The Rookie Bookie

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Table of Contents

I. Introduction

FIRST stands for For Inspiration and Recognition of Science and Technology. It is a global organization with the participation of approximately 100 countries, 615,000 students and over 72,000 teams. It consists of four programs designed for kids from elementary to high school:

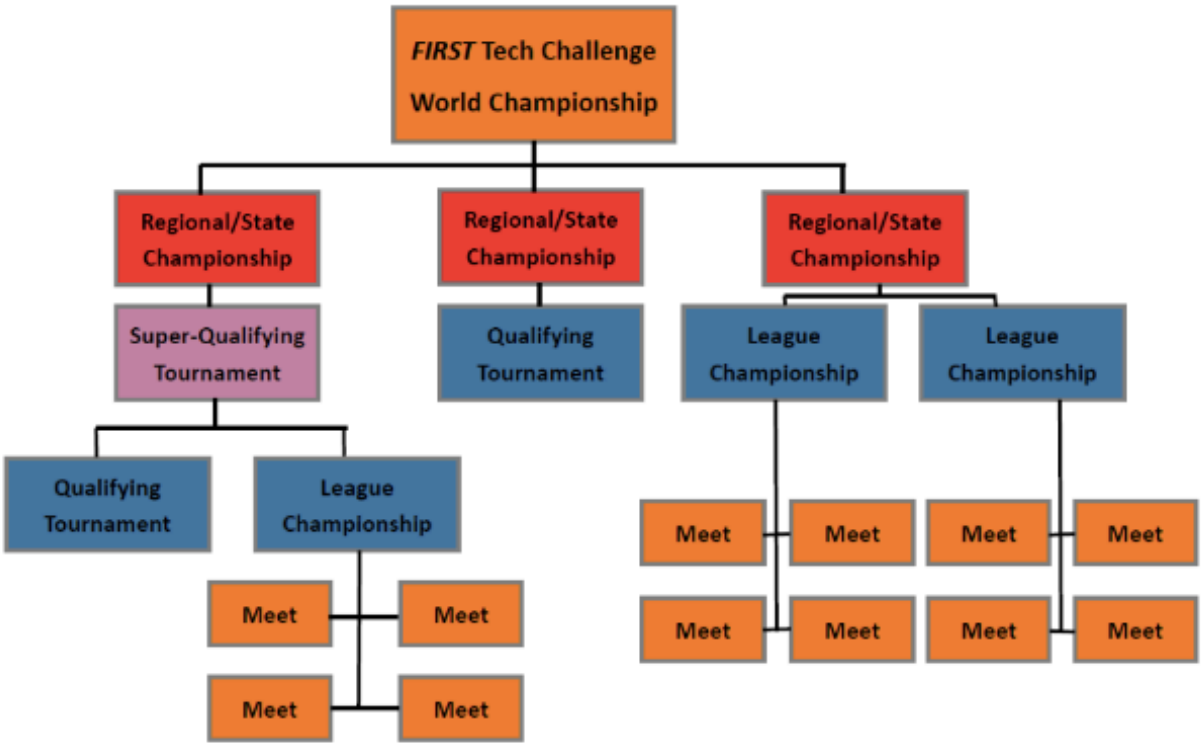
FRC - *FIRST* Robotics Competition - high school students age: 14-18
FTC - *FIRST* Tech Challenge - high school students age: 12-18
FLL - *FIRST* LEGO League - middle school students age: 9-14
FLL Jr. - *FIRST* LEGO League Junior - elementary school students age: 6-10

FIRST enables individual students to thrive in a team setting. Teams build a robot every year to execute a set of challenges set out by *FIRST*. The challenges and size of the robots vary from program to program. For FTC, the robots are 33 by 28 by 55 inches in starting position, and complete tasks on an 8 by 8 foot field. Teams must create an Engineering Notebook that documents the design process of the robot and their sustainability/business plan.

When is the FTC Season?

Registration opens in May, when teams generally prepare for the upcoming season. *FIRST* announces the season's game in September, and teams begin to build their robots. Competition season can begin as early as October, but it typically starts around November and December for qualifying competitions, and higher-level competitions continue into April. After competition season, there are off-season events where teams can strategize, hone their skills, learn new technology, meet other teams, and most importantly- have fun!

FTC Competition Structure



The flowchart above from the *FIRST* website illustrates the various ways teams advance through the competition. Depending on your region, your team's first competition can be a meet or a qualifying tournament. Some teams advance to league championships by competing at meets while others go straight to a qualifying tournament. Every team that advances from either super-qualifying, qualifying, or league championships have the opportunity to go to a regional/state championship to advance to the World Championship in either Detroit, Michigan or Houston, Texas.

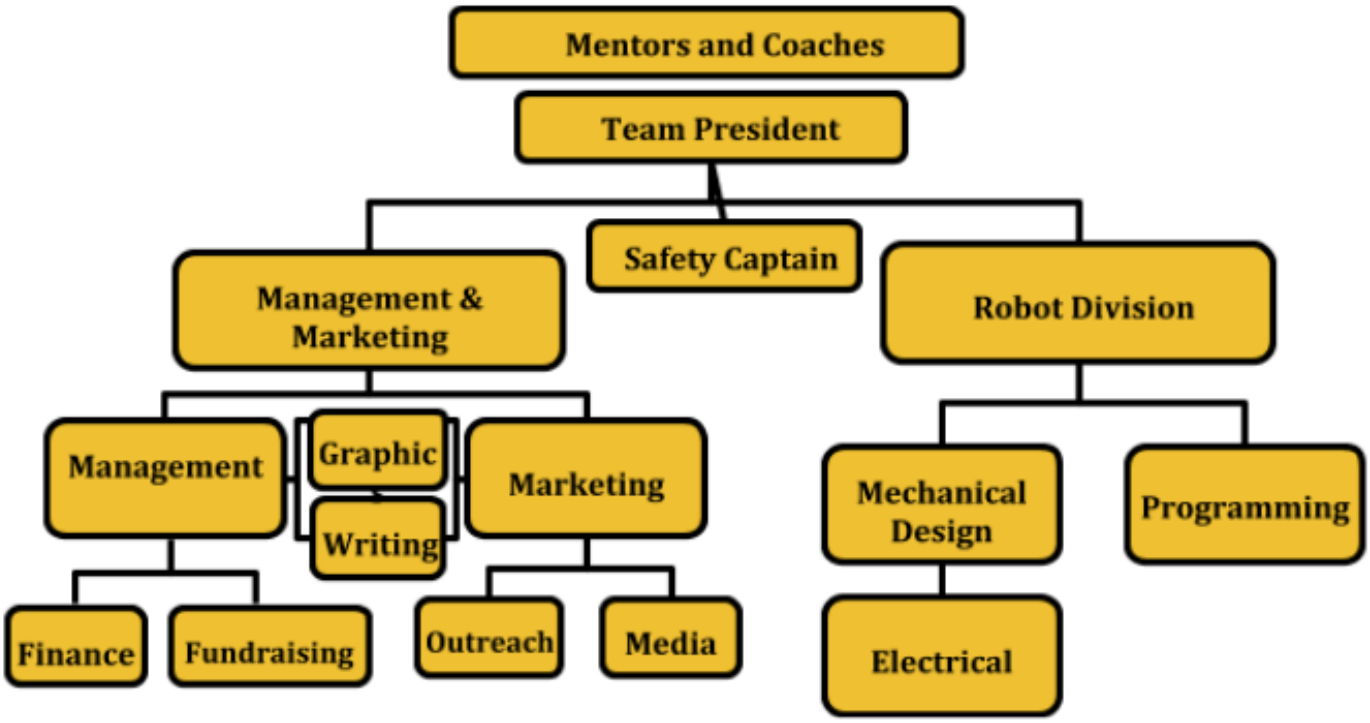
Photo by Team 1676

II.a. Leadership Guide

Team organization is the key to success. As a rookie team, a system of organization is essential for building a strong foundation for the team's future. The establishment of Divisions will allow for an even distribution of work.

Teams can be divided into two Divisions: Robot and Management & Marketing. For each individual Sub-Division, a student leader should be appointed to oversee all aspects and direct team members on their Sub-Division. Depending on the size of your team, you might see it necessary to separate or combine Sub-Divisions, or allow some members to work for more than one Sub-Division.

Sample Leadership Organization



Team President

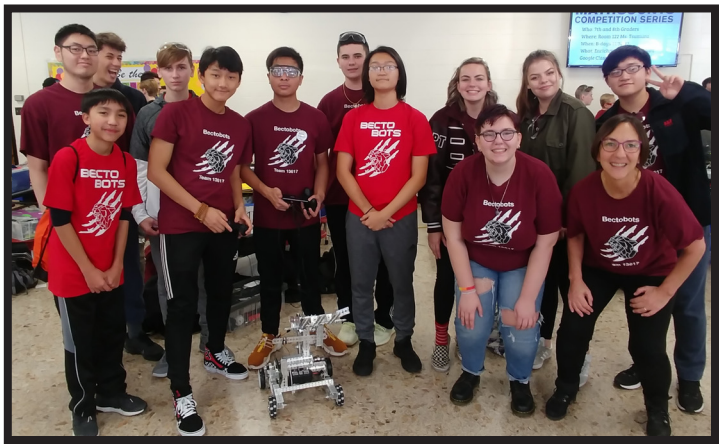
A team President acts as the overarching leader of the team. **This job and its responsibilities should not be passed on to a mentor; a qualified student must be chosen**. This position is vital for maintaining a student-led team. However, the President will partner with the mentors for guidance and assistance. The responsibilities of a President include:

- Organizing & leading team meetings with the mentors and coaches
- Ensuring steady progress is being made in every Sub-Division
- Acting as a link between Sub-Division leaders and the mentors/coaches
- Keeping students involved in team activities
- Dividing work and choosing team Division and Sub-Division leaders

Robot Division

The Robot Division creates a functional robot that is able to complete the goals presented by *FIRST* in order to perform well at the competition each year. Although it varies from team to team, at its core, the team only needs two Sub-Divisions for the robot.

- **Mechanical**
  - The Mechanical Sub-Division is responsible for designing the robot, the drive train, the chassis, and any additional parts specific to the game. An important aspect of being on the Mechanical Sub-Division is wiring the robot correctly and arranging electrical components. For large teams, Electrical can be its own Sub-Division.
- **Programming**
  - The Programming Sub-Division is responsible for programming the robot in autonomous and teleoperated modes. The code is written in Java using Android Studio. The programs can run through the Dashboard and the Robot Controller apps available on the Android phones from the Kit of Parts.



Management & Marketing Division

The Management & Marketing Division is responsible for everything that does not relate to the building of the robot. For larger teams, this can be divided up into Sub-Divisions with individual leaders appointed to each group; for smaller teams, the Management & Marketing Division might have one leader that delegates each of these tasks to individuals or groups. The Management & Marketing Division's responsibilities include:

- **Management**
    - Finance
        - Finance is responsible for management of team funds
        - They organize all receipts/expenses
        - They create the team budget with income/expenses
        - They work with the Writing Sub-Division to apply for grants
        - They work with the Writing Sub-Division to fill out the Business Section of the Engineering Notebook
    - Fundraising
        - Fundraising creates fun and interesting events to raise money for the team
            - Organize bake sales, car washes, sell spirit wear, or any other type of event your team thinks of- be creative!
- **Marketing**
    - Outreach
        - Outreach arranges new, fun events that incorporate STEAM (Science, Technology, Engineering, Art, & Math) into the community and spread *FIRST*
    - Media
        - Media photographs all team events, regular team meetings, and progress of the robot
        - They create and uphold all social media platforms for the team by consistently posting about team activities and the events they are holding
        - They create video submissions for the Promote Award, and also create a record of team activities
        - They can create a website for the team
- **Graphic Design**
    - Graphic design creates a team shirt, team buttons, and a team logo
    - They help with the design and layout of the Engineering Notebook
    - They create brochures and handouts for the team
- **Writing**
    - Writers are responsible for the Team section and the Business section of the Engineering Notebook
    - Responsible for managing daily log of the Engineering Notebook
    - They write any team handout materials

Safety Captain

The Safety Captain is responsible for organizing procedures and protocols to ensure the safety of everyone on the team, including:

- Establishing tool qualification testing, overseeing tool qualifications, and ensuring tool safety is enforced while working
- Establishing and maintaining safety rules during Build Season, Competition Season, and travel
    - Some example rules include:
        - Wear closed-toe shoes when in build area
        - Keep hair tied back when working on robot and with tools
        - Wear safety glasses in build area
        - Know of an emergency meeting place at all competitions and events
        - Have emergency contact information at all competitions
- Creating an injury plan (a plan that outlines what to do in case of an injury/emergency)
- Maintaining a first aid kit, understanding how to use it, ensuring all team members know its location
- Maintaining and upholding the 5S's of Safety. These are measures set in place to keep the workplace organized and efficient. The 5S's are:
    - Standardize
    - Shine
    - Store
    - Sustain
    - Set in order
- https://www.ehstoday.com/safety/5s-workplaces-when-safety-and-lean-meet

II.b. Mentor Requirements

According to the *FIRST* website, “In *FIRST* Tech Challenge, it is important that mentors and students are equal and that the relationship is a partnership. Mentors should be willing to acquire some basic knowledge of programming and robot building. *FIRST* strongly encourages teams to invite people with backgrounds in engineering and programming to share their knowledge and experience.”

- ***FIRST* Responsibilities**:
    - Create a *FIRST* account for your team
    - Create a Team Profile
    - Complete Youth Protection Screening (US/Canada Lead Coach/Mentors only)
    - Invite Team Members to “Join Team” through *FIRST* website
    - Register the team for the season
    - Register for local events
    - Find a build space and a place to store team materials
    - Purchase a Kit of Parts
        - An electronics kit, a control/communication kit, and a competition kit

- **Team responsibilities**:
    - Have basic building materials
        - Allen set
        - Deburring tool
        - Dremel tool or disk sander
        - Hex keys
        - Hand drills
        - Metal file
        - Pliers
        - Small screwdrivers
        - Wrench metric and SAE set
        - Zip ties
    - Electronics
        - Laptop to run your development tool
        - At least one power strip
        - An extension cord (optional)

- **Team Meetings**:
    - Create a meeting schedule & timeline for team goals
    - Facilitate team problem solving and brainstorming
    - Keep the team goal-oriented
    - Ensure students develop mechanical skills without completing tasks for them
    - Work with the team’s Safety Captain to maintain safety standards

II.c. Recruitment

Recruitment is a key part of maintaining a successful and sustainable team. There are many ways to inspire enthusiasm and accumulate members through your school and community:

- Present to your school's science/math classes
- Hold interest meetings before or after school
- Stress the benefits of engaging students in STEAM/*FIRST*
- Reach younger students that will look forward to joining the team
- Promote team through community events
- Create a recruitment flyer and distribute it throughout your school
- Place an advertisement in the local newspaper about your team

II.d. Engineering Notebook

According to *FIRST*, the Engineering Notebook documents "...the team's robot design and records, the time spent doing research, outreach, team meetings, and plans for growth. This notebook includes the phases of the problem definition, concept design, system-level design, detailed design, test and verification, and production of the robot. These notebooks track a team from the beginning of the season and throughout the competition season. Judges review a team's engineering notebook to better understand the journey, design, and team as a whole."

View *FIRST*'s guidelines for the FTC Engineering Notebook here: https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/engineering-notebook-guidelines.pdf

The submission of The Engineering Notebook is a requirement for all FTC teams. It must be brought to all competitions. The Engineering Notebook must include:

- Sketches and explanations of all robot designs, team logos, parts, software updates, etc.
- Notes on discussions at team meetings, including team members' thoughts
- Dates on all pages
- Processes and obstacles of robot/team and their solutions/results

Format

Teams must have one or two binders no thicker than three inches. The notebook can be in an electronic or handwritten format:

- Electronic: must be printed and inserted into a binder, on front and back of each page
- Handwritten: spiral-bound, laboratory or documentation notebooks, must be in ink
  - To insert pictures or outside information into the notebook, tape the picture into the notebook and outline with permanent ink, to note that it was there in case it falls out. Put the corresponding page number on that inserted page
  - If there is an error, draw a single line through the incorrect data. Do NOT erase or use correction fluid. All corrections should be initialed and dated.

1. Front Cover

- Front cover must have:
  - Official team name and number
  - Name of school/address of team meeting place
  - Team logo (if available)
  - Optional: Use team colors
  - Optional: Use FTC logo
- One page summary on inside front cover
  - Concise version of your team's history
  - Bulleted highlights of your team's season
  - Team number
  - A Table of Contents with page numbers
  - List of pages your team would like judges to consider

2. Team Section

The Team Section allows the judges to get to know your team's story.

- **About Your Team**:
  - How, why, and when was your team created?
    - How was the team initiated?
    - Introduce each member of your team (no last names) with their position, grade, and how many years on the team
    - Explain what inspired people to initiate a team
    - Explain the story behind your team's name, logo, and colors
    - Include a timeline of your team's development since its creation
    - Discuss original sponsors
  - What is your team's mission?
    - Compose your team's mission statement
  - How are your team members benefiting from being a part of the team?
    - Some benefits might include learning STEAM skills, presentation skills, teamwork, leadership skills, management experience, andreal-life skills for college and employment
  - What are your team's goals?
    - Provide a plan for how your team will grow and develop in the next three years
  - How do you divide work within your team?
    - Include a team's leadership chart with the first names of your current team leaders, and explain the responsibilities of each Division and Sub-Division
  - What are your team's statistics?
    - Number of members on your team yearly
    - Grade-level distribution
    - Percentage of males/females
    - Graduation rate
    - Percentage of students that pursue STEAM in college/career

- **Outreach**
  - Community Outreach
    - Your team's impact on increasing STEAM/*FIRST* interest within your community
    - Events your team has done to contribute to the community
    - Include dates, times, flyers, and photos from your events
  - School Outreach
    - Recruitment of new members
    - Partnerships with other school clubs
    - Support from the school administration/Board of Education
  - *FIRST* Outreach
    - Team partnerships/collaborations
    - Team mentorships
    - Starting new teams
    - Include dates, times, and photos
    - Include letters/emails of communication and recognition

3. Business Section:

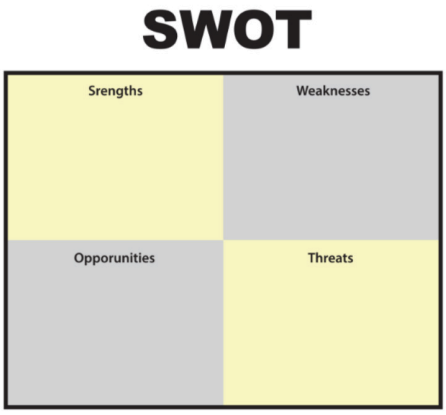
According to *FIRST*, "The Business Plan can act as the backbone and guiding force for your team. This is a living document and may change based on challenges that may arise through the season, lessons learned, or new opportunities. Plan on revisiting this document a few times throughout the season to see if your team is on track of if a new direction is being taken, and modify your Business Plan accordingly."

The business section creates a detailed plan of how your team acquires/ manages resources and how these resources are sustained.

Sections to include are:

- **Finance**
  - Fundraising
    - Your team's fundraising efforts
    - Photos, Videos, Event flyers from fundraising efforts
    - Mention lessons learned from each effort - Was it worth the effort? How can it be improved? What went well?
    - Chart of revenue from each individual event
  - Sponsorship
    - Outreach
      - For example: Presentations to local businesses, school administration/Board of Education, community events
    - How did you relay information to potential sponsors?
    - What was successful, what was not, what did you learn?
    - Chart of all sponsors and their donations
  - Team Budget
    - Chart
      - Income: includes sponsorships, school support, and fundraising
      - Expenses: amount spent on supplies, parts, competition fees, travel, etc.
- **Sustainability**
  - Recruitment
    - What methods does your team use to recruit members?
    - How successful/unsuccessful have your recruitment efforts been?
    - How do you recruit new mentors?
  - Training Team members
    - What is your process to train members?
      - For example: do you hold training sessions?

- **SWOT Chart**
    - Analyzes Strengths, Weaknesses, Opportunities, and Threats
        - Strengths: positive aspects of a team
        - Weaknesses: areas for improvement
        - Opportunities: ways to overcome a weakness/threat
        - Threats: potential unfavorable situations



4. Engineering Section:

The Engineering Section documents the team's robot design and records the time spent on research, outreach, team meetings, and plans for growth. This documentation should include:

- Meeting Log
    - Dates and times of every meeting
    - Each page must be initialed by person logging information
    - All plans made and all ideas discussed at the meeting
        - Each meeting should be a new page, regardless if the previous page was filled or not
- Design Process
    - Show all prototypes, sketches, and initial designs of your robot
    - Explain the process of your robot's development throughout the season
    - Document all failures and obstacles you encountered
    - Discuss software development

- Don't forget to mention how the robot changed during your competition season

- Strategic Design
  - How does the design of your the robot specifically relate to the robot challenges?
    - Explain in detail how each portion of your robot completes each task and why it is the most effective way to complete them
    - Include the process of how you came to the most effective way
- Final Product
  - Explain the function of all the elements in your robot
  - Discuss all the programs and sensors on your robot, and any changes during competition season

Engineering Notebook Questions

Your team journey goes beyond logging the day-to-day "here's what we did" or "we met today."

When logging entries make sure to answer:

- What is the agenda today and what are your goals?
- What decisions did your team make in forming the team, creating the robot, writing the program, the outreach projects, etc.?
- Why was it the logical choice? (Built specific robot element, coded the software that way, chose that group of individuals to outreach to, etc.?
- How did the decision impact your team, robot, or community?
- What is the next step?

III.Finance

Grants

Grants are sums of money donated by corporations, governments, or other large organizations. They are especially useful for teams that need funding to sustain themselves before they begin gaining sponsors. There are grants available through *FIRST* and outside of *FIRST* for rookie teams. If your team is school-based, you can begin by researching grants for afterschool programs. Grants require filling out a form that describes the purpose of the funding. These are the typical requirements and responses:

- **Program Description**:
    - Try to tailor your point of view to the specific type of grant you are applying for (i.e. green initiative, healthy living, STEAM, etc.). Some grants have character limits, therefore you need to be concise and impress them with as few words as possible. Be sure to describe the *FIRST* program, as well as your specific team.
- **Biggest Budget Line Item(s)**:
    - Ex: travel expenses, robot expenses, tools
- **Other Funding Sources**:
    - Provide any additional sources of revenue in list format
- **Program Impact**:
    - Provide a short paragraph or two describing your program's effect on team members, statistics measuring the success of your program, and the short/long-term results you are aiming for.
- **Budget Overview**:
    - Here, you should state the cost to run your team annually, and your intentions for the money you are requesting. Insert a sentence or two to provide specifics on how their money will play into your overall budget.
- **How They Will be Recognized as a Sponsor**:
    - Assure them that your team will feature their name on your team shirt, robot side plates, team website, or elsewhere, based on the amount of money they donate.

- **Additional Comments**:
    - Occasionally, they will offer space to include any additional information that you feel would sway them that did not fit into any of the above categories. Examples include outreach, brochures in PDF and word document format.

Fundraising Efforts

To procure funds for the team and to help offset expenses, it is important to host various fundraising events, such as car washes, bake sales, and community events.

- **Bake sales**:
  1. Get school permission– request a day and a time slot
  2. Assign one mentor to supervise and one student Project Manager to take charge
     a. Send out a team email asking for donations of baked goods from students and parents
     b. Choose/Designate 5-6 student volunteers to work the bake sale
     c. Collect necessary materials (tables, napkins, money box, etc.)
  3. Advertise- make an announcement, send out an email, hang flyers before the bake sale
- **Restaurant Sponsored Events**:
  1. Check restaurant website for fundraising program
  2. Contact the restaurant manager about hosting a fundraising event
     a. Typically, teams receive 15-20% of profit from customers who present the event flyer (which is provided by the team and can be downloaded)
  3. Choose a date and time window
  4. Advertise your event
     a. Before: Post on social media, send throughout your school district, and hang flyers
     b. Contact the local newspaper about the event, if possible
     c. Send email reminders to team members and families two days in advance

- **Donations**

  Bring a donation jar to every team event. Be sure you know exactly what you are going to do with the money raised, to assure your donors that their contribution is going toward a good cause. Are they going to be used to buy your team t-shirts? Are they going to be used to support your trip to the World Championship? Have a plan!

- **School Support**

  It is helpful to establish a strong relationship with your school administration. To ensure school support from the beginning, meet with the administration of your school to explain the goals and what you would need to be successful, such as:

  - Workspace
  - Teacher mentors/coaches
  - A stipend for the coaches
  - Sponsorship

After the initial meeting, maintain and develop your relationship with your school district. Volunteer to participate in school events such as back-to-school nights, orientation for incoming students, and any others your school might host.

IV.a. Outreach

What is Outreach?

Outreach is your team's opportunity to bring the message of STEAM and *FIRST* to your community, school, and beyond. It can be as simple as taking your robot to community events and telling others about your team, or as complex as multi-year projects.

Finding events to participate in:

Check your town calendar/website and local online news outlets

- Parades, town days, community events, and charity events are held in most towns.
- To participate, contact your city/borough/town hall, and they will direct you to the right person.

Project and event creation:

1. Determine Purpose of Event
    a. Promoting *FIRST*, Fundraising, Recruitment, Spreading STEAM, etc.
2. Hold brainstorming sessions with entire team
3. Assign a student Project Manager for each event
    a. A Project Manager will facilitate organization and proper planning, a successful event. A Project Manager is a student who is responsible for the overall event, and designates specific tasks.

IV.b. Project Manager Guide

Outline For Project Manager

What are a project manager's duties?

- Plan projects and execute them
- Assist with gathering resources for the project
- Ensure that all delegated assignments and projects are being completed and progressing as planned
- Calculate a reasonable budget for each project

What qualities do project managers need?

- Efficient time and task management
- Strong leadership
- Ability to communicate and collaborate with others
- Flexibility/ability to perform all roles
- Work under pressure

What are the stages of planning an event?

- Find a location
- Determine a time
- Who are your attendees?
- PR Materials
    - Flyers
    - Newspaper
    - Email sent out to community, team parents, schools
- Decide which teammates will be there to work the event
- Make a packing list
    - Cash box to make change if needed
    - Other items you may need to bring include: team shirts, your robot for a demonstration, team flyers, donation jar, information about *FIRST*
- Appoint a set-up crew and clean-up crew

V.a. Awards

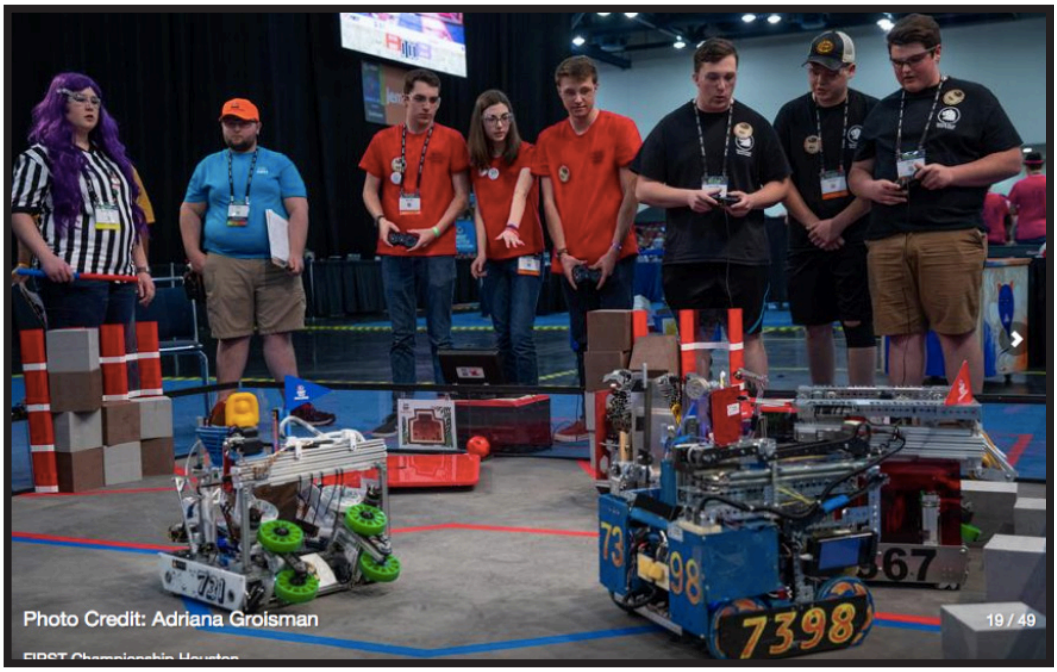
FTC Awards:

- **Individual**
  - **Dean's List**: Two 10th or 11th grade students are selected as model student leaders. This award is given to a student who has "led their teams and communities to increased awareness for *FIRST* and its mission."
  - **Compass Award**: Students may create a one minute video highlighting the mentor they nominated for the Compass Award. This award is given to a mentor that is "a beacon and leader in the journey of *FIRST* Tech Challenge."
- **Team**
  - **Robot**
    - **Rockwell Collins Design Award**: Given to the team with the most creative and innovative robot design. To win, teams should have a detailed summary on how they arrived to their final robot and an explanation on how their robot was strategically designed.
    - **Think Award**: Given to a team that used science and mathematics to plan their robot design and described it in their engineering notebook. It must show a clear understanding of the design process.
    - **Design Award**: Awarded to a team with a functional and aesthetic robot and a detailed design process, including drawings and sketches, in their engineering notebook.
    - **Control Award**: The Control Award celebrates a team that uses sensors and software to increase the Robot's functionality on the field. This award is given to the team that demonstrates innovative thinking in the control system to solve game challenges such as autonomous operation, improving mechanical systems with intelligent control, or using sensors to achieve better results on the field. The control component should work consistently on the field. The team's Engineering Notebook must contain details about the implementation of the software, sensors, and mechanical control.

- **Non-robot**
  - **Connect Award**: This is awarded to a team that connects with professionals in the STEM field, as well as having a detailed Business section in their engineering notebook.
  - **Motivate Award**: This team embraces the culture of *FIRST* and clearly demonstrates what it means to be a team. This judged award celebrates the team that represents the essence of the *FIRST* Tech Challenge competition through team building, team spirit and displayed enthusiasm. This is a team who makes a collective effort to make *FIRST* known throughout their school and community, and sparks others to embrace the culture of *FIRST*.
  - **Promote Award**: The Promote Award is given to the team that is most successful in creating a compelling video message for the public designed to change our culture and celebrate science, technology, engineering, and math. Teams must submit a one-minute long public service announcement (PSA) video based on the PSA subject for the season. The video must follow all the guidelines posted on the *FIRST* website. This award is only offered at some competitions. Research if you are going to a competition that is accepting submissions.

- **Robot and Non-Robot**
  - **Inspire Award**: This judged award is given to the team that embodies the challenge of the *FIRST* Tech Challenge program. The team that receives this award is a strong ambassador for *FIRST* programs and a role model *FIRST* team. This team is a top contender for many other judged awards and is a “gracious” competitor. The Inspire Award winner is an inspiration to other teams, acting with Gracious Professionalism® both on and off the playing field. This team shares their experiences, enthusiasm, and knowledge with other teams, sponsors, their community, and the Judges. Working as a unit, this team will have showed success in performing the task of designing and building a robot.

  - **Judges Award**: This award is up to the judges’ discretion and can be given to any team, for any reason that warrants an award; it could be anything from an exemplary engineering notebook, to outreach, to strategic robot.



V.b. Presentation

Presentation Structure for Competition

All teams must present to judges. The entire team should be in the room, but the maximum is 15 people. If your team is larger than 15 people, choose the 15 most involved members. Talk about team highlights (both Non-robot and Robot). We recommend using the Engineering Notebook as a guideline.

1. Each team will be automatically assigned a 10-minute time slot
2. Four to Five Minute Presentation
    a. Take both the robot and the Engineering Notebooks into the room with your team.
        i. You can give the Engineering Notebook to the judges or hold it, but the robot will be stationary on the table
    b. All team members in the room must be knowledgeable about all topics, but only speak about the ones they directly contributed to.
    c. Suggested flow of presentation (Should be practiced and order should be pre-set):
        i. Team Introduction
            1. Team history and origin
            2. Team organization
        ii. Robot
            1. Discuss the key features that make your robot special. You can also discuss an obstacle your team struggled with and then overcame.
        iii. Engineering Notebook
            1. Present your sketches, explain how your design developed over the course of the meetings, and explain the strategy behind the design.

iv. Business and Sustainability

1. Discuss highlights of your sustainability and business plan, such as sponsors, member recruitment, unique fundraising, or specific aspects of the plan that sets you apart from other teams.

v. Outreach/Other

1. Mention your team's community outreach or impact on the community.

3. Five Minute Question & Answer Session

a. Judges will end your session with a 5 minute Questions & Answer

i. If they have more questions about your team, they will come to your pit

VI.a. Kits

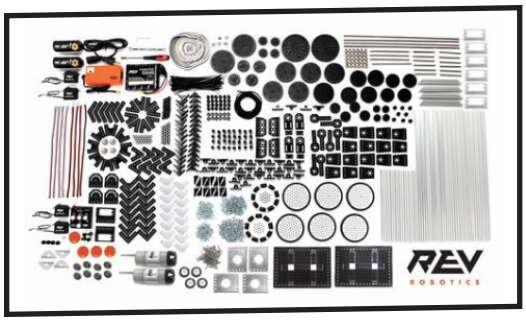
FIRST® releases a new set of challenges each year. Robots compete in an alliance (team) of two robots. Each match consists of two opposing alliances competing to score the most points in two minutes and thirty seconds. Matches follow the following order:

1. **Autonomous period:** (30 seconds): Teams pre-program the robot on Java and choose which program they want to run on the phone attached to the robot.
2. **Scoring:** (1 minute 30 seconds): Robots use this time to score points by completing a variety of tasks. For example, placing balls in scoring areas.
3. **"Endgame"** (30 seconds): The robots complete special tasks to score some extra final points.
    - Note that these specific times may depend on the game for that particular year, and are subject to change year by year.

At competitions, robots play in a series of qualification matches that rank each team based on their wins and losses along with the amount of points they accumulate for their alliance. After the qualification matches, the top four ranked teams pick the other alliance partner to play with in the semi-finals and final matches. The first rank alliance gets the first pick, and so on.

Robot Kits

- To build an FTC robot, a team must purchase one of two starter kits; both offer enough parts to build a basic robot.
    - REV: FTC Starter Kit (~$600)



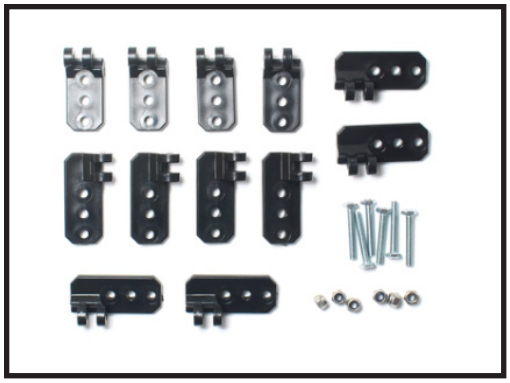
    - Purchase this kit here: http://www.revrobotics.com/rev-45-1270/
    - Visual guide to all the parts in this kit: http://www.revrobotics.com/content/docs/REV-45-1270-PL.pdf

- This kit has fewer pre-drilled parts and requires more customization compared to the Tetrix Kit.
- How to build a drive train with this kit: https://www.youtube.com/watch?v=WG4aA-xWgzM

- **Tetrix *FIRST*® Tech Challenge Competition Set** (Website ~$709.95)

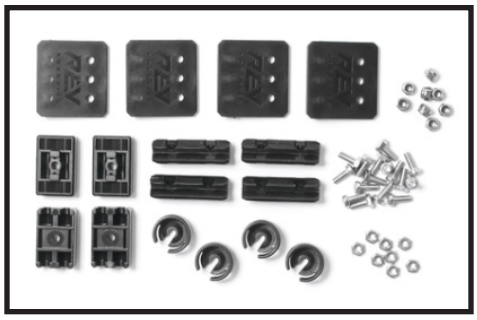
- Purchase this kit here: https://www.pitsco.com/Shop/TETRIX-Robotics/TETRIX-MAX/Robotics-Sets/TETRIX-FTC-Competition-Set
- Visual guide to all the parts in this kit: https://asset.pitsco.com/sharedimages/resources/ftcset_productlist-0719.pdf
- How to build a drive train with this kit: youtube.com/watch?v=GhesbdjBfcU
- CAD files for every piece in this kit: https://drive.google.com/drive/folders/1Uih-VNZf56_fXcEZCgEXUuWfskFKKHANF
- This kit is more expensive than the REV kit, but has many more pre-drilled holes and requires less machine work for each part. For a Rookie Team, we recommend this kit over the REV kit if it is within your team's budget.

- **Special Kits:** After your team decides on the design of your robot, you might need special parts that aren't included in the starter kits. Options for additional kits include:
- **Rev: 15mm Hinge Kit** (~$10)



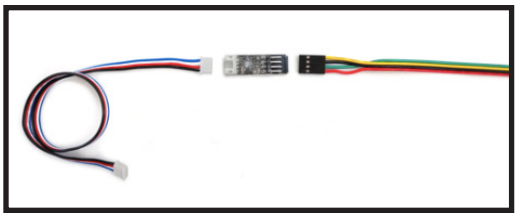
- Purchase this kit here: http://www.revrobotics.com/rev-45-1259/
- CAD files for every part in this kit: https://drive.google.com/file/d/1yiYgASdaJmyzdzkk-TuQukAbRBKrJP4xX/view?usp=sharing
- Includes four left, center, and right hinges (12 total) that can be attached using M3 hardware.
  - M3 means that the diameter of the bolt is 3 mm (i.e. M8 means the diameter is 8 mm).
  - It comes with nylon lock nuts and hex cap screws to attach the hinges.
- Hinges can be used for moving bars that are controlled by a motor.
- We recommend purchasing this kit only if the design you decide upon at the beginning of the season needs a hinge.

- **Rev: 15mm Linear Motion Kit** V2 (~$12)

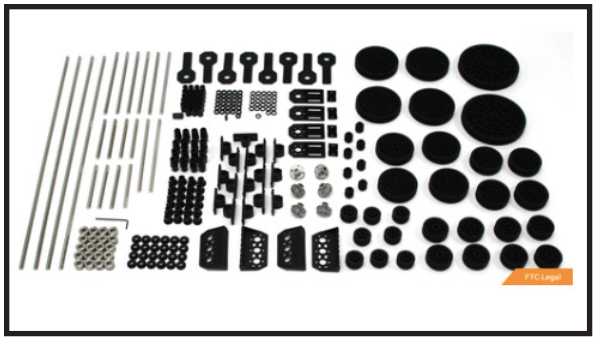


- Purchase this kit here: http://www.revrobotics.com/rev-45-1507/
  - This kit can create a one-stage lifter, or (with two kits) a three-stage lifter. Instructions on how to create the lift are here: http://www.revrobotics.com/content/docs/15mmLinearMotion-Guide.pdf
  - CAD for all parts in this kit: https://drive.google.com/drive/folders/1K1igp-bqW0VB7xUxiCi1l9gPb24TBhE7h
  - This kit is recommended for all teams, because for most competitions, lifting pieces are necessary. Especially if rookies need to lift game pieces, this kit is the recommended way to start, rather than trying to design something new.
- Can also add the following parts if necessary:
  - Pulley Bearings, in addition to a low-stretch rope, can help the linear motion kit create an elevator.
    - Purchase pulley bearings here: http://www.revrobotics.com/rev-41-1368/

        - CAD: https://drive.google.com/open?id=1c20-LZsd-8ooFaXfCCarzeM0h-dICup_9
    - UHMWPE chords help actuate a lift, and it maintains its tension.
        - Purchase the chord here: http://www.revrobotics.com/rev-29-1244/
    - Extra pieces of metal are necessary to create an elevator. The following set is the right amount: http://www.revrobotics.com/rev-41-1432/
    - These additional parts are only recommended if your team would like to build an elevator.
- **Rev: Cable Conversion Kit** (~$25)

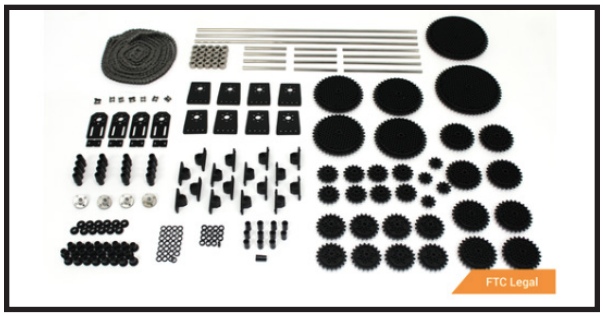


    - Purchase this kit here: http://www.revrobotics.com/rev-35-1173/
    - This contains four different types of cables that connect motors, sensors, and encoders to the REV Expansion Hub.
    - We recommend that all rookies purchase this kit.
- **Rev: Gear Add-on Pack (~$200)**



    - Purchase this kit here: http://www.revrobotics.com/rev-45-1174/
    - This kit equips you with different gears of various sizes (15T, 30T, 45T, etc.) and other materials (shafts, spacers, bearings, etc.) These can be used to create different drive trains.
    - We recommend purchasing this kit as a veteran team that needs extra parts to build more complex drive trains.

- **Rev: Gear Add-on Pack (~$200)**



  - Purchase this kit here: http://www.revrobotics.com/rev-45-1175/
  - This set provides you with a variety of sprockets (10T, 15T, 20T, etc.) along with chain (10ft), a masterlink, and more.
    - The chain can be wrapped around the sprockets and secured with the masterlink.
    - For more info on the uses of both gears and sprockets: https://www.wisegeek.com/what-is-the-difference-between-a-sprocket-and-a-gear.htm
  - This kit is recommended for veteran teams that are looking to build more complex designs.

- **Tetrix MAX Expansion Set** (~$249)

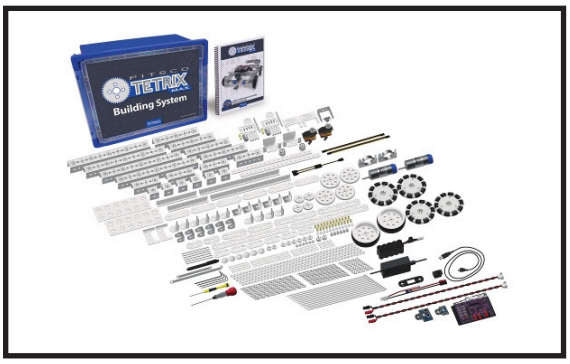
  - Purchase this kit here: https://www.pitsco.com/TETRIX-MAX-Expansion-Set
  - It includes brackets, gears, a continuous rotation servo, additional metal pieces, and a rack and pinion set. It also comes with a storage bin.
    - Includes builder's guide and activities both in the kit and on the website that can get your team thinking about different designs for your robot.

- CAD files for all parts in this kit: https://drive.google.com/drive/folders/1YGgP6xMcxxg-FXxxdQEuMpt24DHUI31Cm
- We recommend this kit for veteran teams looking to build complex robots, but not willing to spend a lot of money doing so. Out of all the additional hardware Tetrix sets, this has the best value for the number of supplies it has.

- **Tetrix MAX R/C Robotics Set** (~$580)

- Purchase this kit here: https://www.pitsco.com/TETRIX-RC-Robotics-Set
- This kit includes two motors, two servos, additional hardware and wheels, and brackets. It includes a storage bin with a sorting tray. On the website, there are video tutorials and other resources that go along with this kit.
- CAD files for all parts in this kit: https://drive.google.com/drive/folders/1FESVxMcE38t-nr4_nxdqokp8TAGb2Rl_N
- We recommend this kit for veteran teams looking to purchase a large set of add-on materials at once, rather than individual parts throughout their seasons as a team.

- **Tetrix Programmable Set** (~$650)



- Purchase this kit here: https://www.pitsco.com/TETRIX-MAX-Programmable-Robotics-Set
- Equipped with a robotic controller, an ultrasonic sensor, omni wheels, additional hardware, two motors, two servos, and a programming guide.
    - Programming Guide provides instructions for basic coding.
        - The website includes tutorials and resources you can download for this kit.
- CAD files for all the parts included in this kit: https://drive.google.com/drive/folders/1f6UMKndoWQsMRr8WHqO_M1fUW9Hm35ry
- We recommend this kit for teams that are looking to have more complex programs using sensors for their robots.

- **Tetrix MAX Duel-Control Robotics Set** (~$775)

- Purchase this kit here: https://www.pitsco.com/TETRIX-MAX-Dual-Control-Robotics-Set
- Includes a line following sensor, ultrasonic sensor, and 670+ building elements. It also comes with the builder's guide and programming guide to get you started.
    - Website has video tutorials and downloadable resources.
- CAD files for all the parts included in this kit: https://drive.google.com/drive/folders/1fladgn9_Gprfl9FwWs2M6x1YGddD_qmM
- We recommend this kit for veteran teams trying to build more complex autonomous combinations.

- Individual Parts: Additionally, individual parts, such as individual brackets, pieces of metal, or wheels, can be purchased on the REV and Tetrix websites. One worth highlighting here is:
  - Omni Wheels (Typical for FTC Robots)
    - Omni wheels are unique because they are able to achieve vectoring movement; they can move freely in many directions.
      - Allows the wheels to move freely in any direction with a minimum amount of friction.

  - For more information:
    - https://www.robotshop.com/media/files/pdf/omni-wheel-introduction-10013.pdf
    - https://www.superdroidrobots.com/shop/custom.aspx/vectoring-robots/44/
  - 4WD Omni-directional Robots
    - Can use either mecanum or Omni wheels mounted at a forty-five-degree angle.
    - Work well for supporting heavy loads.
    - More info:
    - https://www.superdroidrobots.com/shop/custom.aspx/vectoring-robots/44/
  - How to Mount:
    - Omni wheels should be mounted perpendicularly to the center of the robot.

VI.b. Schecule and Design

- Additional raw metal and materials
  - If your kit doesn't offer enough channels of metal, you can purchase additional pieces to avoid having to customize parts. You can buy brackets and channels in sets on the Pitsco website, linked here: https://www.pitsco.com/TETRIX-Channels
- Sensors
  - Your team can purchase additional sensors, such as a touch sensor or additional encoders off of the REV Robotics site for FTC, linked here: http://www.revrobotics.com/ftc/electronics/sensors/
- More additional individual parts can be purchased from the Pitsco and REV websites as needed for your team.

- Communications Set: Rookie teams must also purchase a communications set from FIRST. These are vital to being able to upload programs to the robot and to be able to drive the robot, and there is no way to have a robot without one. The set that rookie teams purchase costs $249 and include:
  - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/kit-of-parts.pdf Step 2
  - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/rookie-registration.pdf (Starting on page ten)
- Review this list to ensure that your team is not using illegal parts: https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/legal-illegal-parts-list.pdf

Robot Schedule and Design

Once the game is released, a Rookie team should follow a schedule so they don't fall behind:

August-September 6th (Pre-Kickoff): Install Software and Prepare for the Season

- During this time, teams must prepare for the season in any way they can. Begin researching robots that your team finds interesting, and learn about how other teams mastered previous games.
  - That being said, you want your robot to be desirable for other robots to align themselves with.

- A fun pre-season team bonding activity could be for each team member to find a past robot that did well at the World Championships and put together a small presentation about the robot for the team. This can get your Rookie team thinking about the possibilities of FTC robots.

- Download all necessary software beforehand so that when the challenge is set out, your team is prepared. Off of the FIRST website, your team can download all necessary software with just a few clicks.

September 7th: Kickoff

- The game will be announced. Have everyone on the team download the game manual and read it in full.
- Research if there is a kickoff event near your team. If not, have your team host one. Take this day as a team bonding opportunity to discuss initial robot ideas.

September 7th-September 14th: Game Strategy Discussions

- The first few days should consist of discussing the challenges the game presents, and how best to tackle them.
  - Consider what your robot should do during the autonomous period, and how your team plans on scoring the most points possible.
  - Keep in mind that you will be playing in an alliance, so something your team might have to sacrifice on your robot might be made up for by your potential alliance partner.
- Decide on priorities for your team, and plan out a rough schedule. If any aspect of the game makes your team consider buying specific parts (ex. Hinges, extra gears), place your orders as soon as possible.
- During this time, your team should aim to meet 2 to 3 times for 1-2 hours.

September 14th-21st: Design ideas

- After fully understanding and analyzing the tasks given to your team, think about how your team will achieve your goals.
- Come up with ideas on how each mechanism will be designed, and backup ideas if one doesn't work out.

    - A team bonding activity could be to assign every team member one of the tasks your team would like to complete, and have the team member come up with a mechanism that could complete that task. Then, have them show their ideas to the team. This will give your team a wide array of ideas to choose from when it comes time to build the mechanism.
- During this time, your team should meet 2-3 times for 1-2 hours each.

September 21st- 28th: Design the main scoring mechanism/ Design drivetrain

- First, a small group of your team members must build a drivetrain, using the links provided earlier. As a rookie team, it is best to spend less time focusing on the drive train. When your team has more experience, consider building a more complex one.
- Another group of students should begin to build a prototype for the main scoring mechanism. The prototype is not what will be put on the robot in the end, but a way to test different ways to improve on the original idea.
    - First, create the basic design and pick a motor.
    - Hook the motor up to the REV Expansion Hub and test the design.
    - See where improvement can be made (ex. can it be lighter, can it take up less space, can it do its job better with the addition of certain pieces?).
    - Continue to test and improve until your team is fully satisfied with every aspect of the mechanism.
    - Keep in mind that your mechanism has to attach to the drive train in some way, and consider how that might work.
- During this time, your team should meet 3-4 times for 2-3 hours.

October 1st- October 27th: Finish Robot/ Begin Flow Chart for Autonomous

- Once the chassis is done, attach the REV Expansion Hub, the Battery and Battery Box (a box to keep the battery safe and contained during the match), the Android Phone protector, and wire the motors already on the chassis.
    - One student or group of students should be in charge of all the electrical components and wiring of the robot.
    - After having the basic wiring done, upload a simple code and test to see if the robot to ensure the wiring was done correctly.
- Begin to attach the main scoring mechanisms, and any other mechanisms that are necessary for the robot.

    - Consider if your robot needs an elevator to move game pieces to different heights, or an arm that can make it climb, or an intake for game pieces. All of these additional pieces must be designed, prototyped, finalized, and attached to the drive train during this time.
- Begin programming for autonomous
    - Attach any necessary sensors to the robot (ex. encoders).
    - Plan out how your team will score, and then create the program.
        - Test every step of the way to ensure it works, and if there are any issues it will be easy to pick them out.
        - If your team has a field, make sure to practice on the real field. If not, make sure to measure out how far your robot is going to that it will translate well in competition.
- During this time, your team should aim to meet at least 3 times a week for at least 3 hours each time. This time is critical, and with any potential setbacks, it is important your team spends as much time as possible to ensure that you will be ready for the competition.

October 28th - November (at least 2 weeks prior to the first event) Drive Team Practice

- Assign roles in your drive team and have them practice driving the robot, scoring game pieces, and communicating with each other.
- See if there are any issues with the robot, and check its durability. Continue testing the autonomous mode.
- During this time, your team should meet 3 times a week for at least 2 hours.

Competitive Season:

- “Scout” other teams during the qualifying rounds. After the qualifying rounds, assess your scouting results and discuss alliance-forming with a veteran team.

***Note:** the competition schedule may vary for some teams, with them being either earlier or later in the season.

Non-Robot Schedule

- Kickoff
    - Every single time your team holds a meeting, record what was discussed and any decisions made in your Engineering Notebook. Have somebody take active notes during every meeting from September until the first competition.

- **First Week: Awards Discussion**
    - Discuss the different awards with your team and delegate award responsibilities.
    - Award Discussions:
        - Discuss the awards (ex. Dean's List, Inspire Award, Think Award, etc..) and designate award responsibilities to team members.
- **October: Edit Engineering Notebook/Plan Presentation**
    - Ensure that your Finance Section is accurate.
    - Have your presentation team write a script and practice before the first event.
        - Choose members to speak
    - Create and edit team bios/team overview.
    - Post on team's social media accounts.
- **POST- SEASON: Plan Outreach and Fundraising Events for your team**
    - Consider demonstrating your newly-built robot in front of an audience- reach out to nearby schools or towns to participate in town events.
    - Create a Sustainability Plan.
    - Plan and record fundraising events.

All Year Notes

- Every time your team meets to discuss/build your robot over the course of the next 2-3 months, all the details of the meeting must be included as entries in the engineering notebook.
- In addition, ensure that the financial section of the engineering notebook is completed early.

FTC TIMELINE

Pascack Pi-oneers

Project Start: Thu, 8/1/2019

Display Week: 1

8/1/19 | 9/1/19 | 10/1/19 | 11/1/19 | 12/1/19 | 1/1/20 | 2/1/20 | 3/1/20

TASK	ASSIGNED TO	PROGRESS	START	END
Pre-Kickoff				
Install Software	Robot		Aug 1st	Sept 6th
Kickoff				
Discuss Game Strategy	Robot		Sept. 7th	Sept. 14th
Awards Discussion	Non-Robot		Sept. 7th	Sept. 14th
Design Ideas	Robot		Sept. 14th	Sept. 21st
Design main scoring mechanism and Design drivetrain	Robot		Sept. 21st	Sept. 28th
Begin build/ Begin flow chart for autonomous	Robot		Oct. 1st	Oct. 27th
Drive Team practice	Robot		October	November
Edit Engineering Notebook/Plan Presentation	Non-Robot		October	November
Post-Season				
Plan Outreach Events	Non-Robot		December	Pre-Season
Plan Fundraising Event:	Non-Robot		December	Pre-Season

VI.c. Electrical System

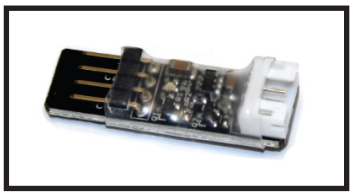
Electrical System

The following is how to do the most basic wiring on your robot.

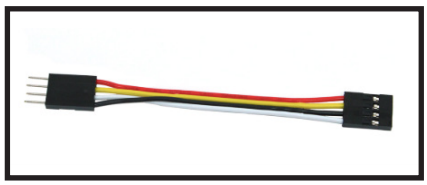
- **Connecting the Battery**
  1. Take the battery switch cable, and plug one of the yellow ends into the yellow battery section of the REV Expansion Hub.
     a. Note: you must attach this switch to your robot in an accessible place, so it can easily be turned off in the event of an emergency.

  2. Plug the other end of the cable into your battery. If your battery does not have a yellow connector on the end and instead has a red and black connector, you need to purchase an Anderson Power Pole To XT30 Adapter.

  3. Secure your battery in a safe place on your robot with a strap so that it won't fall out during a match.



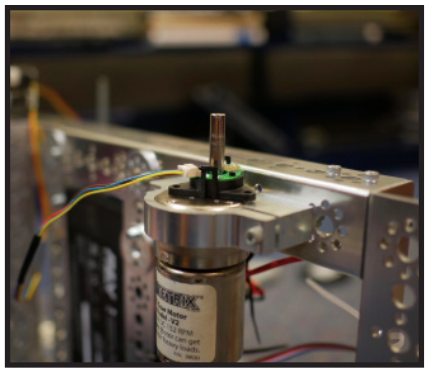
- **Modern sensors**
  1. The wire from your sensor (which should be red, white, blue, and black), should plug into the white end of the Logic Level Converter pictured here.



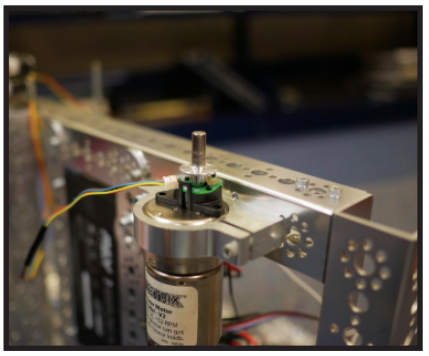
  2. On the other end, plug in the female end (black end with no metal pins sticking out) of a Sensor Cable adaptor wire into the other side of the Level Converter.
     Level sensor boards are necessary for sensors that run on a 5 Volt system since the Expansion Hub runs on a 3.3 Volt system.
  3. Plug the other end of the Sensor Cable into the REV expansion Hub in the top area (the cable will only fit in one place).

- **Writing Encoders**

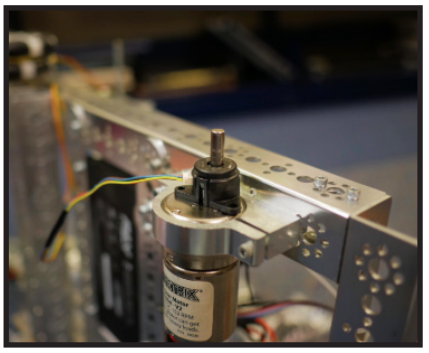
1. For motors without built-in encoders, you must assemble the encoder kit onto the motor.
    a. Take the bottom piece of the kit (the largest plastic piece with the green board) and slide it down the shaft of the motor.



2. Take the silver piece and carefully slide it down the shaft. NOTE: do not touch it with your hands, use gloves or another piece to push down on it, the oils on your hands will damage the piece.



3. Put on the black plastic cover and make sure it snaps into place.
    a. Put the maroon, blue, green, and yellow wire into the cream-colored opening.



4. Take the encoder wire from the motor and plug it into the level converter board. Ensure the red wire from the encoder cable lines up with the 5V on the back of the board.
5. Put two bolts from the plastic fitting into the motor.
6. Connect a JST PH 4-pin cable into the other end of the level converter board.
7. Plug the other end of the JST PH 4-pin Cable into the expansion hub, in the port perpendicular to the motor plug.

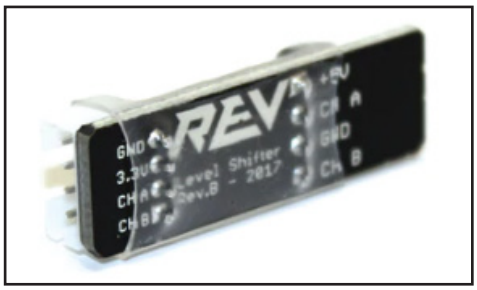
- **Wiring Servos**

1. Take the servo wire and plug it into the first slot on the left on the bottom row of slots on the expansion hub. If the wire is not long enough, purchase an extension and secure the connection between the servo wire and the extension wire with electrical tape.

- **12 Volt DC Motors**

1. To attach a 12 Volt DC Motor to an expansion hub, you will need the motor adapter cables that usually come with the expansion hub itself.
    a. Link the motor cable to the motor adapter cable.
    b. Then, attach the motor adapter cable to any one of the two-pronged connection ports on the hub.

2. Next, you need to connect the encoder to the expansion hub. Connect the encoder to a level converter. Make sure the red wire lines up with the pin that says “5V”. After this, you should connect a JST PH 4-pin to the other side of the level converter.



3. Finally, plug the JST 4-pin to the port next to the two-pronged port you connected it to.

- **Wiring tips:**
    - Secure wires with zip ties.
    - Ensure wires are not near moving parts of the robot.
    - Avoid pulling the wires too tight so that wires are not in danger of ripping out of their respective components.
    - Any connectors that are in danger of slipping out should be secured with zip ties or electrical tape. This includes Anderson to Anderson connections, male to female connections, etc.
    - Secure your battery in a box with a velcro strap.
    - Place the Samsung phone and the Control Hub where no robot can potentially hit or interfere with it, but as far from the 12V DC motors as possible.

VI.d. Example Robots

Examples

The following are examples from the 2017 FTC Relic Recovery Game. Below are some videos of robots from that year as well as what mechanisms they used. Hopefully, this can give your team inspiration and different ideas on building your robot.

- FTC 8680: https://www.youtube.com/watch?v=6p8zrfeR5wc
  - Built using a tetrix kit.
  - Intake
    - Auto-corrects glyph block quickly so it enters up the ramp square.
    - If two blocks are on top of each other, can also choose which enters the intake first.
    - Has four wheels spinning in opposite directions (i.e. the right wheels spin clockwise, the left set of wheels spin counterclockwise).
    - When releasing the blocks into the shelf, the platform the cubes rest on becomes vertical and releases it into the cipher.
  - Chassis
    - Mecanum wheels for vectoring movement on the field.
    - Drivetrain shape: not sure what it is, but could be the classic rectangle shape or holonomic (H drivetrain shape).
  - Why was the robot successful?
    - Versatile (could score points for every mission in the game)
      - Glyph shelf.
      - Knocking away the Jewel.
      - Transporting Relic to the farthest blue square.
      - Balancing on the balance stone.
  - Effective
    - For glyph blocks, it was able to correct the diagonal orientation to square, making it easier for the blocks to enter the intake.
      - Efficient process.
      - Also had the choice of choosing different colored blocks for patterns during the game.

- Autonomous
    - Able to knock away the jewel quickly (sensors).
    - Can detect glyph collection.
    - Can place from 2-4 glyphs into the shelf.
  - Relic arm
    - Could grab the relic at a variety of angles and positions without fail.
    - It saved time during teleop.
    - Bunch of similar-sized metal stacked on top of each other, but when extended, the ends were held together allowed to stretch b/c of a spring attached to it.
    - Space-saving as when retracted it stacked on top of each other against one of the robot's sides.
- FTC 7182: https://www.youtube.com/watch?v=1pS1FdOWDKg
  - Built using a Tetrix Kit.
  - Omni Wheel intake
    - On the side has plastic wheels that retract when two glyphs are held inside the intake.
      - Uses metal piece connected near the side of Omni wheel.
      - Has springs on the top part.
      - A smart way to save space, especially if there are certain parameter requirement.
    - Two glyphs can be held in it because the Omni wheels push the first glyph cube up.
  - Elevator Mechanism
    - Efficient -- can quickly reach desired height to place glyphs.
    - Stable since it doesn't tip or shake when the elevator goes up.
      - It can also move the intake up as it's moving forward.
  - Chassis
    - Mecanum wheels
      - Allows for vectoring movement -- move in any direction.
      - Uses a standard chassis shape.

- Why was the robot successful?
    - Based on the game that year, their main strategy was to be a point-scoring robot with lots of versatility + flexibility:
        - Could complete the glyph cube shelf.
        - Pick up the relic and place it to the farthest box outside the playing field.
        - Knocking away the opposing team color's jewel.
        - *good strategy, however as it takes time to create and develop successful mechanisms/parts of the robot, focus on the most significant parts of your strategy first.
    - Fast and efficient
        - Could move around the field quickly to collect cubes and other game pieces.
        - The intake collects blocks easily and has no trouble releasing them into the shelf (bit diagonal, but still fits).
        - Elevator mechanism works very quickly, even when the robot is moving forward.
        - Intake (all the different parts could move quickly and at the same time).
            - Elevator mechanism.
            - Omni wheel intake.
            - Spring-deploying side pieces that could retract back to save space.
- Durable
    - All four sides of the robot are protected.
        - The wires near the back have plastic (not sure what it would be called) protecting the wires as well as on the sides.
        - The intake/elevator serves as a double purpose.
    - When the elevator mechanism is in action, it doesn't tip over or shake.
            - Can also work in motion (moving forward) without any of those side effects.
- FTC 11100: https://www.youtube.com/watch?v=nykMpg9jQs
    - Built using a tetrix kit.
    - Intake
        - Has spring-deploying wheels that help with aligning the glyphs.
            - Enter the robot better, even if it takes more time.

- Elevator mechanism
    - Contains part of the intake; where the blocks rest on.
    - Uses sliders against x-bar metal pieces.
    - Has springs attached on each side.
    - Can lift two blocks up in a horizontal position before flipping the ramp 90 degrees (vertical) to release.
- Why was this robot so successful?
    - Their strategy was similar to the ones mentioned above: to be both versatile and flexible to score as many points as possible.
        - Autonomous
            - Glyph recognition sensors
                - Can score more points during this time and can choose certain colors they need.
            - Jewel Scoring
                - Color sensing and arm that detaches from the side of the robot to knock away the color.
            - All folded up on the side of the robot.
            - In a semi-folded up position where it can easily extend and retract to place the relic arm.
        - Auto-balancing
            - Save time at the end of the match when the driver is trying to get the robot to balance on the balancing stone.
    - Functional
        - The ramp that the glyphs go on also is used as the release that makes sure that the boxes are in the crypto box (multiple functions using one mechanism rather than multiple).
            - Also has an elevator at the end that can lift two glyph blocks without them falling out.

- Durable
    - Design of the robot allows for all the electrical and mechanical parts to be protected by the strong walls.
        - Both on the exterior and interior as there is a wall separating for glyph blocks.
- Here are a few examples of the FTC Relic Recovery competition matches:
    - https://www.youtube.com/watch?v=G_zCN5i-nX8&list=WL&index=2&t=0s
        - If you look at the red alliance (team 8684 and this unknown team) during their autonomous, they both:
            - Knock away the blue jewel.
            - And collect blocks to begin building their cipher shelves.
        - With thirty seconds left to go, they complete all the missions they need to do.
    - https://www.youtube.com/watch?v=HGchRiKJBZo
        - Focuses on the red alliance (team 9879 and team 7209).
        - During autonomous, they both are able to knock away the opposing alliance's jewel and place some blocks in their glyph shelf.
        - Team 2709 uses a unique intake system where it rotates 180 degrees to pick up a second block (quite efficient).
            - This team supports its ally 9879 near the middle of the video where the crypto box still needs one more glyph.

    - https://www.youtube.com/watch?v=oTCUtUx-dsM
        - Focusing on the red alliance (team 11100 and team 8684).
        - During autonomous, both robots place blocks in their crypto boxes and knock away the jewel.
        - Cooperated well with each other.
            - Team 8684 waiting for team 11100 to finish placing the relic and giving them the space to go back to the balancing stone.

- How an example robot is built: FTC Relic Recovery 2017
    - The following video provides an example of all basic components in detail.
    - Link: https://www.youtube.com/watch?v=89S3aRfL7mY
        - Basic Structure of 2017 robot
            - Drivetrain- a hybrid of parts from several manufacturers, which were designed to function as one.
                - 6 Andymark stealth wheels.
                - Gears- REV robotics Delrin plastic gears.
                - Four AndyMark motors- Never Rest Orbital 20.
                - Ordered Custom Laser Cut Pieces.
            - Chassis
                - REV robotics extrusion 15 millimeter.
            - Arm - excursion from the robot to move the intake (not to be confused with the intake, that picks up the pieces).
                - Single-Axis arm.
                - Whole arm is driven by a never rest motor with a never rest Fort 256 to 1 gearbox.
                    - Very robust, comes with a nub that is integrated.
                        - To that, they bolted one of the ANDYMARK ninja sprockets, and that goes up to one of the REV Delrin sprockets (hybrid system).
                    - With that, the whole structure is a hybrid.
                        - S3 rail from ANDYMARK for the substructure and the arm is the REV 15 millimeter rail (gives whole structure, very strong and lightweight).
                - At the end of the arm is a really simple gripper - taking some of the extrusion, put some surgical tubing on it, and attached a REV robotics smart servo on it just to get the extrusion to be able to grip onto the blocks (glyphs).

Additional References Page

Chief delphi

FTC TUTORIALS SET: https://www.youtube.com/watch?v=uTjYo9w0TaY&list=PLJIJCo7cYsE-ma0iYtb-Cf27s7zgLq-73i

https://gm0.copperforge.cc/en/stable/docs/getting-started-in-ftc/index.html

VII. Packing List

- Your robot
- Engineering Notebook (2 copies)
- Tools
- Spare parts
- Extra surge protector
- Extension cords
- Phone chargers
- Battery chargers
- Gamepads
- Phones
- Laptop
- First aid kit
- Team swag and pit display
- Things you must print and bring:
    - Team Roster
    - Robot Inspection Forms
    - Field Inspection Checklist
    - Scouting Form
    - Control Award Content Sheet
    - Team Judging Self-Reflection Sheet
    - Engineering Notebook Checklist
    - All forms located:
      https://www.firstinspires.org/resource-library/ftc/preparing-for-competition
- Personal
    - Safety Glasses
    - Team shirt
    - Camera for photos & videos

Good luck and see you at the competiton!

FIRST Robotics Competition Team 1676, The Pascack Pi-oneers, was established during the 2004-2005 season in Montvale, New Jersey. Team 1676 created this guide to help rookie teams learn to operate cohesively and and become self-sufficient.

If your team has any questions or concerns, please reach out!

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