanisms. Each group writes up detailed documentation for its mechanism.
- ***Day 3:*** We use the "six hats" process to continue our iterative design. Team members anonymously write and share six categories of reaction to the mechanism designs created on days one and two. White hat: facts we have and need. Red hat: gut feelings. Yellow hat: perceived strengths. Black hat: perceived weaknesses. Blue hat: how to start implementation. Green hat: alternatives and potential improvements. This written process helps speed up our design decisions and makes sure that all of our ideas are documented and accessible to the whole team.
- ***Day 4:*** Our build leaders meet to review team reaction to mechanism designs and decide which mechanisms to prototype. Other team members are encouraged to listen to the discussion so that they learn how to lead the process in the future.
- ***Days 5–7:*** We split into build groups to start prototyping.

Robot Design and CAD

- Game strategy determines our priorities. The robot is built to best fit our strategy, rather than the strategy changing to accommodate the robot we build.
- Students design and CAD the robot structure and begin prototyping mechanisms starting on day 5 of design week.
- After design week, mechanism groups begin detailed design and CAD of each promising mechanism.
- A CAD model of the entire robot is completed as quickly and thoroughly as possible.

Prototyping and Continuous Improvement

- Prototypes are built of materials as identical as possible to materials used in the final mechanisms, allowing more realistic test results.
- LigerBots continue to test, redesign, and prototype mechanisms.

Project Management

- Mechanism groups with student leaders are formed during build season, allowing every LigerBot to concentrate on and feel ownership for one part of the robot. Fluidity of groups ensures the team's needs are always filled.
- A project management system centered around a Trello board, online, for project plannning and a Kanban task board, in our shop, for project staffing, allows students to find tasks that need completing and track progress.
- The Trello and task boards are supplemented by daily progress meetings and weekly group integration meetings, ensuring that the team is working towards its goals and that no group is falling behind.

LigerBots Compete

FIRST Robotics competitions are the big payoff for all of the LigerBots training and build season work. At these competitions our robot performance, our driving skill and strategy, our awards preparation, and our marketing efforts are all put to the test. We enter two district (first tier) events every year. When we do well at these events we go on to compete at the New England District Championship, and, if we do well there, we go to the FIRST World Championship in Detroit. The LigerBots have made it to the World Championship four times in our first ten years. In 2018 we finished sixth out of 68 teams in our division and advanced to the division semifinals before falling to the eventual world champion alliance.

FIRST Robotics qualfiying matches are played by two randomly selected alliances of three teams each, on a playing field about the size of a basketball court. We have a different alliance for each qualifying match. Our alliance drive teams guide our robots around the field to earn points cooperatively and to keep the other alliance from scoring. Everyone on our team sits in the stands to cheer on our robot. Our scouts take notes on every team's robot performance so that we can choose partner teams wisely if we become an alliance captain during the playoffs.

Our pit technicians repair our robot between matches when something breaks. We also lend tools and materials and repair the robots of other teams in the FIRST spirit of "coopertition."

During competitions team members stand in our repair pit and talk to FIRST judges about the robot and about our team's organization and activities. LigerBots also give a formal presentation to compete for the prestigious Chairman's Award, which sends the winning team automatically to the next level of competition no matter how its robot performs. Every year our efforts have resulted in at least one award for our team, for a total of 31 awards during our first 13 years.

2018 competition season. This page, left to right: FIRST official waves the LigerBots flag before a match; LigerBots cheering in the stands. Opposite page: Row 1: LigerBots being interviewed live for the worldwide robot game kickoff broadcast; placing the robot on the field. Row 2: The Red alliance, ready to start a match; 2018 robot, Chronos, placing a "cube" on the "scale" for points; repairing the robot between matches. Row 3: The drive team in the pit; talking to the public in the pit; talking to FIRST judges; Row 4: receiving the Engineering Inspiration award.

Our Strategy Council Helps Us Improve

Computational biologist Noam Shoresh from the Broad Institute talks to the LigerBots about data analysis.

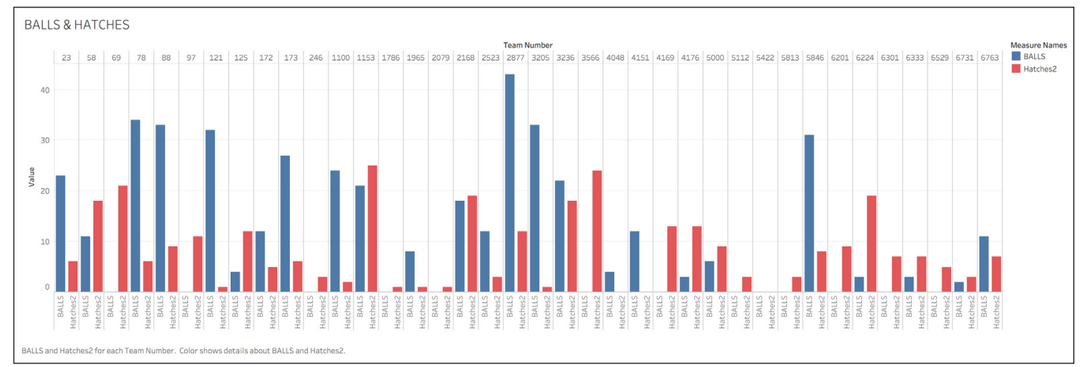
The LigerBots strategy council communicates with other FRC teams, does data analysis, game strategy, design strategy, and scouting.

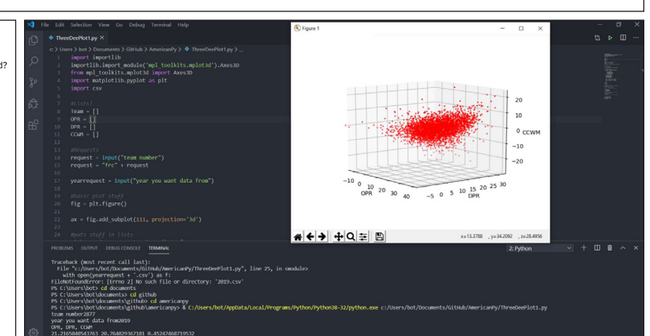
Our ongoing alliance with local FRC teams collects data about other teams at competition, observing matches and then sharing the data within our scouting alliance. We use these scouting data to improve our robot drive team's game strategy, and to optimize our picks of alliance partners when we make it to tournament playoffs as an alliance captain.

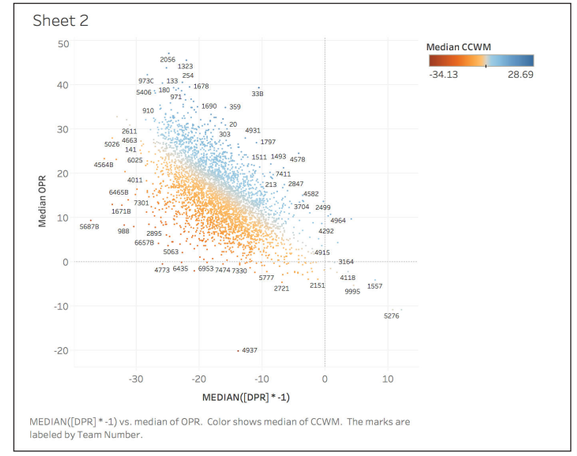
Scouting requires six people in the stands for the entire competition. By scouting together, each team needs to contribute fewer members. Sitting in the stands together as we scout and sharing our data also allow us to grow our connections with other teams.

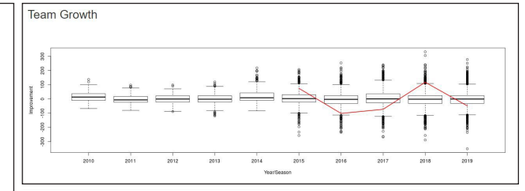
We also use our analyses of game strategy, rules, and design to help train our team members. During the preseason we train rookies to understand the basics of an FRC game, and how we operate as a team. Rookies watch and analyze previous season robot games. We focus on analyzing robot types and game strategy, and on predicting game outcomes in both qualitative and quantitative ways. When the game is announced at "kickoff," the strategy council compiles multiple documents, including a comprehensive guide to build season for rookies, and critical numbers that save our student engineers time and energy during the robot build process.

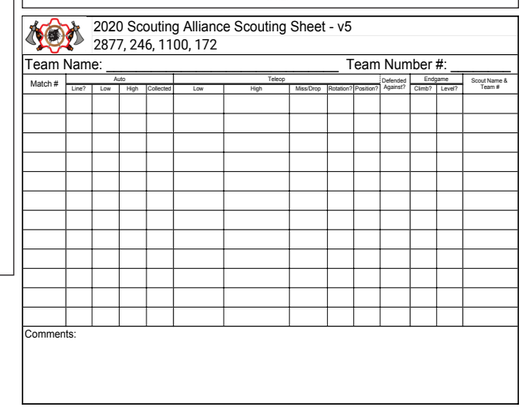
The strategy council also focuses on data analysis, using R and Python. We have been mentored in this process by Noam Shoresh, a computational biologist from the Broad Institute in Cambridge, MA. We share our results with our FRC scouting partners and have posted the blank scouting sheet we developed for our alliance on FRC's Chief Delphi and on our scouting alliance's Discord, two of the forums that FRC teams use to exchange information. One of our ongoing projects is to rank the New England teams using analysis of statistics like offensive power ratings (OPR).











Rows 1-3: data from the 2019 season. Row 1: number of balls and hatches scored by each team's robot. Row 2: correlation between powder coating a robot and its playoff alliance pick number; 3D representation of all teams' offensive power rating (OPR), defensive power rating (DPR), and calculated contribution to win margin (CCWM). Row 3: graph of OPR against DPR with coloring based on CCWM; LigerBots' worldwide rank growth analysis. Row 4: logo and scouting sheet for our 2020 joint scouting project with four other teams.

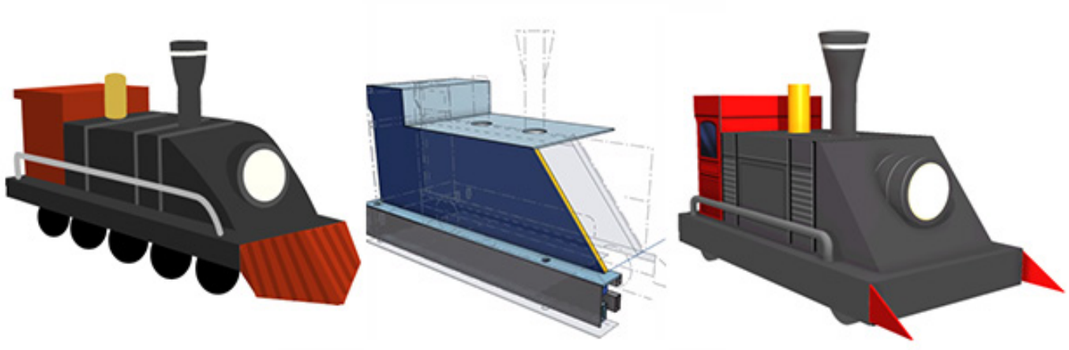
LigerBots Design an Award-Winning Game

The LigerBots are an award-winning team even when we have to go virtual! Since Covid-19 canceled the 2021 in-person competition season, FIRST released three challenges that teams could complete online and then submit for awards. One was a series of robot skill challenges that could be executed with the previous year's robot and videotaped for award submission. The other two challenges were meant to be done completely online. One of them, the Game Design Challenge, invited teams to design their very own FIRST Robotics game and pitch it to the corporate FIRST Robotics Competition game design team, to inspire a future FRC game.

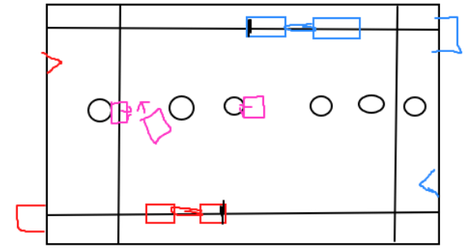
The Game Design Challenge presented a unique opportunity for various LigerBots skill groups to collaborate closely in order to execute a shared vision. Each group offered valuable knowledge and diverse perspectives to the development of the game. Our strategy group worked with our engineers to detail the game logic and rules. The graphics group worked extensively with the engineers to create visuals for the game. Our marketing students brought essential project management to streamline the partnership between the groups.

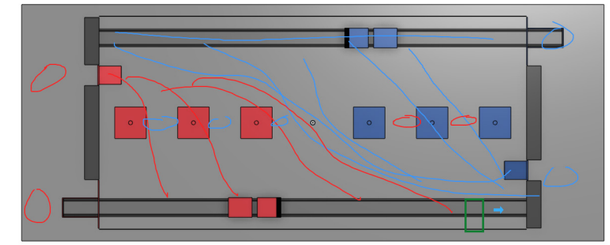
The LigerBots developed a concept involving trains owned by two rival construction companies that were competing to complete new telegraph systems for two nineteenth-century towns. We called the game "Locomotive Linkage." Each robot alliance (of three teams) represented one of the construction companies. Robots earned points by pulling on their locomotive to move their train back and forth on its track, and by collecting "lumber" (foam cylinder game pieces) to put in the train's gondola car. Robots also earned points by climbing a "telegraph pole" in the center of the field, or by toggling an elevated switch attached to the pole.

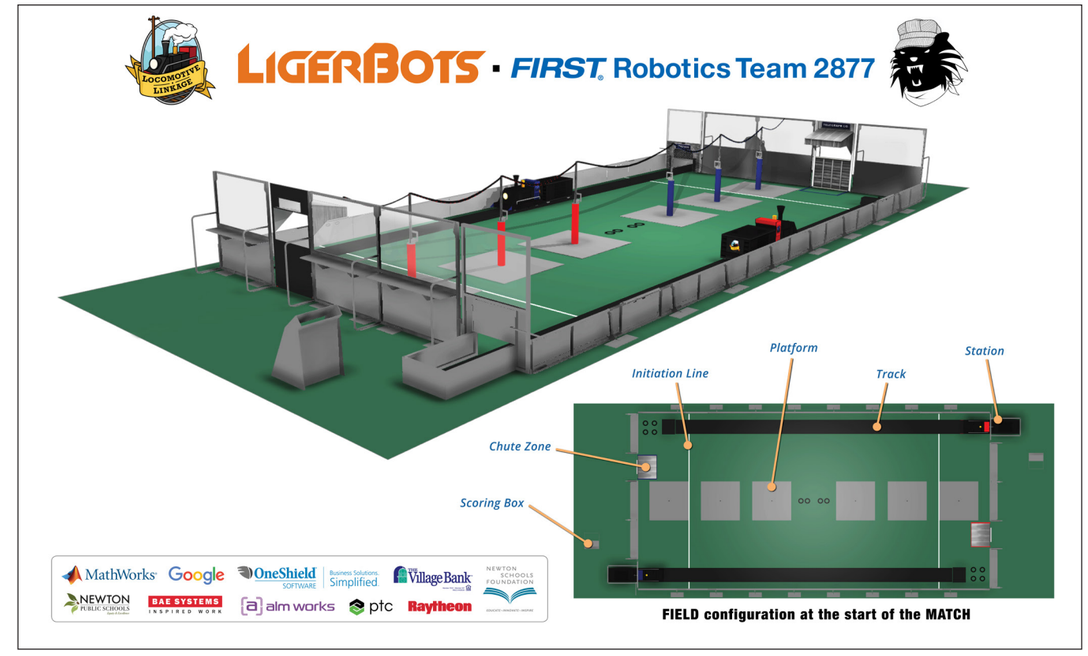
We were thrilled to learn a few weeks after we completed the challenge that we had won the Engineering Design award from FIRST at the district level! The hours spent together on Zoom strengthening our final game design also strengthened our team spirit. In the 2022, in-person season we have remembered our pride in our award and the lessons we learned about cross-team collaboration. We think the LigerBots will always be stronger for our 2021 experience.



Left image: train design drawn by a LigerBots graphics artist. Center image: in-progress CAD of train design. Right image: finished CAD render of train done by a LigerBots engineer, with textures by LigerBots graphics artists.







Game Overview:

In LOCOMOTIVE LINKAGE, rival telegraph companies join forces to link the people of Redton and Blueburg by transporting TELEGRAPH POLES to the building sites of each town's telegraph network. ROBOTS from each ALLIANCE town collect LUMBER from a telegraph pole factory via a CHUTE, move their TRAIN along the TRACKS, and put LUMBER into their GONDOLA CAR. They send the TRAIN back to its STATION to be unloaded, then race off to collect more LUMBER. ROBOTS PRIME TELEGRAPH POLES by toggling the POLES' SWITCHES to accept a message. As the deadline for the telegram between the cities approaches, ROBOTS CLIMB up the POLES or PARK on the PLATFORM to perform final wire maintenance that will ease the transmission. The winning ALLIANCE is the one that has made the biggest contribution to the new telegraph system.

AUTONOMOUS PERIOD: During the 15-second AUTONOMOUS PERIOD, ROBOTS follow pre-programmed instructions. ALLIANCES score points by:

1. Moving from the STARTING ZONE.
2. PRIMING SWITCHES.

TELEOP PERIOD: In the final 2 minutes and 15 seconds of the MATCH, DRIVERS take control of their ROBOTS. ALLIANCES score points by:

Row 1: initial field design sketch; CAD of field. Row 2: final CAD render of field done by LigerBots engineers, with textures by LigerBots graphics artists. Row 3: partial game rules; Locomotive Linkage game logo; Locomotive Linkage-themed team logo.

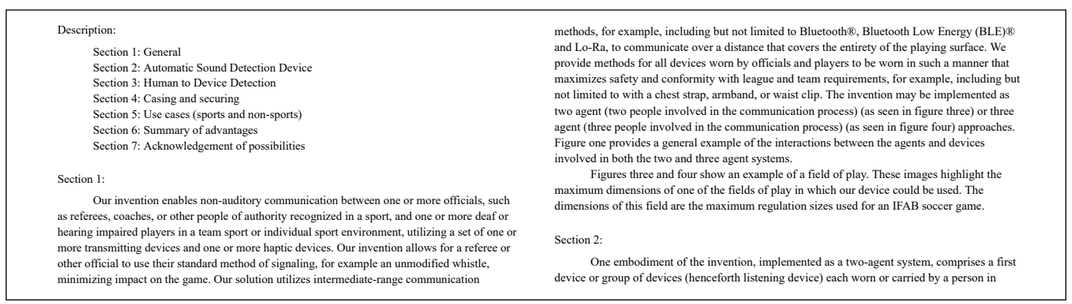
LigerBots Innovate to Help the Deaf Community

With Covid-19 reshaping the 2021 competition season, the LigerBots were excited to take on an online challenge created by FIRST: the Innovation Challenge. This challenge required engineering, programming, and marketing skills to design a solution that helped people achieve "optimum physical and/or mental health and fitness through active play or movement." In other words, teams were asked to devise and pitch a solution to encourage physical activity.

One of the LigerBots noticed that none of the young athletes for whom he refereed soccer were from the Deaf or Hard-of-Hearing community. So, he had the idea to make a non-auditory whistle that would encourage participation by hearing-impaired athletes in team sports. After receiving feedback and concept validation from members of the Deaf and Hard-of-Hearing community, the team committed to pursuing the idea. We spoke with industry experts from iRobot, Excella, and Neosensory about the process of product design and continued to interact with the Deaf and Hard-of-Hearing community along the way, for feedback. We got to know Rory, a six-year-old who felt discouraged from team sports because of overstimulation from his hearing aids. Rory's story and the overwhelmingly positive responses from surveys and interviews inspired our work. Katie McCarthy, a coordinator of outreach and support services at Boston Children's Hospital, described our project as a "wonderful opportunity and a great chance to help Deaf and Hard of Hearing athletes in team sports."

The LigerBots developed two different solutions: an iOS app and a custom hardware design. For the first, more accessible solution, LigerBots designed the LigerWhistle, an app a coach or spectator can use to manually signal a player's Apple Watch (worn on a chest strap) when the referee whistles. The second custom solution involves a device worn by the referee that automatically recognizes when they blow the whistle and sends a radio signal to a vibrating motor the player wears on a chest strap.

The Innovation Challenge offered a unique opportunity at all of its stages for the LigerBots to solve a real-world problem with a real-world impact. Students completed the challenge with priceless, firsthand knowledge of the steps in launching a business, from research to realization. In addition, LigerBots team members learned how to file a provisional patent, for the LigerWhistle and the iOS app. The process of outlining, drafting, and submitting was intense, compounded by the difficulties of working over Zoom. Fortunately, we succeeded in filing the application, and even received praise for our work from a local patent lawyer. Throughout the process we learned valuable skills such as project management and translation of technical ideas into "legalese." Submitting the patent application was a huge accomplishment, and a new and valuable experience for the LigerBots.



Description:

Section 1: General
Section 2: Automatic Sound Detection Device
Section 3: Human to Device Detection
Section 4: Casing and securing
Section 5: Use cases (sports and non-sports)
Section 6: Summary of advantages
Section 7: Acknowledgement of possibilities

Section 1:

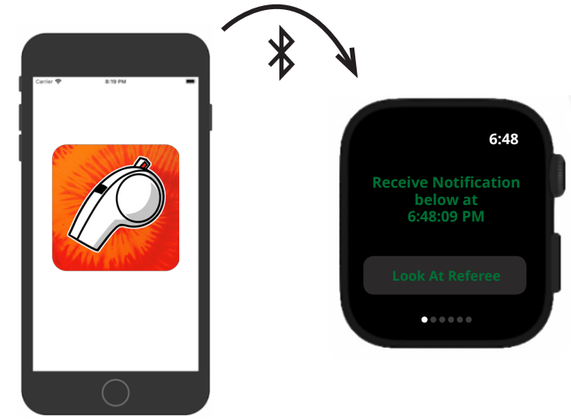
Our invention enables non-auditory communication between one or more officials, such as referees, coaches, or other people of authority recognized in a sport, and one or more deaf or hearing impaired players in a team sport or individual sport environment, utilizing a set of one or more transmitting devices and one or more haptic devices. Our invention allows for a referee or other official to use their standard method of signaling, for example an unmodified whistle, minimizing impact on the game. Our solution utilizes intermediate-range communication methods, for example, including but not limited to Bluetooth®, Bluetooth Low Energy (BLE)® and Lo-Ra, to communicate over a distance that covers the entirety of the playing surface. We provide methods for all devices worn by officials and players to be worn in such a manner that maximizes safety and conformity with league and team requirements, for example, including but not limited to with a chest strap, armband, or waist clip. The invention may be implemented as two agent (two people involved in the communication process) (as seen in figure three) or three agent (three people involved in the communication process) (as seen in figure four) approaches. Figure one provides a general example of the interactions between the agents and devices involved in both the two and three agent systems.

Figures three and four show an example of a field of play. These images highlight the maximum dimensions of one of the fields of play in which our device could be used. The dimensions of this field are the maximum regulation sizes used for an IFAB soccer game.

Section 2:

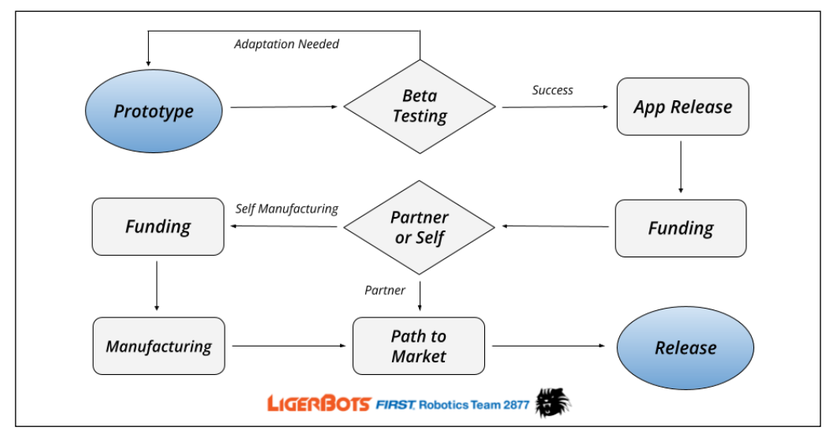
One embodiment of the invention, implemented as a two-agent system, comprises a first device or group of devices (henceforth listening device) each worn or carried by a person in

Provisional patent application (partial).



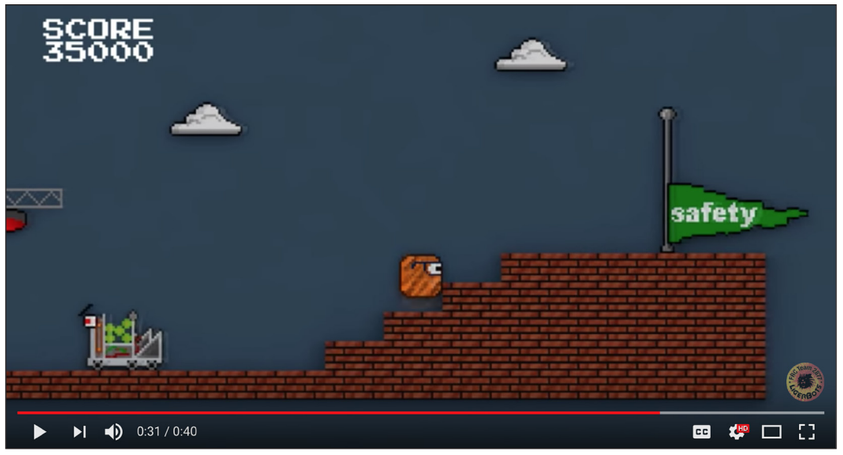
The LigerBots first Innovation Challenge solution involves an iOS app that uses Bluetooth to allow a referee or spectator to manually signal an Apple Watch worn by the player when a whistle is blown.

The second Innovation Challenge solution uses two custom pieces: a device worn by the referee that emits a radio signal when it perceives a whistle being blown, and a vibrating motor worn on a chest strap by the player.



Workflow chart that shows steps from prototype to release for inventing a new product. For the Innovation Challenge, the LigerBots completed beta testing.

We Win the World Safety Animation Contest



In 2018 the LigerBots won our first international award—first place in the world-wide FIRST Robotics Safety Animation competition. Our winning video was shown at many FIRST Robotics competitions to about half a million spectators over the 2018 season. These animated videos combine an educational message about safety with creative art and imagery.

How We Made the Video

In order to follow the retro-1980s arcade theme of the 2018 FRC challenge, we developed a story that combined safety principles with elements of our very own video game. We designed characters and scenery and brought them to life with 3D animation. Finally, we added arcade-style music and sound effects along with a voice-over narration by a LigerBots team member to accompany the visuals.

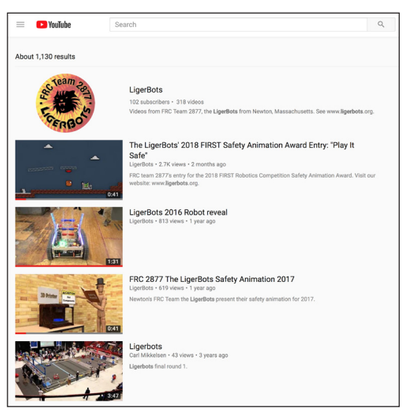
Rising to the Animation Challenge

According to LigerBots' animator Vivek, the biggest challenge was fitting the story into only 40 seconds—the maximum time allowed by rule. The deadline also provided an obstacle, forcing us to make fast decisions and to start the animation process early.

"It took considerable work," said Vivek, "but I'm excited about what it means for our team. It got me thinking about STEM vs STEAM and how the 'A' Art factor ties into the work we do."

We are proud of the work the team did to win this prestigious award and hope that our video will have a lasting impact on the community by encouraging safe practices.

The public can subscribe to our YouTube channel to see this video and all the rest of our team videos.



LigerBots YouTube channel.

LigerBots FIRST Robotics Awards

Year	Event	Award
2021	FRC Game Design Challenge, Scandium Group	Engineering Design
2020	Greater Boston District N. Connecticut District	Chairman's Imagery
2019	New England Championship Central Mass District	Dean's List Finalist Entrepreneurship
2018	Worldwide competition Greater Boston District North Shore District	Safety Animation Engineering Inspiration Imagery
2017	Rhode Island District WPI District	Entrepreneurship Gracious Professionalism
2016	New England Championship WPI District Boston District	Innovation in Control Entrepreneurship Innovation in Control
2015	New England Championship Northeastern District UMass Dartmouth District	Chairman's Competition Finalist Chairman's
2014	Northeastern District WPI District	Competition Finalist Spirit Competition Winner Creativity
2013	Boston Regional	Creativity
2012	Boston Regional WPI Regional	Gracious Professionalism Gracious Professionalism
2011	WPI Regional	Website Dean's List Finalist
2010	Boston Regional WPI Regional	Team Spirit Imagery
2009	Hartford Regional Boston Regional	Rookie Inspiration Highest Rookie Seed Rookie All-Star Highest Rookie Seed

The Chairman's Award is the most prestigious award that FIRST offers, honoring the team that best displays the values and goals of FIRST, while also being a role model for other teams. In 2015 the LigerBots won the Chairman's Award at both the district and NE Championship levels, which qualified the team to compete at the FRC World Championship in St. Louis. Judges chose the LigerBots for the work the team did to spread the message of STEM around Newton and beyond, through education and outreach.

The FIRST Dean's List Award semi-finalists, finalists, and winners are students who have led their teams and communities to increased awareness of FIRST and its mission. These students have also achieved personal technical expertise and accomplishment.

The Engineering Design Award celebrates a team that demonstrates sound engineering in the design process.

The Imagery Award celebrates attractiveness in engineering and outstanding visual aesthetic integration of machine and team appearance.

The Safety Animation Award is the result of a world-wide competition, and is given to the team that produces the best 40-second animated video that combines an educational message about shop safety with creative art and imagery. The LigerBots' winning 2018 video was shown internationally at many FRC competitions.

The Entrepreneurship Award recognizes a team that has developed a comprehensive business plan to scope, manage, and achieve team objectives. Judges chose the LigerBots in 2016 for the team's work in expanding professional relationships with sponsors, acquiring new business mentors, creating a comprehensive business plan, and developing a detailed student leadership structure.

The Innovation in Control Award celebrates an innovative control system or application of control components—electrical, mechanical, or software—to provide unique machine functions. The LigerBots won at both the district and NE Championship levels in 2016 for its robot's adjustable-tipped ball-shooting mechanism and vision-control software.

LigerBots Develop STEAM Activities for Kids

The LigerBots have developed hands-on STEAM activities designed to teach younger students various STEAM concepts. We research and test an activity and then pair it with an instructional flyer written and designed by our graphics students. Each flyer features the steps in the activity and teaches a different scientific concept, ranging from solar power to Newton's laws of motion.

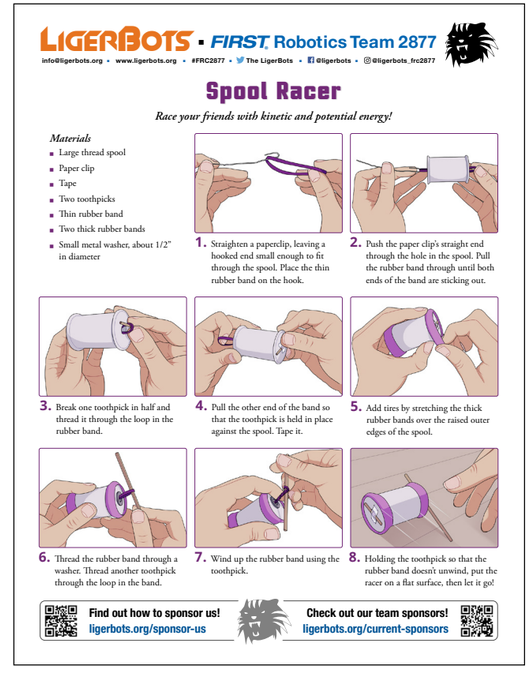
As soon as we had a few activities ready, we began to take them to community events along with our demo robot, and to host STEAM fairs for elementary schools, libraries, and other organizations. We eventually received so many requests for STEAM outreach events that we decided to make our flyers downloadable from our website, providing more accessibility. Currently we have 15 activities available.

Our activities and flyers have not only helped us organize our STEAM outreach, but also have been a key part of our FIRST LEGO League involvement. We host an annual "FLL Info Night" to encourage the creation of new FLL teams in our area. During the info night we set up STEAM activities for students while parents listen to our presentation about FIRST. We also run a STEAM fair at the LigerBots-hosted Massachusetts East FLL Championship, which includes LigerBots STEAM activities as well as demonstrations by many local businesses. Since 2018 the Newton Girl Scouts have used this STEAM fair to replace their own event in which they earn a STEM patch.

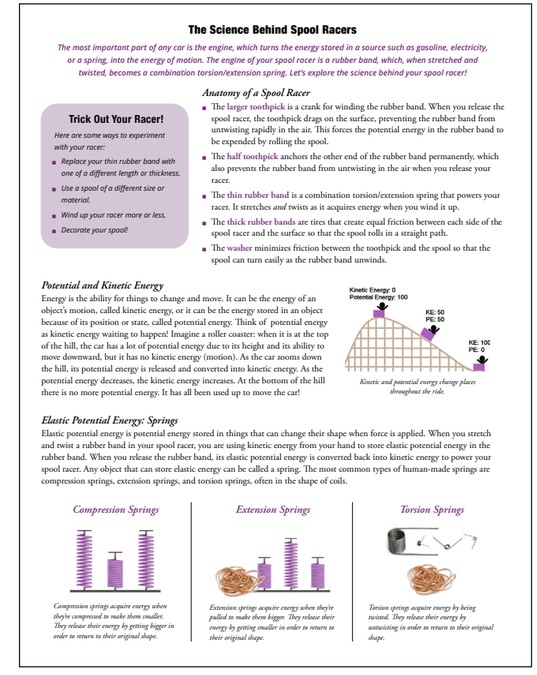
Having a large variety of STEAM activities to choose from helped solve a problem we encountered during the pandemic: finding a way to continue to run this STEAM fair while ensuring the safety of everyone attending. Instead of having our usual tables full of activities in the main hall at Newton North High School, which would have attracted unsafe crowds, we adapted some of our STEAM activities into kits for every FLL student attending the event to bring back to their pits or take home.

The LigerBots find that developing and presenting our STEAM activities not only help us educate our community but also ourselves.

Balloon car STEAM activity kit provided by the LigerBots at the 2021 Massachusetts East FLL Championship.



Spool racer flyer



Slime flyer.

LigerBots Promote FIRST LEGO League

In 2015, the LigerBots hosted an FLL competition and STEAM fair. Feedback from FLL coaches was so positive that New England FIRST asked us to host the Massachusetts East Championship. Since 2016, the team has organized, coordinated, and staffed two competitions each academic year. All events include robots from other FIRST programs.

In addition to our work, we also have had staffing help from FRC 246 Overclocked, Newton South High School's Science Team, and the Newton North High School Computer Programming Club, helping build relationships with other STEM programs both inside and outside of FIRST.

We measure the success of our FLL competitions in two ways: the income the competitions generate and the feedback from those who come. Our FLL competitions attract about 1700 people annually, and help us earn more than $5,000 from a combination of food sales and team registrations. Our feedback from coaches, parents, students, and volunteers is overwhelmingly positive. One parent commented, "I just wanted to thank everyone for all their hard work making this a success. My son will definitely be back, and our younger son is likely to participate." Another parent said, "Every single LigerBot was helpful and friendly. They did a great job of representing their team, their teachers, and their school. Well done!" One even thanked us for inspiring his kids stating "they want to be just like you."

Every year, we host an FLL info night in June to encourage the creation of more teams in Newton. We set up engaging STEAM activities, including brushbots, LEGO towers, and binary beads bracelets, while the parents listen to an overview presentation about FIRST. We have recently facilitated the creation of three FLL teams, as well as an FLL Jr. team, bringing more than 20 families into the FIRST pipeline.

Our students have helped mentor the SuperNovas, a Newton-based team that was created at our FLL info night. LigerBots mentors taught the basics of programming, robot design, essay writing, and public speaking.

The LigerBots also have had a long term mentor relationship with Newton's all-girl team, the Day Dragons. We recently helped the Day Dragons make it to the FLL world championship by coaching them on their project presentation. Once they entered high school, four former Day Dragons became some of our most enthusiastic new LigerBots, and several became team leaders.

LigerBots mentor a presentation by the Day Dragons FLL team.

Visitors make crayons at the LigerBots FLL Info Night.

Row 1: Astronettes compete; the awards ceremony. Row 2: limbo line before an awards ceremony; LigerBots with mentee FLL team the SuperNovas. Row 3: parents snap their FLL teams in front of the LigerBots/FLL backdrop.

LIGERBOTS MAKER FAIRS ARE ENGAGING

Row 1: Brandeis MakerLab; LigerBots slime; LigerBots Outreach robot. Row 2: LigerBots PB&J robot (top); Star Wars 501st Legion (bottom); LigerBots slime; R2 Builders. Row 3: LigerBots 3D printer; Empow Studios.

AT OUR FLL TOURNAMENTS, LIGERBOTS FILL MANY ROLES

Row 1: judging for FLL Jr.; refereeing. Row 2: selling food; staffing safety desk and lost and found. Row 3: MCing; resettting game table; running audio/visual.

LigerBots Help Bring Girls into STEM Fields

We train LigerBots members to share their STEAM knowledge in a way that everyone can understand. All of our FLL competitions include a STEAM (Science, Technology, Engineering, Art and Math) maker fair that brings in outside organizations to share their knowledge with the community. We are especially interested in helping achieve gender balance in STEM fields. Since 2018, the Newton Girl Scouts have used our event to replace their canceled STEAM fair, learning STEAM skills through activities like origami, binary beads, handling 3D printed molecule models, and "coding" our PB&J robot.

The LigerBots also have helped put together three day-long Women In STEM events at Newton North High School to celebrate the accomplishments of women in STEM fields, with the goal of inspiring girls to pursue STEM careers. At these events, LigerBots mentors give presentations about their professional work, and student team members take a hands-on approach to organizing the event.

During the pandemic, LigerBots attended a Women In STEM event on Zoom, hosted by Belmont High School, for Newton high school students.

After we mentored the all-girls FLL team the Day Dragons, four of their members joined the LigerBots when they became high school freshmen, and several rose to be team leaders. (See more on page 32.)

In 2022, LigerBots have 22 girls on the team, and we have normalized the idea of female build leaders. Four of our robot build leaders, in the groups for ball storage, the shooter, the climber, and the bumpers, are girls. Girls also lead our graphics, strategy, and Chairman's Award submission groups.

Exhibitors at Our Recent FLL Maker Fairs

- *Brandeis Maker Lab*
- *Code Ninjas*
- *Einstein's Workshop*
- *Empow Studios*
- *Gamewright*
- *Green Newton*
- *Hatch Makerspace*
- *IRobot*
- *Johnson String Instrument*
- *Made@MassChallenge*
- *Massachusetts National Guard*
- *MassBay Community College STEM*
- *Microsoft*
- *New Art Center*
- *New England Model Engineering Society*
- *New England Optical Association of America*
- *New England R2 Builders*
- *Newton Free Library*
- *NuVu*
- *Orimagi.io*
- *Prospect Hill Forge*
- *Rise Robotics*
- *Robosall*
- *Russian School of Math*
- *SharkNinja*
- *Society of Women Engineers*
- *Star Wars 501st Legion*
- *Students for a Greener World*
- *Woobo.io*
- *LigerBots STEAM activities*

Girl Scouts at the FLL E. MA Championship maker fair with: Row 1: Kevin Osborne, Maker; Gamewright. Row 2: Code Ninjas; Newton Free Library. Row 3: Code Ninjas; LigerBots slime. Row 4: Johnson String Instrument; Hatch Makerspace.

LigerBots Engage with Our Community

The LigerBots have three goals for our outreach: to spread the messages of FIRST; to promote project-based learning; and to give team members experience in sharing STEM ideas with the community. Students learn to communicate the messages of FIRST by practicing giving speeches and presenting them at outreach events.

We take our project-based STEM activities for children and informational flyers about these activities to outreach events. These include brush bots, origami, paper airplanes, slime, binary beads, spool racers, mini light sabers, and needle compasses, among others.

In typical years we run or attend an average of 28 outreach events. Even during the 2020/21 and 2021/22 academic years, which were profoundly changed by Covid-19, we averaged eight events each year. These ranged from bigger community events like the Boston GreenFest to smaller gatherings like our online Scratch hackathon for younger students.

We also regularly assist with Newton Inspires, an annual fundraiser for the Newton Schools Foundation (NSF). Accomplished people in Newton come to talk and learn about the growth and innovation going on in our community. Helping with Newton Inspires helps us maintain a strong relationship with NSF, our parent organization and one of our biggest supporters.

Newton Memorial Day parade.

Closewise from top left: visit to the Field School of Weston; Boston GreenFest; MIT IDE Inclusive Innovation Awards; Electronic Components Industry Association (ECIA) conference; Tour de Newton; Newton Pumpkin Smash.

LigerBots Do Outreach Everywhere!

Events with LigerBots Sponsors

- *Whole Foods/Newton Schools Foundation fundraiser*
- *PTC LiveWorx*
- *Robo Madness, at Google*
- *Sponsor pitch at Fowler High Precision*
- *Sponsor pitch at OneShield*

LigerBots and FIRST Events

- *Girls + Tools Night*
- *FLL Info Night*
- *Newton FLL Qualifier + maker fair*
- *Eastern MA FLL Championship + maker fair*
- *Mentoring FRC 6740, Glue Gun & Glitter*
- *Assisting Newton's Law of Mass FTC team*
- *Field trip to the Museum of Science and Industry*
- *Field trip to studio of maker Todd Cahill*

School Events

- *Just Think! Expo*
- *Newton North and South club fairs*
- *Women in STEM Day at Newton North*
- *Newton South High School parents' night*
- *Newton South science department open house*
- *Bowen Elementary School science day*
- *Cabot Elementary School Invention Invasion*
- *Weston Field School robot demo*
- *Burr Elementary School STEAM fair*

Government Relations

- *FIRST National Advocacy Conference*
- *Southern New England Advocacy Conference*
- *Mayoral candidate visits to our workshop*

Community Events

- *Newtonville and Newton Highlands village days*
- *Newton Inspires*
- *Newton/Needham Innovation District maker space talks*
- *Cambridge Carnival and Robot Zoo*
- *Newton Festival of the Arts*
- *Boston STEM Fair*
- *Pumpkin Smash*
- *Flag planting at Newton Veterans Memorial*
- *Newton Memorial Day parade*
- *Tour de Newton*
- *Newton Free Library STEAM Expo*
- *Newton Free Library Think Big girls' STEM event*
- *Talk at a retirement community*
- *Demo at Cub Scout meeting*
- *Girl Scouts STEAM patch workshop*
- *Girl Up Boston Coalition Steminist Saturday*
- *Boston Greenfest*
- *Newton Green Expo*
- *WaterFire Moon Landing 50th Anniversary*

Tech Events

- *Booz Allen Ideas Festival*
- *Electronic Components Industry Association events*
- *MA STEM Summit*
- *Robotica*
- *Robo Madness*
- *From Global to Local MIT education conference*
- *MIT IDE Inclusive Innovation Awards*
- *MIT Blueprint high school hackathon*

Row 1: visit to the Field School of Weston; Newtonville Village Day. Row 2: Burr Elementary School STEAM fair; MIT IDE Inclusive Innovation Awards. Row 3: Tour de Newton; Electronic Components Industry Association (ECIA) conference.

LIGERBOTS OUTREACH FLYER (FRONT)

LIGERBOTS
FIRST Robotics Team 2877
Newton North and South High Schools

140 Brandeis Road, Newton Centre, MA 02459
info@ligerbots.org ▪ www.ligerbots.org
#FRC2877 ▪ The LigerBots
@ligerbots ▪ @ligerbots_frc2877

About the LigerBots

The LigerBots is FIRST Robotics Competition (FRC) team 2877. FIRST ("For Inspiration and Recognition of Science and Technology") is an international organizer of competitive robotics events whose mission is to lead students toward careers in science, technology, engineering and mathematics (STEM). The LigerBots is a non-profit organization that provides students with the skills they need to prepare for the jobs of the future and become the next generation of engineers and business people. The team combines students from Newton North and Newton South high schools to spread the message of STEM education in the community and help students develop their problem solving and critical thinking skills while they pursue their interests in business and robotics.

LigerBots do intensive technical and outreach training each fall, and have six weeks each winter to build a 120-lb. robot that can compete in the spring in a new game designed by FIRST each year. The LigerBots pride ourselves on our dedicated student leadership infrastructure and variety of mentors, who include scientists, engineers, programmers, marketers, publicists, financial consultants, project managers, and graphic designers. The team's ability to offer these opportunities to high school students is dependent on its generous sponsors. The LigerBots is always looking for new sponsors and donors to help sustain the team. Major sponsors are identified on all LigerBots materials, including marketing documents, the competition pit, the website, and the robot itself.

Sponsor or donate to the LigerBots: ***info@ligerbots.org, www.ligerbots.org***

The LigerBots at the 2020 Northern Connecticut District Event.

Find out how to sponsor us!
ligerbots.org/sponsor-us

Check out our team sponsors!
ligerbots.org/current-sponsors

LIGERBOTS OUTREACH FLYER (BACK)

LIGERBOTS
FIRST Robotics Team 2877
Newton North and South High Schools

140 Brandeis Road, Newton Centre, MA 02459
info@ligerbots.org ▪ www.ligerbots.org
#FRC2877 ▪ The LigerBots
@ligerbots ▪ @ligerbots_frc2877

Be a LigerBot, Mentor a LigerBot

Who is on Our Team

- We are composed of students from Newton North and Newton South high schools.
- We have adult mentors and coaches, including parents of team members and other STEM and business professionals. We are always looking for adult mentors who have expertise in mechanical and electrical engineering, programming, marketing, publicity, finance, project management, and graphics.

LigerBot and mentor work on mock playing field elements.

Our Role in FIRST Robotics

- We design and build a robot with a different function every year, and participate in two to four FIRST competitions.
- We have made it four times to the FIRST World Championship, including in 2018.
- We organize the Newton FLL Qualifier and the Eastern MA FLL State Championship for elementary and middle school students, and we mentor FLL teams.

FIRST Opportunities for Younger Students

- FIRST Lego League (FLL) is robotics for students in grades 4 – 8. Email: fll@ligerbots.org
- FIRST Lego League Jr. is for students in grades 1 – 3. Website: www.juniorfirstlegoleague.org

Be a LigerBot, mentor a LigerBot: ***info@ligerbots.org, www.ligerbots.org***

The 2020 pit crew with Perses, the LigerBots 2020 robot.

The Engineering and Business Skills We Learn

- Mechanical engineering
- Electrical engineering
- Programming
- Computer Aided Design
- Gracious Professionalism
- Entrepreneurship
- Finance
- Time management
- Leadership
- Teamwork
- Event planning
- Public speaking
- Graphic design
- Writing
- Mentorship

The Rhythm of Our Year

- Fall and late spring: Pre- and post-season. We plan projects, do team-building, technical training, fundraising, and STEAM outreach. Team meetings at Newton North High School on Mondays 6:30 p.m., and at Newton South High School on Thursdays at 6:30 p.m.
- Winter: "Build" season. We design and build a robot from Jan. – Feb. Meetings Mon. – Sat. at Newton South High School
- Spring: Competition season. We compete against other FIRST Robotics teams with our robot, weekends in March and April.

LigerBots Awesome Mentorship Program

As businesses closed, schools shut down, and life came to a sudden and shocking halt in March of 2020 due to Covid-19, the LigerBots came up with an idea to run a distance-learning program that paired elementary school students with high school students so they could do activities together. We felt this would help both the high school students looking for volunteer opportunities and elementary school students bored at home. We called this project the Awesome Mentorship Program (AMP).

After the success of our spring program, we decided to develop a summer camp based on AMP, cAMP. cAMP ran for three two-week sessions, and by the end of August the AMP and cAMP programs had connected more than 200 elementary school students with 100 high school volunteers. To share our experience, we wrote a white paper about cAMP that was featured in the *Boston Globe!*

To find mentees, we promoted the program through the NewtonSTEM.org newsletter and the Newton Parents Facebook group. To find interested mentors, we made social media ads, persuaded friend groups to share the program through word-of-mouth, and promoted the program through high school vice principals. Non-LigerBots students went through a vetting process to determine if the mentors were responsible and enthusiastic. Once paired, the students worked together remotely on many different activities, including science experiments like elephant toothpaste, programming through Scratch, and playing Minecraft.

To support the mentors, LigerBots hosted mentor training sessions, created a mentor manual with activity suggestions, and made a Discord server to help mentors support each other and play Minecraft together with mentees.

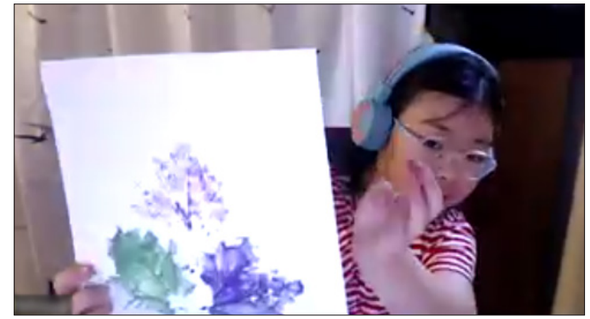
As we developed our AMP program, our team members quickly became expert project planners and troubleshooters. In order to create schedules that would make both campers and counselors happy, we spent 100 hours creating a custom Google Sheet script. When we had trouble getting materials to campers, we came up with a distribution system that involved parent pick-up from a central location. When certain campers needed extra help or space, we came up with Zoom quiet breakout rooms and counselors dedicated to assisting special-needs students.

But the biggest challenge was creating a fun, safe, and engaging community despite being in a remote environment. Kahoot, ice breakers, and cAMP-branded shirts that were sold to counselors and campers helped create a sense of community. Constructing smaller groups that worked together on projects was also key; keeping these groups small sparked conversations and built trust. A final showcase ended each two week session and provided a final bonding event for a community that had already become quite close.

Despite the giant undertaking, cAMP and AMP provided a wonderful experience for our student administrators, mentors, counselors, and campers. Administrators and counselors left with an appreciation for the difficulties their own teachers faced when teaching remotely, and campers received the close knit community they needed during the pandemic.

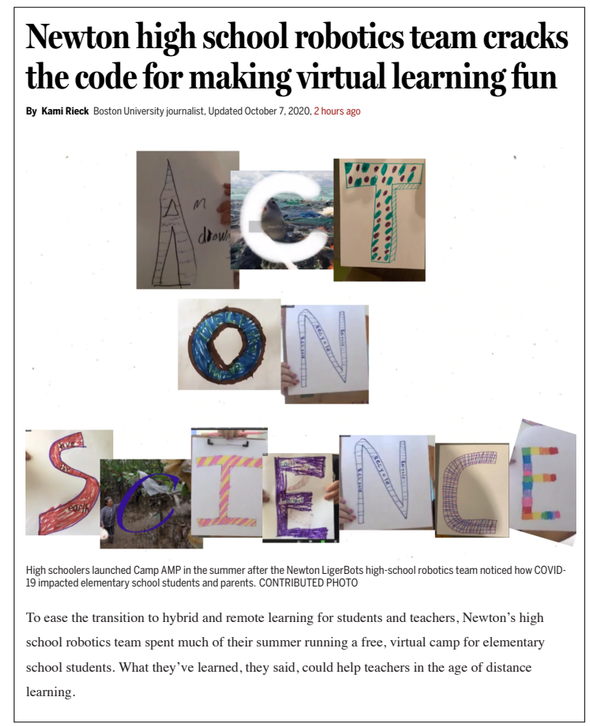
Some Classes Offered During cAMP

- *Song writing*
- *Undersea exploration*
- *Greek mythology*
- *Dungeons and Dragons*
- *TV media*
- *Mythical creatures*
- *Spaceflight, rocketry, and astronomy*
- *Climate and environmental science*
- *Thematic map making*
- *Pencil code*



	Monday	Tuesday	Wednesday	Thurday	Friday
9:00 - 9:25	Morning Meeting	Morning Meeting	Morning Meeting	Morning Meeting	Morning Meeting
9:25 - 10:20	Activity A	Activity B	Activity A	Activity B	Activity A
10:20 - 10:30	Break time	Break time	Break time	Break time	Break time
10:30 - 11:25	Activity B	Activity D	Activity C	Activity C	Activity D
11:25 - 11:35	Break time	Break time	Break time	Break time	Break time
11:35 - 12:30	Activity C	Activity E	Activity D	Activity E	Activity E

	Monday
9:00 - 9:25	Morning Meeting
9:25 - 10:20	Math - Eric Y & Karen T
	Science - Idan M & Belle S(TA)
	Geography - Alex K
	Reading - Danielle B & Giuliana R
	Biology - Henry C
	Thematic Mapmaking - Zoe K
10:20 - 10:30	Break time
10:30 - 11:25	Dance - Kat M & Natasha L
	Math - Audrey K & Abby Z
	Math - Tal E & Michael-David N
	English - Scott P
	Creative Writing - Avery W
	Math - Ruchik T
11:25 - 11:35	Break time
11:35 - 12:30	Art - Rebecca Y & Nicole W
	Mythical Creatures- Claudia & Anson
	Science - Sebastian Y & Asa Z
	Math - Jolie L
	Greek Mythology - Rose G
	Engineering - Tony F



Newton high school robotics team cracks the code for making virtual learning fun

By **Kami Rieck** Boston University journalist, Updated October 7, 2020, 2 hours ago

High schoolers launched Camp AMP in the summer after the Newton LigerBots high-school robotics team noticed how COVID-19 impacted elementary school students and parents. CONTRIBUTED PHOTO

To ease the transition to hybrid and remote learning for students and teachers, Newton's high school robotics team spent much of their summer running a free, virtual camp for elementary school students. What they've learned, they said, could help teachers in the age of distance learning.

Row 1: camper holding up a painting to the camera; cAMP-branded t-shirt. Row 2: general weekly schedule for all sessions; Monday schedule from the session three master schedule. Row 3: beginning of the Boston Globe *article; Instagram ad advertising AMP Fall 2020.*

LigerBots Connect with Our Government

We connect regularly with government officials to advocate for our team and for STEM learning.

During the Newton mayoral election in 2016 the LigerBots workshop became a stop on every candidate's campaign trail. Newton Mayor Ruthanne Fuller became a LigerBots fan, driving our robot at outreach events and inviting us to her office to celebrate a successful season. We regularly email with members of the city council and also take part in community events such as the annual Memorial Day parade.

Our influence reaches Beacon Hill and Capitol Hill. This year we met with Massachusetts state senator Cynthia Creem, and with state representatives John Lawn, Kay Khan, and Ruth Balser.

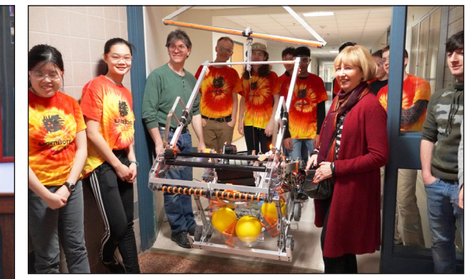
At the federal level, we played a crucial part in passing Act H. R.500, which directs the Department of the Treasury to mint and issue 350,000 $1 silver coins in commemoration of Space Shuttle Challenger astronaut Christa McAuliffe. In the summer of 2018 we worked with 25 teams at the FIRST National Advocacy Conference in Washington D.C., advocating successfully for the reauthorization of the Perkins Act, as well as for fully funding the allocation for the Every Student Succeeds Act. These provide funding for STEM education in schools around the country. We lobbied the offices of Senator Warren, Senator Markey, and Representative Capuano, and talked directly to Representative Kennedy.

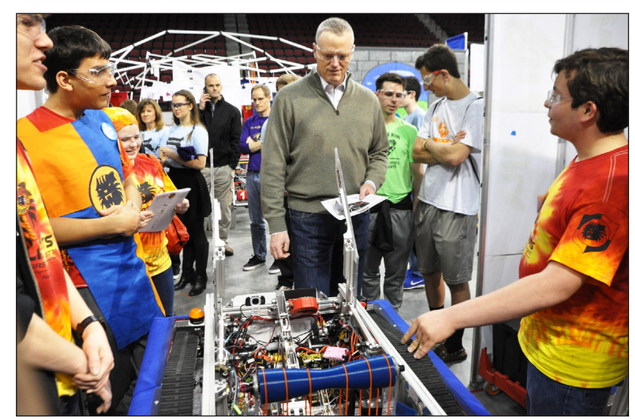
As active members of the FIRST Southern New England Advocacy Conference we contributed to the effort to pass Massachusetts Amendment #238, which would have given FIRST teams 250k total in Massachusetts state funds.

Our elected officials share in our successes. Newton School committee member Matthew Miller responded to our FIRST safety animation award, "Your video was well done, and the execution was insanely creative. I have always been a huge LigerBots fan. Keep on making Newton proud. You all ROCK!!!"

From training to FLL, everything we embark on ensures that the LigerBots remain the core of project-based learning in Newton and an advocate for STEM throughout the country.

FIRST Robotics teams at the 2018 National STEM Advocacy Conference in Washington, D.C. The LigerBots are at the left in the middle of the group.





Row 1: with MA representative Joe Kennedy, III at the 2018 National STEM Advocacy Conference in Washington, D.C.. Row 2: with Massachusetts state representative Ruth Balser at the Massachusetts State House during the FIRST 2019 Southern New England Advocacy Conference; Massachusetts state senator Cynthia Creem views our 2020 robot in our workshop. Row 3: Massachusetts governor Charlie Baker gets an explanation the LigerBots pit during a Boston University FRC competition; Newton mayor Ruthanne Fuller drives the LigerBots robot at the Just Think Expo.

LigerBots Are in the Public Media

LigerBots train our team members in how publicize team activities and events by practicing "elevator pitches" about the team, learning how to interview and be interviewed, and how to write press releases and blog posts.

LigerBots has been featured in the in the *Boston Globe* and and in the *Newton TAB*. The NewtonSTEM.org newsletter has posted more than 85 articles about the team since 2015. We have also been interviewed by TES, one of the largest teacher publications in the world. We maintain regular updates on social media channels and our website blog.

In 2022 the LigerBots started a public blog about our robot build progress on the Open Alliance, a section of the FIRST Robotics discussion form Chief Delphi that is intended to help FIRST Robotics teams share their ideas openly. By publishing CAD, pictures, videos, and documentation, we help other teams learn from our accomplishments and setbacks. Our blog has been viewed more than 3,000 times.

Newton high school robotics team cracks the code for making virtual learning fun

By **Kami Rieck** Boston University journalist, Updated October 7, 2020, 3:48 p.m.

High schoolers launched Camp AMP in the summer after the Newton LigerBots high-school robotics team noticed how COVID-19 impacted elementary school students and parents. CONTRIBUTED PHOTO

To ease the transition to hybrid and remote learning for students and teachers, Newton's high school robotics team spent much of their summer running a free, virtual camp for elementary school students. What they've learned, they said, could help teachers in the age of distance learning.

The high schoolers launched Camp AMP in the summer after the Newton LigerBots high-school robotics team noticed how COVID-19 impacted elementary school students and parents. The free, virtual camp ran from July to August for students who entered first through sixth grade — the majority of participants were Newton students and a few attended from out of state — but the lessons learned over Zoom extended beyond the summer.

"I had to put myself in the shoes of a third-grader who is sitting at a computer at home and wants to be told a story," Skyler Bohnert, a Newton North High School senior who taught a history class at the camp, said. "They don't want to be lectured at, they don't want to take a test, but they want to be involved in a conversation about something they find interesting."

Kavya Ajaykumar, a sophomore at Newton North High School and a co-founder of Camp AMP, said background noises and technological challenges can make it difficult for students to speak naturally to their classmates and teacher over Zoom and socialize with each other and feel a sense of community.

Ajaykumar said they staffed Camp AMP entirely with high school students because they had firsthand experience of abruptly transitioning to online learning when schools closed in March. Focusing on facilitated class discussions and hands-on projects, Camp AMP aimed to build a supportive community and keep elementary schoolers learning.

"I think people, in general, are dependent on having a community of people to socialize and feel comfortable with," Ajaykumar said.

Camp administrators created and monitored "quiet" and "help" Zoom meeting rooms for students who might have fallen behind in their session or become frustrated during the camp. The students could move to one of the designated rooms, and the administrators would talk, play a game, or sit with them.

To inspire communities across the globe, LigerBots now is producing a white paper on the creation of Camp AMP. The high schoolers plan to share the paper with FIRST, an international high school robotics community, and also enter it into the first round of the group's competition, where they could potentially compete internationally. The white paper will include things such as staff and student recruitment, marketing, and building the structure from the ground up. Ajaykumar said she hopes their paper will help other FIRST teams launch similar programs in their communities.

As part of Camp AMP the high school students taught a variety of classes to elementary school students, including Greek mythology, mythical creatures, and art, among others. Nicole Weng, a senior at Newton South High School, said she prepared art lessons and taught participants how to finger paint flowers and make origami airplanes.

"I would tell them to hold up their materials so I could see they had it and really just take them along," Weng said. "The goal of the art class was not to force them into art, but make it so they like the activity and have fun."

Hunter Morton, a second-grader in Newton, is typically reserved in group settings, his mom, Sarah Morton, said, but he formed a strong connection with Weng during camp, playing Pokémon pictionary and chatting one-on-one after each art class. By the end of his first class, Weng said Hunter appeared more comfortable with her, speaking up and confidently asking questions.

"I felt delighted, I felt proud of Hunter, actually, because I saw he finally could ask questions and stand up for himself," Weng said.

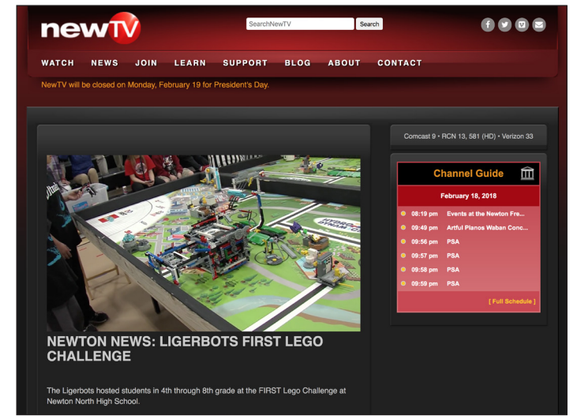
Weng said she has advice for teachers hoping to build a bond with students in the age of distance learning. One-on-one Zoom meetings allow teachers to know their students better, she said, and they also might give students the opportunity to say things they would not feel comfortable sharing in a group setting.

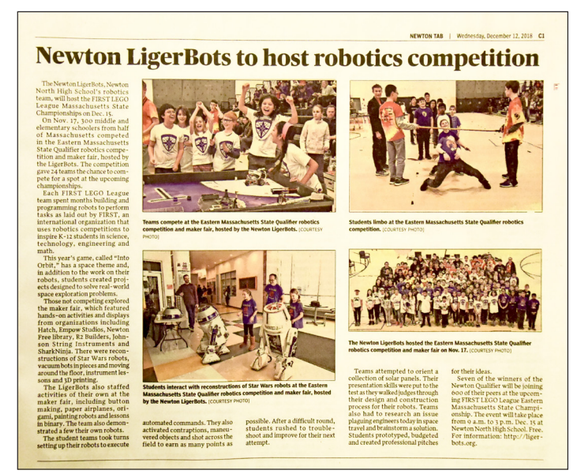
Another piece of advice, she said, is to target a shared interest between the student and teacher and go the extra mile to learn more about it. In Weng's case, she lacked any knowledge about Pokémon prior to the pictionary game with Hunter but researched various characters and trading cards to show her interest.

"Finding a common interest is the most important thing — and just trying to understand that a kid won't always follow what you'll do," Weng said.

Kami Rieck can be reached at newtonreport@globe.com.

Boston Globe *article about the LigerBots AMP and cAMP program.*





NEWTON TAB | Wednesday, December 12, 2018 C1

Newton LigerBots to host robotics competition

The Newton LigerBots, Newton North High School's robotics team, will host the FIRST LEGO League Massachusetts State Championships on Dec. 15.

On Nov. 17, 300 middle and elementary schoolers from half of Massachusetts competed in the Eastern Massachusetts State Qualifier robotics competition and maker fair, hosted by the LigerBots. The competition gave 24 teams the chance to compete for a spot at the upcoming championships.

Each FIRST LEGO League team spent months building and programming robots to perform tasks as laid out by FIRST, an international organization that uses robotics competitions to inspire K-12 students in science, technology, engineering and math.

This year's game, called "Into Orbit," has a space theme and, in addition to the work on their robots, students created projects designed to solve real-world space exploration problems.

Those not competing explored the maker fair, which featured hands-on activities and displays from organizations including Hatch, Empow Studios, Newton Free library, R2 Builders, Johnson String Instruments and SharkNinja. There were reconstructions of Star Wars robots, vacuum bots in pieces and moving around the floor, instrument lessons and 3D printing.

The LigerBots also staffed activities of their own at the maker fair, including button making, paper airplanes, origami, painting robots and lessons in binary. The team also demonstrated a few their own robots.

The student teams took turns setting up their robots to execute automated commands. They also activated contraptions, maneuvered objects and shot across the field to earn as many points as possible. After a difficult round, students rushed to troubleshoot and improve for their next attempt.

Teams attempted to orient a collection of solar panels. Their presentation skills were put to the test as they walked judges through their design and construction process for their robots. Teams also had to research an issue plaguing engineers today in space travel and brainstorm a solution. Students prototyped, budgeted and created professional pitches for their ideas.

Seven of the winners of the Newton Qualifier will be joining 600 of their peers at the upcoming FIRST LEGO League Eastern Massachusetts State Championship. The event will take place from 9 a.m. to 3 p.m. Dec. 15 at Newton North High School. Free. For information: http://ligerbots.org.

Teams compete at the Eastern Massachusetts State Qualifier robotics competition and maker fair, hosted by the Newton LigerBots. (COURTESY PHOTO)

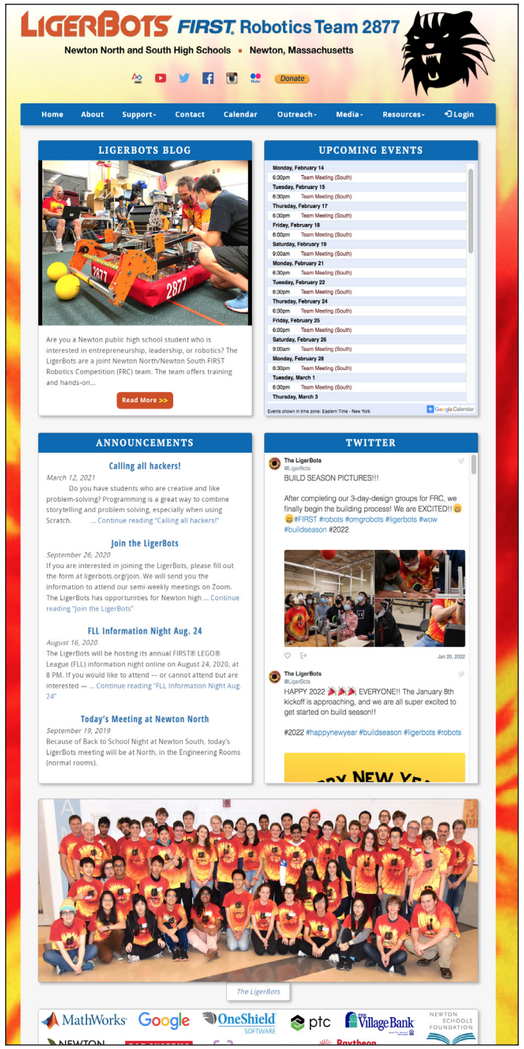
Students limbo at the Eastern Massachusetts State Qualifier robotics competition. (COURTESY PHOTO)

Students interact with reconstructions of Star Wars robots at the Eastern Massachusetts State Qualifier robotics competition and maker fair, hosted by the Newton LigerBots. (COURTESY PHOTO)

The Newton LigerBots hosted the Eastern Massachusetts State Qualifier robotics competition and maker fair on Nov. 17. (COURTESY PHOTO)

Clockwise from upper left: NewTV reporter interviews LigerBots at Just Think Expo; story about the FIRST LEGO League E. MA Championship on the NewtonSTEM.org website; David Pogue of PBS series NOVA *interviews LigerBots at the PTC LiveWorx conference; LigerBots in the Newton TAB; NewTV story about the FLL Eastern MA State Championship.*

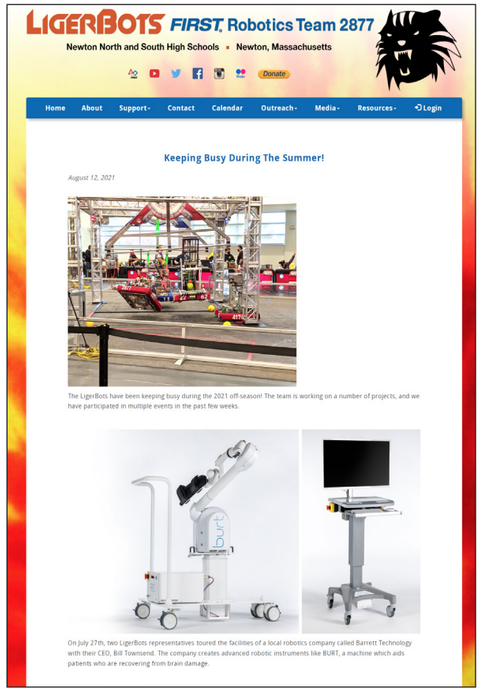
LigerBots Create Our Own Media



LigerBots website home page.

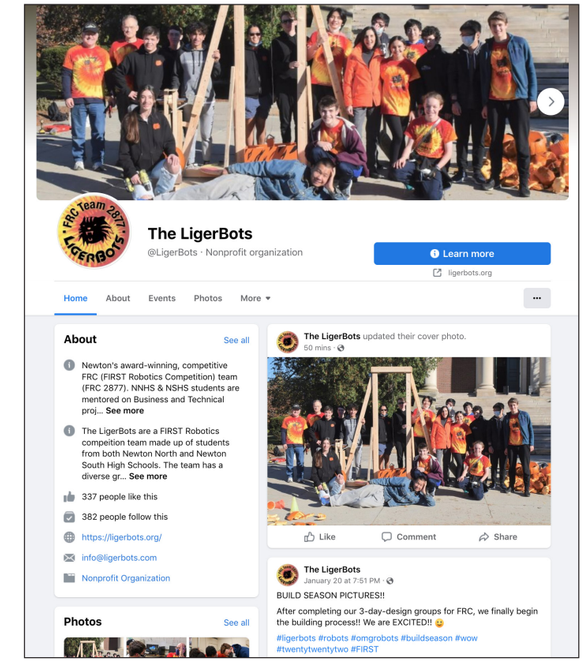
LigerBots Media

- *Website blog posts*
- *Press releases*
- *Media interviews*
- *TED Talks*
- *Twitter*
- *Facebook*
- *Flickr photo album sharing*
- *YouTube videos*
- *Supporter updates*
- *Chief Delphi*
- *Printed marketing and outreach materials*



Part of a blog post.

LigerBots Instagram page.



LigerBots Facebook page.

LigerBots Twitter feed.

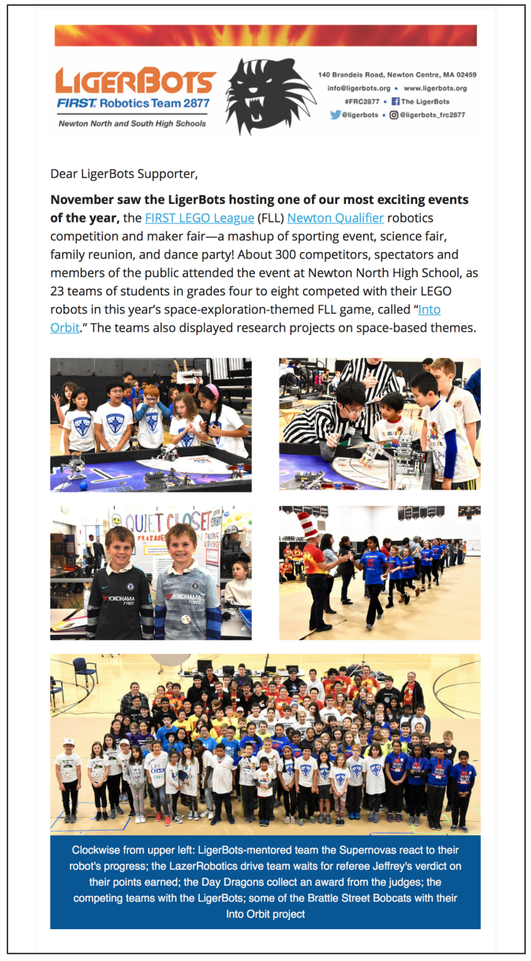
LigerBots Connect with Our Sponsors

In order to sustain our robotics ventures, our extra projects, and outreach events, the LigerBots rely on support from our sponsors. We train students, both business-focused and technical-focused, on how to build and manage sponsor relationships. We run an annual training session in making a brief "elevator pitch" about the team. And we write a monthly supporter update with detailed descriptions of team activities over the past month, complete with photos of these activities.

An important part of our sponsor relations is students having direct relationships with individual sponsors. This involves both emailing contacts and giving pitches face-to-face.

LigerBot practices her elevator pitches with another team member

LigerBots make a pitch to win over new sponsor OneSheild.



LIGERBOTS
FIRST Robotics Team 2877
Newton North and South High Schools

140 Brandeis Road, Newton Centre, MA 02459
info@ligerbots.org • www.ligerbots.org
#FRC2877 • The LigerBots
@ligerbots • @ligerbots_frc2877

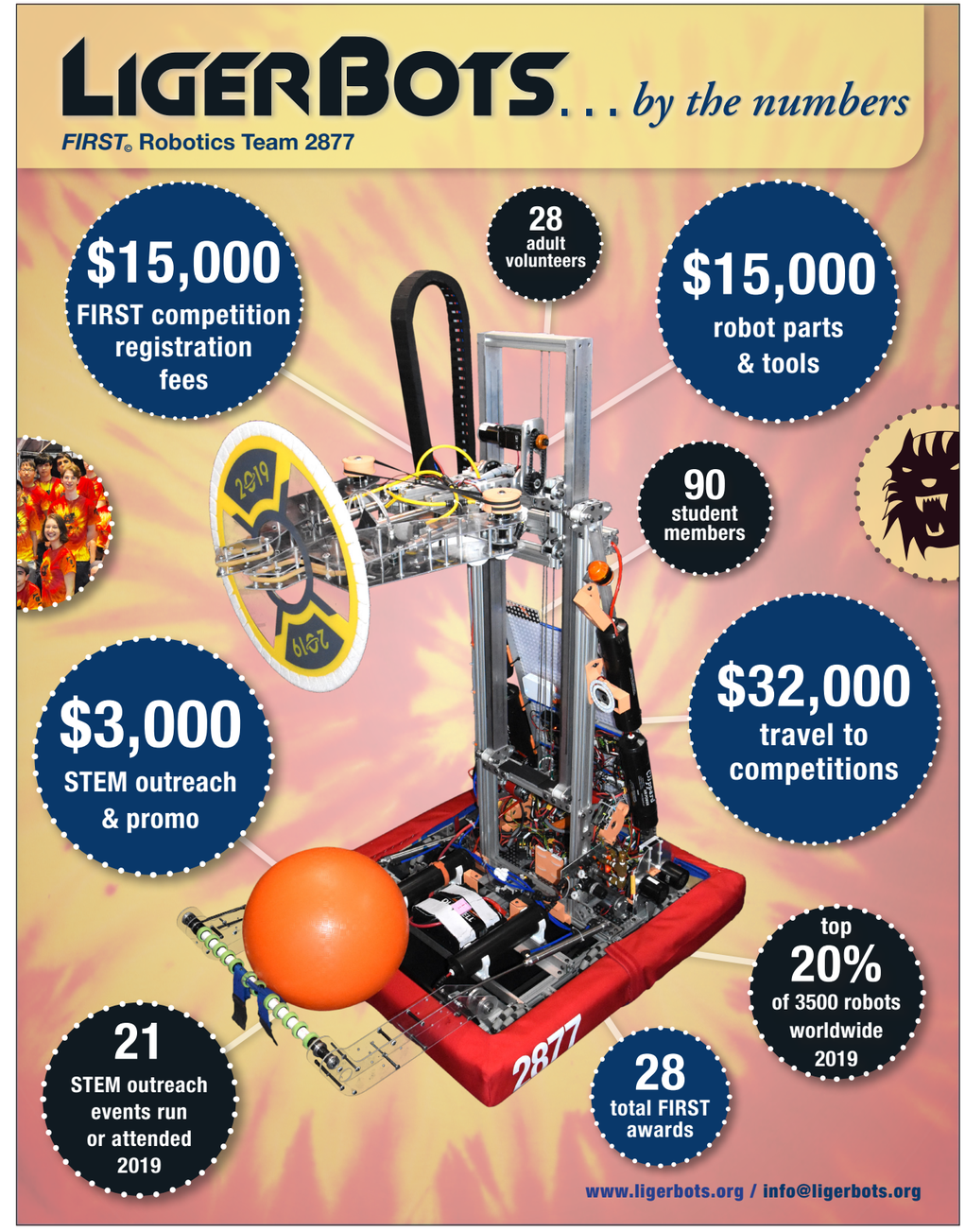
Dear LigerBots Supporter,

November saw the LigerBots hosting one of our most exciting events of the year, the FIRST LEGO League (FLL) Newton Qualifier robotics competition and maker fair—a mashup of sporting event, science fair, family reunion, and dance party! About 300 competitors, spectators and members of the public attended the event at Newton North High School, as 23 teams of students in grades four to eight competed with their LEGO robots in this year's space-exploration-themed FLL game, called "Into Orbit." The teams also displayed research projects on space-based themes.

Clockwise from upper left: LigerBots-mentored team the Supernovas react to their robot's progress; the LazerRobotics drive team waits for referee Jeffrey's verdict on their points earned; the Day Dragons collect an award from the judges; the competing teams with the LigerBots; some of the Brattle Street Bobcats with their Into Orbit project

Supporter update sent via MailChimp.

LIGERBOTS FUNDRAISING INFOGRAPHIC



This infographic shows team fundraising needs in a year we go to the FRC world championship.

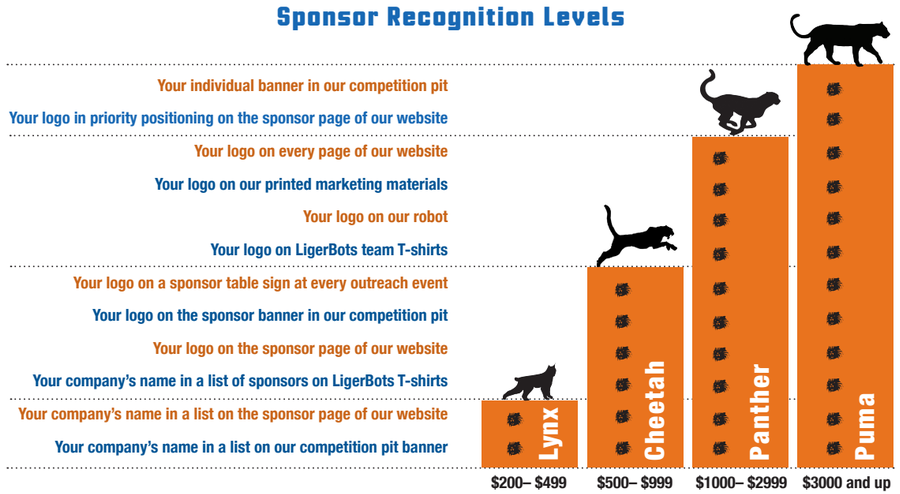
LIGERBOTS SPONSOR RECOGNITION LEVELS FLYER (FRONT)

LIGERBOTS
FIRST® Robotics Team 2877
Newton North and South High Schools

140 Brandeis Road, Newton Centre, MA 02459
info@ligerbots.org ▪ www.ligerbots.org
#FRC2877 ▪ The LigerBots
@ligerbots ▪ @ligerbots_frc2877

Support project-based learning that gives Newton students the skills they need to be contributors and leaders in technology.

Sponsor Recognition Levels



Examples of Sponsor Logos on LigerBots Materials

Left to right: team outreach flyer, 2019 t-shirt back, 2019 competition pit, 2019 robot, website sponsor page

How to Sponsor the LigerBots

To sponsor, please email the LigerBots chief marketing officer at cmo@ligerbots.org

The LigerBots, Newton's award-winning high school FIRST Robotics team

LIGERBOTS SPONSOR RECOGNITION LEVELS FLYER (BACK)

The LigerBots are proud to recognize our sponsors at every event we attend. Thousands of people will see your brand and your support for STEM learning.

The Exposure You Will Get

Educational Events We Typically Attend

- American Assoc. for the Advancement of Science annual meeting
- Boston STEM Fair
- MASS STEM Summit in Worcester, MA
- Electronic Components Industry Assoc. annual meeting
- Assoc. for Unmanned Vehicle Systems International "Robotica" conference
- Xconomy's conference "Robo Madness: AI Gets Real"
- MIT's edtech conference "From Global to Local"
- Cambridge Carnival and Robot Zoo
- Newton Mayor's STEM Night
- "Just Think!" Expo at Newton North High School
- Newton Free Library STEAM Expo
- "Newton Inspires" speaker night
- STEM promotion visits to Newton elementary schools and Cub Scout troops
- Club fairs and science open houses at Newton North and South high schools

LigerBots at the 2019 Newton Newtonville Village Day

FIRST Robotics Competitions We Typically Enter or Run

- FRC district competitions: attend two every year
- FRC New England Championship: qualified last five years
- FRC World Championship in Detroit. 30,000 attendees. LigerBots attended 2009, 2014, 2015, and 2018.
- Newton Qualifier FLL Competition, plus maker fair: run by the LigerBots, 500 attendees.
- Eastern NE FLL Championship, plus maker fair: run by the LigerBots, 900 attendees.

Community Events We Typically Attend or Run

- Newtonville Village Day
- Newton Highlands Village Day
- Newton Memorial Day Parade
- Newton Harvest Fair
- Maker Fair at Newton FLL Qualifier and E. MA FLL Championship

LigerBots at the 2019 Newton Memorial Day parade

How to Sponsor the LigerBots

To sponsor, please email the LigerBots chief marketing officer at cmo@ligerbots.org

LigerBots Fund Our Activities

2021/22 Projected Revenue

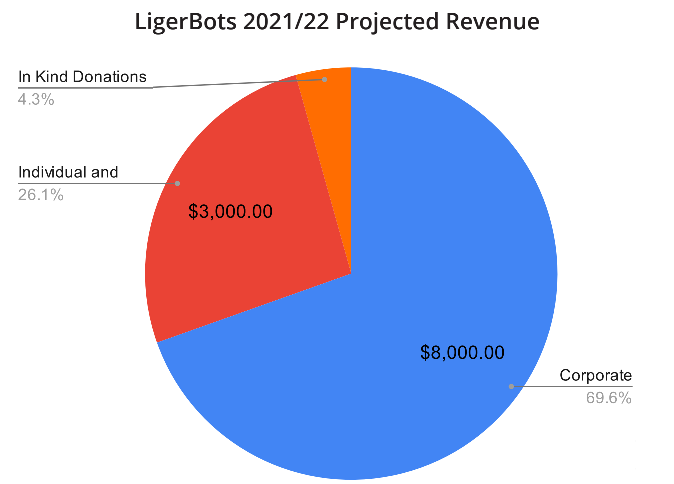
Corporate sponsorships	$8,000
Individual donations	3,000
FLL tournament net income	0
Newton Schools Foundation	0
In-kind donations	500
Transfer from team reserves	$10,100
Total revenue	$21,600
Total expenses	$21,600
Net income	**$0**

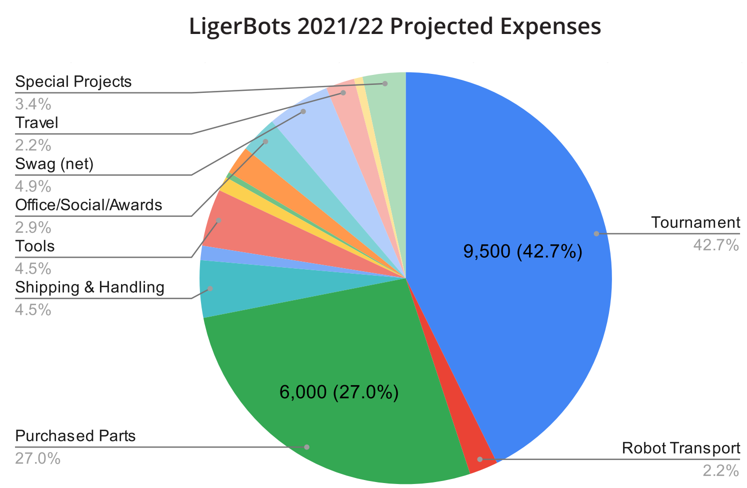
2021/22 Recurring Expenses

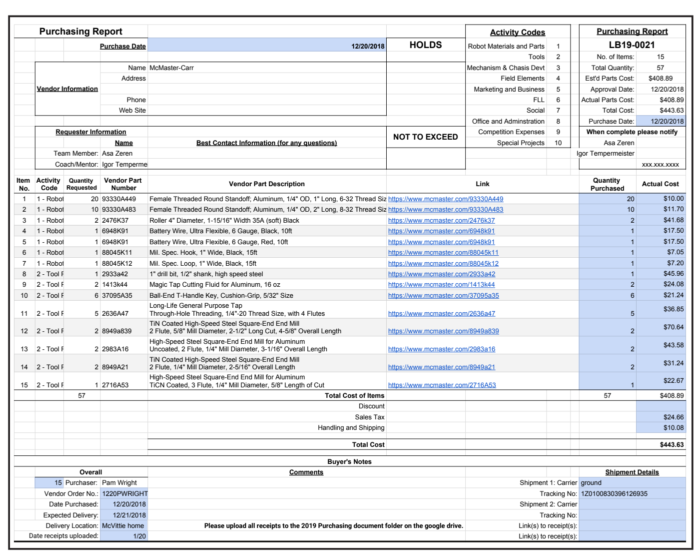
Tournament registrations	$9,500
Robot transport	500
Robot parts	
Purchased parts	6,000
Discounts	-700
Shipping and handling	1,000
Tax	250
Tools	1,000
Field elements	250
Banners and pit	150
Outreach/biz/mktg	500
Office/social/awards	650
Swag (net)	1,100
Travel	500
Printing	150
Total recurring expenses	**$20,850**

2021/22 Special Projects

Outreach bot	$150
CNC router (South)	600
Total special projects	**$750**







Purchasing Report

Purchase Date	12/20/2018	HOLDS	
Vendor Information	Name	McMaster-Carr	
	Address		
	Phone		
	Web Site		
Requester Information	Name	Best Contact Information (for any questions)	NOT TO EXCEED
	Team Member:	Asa Zeren	
	Coach/Mentor:	Igor Temperme	

Activity Codes	
Robot Materials and Parts	1
Tools	2
Mechanism & Chasis Devt	3
Field Elements	4
Marketing and Business	5
FLL	6
Social	7
Office and Adminstration	8
Competition Expenses	9
Special Projects	10

Purchasing Report	LB19-0021
No. of Items:	15
Total Quantity:	57
Est'd Parts Cost:	$408.89
Approval Date:	12/20/2018
Actual Parts Cost:	$408.89
Total Cost:	$443.63
Purchase Date:	12/20/2018
When complete please notify	
Asa Zeren	
Igor Tempermeister	xxx.xxx.xxxx

Item No.	Activity Code	Quantity Requested	Vendor Part Number	Vendor Part Description	Link	Quantity Purchased	Actual Cost
1	1 - Robot	20	93330A449	Female Threaded Round Standoff; Aluminum, 1/4" OD, 1" Long, 6-32 Thread Siz	https://www.mcmaster.com/93330A449	20	$10.00
2	1 - Robot	10	93330A483	Female Threaded Round Standoff; Aluminum, 1/4" OD, 2" Long, 8-32 Thread Siz	https://www.mcmaster.com/93330A483	10	$11.70
3	1 - Robot	2	2476K37	Roller 4" Diameter, 1-15/16" Width 35A (soft) Black	https://www.mcmaster.com/2476k37	2	$41.68
4	1 - Robot	1	6948K91	Battery Wire, Ultra Flexible, 6 Gauge, Black, 10ft	https://www.mcmaster.com/6948k91	1	$17.50
5	1 - Robot	1	6948K91	Battery Wire, Ultra Flexible, 6 Gauge, Red, 10ft	https://www.mcmaster.com/6948k91	1	$17.50
6	1 - Robot	1	88045K11	Mil. Spec. Hook, 1" Wide, Black, 15ft	https://www.mcmaster.com/88045k11	1	$7.05
7	1 - Robot	1	88045K12	Mil. Spec. Loop, 1" Wide, Black, 15ft	https://www.mcmaster.com/88045k12	1	$7.20
8	2 - Tool F	1	2933a42	1" drill bit, 1/2" shank, high speed steel	https://www.mcmaster.com/2933a42	1	$45.96
9	2 - Tool F	2	1413k44	Magic Tap Cutting Fluid for Aluminum, 16 oz	https://www.mcmaster.com/1413k44	2	$24.08
10	2 - Tool F	6	37095A35	Ball-End T-Handle Key, Cushion-Grip, 5/32" Size	https://www.mcmaster.com/37095a35	6	$21.24
11	2 - Tool F	5	2636A47	Long-Life General Purpose Tap Through-Hole Threading, 1/4"-20 Thread Size, with 4 Flutes	https://www.mcmaster.com/2636a47	5	$36.85
12	2 - Tool F	2	8949a839	TiN Coated High-Speed Steel Square-End End Mill 2 Flute, 5/8" Mill Diameter, 2-1/2" Long Cut, 4-5/8" Overall Length	https://www.mcmaster.com/8949a839	2	$70.64
13	2 - Tool F	2	2983A16	High-Speed Steel Square-End End Mill for Aluminum Uncoated, 2 Flute, 1/4" Mill Diameter, 3-1/16" Overall Length	https://www.mcmaster.com/2983a16	2	$43.58
14	2 - Tool F	2	8949A21	TiN Coated High-Speed Steel Square-End End Mill 2 Flute, 1/4" Mill Diameter, 2-5/16" Overall Length	https://www.mcmaster.com/8949a21	2	$31.24
15	2 - Tool F	1	2716A53	High-Speed Steel Square-End End Mill for Aluminum TiCN Coated, 3 Flute, 1/4" Mill Diameter, 5/8" Length of Cut	https://www.mcmaster.com/2716A53	1	$22.67
		57		Total Cost of Items		57	$408.89
				Discount			
				Sales Tax			$24.66
				Handling and Shipping			$10.08
				Total Cost			$443.63

Buyer's Notes

Overall		Comments	Shipment Details	
15 Purchaser:	Pam Wright		Shipment 1: Carrier	ground
Vendor Order No.:	1220PWRIGHT		Tracking No:	1Z0100830396126935
Date Purchased:	12/20/2018		Shipment 2: Carrier	
Expected Delivery:	12/21/2018		Tracking No:	
Delivery Location:	McVittie home	Please upload all receipts to the 2019 Purchasing document folder on the google drive.	Link(s) to receipt(s):	
Date receipts uploaded:	1/20		Link(s) to receipt(s):	

A LigerBots purchase order.

Our Mission

The LigerBots aim to become the recognized leader of project-based learning in Newton. We value creating leadership and learning opportunities for students and inspiring the community as much as we value the quest to build a winning robot.

Our Financial Plan

The team supports its activities via corporate sponsorships, individual contributions, and operating FLL competitions. We also apply for, and have received funding from the Newton Public Schools for competitions at the district level and beyond.

Our Special Projects

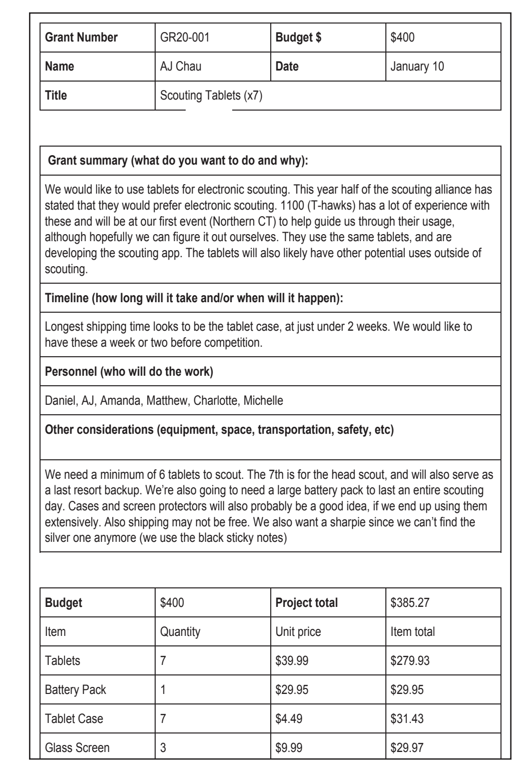
We seek to fund a budget beyond the base requirement of competition fees and robot parts. Special projects, which are funded through a "mini-grant" process, let team members develop financial skills while working on challenging and engaging projects. Any student or mentor can propose a special project. Some of our recent special projects have been:

- ***Scouting tablets:*** Purchased tablets to be used during competition to track the performance of other teams.
- ***Mars rover:*** Built a model Mars rover as an aid to learning basic design and manufacturing strategies.
- ***Swerve drive:*** Built a swerve drive train as student training project.
- ***Vision project:*** Assessed multiple cameras and processors to determine what will work best for robot vision during competition.
- ***Provisional patent application:*** Filed a provisional patent for a non-auditory whistle.
- ***CNC mill:*** Built a new CNC router to increase speed of cutting metal and polycarbonate plates.
- ***Pneumatic test bench:*** Built a test bench to help us prototype pneumatic mechanisms.
- ***Lawn signs:*** Distributed lawn signs to advertise the team during the pandemic.

Managing the budget

Our team treasurer reports weekly to the coaches and execs. Sponsorship proposals and revenue are tracked by the fundraising team. Our purchasing system allows team members to specify items for purchase and approval and our Treasurer to easily track spending. Purchase orders are shared on Slack so the entire team sees and can participate in purchasing decisions. Financial operations are overseen by our financial mentor and one of the head coaches.

Our financial mentor works with a team member on the budget.



Grant Number	GR20-001	Budget $	$400
Name	AJ Chau	Date	January 10
Title	Scouting Tablets (x7)		

Grant summary (what do you want to do and why):

We would like to use tablets for electronic scouting. This year half of the scouting alliance has stated that they would prefer electronic scouting. 1100 (T-hawks) has a lot of experience with these and will be at our first event (Northern CT) to help guide us through their usage, although hopefully we can figure it out ourselves. They use the same tablets, and are developing the scouting app. The tablets will also likely have other potential uses outside of scouting.

Timeline (how long will it take and/or when will it happen):

Longest shipping time looks to be the tablet case, at just under 2 weeks. We would like to have these a week or two before competition.

Personnel (who will do the work)

Daniel, AJ, Amanda, Matthew, Charlotte, Michelle

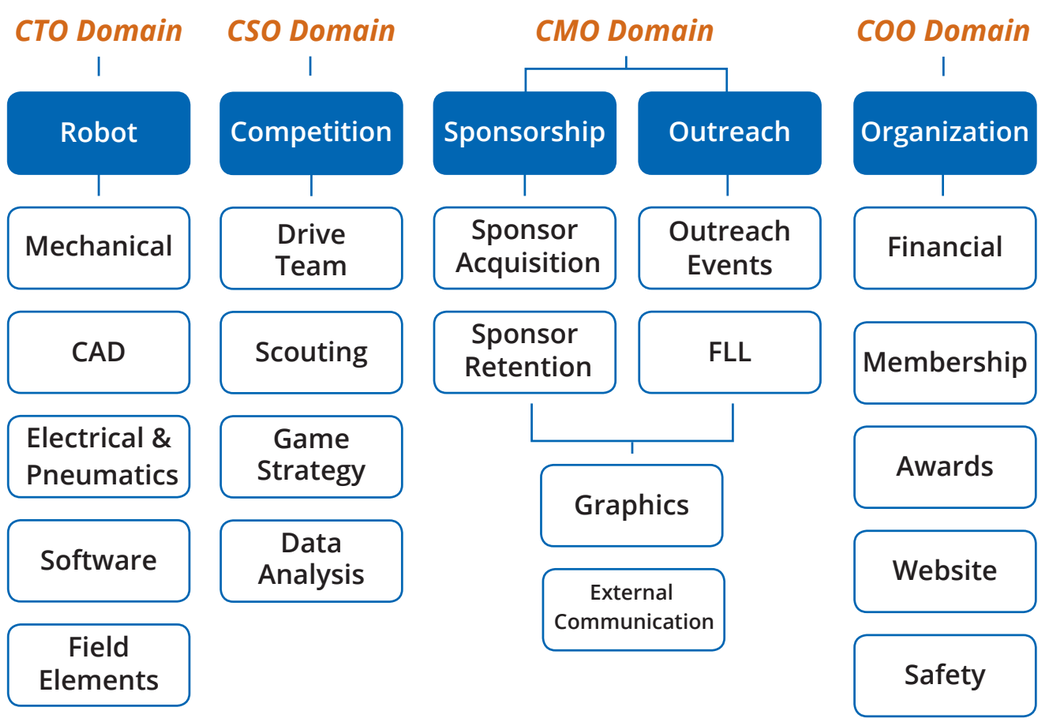
Other considerations (equipment, space, transportation, safety, etc)

We need a minimum of 6 tablets to scout. The 7th is for the head scout, and will also serve as a last resort backup. We're also going to need a large battery pack to last an entire scouting day. Cases and screen protectors will also probably be a good idea, if we end up using them extensively. Also shipping may not be free. We also want a sharpie since we can't find the silver one anymore (we use the black sticky notes)

Budget	$400	Project total	$385.27
Item	Quantity	Unit price	Item total
Tablets	7	$39.99	$279.93
Battery Pack	1	$29.95	$29.95
Tablet Case	7	$4.49	$31.43
Glass Screen	3	$9.99	$29.97

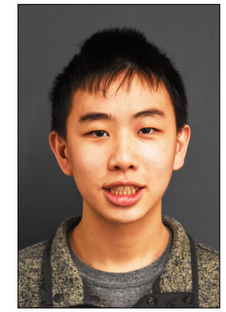
A LigerBots mini grant proposal for tablets to be used when scouting other teams at competitions.

LigerBots Student Leadership Structure



Group leaders gather in front of the task board at the end of a meeting to report on the day's progress.

How I Use My LigerBots Skills Out in the World



"While I was in the marketing group I learned a lot of organizational skills. When we host events like FLL we learn how to manage our time and be efficient with our resources."

–Davis

"Besides learning techniques in the LigerBots workshop, I have improved my writing and public speaking. Leadership opportunities that LigerBots has given me have really helped me build my confidence and my leadership skills."

–Kavya

"The skills I learned from LigerBots are using professional graphics software and learning to design websites. From those experiences, I've grown interested in web design and am considering it for my future career."

–Julie

"I have acquired the ability to show other people how to do things, both through examples and through detailed explanations."

–Jay

"I have learned presentation skills from doing LigerBots social media that I have used in my school work. I have learned to keep the information in my posts concise and to select the best pictures to represent the content that I'm trying to convey."

–Dan

"I have learned to apply a lot of skills I got from building robots to my physics courses, such as how to calculate the shooting process for the robot game piece."

–Randy

"When we are building robots everything has to be in the exact right place, and there are a lot of details to keep track of. Now, I also try to make everything detailed and precise in my schoolwork projects."

–Carolyn

"I've used the CAD I learned at LigerBots to design and build soccer-playing robots with my own 3D printer."

–Keiji

FRC Team 2877 LIGERBOTS

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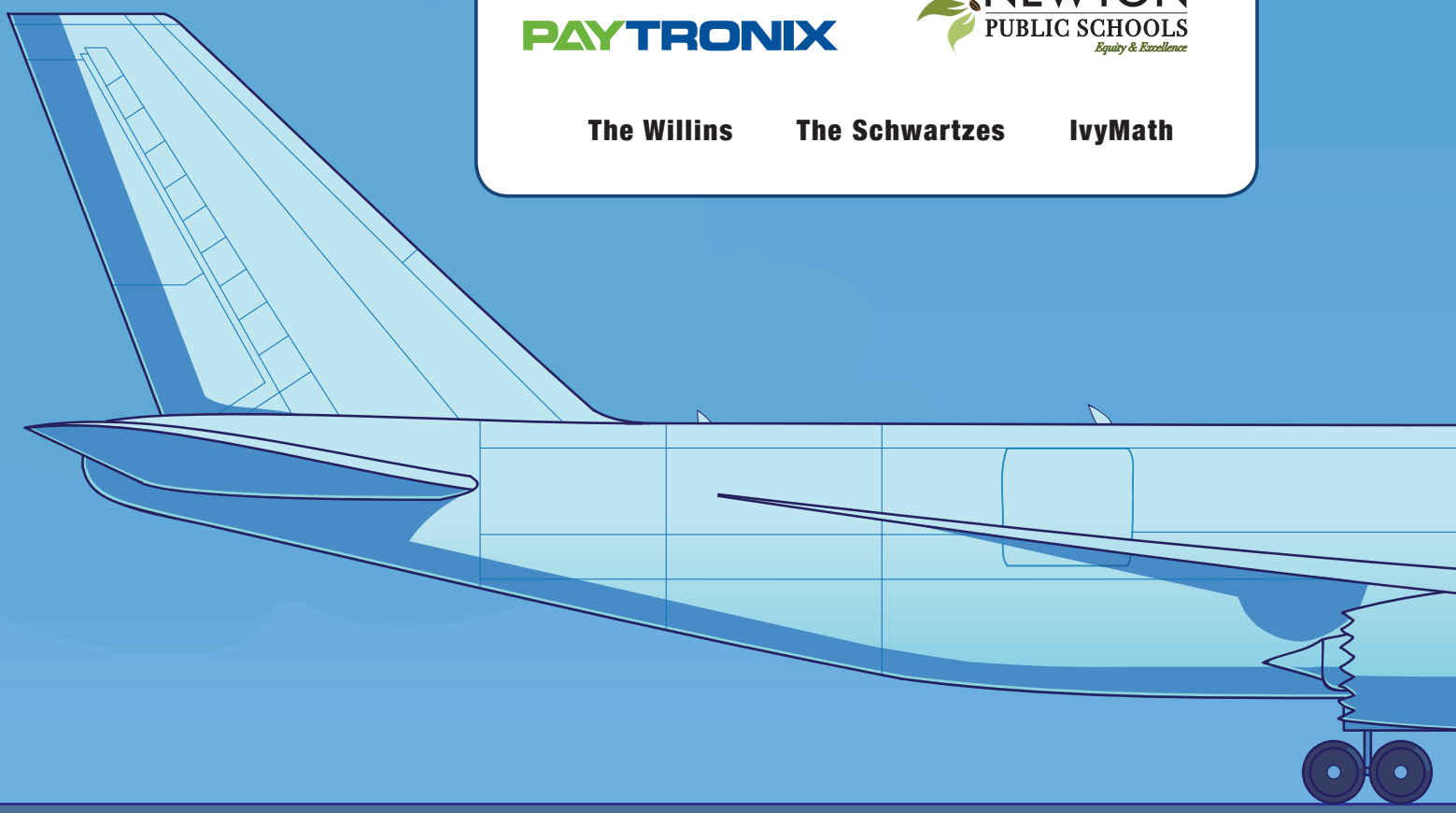
The Willins

The Schwartzes

IvyMath