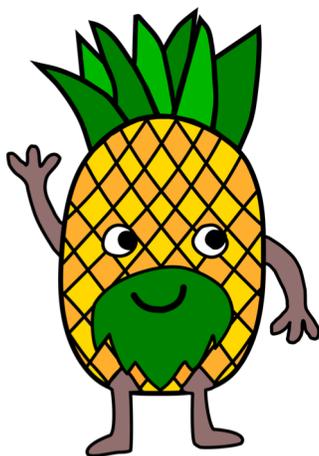


# FTC: What to Expect

## What is this Document?



Our team has found that it can be really hard for new teams to get started with FIRST Tech Challenge, so we want to give your team an idea of all the different areas you can learn about in FTC. Our goal with this document is to set expectations of what your first season will look like and to help you feel a bit less overwhelmed.

The beginning levels of each area are reasonable to aim for during your first season, and the intermediate and advanced levels are intended to give your team an idea of where the team could go. The ceiling is high for FTC and there are new things to learn even if your team stays with the program throughout all the middle and high school years.

## Coming from Different Levels of Experience

### FTC as an absolute FIRST rookie

Use your first year as a learning year and try to do a bit from each section. Come back for a second year after gaining some experience from the first year.

### FTC coming from FLL

Generally, FTC is more time-consuming than FLL. The amount of time it takes to build the robot is much greater. Even prototyping is a lot more time-consuming, as you cannot just snap together LEGOs. The amount of drive practice will also be a lot more, because part of the game is driver controlled and less automated.

In FTC, there is no project, but probably most comparable to the project is the engineering notebook, and outreach and networking are still part of the program.



# Resources

## Beginner

**Read the Game Manuals.** The Game Manual comes in two parts every year. Part 1 is released in mid to early July in the off-season, and Part 2 is released on Kickoff day. The Game Manuals can be found on the resources page for the current season on [firstinspires.org](http://firstinspires.org) (go to *Programs* → *FIRST Tech Challenge* → *Game & Season* → *Game Materials*).

**Get Familiar with the Award Structure.** This can be found in Game Manual Part 1. Make sure to note differences between awards and requirements to meet them, especially differences between Motivate and Connect awards, which are quite similar.

**Get Familiar with the Game Structure.** This can be found in Game Manual Part 1. Make sure you understand what type of structure is used in your regions.

**Attend Workshops with your Team.** Many Kickoff events will host workshops, and some teams do this throughout the season as well. Try to split up your team to attend all of the workshops that your team deems as important.

## Intermediate

**Regularly check the game updates.** The complete pdf of answered questions can be found here: <https://www.firstinspires.org/resource-library/ftc/game-and-season-info>. If your team wants to post on the FTC forum because you have a question, the link above also has resources on registering for and posting on the forum. The forum allows teams to get official feedback.

**Keep up with the FTC Reddit.** Many teams have discussion posts on r/FTC on Reddit. There are also a lot of memes about FTC there, so if you are only concerned about serious discussions, ignore the memes.

**Use YouTube as a resource.** Watch some YouTube videos relating to the current season to get familiar with the game. Many teams will also share tutorials on YouTube. Our team has found YouTube tutorials especially useful when learning to CAD.

## Advanced

**Read Research Papers about Robotics.** When you find that there could be a need for it, find research papers to gain a better understanding of the math needed for your projects. One paper that our team has read was a paper on the math needed for mecanum wheels, which we did our own math for.



# Outreach

## Beginner

**Create a team email account that can be used to contact other teams or outreach event organizers.** When using your email to send out emails, you may want to include your own name along with your team name so people you are in communication with feel like they are talking to a real person.

**Watch email communication from FIRST WA and sign up when they ask for team participation for events.** Respond as soon as possible because spots can fill up quickly. Being easy to contact and responding quickly also shows that your team is reliable, which will also make the team be more likely to be contacted for future events.

## Intermediate

**Email people and ask for outreach opportunities.** It may be helpful to keep a running list of companies you want to contact.

**Mentor FLL or new FTC teams.** Finding mentors can be really hard for some teams so having help from other teams in the community can really help these teams and can also be fun for your team.

**Ask friends, relatives and mentors who work at engineering companies if your team can present at their workplace.** It can be much easier to get in contact with a company if you know an employee. Additionally, it can be much easier to present at a familiar company.

## Advanced

**Contact companies (where you don't know employees) for sponsorships.** Some sponsorships that could benefit your team include: poster printing, t-shirt printing, or parts/manufacturing. If you are able to get them to sponsor you, we recommend that you visit their business because it can give you a better idea of what they can do for you. Sometimes calling these companies to obtain sponsorships can be more effective than emailing them.

**Organize your own outreach event(s).**



# Networking and Social

## Beginner

**Create (a) social media account(s).** Having a social media account can be beneficial because it allows other teams can find contact message you if they need something from your team, but it can also be fun to share your team's journey or to interact with other teams using social media. We have noticed most teams are on Twitter, through there is a good amount on Instagram too. (However, very few teams have a Facebook or a Snapchat account.) Your team may also want to make a YouTube account if you choose to post videos. Your team may choose to create multiple social media accounts for the team, but remember that the more you have, the more work they are to upkeep.

**Start following some teams on social media.** Once you have followed a few, most social media platforms will recommend you more accounts to follow. This will also get your team's social media recommended to other teams, and hopefully the teams you follow will also follow you back.

## Intermediate

**Create a website for your team.** Our team uses Weebly, because it is much easier to design and edit the website, though there are other services that are similar to Weebly that are easy to use. Consider including a link to your website in your emails to strangers, as it will make your team appear more legitimate. Make sure you give information on how to contact your team on the website: include your team email and your social media accounts. Other things you may choose to include on your website: a blog, information about who your team is, or team member bios.

**Start posting on Social Media.** Make sure to use FIRST hashtags to help other teams find your posts. Some of these hashtags include #omgrobots, #FIRSTisSTEM, and #stemsquad. Often, you may also want to use hashtags for specific events (like #FIRSTChamp for the World Championship)

## Advanced

**Use social media to start a new program or cause.** Some existing FIRST-related social media causes include FIRST ladies, LGBTQ+ of FIRST, and FIRST Like a Girl. Explore some of these existing causes and contribute to these existing causes, or choose to start a new one.

**Keep posting on social media and keep your website up-to-date.** Regularly posting whenever you have something interesting to share and keep your social media active.

**Create YouTube videos.** Create tutorials for other teams and/or help existing causes (e.g. FIRST Like a Girl, is a cause that encourages people to make videos on girls in FIRST)



# Competition Preparations

## Beginner

**Attend a scrimmage.** Scrimmages can allow you to practice gameplay with other teams or to exchange ideas and ask questions. Feel what it's like to have four robots on a field. Girl Scouts often organizes one for FLL every year, we hope to have one for FTC soon.

**Plan for at least one hour of drive practice for an event.**

**Be able to recognize small errors in the field that could mess up your robots, and tell the referee about them.** If your robot relies on specific field setup rules (your autonomous is especially prone to this) ensure that the field has been set up correctly.

**Know what to bring to a competition.** Besides needing your robot, if you are going to a competition with judging, you will also need your engineering notebook. You may want to bring some spare parts for robot, especially the ones that may be more prone to breaking (parts like servos). You will also want a few tools, like basic wrenches and duct tape.

## Intermediate

**Plan for at least 5 hours of drive practice for an event.**

**Keep people at your pit.** For events with judging, make sure that you always have people at your table to talk to judges if they come by for pit interviews. These people should be able to answer questions relating to all awards, or know who to ask. Judges will usually be accommodating to your team if you need to get a specific person from your team (e.g. the judges ask about your code, and you need to get the main programmer because they know more about the code).

## Advanced

**Organize and invite other teams to your own scrimmage.**

**Build a pit.** At lower levels of competition, the pits are usually made up tables and very few teams have "designed" pits. However, at higher levels of competition (definitely at Worlds), teams are offered a larger pit space and teams may choose to have a more designed pit. (Picture on the right is our team at West Super-regionals in 2018).



# Scouting

Scouting is the process of interviewing, talking to, or observing teams and their robots abilities to find out which teams could make the best alliance partners during Elimination Matches.

## Beginner

**Know what your robot can do and be able to describe it to other teams.** This not only helps other teams scout you, but can also be necessary to be able strategize well for qualification matches.

**After receiving your match schedule, talk to the teams you will be partnered with to talk about game strategy and to make sure your robots won't run into each other in autonomous.** This way you can avoid damages to both the robots and you can avoid missing points that you would otherwise receive.

**Don't expect to be an alliance captain or to be picked for elimination matches.** Most teams that become alliance captains will likely pick experienced teams that combine well with their robots' abilities.

## Intermediate

**Consider using field diagrams and drawings to show other teams your autonomous paths if you have an autonomous.**

**Start observing other matches to get an idea of other teams' capabilities and reliability.** This allows you to make an educated pick should you happen to be an alliance captain.

**Look at OPR and scoring, ranking.** This can be a good way to scout without having to score your own matches.

## Advanced

**Have team members systematically score matches per robot.** If you combine this with calculations and graphs, you can analyze how consistent a robot is. Scoring matches per robot will give you more data than official match scoring will and will allow you to make educated picks during alliance selection.



# CAD

CAD, or Computer-Aided Design, software is used to design an object on a computer. CAD can be used to design parts that will be manufactured or 3D-printed, but CAD can also be used to design whole robots and mechanisms to ensure they fit together.

## Beginner

**Know the difference between the two types of CAD.** *Part* CAD is designing and modelling a single part, while *assembly* CAD is assembling multiple parts into an *assembly*.

**Choose a CAD program.** There is a variety of programs made available to teams by FIRST robotics or programs that are free for students. Some of these links focus on FRC rather than FTC; Make sure you get the FTC Kit of Parts (KOP) where available.

PTC Creo Parametric: <https://www.ptc.com/en/academic-program/k-12-program/students/first>

Autodesk Inventor/Fusion 360: <https://www.autodesk.com/education/competitions-and-events/first/recommended-software>

Solidworks: <https://www.firstinspires.org/resource-library/frc/solidworks-for-kit-of-parts>

**Download the Kit of Parts.** You should be able to find it with the same links above. Note: you can also download parts from vendor websites when buying other parts.

## Intermediate

**Using the kit of parts, make as assemblies.** Try building a CAD model of an existing robot that your team has built, or design a new robot using CAD.

**Practice part-CAD.** Learn and practice basic sketching and extruding. Model existing real-life parts or try designing a new part.

**Create a simple adapter to mount a sensor on a Tetrrix beam.**

## Advanced

**Use CAD to compute weight/density/COG.** Use more advanced tools to calculate data about your robot.

**Create a linkage and simulate (animate) its movement.** This allows you to build and test mechanisms without having to make a physical prototype.



# Robot Building

## Beginner

**Build, wire, and test-drive a Pushbot.** The Pushbot (which is a basic robot building guide provided by FIRST) can be found at <https://www.firstinspires.org/resource-library/ftc/robot-building-resources>. Pushbot is a great way to get started on learning to put together Tetrax pieces without having to design your own robot first.

**Look at videos of other robots on YouTube from the current season.** Especially observe innovative and consistent mechanisms.

## Intermediate

**Start with a kit of parts and go to the following sites to find more parts.** (Hint: you may need to get adapters for parts if you get parts from different vendors.)

[revrobotics.com](http://revrobotics.com)

[pitsco.com](http://pitsco.com)

[andymark.co](http://andymark.co)

[servocity.com](http://servocity.com)

[mcmaster.com](http://mcmaster.com)

[digikey.com](http://digikey.com)

**Check out some of the following parts:** mecanum wheels, orbital NeveRests, belts and pulleys, and servos with titanium gears.

## Advanced

**Get access to a garage space.** Many organizations have a garage space filled with tools that teams can access, like the Girl Scouts of Western Washington office, at Microsoft, or at Google. Sometimes, your mentors can help you gain access to these garages. Try using a 3D printer, a laser cutter, a drill press, a CNC mill, etc.

**Find other ways to explore robot design.** Try 3D printing: go to [thingiverse.com](http://thingiverse.com) and look for parts to print. Experiment with laser cutting safe plastics or wood.



# Programming

## Beginner

**Many beginning teams will not have an autonomous at their first event.** At the second event, many will have a highly-inconsistent autonomous that only scores some elements.

**Program controllers that allow you to participate in TeleOp, only scoring some elements.** This can get you pretty far at less competitive events when combined with some drive practice.

**Observe other teams at your qualifier events and try to replicate that for the next event.** Rather than staying "ahead of the game", you catch up with the game.

**Consider using the FTC Blocks Programming Tool.** This tool is relatively new, but is much easier for teams to get started with programming. To find [more information](#) on Blocks programming, go to [firstinspires.org](http://firstinspires.org) → "Programs" → FIRST Tech Challenge → Game and Season → Quick Links → Programming Resources.

## Intermediate

**Use Java (or Kotlin).**

**Use Vuforia.** Vuforia can recognize a Vumark (think QR code) and can also tell you where the Vumark is located relative to your robot.

**Have multiple autonomous modes to combine well with other teams.** By having multiple autonomous programs you can avoid running into other robots.

## Advanced

**Depending on how the game works, it is not unheard of that some teams can score all autonomous elements at their first event.** (However, they will usually be a bit inconsistent.)

**Navigation using sensor fusion and/or Computer Vision (OpenCV).** Sensor fusion is combining data from different sensors to get a more precise result (e.g. combining data from the accelerometer, which is noisy, and motor encoders, which don't account for the wheels slipping. By using sensor fusion you can get data that is overall more accurate and avoids errors from all sensors being used.) OpenCV is a software library that allows your robot to process images taken from the robot's camera so the robot can recognize objects in images and use them for navigation or aiming.



# Engineering Notebook

The Engineering Notebook is a tool for teams to document robot design, research, outreach, team meetings, and plans for growth. The notebook often includes sketches, photos, diagrams, software development, and more. The Notebook is also evaluated during the judging process.

## Beginner

**Look at engineering notebook examples online.** FIRST has some posted on their website (go to [firstinspires.org](http://firstinspires.org) → “Programs” → FIRST Tech Challenge → Team Basics → Quick Links → Team Management Resources). Read or skim through a few of these just to get an idea of what one looks like.

**Read the requirements for an engineering notebook.** When these requirements aren’t met, your notebook may be excluded from consideration for notebook-based awards. These requirements can be found on the same page as engineering notebook examples on [firstinspires.org](http://firstinspires.org).

## Intermediate

**Start making notebook entries.** Ideally, start practicing and get in the habit during the off-season. There are a couple ways to get started with writing engineering notebook entries.

Method 1: Buy a bound engineering notebook and handwrite your entries. Write an entry at the end of every meeting.

Method 2: Use an engineering notebook generator – the format is generated for you (FTC team Supposable Thumbs’ version of this: <http://www.supposablethumbs.org/thumb-bumps-tips-tricks/engineering-notebook-app/>)

**If you are creating a digital notebook, find a place to store it.** Choose a place to save and share your notebook that all team members can access (like GoogleDocs or OneDrive).

**Track your engineering notebook entries.** Especially if you have a digital notebook, you may need to find a way to track these entries. Our team uses and recommends Trello for this.

## Advanced

**After experimenting with some different methods of engineering notebook, choose one format/method that works best for your team.** If you want to create a digital notebook, consider creating your own template for notebooks. You may realize that your daily log doesn’t include everything your team wants the judges to know. Many teams include sections in the notebook that are written retroactively and include information about the total outreach and business plan, or pictures of CAD models, etc.



# Team Management

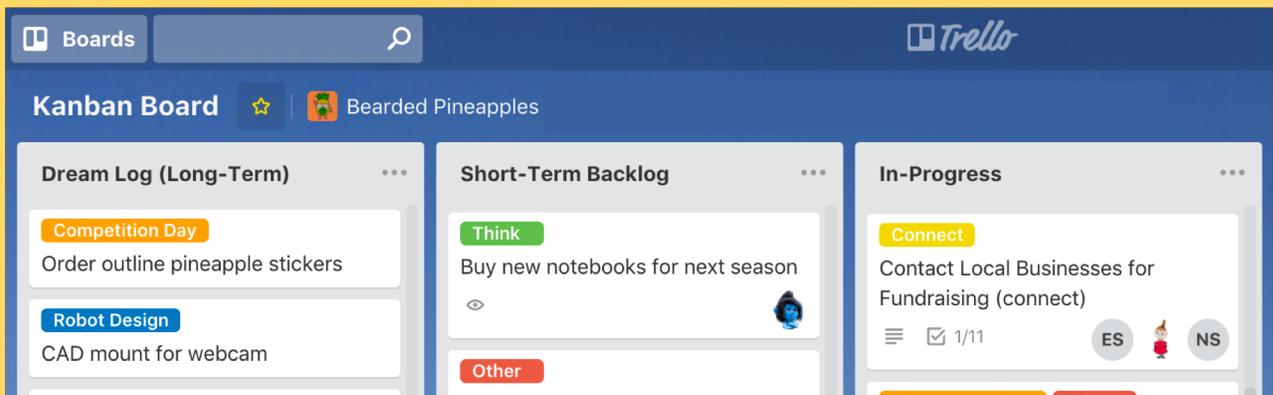
## Beginner

**Find a way to communicate with your team.** We recommend Slack, but if your team prefers email, Google Groups, Band, other messaging apps, etc., those can work too.

## Intermediate

**Set goals.** Consider having regular strategy meetings to stay on track.

**Establish a way to track work items.** Choose a method that works best for your team. We can recommend using a Kanban board, which uses stickies to represent work items. These stickies are transferred through different columns (such as To Do/Backlog as → In Progress → Done) as the work item reaches these stages as well. We personally use Trello, which is a digital Kanban board and allows everyone on the team to access and change the stickies from anywhere. Other teams



## Advanced

**Decide whether or not your team wants to incorporate roles into your team management.** This can be done on different levels: you may choose to separate tasks more (e.g. an email manager who keeps track of the team inbox) or you may choose to group tasks more (e.g. an outreach manager, whose responsibilities include keeping track of the team inbox). While roles may sound like they can restrict members, roles can just be a tool to ensure a team gets all of their tasks done. Some roles that help get tasks done that can be hard to keep track of include Financial Manager, Email Manager, Notebook Manager, Social Media Manager, and Calendar/Scheduling Manager. Some teams choose to have a "Team Captain".

**Manage your own financials and expense your own costs.** Our team has a large Excel document for this.

