

# 2014-2015 *FIRST*Tech Challenge<sup>®</sup> Mentor Guide



FOR INSPIRATION AND RECOGNITION OF SCIENCE AND TECHNOLOGY

**FIRST<sup>®</sup>**

Special thanks to: Enable Training and Consulting, Inc.

Additional thanks to: Steve Pendergrast and the Pope John XXIII Regional High School Robotics Team for contributing content from their book, *FTC® Robotics: Tips, Tricks, Strategies, and Secrets*.

Graphics by Enable Training and Consulting, Inc.

All building instructions for this guide were modeled using PTC Creo/Elements Pro software. PTC, The Product Development Company, Creo, Elements/Pro, Mathcad and Windchill are trademarks or registered trademarks of Parametric Technology Corporation or its subsidiaries in the United States and other countries.

Photos by *FIRST®* Robotics, except: pages 23, 52, 59, 66, and 76 by Scott W. Nichols from The Webb School Qualifying Tournament 2014.

*FIRST®*, the *FIRST®* logo, *FIRST®* Tech Challenge, and *FTC®* are registered trademarks, and *FIRST®* Place™, Coopertition™, Gracious Professionalism™, and Sport for the Mind™ are common law trademarks, of the United States Foundation for Inspiration and Recognition of Science and Technology (*FIRST®*). *TETRIX®* is a trademark of Pitsco, Inc. All other trademarks are the property of their respective owners. ©2012 *FIRST*. All rights reserved.

LEGO®, the LEGO logo, DUPLO®, WeDo®, MINDSTORMS®, and the MINDSTORMS logo are trademarks of the LEGO Group ©2012. *TETRIX* by Pitsco is a trademark of Pitsco, Inc. ©2012.

*\*Pitsco, Inc. is not responsible for bodily injury or property damage that results from misuse of its products. Use this product with caution and follow all directions and safety procedures to ensure student safety.*

©2012 The United States Foundation for Inspiration and Recognition of Science and Technology (*FIRST*) and The LEGO Group. All rights reserved. Corporate logo and the Eagle logo are trademarks of National Instruments.



FIRST® Tech Challenge

## About FIRST®

*“...to create a world where science and technology are celebrated... where young people dream of becoming science and technology leaders.”*

- Dean Kamen, **FIRST®** Founder

**FIRST**: (For Inspiration and Recognition of Science and Technology) was founded by inventor Dean Kamen to inspire young people’s interest and participation in science and technology. Based in Manchester, New Hampshire, **FIRST** is a 501(c)(3) not- for-profit public charity.

As a Volunteer-driven organization, **FIRST** is built on partnerships with individuals, as well as businesses, educational institutions, and government. To help make the **FIRST** mission a reality, some of the world’s most respected companies provide funding, Mentorship, time, and equipment. Mentors include over 130,000 committed Volunteers who are integral to introducing almost 250,000 young people to the joy of problem solving through engineering.

**FIRST** provides four programs:

- **FIRST®** Robotics Competition (FRC®) for grades 9 to12, ages 14 to 18 year-olds;
- **FIRST®** Tech Challenge (FTC®) for grades 7 to 12, ages 12 to 18 year-olds;
- **FIRST®** LEGO® League (FLL®) for 9 to 14 year-olds;
- Junior **FIRST®** LEGO® League (Jr. FLL®) for 6 to 9 year-olds.

Also located at **FIRST** headquarters is the research and development facility called **FIRST Place™**. **FIRST Place** is integral to Game design, new program development, evaluation, and the professional development of **FIRST** Mentors.



*“We want to change the culture by celebrating the mind. We need to show kids that it’s more fun to design and create a video Game than it is to play one.”*

- Dean Kamen, **FIRST** Founder

Dean Kamen is President of DEKA Research & Development Corporation, a dynamic company focused on the development of revolutionary new technologies with a wide range of applications. As an inventor, physicist, and entrepreneur, Dean has dedicated his life to developing technologies that help people lead better lives. Dean’s proudest accomplishment is **FIRST**.

## Table of Contents

About <i>FIRST</i> .....	3
Introduction .....	7
What is the <i>FIRST</i> Tech Challenge Mentor Guide? .....	7
What is the TETRIX Getting Started Guide: FTC Extension? .....	7
A Brief Introduction to FTC .....	8
What is the <i>FIRST</i> Tech Challenge?.....	8
<i>FIRST</i> Tech Challenge (FTC) Core Values.....	8
FTC Coach’s Promise.....	9
Gracious Professionalism™ .....	10
Competing in <i>FIRST</i> Tech Challenge.....	11
Community Outreach .....	12
Youth Protection Program (YPP).....	14
The Mentor .....	15
What is a Mentor? .....	15
Advice for Mentors .....	17
Twelve Basic Guidelines for Mentors .....	18
Mentor Time Management .....	18
The FTC Team.....	20
Team Overview .....	20
Building a Team .....	21
Team Members.....	22
The Team Dynamic .....	30
<i>FIRST</i> Teams .....	30
Creating a Positive Team Dynamic .....	30
Managing Stress.....	33
Resolving Conflicts.....	34
Evaluating Team Progress.....	34
Defining Roles .....	35
The Mentor as a Facilitator.....	35
10 Steps to Being an Effective FTC Facilitator .....	35
Student Responsibilities .....	38
Transferring Ownership from Mentors to Students.....	38

Preparing Students to Be Mentors .....	39
Preparing the Team .....	40
Explaining the Rules and the Challenge .....	40
The Engineering Notebook .....	40
Team Meetings .....	43
Preparing the Team for the Season .....	46
Preparing the Team for Judging.....	47
Preparing the Drive Team for Competition .....	48
Preparing the Pit Crew for Competition .....	49
Getting Familiar with the FTC Competition Kits .....	49
Getting to Work .....	51
Safety for FTC.....	51
Planning .....	52
Developing Strategy.....	53
Brainstorming .....	54
Designing a Robot .....	55
Prototyping .....	58
Building .....	58
Programming .....	60
Tournament 101 .....	63
FTC Events.....	63
Tournament Registration.....	65
Tournament Logistics.....	66
Tournament Areas .....	66
What to Expect at a Tournament .....	67
Adult Supervision and Safety .....	71
Inspections.....	71
Queuing and Rounds.....	72
Game Play .....	72
Scoring .....	74
Alliance Strategy and Scouting .....	75
General Guidelines for Tournaments: .....	75
FTC Judging .....	78

How Judging Works .....78

Awards .....78

FIRSTTech Challenge Awards Categories .....79

Funding .....85

    Planning a Budget .....85

    Gathering Funding and Support .....87

Seasonal Planning Tool .....90

Celebration and Recognition .....92

    Celebrating the End of the FIRST Tech Season .....92

Help and Resources .....94

    FIRST Contact Information .....94

    Registration for FTC .....94

    Affiliate Partners .....94

    Kit of Parts.....95

    Getting Answers to Game Questions.....95

    Technical and Team Support .....95

    Team Development Support.....96

Additional FTC Resources and Extension Activities are available at [www.TETRIXRobotics.com/FTC](http://www.TETRIXRobotics.com/FTC).

## Introduction

### What is the *FIRST*Tech Challenge Mentor Guide?

The purpose of the *FIRST*Tech Challenge Mentor Guide is to:

- Provide new Mentors with a foundation of knowledge and ideas to get their Teams up and running smoothly in the *FIRST*Tech Challenge.
- Familiarize new Mentors and Team members with the *FIRST* experience.
- Help returning Mentors develop a deeper understanding of the Mentoring process as their FTC Team evolves.

The guide focuses on the skills and concepts needed for the development of the following general goals:

- Making the Mentoring process easier for newly-established and veteran Teams.
- Providing a clear understanding of the Mentoring process and relationship.
- Developing reciprocal learning between student and Mentor.
- Providing Mentors with general information, tips, best practices, organizational tools and strategies, planning tools, and guidance to manage a Team effectively throughout the season.



### What is the *TETRIX* Getting Started Guide: FTC Extension?

The *TETRIX Getting Started Guide: FTC Extension* is a resource created in cooperation by *FIRST*, LEGO Education, and Pitsco. This extension is available free of charge to all *FIRST*Tech Challenge participants. It has been created to provide Teams with key experiences for successful participation in FTC and includes extension activities that help Teams get familiar with the Samantha module, Field Control System, and advanced programming techniques for a successful start in FTC. For hands-on activities and support materials specific to FTC, go to <http://www.TETRIXRobotics.com/FTC>.

The *TETRIX Getting Started Guide: FTC Extension* builds on the knowledge and general *TETRIX* building and programming experiences gained from the *TETRIX Getting Started Guide*, available at <http://www.TETRIXRobotics.com/GettingStartedGuide/>.

It is suggested that users begin with a thorough review of the materials and resources available in the *TETRIX Getting Started Guide*, before moving into the FTC-specific *TETRIX Getting Started Guide: FTC Extension*. Additional materials to bring *TETRIX* and Robotics into classrooms and extracurricular clubs can be found at [www.LEGOEducation.us](http://www.LEGOEducation.us).

**Whether you are using a MATRIX or TETRIX kit, the *TETRIX Getting Started Guide: FTC Extension* will be a valuable resource.**

## A Brief Introduction to FTC

### What is the *FIRST*Tech Challenge?

*FIRST*Tech Challenge is a student-centered activity that focuses on giving students a unique and stimulating experience. Each year, Teams participate in a new Game that requires them to design, build, test, and program autonomous and driver-operated Robots that must perform a series of tasks.

The Playing Field for the Game consists of the *FIRST* Tech Challenge Game Pieces set up on a foam-mat surface, surrounded by a metal and Lexan Field frame. Each Tournament features Alliances, which are comprised of two Teams, competing against one another on the Playing Field. Teams work to overcome obstacles and meet challenges, while learning from and interacting with their peers and adult Mentors. Students develop a greater appreciation of science and technology and how they might use that knowledge to impact the world around them in a positive manner.

They also cultivate life skills such as:

- Planning, brainstorming, and creative problem-solving.
- Research and technical skills.
- Collaboration and Teamwork.
- Appreciation of differences and respect for the ideas and contributions of others.

To learn more about FTC and other *FIRST* Robotics competitions, visit [www.usfirst.org](http://www.usfirst.org).

### *FIRST*Tech Challenge (FTC) Core Values

Volunteers are integral to the *FIRST* community. The *FIRST*Tech Challenge relies on Volunteers to run the program at many levels, from managing a region to Mentoring an individual Team. FTC Affiliate Partners coordinate the program in each region or state. These FTC Partners fundraise, run Tournaments, hold workshops and demonstrations, market FTC locally, handle public relations, and recruit Volunteers and Teams. They are a tremendous resource for Mentors and FTC would not exist without them.

*FIRST* asks everyone who participates in FTC to uphold the following values:

- We act with integrity
- We are a Team.
- We do the work to get the job done with guidance from our Coaches and Mentors.
- We respect each other in the best spirit of Teamwork
- We honor the spirit of friendly competition.
- What we learn is more important than what we win.
- We behave with courtesy and compassion for others at all times
- We share our experiences with others.
- We display Gracious Professionalism in everything we do.
- We have fun.
- We encourage others to adopt these values.

**Details about setting up a Playing Field can be found on the FTC website after the yearly Game challenge Kickoff.**



## FTC Coach's Promise

As the Coach of a *FIRST* Tech Challenge (FTC) Team, you are responsible for honoring and communicating FTC core values to Team members, Team Volunteers, and others affiliated with your Team.

*FIRST* expects all Teams to abide by FTC rules and guidelines as they exist now, and as they may be set forth during the season.

*FTC Mentors will receive updates, additions, Volunteer recruitment, screening, and supervision guidelines for the Team via e-mail and/or postings on the FIRST website at [www.usfirst.org](http://www.usfirst.org).*



## Gracious Professionalism™

*FIRST* uses this term to describe the program's intent. This is one of the most important concepts that can be taught to a young person who is learning to get along in the work world. At *FIRST*, Team members help other Team members, but they also help other Teams.

Gracious Professionalism is not clearly defined for a reason. It can and should mean different things to everyone.

Some possible meanings of Gracious Professionalism include:

- Gracious attitudes and behaviors are win-win.
- Gracious folks respect others and let that respect show in their actions.
- Professionals possess special knowledge and are trusted by society to use that knowledge responsibly.
- Gracious Professionals make a valued contribution in a manner pleasing to others and to themselves.

**An example of Gracious Professionalism is a Team loaning a spare motor to a competitor Team.**

In the context of *FIRST*, this means that all Teams and participants should:

- Learn to be strong competitors, but also treat one another with respect and kindness in the process.
- Avoid leaving anyone feeling as if they are excluded or unappreciated. Knowledge, pride and empathy should be comfortably and genuinely blended.

In the end, Gracious Professionalism is part of pursuing a meaningful life. When professionals use knowledge in a gracious manner and individuals act with integrity and sensitivity, everyone wins, and society benefits.



*“The FIRST spirit encourages doing high-quality, well-informed work in a manner that leaves everyone feeling valued. Gracious Professionalism seems to be a good descriptor for part of the ethos of FIRST. It is part of what makes FIRST different and wonderful.”*  
- Dr. Woodie Flowers, National Advisor for **FIRST**

It is a good idea to spend time going over this concept with the Team and to reinforce it regularly. Provide the Team with real-life examples of Gracious Professionalism in practice, such as when a Team loans valuable materials or expertise to another Team that they will later face as an opponent in competition. Routinely highlight opportunities to display Gracious Professionalism at events and encourage Team members to suggest ways in which they can demonstrate this quality themselves and through outreach activities.

## Competing in FIRST Tech Challenge

### Brian Johnson, Mentor of Team 4625, Kings and Queens

Ten tips for Teams heading to World Championship for the first time.

1. The 128 teams that make it to Worlds are for the most part very, very good in almost every way. Most of the alliances at that level don't miss autonomous bonuses, score 24+ blocks per robot, always raise the flag, and hang at least one robot. It seems like the other teams all have memorable costumes, do 30 hours of outreach a week, have at least one Inspire banner, and have a booth that would fit right in at the Consumer Electronics Show. Respect them, but don't let them intimidate you. They put their KEP nuts on one turn at a time just like you do.
2. If you want to be a top team on the field, you have to bring not just your "A" game, but your "A+" game. No matter how many hours your team spent in driver practice, the other guys spent more. And because the teams are so good score differences are usually small and little mistakes and missed opportunities often make the difference between going away a winner and just going away.
3. Even if you brought your "A+++ " game, there will still be things that happen that are outside your control and those things can and do cost you matches. A partner with mechanical problems, laggy field controllers, a bump from another robot that makes you miss the crate with that last block that would have leveled your pendulum, these things happen. All you can do is pull yourself together, congratulate the winner and get ready for the next match; all while keeping your energy up and a smile on your face for the judges.
4. Competing at Worlds is emotionally exhausting. From check-in on Wednesday until finals end on Saturday, you are always "on" and have to be ready for anything. Judges cruise the pits and queue lines regularly and VIPs roam the venue at will. No matter how badly your matches are going or what problems your robot is having, you have to hide your frustration and always be energetic, upbeat, and positive, because the next person to stop by your booth could be Dean Kaman, a panel of judges, the president of SpaceX, or will.i.am.
5. Competing at Worlds is physically exhausting. It takes about 40 minutes to queue up, push the robot cart the 1/4 mile from the pits to the field, queue again, play the match, and then push the robot cart back. Most teams have a match scheduled every hour or so, so you basically spend all your time walking back and forth between the pits and the field. And unless you brought your own chairs with you, when you get back there's no place to sit down. Drink plenty of liquids and keep your blood sugar up.
6. Get plenty of sleep. See 4 and 5 above. It's tempting to stay up until the wee hours planning strategy and tinkering with your robot. DON'T. The World Robotics Championship is hard work and you need your rest.
7. It is very difficult to stand out among such an amazing field. Whatever you think makes your team unique, be it your crazy costumes, your synchronized dance moves, or that FLL league



- you started in China, there are at least three other teams that have or do those same things and probably do them better than you. Don't be afraid to take it to the extreme, and to sing your own praises, but don't be too disappointed if you don't get the attention you're used to getting.
8. No matter how tired and emotionally drained you are, you have to get out of your booth and experience everything Worlds has to offer. Otherwise you'll miss: colleges and companies actively recruiting, tech firms showing the latest innovations, the best of FRC and FLL in competition, the Jr. FLL Expo, the chance to meet and get to know an amazing group of the best and brightest young people from all over the world, and much, much more.
  9. Even if you don't win the Inspire Award or head the winning alliance, the experience is awesome. President Obama addressing the opening ceremonies. will.i.am and Rachael Crow performing live. Cute little Lego Leaguers coming over to FTC see the "big" robots. FRC Leaguers coming over to FTC to see the "little" robots. Senior executives from companies like Qualcomm, Microsoft, and Intel wandering through the pits and chatting with the teams. Technical innovations you never even dreamed of. Over 14,000 robotics nerds just like you all in the one place. Deep discussions on the merits of mecanum wheels vs. omni wheels. The chance to see the best of the best battle it out on the field. And maybe, if everything goes just right, the chance to show that you ARE the best of the best.
  10. No matter what, at the end of the day remember that the purpose of going to World Championship (or any *FIRST* Competition) is to learn, do your best, and have fun.

## Community Outreach

A vital component of FTC is helping to build the *FIRST* community by introducing more young people to the experience and by celebrating science, technology, and engineering. Outreach events include activities to encourage students and Mentors to join existing Robotics Teams or to start new Teams, as well as to raise awareness of Robotics in education in general. While it may seem counter-intuitive for Teams to try to create new competitors, the bigger picture is that *FIRST* is not really about the competition, but about inspiring students. The more Teams there are the more students there are who might be inspired.

Giving back to the *FIRST* community also means supporting other *FIRST* participants by finding ways to help and support new Teams, and by working with other Teams to develop new skills and abilities.

*FIRST* stresses community involvement in several ways, including recognition via Awards, such as the Inspire and Connect Awards.



## Suggestions for Community Outreach

- Contact regional *FIRST* organizations and Volunteer to support their activities.
- Get parents involved. Parents are their children's greatest supporters. They are incredibly valuable as Volunteers, cheerleaders and advocates for the benefits of *FIRST*. Give parents the opportunity to learn more about what their children are doing and to develop their own enthusiasm and appreciation for science, technology, and engineering.
- Assist in the development of new *FIRST* Teams. Mentor another Team or simply act as a resource for a new Mentor or for a community member who is interested in getting involved with *FIRST*.
- Lead a workshop for a local partner. Help other Teams in the local community develop their skills and abilities by supporting them as they learn a new programming language or work with a new mechanism. Share the experience and knowledge that has been gained through previous years of participation.
- Hold an open practice, build day, or scrimmage.
- Do a demonstration at a local event or community center. During outreach events, make sure that there are regular opportunities for Team members to briefly describe the Robot and what Robotics means to them.
- Promote *FIRST* in the community through positive word of mouth and local media, where appropriate. Create flyers to hand out at events or create a press release about upcoming events and distribute it to local newspapers or websites.
- Recruit new Mentors and players.

## Using the *FIRST* and FTC Logos

Download the *FIRST* and FTC logos, the *FIRST* Branding & Design Standards, and the Policy on the Use of *FIRST* Trademarks and Copyrighted Materials from the *FIRST* website at <http://www.usfirst.org/brand>.

### Requirements:

Positive Promotion:

- Use *FIRST* and FTC logos in a manner that is positive and promotes *FIRST*.

Unmodified:

- Use the *FIRST* and FTC logos without modification.
- Use the *FIRST* name and the circle, square, and triangle as seen on the *FIRST* website or letterhead – retain the same proportions and angles, and use it in red, blue, and white, or in black or white.

Authorized Use:

- Currently registered *FIRST* teams and participants may use the *FIRST* and *FIRST* program logos in a way that relates to their *FIRST* team names and activities. If you have any questions regarding whether it is OK to use a *FIRST* or *FIRST* program logo, please send an email to [marketing@usfirst.org](mailto:marketing@usfirst.org), and include details regarding how you wish to use the logo.

Advertising Use Approval:

- All Teams and Sponsors must obtain approval from *FIRST* prior to incorporating our logo in any advertising. Send an email request for advertising approval to [marketing@usfirst.org](mailto:marketing@usfirst.org), and include a description of the ad content, where it will appear, and whether it is paid advertising.

## Youth Protection Program (YPP)

FIRST requires all youth Team members to register in support of our enhanced Youth Protection Program.

FIRST understands that an important component of protecting children is knowing who the children are on our Teams. In addition, having parent/guardian contact information increases our ability to communicate important information, and also provides us with a better understanding of who our programs serve.

Coaches and Mentors are expected to read the Youth Protection Program Guide, available here:

<http://usfirst.org/aboutus/youth-protection-program>

Forms are available here: <http://usfirst.org/aboutus/youth-protection-program>

Information on the US Screening process is available here:

[http://usfirst.org/sites/default/files/uploadedFiles/About\\_Us/US-Youth-%20Protection-Clearance%20Process.pdf](http://usfirst.org/sites/default/files/uploadedFiles/About_Us/US-Youth-%20Protection-Clearance%20Process.pdf)

**All adults working closely with the Team must be registered and screened.**

Information on the Canadian Screening process is available here:

[http://usfirst.org/sites/default/files/uploadedFiles/About\\_Us/Canadian-Youth-Protection-Clearance.pdf](http://usfirst.org/sites/default/files/uploadedFiles/About_Us/Canadian-Youth-Protection-Clearance.pdf)

You can find FAQ and additional information about the FIRST Youth Protection Program on the FIRST website at:

<http://usfirst.org/aboutus/youth-protection-program>



## The Mentor

### What is a Mentor?

Mentoring is an important part of the *FIRST* program and contributes, in a large part, to the program's success. If done correctly, this learning process builds and expands Team member's self-confidence, as well as their knowledge. If the process has a strong foundation and works properly, adult Team members come away with as much as students do.

**Each Team must have at least two adult Mentors, 18 years old or older.**

### A Mentor...

- Requires no special skills, but should have patience, dedication, and a willingness to learn alongside the Team.
- Is any person who works with the Team in his or her area of expertise, for at least one Team meeting?
- Helps provide valuable support and serves as a resource in his or her specialty.
- Directs the process the Team follows to solve the yearly Game challenge, without providing the solution him or herself.
- Is a Coach, teacher, motivator, and facilitator.

**Every adult on a *FIRST* Team is a Mentor, simply because he or she leads through guidance and example. It is important to remember students need guidance, structure, encouragement, and most of all, a fun experience!**

Mentors and students are equal. The relationship is a partnership. Each person works collaboratively towards a mutual and beneficial goal. To succeed, both the Mentor and all Team members must commit to this.

Mentors should also be willing to acquire some basic knowledge of the programming environment and Robot building. Many Teams enlist the support of a technology teacher or technical Mentor for additional assistance. *FIRST* strongly encourages Teams to invite people with backgrounds in engineering and programming to share their knowledge and experience with Teams.

### A Mentor's role includes:

- Inspiring students in science and technology.
- Actively sharing knowledge and experience with the Teams to help foster intellectual growth.
- Motivating and engaging students in meaningful activities.
- Balancing effective work habits with FUN!
- Allowing students to do as much of the work as possible.
- Providing students with opportunities to make choices, both good and bad.
- Encouraging students to take risks and be inventive.
- Allowing and encouraging independent thought.
- Creating, encouraging and facilitating open, honest communication within the Team.
- Fostering a reciprocal environment of trust and respect for every Team member and his or her ideas.
- Encouraging accountability within the Team.
- Facilitating Team activities and discussion.
- Developing roles within the Team.

- Coordinating help.
- Maintaining equipment.
- Communicating with Sponsor organizations.
- Purchasing supplies.
- Registering for competition.
- Planning and scheduling meetings, visits, and trips.
- Acting as a liaison between Team members, Mentors, parents, and Volunteers.
- Informing students and parents about what is expected of them in terms of their commitment to the Team, each step of the way.

### Rewards of Mentoring

- Adults share simple concepts of Teambuilding and cooperation they have learned through job experiences, as well as their knowledge of specific, and perhaps complicated engineering tasks.
- Mentors grow and learn new perspectives from the young minds brainstorming and working under their tutelage.
- Through teaching others, Mentors develop a greater understanding of their own area of expertise.
- Team members learn technical and organizational skills well enough to be assigned some Mentoring roles.
- Young Mentors gain valuable work experience by training, coordinating and facilitating in a collaborative Team environment.
- Mentors strengthen their connections with the community in which they Mentor.
- Participation in *FIRST* is an overall amazing experience, and a lot of fun!

### Possible Mentor Contributions

- Engineers can teach the Team the necessary skills for the Robot's design, while demonstrating the engineering design process.
- Programmers can teach the Team about programming principles and help the Teams to troubleshoot programs.
- High school or college students (preferably *FIRST* Robotics Competition members) can help Teams work through programming or design challenges, share strategizing methods, and serve as role models.
- Marketing experts can teach students about marketing their Team to others, including other Teams, Sponsors, or the local community.
- Graphic artists can provide advice on Team logos and T-shirts.
- General Volunteers are valuable to help with scheduling meetings, providing transportation and snacks, assisting with fundraising, or providing carpentry assistance for Field construction.





## Finding More Mentors

Mentors may be parents, teachers, engineers, college students, Scout leaders, *FIRST* alumni, or members of the local community.

When recruiting a Mentor, be sure to consider diversity. Young people may be more comfortable if there are Mentors on the Team with backgrounds similar to their own. Students can also learn a great deal from individuals with varied life, work and learning experiences. Below are just some of the resources, which may be used to recruit a diverse group of Mentors. Visit their national websites to connect with someone from a local chapter.

## Resources for Recruiting New Mentors

- Parents, teachers, leaders of community organizations
- Leading corporations in local communities
- Local chapters of the American Society of Mechanical Engineers (ASME): <http://www.asme.org>
- Senior Corps: <http://www.seniorcorps.org>
- Society for Women Engineers (SWE): <http://www.swe.org>
- National Society of Black Engineers (NSBE): <http://www.nsbe.org>
- Society of Hispanic Professional Engineers (SHPE): <http://www.shpe.org>
- Mentors may also be found within the *FIRST* community. Many Mentors from FLL and FRC would be happy to support an FTC Team. Use the search engine on the *FIRST* website, [www.usfirst.org](http://www.usfirst.org), for a variety of Mentor documents, resources, and links.

## Advice for Mentors

Mentoring an FTC Team can be one of the most rewarding experiences in a person's life. Like any great reward, it involves a commitment of time and energy. However, it should not be taken too seriously! It should be enjoyed.

The goal of FTC is to help students have fun with Robots while they become comfortable with technology. Whether or not the Team is successful at a competition, Team members win just by participating.

It is important for every adult to remember that there are responsibilities that come with the adult/student relationship. Young people look up to people they trust and respect, and will look to Mentors as role models. A Mentors' actions will be closely watched and their behavior will be perceived as appropriate.

Prior to meeting with students, have a meeting with all Mentors, to set expectations. This can give adults an opportunity to ask questions they may not want to ask in front of the students, openly discuss topics such as diversity, and discuss ideas and potential problems or concerns about working with young people. If a school district has an individual who works with school or business partnerships, they should be invited to this meeting to help answer questions.

**In your Team's rookie year, focus on enjoying the first year of participation as a survey of the course. The objective should be to fully experience FTC. Once a Team has a positive experience, based on realistic goals, your students will overflow with ideas next year.**

FIRST Youth Protection Program has clear guidelines regarding adult and student interaction. Many school districts and organizations that Teams are affiliated do, as well. The Coach/Mentor must understand all of these policies as well as how to enforce them, and make sure that these policies are communicated to every adult working with the Team.

### **Twelve Basic Guidelines for Mentors**

1. Be a mixture of honest guide and cool teacher.
2. Avoid the temptation to do the work or to deprive Team members of the chance to discover the right the answer on their own. Mentors should guide a Team without directing it. This creates the best learning and growth experiences for Team members.
3. A Mentor's behavior and attitude can and will influence how a Team chooses to respond to the environment around them throughout the season and at events. Demonstrate and encourage Gracious Professionalism at all times.
4. Foster discussions between all Team members and groups. Discussions are critical for effective brainstorming and strategy development.
5. Patience is a necessity. Practice it, especially with the most trying of students.
6. Never use sarcasm while teaching or helping someone. A good Mentor never resorts to sarcasm and anger to hasten the process of learning.
7. Mentoring is a two-way street. It is as much a job for a teacher as it is for a learner. Practice both with equal humility.
8. Never let students indulge in fruitless activities during learning hours. Find something to teach in all activities and try to make every activity an educational experience.
9. Infuse enthusiasm in every activity and part of the challenge. To spur creativity, mix humor and a passion for learning and discovery.
10. Get involved in technical and non-technical experiences. Be supportive to students in both regards.
11. Be the Team's best cheerleader, enthusiast, and leader. Happy Teams win many accolades and learn the most.
12. Forging relationships and gaining friends are far more valuable experiences than participating on an unhappy Team and gaining meaningless trophies.

### **Mentor Time Management**

As a Mentor, additional time will be needed each week, beyond Team meetings, to prepare and coordinate the tasks listed above.

#### **Effective Mentor Time Management:**

- Create a realistic meeting schedule. Consider personal and professional commitments, major holidays, and school events.
  - Keep a Team calendar posted in the work area. Note key dates, deadlines, and meetings.
  - Entries in the Team's Engineering Notebook should coincide with these dates. See the Engineering Notebook section of this manual for more details about this component of FTC.
- Have the Team contribute to the selection of deadlines for certain parts of the project, so that they will feel ownership over the process and support Mentors in ensuring all deadlines are met.

- Do not accept procrastination. Be firm about deadlines and do not accept “we have plenty of time” as an excuse for not getting things done. Refer to the calendar that was created with Team input and regularly remind Team members of deadlines.
- Ask for help. Work with other Mentors, parent Volunteers, Mentors in training, and Team members to accomplish Team goals, track progress, and meet requirements on time.



## The FTC Team

### Team Overview

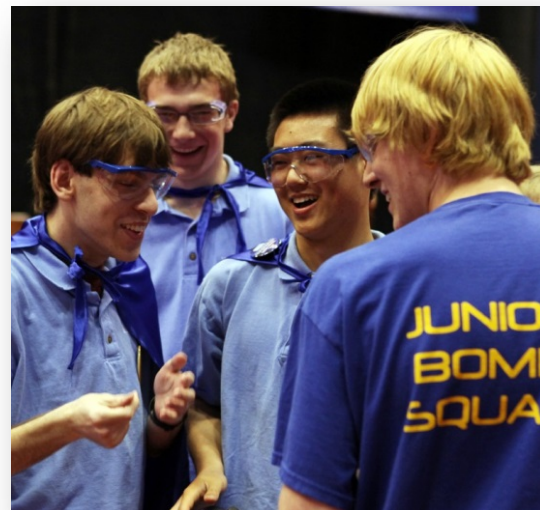
When organizing a Team, consider Team size, diversity, age and skill level, as well as time commitment and scheduling. Remember, Teams grow and change as student interests and abilities develop, and as they move through the educational system. Be prepared for roles and responsibilities to shift throughout and between seasons.

Teams can be formed in any environment and need not come solely from a school. Organizations such as Boy Scouts, Girl Scouts, 4-H Clubs, church youth organizations, and home school communities are excellent starting points to form FTC Teams.

### Team Size

Every Team is different and there is no "ideal" number of students on a Team. Ultimately, the size of a Team is based upon the Mentor's preference and the interest of the students. Some events will have a 10 student limit for access to the pit area, so larger Teams should define Team member roles clearly in advance.

- The minimum number of students is 1.
- The recommended number of students is 10.
- The maximum number of students allowed is 15.



### Age Range

An FTC Team is made up of pre-college students. FTC is designed for students in grades 7-12. Students cannot be older than high school-aged if they are a participating Team member. College students and others who have completed high school are welcome to participate in the role of Mentor or Coach.

Many Mentors find that it is best to stay within a four-year age-span for Team members. Depending on the age and maturity level of the Team, there may be social and developmental differences with mixed-age Teams. This can work as an advantage, but Mentors should be prepared to deal with Team members from a variety of levels.

Note: Some younger students may be comfortable with the technology of the kit and eager to participate. However, the head to head nature of the competition may be overwhelming for younger students.

### Time Commitment

Time commitment for Mentors and Team members will vary with experience and a Team's dynamics. It is important to discuss duties, time commitment, meeting times, and dates up front. If students cannot make a reasonable number of meetings, Mentors need to consider this. The level of commitment should be generally the same among all Team members.

Creating a meeting schedule should be a Team effort and should take into consideration the students' ages, school schedules, and their level of experience in FTC. Set the Team's schedule according to its goals. For example, a rookie Team may require longer, more frequent meetings.

### Time Commitment Guidelines:

- *FIRST* recommends starting with two meetings per week during the Team-building stage.
- During the design and build phase, meetings should take place more frequently, as indicated

- by the Team's needs.
- Sessions lasting 2-3 hours are generally the most productive.
- On a 6-8 week schedule, plan to have the Team meet for at least 10 hours per week.
- If an event is scheduled more than eight weeks from the Kick-off date, a less intensive schedule can be created.

### Building a Team

When recruiting students for a Team, it is important to understand the population of the school or local community and focus recruiting efforts on attracting a broad range of students. Make sure recruiting efforts reach a cross-section of the school or community. Recruiting new students based on status on the honor roll or membership in the Science Club, automatically limits the number of potential applicants. Recruit by targeting the entire school and welcoming individuals with different skills and experience.

Include and encourage a diverse range of individuals to help with recruiting. Students are more likely to be interested in participating if they see and hear someone with whom they can identify.

### Suggestions for Recruiting Students

- Use *FIRST* videos that show a diverse population of students having fun.
- Put posters up in the school.
- Include promotional materials in school newsletters or on school web sites.
- Hold a student assembly where there is a *FIRST* Robotics video and a demo.
- Have a local or previous year's Team put on a demonstration at a school or community event
- Give an overview of *FIRST* in a series of classes where a variety of students are enrolled.
- Engage adults from local corporations, university students, and *FIRST* alumni to speak about the value of participation.
- Enlist *FIRST* alumni and participants on other *FIRST* Teams to "spread the word."

**Using Grade Point Average as the sole criteria for selection may potentially exclude eager students who could most benefit from the program.**

### Suggestions for Recruiting Adults

- Be sure to recruit new adults (Mentors) as well as new students. This will help add talent and new ideas to the Team, curb the tendency to do things in the same manner in which they have always been done, and keep repeat Mentors from becoming exhausted or burnt out.
- Encourage parents to get involved. Even parents without technical careers or experience can help students with other tasks including preparation for public speaking with Judges or Sponsors, creating pit decorations, marketing, publicity, or fundraising.

### Selection Criteria

The number of students who wish to join a Team will likely be more than the Team can accommodate. Use a variety of criteria to select them. Make sure that the criteria used for selection will not exclude students who could potentially make valuable contributions to the Team.

**Effective selection criteria may include:**

- A minimum grade point average, such as 2.0, as opposed to selecting students with the highest grade point average.
- A minimum of 90% attendance.
- Recommendations from teachers, Coaches, supervisors, employers, or community members, etc.
- A strong commitment to the meeting schedule, without conflicting commitments to other Teams, clubs, or employers.

**Be cautious of stereotyping. For example, a girl should not automatically be handed the Engineering Notebook and be told that she is in charge of writing and documentation.**

When there are more students who meet the minimum criteria for participation than there are spots on the Team, it will be necessary to decide which of the students will be invited to participate. Be as objective as possible in the selection of Team members. Think about Team growth and development over time. Encourage students who may not have been selected this season, to participate in upcoming seasons, when spots on Teams may open up or interest levels may prompt the establishment of new Teams.

Many schools have multiple Teams. Mentors should consider creating additional Teams when possible. Adults can be recruited to act as Mentors or existing Mentors may choose to start a second Team themselves.

**Team Members**

Most FTC Team members take on multiple roles. It is suggested that each student be on at least two subgroups: one in which he or she shows strength, and one in which he or she can learn from others.

It may be beneficial to rotate roles so that everyone has an opportunity to try different tasks. Students often discover they enjoy a new or unfamiliar task. This can also prevent boys and girls from falling into stereotypical gender roles.

**Assigning Team Roles and Responsibilities:**

- Discuss responsibilities with the whole Team.
- Be specific when talking about each individual's role and responsibilities.
- Team members will usually have ideas about what they want to do; programming (building, research, marketing, etc.), but be aware of the student who might be pushed out of doing what he or she really wants to do.
- Also, be mindful of those who avoid certain tasks.
- Remind the students often about the importance of collaboration, Teamwork, and sharing the load.
- Instead of assigning roles, think of ways to accomplish this so that Team members feel as though they have a part in the process. Talk about skill sets, projects, and sub-projects, sub-Teams, enjoyment, time constraints, and rules set by the school or by *FIRST*®.
- Challenge students. Encourage Team members to push the limits of their own comfort level and to try something new.
- Make sure that everyone has a clear understanding of his or her roles and responsibilities.
- When defining roles, take advantage of opportunities to tie the student's role on the Team to potential career or educational objectives.
- Recognize that Team members will graduate or move on. Key positions should be staffed

with a veteran and an understudy whenever possible, as replacements will eventually be needed. This will help to ensure long-term Team strength and development.

- Help students prioritize their roles and tasks. Get students involved in the creation of timelines and the identification of key milestones. Help them to connect key tasks and roles that are associated with the completion of each milestone.

On the following several pages there are examples of the roles or sub-Teams that are often established on a Team. Remember, students should be on more than one sub-Team. Make decisions that work best for the Team, but also make an effort to balance leadership.



<b>Team Roles</b>	
<b>Responsibilities</b>	<b>Traits</b>
<b>Mentor (1+ adults)</b>	
<ul style="list-style-type: none"> <li>Detailed information about the Mentor's role can be found starting on page 11.</li> </ul>	<ul style="list-style-type: none"> <li>18 years or older</li> <li>Patient</li> <li>Dedicated</li> <li>Willing to learn</li> </ul>
<b>Future Mentor (1+)</b>	
<ul style="list-style-type: none"> <li>Assist the Mentor and other Team members.</li> <li>Gradually take on responsibilities as the season progresses, to assist the Mentor.</li> </ul>	<ul style="list-style-type: none"> <li>Receptive to feedback and Coaching</li> <li>Actively seeks challenge and greater responsibility</li> <li>Goal-oriented</li> <li>Willing to assume responsibility for his or her own growth and development</li> </ul>
<b>Team Management (1+ students)</b>	
<ul style="list-style-type: none"> <li>Focuses the Team.</li> <li>Ensures that everyone's ideas are heard and works to find compromises.</li> <li>Regularly checks Team goals and deadlines.</li> <li>Gathers information from sub-groups on the Team and tracks Team progress.</li> <li>Keeps everyone on schedule with project timelines.</li> <li>Manages the Team schedule at events.</li> </ul>	<ul style="list-style-type: none"> <li>Clear-headed</li> <li>Organized</li> <li>Confident</li> <li>Punctual</li> <li>Able to mediate discussion and conflict</li> </ul>
<b>Strategy (2+ students)</b>	
<ul style="list-style-type: none"> <li>Discusses ways to help the Team be successful in competition.</li> <li>Understands the Game rules and challenges thoroughly.</li> <li>Gathers input from other Team members to influence strategy.</li> <li>Keeps an active eye for rule updates to ensure Team compliance.</li> <li>Searches the Internet for discussion by other Teams regarding what works.</li> <li>Studies the Team's Robot to see other ways it can do different tasks with little modification.</li> <li>Communicates problems and possible solutions clearly and respectfully with Team members.</li> </ul>	<ul style="list-style-type: none"> <li>Resourceful</li> <li>Creative</li> <li>Innovative</li> <li>Willing to take well-thought-out risks</li> <li>Knows the related subject matter</li> <li>Familiar with rules and regulations</li> </ul>



Responsibilities	Traits
<b>Build Team (2+ students)</b>	
<ul style="list-style-type: none"> <li>• Understands and uses safety precautions while building.</li> <li>• Investigates different solutions to solve mechanical design challenges.</li> <li>• Makes decisions about mechanical design.</li> <li>• Works to achieve consensus among Team members.</li> <li>• Uses guidelines from Team brainstorming to build a Robot.</li> <li>• Communicates and tests to ensure that all mechanisms on the Robot work effectively together.</li> <li>• Works with the Quality/Compliance Control Team to test and refine Robot design.</li> <li>• Communicates problems and possible solutions clearly and respectfully with Team members.</li> <li>• Regularly monitors forums and <i>FIRST</i> resources for rule updates, to ensure Team compliance.</li> </ul>	<ul style="list-style-type: none"> <li>• Knows the related subject matter</li> <li>• Confident, but willing to ask for clarification</li> <li>• Documents carefully</li> <li>• Confident with use of all tools</li> <li>• Familiar with rules and regulations</li> </ul>
<b>Programming Team (2+ students)</b>	
<ul style="list-style-type: none"> <li>• Writes well-commented programs for the autonomous part of the competition.</li> <li>• Schedules time with the build Team to test the chassis when others do not need it.</li> <li>• Alters the programs as necessary.</li> <li>• Regularly monitors forums and <i>FIRST</i> resources for rule updates, to ensure Team compliance.</li> <li>• Communicates problems and possible solutions clearly and respectfully with Team members.</li> <li>• Ensures there is a hard copy of the program at events.</li> <li>• At events, makes any changes the drive Team needs in order to be more efficient during the controlled portion of the match.</li> <li>• If the Team is experienced, offers assistance to Team members that are new to programming.</li> </ul>	<ul style="list-style-type: none"> <li>• Organized and has good tracking skills.</li> <li>• Creative</li> <li>• Innovative</li> <li>• Willing to take risks based on thorough research</li> <li>• Knows the related subject matter</li> <li>• Familiar with rules and regulations</li> </ul>

Responsibilities	Traits
<p><b>Quality/Compliance Control</b> (2+ students)</p>	
<ul style="list-style-type: none"> <li>• Regularly monitors forums and <i>FIRST</i> resources for rule updates, to ensure Team compliance.</li> <li>• Conducts independent tests of the Robot’s performance to identify potential problems and areas for improvement.</li> <li>• Tests for functions that do not work reliably.</li> <li>• Makes recommendations for improvements.</li> <li>• Communicates problems and possible solutions clearly and respectfully with other Team members.</li> <li>• Documents all tests and results in the Engineering Notebook.</li> </ul> <p><b>Note:</b> Robots and programs will need to be tested and revised frequently and regularly.</p>	<ul style="list-style-type: none"> <li>• Detail-oriented</li> <li>• Thorough</li> <li>• Innovative</li> <li>• Documents carefully</li> <li>• Confident, but willing to ask for clarification</li> <li>• Knows the related subject matter</li> <li>• Authoritative yet diplomatic</li> </ul>
<p><b>Hardware/Tools Management</b> (2+ students)</p>	
<ul style="list-style-type: none"> <li>• Understands the function of hardware elements and tools in the kit</li> <li>• Organizes and monitors the use and location of all hardware and tools needed for building and maintaining the Robot.</li> <li>• Keeps track of all wiring necessary to program the Robot.</li> <li>• Keeps track of all power strips and batteries needed for the Robot.</li> <li>• Manages the battery charging process.</li> <li>• Understands and uses safety precautions when using and storing materials, and when charging batteries.</li> </ul>	<ul style="list-style-type: none"> <li>• Organized</li> <li>• Responsible</li> <li>• Uses appropriate terminology</li> </ul>
<p><b>Pit Crew</b> (2+ students)</p>	
<ul style="list-style-type: none"> <li>• Creates safety and Robot functionality checklists throughout the build season, to be used at scrimmages and competition events.</li> <li>• Conducts thorough safety and Robot functionality checks regularly at all events.</li> <li>• After each match, ensures that all nuts and bolts are tight, that metal is not bent or impairing motion, and that all wires are still firmly attached.</li> <li>• Ensures that all materials and tools used for repair are accounted for and returned to the appropriate location after Game play.</li> <li>• Understands and uses safety precautions at all times in the pit.</li> </ul>	<ul style="list-style-type: none"> <li>• Organized</li> <li>• Confident with use of all tools</li> <li>• Works well under pressure</li> <li>• Communicates calmly and effectively with Team members</li> </ul>

Responsibilities	Traits
<b>Driver</b> (2+ students and 1 backup driver)	
<ul style="list-style-type: none"> <li>Operates the Robot in competition using a hand-held remote control to “drive” or move a part of the Robot.</li> </ul> <p><b>Note:</b> Backup Robot operators should be trained and prepared to take part in the competition, in case of illness or nerves. Practice time should include both groups, so everyone is prepared to play in front of a loud, enthusiastic audience.</p>	<ul style="list-style-type: none"> <li>Positive attitude</li> <li>Able to focus in loud, distracting environment</li> <li>Attentive listener</li> <li>Receptive to receiving input from Driver Coach</li> <li>Dedication to practice time</li> </ul>
<b>Driver Coach</b> (1+ students)	
<ul style="list-style-type: none"> <li>Encourages the student members of the Teams to collaborate on match strategy</li> <li>In Game play, watches for information from Referees and communicates with the drive Team</li> <li>Assists the drive Team in following the predetermined strategy or changing it, if necessary</li> </ul> <p><b>Note:</b> Coaches cannot touch the controllers or Robot before or during a competition match. Doing so will lead to a disqualification of the entire Team.</p>	<ul style="list-style-type: none"> <li>Calm</li> <li>Clear verbal communicator</li> <li>Understands Team strategy and Game rules</li> </ul>
<b>Speaking Representative</b> (2+ students)	
<ul style="list-style-type: none"> <li>Lead the group when talking to Judges, scouts or guests in the pit during competition.</li> <li>Promote FTC and their Team by speaking at community outreach events or Team demonstrations.</li> <li>Understands each Team member’s role in order to direct more specific questions to those individuals when necessary.</li> </ul> <p><b>Note:</b> The spokesperson may be the most prominent speaker, but all Team members should be prepared to speak about their Robot and experience in general, and about their own roles on the Team in detail.</p>	<ul style="list-style-type: none"> <li>Confident</li> <li>Polite</li> <li>Good listener</li> <li>Professional manner</li> <li>Able to speak loudly and clearly over noise and distraction</li> <li>Understands and uses appropriate terminology</li> <li>Speaks clearly and concisely</li> </ul>

Responsibilities	Traits
<b>Team Spirit</b> (whole Team with 3+ student specialists)	
<ul style="list-style-type: none"> <li>• Helps to establish and promote Team identity and spirit</li> <li>• Helps to promote a positive attitude and Gracious Professionalism™ throughout the season and at events</li> <li>• Thinks of ways for the Team and its supporters to show their spirit and personality at events.</li> <li>• Assists in the design of T-shirts or pins</li> <li>• Writes cheers and invents unique ways to showcase Team spirit.</li> <li>• Encourages the drive Team to do its best during Game play and cheers whether the Team wins or loses.</li> </ul>	<ul style="list-style-type: none"> <li>• Enthusiastic</li> <li>• Creative</li> <li>• Positive attitude</li> <li>• Receptive to input from the Team regarding spirit ideas</li> </ul>
<b>Documentation</b> (whole Team with 2+ student specialists)	
<ul style="list-style-type: none"> <li>• Records and documents the Team’s activities, actions, failures, and successes in the Engineering Notebook.</li> <li>• Takes photos or video footage of build process, and events for use in marketing and outreach efforts.</li> </ul> <p><b>Note:</b> All Team members should contribute to documentation in some way, especially in the Engineering Notebook.</p>	<ul style="list-style-type: none"> <li>• Creative</li> <li>• Written communication skills</li> <li>• Visual presentation skills</li> <li>• Detail-oriented</li> <li>• Interested in layout and presentation</li> </ul>
<b>Marketing</b> (1+ student)	
<ul style="list-style-type: none"> <li>• Designs and creates the Team logo.</li> <li>• Assembles promotional materials to showcase Team capabilities.</li> <li>• Visits Sponsors and potential Sponsors.</li> <li>• Regularly updates parents and Sponsors about the Team’s progress.</li> <li>• Publicizes the Team in the school and community (e.g., displays, pictures of the Team in action, press releases, social media, or a Team web site).</li> <li>• Contacts the local media, surrounding schools, or civic organizations to increase public awareness of the Team and how students benefit from the FTC experience.</li> <li>• Creates and shares promotional materials with other Teams.</li> </ul>	<ul style="list-style-type: none"> <li>• Creative</li> <li>• Outgoing</li> <li>• Organized</li> <li>• Resourceful</li> <li>• Strong communication skills</li> <li>• Professional manner</li> </ul>

Responsibilities	Traits
<b>Fundraising</b> (2+ students)	
<ul style="list-style-type: none"> <li>• Searches for unique and effective fundraising ideas.</li> <li>• Recruits parents and other students to assist in the fundraising process.</li> <li>• Monitors money and ensures that it is submitted on time.</li> </ul>	<ul style="list-style-type: none"> <li>• Responsible</li> <li>• Innovative</li> <li>• Detail-oriented</li> <li>• Experience handling money</li> </ul>
<b>Recruitment</b> (2+ students)	
<ul style="list-style-type: none"> <li>• Promote <i>FIRST</i> in school and local community</li> <li>• Works to bring new and varied members to the Team</li> </ul>	<ul style="list-style-type: none"> <li>• Outgoing</li> <li>• Personable</li> <li>• Enthusiastic</li> <li>• Professional manner</li> <li>• Speaks clearly and concisely</li> </ul>



## The Team Dynamic

### FIRST Teams

There is more than just camaraderie on many *FIRST* Teams. Many Teams become extended families, with strong, lasting relationships. Students and adults absorb knowledge from each other and grow through a Teambuilding and learning process from which everyone benefits.

It is important to ensure that the Team dynamic remains positive, supportive, engaging, and above all, fun. Throughout the experience, Team members will face long hours and days working on the Robot and Awards submissions. Whenever possible and appropriate, keep the atmosphere friendly and add laughter.

*FIRST* Tech Challenge Teams and their members come from a variety of backgrounds. New Teams should not expect to be like every other Team, and experienced Teams should not expect to be the same from year to year. Each Team will have a different set of skills, experience, and ways of doing things. Take time to get to know each other and find an approach and style that suits the Team and its goals.

Teams are encouraged to develop and promote Team identity. It is a great way to help *FIRST* Judges, announcers, and audiences to recognize a particular Team at a competition. It is also a way to help Teams create a “buzz” about what they are doing in their own communities.

Encourage Team identity by adding the Team logo to Robots, t-shirts, or hats. Create a Team cheer, banner or website and hand out fliers or other giveaways that will make the Team memorable.

### Creating a Positive Team Dynamic

There is a lot at stake during each of the competition stages so developing an environment of trust and respect between all Team members is a priority, and is part of the Mentor’s role. Mentors set the tone for the Team dynamic through their own demeanor, actions, and words. Everyone on the Team needs to know all Team members are valued and they are honest, respectful, and dependable. Stress this point at the very first meeting and encourage this attitude among the Team members throughout the season. Remember, every Team should work towards a balance of work effectiveness and FUN!



The true goals of FTC have very little to do with winning medals or trophies. If a Team can look back at the end of the season and say even one of the following, they have succeeded.

- We learned how useful and fun math and science can be.
- We did something we did not think we could do.
- We respected and considered ideas from everyone on the Team.

- We helped our community.
- We figured out how to manage time, deal with setbacks, and/or communicate ideas.
- We had fun!

Remember to take breaks for snacks, Games, and getting to know each other. Breaks should be timed to maintain productivity, but students should be granted some freedom in how they spend that time. Student managers can be assigned the task of timing the breaks and refocusing the Team afterward.

### Keys to Creating a Positive Team Dynamic:

#### 1. Team Building

- Many Teams have Team-building events and other activities prior to January so new Team members can get to know each other in a fun and relaxed environment. These activities can help make Team members more comfortable and can build the foundation of a good working relationship.
- Team-building exercises allow members to communicate feelings in a positive and healthy way, and encourage Gracious Professionalism™ as they work together toward a common goal.
- Letting students have fun together allows them to develop communication skills and respect, leading to smoother progress when work resumes.
- Encourage laughter. Laughter builds camaraderie and diffuses tension.
- Host a Team-building night to showcase talents and hobbies. Have students and Mentors be prepared to share information about themselves in an informal atmosphere. Possible activities include a karaoke night or talent show, a pizza party or spaghetti dinner, or a simple Games night.

#### 2. Mutual Trust and Respect

- Relationships between all Team members, including the relationship between Team members and Mentors, should be based on common goals and should build on mutual trust and respect throughout the season.
- It is important for Mentors to be approachable and available to students.
- Communication is the key to building trust and respect on a Team.
- All Team members should follow through with commitments made to the Team. This includes Mentors as well as students.
- Respect all ideas. Make sure everyone treats all brainstorming and ideas with respect. Allow people to disagree with or challenge an idea, but do not allow them to Judge an individual.
- A mutual foundation of trust and respect is critical for a supportive learning environment. Everyone's voice should be heard and all ideas should be listened to with a patient and open mind. Part of a Mentor's role is to listen to Team members and to keep lines of communication open. While every idea or suggestion may not be usable, expressing a clear concept or idea is a great learning experience, and may serve as inspiration for other, more effective ideas.

#### 3. Equality of Labor

- Students should feel that they are part of the thinking, contributing, and doing process for the Team. They should feel they are equal with their peers and that their efforts are of equal worth.
- Equal contributions of time and resources among Team members should be considered when tasks and roles are assigned to Team members.
- All efforts of Team members and Mentors should be appreciated and recognized.

#### 4. Communication

- Set clear goals for the season and include expectations for group success at functioning together as a Team.
- All Team members should understand what is expected of them and how their responsibilities have been assigned.
- Let the students know they will have a large part in building the Team's Robot once they have learned and practiced the necessary skills.
- Everyone should know their ideas are important and will receive consideration. Mention this often as the season progresses.
- Keep the group focused. It is the facilitator's job to keep the Team discussions focused on the topic.
- Always be an alert and active listener.
- Include everyone. Bring quiet Team members into the discussion and work to prevent those who feel comfortable with communication from monopolizing the conversation.
- Unite the group. If there is a problem within the Team, allow the Team to communicate its frustration, decide on a course of action, and then help them move forward.
- Do not take sides. Keep conversations to facts, not emotions. Do not let things get personal.
- Paraphrase what has been heard from the others, or get someone else to do it. This keeps communication open because another listener may be able to correct or explain something that has been misunderstood.
- Build on ideas. Encourage people to build on ideas that have already been presented.
- Record ideas. Document brainstorming ideas and decisions for future Team reference.
- Avoid re-hashing. Do not reopen discussions that have already been closed or decisions that have been made unless absolutely necessary. Team members should agree up front not to rehash unless all members of the Team agree to do so.
- Be aware of verbal and non-verbal cues. It may be necessary for a Mentor to step in and help students work through communication difficulties. Validating a Team member's feelings will encourage them to discuss problems when they arise. Sometimes acknowledgement or positive feedback may be all the response a Team member needs.



#### 5. Facilitate

- Clarify the task without doing the work. Define it as a simple task or a complex set of jobs that will take weeks to complete. Make sure the Team understands how the task fits in with their goals and objectives, as well as what is expected of each individual. Provide a realistic deadline for the task completion.
- Be aware of one person's potential impact on the group. Facilitators do not need to be experts in the topic being discussed, but if they are, they must be careful not to lead the discussion to a preconceived outcome.
- Get to know the group, its members, their goals, and their differences. This helps Mentors anticipate conflict and turn the experience into productive learning.



- Prevent group paralysis by watching for problems in achieving consensus, allowing adequate time for discussion, and being prepared to step in if the group cannot make a decision. Knowing when to push the decision on the group, or to make it, is a skill good Mentors develop over time.
6. Keep Students Engaged
- To maintain group enthusiasm, encourage new Team members to share observations about their experience at meetings or events. This will help to bring new members out of their shells and inject the Team with a new perspective and fresh ideas. It can also lead to lively, engaging discussion with more experienced members who can share their experiences and build on the ideas put forth by new members.
  - Play Robot Games during Team meetings and allow all Team members to participate in different roles. Small challenges and Games that involve driving, picking up, or moving objects with the Robot can serve as try-outs for the Drive Team, or provide a fun way for all Team members to develop a greater understanding of how the Robot works. Experimentation with different roles and strategies will benefit the individual and the Team as new approaches are tested and new abilities and interests are discovered.
  - Get creative by involving the Team in marketing and Team identity tasks. Allow all Team members to participate in the development of a Team name and logo or naming the Robot for this year's challenge. Create decorations for the pit or props and costumes for events.

### Managing Stress

Watch for signs of serious stress among Team members. There may be an appropriate reason to intervene. Ask if they need help or suggest they take a break and do something fun to clear their heads

To reduce the pressure of meeting deadlines and meeting Team goals, help Team members clarify tasks and develop strategic plans for individual jobs. Ensure they understand the task list by defining tasks and their complexity. Make sure to show students how the task relates to the timeline.

Remember that Robotics meetings and Tournaments take place in very controlled environments, so Team members may need some time and space to physically move around, relieve stress, and take a physical break from problem-solving or competition. Physical activity can break the tension and help students maintain focus in the end.

When tension starts to take over a Team, take some time to go outside and play Frisbee, throw a ball around, or use available indoor space to play a simple Game like "Statue." In "Statue" one student moves around the room as the rest of the Team remains in a fixed pose. When the individual student is not looking, the other students may jump, wave their arms or move around. If a statue is caught moving, he or she becomes the individual who walks through the Field of statues.



## Resolving Conflicts

Most of the time, groups can resolve interpersonal problems on their own in time. Teams that resolve problems on their own learn to function independently, which indicates that Mentors should avoid intervening as much as possible. However, Mentors must be aware of and help to regulate group dynamics. Since time is short with *FIRST* projects, it may be necessary to intervene and help with the problem or task. It may be enough to simply comment on an interpersonal issue.

### General Guidelines for Resolving Conflicts

- Be conscious of personalities and interactions between Team members. Effective Mentors use the similarities and differences of Team members as assets to help the Team get work done.
- Pay close attention to what and how something is said.
- Try to diffuse sparks by mollifying a somber, defensive, or explosive atmosphere. Sometimes simply noticing and showing concern will defuse a situation, but one of the best ways is to inject some kind of humor into the situation. It is hard to resist a smile, a pat on the back, a silly walk, or a wacky voice.
- Encourage frustrated students to take a few minutes to relax.
- If a dispute arises, help the Team resolve it. Give both parties time away from the group to relate their side of the story, talk through the issue, and then re-focus everyone on a productive task.
- Be specific about what behaviors need changing and offer praise and support for positive social behaviors.
- Be sensitive to the situation. Some conflicts or disputes should be taken seriously.

If the Team asks for intervention on an interpersonal issue, ask what it has done about the problem before proceeding further. The Team members may have taken no action as a Team, and instead may rely on Mentor intervention, rather than solving it on their own. They may simply need help identifying a problem or in coming to a point where they are willing to address their problem(s) as a Team.

## Evaluating Team Progress

Have the adult Mentors evaluate Team progress periodically and compare it to the goals and objectives the Team has set. Another approach is to have an adult Mentor meeting each week to determine the next steps to resolve problems. Be sure to share this information with the whole Team and gather their input.

## Defining Roles

### The Mentor as a Facilitator

As a Mentor, it is important to be involved, but it is equally important to make sure the process is directed and completed by students. Mentors differ in the amount of instruction they give their Teams. Some give very little, and others give much more. While Mentors are often teachers, it is important that the role they play on an FTC Team be that of a facilitator.

- Teachers communicate knowledge they have learned on a given subject to one or more people
- Facilitators enable communication within a group so that everyone contributes knowledge and experience toward the solution.

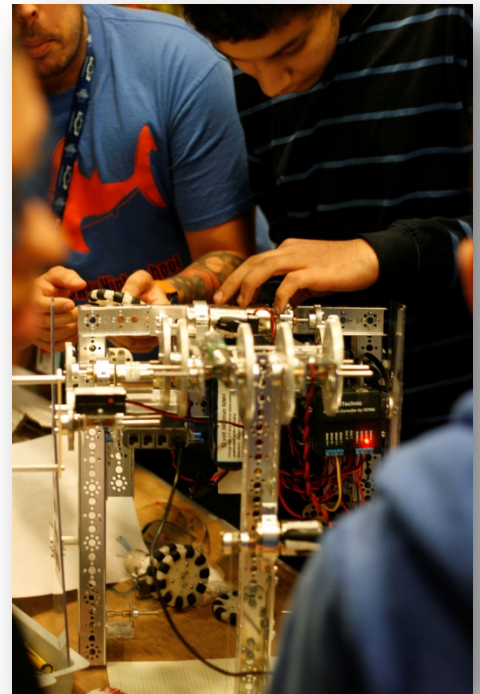
Students will gain the most from the experience if they are the driving force behind the actual Robot planning, building, and programming. The Team must design and build the Robot with only limited assistance from adult Mentors. This way, students may become problem solvers by finding solutions themselves.

Mentors	Students
<ul style="list-style-type: none"> <li>• Are facilitators</li> <li>• Are available to help the Team complete its work</li> <li>• Provide direction that supports accomplishing tasks and Team success</li> <li>• Help the Team stay focused on the jobs that must be completed</li> <li>• Help the Team communicate effectively and improve the way members work together</li> </ul> <p><b>Note:</b> Mentors must be directly involved when safety is a concern.</p>	<ul style="list-style-type: none"> <li>• Are project managers</li> <li>• Are directors</li> <li>• Drive the goals of the Team</li> <li>• Are creators, innovators and problem solvers</li> <li>• Make final decisions about Robot design and strategy.</li> </ul>

### 10 Steps to Being an Effective FTC Facilitator

1. Be an Active Listener
  - Listen before speaking.
  - Listen for the contribution that the person is trying to make. Attempt to identify with what the person is saying. Be understanding. Be empathetic. Evaluate what is being said.
  - Ensure there is an accurate understanding of what was said by paraphrasing.
  - Establish meaningful conversations with Team members and never talk down to anyone.
2. Look for Verbal and Non-verbal Cues
  - These signals are important in communication and in knowing whether something is understood. Some signals that clarification or a new approach is needed include:
    - Raising or lowering of voice
    - Body positioning
    - Raising eyebrows
    - Shifting in one's seat
    - Rapid speech or tone of speech
  - When one of these cues is observed, stop to check for comprehension. The Team may need a short break to relax and re-focus.
3. Listen and Ask
  - Resist doing most of the talking, even if the correct answer seems obvious.

- When communication is one-way and the Mentor has all of the answers, the other Team members will not feel valued.
  - Ask open-ended questions such as "What do you think?" or "How do you think we should approach this?"
  - Avoid questions requiring a simple yes or no answer.
  - Be patient and provide "think time" in discussions.
  - Do not provide an immediate solution.
  - Encourage all Team members to think for a few moments before making a suggestion. Some people require extra time to process information, and some people require extra time to put their thoughts into words, or to build up the courage to speak in a group.
  - Let students finish their thoughts completely. This can also be done one-on-one, if a student requires more time to explain his or her idea than the allotted discussion time allows.
  - Take the time to make sure everyone understands
  - Encourage students to ask questions if something is not clear.
  - Always ask if there is anyone who does not understand, and provide clarification when necessary.
  - Encourage students to politely question their Mentors and their Teammates if they do not understand or agree.
  - Have students paraphrase the point or final decision to check for comprehension. Students (and adults) often say they understand when further clarification is needed. Remember that concepts may not have been covered yet in school. Misinterpretation of explanations or decisions is also common and can cause frustration and mistakes if they are not addressed early on.
4. Provide Positive, Objective, and Constructive Feedback
- Observe what the Team members contribute and provide positive, objective, and constructive feedback to build confidence and help them improve.
  - Help students understand that Mentors provide feedback to help the Team improve. It is about actions or work, and is not a judgment of him/her as a person.
  - Establish and practice effective communication between Team members. Outline routines for feedback and ways to address concerns.
  - Help students see the potential pitfalls in a particular approach to a problem.
  - Help students understand that certain types of solutions may be dependent on more detailed knowledge. Direct them to appropriate resources for investigation.
  - If students provide information concerning Robot rules to the group, be sure they can pinpoint where they found it so accuracy can be checked.
5. Be Sensitive
- If there is a problem, provide constructive criticism immediately following the behavior, if possible. Be sensitive to things that could embarrass an individual, such as commenting in public.
  - Be aware that not all people are receptive to feedback. Some view it as criticism and may be hurt, or react defensively. The way the message is delivered will have an impact on the reaction.



- Be direct, treat all Team members with respect, and deliver positive and constructive comments. For some individuals and some situations, it may be helpful to ask the Team member if he or she would like to receive comments on his or her work. If he or she does, the session should be two-way, allowing him or her to ask questions and clarify the delivered message.
6. Be Safe
    - When there is a safety issue, give immediate feedback to Team members, even at the risk of embarrassing them.
    - Take them aside later and explain that the issue had to be addressed out of concern for that person's well-being and safety. It should be highlighted that speaking up is often required in order to prevent injury.
  7. Let the Students Lead
    - Remember that FTC® offers students a chance to learn in a fun way. Students have frequent, daily opportunities at school to listen to teachers. This is their chance to lead.
    - Make an effort to balance the amount of time students spend listening to a Mentor with the amount of time they spend doing something themselves. FTC should be hands-on and student-driven.
    - For some learners, being a leader is challenging. It may take time for some students to learn to take the initiative and not ask for step-by-step directions.
  8. Encourage Innovation and Critical Thinking
    - Reply to a question with another carefully considered question that will force Team members to use their knowledge of science and hypothesize logical outcomes: "What would happen if . . ." or "How will that affect . . ."
    - Remain flexible and open to new concepts and work to facilitate the student's articulation of what they want to do and their understanding of the technical aspects of their actions, as well as the potential effects on all other aspects of the Team.
    - If at first their understanding appears too narrow, provide students with potential alternatives of viewing a problem.
  9. Be Inclusive
    - Do not scare away quiet members. Provide them with comfortable opportunities to share. They have a lot to offer and a lot to gain from the Team.
    - Have students work in pairs or alone to sketch out ideas with a short description. Do not make students present verbally to the group at first unless they wish to do so. Post the pictures for all to see, and perhaps it will open up discussion.
  10. Promote Routine Self-Evaluation and Evaluation of Team Goals
    - Keep the Team focused on their goals during the season and review the goals periodically, as well as after the competition.

## Student Responsibilities

Some Team members will quickly reach a point where they can work independently, while other Team members may need more direct support from an adult Mentor for a longer period of time. Do not Judge how quickly they move from one phase to the next. Keep in mind that everyone is an individual, comes from a different background, learns at a different rate, and in different ways. Celebrate and facilitate each person's accomplishments, both large and small. All students on the Team, regardless of their experience or skill level, should be working towards the same collective goals.

### All students are expected to:

- Commit to the project.
- Work towards an improved understanding of science and technology.
- Understand the engineering principles and process.
- Be held accountable for their roles on the Team.
- Take individual responsibility for their assigned tasks.
- Develop trust and respect for adult and student Team members.
- Augment their skills.
- Learn to prioritize work effectively.
- Learn when to ask for help or clarification.
- Complete tasks with a high level of independence.

To keep students engaged and challenged throughout the process, it may be beneficial to move them into roles of greater responsibility, or to take on the role of Mentor to other Team members, or other Teams.

The peak of the Mentoring process occurs when a Team member develops the skills, both technical and people-oriented, necessary for he or she to widen the skill circle to include Mentoring others.

## Transferring Ownership from Mentors to Students

During the Mentoring processes, students and other Team members learn and assume more responsibility. Members of the Team grow in knowledge and understanding, and are able to teach and guide others on the Team.

It is important to foster a safe learning environment for Team members. Students should be encouraged to be creative and experimental. Mentors should emphasize that students should be comfortable with both the idea of success and of failure as an important part of the process of discovery and innovation.

In certain areas, the Mentor becomes a sustainer rather than a teacher. The role shifts and allows the students and others to initiate and complete tasks.



The four simple steps below describe this transition. In this process, the Mentor gradually passes responsibility to the student. The Mentor begins the process by demonstrating a task while a student observes. The process is complete when the same student is able to perform the task independently as the Mentor observes.

1. I Do, You Watch
2. I Do, You Help
3. You Do, I Help
4. You Do. I Watch

**When transferring ownership to the student:**

- Be sure he or she is fully prepared and knows the subject well.
- Provide encouragement and make sure he or she is comfortable and wants to shift to a Mentoring role.
- Inform the rest of the participants of what is happening regarding the shift. This will curb ideas that the new Mentor is assuming a role not assigned.

**Preparing Students to Be Mentors**

Through Mentoring and facilitation, students learn how to complete various tasks. As a result, the student has a clear understanding of the skills and is able to answer any questions relevant to them. This process results in more time for the Mentor, now able to assume more of an observer role, and allows the student to work as a Mentor to other students.

This Team evolution not only builds trust and respect, but can also help prevent Mentor burnout. As students who were Team members move into the role of Mentor, it also encourages new Team members or underclassmen that may be unsure of their capabilities to join, participate, and add new life to the Team.

## Preparing the Team

### Explaining the Rules and the Challenge

Each year at Kick-off (usually in mid-September), a new Game and Game Manual will be released, outlining the overall concept of the Game, problems to be solved, rules, guidelines, and policies for the FTC Game. All Team members should read the Game Manual carefully as soon as possible.

Before diving into the challenge, begin by discussing Game rules extensively without referencing Robot design at all. Make sure everyone on the Team has a good understanding of the Game before moving into brainstorming, so that no time is wasted on ideas that may not be permitted or that might be ineffective for the Game as a whole.

Watch the video released by *FIRST* several times, but also read the Game Manual very carefully for important details that may be only mentioned briefly in the video. Have both Mentors and students read the Game Manual thoroughly and ask questions.

Create a Team handbook that outlines all Team responsibilities, rules, procedures and commitments. This will help to ensure that everyone, including parents, understands how the Team operates and what the rules are.

A contract can be another effective tool to set expectations. Have everyone outline concise expectations and come to an understanding of what is expected of each member and the Team as a whole.

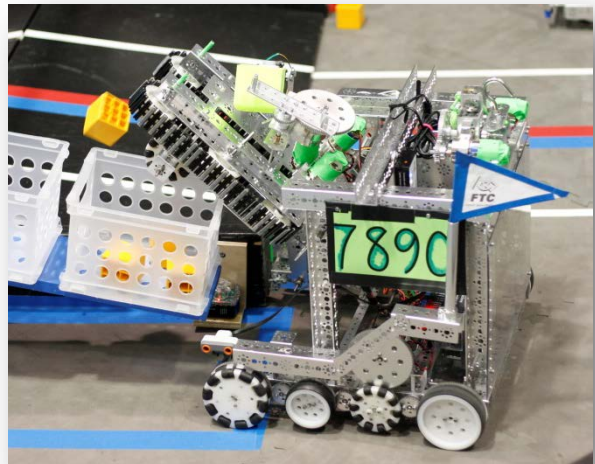
### The Engineering Notebook

One of the goals of *FIRST* and FTC is to recognize the engineering design process and “the journey” that a Team makes during the phases of the problem definition, concept design, system-level design, detailed design, test and verification, and production.

Throughout the building of your Robot you will come across obstacles, lessons learned, and the need to draw things out on paper. This is where you and your Team will use an Engineering Notebook. These notebooks follow your Team from kickoff throughout the competitions. Judges review your Engineering Notebook to better understand your journey, design, and Team. Teams should always check the FTC Game Manual, Part 1, for more information on the Engineering Notebook.

#### Use the Engineering Notebook to:

- Document obstacles that will be faced
- Highlight lessons that will be learned
- Sketch or draw ideas for development and testing
- Record the results of development and testing
- Document Team decisions.





## FTC Engineering Notebook Format

Teams may choose to record their season with either handwritten, electronic, or online documents. No distinction is made between handwritten and electronic Engineering Notebooks during judging.

### A. Electronic/Online

Teams may choose to use electronic or online programs to create their Engineering Notebook. For the purposes of judging, Teams must print out their Engineering Notebooks and place them in a binder, no larger than 2". All pages must be numbered and in order. Only one copy is required per Team.

### B. Handwritten

Spiral-bound, laboratory, or documentation notebooks are available through your school or local stationary supply store or you may use the binder supplied by Rockwell Collins delivered to you in your Kit of Parts. Use the following criteria:

1. Your Team Number and Team Name must be clearly printed on the cover of your Engineering Notebook.
2. Numbered pages are required so that pages cannot be substituted or deleted.
3. Only one Engineering Notebook is required per Team.
4. Multiple Teams may not share an Engineering Notebook.

## FTC Engineering Notebook General Requirements

The FTC Engineering Notebook is a complete documentation of your Team's Robot design. This documentation should include sketches, discussions and Team meetings, design evolution, processes, obstacles, and each Team member's thoughts throughout the journey for the entire season. A new notebook should be created for each new season. Be sure to check the current season's Game Manual, Part 1, for the most up-to-date guidelines and formatting requirements.

### Engineering Notebooks should contain the following:

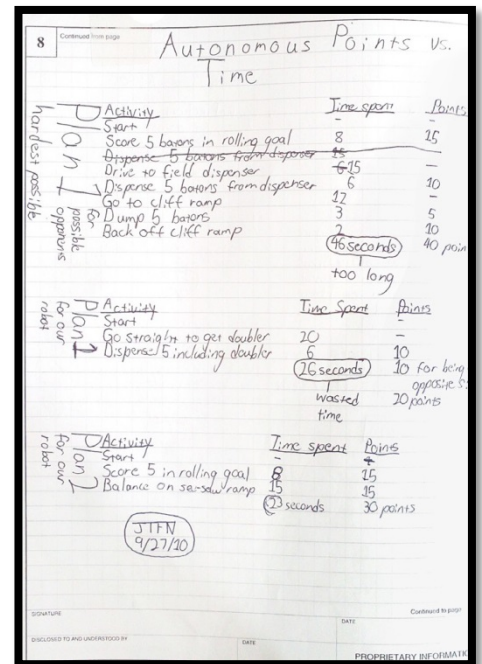
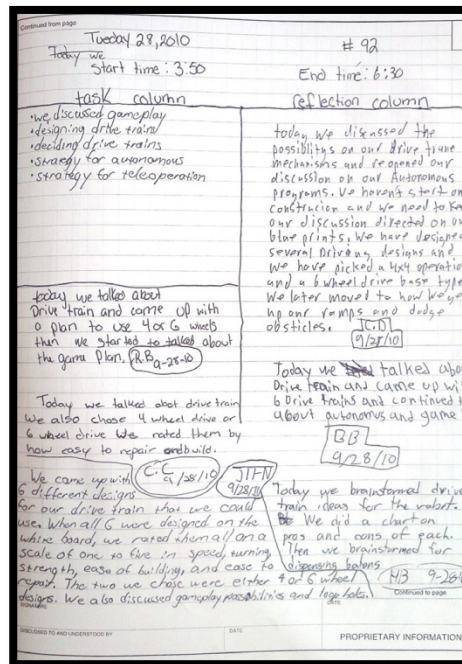
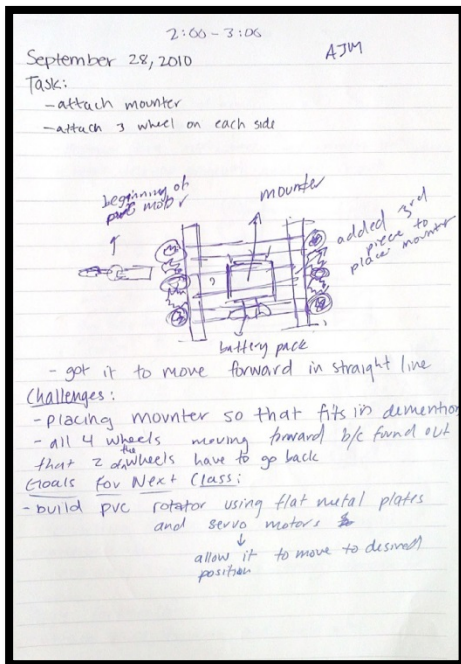
- A summary page
- An Engineering Section
- A Team Section
- It is recommended that Teams add a Business or Strategic Plan Section
- All notebook entries should be completed in permanent ink, and not in pencil
- Pages should not be removed or replaced
- No pages or large areas should be left blank
- Document everything! Include:
- Sketches and photos
- Discussions from Team meetings
- Design evolution
- Processes
- AHA! Moments
- Obstacles and resolutions
- Each Team member's thoughts throughout the journey
- When adding photos or outside information to the notebook, tape or glue the item into the notebook and outline them with permanent ink. This will indicate that something was there if it falls out.

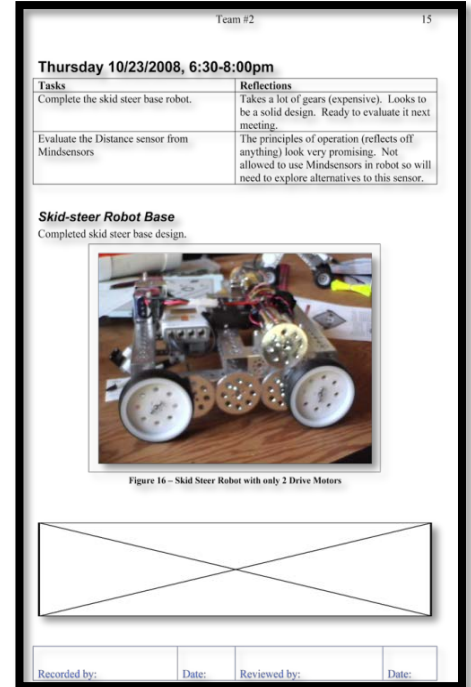
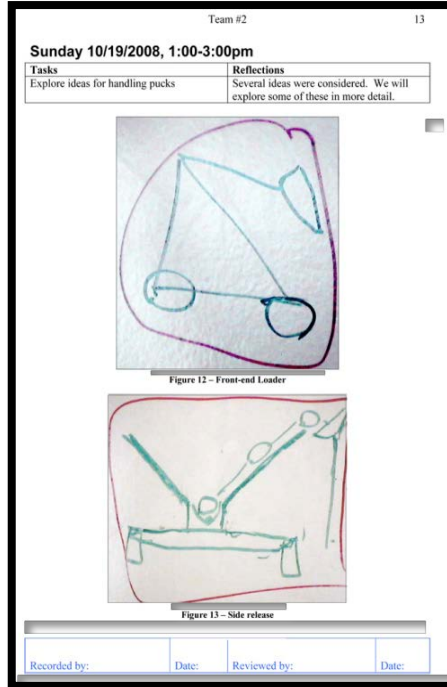
### FTC Engineering Notebook Suggestions

- Read and understand the guidelines for good notebook pages, as presented in the FTC Game Manual, Part 1, before making any entries
  - Make sure the Team name and number are on the cover in a neat, professional manner
  - Make entries at every build meeting. Consider prompting students to start making entries at least half an hour before the end of the meeting
  - Organize the Engineering Notebook so that an outsider will understand the Team and its journey
  - Start the notebook by introducing each Team member and Mentor with a brief paragraph and photo
- Document a failure as precisely as a success. Failures may outnumber successes considerably, but there is always something to learn from them. This demonstrates innovative thinking and a critical investigation of new approaches
- Be as visual as possible. Try to include a picture, diagram, sketch, flowchart, etc. on every page. This will help Judges process the information more effectively and quickly
- Everyone on the Team should make a contribution to the notebook. This provides everyone with at least some experience with documentation and creates a well-rounded notebook. Train new students on correct notebook procedures and have them do some practice entries before writing in the actual notebook

### FTC Engineering Notebook Samples

Show the samples on the following page to the Team. Talk about what makes this sample a strong notebook and how it could be improved.





### Team Meetings

It is important to set a regular schedule and procedure for Team meetings. Make sure all Mentors, Team members, and parents are aware of commitments and the procedure to be followed at meetings.

### Where to Meet

Teams can meet anywhere that is appropriate. For a school-based program, the school itself is ideal. Schools usually have the computers and space to set up a Playing Field. Depending on the situation, Teams may also meet in a private home, a meeting hall, or a company conference room.

### Things to consider:

- Be sure that planned activities and work hours do not conflict with the host's use of the work site.
- Evening or weekend use of the building may require special authorization. Be sure to ask permission to use the site's computers to program the Team's Robot. Before installing software, inform the site host.
- Schools may require background checks for any adults working in the school. These take time. Ask the site to explain any adult supervision and child safety requirements to Team Mentors.

**Select a work place that has as many of the following as possible:**

- Internet access
- Enough space to host the entire Team, the competition Field, the computers, and all kit parts
- A secure place to store the kit and partially assembled Robot between Team meetings
- Good lighting, at least in the work table area
- Simple sets of tools for working with kit parts
- Work tables and chairs.
- Space for at least a partial practice Field. Room on the ends will be needed for drivers.

**Note: A full-sized Field is 12' X 12'.**

**Working with the Site Host**

Meet with the person in charge of the host site and ask for a Volunteer to act as liaison between the Team and host. Explain the concept behind FTC®, and that the benefits of having a Team extend far beyond the Team members. Email a progress report to the liaison once or twice a week and ask that he or she update others at the site about the Team's progress.

**Team Meetings**

At the first Team meeting, outline a list of rules and procedures to be followed throughout the coming weeks. Work with students to establish these rules and explain that some are inflexible (such as rules about safety, Gracious Professionalism™ or respect), and other rules may be open to revision as the Team evolves and discovers new approaches to problems or procedural challenges (such as who completes documentation tasks in the Engineering Notebook, and at what point in the meeting this occurs).

**General Guidelines for Effective Meetings:**

- Maintain an accurate Team email list that includes parents.
- Start and end on time. This helps parents and lets students know that punctuality is important and that time must be used effectively.
- Keep most meetings in the range of 2-3 hours. This is long enough to get organized and accomplish something, but focused enough that students do not lose interest. Aim to meet for about five hours per week, starting immediately after the new Game is announced. Time management is a key factor in a Team's success.
- Towards the end of the season, meetings may need to be longer for testing and repairs.
- If a meeting is right after school, have a snack ready at the start. (This also may help ensure students will show up on time). Make clear rules about eating and drinking near the Robot, tools, and Playing Field.
- Schedule approximately 15 minutes at the end of every meeting for clean-up. If some Team members are going to stay and work longer, clean-up should still be complete at the end of the normal time. This should include maintenance such as sweeping the floor, cleaning up from snack time, and dumping trash. In terms of clean-up, Teams should be encouraged to pick up after themselves. The Coach should do nothing more than lock doors when the Team is done.
- Take pictures of Team meetings and events. Use a checklist of Team members so there are at least some pictures of every student.

## Setting Expectations

- Clearly communicate meeting schedules. Meeting notices should go out weekly, at least a day before the meeting. Include a short description of the purpose of the meeting, but keep emails brief and to the point.
- Take attendance at the beginning of each meeting. Set clear expectations for participation from the first meeting and follow up with Team members who are frequently absent. Not every meeting will involve every student. Some meetings may focus on programming, while others may focus on driver training.
- Keep students aware of deadlines. At the beginning of each meeting, have a brief progress review and set the objectives for the day. Document objectives and progress in the Engineering Notebook at the end of each meeting.
- Identify what the Team is working to accomplish and establish criteria for agreement as necessary. It is also a good idea to write the objectives for the day on a board, a large piece of paper, or another visually prominent place in the workspace. This will help students stay focused throughout the meeting.
- Review the Team's Engineering Notebook, Team goals, and the Team calendar weekly to see if the Team is on track.
- Ensure students are sharing tasks.

## Working Together

- Have some Team-building activities to help all members of the Team get to know each other and some of their key interests.
- Teach members how to organize the tools and parts according to an established system, or have the Team agree on a system of its own. Label the locations for storing different items.
- Use brainstorming techniques to get input from everyone and write down all ideas. Weigh alternatives against the objective criteria that have been previously established. Some common techniques are weighted voting, combining similar ideas, testing the feasibility of an idea, and group consensus.
- Write down any decisions and state which ones will be implemented.
- Be sure to ask if there is anyone who does not understand the solution/plan.
- Implement the selected solution and make sure what is put into practice meets the original intent.

## Communication and Brainstorming Tools for Meetings:

All students learn differently. Use the tools below to facilitate instruction and learning at meetings.

### 1. Language Tools

Use a variety of approaches to get students to contribute to the conversation. These words and phrases will help facilitate the group, work with all learning styles, and encourage the Team members to use logical thinking skills.

Consider...

- What would happen if?
- What do you think?
- How do you think we should approach this?
- How do you suppose?
- Think about what might make....
- Visualize...
- Compare...
- Close your eyes and picture.....

## 2. Learning Styles

- When people use their senses, they take in information and they learn. Some people learn best by seeing something, others by hearing, and others by hands-on activity. For many people, it is a combination, but one style of learning probably dominates the others. It is important to understand the characteristics of these different styles in order to reach every person.
- Talk to students about the way they learn and about which experiences are the most effective and engaging for them.

### Preparing the Team for the Season

From the beginning, it is important for the Team to establish good work habits and practices. The following practices are simple, effective ways to promote learning, and enhance a Team's performance overall.

#### General Best Practices for Teams

- Document frequently and thoroughly.
- Monitor the forums on the *FIRST* website regularly for clarification on building materials, Game rules, permitted strategies, and more. Remember that the FTC Game Q&A forum is the only place to get an official answer to Game questions (<http://ftcforum.usfirst.org>).
  - In a notebook, record all findings so other Team members aren't repeatedly searching for the same information.
  - Keep track of the last date the forums were used. It is useful to have a point of reference for forums that have new postings.
- Have Mentors post questions on forums when necessary, but only after checking to make sure a question is not being repeated.
  - Mentors will receive a login code with their Team's registration.
  - Limit posts to one question per post.
  - Break up multiple questions into multiple postings so it is easier for others to search for answers.
- Use the correct names for all TETRIX, LEGO, HiTechnic elements, standard building parts (including screws, nuts, washers, and so on), and all tools used to build the Robot.
  - This is helpful and efficient in daily communication about the Robot and its components.
  - Using accurate terminology will better prepare students for school and careers in the future.
  - It is important to use accurate terminology in Engineering Notebooks and when speaking with Judges at Tournaments.



- Name the structures on the Robot intelligently. Use names that clearly explain the purpose of major structures, or that are analogous to other machines. Use those names consistently in casual discussion, Engineering Notebooks, judging presentations, and computer code comments and variable names.
  - This reinforces learning for students.
  - It also helps students make connections to similar structures in real-life or in similar technology.
  - It is important to use accurate terminology in Engineering Notebooks and when speaking with Judges at Tournaments.

#### Some common names for Robot structures are:

- The chassis is the basic frame of the Robot on which other items are mounted.
- The drive train refers to the combination of motors, wheels, gears, chains, etc. that make the Robot move over distance.
- A hopper is a container on the Robot that stores Game scoring elements.
- A harvester is a mechanism used to convey Game Elements from the Field into the hopper.
- An indexer is a mechanism that helps feed Game Elements from a hopper into a scoring mechanism.
- An agitator is a mechanism that prevents Game Elements from becoming jammed in the hopper or while being indexed (often by shaking or moving).
- An effector or actuator is a general term for a mechanism on the Robot that performs a specific task, typically using servos or motors, such as an arm. End-effectors are effectors that are at an extremity, such as a gripper attached to an arm.

#### Preparing the Team for Judging

Judging is an important part of competition and should be taken seriously. It is something that should be practiced throughout the season. Remember, your Team's Gracious Professionalism™ is a key factor in their eligibility for all FTC Judged Awards!

In some competitions, Mentors may be present, but may not speak. A Mentor's participation is dictated by the specific event's guidelines, and not all competitions allow Mentors to be present. It is up to the student members of the Team to showcase what they have accomplished and talk about their Robot, so it is a good idea to assign one or two students the role of Team representative or spokesperson. However, all members of the Team should be prepared to speak about their own experience and areas of expertise.

**Student Team members should be prepared to speak about how the Robot was designed and built, driving, Game strategy, the Engineering Notebook, community service, outreach, and fundraising.**

Divide the Team into specialists to answer specific kinds of questions and make sure that each student knows the kinds of questions that may be directed towards them. Everyone should know a little about everything, and a lot about a few things. The official Team representatives should have a working knowledge of the Robot and the Team's procedures overall, but should sometimes politely direct specific questions to Teammates who have a more in-depth knowledge of the subject matter.

It is a good idea to hold mock judging sessions throughout the season to develop confidence, knowledge of the Robot and Team's process, and develop public speaking skills. Have all students brainstorm questions they think the Judges may ask, and have them play the role of both the Judge and the Teammate. Encourage students to think about why the Judge might ask these questions. Have Team members work in pairs or small groups to prepare answers and provide constructive feedback to each other before practicing answering the questions as a Team.

**General Tips for Speaking with Judges:**

- The entire Team should speak at some point. Do not leave anyone out.
- Hit the most important points first. There is often a limited time, so keep answers short and to the point. Practice will help with this.
- Etiquette is important. Do not interrupt a Teammate who is speaking. Practice polite and respectful ways to chime in or build upon what someone else says, and ways to pass the question on to a more experienced Teammate.
- Stress community involvement and outreach activities. Talk about how the Team is helping to start or assist other *FIRST* Teams.
- Display Gracious Professionalism at all times.

**Preparing the Drive Team for Competition**

Robot drivers and operators should practice throughout the season. Game play can be exciting and stressful. Drivers should be prepared to focus through all the fun and chaos. Driver Coaches should also be well-prepared and practiced in their role. Driving Teams should be comfortable operating the Robots for both accuracy and speed, as different matches and different opponents will change the way the Game needs to be played.

As a general rule, Teams should practice the same way they would play and use the same strategies they plan to deploy at events in their everyday practice. When designing strategies, consider the different kinds of hardware failure that could be encountered during Game play. Review these strategies with the driver Team frequently.

To prepare Drivers and Coaches, design a series of timed drills based on the Game. This will give the drivers a way to measure their own progress and push themselves to achieve better scores. As the drills are practiced, the results for each Driver can be tracked over the course of the season. This will demonstrate how the drivers improve, but also show how hardware changes can affect the driver's ability to perform critical Game tasks.

**General Guidelines for Driver Training:**

- Build a simple sparring partner Robot out of spare parts against which students can play defense. This will teach drivers how to deal with opposition on the Playing Field.
- Hold joint practice sessions or scrimmages with other Teams in the area. This will help reduce stage fright, and prepare drivers for the stress that can be felt on the Playing Field.
- Teach the drivers to take deep breaths and relax before rounds.
- Always be extremely respectful towards the Referees, opponents, partner Teams, and Teammates.



## Preparing the Pit Crew for Competition

The pit crew is another part of the Team that needs to be prepared throughout the season. Having effective organization of pit materials and a Team that knows their Robot well can make a big difference when time is limited and repairs need to be made quickly.

Throughout the season, the pit crew should make a checklist of items to review and check on the Robot between rounds. This comes with experience and a thorough knowledge of the Robot's basic construction, strengths, and possible points of failure. This checklist should be completed routinely throughout the season and checked thoroughly between rounds in a match. The checklist may include:

- Check the harvester chain tension.
- Check the drive wheels for tightness and wobble.
- Check the overall structure for loose parts or screws.
- Check all motor collar bearings.
- Check the motor gearbox.
- Check the servo motors.
- Charge the batteries.

### General Guidelines for Pit Crew Training

- During build sessions, when common problems occur that need to be fixed, time the pit crew to see how long the repair takes.
- Pit crew members should know how long it takes to repair a problem, such as a burned-out motor.

## Getting Familiar with the FTC Competition Kits

FTC offers Teams a wide array of choices when designing and building their Robots. These choices begin with a LEGO MINDSTORMS NXT processor and the selection of one of two Robotics platforms: TETRIX by PITSCO or MATRIX Robotics. There are a number of resources to help you learn how to start designing, building and programming your Robot at [www.usfirst.org/ftc](http://www.usfirst.org/ftc).

A good place to start is the FTC Robotics for Mentors and Coaches continuing education unit. This free, accredited course will help you get up to speed on the basics of building and programming a Robot for an FTC competition. You can find the course at <http://ftctraining.usfirst.org>.

Another good resource is the TETRIX Getting Started Guide (<http://www.TETRIXRobotics.com/GettingStartedGuide>). This will help you become familiar with the basics of Robot construction and programming in either LabVIEW for LEGO MINDSTORMS or ROBOTC. These lessons are specific to the TETRIX building kit, but the concepts are the same across both Robotics platforms. Rookie Teams and classroom teachers interested in bringing FTC into their daily curriculum will find activities and support materials to help students create and understand:

- A basic Line Follower program
- An Arm and Gripper extension
- A Harvester and Transporter extension
- A Launcher extension
- A Dispenser extension

To learn more about how to specialize a TETRIX with LEGO MINDSTORMS Robot for successful participation in FTC, go to <http://www.TETRIXRobotics.com/FTC>. Teams and Mentors will find detailed extension activities and support materials for programming in LabVIEW for LEGO MINDSTORMS and ROBOTC. The activities here will help teachers take students from the classroom into competition, will help Teams new to FTC be successful, and will give veteran Teams tips and ideas on how to improve their Robot and provide practice and activities for the off-season.

Teams will learn about:

- The Samantha Module
- Using the Field Control System
- Using the FTC Programming Template
- Advanced Programming for FTC



## Getting to Work

### Safety for FTC

One of the first things a Team should review is safety. Introduce the topic at the first meeting and mention that each person will be responsible for both Team and personal safety. Stress safety at each meeting and post a list of safe practices in the meeting area!

Some Teams come up with a system for monitoring Team safety and use a checklist to document both good work habits and the safety blunders of Team members. This information can be included in the Team's Engineering Notebook.

Ensure students have at least one partner at the work location, while traveling, and at the events. This way, if an accident or problem occurs, there is help nearby. When traveling to events, make sure students also have the Mentor's contact information and room numbers.

**In addition to the safety guidelines below, review the general Safe Practices Guide in the *TETRIX Getting Started Guide*.**

### Supervision

- Adult supervision is required at all times, especially when power tools and electrical systems are used.
- Students should be trained on the proper use of tools and pass a safety test before using them. This includes simple hand tools, as well as power tools.
- Mentors cannot be everywhere at all times. Students should speak to Mentors if they observe other students acting unsafely.

### Apparel

- From the first meeting, make sure all members have ANSI-approved non-shaded safety glasses. Rose, Blue, and Amber tints are *FIRST* approved, but reflective lenses are not, because participant's eyes must be clearly visible to others at all times.
- Make sure that each person:
  - Labels their glasses with their name and Team number, and has a specific place to store them.
  - Wears them at all times when working on the Robot or when in the vicinity of someone working on the Robot.
  - Wears the required side shields.
  - Wears safety goggles over corrective eyeglasses, if they are not polycarbonate or a similar safety material.
  - Is especially careful when near grinding or machining equipment.
- Wear close-toed shoes. These are required at all *FIRST* events and should be required at all Team meetings.

***FIRST* has a strict requirement for non-shaded safety glasses/goggles use in the pit area and on or within five feet of the Playing Field. Safety glasses are required at all FRC and FTC competitions. Without them, students will not be allowed onto the Playing Field.**

- Wear appropriate clothing when working. Do not wear loose clothing, dangling jewelry, or other items that could be caught in the machinery. Long hair should be tied back for the same reason.
- Use ear plugs to protect hearing loss when using loud equipment or at loud events.

### The Workspace

- Keep a first aid kit in the workspace at all times, including disinfectant and bandages. Bring it to events. Any accidents should be reported immediately to Mentors. Make sure there is a telephone in the workspace at all times, in case of a more serious injury.
- Be sure to have a fire extinguisher in the workspace, and that everyone knows where it is and how to use it.
- The workspace should be kept clean and uncluttered. Cords should be kept out of walking paths and tools and materials should be kept in a designated storage area when not in use.

### General Safe Practices

Encourage students to be aware of their surroundings at all times. Walk through hazards in the workspace and ensure students understand the necessary precautions for dealing with:

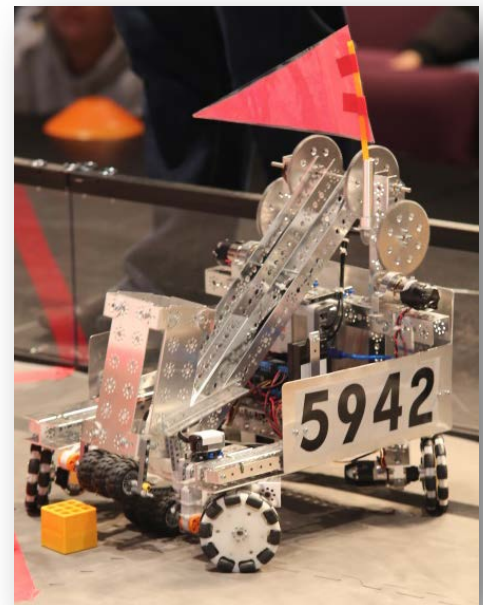
Stored energy hazards, electrical, mechanical, and pneumatic springs, chains and gears, batteries, pneumatic cylinders and lines, extended “arms,” bound joints, and lifted weights.

- Hazards of the autonomous mode.
- Electrical hazards.
- Pinching and crushing hazards.
- Trips and falls prevention.
- Horse play of any kind cannot be permitted in the workspace. Even small motors and mechanisms can be dangerous.
- Always turn off the “kill switch” or unplug the external battery before doing any repair or adjustment to the Robot.
- Inappropriate emotional or physical behaviors/actions cannot be permitted. Establish a reporting procedure for this type of harassment and discuss it with the group.

### Planning

Use the tools below to challenge students to think ideas through in a constructive and positive way.

- Project Maps are detailed timelines. Creating a visual project map is helpful in identifying tasks Team members will need to accomplish.
- Mind-Mapping is a visual writing and note-taking brainstorming process that can help Teams break through creative dry spells. This works well with flip charts or sticky notes placed on a wall and separated into categories.
- Cause-Effect Diagrams to help Teams brainstorm, discuss, and diagram the cause and effect of each situation on the list. This is a helpful tool to use before the season begins.
- Problem Identification and Multiple Solutions will encourage creative Team thinking. Teams identify the problem and create more than one solution to it.



- Logic Trees are also useful for brainstorming. Diagram vertically or horizontally, using boxes and arrows. Brainstorm for a solution, being sure to include sub-problems and solutions to each. Logic trees assist in handling of problems by:
  - Facilitating clear definitions using a visual representation of the problem.
  - Clarifying contributing factors and their interactions and effects.
  - Partitioning problem solving into sub-Teams, without losing sight of the whole.
  - Improving communication between sub-Teams.
  - Assessing various obstacles, such as expertise, materials, and time constraints.

**Developing Strategy**

Developing an effective strategy for Game play is part of the FTC® experience and is vital to a Team’s success. As a Team builds and programs its Robot, it is important to make decisions about strategy and incorporate them into the design of the Robot. One key consideration is the balance between offense and defense.

A Robot geared towards a more offensive approach may be built for speed and agility. It may be smaller and lighter so it can move around easily to pick up Game Elements or to avoid or overcome obstacles on the Playing Field. This Robot will also be more easily moved around by other, larger Robots.

A Robot geared towards a more defensive approach may be larger, heavier, and more stable. This Robot may not move as quickly or pick up as many Game Elements, but it may also be less likely to tip or be moved out of position by other Robots. The focus would be on scoring a few valuable points and preventing other Robots from matching one’s own efforts.

Teams should brainstorm strategic ideas and carefully discuss the advantages and disadvantages of different approaches. See the table on the following page for an example of this.

Strategy		Possible Results
<b>Defense</b>	Turn an opponent away from its scoring position.	<ul style="list-style-type: none"> <li>• This strategy focuses on preventing the opponent from scoring.</li> <li>• It also takes time away from one’s own scoring ability.</li> <li>• Make sure not to be overly aggressive or to pin the other Robot. These actions are not permitted in FTC®.</li> </ul>
	Occupy an opponent’s preferred scoring position.	<ul style="list-style-type: none"> <li>• This can be easier than trying to move another Robot out of position.</li> <li>• This takes time away from one’s own scoring ability.</li> <li>• Make sure not to be overly aggressive or to pin the other Robot. These actions are not permitted in FTC®.</li> </ul>

Strategy		Possible Results
Offense	Focus on one scoring element.	<ul style="list-style-type: none"> <li>This strategy allows for very specialized or focused Robot design and operation.</li> <li>It may limit scoring ability if opponent plays successful defense or if one scoring mechanism on the Robot fails.</li> </ul>
	Focus on several different scoring elements.	<ul style="list-style-type: none"> <li>This strategy increases the likelihood of scoring, even if an opponent plays successful defense or if one scoring mechanism on the Robot fails.</li> <li>It requires extra training and quick thinking to switch between strategies.</li> <li>If one scoring mechanism fails, another approach can be used.</li> </ul>
Build	Make the Robot heavy.	<ul style="list-style-type: none"> <li>This makes the Robot harder to push around on the Playing Field.</li> <li>It also gives the Robot better traction on the Field surface.</li> <li>Unfortunately, this strategy may also make the Robot more difficult to maneuverer.</li> </ul>
	Make the Robot large.	<ul style="list-style-type: none"> <li>This strategy helps the Robot effectively occupy strategically crucial space on the Playing Field, which means that other Teams cannot use it.</li> <li>It may make the Robot harder to push around on the Playing Field but also more difficult for the driving Team to maneuverer.</li> <li>It may make the Robot more likely to be selected as an Alliance partner for defensive purposes.</li> </ul>
	Keep the center of gravity as low as possible.	<ul style="list-style-type: none"> <li>This saves time and effort from righting the Robot because tipping will be far less likely.</li> <li>This can be an advantage when stability is important for Games with ramps.</li> </ul>

## Brainstorming

Before moving into approaches for a Game challenge, it is important to make sure everyone understands the rules, compliance restrictions, and has read the Game Manual carefully. Clear up any questions or confusion about these things before moving into the brainstorming process.

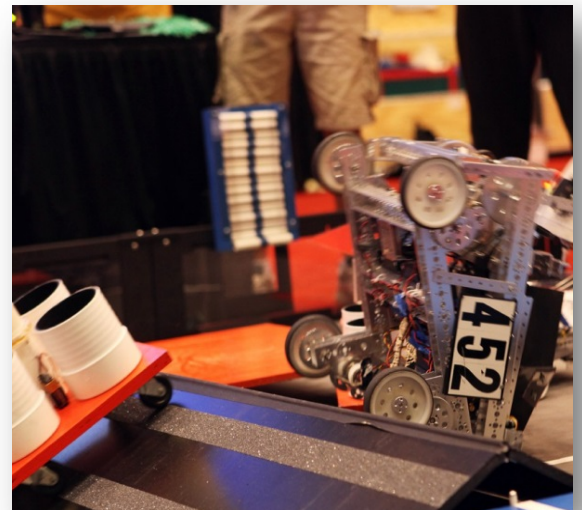
### Effective Brainstorming for FTC

- Discuss general strategies for achieving different Game objectives without referencing specific mechanisms.
- Discuss strategies without deliberating on how a Robot would actually achieve that strategy (e.g., shooting the ball through the air, elevating the ball without shooting it).
- There are many different mechanisms to do each of these tasks, but do not talk about them yet. Note any ideas for mechanisms if they come up, but keep the conversation focused on big ideas because talking about the mechanisms too early may lead a Team to overlook the best solution.
- Nothing is rejected unless it is clearly impossible, or clearly against the Game rules.

- List specific mechanisms that can implement each strategy.
- Again, try to be comprehensive and do not reject any ideas that are not impossible or against Game rules.
- For each big idea, try to think of every possible class of mechanism that could implement that strategy.
- Document all ideas in the Engineering Notebook. They may be useful later.
- Evaluate alternative designs. Evaluate the advantages and disadvantages of each possible mechanism.
- Think about speed. Will this mechanism generally be faster or slower than others?
- Consider accuracy. How consistently does the mechanism achieve the desired result?
- Complexity is an important consideration. Will the Team be able to build it and keep it working and properly adjusted?
- Think about the size of the Robot. Will this design fit in the Robot's required dimensions?
- Consider programming requirements. Does this mechanism require sensors and programming that might be difficult to integrate?
- Rank each mechanism according to how likely it is to be the best solution. Consider how each mechanism will help to score points in competition.
- Try to solve all of the problems. Explore all possibilities.
- There are time limits, so always consider speed when evaluating different designs.
- Start with a basic, solid design, and then improve it incrementally, using sensors or refinements.
- Start simple, test and take measurements, think about ways to improve it, make those changes, and then test again.
- There is always the option of sticking with or going back to a simpler design.
- Test thoroughly.
- Avoid single points of failure whenever possible! Always consider what the result would be if one single item on the Robot failed. Would this take the Robot totally out of action, or just be a minor irritation? If there is a single point of failure, check it constantly and make sure it can be quickly repaired by the pit crew if necessary.

### Designing a Robot

It is important to remember that design is an iterative, ever-changing process and that effective design involves making compromises. In general, it is best to keep design simple whenever possible. Simplicity of design is a key component to a successful outcome and student involvement. In the engineering world, simple solutions are much more desirable than complex ones. The complex solution has many more places to fail, is more difficult to repair, costs more, and its operation is less intuitive. Students are sometimes drawn to complex solutions. Keep reinforcing the principle of simplicity. Ask the Team to distill its ideas down, to make the solution as simple as possible. Driving and operating a Robot can be challenging with a variety of obstacles on the Playing Field. At times like this, a simple Robot is far easier to use than one that requires many complex steps to perform a task.



**What?**

Think about what the Robot will need to do, what it can do to win the Game, and what kinds of objects the Robot will need to manipulate. These discussions all involve trade-offs and compromises, as it may be impossible to do everything at once. Teams will need to decide what is most important.

**Check out the *TETRIX Getting Started Guide* for open-ended challenges and practice ideas.**

**How?**

Once it has been decided “what” the Robot will do, it is necessary to figure out “how” the Robot will do it. This is often more difficult. It is easy to decide “We need the Robot to pick up a parking-cone,” but it is difficult to figure out a feasible way to do it within the *FIRST* Tech Challenge restrictions. This is where experimentation is important.

In general, FTC Robot design can be divided into two major categories: drive train and mechanism.

**Robot Drive Train Design**

One of the major systems of the Robot is the drive train, the system that moves the Robot around on the Field. There are many different drive train configurations, but they all consist of:

- One or more motors
- Some means of transferring their torque/motion to the floor (a wheel, etc.)
- Some means of steering

The most traditional drive train configuration is called “skid-steer,” sometimes called “tank drive.” This is a system in which each “side” of the drive train is powered independently; turning is completed by running one side forward and the other side in reverse.

There are many options and drive train design is often a matter of personal preference. It does not matter what the drive train looks like, as long as it is capable performing the following specific tasks:

- Moving the Robot at a “reasonable” speed without overloading the motors.
- Turning/Maneuvering at a “reasonable” rate without overloading the motors.
- Overcoming any required Field obstacles. (Climb stairs, etc.)

The Team ultimately determines what defines an acceptable performance. Experiment and determine what works best. There are ways to tweak the drive train to enhance performance in several areas, but like most aspects of design, trade-offs and compromises will need to be made.

**Robot Mechanism Design**

In addition to moving around the Playing Field, an FTC Robot has to manipulate various objects. Manipulation is perhaps the hardest aspect of the *FIRST* Tech Challenge, especially for newer Teams. What looks simple to humans can be extremely difficult for a Robot. Reality quickly sets in after the Team begins to experiment with the Game and begins to understand the difficulty involved. Try to create an elegant system that effectively utilizes the available resources to accomplish as many tasks as possible.

Most years, the FTC Games include several different methods of scoring. Each Team must decide which methods of scoring are most important and how they will accomplish them. It is often impossible to design one system to do everything, and this is where every Team must make design compromises. It is important to help Teams prioritize Robot functions, design as many options as possible, and attempt to build mechanisms that perform multiple tasks.



Use real world examples for design inspiration. Look at past FTC Robots (<http://www.TETRIXRobotics.com/Competitions/Gallery/default.aspx?aid=39>) or take Field trips around the community to look at machines and mechanisms that are used to accomplish tasks similar to those required for the competition, such as forklift trucks or cranes. If the Team meets in a library, look through books or conduct online research into different machines and their functions.

Take those ideas that apply to the task, and work to convert them to the challenge. After the Team researches mechanisms for a while, brainstorm, then prototype the ideas the Team selects.

**It is often better to be very good at one thing than mediocre at everything. Once the Team has decided what to do, it must figure out how to best accomplish the task. The biggest challenge with mechanism design is a Team member's lack of experience.**

Do not waste time trying to get a perfect working model right away. What is learned from the quick and rough prototype may completely change a final approach. Try to get multiple sub-Teams working on various solutions simultaneously. Competition and learning can be effective motivators.

#### Notes:

- Try to minimize the weight and complexity of manipulators. Large, heavy accessories bog down the Robot, waste batteries, and cause navigation to become less predictable and repeatable.
- The more complex a design is, the more likely it is to fail during competition. Design elegance is a difficult thing to achieve. Encourage the Team to look for simple solutions that will work consistently at the event and be better in the long run.

### 3-D Modelling Software

Another option for design and prototyping is the use of 3-D modeling or CAD (computer-aided design) software. This kind of software uses computer technology to design and document design. Elements can be modeled and assembled in the software to test and observe their efficacy. The FTC Registration Kit includes instructions on how to download a one-year Team license for PTC's CREO CAD software, Mathcad Prime and Windchill Product Lifecycle Management software. This software is provided via a generous donation by PTC.

While learning to use these types of software can take some extra time, it is a valuable skill for students to learn, of great benefit when designing and prototyping a Robot, and an excellent experience for students interested in drafting and design for future careers.

The *TETRIX Getting Started Guide* and *TETRIX Getting Started Guide: FTC Extension* includes sample 3D models and building guides that were created using PTC's ProE software.

3-D modelling options for FTC include applications created by:

- PTC
- SolidWorks
- AutoDesk

## Prototyping

The FTC Competition Kit provides for an infinite number of design possibilities. It is easy to build something, test it, and then rebuild it into something else. Brainstorm a multitude of ways to accomplish the Team's goals, and then test them to see what works best. This is called prototyping.

Once there is something with which the Team is comfortable, do not be afraid to modify it so it works better -- and then do not be afraid to modify it again! Design is an iterative, systematic process. Emphasize to students that it is okay to try things again and again to improve the machine and increase results.

Students, especially new Team members, should spend some time simply playing around with the parts. This can take place before the new season's Game is announced, and it is vital for students to develop an innate understanding of what the parts are capable of doing or not doing, how they fit together, etc. After the Game is announced, experimenting with parts with the Game goals in mind can still be useful for visualizing solutions.

During initial prototyping, do not worry too much about size or material limitations. Focus on getting something that actually works to solve a Game problem. Once a concept has been proven, Teams can focus on reducing the size or bringing the design back into materials compliance.

Try multiple prototypes for each sub-system and worry about hooking it all together later. Use two-dimensional corrugated cardboard plastic, or foam models to quickly determine feasibility and dimensions.

Cut everything to scale. Once precise dimensions are determined, use the prototype parts to trace for cutting the real material. Keep these templates to be used as "cut sheets" in hardware inspection. If new templates are made, be sure to mark the old one "OBSOLETE" to prevent confusion.

Objectively evaluate the prototypes before deciding which mechanisms to use. Often students and adults get emotionally invested in ideas or directions. To get the best mechanism, set aside those feelings and use objective evidence as the only criteria for judging one design versus another. Document all prototyping and testing carefully. Even if considerable time is spent and a mechanism is rejected, this provides a valuable real-life engineering experience, and demonstrates sound decision-making and innovation to the Judges.

## Building

Once planning, brainstorming, design and prototyping are completed, building the Robot for the Game challenge can begin. Each year, the FTC competition challenge will become available to Teams at Kick-Off, in September. Be sure to check material limits, types of materials, dimensions, and building strategies for compliance with FTC rules. Ensure that the Team is very familiar with these rules, and that they are checked regularly for updates.

### Notes:

- From year to year, the minimum required parts and compliance standards will change, so make sure to consult the most current Game Manual for details.
- It is also a good idea to keep receipts and document any parts that have been purchased for use that have not been provided in the FTC Resource Set. These can be helpful to

**Use colored tape or small labels to identify small hex keys that are not marked clearly with their size. Ensure students know which hex key size or color is used with particular elements.**

have if questions come up during inspection at Tournaments.

- Teams must present a bill of materials (BOM) listing any parts used on their Robot, along with the Robot rule or Forum Q&A post that allows the part. LEGO, TETRIS and MATRIX parts, as well as fasteners, do not need to be included on the BOM. Refer to the Robot Rules in the FTC Game Manual, Part 1, for full details on the bill of materials.

In addition to the tools provided in the FTC Resource Kit, additional tools may be required to assemble the model, customize elements, and modify the Robot as required. Review safety practices and safe tool handling with students before anyone gets to work.

Recommended Tools	Additional Power Tools	Helpful Supplies
<ul style="list-style-type: none"> <li>• Allen Wrench, 7/64"</li> <li>• Allen Wrench, 1/8"</li> <li>• Wrench (open end / box end), 5/16"</li> <li>• Wrench (open end / box end), 1/4"</li> <li>• Hacksaw, 32 tooth blade</li> <li>• Hand Files (flat and round)</li> <li>• Wire Strippers</li> <li>• Wire Cutters</li> <li>• Needle Nosed Pliers</li> </ul>	<ul style="list-style-type: none"> <li>• Soldering Iron</li> <li>• Jigsaw</li> <li>• Drill</li> <li>• Heat Gun</li> <li>• Extra Vise Grip</li> </ul>	<ul style="list-style-type: none"> <li>• Shrink Wire Wrap</li> <li>• Electrical Tape</li> <li>• Black, Red and Green Wire</li> <li>• Small Zip Ties</li> <li>• Blue Lock Tight</li> <li>• Fuses for 12 volt battery</li> <li>• Gear and Axle Lubricant</li> <li>• Extra Fuses for 12V Battery</li> <li>• Cable Ties</li> </ul>

Before beginning construction on the Robot, ensure students have had time to play with the elements and get used to how they are assembled. Remind students that the design they are building may not be the final design. Part of the engineering process is determining where problems are occurring and finding new solutions for them. A Robot design may not work out as planned, or may not work well for the objectives a Team is trying to reach.

Teams should not get locked into continually trying to improve a bad design. Sometimes it may be necessary to step back, rethink, tear down, and rebuild a Robot. Times like these are great opportunities to return to the Engineering Notebook to investigate other concepts and strategies that were recorded during the brainstorming, design and prototyping stages of the development process.

### Modifying Parts

Metal (non- electric) parts can be drilled, cut, or otherwise modified to create customized elements for each Robot. This provides an excellent learning experience for students, but also requires a little extra caution. Try not to cut metal parts unless it is absolutely necessary. Remind students that building supplies are limited, so they should always measure twice and cut once. Students who are unsure should have a partner or Mentor help them double-check their measurements and angles until they are confident doing it independently. When customizing metal parts, it is important to smooth or cover any sharp edges. These precautions should be taken to avoid injury, but also to prevent damage to wires and other components as Robots compete on the Field.



## General Building Best Practices for FTC

- Consult the *TETRIX Getting Started Guide* for general best building practices with TETRIX.
- Design to facilitate easy repair. Make sure that every part is accessible and easy to fix for quick and painless pit repair.
- Build the Robot for competition. Consider the outcome of different types of collisions and add guards and bumpers in the design to minimize impact. Protect wires and position motors so that the end of the wire is inside the Robot body.
- As screws, nuts, and washers are removed from the Robot or from early prototypes, check them for damage and discard or mark parts that are no longer perfect.
- Keep drive wheels symmetrical. Asymmetrical wheels will make the Robot behave differently when turning in one direction or the other, which makes it more difficult for the drive Team.
- Investigate and experiment with gear ratios.
- Investigate and experiment with traction.
- Make sure that only flat metal or plastic elements are under or around the battery mounting position. Sharp objects, screws or nuts are dangerous in this location.
- At the end of each build session, unplug all chargers.
- Always double-check to make sure that fuses are matched exactly in type and amperage, and never use anything other than the correct fuse to bridge the connection because batteries can overheat and catch fire if too much current is drawn.
- Reroute wires through channels where possible, for safety, and to prevent entanglement.
- Position the kill switch where it will be least likely to be accidentally tripped during Game play.

## Programming Software

There are two programming software options that Teams can use to program Robots for competition in the *FIRST*® Tech Challenge. These packages, LabVIEW for LEGO MINDSTORMS and ROBOTC, vary in functionality and cater to users of different levels. Teams will need to determine/select a programming package based on personal preference.

For those who have some experience with the software, but little experience applying it within the context of a *FIRST* Robotics competition, sample programs, programming guides and video tutorials have been provided with the online activities for in the *TETRIX Getting Started Guide* and the *TETRIX Getting Started Guide: FTC Extension*. Resources have been provided to help Teams get up and running using either LabVIEW for LEGO MINDSTORMS or ROBOTC. For more information, visit <http://www.usfirst.org>.

## Programming

It is always a good idea to have more than one Team member responsible for the programming and to have all Team members familiar with it. A good way to achieve this is to assign each Team member a tutorial to present to the rest of the group.

- Create a flowchart to make the programming more of a Team effort, and to keep with good programming practices, have the Team create a flowchart of the program as a group effort. Keep the flowchart simple and only outline the major steps of the program as blocks. Leave it to the programming Team to fill in the details of each block, with the understanding that if they

**Occasionally, a software vendor might make changes to their programming package. Make sure to check the [usfirst.org](http://www.usfirst.org) web site for software update advisories and software update links. Programming software information can be found at <http://www.usfirst.org/roboticsprograms/ftc/team-resources>**

- get stuck on a block, they can, and should, ask the rest of the Team for assistance.
- Test and Archive once the programming Team is ready to test the program, have them prepare a simple set of instructions and turn the testing over to a testing Team. It is better to have Team members who are not intimate with the code do the testing, following only a simple set of instructions.

### Field Control System

The Field Control System (FCS) is software used to establish communication between one or two Game controllers and the Robot. Essentially, the FCS serves as a translator. This occurs when the FCS software receives data from the Game controllers, converts the data into a form the NXT Brick can understand, and then sends the data to the NXT Brick on the Robot. **The FCS is available for download from the FIRST website at: <http://www.usfirst.org/samantha-resources>. It is a requirement of FIRST that all FTC Teams use the FCS during FTC competition.**

### Samantha Module

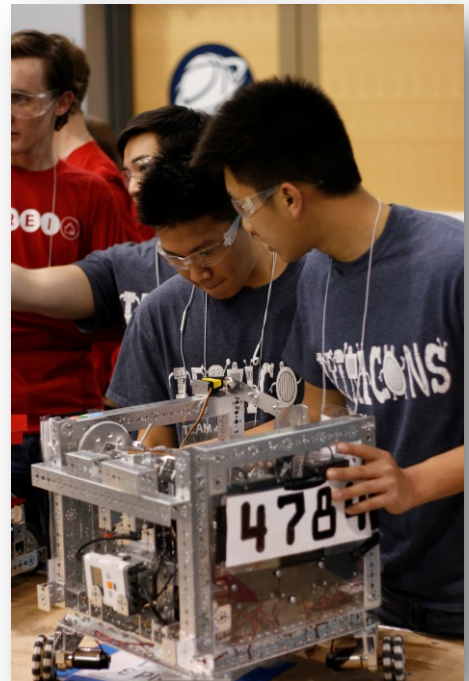
The Samantha Wi-Fi module is a wireless USB adapter designed for use with the LEGO NXT Intelligent Brick and the TETRIX Robot Kit. It is used in FIRST Tech Challenge to reduce problems and delays in communication between the LEGO Mindstorms NXT Brick and the Robot.

**Participants in FIRST competitions are required to use the LEGO Mindstorms NXT brick to control their Robot's functions.**

Prior to each match, each NXT Brick must be associated with the Field Control System (FCS) responsible for Game play. The goal of the Samantha Module is to provide ready and reliable connectivity from the FCS to the NXT Brick. More information about the Samantha Module can be found on the FIRST website at: <http://usfirst.org/samantha-resources>.

### General Programming Best Practices for FTC

- Always back up programs before the start of each programming session. A copy of the last working version should always be available, in case of a broken program.
- Create flow charts of code and include them in the Engineering Notebook.
- Create comments on the code, right from the beginning. This helps with debugging, or a situation arises where another programmer needs to step in and take over the role.
- Avoid cryptic names. Variable names are much more readable and less likely to be forgotten over time. ("MotorLeftFront" is much more descriptive than "mtr\_S1\_C1.") Give multiple variables that belong to the same physical structure or concept the same prefix.
- By the time autonomous programming begins, structural changes to the Robot hardware should be complete, in particular, anything that has to do with wheels and drive train. After any significant hardware change, the autonomous programs must be tested and re-adjusted if necessary. Remember that a simple thing like changing wheel size will change the Robot's speed.
- Do not try to accomplish all of the tasks for the entire Challenge at the same time. This is especially true for the programming Team. Working through each step individually may be less exciting for students, but is a more accurate and efficient approach to the problem in the long run.



- Allow some settling time after a motion or turn. Allow about 100 milliseconds to let the Robot finish all of its movement actions before beginning again.
- Daisy chain controllers to conserve sensor ports.
- Design repeatable tests for all major subsystems. Document baseline tests in the Engineering Notebook. Compare improvements with the baseline and document them as well. Track how well the autonomous mode works at different battery levels, so there are no surprises. Test light sensors under different lighting conditions.
- Make small changes and test frequently. If several things are changed at once and something does not work, it can be hard to figure out where the problem is.
- Make sure to practice using the same version that will be used at the competition. The final practice before any competition should be run using the latest software, so there is time to address any new problems that the changes may introduce.
- Think about all the ways a system could fail and conduct trials to determine them. Figure out which failure modes are the most prevalent and concentrate on fixing them first.

## Tournament 101

### FTC Events

The FTC season culminates with several event types: Local events (including scrimmages and workshops), Qualifying Tournaments and Leagues, Championship Tournaments, Super-Regional Tournaments and the FTC World Championship). Team saturation generally dictates the number and type of events in a region. Encouraging others to become involved and building the FTC community is the best way to encourage more events in a region.

### Local Events

- Generally, but not always, these are smaller than other Tournaments.
- They are run by Volunteers or Teams who have the freedom to choose the format, judging guidelines, and Awards.
- Local Tournaments do not qualify a Team to attend a Championship Tournament.

Type of Event	Description of Event
Scrimmages	<ul style="list-style-type: none"> <li>• These are unofficial or practice Tournaments.</li> <li>• They are usually held early in the season to practice against real competitors in the season's new Game.</li> <li>• They often serve as practice sessions for Referees and officials who are learning a Game that has never been played before.</li> </ul>
Workshops	<ul style="list-style-type: none"> <li>• These are events which can be conducted by area Alliance Partners or experienced Teams</li> <li>• They usually involve sessions on technical and non-technical topics:</li> <li>• Technical topics could include: ROBOTC and LabVIEW programming, PTC software, and mechanical design.</li> <li>• Non-technical topics could include: Fundraising, Team Organization, and</li> <li>• Tournament Day Preparation.</li> </ul>
Practice Days	<ul style="list-style-type: none"> <li>• Some organizers hold events early in the season, which combine a morning help session with an afternoon scrimmage.</li> <li>• If a Practice Day is held in a Team's area, it is a good opportunity to obtain assistance from veteran Teams and Mentors, especially if the Team is facing significant challenges.</li> <li>• The goal of a Practice Day is to have all attending Teams competing, in some fashion, in the afternoon mini-scrimmage.</li> </ul>

### Tournaments

- FTC Partners and Volunteers plan, coordinate, and run the Tournaments.
- Most events have opening and closing ceremonies, trophies and/or medals, Teams with personalized T-shirts, hats, banners, and even some costumes.
- Teams are recognized for excellence in various aspects of the Challenge and associated Teamwork.
- Tournaments require that Teams win at a qualifying or regional Tournament in order to advance to a Championship.

Type of Event	Description of Event
<p><b>Qualifying Tournaments</b></p>	<ul style="list-style-type: none"> <li>• These events usually follow judging guidelines and a similar format to Championship Tournaments, but have some flexibility in format and Awards.</li> <li>• There may be anywhere from one to twelve winning Teams from these Tournaments advancing to a region's Championship Tournament.</li> </ul> <p><b>Note:</b> Qualifying Tournaments do not qualify a Team to attend the <i>FIRST</i>-sponsored FTC World Championship event.</p>
<p><b>Leagues/ Meets</b></p>	<ul style="list-style-type: none"> <li>• If your region has been chosen to participate in a pilot of the Meet format, some of the standard Tournament and Championship guidelines may be modified. For information about the scheduling, structure, advancement and processes that are unique to a pilot event in your region, please contact your local Affiliate Partner.</li> </ul>
<p><b>Regional Championship Tournament</b></p>	<ul style="list-style-type: none"> <li>• For many FTC Teams and regions, a Championship Tournament is the highest level of FTC Tournament participation.</li> <li>• Championships may include Teams from a geographic region, province, state, country, or several countries.</li> <li>• Teams in the U.S. will advance from Regional Championship Tournaments to Super-Regional Tournaments based on the advancement criteria outlined in the FTC Game Manual, Part 1.</li> <li>• These Tournaments abide by specific standards in format, judging, Awards, and overall quality.</li> <li>• The key Volunteers responsible for a Championship Tournament are usually FTC Partners.</li> <li>• If applying for a Championship Tournament, determine whether the Team needs to attend a qualifying or regional Tournament first by checking the Tournament information. Be sure to confirm the criteria that determine advancement to the Championship Tournament.</li> </ul>
<p><b>Super-Regional Championship Tournament</b></p>	<ul style="list-style-type: none"> <li>• U.S. Teams have the opportunity to compete in an additional level of Championship play</li> <li>• Four Super-Regional Championship Events will be held, and hosted, by an FTC Affiliate Partner</li> <li>• Super-Regional Championship Tournaments abide by certain standards in format, judging, Awards, and overall quality</li> <li>• Teams advance from their Super-Regional Championship to the FTC World Championship</li> </ul> <p><b>Note:</b> Check with current-season documentation to learn more about the Super- Regional Championship Tournaments</p>



Type of Event	Description of Event
<p><b>FIRST Sponsored FTC World Championship Tournament</b></p>	<ul style="list-style-type: none"> <li>• The <i>FIRST</i> sponsored FTC World Championship event, held in conjunction with the <i>FIRST</i> Championship and the FLL World Festival, is a global celebration of FTC Teams from around the world.</li> <li>• The selection process for the FTC Championship event may change from year to year, depending upon the number of spaces available and the number of Teams participating in FTC.</li> </ul> <p><b>Note:</b> (<i>U.S. Only</i>) Only Teams who have earned advancement from a Super-Regional Championship Tournament are invited to the FTC World Championship.</p>

### Post Season Events

- These may be hosted in local regions, just for fun!
- They give Teams one more chance to play that year's Game.

### Tournament Registration

Most FTC events are open and free to spectators from the public. Encourage parents, siblings, Sponsors, and friends to attend the Tournament and to cheer on local Teams!

### Finding Tournaments

It is the responsibility of the Team to find and register for FTC Qualifying and Championship Tournaments. Events are generally filled on a first-paid, first-served basis and many FTC Partners coordinate their own registration process, so make sure to check the FTC website to determine how the Team can apply.

There will be a listing of confirmed Championship Tournament sites on the FTC website beginning in late September or October. In October, Teams apply either online or directly with the Tournament organizer for most Championship Tournaments.

It is important to note that Championship Tournaments often require advancement through a Qualifying event, and some Championship Tournaments are open only to Teams in a specific geographic area. Always check with the Affiliate Partner for the event(s) that determine a Team's eligibility to attend.

In order to receive FTC updates during the season, be sure that the Team's Team profile contact information is up-to-date and complete before registering for a Tournament. Both primary and secondary contact information should be verified for accuracy.

### The Registration Process

Once the registration period ends, confirmed Teams receive detailed information from the FTC Partner hosting the event. This information includes specific details about the site, special instructions, forms, and schedule information. Teams can expect to pay a fee to attend a Tournament. The Tournament coordinators will inform Teams about fees and payment procedures. For Tournament information, go to the FTC website <http://www.usfirst.org/whatsgoingon>.

Contact information for Affiliate Partners in each area can also be found on the *FIRST*® website. An outreach can be made to these individuals if Tournament information is absent or there are questions. Do not miss an opportunity to compete.

#### Notes:

- The event schedule may not be complete until the season is well underway. Consequently, the Tournament registration process is entirely separate from the on-line Team registration process.
- Due to limited site capacity at some Tournaments, registration does not ensure acceptance at an event.
- There is no limit on the number of Tournaments in which a Team may participate, as long as space is available. However, participation in the next Tournament level is based on the Team's performance in its first three Tournaments only. This rule applies at all levels of competition.

#### Tournament Logistics

Once a Team has registered for a Tournament, either through the FTC website or with a local Tournament organizer, it is a good idea to check the Tournament website regularly for changes and updates. Every Tournament is different in some way. *FIRST* gives latitude to Tournament organizers to adjust the format to match their conditions. If there are specific concerns, always double-check with the Tournament organizer.

#### Before the Tournament:

- Confirm event start and end times, parking details, what to bring, food service, and so on.
- Ensure that each Team member is registered and has obtained parent consent in the online Youth Team Member Registration System. Information on registering Teams is located at:

<http://www.usfirst.org/roboticsprograms/team-member-registration-process-overview>

**Any Team members lacking the completed registration at the event will be ineligible to participate.** Team members unable to complete online registration will find information on how to register here:

<http://www.usfirst.org/roboticsprograms/team-member-registration-faq>

- If travel to a competition is required, follow school or other Sponsor's procedures.
- Make sure that each driver is properly insured and that any relevant, completed paperwork, such as school permission slips have been signed and gathered.



#### Tournament Areas Registration Area

At the Registration Table Tournament Volunteers will collect paperwork, forms, and Engineering Notebooks. They will tell Teams where to find the pit station, the competition area, judging rooms, and where Teams can eat lunch. They will also give Mentors a schedule for their Team.

## The Pit

The Pit will be the Team's home for the day. A specific location may be assigned at registration, but some events have areas that are first-come, first-served. Check with the officials to confirm that spectators are allowed in the pit. Some facilities allow only Team members, Coaches, and Mentors in the area. Regardless of the size of the station, be gracious and make sure the Team remains within the confines of the allotted space.

Generally, Teams will have a table provided in their pit area to set up a display for other Teams to see, show off their Robot, and make minor repairs. Some, but not all, venues will provide chairs. If the Team has any posters or banners, they should be set up to showcase Teamwork and Team spirit. Bring additional chairs as needed.

Electricity may be provided in the pit, but it is a good idea to make sure that laptops are fully-charged. Some venues have no power other than a few scattered laptop-recharging stations, so plan accordingly. A heavy-duty extension cord and a power strip can be very useful. Be sure to arrive with everything the Team needs. Many Tournaments send out lists to assist with this.

## Practice Playing Field

Many Tournaments provide access to a practice Field where Teams take turns running rounds. If there is a Field, scheduling is often tight and reservations may need to be made ahead of time. Remember to use Gracious Professionalism™ when sharing the practice Fields with other Teams.

## Competition Area

The competition area is where the official Robot competition Playing Fields are located. Referees score the rounds in this area.

## Judging Room and Equipment

Generally, but not always, judging takes place in rooms that are separate from the rest of the competition, and occurs before the matches begin. Teams will report to each of these rooms at some point during the day, so make sure that locations and arrival times have been clearly communicated and understood. Always show up a few minutes early for a scheduled interview time. If there is a schedule conflict, inform an event Volunteer, to ensure Judges can be notified.

## What to Expect at a Tournament

Be flexible, and if there are questions about the day or Team schedule, check in with the pit administration or registration table.

Make sure to review the day's schedule with Team members. Competition schedules are usually very tight, so it is important to be ready and on time. Do not miss inspection or judging sessions. If the schedule for the day does fall behind, the Tournament organizer may juggle a Team's interviews to accommodate the changes. There should be one Mentor who focuses on getting to scheduled judging appointments and rounds on time. Delegate the responsibility of keeping the Team together to other Volunteers.

Each Tournament is a little different, but these basic phases will occur in some form at all Tournaments. Pre-season or local events may have some special rules. Check with organizers for detailed information.

**Some events hold a Coach's meeting where Mentors receive up-to-date information and have an opportunity to discuss any Robot rule clarifications.**

What Happens	What Teams Can Expect at a Tournament
<p style="text-align: center;"><b>Arrival at the venue</b></p>	<ul style="list-style-type: none"> <li>• Arrive and enter the venue.</li> <li>• Unpack the Robot and supporting materials.</li> </ul> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• At most Tournaments, all of the Teams arrive at approximately the same time. Team check-in can be very chaotic, with lines at the registration table.</li> <li>• Make sure to arrive at the earliest allowed time. This provides wiggle room to recover if any problems arise.</li> </ul>
<p style="text-align: center;"><b>Registration at the Registration Area</b></p>	<ul style="list-style-type: none"> <li>• Check in.</li> <li>• Hand in all registration forms.</li> <li>• Submit the Engineering Notebook.</li> <li>• Receive an information packet that contains the day's schedule, information on food concessions, driver buttons to be worn by Team drivers, and other useful materials. Do not lose this packet.</li> </ul> <p><b>Note:</b> To make the process smooth and to reduce the wait, keep all forms organized and ready for registration upon arrival.</p>
<p style="text-align: center;"><b>Setup in the Pit</b></p>	<ul style="list-style-type: none"> <li>• Go to pit area and locate the Team's pit space by finding a sign with the Team number on it.</li> <li>• Unpack the Robot and laptop.</li> <li>• Immediately check to make sure the Robot is in running order, in case it was damaged during travel.</li> <li>• Decorate the pit area.</li> </ul> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• Wear safety glasses and close-toed shoes at all times here.</li> <li>• There will typically be a power cord in the area to charge batteries, laptops, etc.</li> </ul>

What Happens	What Teams Can Expect at a Tournament
<p style="text-align: center;"><b>Inspections in the Judging Room or the Pit (varies)</b></p>	<ul style="list-style-type: none"> <li>• As soon as Robot is up and running, get in line for hardware and software inspections, which can take a long time. Get into inspection lines as soon as possible. Participation in practice rounds may depend on going through this process.</li> <li>• When a Robot has passed inspection, the Team will receive a sticker or another marker for the Robot.</li> <li>• If a Robot does not pass inspection, do not panic. Calmly correct the problem and get back into line as soon as possible.</li> </ul> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• Use pre-Tournament inspection checklists to assess the Robot before arriving at the Tournament. These will be made available to Teams via email before each Tournament.</li> <li>• Make sure that last-minute Robot modifications do not bring the Robot out of compliance.</li> <li>• Have cut sheets and materials receipts available for the inspectors. Be sure to allow plenty of time for inspection. It is best to have the Robot inspected early to ensure that the Team is not standing in line for inspection when their first match is scheduled to begin.</li> </ul>
<p style="text-align: center;"><b>Judging in the Judging Room</b></p>	<ul style="list-style-type: none"> <li>• This may be a part of, or separate from, inspections.</li> <li>• Judging can take place at any time during the early part of the Tournament.</li> <li>• There is a break between each judging session so Teams can travel to their next location and Judges can properly assess the previous judging session.</li> <li>• A timekeeper typically ensures that sessions remain on schedule.</li> </ul> <p><b>Notes:</b></p> <ul style="list-style-type: none"> <li>• To keep the schedule on target throughout the event, Teams should arrive five minutes before their scheduled judging appointment.</li> <li>• All Team members should attend and be ready to speak. Mentors may attend, but are not allowed to speak.</li> </ul>
<p style="text-align: center;"><b>Opening Ceremony in the Competition Areas (location varies)</b></p>	<ul style="list-style-type: none"> <li>• This is a high-energy event that sets the tone for the day.</li> <li>• Judging and inspections may not be finished when this happens. They will usually be put on hold so that everyone can attend the ceremony.</li> <li>• There will usually be a brief speech from the Tournament organizers or invited guests.</li> <li>• Judges and special guests are introduced.</li> <li>• The Challenge and scoring are explained.</li> <li>• The National anthem is often performed.</li> <li>• After the opening ceremony, Teams not immediately scheduled for the competition rounds or a judging meeting should return to the Pit to listen for queuing.</li> </ul> <p><b>Note:</b> At most Tournaments, Teams have about two hours for registration, setup, inspection, judging and time on the practice Fields prior to the opening ceremony. Some Tournaments schedule the opening ceremony for mid- day, before the Robot performance rounds.</p>

What Happens	What Teams Can Expect at a Tournament
<p><b>Practice Rounds on the Practice Playing Field (if available)</b></p>	<ul style="list-style-type: none"> <li>• This phase does not always happen.</li> <li>• Sometimes only Teams that have completed inspections can play in them.</li> <li>• These are a good opportunity to find out how slightly different Field conditions or lighting conditions can affect the Robot's performance.</li> </ul>
<p><b>Driver Meetings in the Competition Area (location varies)</b></p>	<ul style="list-style-type: none"> <li>• These meetings usually take place after the opening ceremony.</li> <li>• Drivers on a Team will receive a briefing from Tournament directors and often the Referees.</li> </ul> <p><b>Note:</b> At most events, all drivers are required to attend. If the meeting space is tight, the event organizer may ask that only one driver per Team attend.</p>
<p><b>Qualifying Rounds in the Competition Area</b></p>	<ul style="list-style-type: none"> <li>• Match Schedules are not generated and distributed until every expected Team has checked in and has passed inspection.</li> <li>• There are usually 4-5 qualifying rounds.</li> <li>• Teams will be paired with a random partner Robot and face randomly-paired opponents.</li> <li>• The purpose of these rounds is to identify the top few Teams, who will become captain Teams for the elimination rounds later.</li> </ul>
<p><b>Alliance Selection</b></p>	<ul style="list-style-type: none"> <li>• After all qualifier rounds have been completed, the Teams are ranked in "seed order."</li> <li>• The top few Teams (usually 4 per division) become "captain Teams."</li> <li>• The captain Teams select partner Robots (Alliances) for the elimination rounds.</li> </ul>
<p><b>Elimination Rounds in the Competition Area</b></p>	<ul style="list-style-type: none"> <li>• Alliances now face each other.</li> <li>• The first seed Alliance faces the fourth seed, and the second seed faces the third seed in the semi-finals.</li> <li>• Teams play for the best two out of three Games, with the losing Alliance being eliminated.</li> <li>• The two winning Alliances in the semi-finals then face each other in the finals, again in a best two of three Games format.</li> </ul> <p><b>Note:</b> In large Tournaments, there may be two divisions and the winners of each division would then face each other in a grand finale.</p>
<p><b>Awards and Closing Ceremony in the Competition Area (location varies)</b></p>	<ul style="list-style-type: none"> <li>• Teams should return to the main competition area for the closing ceremony.</li> <li>• Immediately after the final (or grand finale, if there are two divisions) is complete, an Awards ceremony is held.</li> <li>• Teams receive Awards, medals, and recognition for demonstrated efforts.</li> <li>• There will be plenty of cheering, loud music, and a sea of smiling faces to end the Tournament and celebrate the students' accomplishments.</li> </ul>

## Adult Supervision and Safety

Adult supervision is a critical factor for a successful Tournament. Whether the Team is in the Pit, moving about the site, or performing competition rounds, make sure that all Team members are supervised. Remind each person that the Team is expected to demonstrate FTC values at all times. This includes Mentors and Team parents. Inappropriate and/or non-gracious behavior of an adult with the Team can jeopardize the Team's chances of winning an Award or doing well in the Alliance selection. Negative adult behavior could also lead to the disqualification of a Team during a match and the removal of the adult from the venue.

Remember this is the Team's opportunity to shine. Adult interference during the judging process will reflect negatively on the Team. A Team's inability to answer questions, or make Robot adjustments without the direct assistance of an adult, will be evident to the Judges and may adversely affect the Team's score. Remember, the students come first!

It is often difficult for Judges and event organizers to determine if the adults accompanying a Team are Coaches, parents, or both. Be sure that FTC's rules on adult intervention and Gracious Professionalism™ have been communicated to all of the adults and students accompanying the Team. The behavior of one person reflects on everyone associated with the Team. When there are disappointments at a Tournament, students take their cue from the adults around them. Remember to model FTC values, honor what the students achieve, and help them to focus on those achievements.

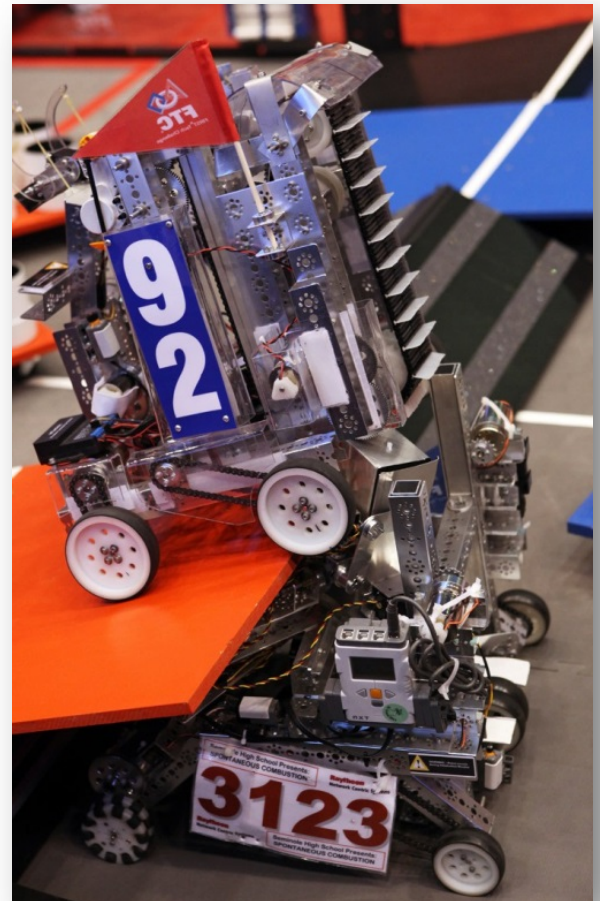
Some Tournaments have restrictions on the number of adults that accompany students into the sessions.

## Inspections

At the event, the Team should be prepared to undergo three inspections: a hardware inspection, a software inspection, and a Field inspection. These inspections can be time consuming, so it is a good idea to line up at inspection stations as soon as possible. The Hardware and Software Inspection Checklists used at competitions are available in the FTC Game Manual, Part 1. Teams should conduct a self-inspection prior to arriving at their competition. This will ensure a quicker and more efficient inspection process. **Failure to pass any of the inspections will disqualify a Team from competition.**

### Hardware Inspection:

During the hardware inspection, inspectors will examine Robot construction against a Hardware Inspection checklist. Some examples of a typical hardware inspection include: the size of the Robot, safety standards for the hardware (e.g. No sharp edges or corners), ensuring the Robot contains Official TETRIX and LEGO MINDSTORMS components, and ensuring the Robot contains only the acceptable allotment of additional materials (e.g. additional plastic or polycarbonate).



**Software Inspection:**

During the software inspection, NXT configuration will be examined. In addition, the Team will be asked to declare an understanding of the Game rules which apply to the queuing process. These rules include:

- No software changes are permitted in the queuing area.
- Where to receive Game flags and where to return them.
- An understanding that pre-loaded Game Elements that are not used will remain out of play for the duration of the match.

**Field Inspection:**

During the Field inspection, an inspector will check to ensure that the Team's Field setup is correct, the Team's Robot modes are functional and configured, and that the Team understands the match process.

**Queuing and Rounds**

During the day, Teams will be scheduled for numerous matches, with the exact number determined by the size of the Tournament and the number of attending Teams. Teams are responsible for their own schedules and failure to arrive for a match can result in a loss of points.

Listen carefully for queue calls. Teams will line up for rounds in a designated area. Assign two individuals to listen for queuing calls or watch for match queue runners and keep the Team on schedule. Unexpected delays may occur, so remain flexible. Remember that the Tournament organizers are Volunteers too.

When a round begins, the driver Team will be on the Playing Field while Mentors get their Team settled in the Team seating/standing area. Robot operators should follow the Field Manager's instructions on the Playing Field. Before starting, have them scan the Playing Field and their Robot to make sure everything is set up properly. Once the match starts, Team operators may not handle the Robot.

**Team adults are *never* allowed to handle or touch the Game controllers or the Robot while it is on the competition Field.**

**Game Play**

Each Game match is made up of three distinct kinds of play. All the stages of Game play are built using templates provided by FTC in ROBOTC and LabVIEW for LEGO MINDSTORMS softwares. The kinds of play are:

1. Autonomous
2. Driver-Controlled
3. End Game

**1. Autonomous Stage**

The Autonomous mode of Game play is typically a 30 second period in the beginning of a match where the Robot's actions are controlled purely by the code created by the Team. In this stage, Team drivers are not allowed to handle the Robot at all. There are several different strategies to consider when programming for the autonomous strategy:

- Defensive: the programming is designed to attempt to stop the other Team's autonomous Robot from achieving its goal.
- Counter Defensive Autonomous: the Team's Robot will try to block an opponent who is trying to stop their Robot by ramming it.
- Low Scoring Autonomous: under this strategy, the autonomous Robot will attempt one of the simpler tasks defined by the Game.



- High Scoring Autonomous: under this strategy, the autonomous Robot will attempt to score multiple Game Elements in a high scoring goal.
- Harvesting Autonomous: using this strategy, the autonomous Robot will be able to dispense and harvest as many Game points as possible. Remember, if this strategy is chosen, it will exclude those components from the teleop phase.
- Combination Autonomous: this strategy combines two or more kinds. For example, the Robot will start in a high scoring mode and then go ram the opponent to interfere with their plans.

Throughout the season, Teams should experiment with different strategies and learn to predict the strengths and weaknesses of their opponents. By the time of the Team's first championship Tournament, the goal should be to have a consistent High Scoring Autonomous that works from at least one Field position, a Low Scoring Autonomous that works from the other Field position, plus a good Defensive Autonomous. Having several good programs in place will help the Team when planning strategy with their partner Robot.

## 2. Driver-Controlled Stage

The Driver-Controlled (or Teleop) stage of Game play is part of the competition where the Robot is controlled by the Team drivers. In this stage, Teams will have to choose their joystick controls and program their software accordingly. Consider the following tips when approaching planning and programming in this Game stage:

It is a good idea for Teams to place a labelled diagram of their joystick controls into their Engineering Notebook. This representation will explain their controls to Judges and provide an easily accessible reference for Team members.

- When choosing controls, the Team's programmers should approach the problem logically. It is important to remember that choosing controls at random or arbitrarily will make the Robot more difficult and increase their driver(s)' training time.
- Consider the kinetics of a driver's hands versus the requirements of the program. How many buttons need to be pressed simultaneously? Is it possible to do several motions at the same time easily?
- It is a good idea to program buttons to select speed levels instead of programming the joysticks to select speed by range of motion. Often, drivers will be caught up in competition and simply "peg" joysticks all the way up or down spoiling their ability to maneuver when there are fine motor requirements.

## 3. End Game Stage

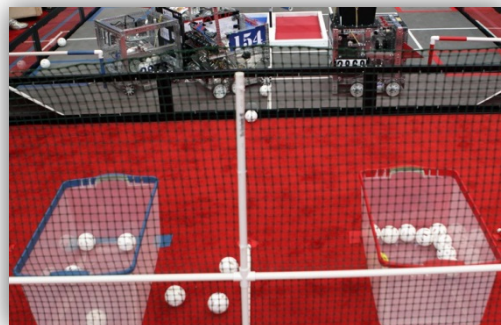
The End Game stage usually comprises the last 30 seconds of a match Game. This portion of the competition changes from season to season, but is an opportunity for Teams to score a great number of points. Typically, this high-scoring portion of the Game occurs in the last 30 seconds of the teleop stage.



## Scoring

At the conclusion of the match, the Referees will score the round. This is the official score and includes any penalties that were part of the match, as well as the autonomous round score. If students wish to question the score, one student can be sent to speak to the Referee. Questions about scoring, Referee decisions and penalties must be brought to the head Referee within two matches. Most events will have a specific “concern” area for a student to go to in order to discuss their question. The student should be prepared to calmly and professionally present the Team’s concerns. The Referee will listen to the student’s argument and make a final ruling. The Referee’s ruling on the Field is final. It is essential to graciously accept the Referee’s decision. For Game-specific FTC® rules, policies, and practices, please refer to the Game Manual, as posted on the FIRST® website each year.

At the conclusion of the qualifying rounds, Official Tournaments will hold an Alliance selection process and subsequent elimination rounds, while others may not. Smaller local or league events may have their own ways of determining a winner for their event. Please contact a local organizer if you have questions.



## Qualifying Points vs. Ranking Points

Qualifying Points (QP)	Ranking Points (RP)
<ul style="list-style-type: none"> <li>• QPs are considered the first basis of determining Team rankings</li> <li>• Awarded at the conclusion of every Qualifying Match</li> <li>• Teams receive points as follows:                             <ul style="list-style-type: none"> <li>○ Winning Teams: Two (2) QP</li> <li>○ Losing Teams: Zero (0) QP</li> <li>○ Matches where Teams tie: All four Teams receive One (1) QP</li> <li>○ Disqualified Teams: Zero (0) QP</li> <li>○ Teams who are declared a “no show”: Zero (0)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• RPs are the second basis of ranking Teams.</li> <li>• These points are used to determine ranking in the event of a tiebreaker when Teams have an equal number of Qualifying Points.</li> <li>• RPs are Awarded under the following conditions:                             <ul style="list-style-type: none"> <li>○ The number of RP’s assigned for each match is that of the losing Alliance’s score.</li> <li>○ In the event of a tie, both Alliances receive an equal number of RP’s; the number equal to the tie score.</li> <li>○ If both Teams on an Alliance are disqualified, the Teams on the winning Alliance will be Awarded their own score as their RP for the match.</li> </ul> </li> </ul>

**Note:** At the conclusion of all Qualifying Matches, all Teams will be ranked from first through last based on their total Qualifying Points (QPs). If multiple Teams have the same number of QPs, then the Teams will be ranked based on their total Ranking Points (RPs). In the event that multiple Teams have the same RP total as well, the Teams will be ranked on the basis of their highest match score. In the event that this comparison still results in a tie, the next highest match score will be used until the tie is broken. In the unlikely event that this still results in a tie, the ranking will be determined by random electronic draw.

## Alliance Strategy and Scouting

In Tournament play, Alliances are very important. Teams that have earned wins throughout the qualifying rounds may earn enough to become a captain Team.

Throughout the rounds, Teams are randomly assigned an ally and an opponent. However, in elimination rounds, top-ranking Teams are able to choose their own Alliance partners. For this reason, it is important that all Teams pay close attention to the capabilities and attitude of other Teams. If a Team has made it to the elimination round, the selection of a complementary Alliance partner is crucial. If a Team has not made it to the elimination round, being selected can provide them with that opportunity.

Alliances are created with the first pick going to the highest ranked Team. After an Alliance invitation has been extended, a representative from the other Team must come up to accept or decline the invitation. The only rule of this process is: if a Team declines an Alliance invitation, it may not be selected by any other Alliance. In this case, the declining Team does not lose their right to select if they are an Alliance captain.

**Your Team should demonstrate Gracious Professionalism throughout your Tournament. This includes Teams you compete against.**

**Alliances require Teams to work closely together. Communication skills, teamwork and sportsmanship are just as important in Alliance selection as ranking and points accumulated.**

### How to Get Noticed by Alliance Scouts:

- Always demonstrate respect and Gracious Professionalism in Game play and in the pit area.
- Create a one-page flyer that advertises the Robot's capabilities and if possible, its performance record. Bring copies to the Tournament and hand them out to other Teams and visitors before the qualifying rounds have been completed.
- Be friendly and sociable with other Teams. Compatibility and a positive attitude will linger in other Teams' memories.

### How to Select an Alliance Partner:

- Find a complementary Robot to balance strengths and weaknesses in one's own Robot.
- Do not depend on final rankings after qualifiers. Team experience and standings may shift throughout the Tournament.
- Take notes about other Teams throughout the day. Track their strengths, weaknesses, strategies for defense or offense, success, and scores. Consider the types of strategies other Teams have been using.
- Scouts should also walk around the pits and observe possible capabilities of opponents they have not yet seen play.

## General Guidelines for Tournaments:

### Procedures

- Always inform the Coach/Mentor when leaving the pit area (to eat, watch a match, etc.).
- Always put DRIVER/COACH designation buttons in the same place when not being worn by the drive Team. Do not lose them.
- Label everything with the Team name and number. Mark all batteries and chargers with the Team name so they are not lost or mixed up at events.
- Have a system to keep track of which batteries are fully charged. (e.g., use a rubber band to designate a battery that has been charged and is ready to use.)

- Create checklists for the pit crew and other sub-groups on the Team to ensure that checks and organizational tasks are completed throughout the day.

### Communication

- Mentors and Coaches should each have a master list of cell-phone numbers for everyone attending.
- Use social media and online networking tools for reporting results to parents back home and the Team themselves. This can also be useful to communicate between Team members at large Tournaments.

### Well-Being

- Eat when possible. There may not be scheduled lunch breaks.
- Bring healthy snacks and refreshments for Team members to keep their energy up (if this is permitted at the venue).
- Make note of any dietary needs or restrictions of Team members. Be aware of food allergies or sensitivities and students who may have medical concerns.



### Documentation

- Try to have one student or Mentor video tape rounds of play to post on websites, publicize the Team, or look back and analyze how well strategy and hardware worked during Game rounds.

### Laptop

- Make sure that virus scans and other background programs are disabled during Game play. They can cause lags and lost connections.
- Make sure laptop power saver settings are configured so the laptop never goes into hibernation or sleep mode.
- Reboot the laptop and the NXT Brick every few rounds of play.

### The Pit

- Have a theme for the Team that carries through in pit decorations, Team uniforms and Robot designs.
- A 6-foot banner is a cost-effective pit decoration. Make the banner two-sided, as both sides may be visible.

### What to Bring:

- A Robot
- The Team Engineering Notebook
- A first aid kit and a binder containing medical and emergency contact information for all Team members.
- Rolling cart for the Robot that can easily be disassembled (easier for transport). Reinforce or modify it as necessary. Create an emergency repair kit that stays with the cart during rounds.

- A small box with an assortment of metal parts, brackets, channels, flats, pieces of plastic, or sheet metal for repairs.
- Spare electrical components (motors, servos, motor controllers, servo controllers, sensors) as budget allows. Keep spare fuses in the Team toolbox and an emergency repair kit at Tournaments.
- Basic tools for repairs.
- Try to have at least two or three 12v batteries for each Robot, at least 2 rechargeable NXT batteries, and at least two of each kind of battery charger. This will allow Teams to use a freshly charged battery for each round of play.

**During Game Rounds:**

- Always reset the inactivity timer on the NXT Brick (in the firmware options menu) every time the NXT Brick BIOS is flashed. This will ensure that the brick does not turn itself off.
- If possible, have a backup NXT Brick ready with all of the latest programs installed.
- Reboot the NXT Brick every few rounds. Rebooting will help to clean the memory and work to prevent crashes.
- Do not let the NXT Battery fall below 7.9 volts. A battery charge lower than this may result in loss of connectivity to the Field.
- Swap batteries between rounds and do not let the 12v battery fall below 14.0 volts at the start of any round. This will help ensure maximum speed and power.
- Keep the pit tools and emergency repair materials organized. Searching will waste time and cause stress.
- During elimination rounds, remember that one time-out per Alliance can be called for repairs. Check the Game Manual for the official length of the time-out.

## FTC Judging

### How Judging Works

FTC Judges are Volunteers. They receive training from *FIRST* or from the local FTC Partner before the event.

At Championship Tournaments, FTC Judges use a set of guidelines that represent qualities FTC considers important and useful for evaluating Team performance. Judges also refer to a list of judging questions and may even add their own.

During scheduled interview sessions, Judges will ask questions and Team members will need to articulate and demonstrate various aspects of their FTC experience. Also important to the Judges is the Team's knowledge of the Robot, Teamwork, demonstration of FTC values, as well as the influence of the Team's Mentors. The focus is on the Team members and their ability to express what they have learned.



Usually, Teams meet with Judges regarding Awards for a designated time period. Some Teamwork judging is simply observing Teams in action. Judges may also evaluate Teams during conversations and observations in the Pit and competition areas. These informal conversations are an opportunity for Judges to hear unique stories and uncover exceptional qualities not readily apparent during the more formal judging. The process is not meant to overwhelm the students. Mentors should encourage them to feel comfortable speaking with the Judges, as Judges understand the interview process is stressful for some students. Check with the Tournament organizer to find out which judging format will be used.

### Awards

In addition to Robot matches, Teams are also eligible to win several Judged Awards. To ensure fairness to all Teams and provide equal opportunity for Teams at a *FIRST*® Tech Challenge Championship Tournament, Teams are only eligible to win an Award at the initial three Championship Tournaments that they attend for the season. Those Teams who compete in four or more Championship Tournaments do so for the purpose of being involved in the fun and excitement of the Championship Tournament, not for the intention of winning multiple Awards. **This rule applies at all levels of competition.**

**Awards Determination Process**

Choosing the Award winners is, by far, the most difficult job of the day, and Judges take it very seriously. Every Team is a winner, and yet the Judges have to select one to receive special recognition. It can take some time for the Judges to deliberate, and they try to be as fair as possible. Not every Team can win an Award. FTC is about an entire season, not just one day. Showing support for other Teams is an important part of Gracious Professionalism and Teamwork.

Another Team's Award takes nothing away from the Team's achievements and those accomplishments should be everyone's focus. As a Mentor, set the tone for the whole Team. Remind students of all their success and achievements throughout the season.



**FIRSTTech Challenge Awards Categories**

Award and Description	Criteria
<p><b>FTC Inspire Award</b></p> <p>This formally Judged Award is given to the Team that truly embodied the 'challenge' of the FTC program. The Team that receives this Award is chosen by the Judges as having best represented a 'role-model' FTC Team. This Team is a top contender for all other judging categories and is a strong competitor on the Field. The Inspire Award Winner is an inspiration to other Teams, acting with Gracious Professionalism™ both on and off the Playing Field. This Team is able to communicate their experiences, enthusiasm and knowledge to other Teams, sponsors, and the Judges. Working as a unit, this Team will have demonstrated success in accomplishing the task of creating a working and competitive Robot.</p> <p>In past seasons, the winner of the Inspire Award at each Tournament level has received an automatic invitation to the next Tournament level. Once a Team has won an Inspire Award at a Championship, they are no longer eligible to win the Inspire Award at additional championship Tournaments they may attend. Similarly, once a Team wins an Inspire Award at a Qualifying Tournament, they are no longer eligible to win the Inspire Award at subsequent Qualification Tournaments within the same region.</p>	<ul style="list-style-type: none"> <li>• Team must demonstrate respect and Gracious Professionalism both for Team members and fellow Teams</li> <li>• Team is a strong contender for all Judged Awards. The Inspire Award is based on the guidelines for all of the Judged Awards</li> <li>• Engineering Notebook must be submitted, and must include an Engineering Section, a Team Section and a Business or Strategic Plan. The entire Engineering Notebook must impress the Judges</li> <li>• Team demonstrates and documents their work in their community spreading awareness of the Team, FIRST, and FTC within the community</li> <li>• Team displays good communication and Teamwork skills within the Team as well as with their Alliance partners</li> <li>• Team communicates clearly about their Robot design and strategy to the Judges</li> <li>• Team presents themselves well in the Judges' interview</li> <li>• Robot and Team effectively competes in the Game challenge and impresses the Judges</li> <li>• Team and Robot consistently perform well during matches</li> </ul>

Award and Description	Criteria
<b>Rockwell Collins Innovate Award</b>	
<p>The Rockwell Collins Innovate Award celebrates a Team that not only thinks outside the box, but also has the ingenuity and inventiveness to make their designs come to life. This Judged Award is given to the Team that has the most innovative and creative Robot design solution to any or all specific Field elements or components in the FTC Game. Elements of this Award include elegant design, robustness, and ‘out of the box’ thinking related to design. This Award may address the design of the whole Robot, or of a sub- assembly attached to the Robot. The creative component must work consistently, but a Robot does not have to work all the time during matches to be considered for this Award. The Team’s Engineering Notebook should be marked with journal entries to show the design of the component(s) and the Team’s Robot in order to be eligible for this Award, and entries should describe succinctly how the Team arrived at that solution.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all.</li> <li>• Robot or Robot sub-assembly must be elegant and unique in its design.</li> <li>• Creative component must work reliably.</li> <li>• Team must submit an Engineering Notebook with an Engineering Section.</li> <li>• Robot is stable, robust and controllable.</li> <li>• Robot design is efficient and consistent with Team plan and strategy.</li> </ul>
<b>PTC Design Award</b>	
<p>This Judged Award recognizes design elements of the Robot that are both functional and aesthetic. All successful Robots have innovative design aspects; however, the PTC Design Award is presented to Teams that incorporate industrial design elements into their solution. These design elements could simplify the Robot’s appearance by giving it a clean look, be decorative in nature, or otherwise express the creativity of the Team. The winning design should not compromise the practical operation of the Robots but complement its purpose. This Award is sponsored by Parametric Technology Corporation (PTC), developers of the CAD tools, Creo and Mathcad. PTC gives licenses to the FTC student Teams for these software products to help them with their designs. Use of these tools is not required to be eligible, however, Teams that use them in their design are given extra consideration for this Award.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all.</li> <li>• Team must submit an Engineering Notebook with an Engineering Section that includes detailed Robot design drawings.</li> <li>• Robot differentiates itself from others.</li> <li>• Design is both aesthetic and functional.</li> <li>• Basis for the design is well considered (i.e. inspiration, function, etc.).</li> </ul>



Award and Description	Criteria
<b>Connect Award</b>	
<p>This Judged Award is given to the Team that most connected with their local community and the engineering community. A true <i>FIRST</i> Team is more than a sum of its parts, and recognizes that its schools and communities play an essential part to their success. The recipient of this Award is recognized for helping the community understand <i>FIRST</i>, the FTC, and the Team itself. The Team that wins this Award is aggressively seeking engineers and exploring the opportunities available in the world of engineering, science and technology. In addition, this Team has a clear Business or Strategic Plan and has identified steps to achieve their goals.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all</li> <li>• An Engineering Notebook must be submitted and must include a Business or Strategic plan.</li> <li>• Team provides clear examples of outreach to community</li> <li>• Team has worked to develop an in-person or a virtual connection with the engineering, science or technology community</li> <li>• Team has a business or strategic plan that identifies their future goals and the steps they will take to reach those goals. The plan could include fundraising goals, sustainability goals, timelines, and outreach and community service goals.</li> </ul>
<b>Motivate Award</b>	
<p>This Judged Award celebrates the Team that exemplifies the essence of the FTC competition through Team building, Team spirit and enthusiasm. They celebrate their Team, their individuality and their spirit through costumes and fun outfits, a Team cheer and their outstanding spirit. This Team has also made a collective effort to make <i>FIRST</i> known throughout their school and community.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all.</li> <li>• Team functions as a cohesive unit to discover the goals of the program.</li> <li>• Team can articulate the journey of becoming a Team of individuals with different roles.</li> <li>• Team has formed and can articulate internal processes to assign roles and communicate between Team members.</li> <li>• Team attitude of celebration and spirit is consistent throughout the Team and the competition.</li> <li>• Team is enthusiastic.</li> <li>• Team functions well as a unit.</li> <li>• Team enthusiasm is evident in community outreach.</li> </ul>

Award and Description	Criteria
<b>Think Award</b>	
<p>This Judged Award is given to the Team that best reflects the “journey” the Team took as they experienced the engineering design process during the build season. The engineering section of the notebook is the key reference for Judges to help identify the most deserving Team. The Team’s Engineering Notebook should focus on the design and build stage of the Team’s Robot. Journal entries of interest to Judges for this Award will include those describing the underlying science and mathematics of the Robot design and Game strategies, the designs, re-designs, successes, and those ‘interesting moments’ when things weren’t going as planned. A Team is not a candidate for this Award if they have not completed the Engineering Section of the Engineering Notebook.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all.</li> <li>• Team must submit an Engineering Notebook with an Engineering Section Team notebook must be clearly identified with the Team # and Team Name.</li> <li>• Engineering Notebook must demonstrate that the Team has a clear understanding of the engineering design process, with pictures or drawings and details documenting all stages of Robot design.</li> <li>• Engineering Notebook must be organized and follow the formatting guidelines provided by <i>FIRST</i> and include a Summary Page.</li> <li>• Teams must tab/flag 6 to 8 pages of the Engineering Section to support entries on the summary page.</li> <li>• It is acceptable to include designs/ideas that are adapted from an outside source, providing that this is noted and credit is cited to the original source.</li> <li>• Supporting drawings and diagrams must be included in the correct chronological order, not in a separate section.</li> </ul>
<b>Control Award</b>	
<p>The Control Award celebrates a Team that uses sensors and software to enhance 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, enhancing 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 should contain details about the implementation of the software, sensors, and mechanical control. Please check with your local Affiliate Partner to find out if this Award will be offered in your region.</p>	<ul style="list-style-type: none"> <li>• Team demonstrates respect and Gracious Professionalism to all.</li> <li>• Team must submit an Engineering Notebook with an Engineering Section.</li> <li>• Control Components must be documented in the Engineering Notebook.</li> <li>• Control Components must enhance the functionality of the Robot on the Field.</li> <li>• Control Components must work reliably.</li> <li>• Teams are encouraged to demonstrate control components to the Judges.</li> <li>• Advanced software techniques and algorithms are encouraged.</li> <li>• Prototyped sensors and custom hardware are encouraged.</li> </ul>

Award and Description	Criteria
<b>Promote Award (Optional Award)</b>	
<p>This Judged Award is optional and may not be given at all Tournaments. Please contact your Tournament organizer to determine if it will be given at an event you attend. 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. Winning videos will be submitted to FIRST and used to promote the higher values of the FTC. Teams may win the Promote Award only once at a Championship level event and only once at a qualifying level event. Team must submit a one-minute long public service announcement (PSA) video one full week prior to the event to be eligible for this Award. Additional submissions are welcome but will not be eligible for Awards. The submission process for this Award may vary by Tournament. Please check with your Tournament's organizer for details.</p>	<ul style="list-style-type: none"> <li>• Team must present a thoughtful and high-quality video which appeals to the general public.</li> <li>• Strong production value is important, but the message and impact of the video are of greater weight for the Judges.</li> <li>• Creativity in interpreting the annually assigned theme is desired.</li> <li>• Submissions for this Award will be considered for the Inspire Award but are not required.</li> <li>• Team must have rights to any music used in the video.</li> </ul> <p><b>• PSA Subject is announced each year in the Game Manual Part I.</b></p>
<b>Compass Award (Optional Award)</b>	
<p>An FTC Team is about more than building Robots, and competing at Tournaments, it is a journey to a destination through trial and error, success and failure, with challenging new technology and obstacles to navigate where no road maps are provided. How does a Team find their way? The Compass Award recognizes an adult Coach or Mentor who has provided outstanding guidance and support for a Team throughout the year. The winner of the Compass Award will be determined from candidates nominated by FTC Team members, via a 40-60 second video submission, highlighting how their Mentor has helped them become a champion Team. We want to hear what sets the Mentor apart.</p>	<ul style="list-style-type: none"> <li>• Only one video submission per Team will be considered. Teams may submit new or updated videos at each Tournament.</li> <li>• The video must be submitted at least one week prior to Tournament day. Instructions for submitting videos may vary from Tournament to Tournament. Please check with your Tournament's organizer for details.</li> <li>• Videos must not be longer than 60 seconds (including introduction and credits if you choose to use them).</li> <li>• Videos must be submitted in AVI, WMV or MOV format. Remember that the winning video may be shown on a large screen during the Awards ceremony. Use the best resolution you have available for your final version.</li> <li>• Team must have rights to any music used on the video.</li> <li>• Team must submit an Engineering Notebook.</li> </ul>

Award and Description	Criteria
<b>Judges Award</b> (Optional Award)	
<p>During the course of the competition, the judging panel may encounter a Team whose unique efforts, performance or dynamics merit recognition, yet doesn't fit into any of the existing Award categories. To recognize these unique Teams, <i>FIRST</i> offers a customizable Judges Award. The judging panel may select a Team to be honored, as well as the name of the Judges Award.</p>	
<b>Winning Alliance Award</b>	
	<ul style="list-style-type: none"> <li>• This Award will be given to the winning Alliance represented in the final match.</li> </ul>
<b>Finalist Alliance Award</b>	
	<ul style="list-style-type: none"> <li>• This Award will be given to the finalist Alliance represented in the final match.</li> </ul>



## Funding

---

### Planning a Budget

To ensure a positive experience and the long-term viability of a Team, spending must be planned carefully. It is important to know how much money will be needed for the season and how it will be gathered. In addition to the need to plan spending carefully, Sponsors may ask how money will be allocated, and it is important to be able to give them a clear answer. Teams should keep all receipts and records of purchases in an organized manner for easy reference when necessary.

Creating a budget will simplify goal setting for fundraising and sponsorship efforts. Many of the costs listed here can be subsidized with in-kind and monetary donations.

Be sure to budget for advancement to Super-Regional Championships and the World Championship. Some Teams receive their invitation very late in the season and it can be a challenge to raise the necessary funds in a short time frame.

### Sample Budget

On the next page is a sample of estimated expenses, based on estimated costs and assuming no in-kind donations, such as goods or services. Most of these will vary, based on individual Team situations. Costs have been estimated in USD.

**Use the column on the right to record actual costs throughout the season, in order to more accurately estimate a budget for the following year.**

### Sample Team Budget

Item	Anticipated/ Approximate Cost	Actual Cost
FTC Team registration fee	\$275	
FTC Competition Kit (TETRIX/MATRIX)	\$700	
Additional Parts	\$100-\$500	
Samantha Wi-Fi Module	\$85	
Yearly seasonal upgrades	Costs will vary based on what is available to re-use from previous years, and yearly requirements.	
LabVIEW for LEGO MINDSTORMS	\$0 (National Instruments graciously donates one license per Team)	
ROBOTC	\$49-\$499	
Tournament registration fees	\$0-\$300 (Costs for Tournaments are determined by the FTC Affiliate Partner)	
Regional travel, lodging, food, etc.	Costs will vary with the distance to the event and the number of people attending.	
Supplies, storage container, etc.	Costs will vary based on what is available to re-use from previous years, and yearly requirements.	
Practice Field and Game Elements	Costs will vary based on what is available to re-use from previous years, and yearly requirements.	
Team t-shirts, pins, etc.	\$0-\$200 (Optional)	
Pit decorations	\$0-\$200 (Optional)	
Miscellaneous	\$0-\$200	
Super-Regional Championship Registration Fee	\$500	
FTC World Championship Registration Fee	\$1,000	
Championship travel, lodging, food	\$1,500-\$5,000 Costs will vary depending on the distance to the event and the number of people attending	
Total Cost:		

## Ordering Components

Make sure to inventory parts before the season begins, and at regular intervals throughout the season. This will help to cut back on unnecessary spending and avoid expedited shipping charges when parts are needed at the last minute.

During competitions or testing, it is likely that Robot parts will need to be replaced. Motors may burn out or sensors may be damaged. Try to order in larger quantities, when possible, to ensure that a specific part will always be available when it is needed, or to try out optional ideas when building.

## Ordering Extra Components

Order at least one of every available part, or more if your budget allows (specifically Samantha Module, batteries, motors, sensors, etc). Over the season there will be changes made to the Robot. It is a good idea to have different materials to experiment with, without having to wait for them to be shipped. There are often multiple approaches to a problem and having all parts on hand will allow for immediate testing and experimentation.

## Gathering Funding and Support

Many Teams will need to do some form of fundraising to pay for participation in FTC. This can be challenging, but it can also be a unifying and empowering experience for young people.

### 1. Personal Funding

Individuals can fund Teams using personal funds or divide the costs between Team members.

### 2. Sponsorship

In addition to relieving financial pressure, seeking a Sponsor and general fundraising can spread awareness of FTC and develop support for *FIRST*® in the community. Start by looking for a local company to sponsor the Team.

Use fundraising as an opportunity to strengthen a Team's speaking and presentation skills. Students may feel a vested interest in the funding of their Team when they are directly responsible for soliciting businesses for funds. They can create their own marketing materials, such as PowerPoint presentations and display boards. These materials should include information about the Team, and realistic goals that the Team would like to achieve during their season.

**A requirement of contributing to the Team's costs may be a considerable expense for some Mentors or families, which can potentially exclude eager Volunteers and students from participation.**

## Reasons Why a Company Should Sponsor an FTC Team:

- Funding FTC Teams encourages a talented future workforce.
- Sponsors help to develop the community in which they exist by providing for positive experiences for young people.
- Sponsorship creates and enhances awareness of the company in the local community.
- Companies can add their logo on to Team banners or T-shirts.

## Finding a Sponsor

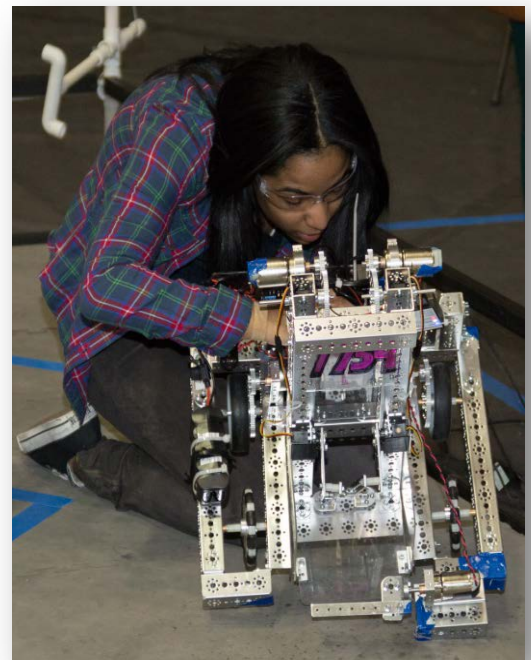
- Call local businesses and offer to come and discuss the Team.
- Ask for a donation of funding or services to support the Team.
- Offer to put sponsor logos and stickers on the Robot, pit banner, etc.
- Invite Sponsors to visit the Team and give a presentation about what their organization does.
- Have students prepare a 10 – 15 minute presentation that emphasizes the educational value of Robotics. Demonstrate a Robot if possible and let one of the Sponsors drive for a brief period of time.
- Create a one-page flyer or small Team profile package to give to the Sponsor.
- Maintaining Sponsor Relationships
- If a Sponsor asks, be prepared to explain how donations are being used.
- Update donors or Sponsors regularly and remind them how their contribution helps to inspire a life-long appreciation for science and technology, as well as lasting intellectual and life skills.
- Encourage Sponsors to come to events when possible.
- Create a video on DVD to show the Team in action and how the Sponsor's donation helped the Team.
- Write a thank you letter to every Sponsor, no matter how small their contribution.

### 3. Fundraising

Team fundraising builds unity and develops enthusiasm for success. In addition to the obvious monetary benefit, it also fosters a sense of ownership in the Team. Choosing a fundraiser that is appropriate for a Team and its community can be the difference between a mediocre result and a great one. Team members should brainstorm for creative fundraising ideas early in the season, or search online to find both traditional and innovative ideas.

### Tips for Fundraising

- Always be sure that the host organization approves the chosen fundraiser.
- To be more original, make and sell items that complement the community.
- Make it fun! The more fun the fundraiser is, the more donors will want to be part of the excitement.
- Think of fundraising ideas that do not require additional Volunteers, or a greater time commitment.
- Ask community groups to support the Team in any way they can. A number of major retail franchises may match money raised at their sites, while others may offer community groups free or discounted products. Be sure to call local businesses and ask them what they might do to help. Every little bit raised is helpful!
- Visit local businesses and companies to grow the program in the area and bring community awareness for the Team.
- \$100 from ten businesses might be easier to attain than \$1,000 from one Sponsor.
- Several small fundraisers are easier to coordinate than a single large one.





#### 4. Non-cash donations:

- Sponsors can provide technical or non-technical Mentors for the Team.
- Services like laser-cutting, CNC machining, graphics work for Robot or pit decorations, food, t-shirts, materials, office supplies, copying services, etc. are all valuable donations.
- Discounts on goods and services can be very helpful to Teams.
- Sponsors can make a space donation for meetings or to house a practice competition Field.
- Used laptops, computers, filing cabinets to organize workspace, old office furniture for work tables, etc. are all useful donations.
- Sponsors can provide Volunteers or Mentors.

## Seasonal Planning Tool

Coordinating a Team over the better part of a year is a lot of work. Make sure all dates and expectations are clear to Mentors, Volunteers, parents and students. While exact dates and deadlines will vary from year to year, some general timelines will remain consistent between seasons.

### Registration (Early May)

### Order Parts (Early May)

### Pre Kick-off (August – Early September)

- Attend FTC events in the area as a spectator to see the flow of the day, meet Mentors, talk to Teams about their experiences, and witness the high energy level first-hand.
- Talk to local FTC Partners listed on the FTC website <http://www.usfirst.org>, to get answers to questions, and to get in touch with experienced Mentors in the area.
- Try building practice Robots.
- Visit <http://www.usfirst.org> and go to the *FIRST* Tech Challenge site to see pictures of previous competitions.
- Find another local FTC Team Mentor with whom Mentors can compare notes, possibly share a Playing Field, or even set up late-season scrimmages.
- Choose a type of programming software for the kit and practice using it. Have a Team member start learning to use it.
- Host or support outreach events.
- Attend pre-season Workshops, if available.

### Kick-off and Game Reveal (Mid-September)

- Access all materials related to the new Challenge.
- Download manuals and graphics, access the rules of the new Robot Game, and view the season's Playing Field drawings
- Contact an Affiliate Partner for information pertaining to Kick-off events in the local area.
- Many Teams gather on that day for a Team party to celebrate the new yearly Game challenge.
- For some Teams, this meeting is a season opener.
- Download the materials together and come up with a Game plan for the new season.
- Raise Team awareness of the build excitement ahead of time and show them where to find information during the build season.
- It is a good idea to start budgeting for advancement to the World Championship. Some Teams receive their invitation late in the season and it can be challenging to raise the funds needed in such a short period of time.

### Early Season Meetings (September)

- Practice Team building.
- Establish procedures and routines.
- Get familiar with kits and parts
- Clean up and prepare workspace.
- Inventory resources from previous years.

### Build Season (October)

- Teach the Team about overall design.
- Decide which design to use as a Team.

- Programmers get comfortable with the programming software by reviewing the resources at [ftctraining.com](http://ftctraining.com), then create programming flowcharts and begin writing programs for autonomous mode.
- Building Team constructs prototypes and then builds the chassis and manipulators.

#### **Practice Season** (Late October – November)

- Programmers focus on autonomous mode requirements.
- Drivers practice remote control driving.
- Builders focus on organizing the pit area, assist with testing and driving practice, and enhance the Engineering Journal.
- Pit crew practices checks and repairs for efficiency.
- The whole Team works towards accomplishing all of the required tasks for the Challenge.
- Try to attend at least one scrimmage to practice under real conditions.

**Some regions may have earlier scrimmage and practice opportunities. Consult your local Affiliate Partner/Event organizer.**

#### **Qualifying Tournaments** (October – February)

- Register for Tournaments as early as possible in the season. Pay attention to qualifier requirements. Some Tournaments fill up quickly.

#### **Championship Tournaments** (December – March)

- There will be a listing of confirmed Championship Tournament sites on the FTC website, beginning in late September or October. Teams can apply either online or directly with the Tournament organizer for most Championship Tournaments.

#### **Super-Regional Championships** (March-April)

#### **World Championships** (April)

#### **Post-Season** (May – June)

- Organize post-season events.
- Celebrate end of the season.
- Get an early start on next season's registration (useful for schools using current year budget funds)

#### **Recruitment Season** (June – July)

- Some areas hold outreach events, which include demos or scrimmages to attract new Teams.
- Outreaches are a good opportunity to keep Team members together and engaged for a longer season.
- Outreach participation is also valuable in building a Team's CONNECT portfolio and contribute to the growth of *FIRST*®/FTC.

## Celebration and Recognition

### Celebrating the End of the *FIRST*Tech Season

At the end of the *FIRST* Tech Challenge season, the Team should be proud of its accomplishments. Team members created a unique machine they designed, programmed, and built to perform difficult challenges, and they learned how to work together successfully.

It is important to recognize what has been accomplished together. Be sure to think ahead and include a plan for celebration in the schedule. Whether or not a Team attends a Tournament, be sure to make some one-on-one time for each Team member. Tell each how she/he contributed to the Team, and remind them of the great ideas, problems solved, the way each supported Teammates, and the things learned during the season. This is an important job as a Mentor, so take time and be thoughtful about what is said to each student.



### Recognize Team Members

Plan a celebration and invite family and friends to see what the Team has accomplished. Ask the Team member's school to hold a special assembly, or ask a sponsoring organization to hold a Team social where the Team can demonstrate its Robot and showcase Team mementos, journals, or photos.

As an end-of-the-season Teamwork exercise, ask the Team to write down what each member contributed and then present each student with a certificate showing the contributions as recognized by other Team members. Ask Team members to vote on a future profession they think each Team member is most likely to pursue. One Team member could be “Most Likely to Invent Something to Change the World,” another student could be “Most Likely to Create a New Computer Program,” “Most Likely to Run a High-Tech Company,” or “Most Likely to Be President of a Research Facility.” This kind of recognition helps students understand how their newfound skills and talents could translate to the professional world.

Ask them to review the list of FTC values and choose the one that each member best exemplifies. This is a great way for the students to understand that their contributions to the Team are greater than the tasks that each one performed. Recognitions may include a “Gracious Professionalism” Award, a “Spirit of Friendly Competition” Award, and any other that the Team creates.

A certificate presentation could be part of a larger ceremony with the Team. Take a picture of each student with his certificate. This ceremony can be held as part of a celebration dinner or pizza party. Whatever it is, make it special!

Tell the group how their accomplishments as a Team were special, innovative, or unique. Sometimes it is difficult to say the words, but it is important that the Team understands what Coaching means to Mentors. Recognizing the entire Team, as well as praising each student individually in front of his or her Teammates, will create a lasting memory of working together on the *FIRST* Tech Challenge.

### Recognize Sponsors, Mentors, and Volunteers

Be sure the Team recognizes the contributions of Mentors and Volunteers at the end of the season. The Team can provide its Mentor a framed Team or Robot photograph, or a certificate or letter that recognizes the special talents she or he shared. To give a gift with a *FIRST* logo to Volunteers, Mentors, or Sponsors, visit the *FIRST* on-line store for clothing, Awards, and other customized items.

### Host a Local Event

In the post-season, Teams may consider hosting an unofficial local event. Other Teams in the area can be invited to attend and participate. This can be done in addition to subsequent FTC competitions or the Championship event. Visit the Events section of the FTC website for more information.

Hosting an unofficial local event will help Team members learn new skills and take more responsibility for their work, as they will be running the event. Students may consider the local event a showcase for their FTC accomplishments, and they love the opportunity to see what other Teams have done with their Robots.

Customize local events to suit the Team's needs and resources. The flexible format for local events allows for the inclusion of elimination rounds, special Robot challenges, Teamwork activities, and demonstrations of other special components/ subassemblies that the Team may have developed. Sometimes host Teams participate in the competition, but choose not to be eligible for an Award, enjoying it for the experience rather than for competitive reasons. Whatever the Team chooses to do, let other participating Teams know what they can expect.



## Help and Resources

### FIRST Contact Information

FIRST Tech Challenge staff can be reached by phone at (800) 871-8326 or email at FTCTeams@usfirst.org. The office is open Monday through Friday from 8:30 a.m. to 5:00 p.m. Eastern Time.

**Note:** Be sure to provide the FTC Team number in the message.

### Registration for FTC

#### Registration for *FIRST*:

Registration for the *FIRST* Tech challenge can be accomplished online (<https://my.usfirst.org/ftc/tims/site.lasso>). New users will be asked to provide contact information for the creation of a new Username and Password.

#### Once logged in a user can:

- Edit Team information
- Register for *FIRST*
- Pay registration fees
- Order materials and register with *FIRST* partners for events and access to the official *FIRST* forums
- Ensure that each Team member is registered and has obtained parent consent in the online Youth Team Member Registration System. Information on registering Teams is located at: <http://www.usfirst.org/roboticsprograms/team-member-registration-process-overview> Team members unable to complete online registration will find information on how to register here: <http://www.usfirst.org/roboticsprograms/team-member-registration-faq>

**The FTC Team registration fee is \$275. This fee gives your Team access to discounted parts ordering and the ability to register for Official FTC Events during the 2014 - 2015 Season. Additional tournament registration fees may apply.**

#### Registration at a *FIRST* Event:

The registration process for individual events is often quite similar. Once a Team has arrived at the venue, a Team member or the Coach will report to the registration desk and announces the Team's arrival. At this time, the Team will be asked to submit their registration documentation and, in some cases, their Engineering Notebooks. Once the necessary documentation has been submitted, the Team will probably receive an information packet that contains the day's schedule of events, information on food and concessions, driver buttons, and other materials.

### Affiliate Partners

FTC Affiliate Partners are a great source of information and support. They are responsible for coordinating the program in each region or state. FTC Partners fundraise, run Tournaments, hold workshops and demonstrations, market FTC in their region, handle public relations, and recruit Volunteers and Teams. Due to the fact that Affiliate Partners organize events, the registration process and costs to participate will vary by event. Therefore, it is important to contact Affiliate Partners with questions regarding event registration and fees.

To find a region's Affiliate Partners, visit the *FIRST* Regional Contacts webpage (<http://www.usfirst.org/regionalcontact.aspx>). If the region of interest is not listed, contact *FIRST* directly using this online form (<http://www.usfirst.org/contactform.aspx>).

## Kit of Parts

The Kit of Parts for FTC is provided entirely by independent vendors and their distributors. Details about the Kit of Parts for each year's Game are provided at the time of registration. Links to ordering will be provided as part of the process when a Team becomes a FIRST member in good standing.

## Getting Answers to Game Questions

Only registered Teams may post questions to the FTC Game Forum. Only Team leaders can email questions. Only one question should be submitted at a time. The Team login and password to the forum can be found on the Team registration site.

### How to Post a Question to the FTC Game Forum

1. Log into the registration site and go to the main page for the Team.
2. The login and password will be displayed on the right hand side of the screen.
3. Log on to the forums.
4. Click "General Discussion."
5. Click "FIRST Tech Challenge."



## Technical and Team Support

For detailed information on the *FIRST* Tech challenge program, Robot kit, accessories, or Playing Field go to:

Website, E-Mail, or Phone	Support Available
FTCTeams@usfirst.org	General information and questions about the <i>FIRST</i> Tech Challenge
<a href="http://www.usfirst.org">www.usfirst.org</a>	<i>FIRST</i> Tech Challenge information, registration, FAQs, and Team resources
<a href="http://www.ni.com/ftc">www.ni.com/ftc</a>	Online tutorials for LabVIEW. The forums at the site will be managed daily by National Instruments Staff
<a href="http://www.usfirst.org/ftc">www.usfirst.org/ftc</a>	FTC information, FAQs, and Team resources
<a href="http://ftcforum.usfirst.org/forum.php">ftcforum.usfirst.org/forum.php</a>	FTC Game Q&A and Samantha Forum
<a href="http://www.usfirst.org/Roboticsprograms/ftc/Game">www.usfirst.org/Roboticsprograms/ftc/Game</a>	FTC Game Information and links to other resources
<a href="http://www.usfirst.org/roboticsprograms/ftc/team-resources">www.usfirst.org/roboticsprograms/ftc/team-resources</a>	Samantha Information Resources
<a href="http://www.TETRIXRobotics.com">www.TETRIXRobotics.com</a>	Central hub for all information on the TETRIX Building System, including building tips, downloads, and competition information
<a href="http://www.TETRIXRobotics.com/GettingStartedGuide">www.TETRIXRobotics.com/GettingStartedGuide</a>	Information, activities for creating TETRIX with LEGO MINDSTORMS Robots
<a href="http://www.TETRIXRobotics.com/FTC">www.TETRIXRobotics.com/FTC</a>	Information to help Teams adapt and improve a Robot for FTC competition
phone: 866-349-LEGO e-mail: <a href="mailto:LEGOeducation.us/help">LEGOeducation.us/help</a>	LEGO Education Technical Support Staff provide help and support to Teams by phone or email

### Team Development Support

In addition to the staff at *FIRST* headquarters, a regional support is available through *FIRST* Regional Directors, *FIRST* Senior Mentors, and *FIRST* VISTA Volunteers.

Regional Support	Support Available
<b>Regional Directors</b>	<ul style="list-style-type: none"> <li>• Assist with Team-related needs such as finding a Team Sponsor</li> <li>• To find out the name of a local Regional Director, send an email request to <a href="mailto:ftcTeams@usfirst.org">ftcTeams@usfirst.org</a></li> </ul>
<b><i>FIRST</i> Senior Mentors and VISTA Volunteers</b>	<ul style="list-style-type: none"> <li>• Experienced <i>FIRST</i> Volunteers</li> <li>• Assist Teams with Team development, Team Mentor guidance and other needs</li> <li>• To inquire if a Senior Mentor or VISTA Volunteer is available in the local area, send an email to <a href="mailto:ftcTeams@usfirst.org">ftcTeams@usfirst.org</a></li> </ul>
<b>Affiliate Partners</b>	<ul style="list-style-type: none"> <li>• Assist with Team-related needs such as finding a Team sponsor</li> <li>• Experienced <i>FIRST</i> Volunteer</li> <li>• Assist Teams with Team development, Team Mentor guidance and other needs</li> </ul>

