



**FIRST
TECH
CHALLENGE**

*Training and
Support*



2016-2017 **FIRST®** Tech Challenge Mentor Manual

www.firstinspires.org

200 BEDFORD STREET ■ MANCHESTER, NH 03101

FOR INSPIRATION & RECOGNITION OF SCIENCE & TECHNOLOGY

FIRST
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Thank you for taking the time to volunteer for a FIRST® Tech Challenge event. FIRST® and FIRST® Tech Challenge rely heavily on Volunteers to ensure events run smoothly and are a fun experience for Teams and their families, which could not happen without people like you. With over 4,600 Teams competing annually, your dedication and commitment are paramount to the success of each event and the FIRST Tech Challenge program. Thank you for your time and effort in supporting the mission of FIRST!



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How to Use This Manual

We recommend downloading this Manual, looking through it cover to cover once (or at least skim through the Table of Contents to familiarize yourself with what's covered), and then keep the downloaded version saved and readily accessible on your electronic device. When you need to look something up, open the file back up. The PDF version of this Manual is easily searchable: you can click on any item in the Table of Contents to immediately go to that section of the Manual.

Throughout the Manual there are underlined, linked items that take you to other areas of the Manual or in the [Appendices](#), clicking on these will bring you right to the item-no scrolling or searching required! In addition, there are items linked to webpages, if you are connected to the internet, clicking on these items will bring you right to the webpage. Lastly, many of the Appendices are available as PDF or editable Word documents (as applicable) and can be found predominantly from the Rookie Resources Page or the Veteran Resources Page.

Throughout the Manual, you will find boxes with additional information

 Reminder These boxes highlight key information you'll want to remember.	 In the Classroom These boxes highlight tips for teachers using FIRST in their class.	 Inclusion These boxes highlight ways to build team by including all members fully.	 Tip These boxes include tips and tricks to help the team have an easy season.
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Introduction

What is 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 FIRST Tech Challenge and other FIRST Programs, visit www.firstinspires.org.

FIRST Tech Challenge Core Values

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

FIRST asks everyone who participates in FIRST Tech Challenge to uphold the following values:

- We display *Gracious Professionalism*® with everyone we engage with and in everything we do.
- We act with integrity.
- We have fun.
- We are a welcoming community of students, Mentors, and Volunteers.
- What we learn is more important than what we win.
- We respect each other and celebrate our diversity.
- Students and adults work together to find solutions to challenges.
- We honor the spirit of friendly competition.
- We behave with courtesy and compassion for others at all times.
- We act as ambassadors for FIRST and FIRST Tech Challenge.
- We inspire others to adopt these values.



FIRST Tech Challenge is MORE THAN ROBOTS™!
While competing, students develop personal and professional skills they will be able to rely on throughout their life.

What is the FIRST Tech Challenge Mentor Manual?

The purpose of the FIRST Tech Challenge Mentor Manual 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 FIRST Tech Challenge Team evolves.

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

- Making the Mentoring process easier for rookie 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.
- Direct Mentors to other resources to support them in their role.



FIRST Tech Challenge Coach's Promise

As the Coach of a FIRST Tech Challenge Team, you are responsible for honoring and communicating the Program's Core Values to Team members, Team Volunteers, and others affiliated with your Team.

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



FIRST Tech Challenge Mentors will receive updates, additions, Volunteer recruitment, screening, and supervision guidelines for the Team via e-mail and/or postings on the [FIRST Tech Challenge Team Email Blast Archives](#) webpage. We encourage other members of the Team to opt in to the weekly Team email blast by signing up in the Team Registration or email ftcteams@firstinspires.org.

Gracious Professionalism®

FIRST uses this term to describe our programs' 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.

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.

Watch Dr. Woodie Flowers explain *Gracious Professionalism*® in this [short video](#).



"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**



An example of *Gracious Professionalism*® is patiently listening to a Team's question and providing support despite having several pressing things to do on the day of the event.

Youth Protection Program

The purpose of the *FIRST*® Youth Protection Program (*FIRST* YPP) is to provide Coaches, Mentors, Volunteers, employees, others working in *FIRST* programs, team members, parents, and guardians of team members with information, guidelines, and procedures to create safe environments for everyone participating in *FIRST* programs.

The *FIRST* YPP sets minimum standards recommended for all *FIRST* activities. Adults working in *FIRST* programs must be knowledgeable of the standards set by the *FIRST* YPP, as well as those set by the school or organization hosting their team.

Youth Protection Expectations and Guidelines

Coaches and Mentors are expected to read and follow elements in the [*FIRST* Youth Protection Program guide](#) that are labeled as required are mandatory in the United States and Canada, and may not be waived without the approval of the *FIRST* Youth Protection Department.

FIRST recommends that the standards set forth in the [*FIRST* Youth Protection Program guide](#) be applied outside of the United States and Canada to the extent possible. At a minimum, local regulations regarding youth protection must be complied with.

Forms are available here: <http://www.firstinspires.org/sites/default/files/uploads/about/FORMS.zip>

Information on the US Screening process is available here:

<http://www.firstinspires.org/sites/default/files/uploads/about/us-screening-2016-2017.pdf>



Everyone working with *FIRST* Teams should be familiar with the *FIRST* YPP policies.

Information on the Canadian Screening process is available here:
<http://vimeo.com/30137373>

You can find FAQ and additional information about the *FIRST* Youth Protection Program on the *FIRST* website at:
<http://www.firstinspires.org/resource-library/youth-protection-policy>

NOTICE OF NON-DISCRIMINATION

United States Foundation for Inspiration and Recognition of Science and Technology (*FIRST*®) does not discriminate on the basis of race, color, national origin, sex, disability, or age in its programs and activities. The following person has been designated to handle inquiries regarding the non-discrimination policies: Lee Doucette, Youth Protection Program Manager, 200 Bedford Street, Manchester, NH 03101, 603-666-3906, Ext. 250.

FIRST Tech Challenge Glossary

As with learning anything new, part of the learning curve is learning the “lingo”. Below are some important FIRST Tech Challenge terms that you will encounter in this Manual:

Affiliate Partner – coordinates the Event structure, Team recruitment and support, and funding for the FIRST Tech Challenge program in their region.

Awards – all Teams participate in Judging Interviews which the Judges use in determining the winners of FIRST Tech Challenge Awards. Read more in the [Awards section](#) of this Manual or on the Program [Awards webpage](#).

Coach – anyone assisting the Team who is not a student Team member and works to help the Team achieve their goals. Each Team must have two adult, screened Mentors. Coach and Mentor are used interchangeably.

Competition Season – Teams compete against other Teams in Tournaments. Tournaments start as early as October in some regions and culminate in the FIRST Tech Challenge World Championships in April. Read more about the [FIRST Tech Challenge Tournament Structure](#) and different Events or visit the [Events webpage](#).

Coopertition – means that Teams support and help one another even as they compete to the best of their ability. Read more on the [FIRST webpage](#).

Engineering Notebook – Teams document their experience both as a Team and with the Robot and compile everything together in a Notebook which they share with Judges. Read more and see examples in the [Engineering Notebook](#) section.

Events – FIRST Tech Challenge Events can happen anytime during the year. These include informal workshops and trainings, scrimmages, or Tournament Events. Read more about the [FIRST Tech Challenge Events](#) or visit the [Events webpage](#).

Game Challenge – in September at Kickoff, FIRST Tech Challenge announces the annual Challenge in which Teams will compete with their Robots. Information on the Game is published in the Game Manual Part II released at/during Kickoff.

Game Design Committee (GDC) – Volunteers from various fields, including science, technology, and engineering, who design the annual Game Challenge, write the Game Manuals, and moderate the FIRST Tech Challenge forum.

Game Manual Part I and II – read them, know them, love them. They outline everything Teams need to know about building the Robot, the Game Challenge, Engineering Notebook, Judging/Awards, etc. They are published on the on the [FIRST Tech Challenge Game webpage](#) – Part I is released in July and Part II is released on Kickoff.

Gracious Professionalism – means that Teams support and help one another even as they compete to the best of their ability. Read more in the [gracious Professionalism®](#) section or on the [FIRST webpage](#).

FIRST Tech Challenge Forum – Teams, Mentors, and Volunteers connect to ask questions and read answers about the annual Game Challenge and/or participate in information sharing.

FIRST Tech Challenge Sponsors – FIRST Tech Challenge is grateful for our global sponsors. Read more about [FIRST Tech Challenge Sponsors](#).



Water Game – an ongoing joke around FIRST Tech Challenge and FIRST Robotics programs just before the Game is revealed.

FIRST Tech Challenge Vendors – several companies provide materials to the FIRST Tech Challenge program and Teams. These include the Kit of Parts vendors: Pitsco (TETRIX) and HiTechnic (MATRIX), Modern Robotics, and [Intelitek](#) (Technology training materials).

Kickoff – the FIRST Tech Challenge season commences in early September with the annual Kickoff. Many regions host Kickoff events. The FIRST Tech Challenge program release the Game Manual Part II and all information about the Game Challenge on Kickoff Day via the [Game Page](#).

Kit of Parts – materials Teams can purchase to use in building their Robots, choosing between TETRIX or MATRIX, and purchasing the Android phones, sensors, and modules. Read more on the [Registration and Costs webpage](#). Read more in the [Purchasing Robot Supplies](#) section.

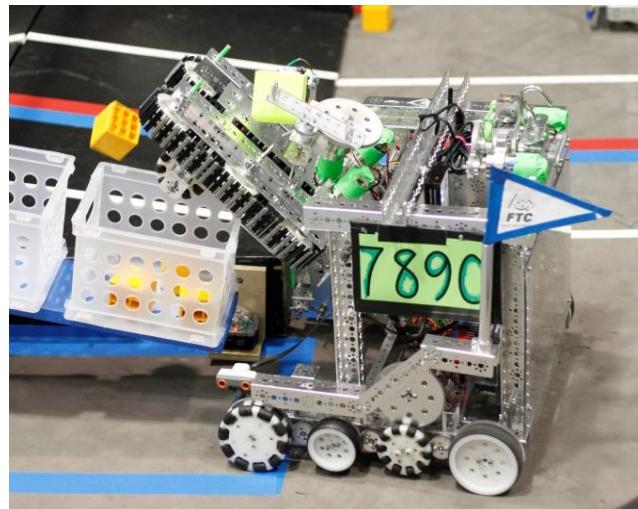
Mentor – anyone assisting the Team who is not a student Team member and works to help the Team achieve their goals. Each Team must have two adult, screened Mentors. Coach and Mentor are used interchangeably.

Team – a group of students grades 7-12 who come together to form a Team, design, build, and compete with a Robot in the annual FIRST Tech Challenge Game Challenge. Read more in the [Building the Team](#) section.

Team Email Blast – stay connected and get the latest news from FIRST Tech Challenge. Teams can sign up in the Team Registration Portal where it is called “Email Broadcast”. For other ways to stay connected to FIRST Tech Challenge, check out the [FIRST Tech Challenge Resources](#) section of the Appendices.

Team Registration – an online platform where Mentors can register, setup the Team’s account, order Kits, complete payment, and manage Team information. Read detailed information on the [Information Management Systems Support and Resources webpage](#).

Tournament –Teams compete against other Teams in Tournaments. FIRST Tech Challenge Tournaments start as early as October in some regions and culminate in the FIRST Tech Challenge World Championships in April (event seasons vary by region, but always start with the Kickoff in September). Read more about the [FIRST Tech Challenge Tournament Structure](#) and different Events, our [season timeline](#) or visit the [Events webpage](#).



Virtual Events – training calls and videos produced by the FIRST Tech Challenge staff as well as experts. View the current schedule and past events on the [Virtual Events website](#) and more training videos on [FIRST Tech Challenge's YouTube channel](#).

Volunteer Roles – all of FIRST relies on Volunteers throughout the season, including Mentors, but also Tournament Volunteers. Read more on the [FIRST Tech Challenge Volunteer Resources webpage](#).

Youth Registration– an online platform where parents/guardians can complete registration information for their student. Housed on the Dashboard when you log into www.firstinspires.org.

Season Timeline

The FIRST Tech Challenge in North America and Mexico is a year-long program, starting with Registration in May and ending with the FIRST Tech Challenge World Championships in April. The Competition season varies from region to region, but can start as early as October and run as long as March, for Teams that advance. The following chart details the different aspects of the season and when they happen:

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Registration Opens	Red											
Pre-Season		Orange	Orange	Orange								
Kickoff					Yellow							
Build and Practice Season					Green	Green	Green	Green				
Qualifying Season						Cyan	Cyan	Cyan	Cyan			
State/Regional Championships								Purple	Purple	Purple	Purple	
Super-Regional Championships										Gray	Gray	
World Championships												Orange

Be sure to refer to the [Season Planning Tool in Appendix B](#).

For more information, refer to the [FIRST Tech Challenge Season Timeline webpage](#).

The Mentor Role

What is a Mentor?

Mentoring is an important part of the *FIRST* program and largely contributes 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. Read about one [Mentor's Impact in this *FIRST* Tech Challenge blog post.](#)

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 as little as one Team meeting or as many as all of them.
- Helps provide valuable support and serves as a resource in his or her area of 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.

In *FIRST* Tech Challenge, it is important that Mentors and students are equal and that the relationship is a partnership. Each person works collaboratively towards a mutual and beneficial goal. To succeed, all of the Mentors and Team members must commit to this.

Mentors should also be willing to acquire some basic knowledge of programming 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.

Spectrum of Involvement

Each Team will need to determine the balance they require or desire between the Mentor coaching, helping, or doing. This is true for running the Team, funding the Team, and designing and building the Robot. *FIRST* Tech Challenge does not outline rules or expectations for how the Team should function and how much/how little a Mentor should be involved. Ideally, the Mentor will gauge the needs of the Team and then slowly release responsibility to the Team so that the members build skills and confidence. For more information on release of responsibility, read the [Developing Leaders](#) section of the Manual.



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!



Each Team must have at least two Mentors that are 18 years old or older.



For Mentors teaching *FIRST* Tech Challenge, the spectrum of involvement of the Mentor may be based on the structure of the course.

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.
- Encouraging the Team to welcome and include all members.
- 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 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 and purchasing supplies.
- Communicating with Sponsor organizations.
- Registering for Competition(s).
- 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.
- Being a champion for *Gracious Professionalism* and role modeling the principle within the Team.

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 so well that they take on 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!
- Create opportunities for student Team members to learn and grow and become. [Watch John Fogarty](#) explain his FIRST experience and the impact it had on his life at the 2013 FIRST Tech Challenge World Championships.



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 can help Teams work through programming or design challenges, share strategizing methods, and serve as role models.
- Marketing experts can teach students about promoting their Team to others, including other Teams, Sponsors, or the local community.
- Graphic artists can provide advice on Team logos and T-shirts as well as website design, promotional materials, etc.
- General Volunteers are valuable to help with scheduling meetings, providing transportation and snacks, assisting with fundraising, or providing carpentry assistance for Field construction.
- Teachers and guidance counselors can help with Teambuilding, conflict resolution, or college and career exploration and preparation.

The Teacher Mentor

Approximately 65% of FIRST Tech Challenge Mentors are also classroom teachers. Some teach FIRST Tech Challenge in their robotics class, while others coach the Program as an after school club, and still others fall somewhere in between on the spectrum of possibilities. In this instance, we are speaking specifically about the Mentor teaching in the classroom.

While every FIRST Tech Challenge Mentor needs to know and uphold the policies and values of FIRST and FIRST Tech Challenge, Teachers will need to also know, understand, and follow the policies of their school.

FIRST Tech Challenge has resources to help Teacher Mentors:

- [List of resources for Rookie Teacher Mentors](#)
- [Standards Alignment Map](#) (2012)
- [Gear Up with FIRST Tech Challenge in the Classroom! 2015 Virtual Summer Conference](#)
- Read more in the [FIRST Tech Challenge in the Classroom](#) section of this Manual.

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 a Team be that of a facilitator. The difference is outlined below:

- 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 should design and build the Robot with only limited assistance from adult Mentors. This way, students may become complex problem solvers by finding solutions themselves and developing confidence in their ability to do so.

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

Read more tips on facilitating in [Appendix C: 10 Steps to Being an Effective FIRST Tech Challenge Facilitator](#).

Advice for Mentors

Mentoring a 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!

The goal of FIRST Tech Challenge 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. Be intentional and conscientious in your behavior and language.

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 this is a school-affiliated Team and the school district has an individual who works with school or business partnerships, they should be invited to this meeting to help answer questions.

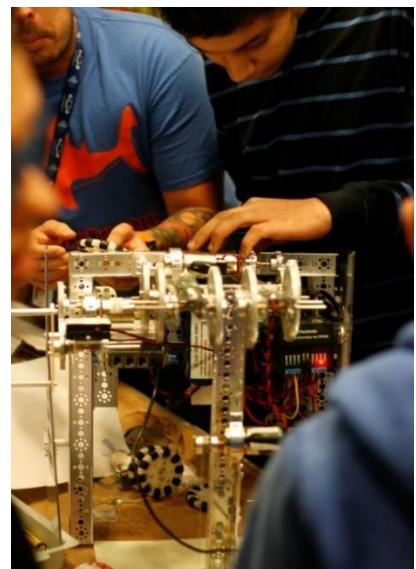
[FIRST Youth Protection Program](#) has clear guidelines regarding adult and student interaction. Many school districts and organizations that Teams are affiliated do as well. The Mentor must understand all of these policies as well as how to enforce them, and communicate these policies to every adult working with the Team.



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

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 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 cheerleader, enthusiast, and leader. Happy Teams win accolades and learn the most.
12. Forging relationships and gaining friends are far more valuable experiences for Team members 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 already discussed.

Effective Mentor Time Management

- Be aware of the [Season Timeline](#) and keep your Team focused on upcoming elements.
- 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.
- 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.
- Coach students on time management, including breaking larger tasks into smaller steps with 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.

Registering the Team

Registration

Registration for the FIRST Tech Challenge can be accomplished online through our [FIRST webpage](#). New users will be asked to provide contact information for the creation of a new Username and Password.

The following resources will be helpful in registering:

- Information about registering can be found on the [Register Your Team webpage](#).

Once logged in to the Team Registration, a user can:

- Edit Team information.
- Register for the season.
- Apply for grants (if applicable).
- Access the Storefront to pay season registration fees and order materials (see [Purchasing Robot Supplies](#) below).
- Once registered in the Team Registration, connect with your local Affiliate Partner for events (see [Registering for Events](#) below).
- Obtain Team 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. Read [Information on registering Teams](#).
- Print a Team Roster, which is required at check-in for Events. View a sample Team Roster in [Appendix D: Sample Team Roster](#).

Purchasing Robot Supplies

Once you have created a Team in our Team Registration, you will be able to purchase supplies or kits through our FIRST Tech Challenge Storefront. This Storefront can be accessed multiple times and you are able to purchase up to one item from each section. Registration is automatically placed in your Cart upon entry, however, you are able to purchase supplies or kits at a later date if necessary. Read about the [FIRST Tech Challenge Kit of Parts Options](#).

Registering for Events

Once your Team is registered and paid for the season, you will be able to register with the FIRST Tech Challenge Affiliate Partner in your region to compete in Events in your area. There are a variety of Events for Teams to compete in, so be sure to check out the [Events webpage](#) for more information.

To find Events in your area, go to the [FIRST Event Portal](#) and select the information that meets your regions criteria. Events are added from May until October, sometimes even later, so be sure to keep checking back.



Each region offers varying numbers of Events and has different policies about how many Teams each Event can have, how many events a Team can attend in the region, and whether they will allow Teams from outside their region to participate. Be sure to contact your Affiliate Partner (info can be found in the [FIRST Regional Contacts Portal](#)) for more information about the Events in your region.

Funding the Team

How much does it cost to have a team?

On average, it can cost from \$2,000 - \$4,000 for an *FIRST* Tech Challenge Team to get started. This amount is variable, depending on the number of tournaments the Team attends and how far they need to travel. Use the modifiable budget in [Appendix E: FIRST Tech Challenge Sample Budget](#) or on the [Cost and Registration webpage](#) and the advice listed on how to reduce costs.

A typical *FIRST* Tech Challenge season costs may include:

- \$1,300 Rookie Team Kit-of-parts*
- \$275 - Team Registration Fee*
- ~\$150 - Qualification Tournament Registration (each Event)*
- Extra tools & parts for the robot (variable)
- Lodging and travel costs to attend tournaments (variable)
- Team T-shirts & flare (variable)

*These are required fees.



Business/Strategic Plans

Many Teams create a business plan which they include in their Engineering Notebook which outlines how the Team is organized and their plan for Team sustainability. Your Team does not need to do a business plan, however the business plan is required for a Team to be considered for some of the awards. It, and the [Engineering Notebook](#), are optional, but highly recommended. At the very least, the Team may find it useful when creating goals, the strategies to accomplish the goals, and the necessary fundraising to sustain it.

Be sure to check out these resources:

- [Marketing and Business Strategies for FIRST Tech Challenge Teams](#) (video)
- [FIRST Business Plan Overview training](#) (video)
- [FIRST Tech Challenge Fundraising Guide](#)
- [Appendix N: Sample Business Plan](#)

How much funding do we need?

Before asking for any funding, your team should develop a plan that answers the following questions:

- How much money does your Team need to get started and for what? (ie: a budget)
- How much money does your Team need to sustain it for multiple years?
- How much money does your Team plan to raise through [fundraising](#) efforts?
- How much money does your Team anticipate raising through [grant](#) opportunities?
- How much money/in-kind donations does your team plan to raise through [sponsorship](#)?
- How will you promote a business/organization if you receive a sponsorship? (Logo on team t-shirts and flare, etc.)

Funding Sources

Teams are responsible for obtaining funds to sustain their Teams. Most Teams secure funding through a combination of grants, fundraising activities, and sponsorships/private donations. While many Teams seek funding for just one year, long-term funding can ensure there's continuing support for your Team. The following sections provide both information and resources available to assist your Team in its fundraising efforts.

In addition, there are several comprehensive resources available to your Team, including:

- [Fundraising Resources webpage.](#)
- [FIRST Tech Challenge Team Fundraising Virtual Event Training](#) (video)

Fundraising

Teams use a variety of means to gather the funds they need each season. Some have support from their school or sponsor organization (such as the Girl Scouts), but a lot of Teams rely on fundraising. This might include:

- Team dues or parent donations.
- Bake sales, car washes, tag sales, shirt sales (see [Booster.com](#)), etc.
- Fundraising events, such as Uno's Dough Raisers, where local restaurants donate a portion of the night's sales.
- Fundraising campaigns, such as Tupperware, where a certain amount of the sales profits collected by the Team are donated.
- Creating and selling team "swag" – for example, some Teams 3D print key chains, etc to sell.
- Many websites now exist for "crowd sourcing", where a group posts their fundraising goal and asks family, friends, and strangers on the internet to help them with their fundraising efforts. Examples include [GoFundMe](#) or [GiveForward](#).
- For more tips, check out this list on [SignUpGenius](#).

Grants

A grant is money that is being given by a business or organization with a specific purpose. For example, there are grants for teachers to help them pay for field trips. Most grants have an application process that requires time and work to complete and they usually want to know a lot of information about your Team and how you will be using the money. There is a lot of grant money available, and sometimes people do not know about the opportunity or just don't apply. For FIRST Teams, there are a few places to find grant money.

FIRST Tech Challenge is supported by a strong network of businesses, foundations, educational and professional institutions, and individuals that provide grants and other levels of support. When funding is available, *FIRST* Tech Challenge offers grants to Teams. Read more on the [FIRST Tech Challenge Grants](#) webpage.

To learn more about regional grants available for *FIRST* Tech Challenge Teams in your area, contact your local Affiliate Partner. Use the [Regional Contacts](#) tool to find their e-mail address.

Lastly, lots of companies and organizations offer grants for new initiatives. This will require a lot of research and filling out paperwork, including a grant proposal, but it is really worth the effort. Be prepared to hear no each time you ask, but don't give up! The more you ask, the closer you get to someone saying yes!

For more tips, check out the following online resources:

- [CESA #2](#)
- [STEMgrants.com](#)
- [GrantWrangler.com](#)
- [Afterschool Alliance](#)
- [STEMfinity](#)



Connect with other Teachers and staff in your school or district, especially the Guidance Department staff. They may be able to connect you with other resources or be willing to help co-Mentor or support the Team.

Sponsors

Local businesses and other organizations often want to sponsor local Teams, because:

- FIRST Tech Challenge Teams support the employment pipeline and the local economy.
- FIRST Tech Challenge prepares students to work as part of a team while nurturing leadership skills.
- FIRST Tech Challenge helps students identify and become proficient with problem solving methods.
- FIRST Tech Challenge builds confidence in students.
- FIRST Tech Challenge provides opportunities to promote their business or organization.

FIRST Teams are encouraged to seek sponsorships not only to help fund the purchase of the Competition equipment and registration fees and maintain Team longevity, but also to highlight the collaboration with businesses and other organizations. Sponsorship can be done on a variety of levels, including cash donations, item donations (ie: tools from a hardware store), or in-kind donations (ie: a company might embroider your Team T-shirts for free). Have a list of what you are in need of prior to asking for sponsorship.

Start by asking your Team to make a list of businesses and organizations that they have a personal relationship with. Possibilities include:

- A business owned by a family member or friend.
- A business in which your family or friends are employed.
- A business they regularly visit (dentist, restaurant, etc.).
- A business or organization that strongly supports the FIRST mission.
- Parent/teacher organizations.
- Local groups such as the Elks Lodge, Kiwanis, or IBEW, etc.



Keep in mind that most Sponsors make donations because they are personally asked by someone they know. If you don't ask, you will never know if they are willing and able to support your Team!

When collecting Sponsors, remember that a cash donation, an in-kind donation, or an item donation are all equally helpful and should receive your Team's thanks and ongoing support. Some Teams write thank you cards and send photos, some put Sponsor logos on their shirts, websites, or Pit displays, other Teams send end-of-the-season reports and explain how the Team did and how the sponsorship helped, and still other

Teams give gifts to their Sponsors. While each of these are nice (and you should always thank your Sponsors in some way), most Sponsors are more excited about supporting your Team than receiving the benefits.

Program Sponsors

FIRST Tech Challenge Global Sponsors Rockwell Collins and PTC receive recognition at each official FIRST Tech Challenge Event. [Rockwell Collins](#) is the Official Program Sponsor, [PTC](#) is the CAD and Collaboration Sponsor, and [Qualcomm](#) is the Official Control System Sponsor. Teams do not need to do any additional recognition for these Sponsors unless their Team receives additional support from Rockwell Collins or PTC.

FIRST Tech Challenge in the Classroom

Lots of Mentors are teachers using FIRST Tech Challenge in their classroom in part or full. We surveyed the FIRST Tech Challenge community in the Spring of 2015 and learned quite a bit about our Teacher Mentor community. For example, they not only teach: Math, Science, Engineering, and Technology, but also: Business, English, Art, Humanities, and Special Education, primarily in grades 10-12. We also learned that while one third of the respondents do not use FIRST Tech Challenge in their classroom, they want to. Whether a Teacher Mentor is currently using the Program in the classroom or hopes to in the near future, the message was clear that they would like some support to be successful in using FIRST Tech Challenge in the classroom.

Classroom Resources

Like all teachers, FIRST Tech Challenge Teacher Mentors need more money, more time, more space, and more support to be successful. It is our goal that the many resources in this Manual provide some of the support Teacher Mentors are seeking. If you are a Teacher Mentor doing something awesome in your classroom or you have a suggestion for improving or adding to our existing materials, please email ftcteams@firstinspires.org. Here are some resources for FIRST Tech Challenge Teacher Mentors:

Standards

- [FIRST Standards Alignment Report](#) (2012)
- [FIRST Tech Challenge Standards Alignment Map](#) (2015) – includes Common Core Math, Common Core English, Next Generation Science Standards, and the 21st Century Learning Skills.
- The International Engineering Educators Association Standards Alignment Map (out 2016).

Teacher Mentor Training

- FIRST Tech Challenge virtual summer conference: [Gear Up with FIRST Tech Challenge In the Classroom!](#)
- [Mentor 101 training](#) (video)
- Building Teams that Build Robots (*coming soon*)
- [FIRST Tech Challenge in the Classroom Resources](#)

Classroom Tools

- [Inteltek Training for Teams](#)
- [Inteltek Training for Teams](#) – App Inventor – 5 hours of content
- [Inteltek Training for Teams](#) – Android Studio (Java Programming) – 12 hours of content
- [PushBot Build Guide](#)
- [Appendix P: FIRST Tech Challenge Case Studies](#)

STEM Connections

- [FIRST Tech Challenge's Real World Robots blog series](#)
- [FIRST Tech Challenge Engaging Girls in STEM video](#)
- [FIRST Tech Challenge's Networking Tips blog](#)
- [FIRST Tech Challenge's FIRST Ladies blog](#)
- [The Connectory's list of STEM Resources](#)



The [Teaching Tolerance](#) website has great classroom resources that also focus on diversity and inclusion of the content and instructional practices.

College and Career Resources for Students

- [FIRST Scholarship Program and Search website](#)

- [FIRST Scholarship Resources webpage](#)
- [FIRST Alumni and Internships webpage](#)
- [Scholarships and Looking Ahead to College](#) Virtual Event (video)
- [FIRST Tech Challenge blog post: FIRST Scholarships: It's Not Hard, but it Can be Hard to Get Started](#)
- Read more in the [Career and College Preparation](#) section of this Manual.

Share and Loan

Teachers often get ideas from other Teachers, and to help foster a community of sharing, FIRST Tech Challenge has created space on the [FIRST Tech Challenge Forum](#) for Teachers to ask questions or each other and share what they are doing. Many Affiliate Partners have resources for Teachers, so be sure to reach out to your local Affiliate Partner. They may also be able to facilitate an in-person workshop or training specifically for Teachers (some already do). FIRST Tech Challenge also has a [FIRST Tech Challenge Facebook group](#) which is another way you could connect with other Teacher Mentors online.

Teacher to Teacher Classroom Resources online

Here are just a few websites that offer resources to Teachers to use in their classrooms, often created by Teachers. Some are free, some are not:

- [PBS Teacher Resources](#)
- [Teachers Pay Teachers](#)
- [Discovery Education](#)
- [Edutopia](#)
- [Library of Congress Teacher Resources](#)
- [National Archives](#)
- [National Science Teachers Association Resources](#)

Building the Team

Team Identity and Spirit

There is more than just camaraderie on *FIRST* Tech Challenge 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. Read this [*FIRST* Tech Challenge blog post about The Importance of Teamwork.](#)

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. Each member of the Team impacts the dynamic and capabilities of the Team, so each time a new member joins, the Team dynamic will change a little. 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 helps to unite the Team and develop a sense of belonging and group pride. It is also a great way to help Judges, announcers, and audiences to recognize a particular Team at a competition. It can also help Teams create a “buzz” about what they are doing in their own communities. Read more in [Building Teams That Build Robots](#) section.

Encourage Team identity by creating and adding the Team name and 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.

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. What a Team member was interested in last year might change as they grow confident and look to explore new opportunities.

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, home school communities, or a group of interested students are excellent starting points to form *FIRST* Tech Challenge Teams.



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.



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. You also want to ensure that every student has an active role that they love, and has the ability to learn other roles: too large of a Team and this becomes harder to do, while too small of a Team may end up with Team members being overwhelmed with too much responsibility. Strive to achieve the right size balance for your Team. In addition, 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.



If you have a single-sex Team, try to find ways to partner with other Teams in order for your Team to get experience working with all genders.

Age Range

A FIRST Tech Challenge Team is made up of pre-college students 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.

Some 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 and eager to participate. However, the head-to-head nature of the Competition may be overwhelming for younger students. Mentors with younger students should be sure to discuss the nature of the FIRST Tech Challenge Competition and prepare students for developing [offensive, defensive, and other game strategy skills](#).

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. If the Team commitment is not high, the Mentor should not step in and complete the work: the Team needs to learn to take responsibility for the project and completing it, or not if that is the case.

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 FIRST Tech Challenge. Set the Team's schedule according to its goals. For example, a rookie Team may require longer, more frequent meetings. Read more in the [Mentor Time Management](#) section of this Manual.

Time commitment guidelines:

- FIRST Tech Challenge recommends starting with two shorter meetings, or one longer meeting per week during the Teambuilding stage.
- During the design and build phase, meetings should take place more frequently, as indicated by the Team's needs. Depending on the role division, not every Team member may need to be at every meeting.
- 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 Kickoff date, a less intensive schedule can be created.



Finding Team Members

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.
- Hang posters in the school, at the local library, in businesses and organizations, especially at/in Sponsor organizations.
- Publish notices in the local paper.
- Include [promotional materials](#) in school newsletters or on school web sites.
- Hold a student assembly where there is a FIRST Tech Challenge 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 Tech Challenge 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.



When planning your recruitment, think about what you can do to attract a wide pool of candidates, such as reaching out to diverse groups in your area.

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 might include:

- A minimum Grade Point Average (GPA) such as 2.0, as opposed to selecting students with the highest grade point average. Keep in mind that some of the best kids to have on the Team may not have a great GPA.
- Commitment or interest in a STEM field of study or career.
- 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.
- Diversity of backgrounds, skills, or experience will create depth to the Team.

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.

If you have a large pool of interested students, consider starting additional Team(s) to accommodate the interest. Many schools have multiple Teams and 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.

Finding Team Mentors

Anyone can be an *FIRST* Tech Challenge Mentor. Time and interest are the only requirements. As with the Team, having a diverse pool of Mentors only benefits the Team. Some Mentors bring business expertise, some technical expertise, some are great at marketing, while others have leadership skills with experience in building strong teams. An *FIRST* Tech Challenge Team can use all of these skills.

Each Team will need at least two screened, committed adults to see them through the season from start to finish, but these do not have to be Mentors with technical skills. Mentors can recruit other adults to serve a shorter time commitment and act as technical Mentors. For example, a Team might need help with wiring their Robot, so they find an electrician who comes in for two meetings to help them learn wiring skills and perfect their wiring plan.

Note: the electrician does not solve the problem.

Lots of adults will want to help the Team, but be unable to commit to the whole season, so understanding the strengths and weaknesses of the lead Mentors and the Team's needs will help to identify the areas where additional support will be needed. Target your recruiting efforts to those areas.



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



Recruiting 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 tools which may be used to recruit a diverse group of Mentors.

Recruiting New Technical Mentors

Always start by identifying the help you need and the time commitment that assistance will require. Some folks are happy to help if they know it will only require a few hours from them.

It's important that you know your community. Truly, a wonderful technical member could be anywhere, just waiting for you to ask them for help! Start by polling your Team's parents and families and see if there are any technical Mentors in that group. Also, many Mentors from FIRST® LEGO® League and FIRST® Robotics Competition would be happy to support a FIRST Tech Challenge Team, so ask the other FIRST Teams in your area, including other FIRST Tech Challenge Teams. Some Teams or Mentors might also be willing to skype and offer assistance long-distance.

If you are still unable to locate the help you need, try these locations:

- High school teachers or college professors
- Leaders of community organizations, such as the IBEW
- Leading corporations in local communities, such as Rockwell Collins or PTC
- 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>

Recruiting New Non-Technical Mentors

Some Teams don't need technical help; they need man-power for printing, stapling, painting, coloring, driving to events, cleaning, fundraising, etc. Or they might need help developing a Business Plan or to talk about college and career preparation. As mentioned earlier, always start by identifying the help you need and the time commitment that assistance will require. Some folks are happy to help if they know it will only require a few hours from them or if they can do the work while watching their favorite TV program at night.

Next, ask the Team members and their families, or the other FIRST Teams in your area, including other FIRST Tech Challenge Teams. If you are still unable to locate the help you need, try these locations:

- Teachers, coaches, school administrators
- Community organizations, including Girl Scouts, Boy Scouts, Boys and Girls Club, but also Elks Club, Kiwanis Club, etc.
- Leading corporations in local communities, whether technical or not. Lots of companies encourage their employees to volunteer.
- [Senior Corps](#).

Additional Suggestions for Recruiting Adults

- Be sure to recruit new adults Mentors each year 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.
- If your Team is affiliated with a school, organization, or church, see if other adults in that community would be willing to help.
- Never turn down an offer to help. During outreach efforts, adults might come forward and ask to become involved. Find out where their strengths lie and determine how they can best help the Team.



If your Team is a diverse mix of students, consider reaching out to potential Mentors with some of the diverse qualities of the students to provide positive role models. For example, an all-girl Team might recruit a female engineer to Mentor the Team.

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. For more tips, refer to the [Mentor Time Management](#) section and the [Time Commitment](#) section of this Manual.

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 (for more information on setting up a Playing Field, refer to the Game documents available on [The FIRST Tech Challenge Game webpage](#)). 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 space.
- 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, check with 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 computers, and all supplies.
- A secure place to store the parts and partially assembled Robot between Team meetings.
- Good lighting, at least in the work table area.
- Simple sets of tools for working with 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 FIRST Tech Challenge, 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.

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

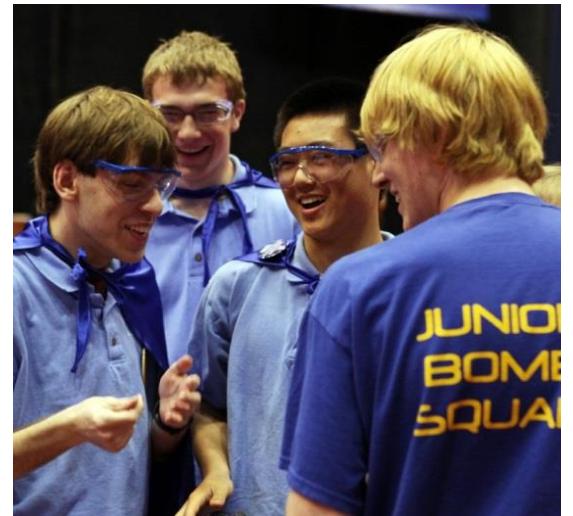
- Maintain an accurate email list that includes parents.
- Start and end on time. This helps parents and lets students know that punctuality is important and that time must be used effectively.
- Keep most meetings in the range of 2-3 hours. This is long enough to get organized and accomplish something, 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.
- Toward the end of the season, meetings may need to be longer for testing and repairs to the Robot.
- 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 start of each meeting for a check-in or Teambuilding activity to set the tone for the group and how you will use your time together.
- 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 is a few pictures of each 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.



Check out [Building Teams that Build Robots](#) for more tips on using Team meeting time.



Working Together

- Have some Teambuilding 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. Many students come to FIRST Tech Challenge lacking skills and/or confidence and the Team can be a great way for them to gain both. Intentional choices by the Mentors to organize the Team and meeting times in ways that are professional, effective, and inclusive will role model to the students the skills you are trying to teach. Use the tools below to facilitate instruction and learning at meetings or competitions.

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...
- What could we try?
- Compare...

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. Use a free online test like [Edutopia's Multiple Intelligences Test](#) to help if they are not sure what works best.
- If the majority of the group uses a particular learning style, be careful not to always use the style. You can help them develop other learning styles, push them out of their comfort zone, and be inclusive of all learner styles in the group by diversifying the strategies you use.
- Some students work best on their own. Be mindful of balancing the amount of group work time and individual work time.
- Read Tolerance.Org's [Civil Discourse in the Classroom](#) for tips on facilitating group discussions (effective whether your Team is a classroom Team or not).

Team Roles

The FIRST Tech Challenge program incorporates a lot of skills and tasks which allows for a tremendous amount of individual and Team growth. However, without proper management of roles and responsibilities of Team members, it will be very easy for the Team to get overwhelmed or off track. Proper division of labor will allow the Team to leverage individual strengths and skills, but also allow for each member to also develop new skills. As such, most FIRST Tech Challenge 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.



Be cautious of stereotyping.
For example, a girl should not be handed the Engineering Notebook and be told that she is in charge of writing and documentation unless she asks to do it.

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.

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 to widen the skill circle to include mentoring others.

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.
- 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.



[Appendix F: FIRST Tech Challenge Team Roles](#) outlines several 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.

Developing Leaders

One of the key outcomes of FIRST Tech Challenge, beyond the Robots and STEM skills, is the invaluable life skills Team members develop, including a variety of leadership skills, such as:

- Positive Attitude
- Responsibility
- Working in groups
- Decision-making and delegation
- Time management
- Organization
- Planning and problem-solving
- Self-motivation and motivating others
- Professionalism
- Written and oral communication
- Adaptability

In addition to benefitting students' personal and professional growth, developing leadership qualities in each Team member will benefit the Team. First, having a strong pool of qualified members allows the entire Team to reach for bigger goals. Second, it fosters Team longevity and prevents Mentor burnout. When veteran members reach out and recruit new members, they are provided with opportunities to lead and the support they provide allow the Mentors to focus their attention on other Team management tasks. When Team members help other Team members, it fosters a positive environment of support and camaraderie from which everyone benefits.

Developing strong leadership skills requires good Mentoring, including role-modeling and providing opportunities for growth. Some people will take on challenges, others might require encouragement, and still others will require it to be given to them. No matter how it is done, once faced with a challenge, Team members will require support in the form of encouragement, resources, and feedback from their Mentors. A good primer on challenge and support is available online here:

<http://www.wilderdom.com/theory/GrowthChallengeSupport.html>.

A key factor to developing leaders is to allow students to take on more responsibility and ownership as they progress. Over time, members of the Team grow in knowledge and understanding, and are able to teach and guide others on the Team. Read this 2015 FIRST Championship Conference on [Building Leadership](#).

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.

There are many resources available on the web which will be useful to Mentors as they work on developing leadership skills among the Team. Here is just one example:
http://leadership.uoregon.edu/resources/exercises_tips.

Team members should be coached on the concept of self-efficacy and how [Achievement Starts with Belief](#). There are also lots of great quotes, poems, and inspiration items on the web as well. Try doing a google search of "leadership quotes" and sharing one at the beginning or end of each meeting to promote an atmosphere that focuses on leadership qualities.



"Leadership and learning are indispensable to each other."

- John Fitzgerald Kennedy



Transferring Ownership to Students

In certain areas, the Mentor becomes a sustainer rather than a teacher. This is an example of transferring ownership from Mentor to Student, which 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.
- Provide supportive feedback as they develop in the Mentoring role.

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.



In the classroom, students look to Teachers as having all the answers and the power, because of the way traditional grading works. Teachers can still relinquish some responsibility for learning and grading to students by: including self-assessments; peer reviews; design-your-own projects; and even Job Shadowing projects.

Teambuilding

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 *FIRST* Tech Challenge 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. Teambuilding

- Many Teams have Teambuilding 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.
- Teambuilding 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.



Choose activities that are accessible and welcoming to every Team member. One way to do this is to ask each member what activity they like, and then trying to do as many as possible throughout the season.

- Host a Teambuilding 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.



Encourage Team members to communicate with each other, not through the Mentors.

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 including expectations for success at functioning as a Team.
- All Team members should know what is expected of them and how responsibilities are 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.
- 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. 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. Draw Everyone In

- Most Teams have one or more shy students who do not like to speak up in group discussions. A little coaching and encouragement might get them to open up in group discussions over time, but for others, allowing them to be quiet is exactly what they need. Also, try not to call on them to speak out unless they have told you that that is a helpful tool for engaging them in group discussions (lots of shy people find being called upon painful and awkward). Role model reaching out to them for their opinion after the meeting and Team members will start doing so, too. See if you can make group decisions after a recess or small group session where folks talk in pairs or informally and then decide. This may give quiet students the opportunity to have their opinions voiced.
- On the flip side, some Teams have extremely outgoing or talkative students who want to dominate the group discussions. Again, coach these students on better group behavior or tricks they can use, such as waiting until three other people have spoken before they share their opinion, or allowing them to speak up once per discussion topic. Don't yell or belittle them in front of the group, because this may teach the other members of the group that this is an okay way to treat them.



Looking for ways to engage students? How about making a STEM-focused project STEAM-focused with ideas from the [STEM to STEAM: Edutopia Resource Roundup](#).

- If your Team has a special needs or disabled member, ask them how they would like to be involved in the Team and what support they will need from you as the Coach and from the Team members. Bear in mind that they might not be able to articulate their needs, but they should be able to express areas of interest. Treat them as you would any other member, providing support where needed, and share with the group only the issues or concerns that they have asked you to share. Do not ignore their needs or disability, but provide support so they can participate on the Team to the depth every other Team member is participating. Role modeling inclusiveness and support will help other students learn how to treat this Team member as well, and not leaving it to the Team member to coach the Team (unless they want to) on how to treat them may make them feel more comfortable.



For more thoughts on how have a diverse Team can benefit everyone involved, read the FIRST Tech Challenge blog post [Team Recruitment: Who Are You Missing?](#)

7. 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.
- Let members try out/take on new roles, especially if they return to the Team for another season.
- 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.

Building Teams that Build Robots

For more useful information on Teambuilding, check out the resources available on the [Team Management webpage](#), including:

- Building Teams that Build Robots
- Team Organization and International Connections
[Gear Up with FIRST Tech Challenge! Summer Conference 2014](#) presented by The Bears from Mexico (video)
- [Achievement Starts With Belief](#)



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 Team meetings and competitions 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.



Deal with stress as soon as you notice signs – the more it builds, the more problems it will create.

When tension starts to take over a Team, there are two easy fixes: laughter and movement. Take some time to be silly, 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. There are more teambuilding games on the web, including: <https://www.pinterest.com/explore/team-building-activities/>.

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 the FIRST Tech Challenge season, 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

- Conflict in groups often arises from role confusion and process clarification. Start the season off with clear expectations and roles for all of the adults, students, and even parents. This should head off a lot of conflict early on.
- Never tolerate bullying or behavior that belittles or minimizes a Team member’s contributions.
- 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 calming 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. It is hard to resist a smile, a pat on the back, a silly walk, or a wacky voice.
- Encourage frustrated folks 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 desirable behaviors.
- Be sensitive to the situation. Some conflicts or disputes should be taken seriously.

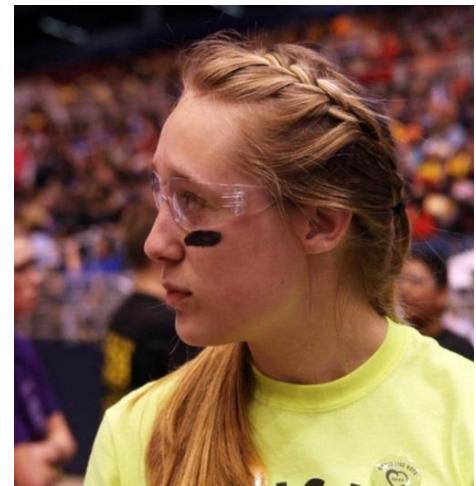


Use your Guidance Department to help resolve Team conflicts. An objective opinion often helps to diffuse the situation easier.

Managing Mentor to Mentor Conflicts

When conflict arises between two of the Mentors, it is important to address or diffuse the situation amicably as soon as possible. The students are watching and will notice tension quickly. Any conflict can sour the experience for everyone, but especially so if the conflict is between the adult role models. Here are some tips for dealing with Mentor to Mentor conflict:

- Start the season off with a Mentor meeting. Be clear about the Team's goals and objectives. Clearly state how you would like Mentor and Coaches involved and what your expectations are appropriate behavior.
- Educate all Mentors on the [FIRST Tech Challenge Core Values](#), [Gracious Professionalism](#), and Coopertition. Use the [Appendix P: Case Studies](#) to help Mentors see conflicts in action and understand the appropriate behavior expected of them.
- Determine if the conflict needs addressing or will it pass on its own.
- Is the conflict a personality clash? Some personalities will not mesh easily, but the individuals can learn to appreciate the strengths each brings to the Team. A Lead Mentor can help the Mentors in conflict to notice and appreciate their individual strengths, and then find ways for each person to feel they have a contribution to bring to the Team.
- Is it a Team management or organization issue? One of the Lead Mentors should work with the individuals to remind them of the Team's goals and philosophy and get the Mentors back on board with the plan.
- Notice the timing. Is it due to impending deadlines or competition? Is it at a competition? When tension rises, so will individual stress levels, creating an environment ripe for conflicts. Remind conflicting Mentors about the goal of the program and that it is about celebrating the students. Ask them to take time to cool off if need be.
- Does the conflict involve one or both Lead Mentors? If there isn't an adult on the Team able to step in and mediate the conflict, find a local advocate (ie: school staff person, Guidance Counselor), or contact the local Affiliate Partner for assistance.



Managing Parent/Volunteer Conflicts

Involving parents and other adults with the Team is essential in many ways. Parents and volunteers can help with transportation, fundraising, and encouragement. However, some adults may become overly emotionally involved and that may lead to conflicts. Here are a few tips for dealing with adult conflicts of the parent or volunteer variety:

- Start the season off with a parent or volunteer meeting. Be clear about the Team's goals and objectives. Clearly state how you would like adult involvement and what your expectations are for parent and volunteer behavior.
- Educate all parents and volunteers on the [FIRST Tech Challenge Core Values](#), [Gracious Professionalism](#), and Coopertition. Use the [Appendix P: Case Studies](#) to help these adults see conflicts in action and understand the appropriate behavior expected of them.
- Determine if the conflict needs addressing or will it pass on its own.

- Prior to Competition, remind adults of the appropriate behavior and emphasize how anyone associated with a Team can affect how the Team is perceived by other Teams, Volunteers, and Judges. In addition, remind these adults of what behaviors could impact a Team's experience on the Playing Field, including Match disqualification. Note that unruly and inappropriate adult behavior may lead to the Event Director asking the adult to leave.
- Head off problems early: if a parent or volunteer makes a comment or acts in an ungracious way, coach them early in the season and be consistent. Be kind and Gracious, but set the tone and expectation that if the behavior isn't changed, they may not be allowed to participate more fully in the Team.



IMPORTANT! Anyone associated with a Team can affect how the Team is perceived by other Teams, Volunteers, and Judges.

Managing Team Conflicts

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. Should conflict arise, here are a few tips for addressing it:

- Head off conflict early in the season by setting clear expectations for the Team, appropriate behavior, and be clear about each Team member's role(s) on the Team. Spend time just on Teambuilding so individual members can learn about and become comfortable with each other, and also learn the value of working together as a group.
- Determine if the conflict needs addressing or if it will pass on its own in time.
- Is the conflict a personality clash? Perhaps the students can work on different projects to avoid too much contact (they don't need to avoid each other, just reduce the amount of contact). Also spend some time on Teambuilding activities for the whole Team that emphasizes understanding and valuing everyone's strengths.
- Is the conflict about competition? Some students are overly competitive in everything they do and this can lead to conflict. Remind all students involved (as necessary) of the Team goals and expectations, and that individuals must learn to work together for the success of the Team, not their own successes.
- Is the conflict about another Team or another Robot? Help the Team members to let go of focusing on other people's behaviors and results and instead focus on their own accomplishments.
- Read the tips on the [Center for Women's and Children's Health Network Conflict and Negotiation webpage](#).

Self-Assessment

Whenever we set a goal, we need a marker for whether or not we achieved the goal. Sometimes this is easy to do: the Team wants to build a Robot that can scoop up a ball and dump it into a scoring goal in Competition. If the Robot completes the task, then, goal accomplished. However, sometimes the goal has more subjective results. For example, the Team wants to improve their public speaking and outreach skills. How will they know they achieved that goal? When the goal is set, you will want to determine the markers for achievement. You can get external or internal feedback.



Self-assessment is important in the classroom, too, and an easy activity. Consider doing self-assessments after each individual or group project.

- External feedback – someone or something outside of the individual or Team determines the outcome based on the goal and markers.
- Internal feedback – the individual or Team determines the outcome based on the goals or markers. This is called self-assessment.

While we can all easily determine our own success, we often value external feedback more highly than internal feedback. Academic grades and test scores, competition results, and even levels of pay and raises are forms of external feedback that we view as validating our success. However, when we set our own goals and markers, and then assess our own achievement, this too is valuable. And in fact, maybe even more so as it also helps develop our sense of self and build confidence levels.

In FIRST Tech Challenge, you could say that external feedback is provided on how a Robot performs on the Competition Field through scores and how the Team does in the Judging Interview through Awards. However, the reality is that these are markers established by FIRST Tech Challenge as part of the Competition. When a Team comes together to start the season, there are other, more valuable goals to work toward other than scores and Awards. Teambuilding, individual growth, leadership skills, confidence, fundraising, community outreach... all of these aspects of being a Team are incredibly rewarding even if there isn't always a way to honor them on the Competition Field or in the Awards Ceremony. FIRST Tech Challenge knows the value of all of these goals and skills, and encourages Teams to engage in defining goals, establishing markers for success, and developing the habit of self-assessment.

Read more about self-assessment in this [2014 FIRST Tech Challenge blog post](#). Use the tool in [Appendix G: Team Judging Session Self-Assessment](#) to reflect on your team's Judging Interview or adapt the tool to use in outlining and assessing any and all of your Team's goals. As a training tool, watch this 12 minute TEDx Talk by Jia Jiang: [Lessons Learned from Rejection](#).

Community Outreach

A vital component of *FIRST* Tech Challenge 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 changing the culture by inspiring students. The more Teams there are, then the more students there are to inspire.

FIRST stresses community involvement in several ways, including Dean's Homework, with [Gracious Professionalism](#), and with recognition via [FIRST Tech Challenge Awards](#), such as the Inspire, Motivate, Connect, and Promote 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*. Recruit new Mentors. Read about [FIRST Tech Challenge Teams Mentoring Teams in this FIRST Tech Challenge blog post](#).
- 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. Read about [FIRST Tech Challenge Teams doing outreach in this FIRST Tech Challenge blog post](#).
- Hold an open practice, build day, or scrimmage. Use the Tournament Guide to help located on the [FIRST Tech Challenge Volunteer Resources webpage](#).
- 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 or use [FIRST Tech Challenge Outreach & Marketing Resources webpage](#).
- Participate in community activities and service opportunities. Wear your Team or *FIRST* Tech Challenge gear and talk about your experiences. Read this [FIRST Tech Challenge blog post on Making it Loud](#).
- Learn how the Team can improve their Outreach and benefit their Team in the *FIRST* Tech Challenge training video [Marketing and Business Strategies for Teams](#).

Using the FIRST and FIRST Tech Challenge Logos

Download the FIRST and FIRST Tech Challenge 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.firstinspires.org/resource-library/ftc/team-outreach-and-marketing-resources>.

Logo Requirements

Positive Promotion:

- Use FIRST and FIRST Tech Challenge logos in a manner that is positive and promotes FIRST.

Unmodified:

- Use the FIRST and FIRST Tech Challenge 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 okay to use a FIRST or FIRST program logo, please send an email to marketing@firstinspires.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@firstinspires.org, and include a description of the ad content, where it will appear, and whether it is paid advertising.

Career/College Preparation

Participation on a FIRST Team provides students with many opportunities, and for most, it is a chance to explore career possibilities. Some students enter the program knowing they want to pursue engineering, but lack specific understanding of what a career in engineering might look like. Others come in with no ideas of what they want to do. The opportunity for exploration and skill building is ever-present with FIRST Tech Challenge, so this is a great occasion to take advantage of that and help the students on the Team with the huge, and often overwhelming, decisions about their future. The following sections provide just a few ideas on how to engage students in conversations about career preparation and college planning. These are optional, but easy to do without adding much work onto the Mentor(s), while benefitting the entire Team.

An invaluable resource is the local high school Guidance Department, so be sure to see how they can assist in this process and what tools they might already have that you can borrow or use. Some communities also have organizations or businesses that help prepare students for career or college, which might have resources to share as well.



Be cautious of making assumptions about a student's college and career opportunities. Provide the same resources and support for all students until they say otherwise.

Discussing and Exploring Career Tracks

Mentors, whether technical or not, can help students learn about a variety of careers and how the skills they are learning can help them prepare for that career. One simple way is to talk to students about how you made your way to your current career and what your work entails. Ask all of the other Mentors, and even parents, to do the same. If a student expresses interest in mechanics and one of the Mentors works in the field, encourage them to talk about the field and the training required.

Another easy method is to find out what areas of work your students are interested in, and then bring in professionals from those fields to share with the students what their career entails and what kind of training and education is required. If possible, take Team field trips to various companies and see what they do first-hand, especially any manufacturing or engineering companies.

For students who have no idea what they would like to study, help them explore areas of individual skill or talent. Encourage them to try out all the various elements of the *FIRST* Tech Challenge Program, from design to programming to building the Robot, or developing the business plan, marketing the Team, raising funds, or presenting.

One of the strategies guidance counselors and teachers use is career assessments. If the local high school guidance department offers one, encourage your students to check it out. If not, there are plenty on the web. Encourage them to take two or three different ones and then compare the results. Some assessments ask questions about various career tasks, while others focus on asking questions about personality or environment preferences. These assessments should be considered tools for understanding interests only and the information should be taken with a grain of salt. No test can accurately understand and assess the nuances of every individual, nor predict what would make them happy and fulfilled in a future career. Here are examples of online assessment tools:

- [Your Free Career Test](#)
- [Career Colleges Assessment Test](#)
- [eLearning Planner Career Assessment](#)
- [Human Metrics Typology Test](#)



A lot of students worry about making the “wrong” decision in selecting a career or college, but as experienced adults know, there are no real wrong decisions. Every experience teaches something new that leads to the next experience. However, since it is stressful for students, Mentors can help by talking to them about their strengths and coaching them to consider a career in an area for which they have a passion.

One way to do this is to talk about the idea of “flow”: when we are doing something that uses our innate gifts and brings us a sense of purpose and inner joy, we are said to be in “flow”. One way to measure that is to think of times when you were doing something and you lost track of time – when time seems to stop or fly right by because you were engrossed in what you were doing or having so much fun. What were you doing? What about it made you feel that sense of “flow”? Talking to students about this idea, or showing them [Mihaly Csikszentmihalyi's TED talk](#) on the topic of happiness and flow to provide them tools for assessing how they might like to spend their time at future work.

Internship Opportunities

A great way for students to explore careers they think they are interested in is with job-shadowing or internships. Again, encourage students to work with the local high school Guidance Department if possible, but if that is not an option or doesn’t work out, students can identify and create their own opportunities with a little research and self-promotion.

If a student knows they are interested in computer science, help them identify a company or individual who works in the field. Reach out to the owner and see if they would be interested in allowing the student to job

shadow or put together a paid/unpaid internship. Sometimes age is a factor in whether the student can do an internship, which is why they might need to do a job shadow instead; either way, they will have the opportunity to see the profession in action and they can put the experience on their resume.

FIRST Alumni Programs are piloting an [Internship Portal](#) that can shed some light on some of the many potential internship opportunities with FIRST supporting organizations.

FIRST on the Resume

A lot of people think high school students are too young to have a resume, but it is a great life skill that they can practice. While most colleges do not require a resume for their application process, they will accept it and add it to a student's application file. It never hurts if the resume has a diverse set of information on it and/or emphasizes items that are not highlighted by the application, college essay, high school transcripts, or test scores. In this case, it can be a chance to highlight how their FIRST experience has prepared them for challenging and professional work. Check out [Appendix H: Sample Resume](#).



Networking is important on the resume, too. Students can use contacts as references, to review their resume, or to get ideas on internship opportunities and how to leverage those experiences.

Listing a Mentor or Coach as a reference is a must. A resume has typically 3-5 references, and a person should include people that represent a wide representation of the person's involvements. Students typically include teachers, ministers, sports coaches, club advisors, etc, and an FIRST Tech Challenge Mentor/Coach would be a perfect addition.

Resumes are divided into sections, and FIRST could fit into a number of them; truly it all depends on how the student chooses to format their resume. Here are some places it could show up:

- Academic Work – if the student is able to get academic credit for their FIRST Tech Challenge experience, it could fit here.
- Computer Skills – if the student has learned a computer skill above and beyond what average folks know (such as CAD, Java Programming, etc) they could list each program they are skilled in here. If they are not skilled, they should not list it.
- Presentations – if the student or Team has done presentations or community outreach where public speaking is involved, they can list that here. Judging Interviews do not count here.
- Community Service – if the student or Team has participated in community service or outreach activities, they should list them here, including if the student Mentors another FIRST Team.
- Travel – if the student travels outside their state for a FIRST event, it could go here.

In addition, check out [Appendix G: Sample Resume](#) or this [2015 FIRST Championship Conference](#) to see examples of the above items and other ways of showcasing the FIRST and FIRST Tech Challenge experience on a resume.

College Planning

Some families have been preparing their children for college since birth – or at least since they started high school, but this is not always the case. Sometimes high schools provide training and resources for students in exploring and preparing for college, but again, this is not always the case and some students might not take advantage of the opportunities presented in school. Furthermore, a student who doesn't know what they want to do when they grow up will likely not know if they want to go to college.

While it is not a required role of the Mentor to assist in college planning, it can be easy to spend a few minutes of one or more meetings talking about various careers related to the *FIRST* Tech Challenge skills the Team is learning or STEM in general (as discussed above) and sharing information on what college degree(s) might be required in order to work in that career. In addition, Mentors who have attended college can talk about the application process, what college work is like, and how to maximize the college experience to increase the potential of finding employment in a given field after graduation.

Some other ways that Mentors can assist students with college planning might include:

- Discussing the differences in various degrees (ie BA vs PhD).
- Discussing the differences in types of schools (ie Technical College vs University).
- Discussing ways to pay for college, including [*FIRST* Scholarship](#) opportunities.
- If there is a nearby campus, take a Team field trip to check it out and have a tour, specifically looking at the departments or buildings where the academic programs Team members are interested in are housed.
- Assist students in completing their college applications (if you feel comfortable in doing so), including reminding them of deadlines, proofreading materials and essays.
- Discussing and helping them to [Explore Career Tracks](#).
- Share this 2015 *FIRST* Championship Conference on [How to Apply to College](#) with your Team.
- Pointing them to resources in their school or community, including:
 - Guidance Counselors
 - Teachers or professors
 - Community organizations or businesses

***FIRST* Scholarship Opportunities**

Participation in *FIRST* qualifies *FIRST* Tech Challenge students to access to more than 16 million dollars in [*FIRST* scholarships](#). Most scholarships that are part of the *FIRST* Scholarship Program are offered by specific colleges or universities for study on their campus, or require a major in a specific field (like computer science), but others do not. Students planning on college should start exploring the scholarship criteria early, **even as freshman or sophomores**, and should plan to apply in their junior or senior year. Each year the [scholarship database](#) is updated and added to as the opportunities grow throughout each year

For more information on *FIRST* Scholarship Program, check out the following links:

- [*FIRST* Scholarship Program website](#)
- [*FIRST* Alumni and Internships webpage](#)
- [*FIRST* Tech Challenge Scholarships and Looking Ahead to College Virtual Event \(video\)](#)
- [*FIRST* Tech Challenge blog post: *FIRST* Scholarships: It's not Hard, but it Can be Hard to Get Started](#)

Networking

One of the most important things that a Mentor or student can gain from their time in *FIRST* Tech Challenge is the incredible exposure to other Mentors, Teams, Volunteers, etc. Every time you meet and interact with someone new, it is networking. Networking is one of those business ‘buzzwords’ that people throw around a lot, but what it really is boils down to this: expanding the group of people you know to include more people similar and different from you. Each person you meet enables you to learn something new, and taking advantage of these relationships by learning and growing, or getting to know even more people is an essential life skill. Helping students learn how to network, to talk about themselves, the Team, the Robot, *FIRST* Tech Challenge, and *FIRST* is just one more skill that will help them throughout their life.



Getting connected can happen in the Forums online, on social media, via email or skype, and especially at outreach events and *FIRST* Tech Challenge Competitions. Coach students on the importance of networking and how to take advantage of the opportunities available to them - and role model this skill, too.

Here are some great *FIRST* Tech Challenge networking resources:

- Check out and participate in [*FIRST* Tech Challenge social media](#).
- Join the [*FIRST* Alumni group on LinkedIn](#).
- [Check out this *FIRST* Tech Challenge blog post on Networking](#).
- Read about how one [Team Built International Connections through *FIRST* Tech Challenge in this blog post](#).
- Connect with Team-created groups such as [*FIRST* Ladies](#).

The Engineering Notebook

One of the goals of *FIRST* and *FIRST* Tech Challenge 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 the Robot, Teams encounter obstacles, lessons learned, and the need to draw things out on paper. This is where the Team will use an Engineering Notebook. These notebooks follow your Team from Kickoff throughout the Competitions. Judges review the Engineering Notebooks to better understand the Team, their journey, and Robot design. Teams should carefully read Section 7 of the *FIRST* Tech Challenge [Game Manual Part I](#), for more information on the Engineering Notebook.

Use the Engineering Notebook to:

- Record meeting tasks and outcomes
- 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

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.

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, double-sided and place them in a binder, no larger than 3" thick. Use additional binders if more space is needed. All pages must be numbered from within the program you are using and in order. Only one copy is required per Team.

Handwritten

Spiral-bound, laboratory, or documentation notebooks are often available through your school or local stationary supply stores or utilize a binder (make sure to number your pages).

Requirements

Whether electronic or hand-written, use the following criteria:

1. Team Number and Team Name must be clearly printed on the cover of the 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.



The English department may require students to write in journals. They may have resources to share, advice to offer, or allow students to receive credit in English class for writing they are doing in the Team's Notebook.

Engineering Notebook General Requirements

The FTC Engineering Notebook is a complete documentation of the 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 I](#), for the most up-to-date guidelines and formatting requirements.

Engineering Notebooks should contain the following to be eligible for all of the Awards (see [Awards Categories](#) or the Game Manual Part I for more information):

- Team Name and number MUST be clearly displayed on the front of the Engineering Notebook.
- A summary page (read the specific requirements in the Game Manual Part I)
- An Engineering Section (info in the Game Manual Part I)
- A Team Section
- [A Business/Strategic Plan](#)

Engineering Notebook Suggestions

Review the [Engineering Notebook Guidelines and Self-Assessment](#), [Appendix I: Engineering Notebook Samples](#), and the [Engineering Notebook Examples](#) on the Team Management Resources webpage and discuss them when planning the Team's Engineering Notebook and how it will be used to support the Team's experience. Additional tips include:

- Make sure the Team name and number are on the cover in a neat, professional manner.
- 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. Empty spaces should have a single diagonal line drawn through them to indicate that no information is missing from that page.
- 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. as often as possible. 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.
- Consider including a list of the Team members with a photo and a few details about their role on the Team and/or personal interests in FIRST or STEM.
- 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 a hand-written 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.

- Make entries at every build meeting. Consider prompting students to start making entries at least half an hour before the end of the meeting. Include task and reflections for each of these build meetings.
- Many Teams include lists:
 - Outreach Activities
 - Awards received
 - Teams they've started and Mentored

Building Robots

Safety for FIRST Tech Challenge

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 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.

Supervision

- Adult supervision is required at all times, especially when using power tools and electrical systems.
- 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 the appropriate clothing for working in the work space and around the Robot, including 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 has safety glasses and:
 - Labels their glasses with their name and Team number, and has a 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 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.
- 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.



FIRST has strict requirements for safety glasses/goggles use in the Pit area and on or within five feet of the Playing Field. Safety glasses are required at all FIRST Tech Challenge competitions. Without them, students will not be allowed in these areas.

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.
- 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.

Kit of Parts

Teams can order their Robot supplies in the Team Registration in what is called the FIRST Tech Challenge Storefront.

Registration is automatically added to your Cart. You are able to enter the Storefront multiple times and purchase up to one item from each category. Awarded grants will appear in the Storefront and automatically deduct from the final total. **If you do not see a grant that you were expecting, please DO NOT check out.** Please check again in a few days.

FIRST Tech Challenge has created resources to assist Mentors in ordering Robot supplies through the Team Registration:

- 2016 Storefront Walkthrough Instructions (*coming soon*)
- 2016 Storefront Walkthrough Video (*coming soon*)

The screenshot shows the FIRST Tech Challenge Storefront interface. At the top, there's a navigation bar with links for SUPPORT, WELCOME (which is highlighted in blue), CONTROL SET, ELECTRONICS SET, COMPETITION SET, and CHECKOUT. Below the navigation is a header with the FIRST logo and a shopping cart icon showing \$0 (USD) and 0 items. The main content area is titled "Welcome Team #". It includes a "Order History" section with four items: Season Registration (Required), Control Set* (Not Ordered Yet), Electronics Set* (Not Ordered Yet), and Competition Set* (Not Ordered Yet). A note below states: "While these items are necessary to build a functioning robot, teams are not required to purchase them in this Storefront (with the exception of season registration). Teams may reuse equipment from previous seasons or purchase components from other vendors." There's also a "Terms and Conditions" section with a checkbox for agreeing to the terms and a "CONTINUE" button. At the bottom, a footer note says: "© 2016 FIRST. All rights reserved. All prices are in US dollars."

The chart below details each of the FIRST Tech Challenge Storefront Kit of Parts options and what is included:

Categories	Set of Parts Name	Cost	What's In The Set
Teams may purchase ONE of these Control & Communication Sets	Control & Communication Set 1	\$284	<ul style="list-style-type: none"> Moto G phones (2) & protective covers (2) USB Hub Micro to USB OTG Cable
	Control & Communication Set 2	\$318	<ul style="list-style-type: none"> Moto G phones (2) & protective covers (2) USB Hub Micro to USB OTG Cable Logitech Gamepad F310 Controllers (2)
Teams may purchase ONE Electronics Modules Set	Electronics Modules and Sensors Set	\$365	<ul style="list-style-type: none"> Power Module DC Motor Controllers (2) Servo Motor Controller Advanced Sensor Module IR Sensor (Seeker v3) Reflected Light Sensor (EOPD) Analog Touch Sensor Phone to Power Module Cable USB Cables (4) 12 volt Power Cables (3)
Teams may purchase ONE of these Competition Sets	TETRIX FTC Competition Set	\$580	Storage bin and 843 heavy-duty pieces, including: <ul style="list-style-type: none"> Brackets, mounts, hard point connectors Structural channels, angles, and plates Wheels and gears Omni wheels Battery pack and charger Servos and DC Motors Fasteners and tools
	MATRIX FTC Competition Set	\$550	Storage bin and 1,000+ parts, including: <ul style="list-style-type: none"> 12v battery and electrical components 12v motors with built in encoders Heavy duty servos with metal gears Metal gears, channels, triangular plates Wide wheels and dual Omni wheels Beams and fasteners

Planning

Right away, take the time to have Team members complete some additional training, including:

- Have a Mentor or knowledgeable Team member unpack the [Kit of Parts](#) for the rest of the Team and explain what all the pieces are and what they can do.

- If you have the time, have the Team build the [FIRST Tech Challenge PushBot](#). No need to program if you don't want to get that deep in, but just building the chassis and wiring the Robot can help the Team understand the basics and what the Kit of Parts is capable of.
- Have Team members complete at least the first part of the [Intelitek FIRST Tech Challenge Android Platform Training modules](#):
 - Part 1: Platform elements, how they work, and how they interact
 - Part 2: App Inventor
 - Part 3: Android Studio (Java Programming)

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.



Check out the [Office of Quality Management's Facilitator's Tool Kit](#) for resources on planning and brainstorming with Teams.

Developing Strategy

Developing an effective strategy for Game play is part of the FIRST Tech Challenge 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 and/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 following table for an example of this.

Strategy		Possible Results
Defense	Turn an opponent away from its scoring position.	<ul style="list-style-type: none"> This strategy focuses on preventing the opponent from scoring. It also takes time away from one's own scoring ability. Make sure not to be overly aggressive or to pin the other Robot. These actions are not permitted in FIRST Tech Challenge.
	Occupy an opponent's preferred scoring position.	<ul style="list-style-type: none"> Can be easier than trying to move another Robot out of position. This takes time away from one's own scoring ability. Make sure not to be overly aggressive or to pin the other Robot. These actions are not permitted in FIRST Tech Challenge.
Offense	Focus on one scoring element.	<ul style="list-style-type: none"> This strategy allows for very specialized or focused Robot design and operation. It may limit scoring ability if opponent plays successful defense or if one scoring mechanism on the Robot fails.
	Focus on several different scoring elements.	<ul style="list-style-type: none"> This strategy increases the likelihood of scoring, even if an opponent plays successful defense or if one scoring mechanism on the Robot fails. It requires extra training and quick thinking to switch between strategies. If one scoring mechanism fails, another approach can be used.
Build	Make the Robot heavy.	<ul style="list-style-type: none"> This makes the Robot harder to push around on the Playing Field. It also gives the Robot better traction on the Field surface. Unfortunately, this strategy may also make the Robot more difficult to maneuver.
	Make the Robot large.	<ul style="list-style-type: none"> This strategy helps the Robot effectively occupy strategically crucial space on the Playing Field, which means that other Teams cannot use it. It may make the Robot harder to push around on the Playing Field but also more difficult for the driving Team to maneuver. It may make the Robot more likely to be selected as an Alliance partner for defensive purposes.
	Keep the center of gravity as low as possible.	<ul style="list-style-type: none"> This saves time and effort from righting the Robot because tipping will be far less likely. This can be an advantage when stability is important for Games with ramps.

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 Manuals](#) carefully. Clear up any questions or confusion about these things before moving into the brainstorming process. Training for programming, etc can come later, however these pieces can vastly improve what students know about Robots, the Kit of Parts, and the potential designs.

Effective Brainstorming for FIRST Tech Challenge

- Discuss general strategies for achieving different 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.
- Try to be comprehensive and do not reject ideas unless it is impossible or against Game Rules.
- For big ideas, 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 and 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, identify ways to improve, 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.



FIRST Tech Challenge PushBot Guide

In 2014, FIRST Tech Challenge asked two Teams to design, build, program, and test a competition-ready Robot that was simple enough that a new Team could not only build it successfully, but compete with it also. We then asked them to write out step-by-step instructions with pictures and the result was two awesome PushBot Guides: one for MATRIX and one for TETRIX. Last year, we saw quite a few PushBot or modified-PushBot Robots at Competitions around the country. With the changes to the [FIRST Tech Challenge technology](#), we needed the Robot and Guides to be updated, and the result is one [PushBot Guide](#) which will have extensive Appendices (available on the [Robot Building Resources webpage](#)). You can read more about the creation of the PushBot Guides in this [FIRST Tech Challenge blog post](#).

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 distil 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.



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.

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.

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, FIRST Tech Challenge 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, a *FIRST* Tech Challenge 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 *FIRST* Tech Challenge 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 [FIRST Tech Challenge Robots on the TETRIX](#) site 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. 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, and then prototype the ideas the Team selects.

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.



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.

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 *FIRST* Tech Challenge 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.

Team resources for 3D Printing include:

- [PTC for FIRST Teams](#)
- [3D Printing for FIRST Teams blog series by PTC](#)

Prototyping

The [Kit of Parts](#) 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.

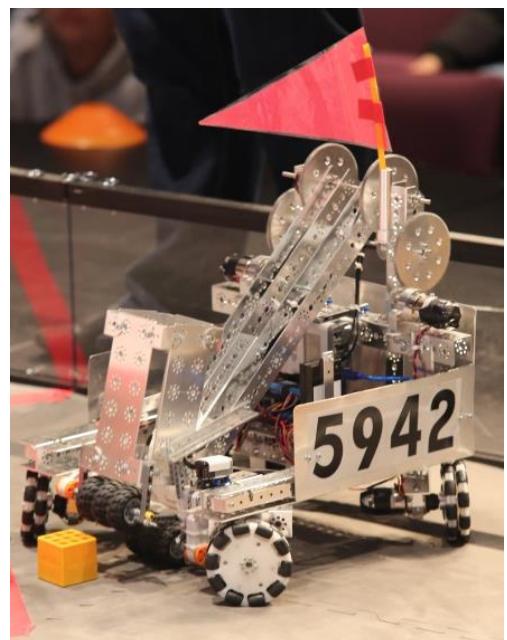
During initial prototyping, do not worry too much about size or material limitations. Focus on getting something that actually works to solve a Game problem. Once a concept has been proven, Teams can focus on reducing the size or bringing the design back into materials compliance.

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.



3-D design lessons and the PTC Creo software could be used in many different classes: drafting, art, math, engineering, computer programming, etc.



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 *FIRST* Tech Challenge Challenge will become available to Teams at Kickoff in September. Be sure to check material limits, types of materials, dimensions, and building strategies for compliance with *FIRST* Tech Challenge 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 *FIRST* Tech Challenge Kit of Parts. These can be helpful to have if questions come up during Inspection at Tournaments.



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.

In addition to the tools provided in the Kit of Parts, additional tools may be required to assemble the model, customize elements, and modify the Robot as required. Remember to 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"> • Allen Wrench, 7/64" • Allen Wrench, 1/8" • Wrench (open end / box end), 5/16" • Wrench (open end / box end), 1/4" • Hacksaw, 32 tooth blade • Hand Files (flat and round) • Wire Strippers • Wire Cutters • Needle Nosed Pliers 	<ul style="list-style-type: none"> • Soldering Iron • Jigsaw • Drill • Heat Gun • Extra Vise Grip 	<ul style="list-style-type: none"> • Shrink Wire Wrap • Electrical Tape • Black, Red and Green Wire • Small Zip Ties • Blue Lock Tight • Gear and Axle Lubricant • Extra Fuses for 12V Battery • Cable Ties

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.

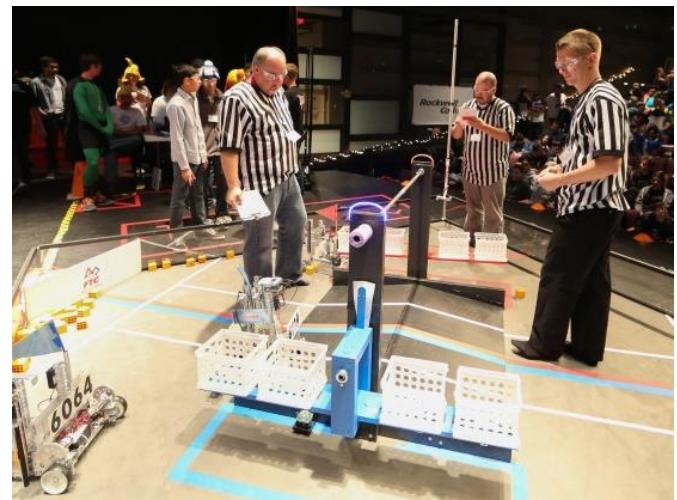
Teams should not get locked into continually trying to improve a bad design. Sometimes it may be necessary to step back, rethink, tear down, and rebuild a Robot. Times like these are great opportunities to return to the Engineering Notebook to investigate other concepts and strategies that were recorded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

- Consult the [PushBot Guide](#) for general building practices.
- 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.
- Watch the [Materials to Enhance Robot Design](#) instructional video for more ideas.

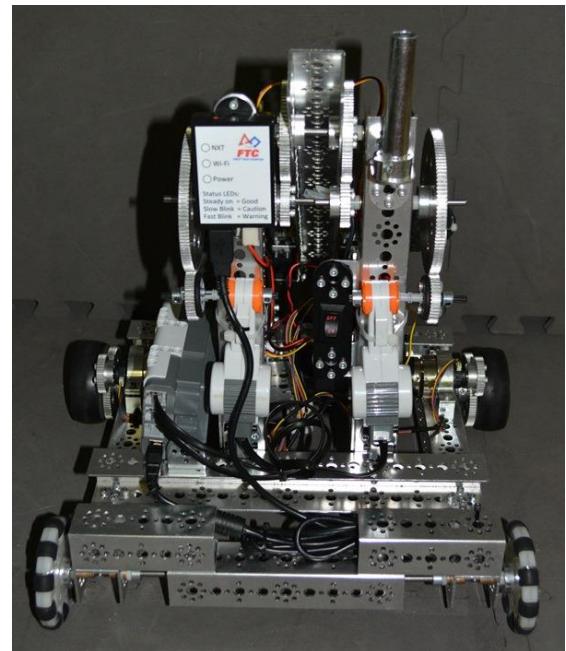


Wiring

Wiring is one of the most important components of a Robot. However, wiring often does not receive the same care and attention as the rest of the Robot. Even the briefest of power interruptions can cause communication system to have to reboot. Good wiring allows Teams to create tight connections and to better troubleshoot problems as they occur. Such wiring takes a lot of patience and practice, and Teams should budget time accordingly.

In addition to building a great Robot, there are best practices for general wiring of the Robot – good habits to start as soon as possible.

- Make wiring diagrams
- Use the proper tools
- Label the wires
- Keep it neat
- Use proper wire management
- Tie it all down
- Be careful with power switch placement
- Conduct proper maintenance



For more information on wiring best practices, check out these resources:

- [Robot Wiring Guide \(pdf\)](#)
- [Gear Up with FIRST Tech Challenge! Virtual Summer Conference session: Robot Wiring Troubleshooting \(video\)](#)

Programming

Software

There are two programming software options that Teams can use to program Robots for competition in the FIRST Tech Challenge. These tools, the App Inventor and Android Studio, 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 FIRST Tech Challenge, sample programs, programming guides, and video tutorials have been provided with the online activities for Teams in the following resources:

- [Inteltek Training materials](#)
- [PushBot Guide](#)
- [FIRST Tech Challenge Technology Forum](#)
- [Robot Building Resources](#)



Occasionally, a software vendor might make changes to their programming package. Make sure to check the [FIRST Tech Challenge Team Resources](#) webpage for software update advisories and software update links.

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 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.

FIRST Tech Challenge Android-Based Technology

The Android-based technology uses a point-to-point system. Teams should refer to the below resources during the season for additional help:

- [Intelitek Training materials](#)
- [PushBot Guide](#)
- [FIRST Tech Challenge Technology Forum](#)
- [Robot Building Resources](#)

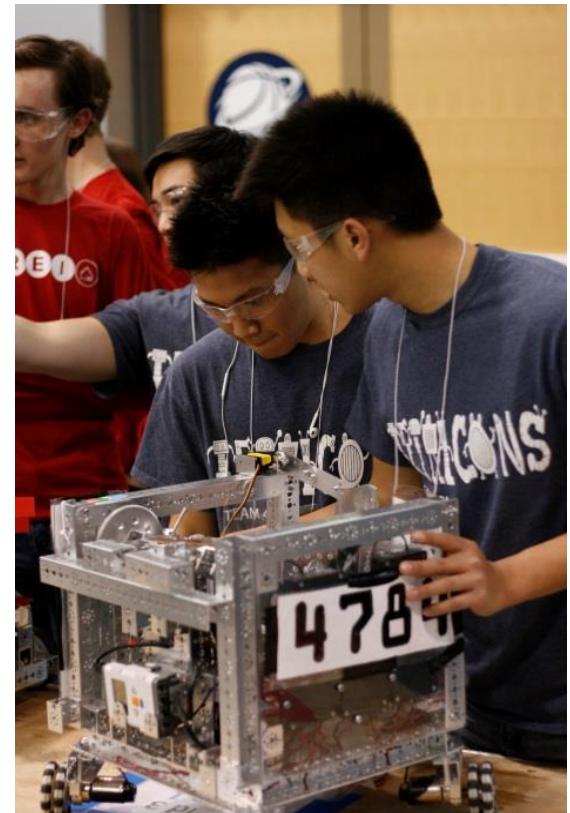
General Programming Best Practices for FIRST Tech Challenge

- 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.

- 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.

Iteration

It takes a lot of planning and trial and error to build a successful Robot. One of the advantages to the [Season Timeline](#) is the opportunity for Teams to continue to work on their Robot before, during, and after Competitions – and again before the next level of Competition. Teams are constantly seeing what other Teams are doing, learning new skills, and identifying strategies that might require changes to the Robot. Don't be afraid to change your Robot! The engineering process depends on the willingness to try something new, scrap it, and then try something else.



Navigating the Competition Season

Preparing the Team

FIRST Tech Challenge Competitions are different from almost any other experience your students will have had, so helping them be prepared for what they will encounter will allow them to be more confident and focused on the Team's objectives for the Event. The following sections provide lots of information and tips on helping the Team know what to expect and be prepared on how to perform on the day of Competition. Also bookmark this helpful webpage on [Preparing for Competition](#) as a review tool prior to heading off to your Event.

Game Challenge and Rules

Each year at Kickoff (usually in mid-September), a new [Game Challenge and Game Manual Part II](#) will be released, outlining the overall concept of the Game, problems to be solved, Rules, guidelines, and policies for the FIRST Tech Challenge 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 [Kickoff 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.

Drive Team

- Must wear their badges to be allowed access to the Field (if applicable).
- Needs to know where the Robot Power switch is located.
- Needs to have a plan for who will position the Robot on the Field and how.

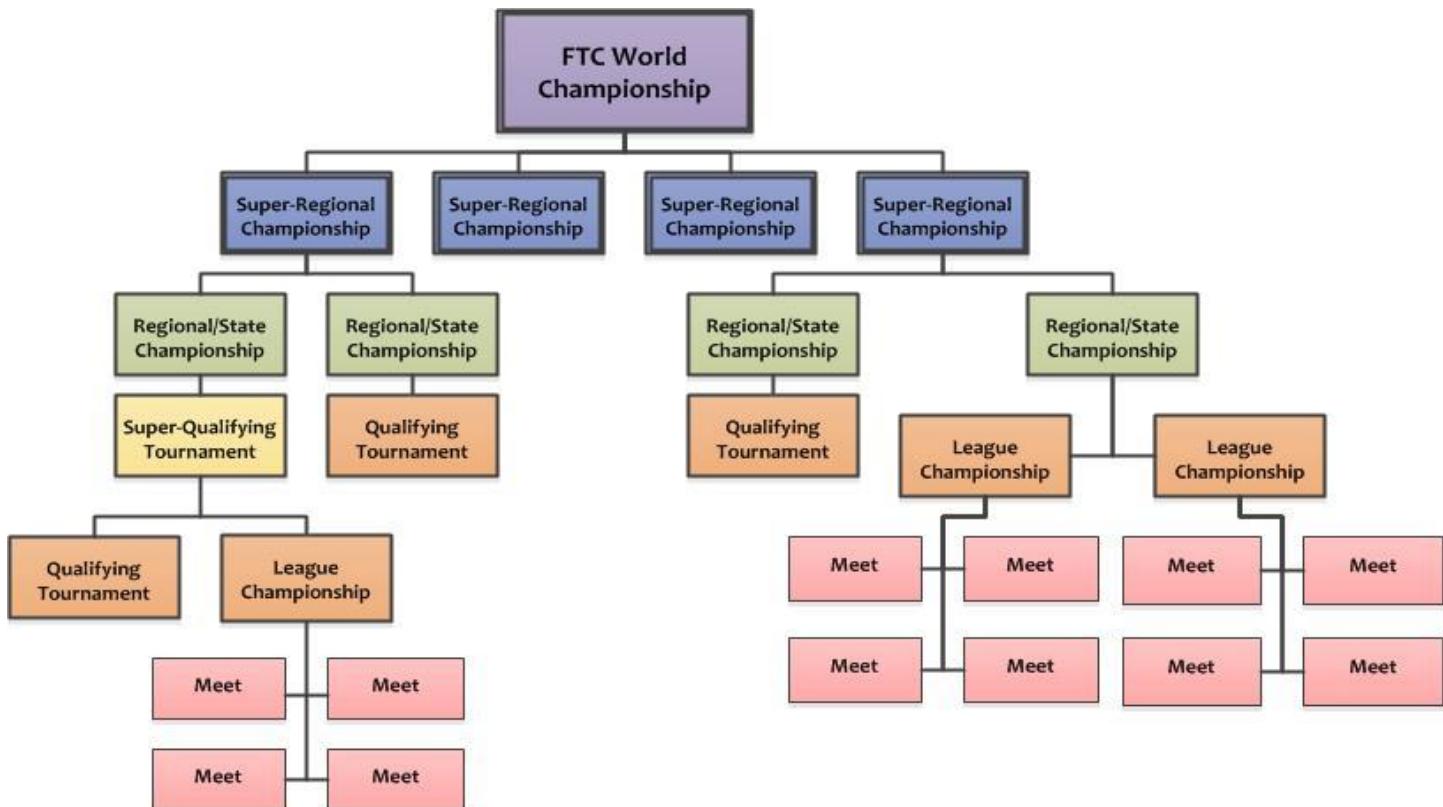
Pit Crew

- Keep the [Pit area](#) clean and organized so tools are easy to find if/when needed.
- Needs to be prepared for informal Judging conversations should the Judges stop by the [Pit display](#).



FIRST Tech Challenge Tournament Structure

The FIRST Tech Challenge program is both competition- and merit-based. The Tournament structure is tiered with levels of advancement that lead to the World Championships. Teams advance by accumulating Qualifying Points and Ranking Points received on the Field and through Judged Awards. To learn more about the advancement and ranking process, review the [Game Manual Part I](#).



Types of FIRST Tech Challenge Events

There are many types of FIRST Tech Challenge Events. Some Events are “Official”, meaning that they are a part of the advancement structure for the FIRST Tech Challenge. “Endorsed” means that the Event is not a part of the advancement structure for the Program, but the Event is hosted by or sanctioned by a FIRST Tech Challenge Affiliate Partner or FIRST Tech Challenge Headquarters. Other Events are “Unofficial” and could be hosted by anyone with an interest. Official and Endorsed Event information provided by the Affiliate Partners is promoted on the FIRST website and via the @FTCTeams Twitter and Facebook accounts. Unofficial Events are not promoted by FIRST or FIRST Tech Challenge.

The FIRST Tech Challenge competition season runs from mid-October to late April and includes several event types. Team saturation generally dictates the number and type of events in a region. Encouraging others to become involved and building the FIRST Tech Challenge community is the best way to encourage more Events in a region. Read detailed information in [Appendix J: Types of FIRST Tech Challenge Events](#).

Tournament Registration

Most [FIRST Tech Challenge 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 *FIRST* Tech Challenge League, Qualifying, and Championship Tournaments. Events are generally filled on a first-paid, first-served basis and many *FIRST* Tech Challenge Affiliate Partners coordinate their own registration process, so make sure to check the Affiliate Partner's website to determine how the Team can apply.

There will be a listing of confirmed Championship Tournament sites on the [Events portal website](#) beginning in late September or October. In October, Teams apply either online or directly with the Event organizer for most Tournaments.

It is important to note that Championship Tournaments usually require advancement through a Qualifying or League 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 *FIRST* Tech Challenge updates during the season, be sure that the Team's profile and contact information in the Team Registration System 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 *FIRST* Tech Challenge 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.

Contact information for Affiliate Partners in each area can also be found on the [FIRST Regional Contacts portal](#). 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 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.

What to Expect



Tournament Logistics

Once a Team has registered for a Tournament, either through the *FIRST* Tech Challenge website or with a local Tournament organizer, it is a good idea to check the Tournament website (if applicable) 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 (STIMS).
- **Any Team members lacking the completed registration at the Event will be ineligible to participate.**
- Print a Team roster in the Team Registration System. Be sure to include any signed Consent and Release forms for students not registered via STIMS.
- 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.

Read this great blog post and see several pictures of the [FIRST Tech Challenge Pits](#).



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 Playing Fields are located. Referees score the rounds in this area. There will be seating for fans and Teams not part of the Drive Team.

Judging Rooms

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 an Event

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 Interviews. 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 Interviews 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.

Read through [Appendix K: Coach Brian Johnson's Top Ten Tips for Teams Advancing to World Championships](#). It is full of excellent advice that is useful no matter what level of competition your Team is advancing to.

Read more in [Appendix L: What to Expect at Events](#) and the [FIRST Tech Challenge Get Ready for Competition webpage](#).

General Guidelines for Tournaments

Procedures

- Team members should always inform the Coach/Mentor when leaving the Pit area (to eat, watch a match, etc.). Employ the “buddy system” where no one wanders off without someone else.
- If DRIVER/COACH designation buttons are provided, always put them 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



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



Be sure to follow your school's field trip policies when attending Events.

organizational tasks are completed throughout the day.

Communication

- Mentors and Coaches should each have a master list of cell-phone numbers for everyone attending as well as contacts for their Parent/Guardians.
- 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.
- Keep the energy light – encourage laughter and fun.

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. Remember that match videos may not be used when asking an event official for a game call clarification or revision.

Technology

- 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 Android Technology every few rounds of play.

The Pit

- Have a theme for the Team that carries through in Pit decorations, uniforms, and Robot designs.
- A 6-foot banner is a cost-effective pit decoration. Make it two-sided, as both sides may be visible.
- Encourage your Team to explore other Team Pits and [Network](#).

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.

During Game Rounds:

- 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.

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 *FIRST* Tech Challenge 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 Interview 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. Some Tournaments have restrictions on the number of adults that accompany students into the Interview sessions. Be sure that *FIRST* Tech Challenge'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.

Event Etiquette

Practicing *Gracious Professionalism* will ensure everyone has a fun experience, whether or not they win. Here are some easy tips for bringing your *Gracious Professionalism* to the Event:

- Mentors need to stay in control of their own emotions. The Event can be stressful, but the focus should be on the Team members having a great experience. It's hard to do that if the Mentor is upset.
- Speak gently and kindly to Team members when providing feedback or information at all times, but especially at Events.
- Ensure your team stays within their designated Pit space. Some teams have bigger Pit displays or a larger Team, but it is Gracious to not invade someone else's space. Asking them to give up space is not Gracious, because they might say yes because they don't feel they can say no. Design your display to fit into the designate space.
- Coach all the Team members, Mentors, and parents on how to cheer in a way that honors everyone and hurts no one.
- Coach Team members and Mentors on appropriate ways to ask questions, challenge scores, or report issues to Event Volunteers and staff. Even when upset or stressed, stay Gracious.
- When there are disappointments at a Tournament, students take their cue from the adults around them. Remember to model *FIRST* Tech Challenge values, honor what the students achieve, and help them to focus on those achievements.



**On the Competition Field,
ONLY Team members may
use the Question Box to
speak to the Head Referee.
Adults are not permitted to
question or challenge
Match results or decisions.**

Inspections

At the event, the Team should be prepared to a Robot 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. Teams should complete a [Team Judging Self-Inspection Checklist](#) prior to arriving at the Competition. This will ensure a quicker and more efficient inspection process. **Failure to pass any of the inspections will disqualify a Team from competition.** However, it is important to know that the Inspector's main goal is to help Teams pass.



Robot Inspection

During the Robot Inspection, Inspectors will examine Robot construction against a Hardware Inspection checklist. Some examples of a typical Hardware Inspection items include: the size of the Robot, safety standards for the hardware (e.g. No sharp edges or corners), ensuring the Robot contains official TETRIX or MATRIX components, and ensuring the Robot contains only the acceptable allotment of additional materials (e.g. additional plastic or polycarbonate). The Robot Inspector will also check the Robot Controller to confirm that it is named appropriately, has the correct Android Operating System installed, and that Robot Controller app is the default application being used to connect to the Core Robot modules.

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.



Game Play

Each Game Match is made up of three distinct kinds of play. The kinds of play are:

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

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 block 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 Alliance partner's Robot.

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.



The **Drive Team** includes 2 Drivers and 1 Coach. Adults should encourage all students to try out these roles prior to Competition and then have the Team select the three members to fill the roles at the Event.

- 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.

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 Question Box 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 FIRST Tech Challenge rules, policies, and practices, please refer to the [Game Manual Part II](#).

Question Box Etiquette

FIRST Tech Challenge Rules state that only members of the Drive Team can stand address the Referees from the Question Box. Mentors should coach the Team on what to expect and how to behave:

- When a Team member has decided to ask a question, she should stand in the designated area and wait to be addressed by the Head Referee. This may take a few minutes, so patience is necessary.
- When addressed, present the question or concern as calmly as possible. The Referee may need to confer with the Score Sheet, Scoring table, or other Referees, so again, be patient. These Volunteers want to ensure they are being as fair and consistent as possible.
- Once the Referee delivers a decision or explanation, Graciously accept the response or ask an additional clarifying question.
- Learn more in this [helpful video](#).



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.

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

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 an Alliance 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.

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.
- For more ideas and resources, check out the [FIRST Tech Challenge blog post 5 Tips for Scouting](#).

FIRST Tech Challenge Judging and Awards

Why Judging Interviews?

In addition to providing information to help Judges make determinations about Award winners, the *FIRST* Tech Challenge Judging Interview provides an opportunity for Teams to practice and develop invaluable life skills. In addition, Judging Interviews and the [FIRST Tech Challenge Judged Awards](#) allow Teams to be honored and recognized for the complete *FIRST* Tech Challenge experience and not just the Robot and how it performs on the Competition field, including:

- The overall Team experience, organization, and dynamic
- Robot design, prototype, build, and iteration process
- The Team Engineering Notebook
- The Team Business Plan, Budget, and Funding
- Team and community outreach

Teams should look at Judging Interviews as practice for future job interviews and presentations. Mentors can help them prepare by coaching them on developing an elevator speech or pitch, presentation skills, and professional behavior and dress. The follow sections go into greater detail about Judging Interviews, preparing the Team, and the *FIRST* Tech Challenge Awards.

How Judging Works

FIRST Tech Challenge Judges are Volunteers. They receive training from *FIRST* Tech Challenge and sometimes additional training from the local *FIRST* Tech Challenge Affiliate Partner before the Event. At Tournaments, Judges use a set of guidelines that represent qualities the Program 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 *FIRST* Tech Challenge experience. Also important to the Judges is the Team's knowledge of the Robot, teamwork, demonstration of [FIRST Tech Challenge Core 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 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 Interview. 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. As a training tool, watch this 12 minute TEDx Talk by Jia Jiang: [Lessons Learned from Rejection](#).



Judging is subjective, just like many things in life, but most notably like a job interview.



Provide every Team member with the tools and practice they need to be comfortable speaking during the Judging Interview or to Judges around the Competition Field and Pit area. Even shy students can be coached to feel confident in speaking a small amount and ALL students should be given the chance to speak on behalf of the Team.

Preparing and Practicing

Teams will be evaluated by Judges in a number of ways, including:

- Judging Interviews.
- Observations on the Competition Field or around the Pits.
- Conversations on the Competition Field or around the Pits.

Team members should be prepared for the more formal Interview and the informal observation and conversation aspect of Judging. Talk to them about the real world application of both skill sets and set aside Team meeting time for practicing both.



The Elevator Speech

Whenever you have an opportunity to speak about your Team or FIRST, you're likely going to need to try to explain what it is we do, usually briefly, but that is often easier said than done. However, taking the time to prepare for these impromptu moments will make it less overwhelming when the time comes. To do so, craft an "elevator speech" to review and practice. We looked over the tips created by [Mind Tools](#) and here is what they suggest that you include:

1. Explain What You Do
2. Communicate Your Unique Selling Point
3. Engage with a Question

In addition, you might also discuss the structure of the Team, including the [spectrum of involvement of the Mentors](#) in the various workings of the Team, as well as Team outreach or goals, and successes.

Resources to help the Team prepare for Judging:

- [Preparing for Competition](#) webpage
- [Gearing Up Mad Interview Skills](#) presentation
- [Video Tutorial on Judging](#)

A great tool is to record individual students practicing explaining the Robot to another Mentor (or a guest adult), talking about the Team's outreach activities, or the overall Team experience. Watch the video with the student and coach them on ways they can improve. More often than not, they will just need to become comfortable with the skill, so allow many opportunities for practice.

An essential tool to help gauge how prepared a Team is for Judging at an Event is the [Team Judging Session Self-Assessment \(Appendix G\)](#). Read more about this tool in the [Self-Assessment](#) section of this Manual and in the blog post [Reflection: Your Key to Team Improvement](#).

The Judging Interview

The Judging Interview is usually about ten minutes long. Teams will have an opportunity to speak about their Team or Robot, and then Judges will ask a few questions. Teams vary how they prepare for the Interview, from having a fully prepared presentation that is memorized, to just talking informally about the Team and Robot. Either style is fine, but both require a little coaching to help prepare the Team members. Some people are comfortable with talking "off the cuff" and do an excellent job covering the material, but many people are much more comfortable with a prepared responses or speech or notecards

Appropriate Behavior

While Teams will want to stand out as memorable to the Judges, they should also remember that they are practicing professional skills and should always be Gracious.

- In the Judging Interview, Teams should not expect to be able to give a PowerPoint or video presentation, should not sing and dance, and should not have a canned speech or presentation that lengthens their allotted Interview time. Judges need to Interview a lot of Teams in a short amount of time.
- Teams should not expect Judges to provide feedback. It is not part of their Volunteer role and they do not have enough time to provide quality feedback to all the Teams at the Event.
- When Judges are walking around, Teams should not approach them to ask questions, solicit feedback, or attempt to share more about the Team. Judges need to be able to observe, uninterrupted and in order to give equal attention to all Teams, wait for the Judges to approach the Team.

Judged Awards

All Teams at an *FIRST* Tech Challenge Event are eligible to win several Judged Awards. To ensure fairness to all Teams and provide equal opportunity for Teams at an *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.**

Submission Requirements

Teams do not need to apply to be eligible for Judged Awards, but they must be sure they meet the criteria outlined in the [Appendix M: FIRST Tech Challenge Judged Awards Categories](#). Every Award requires the Team to display Gracious Professionalism in everything they do, most require Teams to submit an Engineering Notebook, and then three Awards require additional materials: Control Award requires the Team to submit a [Control Award Content Sheet](#), and the [Compass and Promote Video Awards](#) require a video submission.

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. *FIRST* Tech Challenge 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.



Read detailed descriptions about each of the *FIRST* Tech Challenge Awards and more in the following resources:

- [Game Manual Part I](#)

- [Appendix M: FIRST Tech Challenge Judged Award Categories](#)
- [FIRST Tech Challenge Awards Webpage](#)
- [FIRST Tech Challenge Hall of Fame Webpage](#)

Video Awards

FIRST Tech Challenge has two optional Awards that involve creating a video that is submitted prior to the Competition: the Promote Award and the Compass Award. A panel of Judges will review the videos and select the winner, usually prior to the Event day due to the time and technology needed. As an optional Award, Event hosts may choose whether or not to give out the Award and will communicate details about submitting videos for the Award in advance of the Event. Details about these two Awards, as well as video guidelines can be found in [Game Manual Part I](#) or [Appendix M: FIRST Tech Challenge Judged Award Categories](#). And be sure to watch previous season's submissions, including winning videos on the [FIRST Tech Challenge YouTube Channel](#) for inspiration.

Other Awards

In addition to Judged and Competition Awards given out at Events, FIRST and FIRST Tech Challenge offer additional Awards that follow a different procedure and Judging process. You can read information and details about all Awards FIRST Tech Challenge Teams are eligible for on the [FIRST Tech Challenge Awards](#) webpage.

Dean's List Award

In an effort to recognize the leadership and dedication of FIRST's most outstanding secondary school students, the Kamen family sponsors awards for selected 10th or 11th grade students called the FIRST Dean's List Award. The students who earn FIRST Dean's List status are great examples of current student leaders who have led their teams and communities to increased awareness for FIRST and its mission while achieving personal technical expertise and accomplishment. FIRST Tech Challenge Team members are nominated by their Mentor(s) for this Award. For more information, read the [FIRST Tech Challenge Dean's List Submission Guide for Mentors](#) and review Award criteria and past winners on the [FIRST Tech Challenge Hall of Fame webpage](#).

FIRST Future Innovators Award

The FIRST Future Innovator Award (FFIA) recognizes creativity in effectively solving a real-world, complex problem through the invention of a unique solution beyond the requirements of the FIRST competition season. Sponsored by the [Abbott Fund](#), this Award directly links to the FIRST mission to inspire young people to be science and technology leaders and to the FIRST vision to transform culture by creating a world where science and technology are celebrated. Teams apply for this Award; Award criteria and the application process can be found on the [FIRST Tech Challenge Awards webpage](#).

Outreach Activities for Teams

Advantages to Outreach

Most *FIRST* Teams participate in outreach activities, or opportunities to showcase their skills and knowledge to the “outside” or non-*FIRST* world. Outreach activities can benefit Teams by:

- Allowing Teams to practice their public speaking skills and help prepare them for [Judging Interviews](#).
- Providing a public audience to showcase the learning the students are going through.
- Creating networking opportunities for the Team and individual members.
- Introducing *FIRST* Tech Challenge to potential new Team members or Mentors.
- Recruiting additional Teams to *FIRST* and creating connections between *FIRST* Teams.
- Helping achieve the mission of *FIRST* by raising awareness of *FIRST*, *FIRST* Programs, and STEM.
- Connecting the Team to potential Sponsors.

Types of Outreach

Outreach activities can be anything, really, that gets the Team out and connecting with non-*FIRST* people, businesses, etc.



Workshops

Many Teams either host or attend an *FIRST* Tech Challenge workshop event. These are typically training opportunities where interested parties are able to learn about *FIRST*, *FIRST* Tech Challenge, and either drive or possibly work on a Robot. Look for more information in the *FIRST* Tech Challenge Quick Build Event Guide (*coming soon*).

Demonstrations

There are lots of opportunities for Teams to show the public their Robot(s) and what they are learning as a part of the *FIRST* Tech Challenge program and community. This can take place in their school, for a community organization, in the local parade, at a fair, etc.

Trade Shows

This type of opportunity can vary by name, but typically the Team will set up a [booth](#) (basically a modification of their Pit display) and talk about *FIRST*, *FIRST* Tech Challenge, provide handouts, and show off their Robot to folks stopping by the event. The [Team Management Resources](#) webpage and the Appendix of the Manual provide [FIRST](#) and *FIRST* Tech Challenge promotional materials.

Presentations

Whether it is for a potential or confirmed Sponsor, school robotics class, the school board, a local organization, the Elementary School, or a STEM business, this is a fabulous opportunity for the Team to practice their Judging Interview skills and to share a lot of information about the program and the Team in a short amount of time.

Online

The internet has created awesome opportunities for our Teams to connect with one another online, as well as to reach out to others in their community, both near and far. This can be done through social media ([FIRST Tech Challenge social media accounts](#), Facebook groups, LinkedIn, etc) or via groups designed just for this purpose, such as [FIRST Ladies](#). Learn more in the Gear Up with *FIRST* Tech Challenge in the Classroom! virtual summer conference video [More Than Robots](#).

Finding Outreach Opportunities

For large, public events, determine how far you are willing and able to travel, and then you can easily do a search online or follow your local news media calendar of events. Any event that will allow the Team to talk to interested persons about robotics, *FIRST*, and STEM education is a good fit. Contact the organizers and see if they are interested in the Team being a part of the event and be sure to ask about cost and expectations for what the Team will do and provide at the event.

For smaller, more intimate events, contact organizations or businesses with whom you would like to collaborate. Share with them your goals for the outreach and ask if they have any events coming up that your Team could participate in. This might require advance planning on your part.

Creating Your Own Outreach Event

If your Team would like to create their own outreach event, such as the workshop option listed above, use the following steps:

- Identify the goals of the event (who is it for? Is it to raise funds? Recruit team members?)
- Develop a planning committee
- Identify any cost and collaborators
- Identify a space to use
- Reach out to your [local Affiliate Partner](#) or other *FIRST* Teams in your area for ideas and support.
- [Promote your Event in the media](#).
- Get to work!

You will find lots of useful tips in the [Event Guide](#) (even if you are not planning a Scrimmage, the tips in there will be helpful) and look for more information on hosting an event in the *FIRST* Tech Challenge Quick Build Event Guide (coming soon).



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.



Read more in the [FIRST Tech Challenge blog post: When You Lose, You Win](#). As a training tool, watch this 12 minute TEDx Talk by Jia Jiang: [Lessons Learned from Rejection](#).

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 [FIRST Tech Challenge Core 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 Seniors and Outgoing Members

At graduation ceremonies across the country, seniors dressed in caps and gowns are honored for their academic, extracurricular, and athletic successes. We know many of those graduates have accomplished amazing things as part of *FIRST*. Mentors can purchase *FIRST* Honor Cords to bestow on the graduating seniors. Honor cords are typically given in recognition for academic achievement. They are worn over the graduation robe and the colors are symbolic of the honor society membership or school colors. As they walk across the stage, their cords will stand out as a symbol of their hard work and achievement while a part of *FIRST*. If your school, program, or Team would like to honor your graduates, you should first contact your local high school to find out how to be involved. The *FIRST* Tech Challenge honor cord pairing can be purchased through the [BrandIt store for *FIRST* Teams](#).

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 *FIRST* Tech Challenge competitions or the Championship event. Visit the Events section of the *FIRST* Tech Challenge 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.



Maintaining Team Longevity and Sustainability

Why Longevity and Sustainability?

Some Teams are created so that a few students can develop some skills to supplement their school learning. Once the few students either leave or graduate, the Team dissolves. Some Teams are created for one year and then, due to funding, are unable to return. And then other Teams are part of a school or organization and the plan is for the Team to be around forever. These are just a few examples of the life span of a Team, and all are acceptable. The decision to be a short-term or long-term Team is personal to the Team. However, if your Team plans to compete for more than one season, then there are a few things your Team can and should do to ensure that the Team lasts as long as desired and is able to flourish with adequate funding and support. This section of the manual outlines the key elements to maintaining and sustaining your Team. For additional information or advice, reach out to other *FIRST* Teams in your area or your local [Affiliate Partner](#).

Goal-Setting and Self-Assessment

The first year of a Team, the focus is on building a robot that can successfully compete in the Game Challenge. A secondary goal is to learn as much as possible about the *FIRST* Tech Challenge program and connect with other Teams.

Each year after the rookie season, the Team should establish broader, more challenging goals for that season and beyond, perhaps a three-year plan that is re-visited each year and then re-written every three years. Each year there can be short-term goals, with the Team always working toward those longer two- or three-year goals.

Some short-term goal examples:

- Design and build a Robot that can _____.
- Use PTC Creo to create 3-D designs prior to building the Robot.
- Train all Team members on using Java programming language.
- Advance the Team to the regional Championship/Super-Regional/World Championship.
- Compete in an international Event.
- Raise \$10,000 for the Team budget.
- Volunteer 500 hours in their local community.
- Recruit and mentor two other *FIRST* Teams.



Some long-term goal examples are:

- Nominate two members for the Dean's List Award each year.
- Advance the Team to the World Championship every year.
- Build up a Team savings account up to \$30,000.
- Create a scholarship fund for graduating seniors.
- Get an annual Team Sponsor.

To maintain interest moving forward each year, keep setting new goals as a Team and for individual members. Help the Team succeed by establishing check points for the goals and celebrate successes.

Each year, do Team self-evaluation, ideally at the end of the season when the experience is still fresh, and then again at the start of the next season when everyone has had a little break which can provide perspective.

Building Leadership

In order to sustain a strong Team over the years, you need leaders, and not just Mentors in a leadership role. Early in the season, identify students who already possess leadership skills and work to help them develop into strong Team leaders. Those leaders should always be helping to train their replacement, since Team members will eventually graduate or leave the Team. Start with the strategies listed in the [Developing Leaders](#) section of this manual, read the blog post [Achievement Starts with Belief](#), and then build your leadership training to include outside workshops or conference opportunities for Mentors and Team members. Bring in business leaders from the community to speak about various leadership skills and how to develop them. Inspire leadership on the Team with TED talks on leadership. More importantly, leadership is an action, so provide opportunities for Team members to coach and help their peers on the Team, as well as Mentor other FIRST Teams whenever possible.

Funding

In the [Fundraising the Team](#) section of this manual, there is a lot of information on how to raise money to support the Team in achieving their goals throughout the rookie season, including buying parts, registration fees, and travel expenses, among others. In order to sustain the Team for longer than one season, you will need to create and achieve even bigger fundraising goals each year. While you may spend less on parts after the first season, when you create loftier goals, it will require a larger pool of funds (ie: traveling further, purchasing a 3-D printer, etc.).

Starting in the first year, you will want to develop your fundraising plan to include building a savings/rollover fund each season. This will mean seeking larger grant opportunities, finding a long-term or annual Sponsor, etc. It might be smart to bring in experts on budgeting and accounting to help you develop your Team budget or an expert on fundraising to help you brainstorm strategies for achieving your long-term financial goals.

Developing Community Support

If the Team is going to be around for many years to come, develop a plan for building community partnerships. This can provide support for the Team in terms of funding, mentor and student recruitment, and skill development for Team members (ie: networking for internship opportunities). In this way, more people become invested in ensuring the Team has the resources (material, financial, and human) to compete each season.

In your Team business or strategic plan, identify a few key connections you'd like to make with community organizations or businesses – and then just target two or three each year (keep it small to ensure success). For example, if your Team is school-based, build a partnership with groups like 4-H, Girls Scouts, or The Boys & Girls Club. The Team can do outreach activities with the organization and that can become a great tool for Team recruitment.

If you haven't already, check out these resources:

- [Marketing and Business Strategies for Teams](#) (video)
- [FIRST Business Plan Overview training](#) (video)
- [FIRST Tech Challenge Fundraising Guide](#)
- [Appendix N: Sample Business Plan](#)

Archiving Information

Whether it is preserving great ideas that are unused from project to project and year to year or cataloging accomplishments, whatever the information contains, the Team should identify a strategy for archiving information, including a Team member database, text documents, CAD drawings, programming language, pictures, and videos. While it might be easiest to use a Mentor's computer or email account, what would happen to the information if the computer crashes or the Mentors decide to leave the Team?

For the long haul, Teams should create a set of accounts and ensure that more than one person has account privileges and access. In addition, creating an online presence can both archive information and create opportunities for outreach. Accounts to include:

- Email
- Cloud-based storage (ie: Dropbox, OneDrive)
- Webpage/blog (ie: WordPress)
- Social Media (Twitter, Facebook, Instagram, etc)
- Video or Photos (YouTube or Flickr)

Each season, identify who is the key person (Mentor, Team member, one of each) to monitor and update the account(s). Make sure they have enough time to handle the task, and set aside meeting time to check in with them. Set up parameters for what is appropriate use of the account and provide training as needed. In addition to the point person, be sure there is an additional person or two who are learning the ropes and/or assisting with content creation, etc so that the skills and knowledge aren't lost when the Team member or Mentor move on.

Passing on Leadership to a new Mentor

As with all things, Mentors will come and Mentors will go. The harder a Mentor works each season will likely speed up their exit due to overwork if there are not enough Mentors sharing the responsibilities of running the Team. Ideally the Team will be able to survive these changes seamlessly, but here are a few tips to help with the transition:

- Always have more than one Mentor know the inner workings of the group, especially Team registration and communication with FIRST, account usernames and passwords, budget and fundraising, etc.
- In the Team Registration, two Mentors must be registered and pass screening, but the Lead Mentor must pass on responsibility for the Team prior to their leaving the Team to avoid extra steps to maintain the Team's account and number.
- Delegate tasks whenever possible to other Mentors: this helps them learn and know what needs to be done, but also helps them stay connected to and invested in the Team.
- Find ways to include parent or volunteers in the workload of the Team. This can defray costs (perhaps a parent can make copies at home), provide a warm body to supervise meetings (allowing a Mentor the night off), and help them stay positively invested in the Team.

FIRST® Tech Challenge

Mentor Manual

Appendices

Appendix A: Resources

Game Forum Q&A

<http://ftcforum.usfirst.org/forum.php>

Anyone may view questions and answers within the FIRST® Tech Challenge Game Q&A forum without a password. In order to submit a new question, you must have a unique Q&A System User Name and Password for your team.

FIRST Tech Challenge Game Manuals

Part I and II - <http://www.firstinspires.org/resource-library/ftc/game-and-season-info>

FIRST® Headquarters Support

Phone: 603-666-3906

Mon – Fri

8:30am – 5:00pm

Email: FTCTeams@firstinspires.org

FIRST Website: firstinspires.org

[FIRST Tech Challenge Page](#) – For everything FIRST Tech Challenge.

[FIRST Tech Challenge Volunteer Resources](#) – To access public Volunteer Manuals.

[FIRST Tech Challenge Event Schedule](#) – Find FIRST Tech Challenge events in your area.

FIRST Tech Challenge Social Media

[FIRST Tech Challenge Twitter Feed](#) - If you are on Twitter, follow the FIRST Tech Challenge twitter feed for news updates.

[FIRST Tech Challenge Facebook page](#) - If you are on Facebook, follow the FIRST Tech Challenge page for news updates.

[FIRST Tech Challenge YouTube Channel](#) – Contains training videos, Game animations, news clips, and more.

[FIRST Tech Challenge Blog](#) – Weekly articles for the FIRST Tech Challenge community, including Outstanding Volunteer Recognition!

[FIRST Tech Challenge Team Email Blasts](#) – contain the most recent FIRST Tech Challenge news for Teams.

[FIRST Tech Challenge Google+](#) community - If you are on Google+, follow the FIRST Tech Challenge community for news updates.

Product Support

FIRST will handle questions about team registration, grants, events and partners. Pitsco will handle questions about ordering, payment and delivery of competition sets and materials.

- U.S. & Canada: 800-835-0686 FREE
- Outside U.S. and Canada: 620-231-0100
- U.S. Fax: 800-533-8104

Team Development Support

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

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

Feedback

We strive to create support materials that are the best they can be. If you have feedback regarding this manual, please email ftcteams@firstinspires.org. Thank you!

Appendix B: Season 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 (May-June)

Pre Kickoff (August – Early September)

- Attend *FIRST* Tech Challenge 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 the local [Affiliate Partner](#) to get answers to questions, and to get in touch with experienced Mentors in the area.
- Try building practice Robots.
- Go to the [FIRST Tech Challenge website](#) 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.
- Acquire Java programming software practice using it. Have a Team member start learning to use it.
- Host or support outreach events.
- Attend pre-season Workshops, if available.

Kickoff 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 the [Affiliate Partner](#) for information pertaining to Kickoff 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 Event advancement. Some Teams receive invitations to [Super-Regionals](#) or [World Championship](#) 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)

- Do lots of [Teambuilding](#).
- Establish procedures and routines.
- Get familiar with kits and parts
- Clean up and prepare workspace.
- Inventory resources from previous years.



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

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 [Intelitek resources](#), 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 Notebook](#).
- 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.

League Events & 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 [Events Portal](#), 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.

Appendix C: 10 Steps to Being an Effective FIRST® Tech Challenge 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: "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 FIRST Tech Challenge 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. FIRST Tech Challenge 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.

Appendix D: Sample Team Roster

Team Member Roster

(Maximum Student Participants is 15)

Team Information

Program:	FIRST Tech Challenge	Season:	2015
Team Number:	XXXX	Team Location:	City, State/Province, Postal Code Country
Team Name:	Team Name	Team Nickname:	Team Nickname
Team Location:	City, State/Province, Postal Code Country		

Main & Alternate Team Contacts

Role	Name	Phone	Email	Consent Form Status	Consent Form Date Complete
Main	Firstname Lastname	W: 555-555-5555	email@domain.com	Accepted	04/01/2015
Alternate	Firstname Lastname	W: 555-555-5555 H: 555-555-5555	email@domain.com	Accepted	05/06/2015

Mentors & Other Team Contacts

Role	Name	Phone	Email	Consent Form Status	Consent Form Date Complete

Student Team Members

Role	Team Member Name	Parent Name	Application Status	Consent Form Status	Consent Form Date Complete
Student	firstname lastname	Firstname Lastname	Accepted	X Incomplete	
Student	firstname lastname	Firstname Lastname	Accepted	Accepted	06/29/2015

Additional Student Team Members and Mentors Not Listed Above (write in)

Role	Student Name	Parent Name



All students **MUST** have a completed Consent & Release form, either online or printed in order to participate at an Event.

Appendix E: FIRST® Tech Challenge Sample Budget

The following sample budget was created for a team was a rookie team and cost reflect one-time purchases for their robot and one event. Adding additional supplies and event registration and travel will cost more. Teams should anticipate some of the costs as they are planning their budget and fundraising. For team longevity, teams will want to end the season with some surplus, if possible, to help get them started in the next season.

At the start of the season, create a budget that guesstimates expenses. Using the template below, put anticipated expenses and the projected amount in the column named “Budgeted Amt. As money gets spent, track the line items and the actual dollar amount in the column labelled “Actual Cost”. For teams who need to report their budgets out for awarded grants, sponsors, or schools, you might need to use the “Category” and “Rationale” columns to separate out how each expense is applied and the purpose for it.

To modify this budget in Microsoft Excel, download the template from our [Team Management Resources page](#).

Item	Budget Amt.	Actual Cost	Category	Rationale/Explanation
Expenses				
Registration	275.00		Registration	Season registration fee (required).
Kit of Parts: Competition Set	580.00		Robot Supplies	Rookie teams will need to start with either a TETRIX or MATRIX kit.
Kit of Parts: Control & Communication Set 2	318.00		Robot Supplies	Rookie Teams will need to the Technology used in FIRST Tech Challenge, primarily phones and adapters for events. Veteran Teams may need replacements.
Kit of Parts: Electronics Modules & Sensors Set	365.00		Robot Supplies	Teams can choose to add modules, sensors, or other supplies to their kit.
Tools	200.00		Robot Supplies	Rookie teams will likely need to invest in purchasing some basic, essential tools.
Misc Parts & Supplies	200.00		Robot Supplies	Needs arise for parts, etc, so budget accordingly so you have the money.
Team T-Shirts	150.00		Team Supplies	To promote the team and show spirit.
Team Buttons	60.00		Team Supplies	To promote the team and raise funds.
Pit Display	50.00		Team Supplies	To promote the team at events.
Printing	100.00		Team Supplies	The team will likely incur printing costs (paper, ink), so plan for it in the budget.
Tournament Registration	75.00		Registration	Event registration fees vary by region.
Gas	100.00		Travel	Getting the team and the robot to the event often takes a bus.
Food	200.00		Travel	Feed the team at meetings and/or events.
Sub-Total	2673.00			Projected total expenses for the season. Actual Costs may be lower/higher, but it's best to plan high.

Monies				
Rollover Amount	0.00			Money left over from the previous season (applies only to veteran teams)
Grant	575.00	Grants		Team applied for and received a grant from an organization.
School Allocated Club Funds	500.00	Income		Some schools provide clubs and organizations with a set amount of money each year.
Pizza Fundraiser	300.00	Fundraiser		Planned team fundraiser with ideal amount raised.
Car Wash	300.00	Fundraiser		Planned team fundraiser with ideal amount raised.
Button Sales	300.00	Fundraiser		Planned team fundraiser with ideal amount raised.
Sub-Total	1975.00			Anticipated amount of money coming in throughout the season. Actual amount may be lower/higher, but it's best to over-plan ways to raise money.
Bottom Line				
Credit/Deficit	-698.00			Current money still left/Money owed that still needs to be raised (marked in red)
Rollover Amount				Any money that can be moved over to the next season's budget at the end of the current season.

Ways to Reduce Expenses for Rookies

The above budget is planned for a rookie team purchasing the maximum amount of supplies through the FIRST Tech Challenge Storefront and attending one Qualifying Tournament. Reductions in this budget could include:

- Borrow tools – about \$200 savings
- Reduce extra parts and supplies needs with frugal robot design – about \$150 savings
- Don't buy Team Swag (T-shirts or Pit display) – about \$200 savings
- Parents donate gas, travel expenses, and food – about \$200 savings
- Get a local print shop to donate printing – about \$100 savings

Total potential savings: about \$850 if all above measures were combined. New Expense Sub-Total: \$1,823.

Ways to Reduce Expenses for Veterans

The above budget is planned for a rookie team purchasing the maximum amount of supplies through the FIRST Tech Challenge Storefront and attending one Qualifying Tournament. Reductions in this budget could include:

- Don't buy a new Kit of Parts - about \$600 savings
- Use old tools – about \$200 savings
- Reduce extra parts and supplies needs with frugal robot design – about \$150 savings
- Use previous T-Shirts and Pit display – about \$200 savings

- Parents donate gas, travel expenses, and food – about \$200 savings
- Get a local print shop to donate printing – about \$100 savings

Total potential savings: about \$1,450 if all above measures were combined. New Expense Sub-Total: \$1,223.

Optional Costs

Many Teams want to build and test their Robots using off-the-shelf materials and a real Playing Field. This is, however, totally up to the Team and what they can afford, but will increase their expenses throughout the season. Example expenses include:

- **FIRST Tech Challenge Playing Field Perimeter** – approximately \$700 (or you can save money by building one using the *FIRST* Tech Challenge Low-Cost Field Perimeter Build Guide).
- **FIRST Tech Challenge Playing Field Tiles** – approximately \$360 for a full field (or you can save money by only buying a few tiles, like 6, to practice on).
- **FIRST Tech Challenge Field** – a full field will cost \$450, or you can save money by buying just a half field for \$300, or just a few of the field elements with varying costs by part (or you can save money by building a Field using the *FIRST* Tech Challenge DIY Field Build Guide and Blueprints).

Appendix F: FIRST® Tech Challenge Team Roles

FIRST Tech Challenge Team Roles	
Responsibilities	Traits
Mentor (2+ adults)	<ul style="list-style-type: none"> • Read about the Mentor's Role. <ul style="list-style-type: none"> • 18 years or older • Patient • Dedicated • Willing to learn
Future Mentor (1+)	<ul style="list-style-type: none"> • Assist the Mentor and other Team members. • Gradually take on responsibilities as the season progresses, to assist the Mentor. <ul style="list-style-type: none"> • Receptive to feedback and Coaching • Actively seeks challenge and greater responsibility • Goal-oriented • Willing to assume responsibility for his or her own growth and development
Team Management (1+ students)	<ul style="list-style-type: none"> • Focuses the Team. • Ensures that everyone's ideas are heard and works to find compromises. • Regularly checks Team goals and deadlines. • Gathers information from sub-groups on the Team and tracks Team progress. • Keeps everyone on schedule with project timelines. • Manages the Team schedule at events. <ul style="list-style-type: none"> • Clear-headed • Organized • Confident • Punctual • Able to mediate discussion and conflict

Responsibilities	Traits
Strategy (2+ students) <ul style="list-style-type: none"> • Discusses ways to help the Team be successful in competition. • Understands the Game rules and challenges thoroughly. • Gathers input from other Team members to influence strategy. • Keeps an active eye for rule updates to ensure Team compliance. • Searches the Internet for discussion by other Teams regarding what works. • Studies the Team's Robot to see other ways it can do different tasks with little modification. • Communicates problems and possible solutions clearly and respectfully with Team members. 	<ul style="list-style-type: none"> • Resourceful • Creative • Innovative • Willing to take well-thought-out risks • Knows the related subject matter • Familiar with rules and regulations
Build Team (2+ students) <ul style="list-style-type: none"> • Understands and uses safety precautions while building. • Investigates different solutions to solve mechanical design challenges. • Makes decisions about mechanical design. • Works to achieve consensus among Team members. • Uses guidelines from Team brainstorming to build a Robot. • Communicates and tests to ensure that all mechanisms on the Robot work effectively together. • Works with the Quality/Compliance Control Team to test and refine Robot design. • Communicates problems and possible solutions clearly and respectfully with Team members. • Regularly monitors forums and FIRST resources for rule updates, to ensure Team compliance. 	<ul style="list-style-type: none"> • Knows the related subject matter • Confident, but willing to ask for clarification • Documents carefully • Confident with use of all tools • Familiar with rules and regulations

Responsibilities	Traits
Programming Team (2+ students)	
<ul style="list-style-type: none"> • Writes well-commented programs for the autonomous part of the competition. • Schedules time with the build Team to test the chassis when others do not need it. • Alters the programs as necessary. • Regularly monitors forums and FIRST resources for rule updates, to ensure Team compliance. • Communicates problems and possible solutions clearly and respectfully with Team members. • Ensures there is a hard copy of the program at events. • At Events, makes any changes the drive Team needs in order to be more efficient during the controlled portion of the match. • If the Team is experienced, offers assistance to Team members that are new to programming. 	<ul style="list-style-type: none"> • Organized and has good tracking skills. • Creative • Innovative • Willing to take risks based on thorough research • Knows the related subject matter • Familiar with rules and regulations
Quality/Compliance Control (2+ students)	
<ul style="list-style-type: none"> • Regularly monitors forums and FIRST resources for rule updates, to ensure Team compliance. • Conducts independent tests of the Robot's performance to identify potential problems and areas for improvement. • Tests for functions that do not work reliably. • Makes recommendations for improvements. • Communicates problems and possible solutions clearly and respectfully with other Team members. • Documents all tests and results in the Engineering Notebook. <p>Note: Robots and programs will need to be tested and revised frequently and regularly.</p>	<ul style="list-style-type: none"> • Detail-oriented • Thorough • Innovative • Documents carefully • Confident, but willing to ask for clarification • Knows the related subject matter • Authoritative yet diplomatic

Responsibilities	Traits
Hardware/Tools Management (2+ students)	
<ul style="list-style-type: none"> • Understands the function of hardware elements and tools in the kit. • Organizes and monitors the use and location of all hardware and tools needed for building and maintaining the Robot. • Keeps track of all wiring necessary to program the Robot. • Keeps track of all power strips and batteries needed for the Robot. • Manages the battery charging process. • Understands and uses safety precautions when using and storing materials, and when charging batteries. 	<ul style="list-style-type: none"> • Organized • Responsible • Uses appropriate terminology
Pit Crew (2+ students)	
<ul style="list-style-type: none"> • Creates safety and Robot functionality checklists throughout the build season, to be used at scrimmages and competition events. • Conducts thorough safety and Robot functionality checks regularly at all events. • 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. • Ensures that all materials and tools used for repair are accounted for and returned to the appropriate location after Game play. • Understands and uses safety precautions at all times in the pit. 	<ul style="list-style-type: none"> • Organized • Confident with use of all tools • Works well under pressure • Communicates calmly and effectively with Team members
Driver (2+ students and 1 backup driver)	
<ul style="list-style-type: none"> • Operates the Robot in competition using a hand-held remote control to “drive” or move a part of the Robot. <p>Note: 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"> • Positive attitude • Able to focus in loud, distracting environment • Attentive listener • Receptive to receiving input from Driver Coach • Dedication to practice time

Responsibilities	Traits
Driver Coach (1+ students) <ul style="list-style-type: none"> Encourages the student members of the Teams to collaborate on match strategy In Game play, watches for information from Referees and communicates with the drive Team Assists the drive Team in following the predetermined strategy or changing it, if necessary <p>Note: 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"> Calm Clear verbal communicator Understands Team strategy and Game rules
Speaking Representative (2+ students) <ul style="list-style-type: none"> Lead the group when talking to Judges, scouts, or guests in the Pit during competition. Promote FIRST Tech Challenge and their Team by speaking at community outreach events or Team demonstrations. Understand each Team member's role in order to direct more specific questions to those individuals when necessary. <p>Note: 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"> Confident Polite Good listener Professional manner Able to speak loudly and clearly over noise and distraction Understands and uses appropriate terminology Speaks clearly and concisely
Team Spirit (whole Team with 3+ student specialists) <ul style="list-style-type: none"> Helps to establish and promote Team identity and spirit. Helps to promote a positive attitude and Gracious Professionalism™ throughout the season and at Events. Thinks of ways for the Team and its supporters to show their spirit and personality at Events. Assists in the design of T-shirts or pins Writes cheers and invents unique ways to showcase Team spirit. Encourages the drive Team to do its best during Game play and cheers whether the Team wins or loses. 	<ul style="list-style-type: none"> Enthusiastic Creative Positive attitude Receptive to input from the Team regarding spirit ideas

Responsibilities	Traits
Documentation (whole Team with 2+ student specialists)	
<ul style="list-style-type: none"> Records and documents the Team's activities, actions, failures, and successes in the Engineering Notebook. Takes photos or video footage of build process and Events for use in marketing and outreach efforts. <p>Note: All Team members should contribute to documentation in some way, especially in the Engineering Notebook.</p>	<ul style="list-style-type: none"> Creative Written communication skills Visual presentation skills Detail-oriented Interested in layout and presentation
Marketing (1+ student)	
<ul style="list-style-type: none"> Designs and creates the Team logo. Assembles promotional materials to showcase Team capabilities. Visits Sponsors and potential Sponsors. Regularly updates parents and Sponsors about the Team's progress. 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). Contacts the local media, surrounding schools, or civic organizations to increase public awareness of the Team and how students benefit from the <i>FIRST</i> Tech Challenge experience. Creates and shares promotional materials with other Teams. 	<ul style="list-style-type: none"> Creative Outgoing Organized Resourceful Strong communication skills Professional manner
Fundraising (2+ students)	
<ul style="list-style-type: none"> Searches for unique and effective fundraising ideas. Recruits parents and other students to assist in the fundraising process. Monitors money and ensures that it is submitted on time. 	<ul style="list-style-type: none"> Responsible Innovative Detail-oriented Experience handling money
Recruitment (2+ students)	
<ul style="list-style-type: none"> Promote <i>FIRST</i> in school and local community Works to bring new and varied members to the Team 	<ul style="list-style-type: none"> Outgoing Personable Enthusiastic Professional manner Speaks clearly and concisely

Appendix G: Team Judging Session Self-Assessment

For Team use only – NOT to be handed in

Skill	Comments
Pre-Assessment (to be completed prior to the Judging Session)	
Team has prepared for the Judging session and has a plan for who will speak, when, etc.	What did the Team do well in preparing for the Judging Interview?
Team has held practice Judging sessions.	What is one thing the Team can focus on improving before the next Event?
Team has identified a goal for the Judging session.	
First Impression (to be completed AFTER the Judging Session)	
All members exhibited Gracious Professionalism through their language and behavior.	What did the Team do well at making a First Impression?
Team spirit was visible in dress, energy, materials, or preparedness.	What is one thing the Team can focus on improving in this area?
Used Judging session time efficiently and effectively.	
Team Dynamic (to be completed AFTER the Judging Session)	
Team shares the spotlight in Judging, inspection, Competition, and in the Pits by ensuring every member has a role and communicates this by words and actions.	What did the Team do well in Team Dynamic?
Team has a rapport that shows attention to Teambuilding and behaves as Gracious Professionals to each other.	What is one thing the Team can focus on improving in this area?
Speaking Skills (to be completed AFTER the Judging Session)	
Speakers spoke clearly and enunciated.	What did the Team do well in Speaking Skills?
Responded to Judges questions with thoughtful, thorough responses.	
“Is there anything else you want to share?” – Team prepared with a unique tidbit about the Team or the Robot.	What is one thing the Team can focus on improving in this area?
Presentation Skills (to be completed AFTER the Judging Session)	
Members made eye contact and maintained good posture when speaking to Judges, staff.	What did the Team do well in Presentation Skills?
Team materials were professional, clean, easy to read.	
If applicable, presentation was organized and well-rehearsed.	What is one thing the Team can focus on improving in this area?
Listening Skills (to be completed AFTER the Judging Session)	
Team understood the Judges questions or asked for clarification.	What did the Team do well in Listening Skills?
Team fully responded to the Judges questions.	
Team paused to allow for Judges follow-up questions.	What is one thing the Team can focus on improving in this area?
Content (to be completed AFTER the Judging Session)	
Team shared authentic stories, proud moments, and unique tidbits.	What did the Team do well in the Content of their Interview?
Team articulated how, as individuals and as a Team, they have grown and interacted with others during the season.	
Focused on what is unique about the Team.	What is one thing the Team can focus on improving in this area?
Team was able to show the breadth of their Team and how each member plays a key role.	
Overall Post-Assessment (to be completed AFTER the Judging Session)	
What are two Team Judging Interview strengths ?	1. 2.
What is one area the Team can focus on improving?	1.

Appendix H: Sample Resume

STUDENT NAME

Street Address, City, State Zip

Email Address

Phone Number

Education

Name of School
Street Address
City, State Zip

Dates of Attendance
GPA

Work Experience

Title, Name of Company, dates employed

- Bullet list of tasks or responsibilities, each starts with an active verb like: managed, developed, created, taught, designed, programmed, responsible for, or built. For example:
- Produced report on the impact FIRST Tech Challenge has on graduation rates in the local school system.



Only include sections that apply to your experiences. Do not list items twice, even if it applies to more than one category. Include a mix of experiences that show your diversity of interests and skills. Keep your resume content to one page (pick only the key items) and use .5-1" margins.

Computer Skills

Single line list of skills, or separate by skill levels: proficient, knowledge of, capable. If you only have basic knowledge, probably best not to include. For example:

Proficient in programming using Java, 3D design using PTC Creo, and Adobe Publisher.

Languages

Single line list of languages mastered if you speak more than one, or separate lists by proficiency: fluent in, conversational, etc. If you only have basic knowledge, probably best not to include. For example:

Fluent in English and Mandarin.

Travel Experience

Single line list of countries and year traveled if it is part of the job description, contributes to the diversity of your skillset, or demonstrates mastery in language(s) as listed above). For example:

Three months in China (2010), week-long vacations to: Italy (2013), Puerto Rico (2014), and Australia (2015).

Involvements

- Bullet list of activities such as clubs, sports, organizations, dates participated, reverse chronological order, title (if applicable). For example:
- FIRST Tech Challenge Team #0001, RoboHornets, Mad River High School, 2015-present.
- Drama Club, Mad River High School, 2013-2015, Fundraising Chair.
- Varsity Basketball, Mad River High School, 2012-present.

Community Involvement

- Bullet list of activities such as community service or outreach, dates participated, role held, reverse chronological order. For example:

Presentations

- Bullet list of activities, dates participated, reverse chronological order. For example:

Hobbies

Single line list of activities you enjoy doing in your spare time, not related to school or any of the activities you already listed. Use this as a chance to show a wider range of skills, especially if your entire resume so far is robots, robots, robots. No need to be the best at it! For example:

Kayaking, swimming, and playing saxophone.

REFERENCES

Reference Name

Title
Company
Street Address
City, State Zip
Phone
Email address
Relationship to you



References should be listed on its own page. You should have 3 minimum, 5 maximum. Include a mix of folks who have worked with you a variety of capacities and who can speak positively about you. Include a teacher, your robotics

Jessica Walker

Computer Programmer
Red Apple Corporation
200 Bedford Street
Manchester, NH 03101
jessicawalker@redapple.com
(123) 456-7890

FIRST Tech Challenge Team Mentor

Appendix I: Engineering Notebook Samples

Show the samples below to the Team ([more online!](#)). Talk about what makes the sample a strong Notebook and how it could be improved. Brainstorm a plan for how to capture your Team's experience in their Notebook. The following examples have notations pointing out key elements of the examples that are successful.

got robot? FTC 5037 Engineering Notebook — Cascade Effect

9.16.14 PROTO-STORM!!

Duration 6:00 pm - 8:00 pm

Attendance:

Bo, Chris, Matthew, Aidan, PJ, Kristen, Marcos, Coach, Programming Coach Stephen, Mrs. Laker, Mrs. McKellar, Mr. Solomon

Tasks:

1. Plan ideas for a practice "sparring" robot that we would use as an "opponent" for the rest of the season.
2. Brainstorm ideas for ways of picking up and scoring balls
3. Put the ideas presented into CAD so they can be tested virtually.
4. Brainstorm new ideas for our robot.

Reflections:

1. Aidan was tasked with developing the sparring bot, a robot which we will use for training during driving practice. (See details.)
2. Matt, Marcos, Kristen, PJ, Coach, and Mr. Stephen spent time generating ideas for ways that our competition robot could pick up balls and deploy them. (See details.)
3. Bo and Chris would work on getting the ideas that are presented into CAD. (See details.)
4. The two major discussion points involved the construction and requirements of the drivetrain, and ball transfer devices. Possible drivetrains included the likes of swerve and holonomic, while the ball mechanisms discussion included inertial kickers, slides, and conveyors. (See details.)

Clearly states tasks and team reflections



Reviewed: _____

5

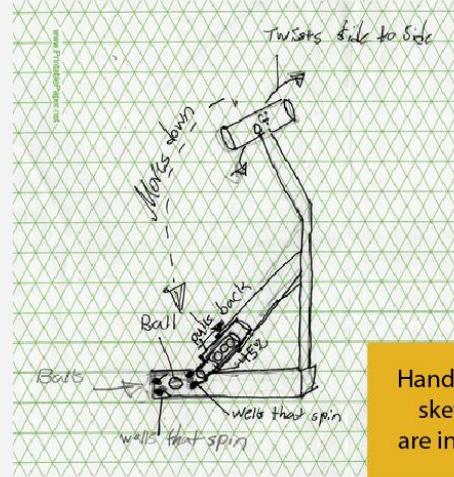
got robot? FTC 5037 Engineering Notebook — Cascade Effect

Details:

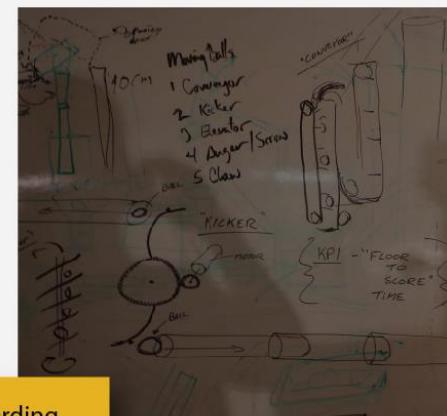
1. My current idea is to make a sparring bot with a telescoping lift that has a scoop/tube attached at the top. This tube will have a pivot in the middle. There will be a scoop with a zip-tie intake in the front and behind the scoop at the opposite side of the tube will be an opening hatch. In order to pickup balls the lift will lower all the way while the tube moves on its pivot to become parallel with the ground, allowing balls to enter through the zip-tie intake. Once the pipe is full the lift would raise and the pipe would become vertical. To score, the robot would move its lift/tube to roll the balls into a rolling goal we would have attached on the back. This goal would not be released so we could continue scoring easily. --AMP

2. During our brainstorming section for the robot's intake/delivery multiple ideas were presented.

- a. I thought of a 2 part delivery mechanism.



Hand-drawn sketches
are included



Recording
ideas for
possible design

Delivery Mechanism:

My idea entails a pipe and an arm with 2-3 claws mounted at the end. The illustration to the left shows how these components go together. At the bottom is a square frame/base, which the drawer slide is mounted to, on the front. The top of the slide has two straight bars that make up an arm connecting the slide system to a horizontal 'pipe' at the very top. This 'pipe' will be able to hold 5 balls total. Through the slide changing elevation the arm and thus the pipe will move as desired. This mechanism will have 4 preset movement capabilities:

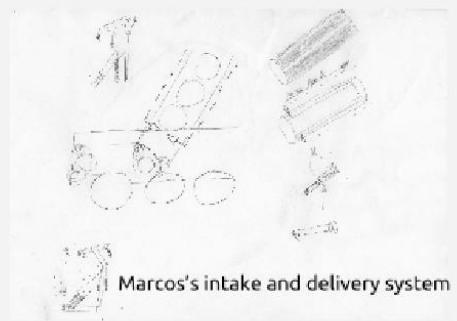
- Pipe end facing ground at 45° from vertical
- Wrist will rotate left/right
- Arm shoulder rotates up/down so that the arm rises
- Pipe end facing ground at 45° from vertical on either side

Reviewed: _____

got robot? FTC 5037 Engineering Notebook — Cascade Effect

Intake System:

In my design the pipe is connected at 45° to the base. This pipe has three slits in it. Overall there are two pipes: an intake system/pipe, which is smaller, and the delivery system/pipe, which is larger. The downward position will be at a 45 degree angle. When grabbing balls the delivery pipe will interlock with the intake pipe. Once locked the delivery system will retract the attached claws and will connect with the slots in the intake system. Interlocked the delivery system will pull back. When all is done the systems will release and the intake will rise to the delivery positions. -MM Ms



Marcos's intake and delivery system

Initial entries.

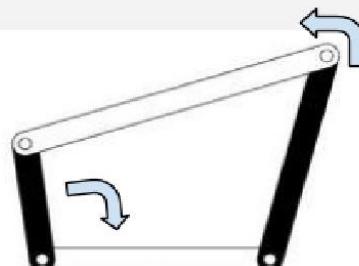
Include photos of prototypes as well as detailed explanations.

- b. While prototyping ideas I developed a closeable scoop to drive up to the balls then close the top half of the scoop bucket to trap a ball. The scoop would be mounted on a longer jointed arm to reach up, then open the upper scoop to drop the balls in the rolling goal. I used Tetrix parts, cardboard, and masking tape to create a prototype to show my idea to the team.

-K McK



3. Chris and I worked on making a 4 bar linkage that we could combine with Kristen's pipe and arm idea so the tube could easily be lifted off the floor. We tested out our idea in SolidWorks and it worked quite well!
-Bo



Reviewed: _____

7

got robot? FTC 5037 Engineering Notebook — Cascade Effect

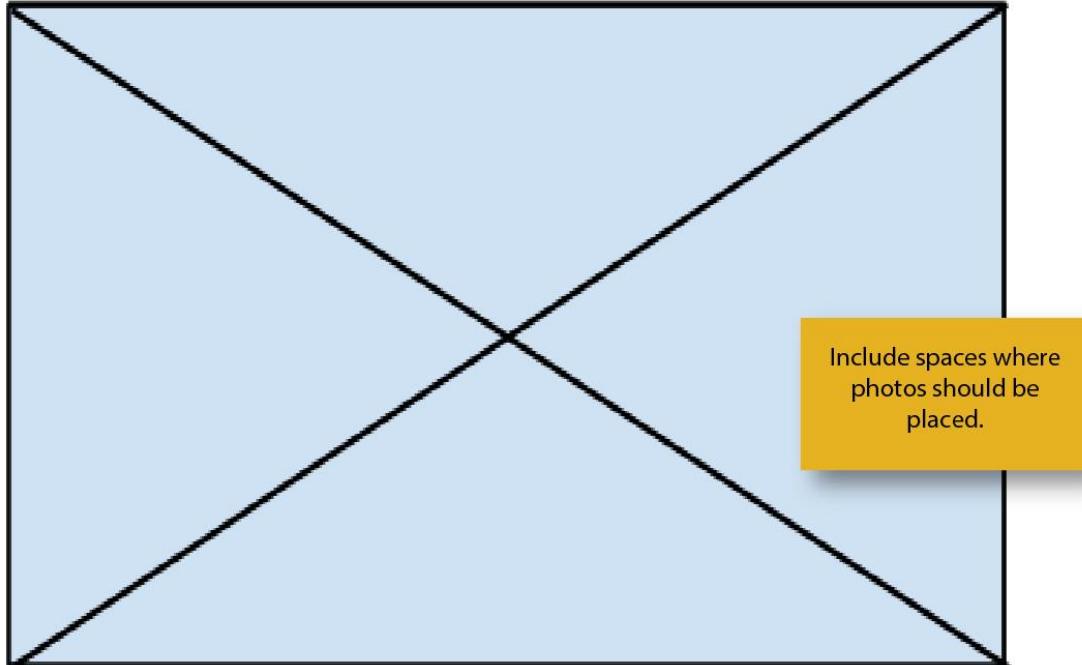
4. During the discussion with the team it became readily apparent that some form of omnidirectional drive train would be advantageous for our scoring ability. This drive would allow us diagonal and horizontal movement across the field. Having already implemented a functioning holonomic drive on our Ring It Up robot, we plan on using it as a platform in pursuit of testing holonomic drive platforms in general. Some capabilities we need to test include:

driving uphill, pushing, and autonomous accuracy

As per mission operandi, the inability for mecanum wheels to effectively move diagonal eliminates them as a drive platform, leaving us with the more exotic options to explore.

Among the more interesting discussed drive platforms are spindle and swerve. Swerve drive as a platform may offer us a significant boon to both autonomous accuracy and defensive driving, allowing us to essentially lock in a direction and go.

Methods of powertrain were discussed. The two most viable options for swerve at the moment seem to be a short length of speedometer cable between the motor and the wheel, and 22.5° bevel gears, with one pair integrated into the drive wheel. - Matthew



Number each page.

Reviewed: _____

Appendix J: Types of FIRST® Tech Challenge Events

There are many types of FIRST Tech Challenge Events. Some Events are “Official”, meaning that they are a part of the advancement structure for the FIRST Tech Challenge. “Endorsed” means that the Event is not a part of the advancement structure for FIRST Tech Challenge, but the Event is hosted by or sanctioned by an Affiliate Partner or FIRST Headquarters. Other Events are “Unofficial” and could be hosted by anyone with an interest. Official and Endorsed Event information provided by the Affiliate Partners is promoted on the FIRST website and via the @FTCTeams social media accounts. Unofficial Events are not promoted by FIRST or the FIRST Tech Challenge Headquarters.

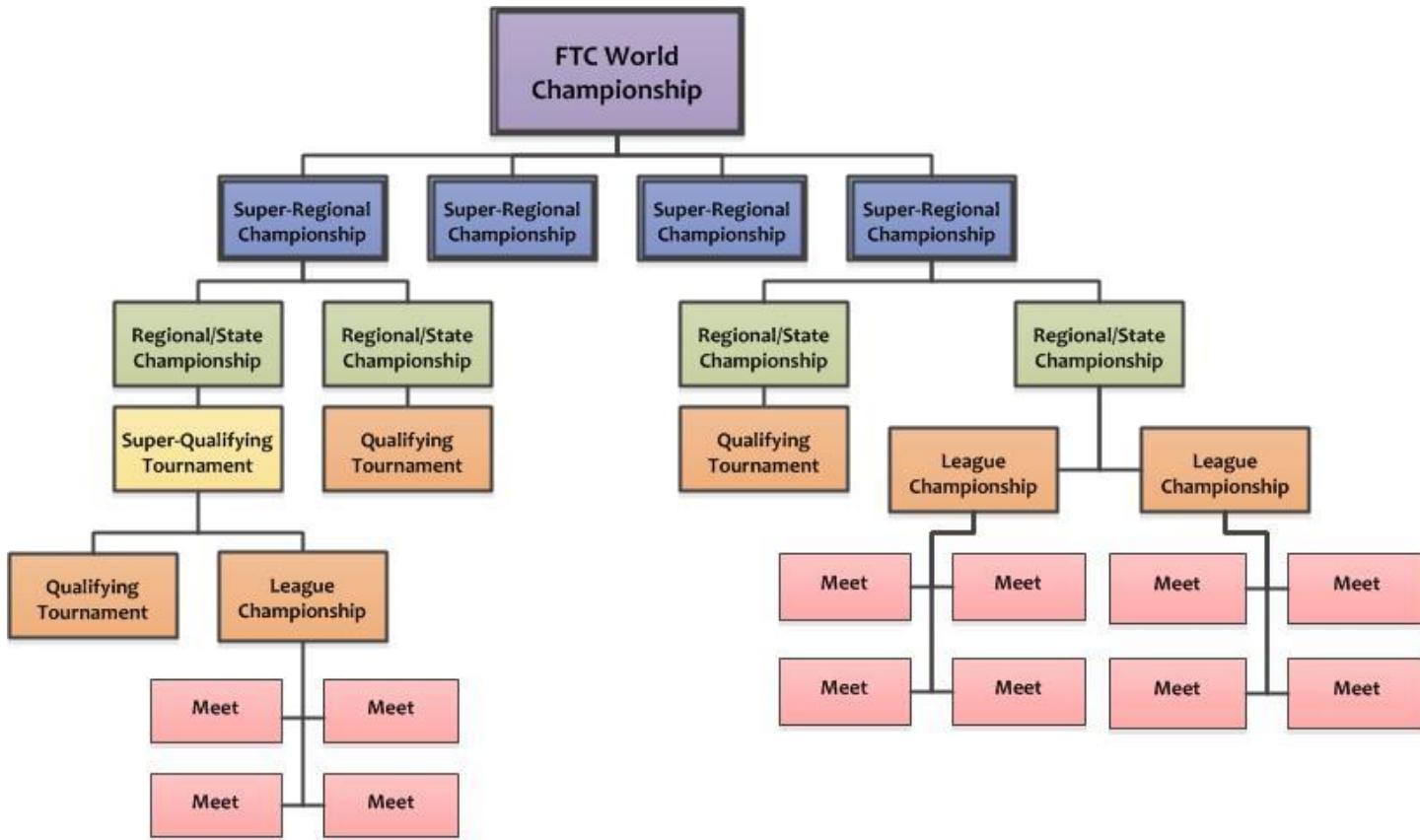
Unofficial or Endorsed Events

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

Official Events

- FIRST Tech Challenge Partners and Volunteers plan, coordinate, and run the Competitions.
- Most events have opening and closing ceremonies, trophies and/or medals, Teams with personalized T-shirts, hats, banners, and even some costumes. One major exception are League Meets which have a different set of standards for what they can and must include.
- Teams are recognized for excellence in various aspects of the Challenge and associated Teamwork.
- Event types vary from region to region. Some regions participate in Leagues, while others do not. Some regions will have Super-Qualifiers, while others do not. The Advancement Structure chart below will demonstrate the various possibilities for Advancement depending on the region.
- The Advancement Structure does require Teams to win at a Qualifying, Super-Qualifying, or League Championship in order to advance to a state or regional Championship (see chart below).

Advancement Structure



Event Descriptions

Type of Event	Description of Event
Leagues Meets	<ul style="list-style-type: none"> If your region has chosen to participate in the League 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 the League program and events in your region, please contact your local Affiliate Partner.
League Championship	<ul style="list-style-type: none"> If your region has chosen to participate in the League 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 the League program and events in your region, please contact your local Affiliate Partner.
Qualifying Tournaments	<ul style="list-style-type: none"> These events usually follow judging guidelines and a similar format to Championship Tournaments, but have some flexibility in format and Awards. There may be anywhere from one to twelve winning Teams from these Tournaments advancing to a region's Championship Tournament.

Type of Event	Description of Event
Super-Qualifying Tournament	<ul style="list-style-type: none"> If your region has chosen to use Super-Qualifiers in the regional Tournament structure, some of the standard Tournament and Championship guidelines may be modified. For information about the scheduling, structure, advancement and processes that are unique to the Super-Qualifier program and events in your region, please contact your local Affiliate Partner.
Regional Championship Tournament	<ul style="list-style-type: none"> For many Teams and regions, a Championship Tournament is the highest level of <i>FIRST</i> Tech Challenge Tournament participation. Championships may include Teams from a geographic region, province, state, country, or several countries. Teams in the U.S. will advance from Regional Championship Tournaments to Super-Regional Tournaments based on the advancement criteria outlined in the Game Manual Part I. These Tournaments abide by specific standards in format, judging, Awards, and overall quality. The key Volunteers responsible for a Championship Tournament are usually <i>FIRST</i> Tech Challenge Affiliate Partners. 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.
Super-Regional Championship Tournament	<ul style="list-style-type: none"> U.S. Teams have the opportunity to compete in an additional level of Championship play Four Super-Regional Championship Events will be held, and hosted, by an <i>FIRST</i> Tech Challenge Affiliate Partner Super-Regional Championship Tournaments abide by certain standards in format, judging, Awards, and overall quality Teams advance from their Super-Regional Championship to the <i>FIRST</i> Tech Challenge World Championship <p>Note: Check out the FIRST Tech Challenge Super-Regional webpage to learn more about the season's Super-Regional Championship Tournaments.</p>
<i>FIRST</i> Sponsored <i>FIRST</i> Tech Challenge World Championship Tournament	<ul style="list-style-type: none"> The <i>FIRST</i> sponsored <i>FIRST</i> Tech Challenge World Championship event, held in conjunction with the <i>FIRST</i> Championship, <i>FIRST</i> LEGO® League World Festival, and <i>FIRST</i> LEGO® League World Expo, is a global celebration of <i>FIRST</i> Tech Challenge Teams from around the world. The selection process for the World Championship event may change from year to year, depending upon the number of spaces available and the number of Teams participating in <i>FIRST</i> Tech Challenge. (U.S. Only) Only Teams who have earned advancement from a Super-Regional Championship Tournament are invited to the <i>FIRST</i> Tech Challenge World Championship. <p>Note: Check out the World Championship webpage to learn more about the upcoming Event and find previous World Championship results.</p>

Appendix K: A FIRST® Tech Challenge Mentor Reflects: Competing in FIRST Tech Challenge

By Brian Johnson, Mentor of Team 4625, Kings and Queens, May 2014

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 Kamen, 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 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 FIRST Tech Challenge World 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 FIRST LEGO League 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 FIRST Robotics Competition and FIRST LEGO League in competition, the FIRST LEGO League Jr. 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 FIRST Tech Challenge see the "big" robots. FIRST Robotics Competition students coming over to FIRST Tech Challenge 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.

Appendix L: What to Expect at Events

What Happens	What Teams Can Expect at a Tournament
Arrival at the venue	<ul style="list-style-type: none"> • Arrive and enter the venue. • Unpack the Robot and supporting materials. <p>Notes:</p> <ul style="list-style-type: none"> • 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. • Make sure to arrive at the earliest allowed time. This provides wiggle room to recover if any problems arise.
Registration at the Registration Area	<ul style="list-style-type: none"> • Check in. • Hand in all registration forms. • Submit the Engineering Notebook. • 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. <p>Note: To make the process smooth and to reduce the wait, keep all forms organized and ready for registration upon arrival.</p>
Setup in the Pit	<ul style="list-style-type: none"> • Go to pit area and locate the Team's pit space by finding a sign with the Team number on it. • Unpack the Robot and laptop. • Immediately check to make sure the Robot is in running order, in case it was damaged during travel. • Decorate the pit area. <p>Notes:</p> <ul style="list-style-type: none"> • Wear safety glasses and close-toed shoes at all times here. • There will typically be a power cord in the area to charge batteries, laptops, etc.

What Happens	What Teams Can Expect at a Tournament
Robot and Field Inspection in the Judging Room or the Pit (varies)	<ul style="list-style-type: none"> As soon as Robot is up and running, get in line for Robot and Field inspection, 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. When a Robot has passed inspection, the Team will receive a sticker or another marker for the Robot. If a Robot does not pass inspection, do not panic. Calmly correct the problem and get back into line as soon as possible. <p>Notes:</p> <ul style="list-style-type: none"> 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. Make sure that last-minute Robot modifications do not bring the Robot out of compliance. 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.
Judging in the Judging Room	<ul style="list-style-type: none"> This may be a part of, or separate from, inspections. Judging can take place at any time during the early part of the Tournament. 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. A timekeeper typically ensures that sessions remain on schedule. <p>Notes:</p> <ul style="list-style-type: none"> To keep the schedule on target throughout the event, Teams should arrive five minutes before their scheduled judging appointment. All Team members should attend and be ready to speak. Mentors may attend, but are not allowed to speak.

Opening Ceremony in the Competition Areas (location varies)	<ul style="list-style-type: none"> • This is a high-energy event that sets the tone for the day. • Judging and inspections may not be finished when this happens. They will usually be put on hold so that everyone can attend the ceremony. • There will usually be a brief speech from the Tournament organizers or invited guests. • Judges and special guests are introduced. • The Challenge and scoring are explained. • The National anthem is often performed. • 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. <p>Note: 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>
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What Happens	What Teams Can Expect at a Tournament
Practice Rounds on the Practice Playing Field (if available)	<ul style="list-style-type: none"> • This phase does not always happen. • Sometimes only Teams that have completed inspections can play in them. • These are a good opportunity to find out how slightly different Field conditions or lighting conditions can affect the Robot's performance.
Driver Meetings in the Competition Area (location varies)	<ul style="list-style-type: none"> • These meetings usually take place after the opening ceremony. • Drivers on a Team will receive a briefing from Tournament directors and often the Referees. <p>Note: 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>
Qualifying Rounds in the Competition Area	<ul style="list-style-type: none"> • Match Schedules are not generated and distributed until every expected Team has checked in and has passed inspection. • There are usually 4-5 qualifying rounds. • Teams will be paired with a random partner Robot and face randomly-paired opponents. • The purpose of these rounds is to identify the top few Teams, who will become captain Teams for the elimination rounds later.
Alliance Selection	<ul style="list-style-type: none"> • After all qualifier rounds have been completed, the Teams are ranked in “seed order.” • The top few Teams (usually 4 per division) become “captain Teams.” • The captain Teams select partner Robots (Alliances) for the elimination rounds.

Elimination Rounds in the Competition Area	<ul style="list-style-type: none"> • Alliances now face each other. • The first seed Alliance faces the fourth seed, and the second seed faces the third seed in the semi-finals. • Teams play for the best two out of three Games, with the losing Alliance being eliminated. • The two winning Alliances in the semi-finals then face each other in the finals, again in a best two of three Games format. <p>Note: In large Tournaments, there may be two divisions and the winners of each division would then face each other in a grand finale.</p>
Awards and Closing Ceremony in the Competition Area (location varies)	<ul style="list-style-type: none"> • Teams should return to the main competition area for the closing ceremony. • Immediately after the final (or grand finale, if there are two divisions) is complete, an Awards ceremony is held. • Teams receive Awards, medals, and recognition for demonstrated efforts. • There will be plenty of cheering, loud music, and a sea of smiling faces to end the Tournament and celebrate the students' accomplishments.

Appendix M: FIRSTTech Challenge Awards Categories

Inspire Award

This judged award is given to the Team that truly embodied the ‘challenge’ of the *FIRST* Tech Challenge program. The Team that receives this award is a strong ambassador for *FIRST* programs and a role model *FIRST* Tech Challenge Team. This Team is a top contender for many other judged awards and is a gracious competitor. The Inspire Award winner is an inspiration to other *Teams*, acting with *Gracious Professionalism*® both on and off the Playing Field. This Team is able to communicate their experiences, enthusiasm and knowledge to other Teams, sponsors, their community, and the Judges. Working as a unit, this Team will have demonstrated success in accomplishing the task of designing and building a Robot.

Required criteria for the Inspire Award:

- Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a *FIRST* Tech Challenge Event.
- Team is a strong contender for several other Judged awards. The Inspire Award celebrates the strongest qualities of all the Judged Awards.
- The Team is an ambassador for *FIRST* programs and demonstrates and documents their work in their community.
- Team dynamic is positive and inclusive, and each *Team* member contributes to the success of the Team.
- 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 be high quality, thoughtful, thorough, detailed and well organized.
- Robot design is creative and innovative, and the Robot performs reliably on the field. Team communicates clearly about their Robot design and strategy to the judges.
- Team presentation is professional and engaging.

Think Award

Removing engineering obstacles through creative thinking.

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 Section must focus on the design and build stage of the Team’s Robot. Journal entries must include those describing the underlying science and mathematics of the Robot design and game strategies, the designs, re-designs, successes, and opportunities for improvement. A Team is not a candidate for this award if they have not completed the Engineering Section of the Engineering Notebook.

Required criteria for the Think Award:

- Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a *FIRST* Tech Challenge Event.
- Engineering Notebook must have an Engineering Section that includes entries describing underlying science, mathematics, and game strategies.

- **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.**
- **Notebook must recount the Team's journey, experience and lessons learned throughout the season.**

Strongly suggested criteria for the Think Award:

- Teams should tab/flag 6 to 8 pages of the Engineering Section to support entries on the summary page.
- Engineering Notebook should be organized and follow the formatting guidelines provided by FIRST and include a Summary Page. Note: Teams should review the Engineering Notebook section of this manual for a complete description and format specifications.

Connect Award

Connecting the dots between community, FIRST, and the diversity of the engineering world.

This judged award is given to the Team that most connects with their local science, technology, engineering and math (STEM) community. A true FIRST Team is more than a sum of its parts, and recognizes that engaging their local STEM community plays an essential part in their success. The recipient of this award is recognized for helping the community understand FIRST, the FIRST Tech Challenge, and the Team itself. The Team that wins the Connect Award aggressively seeks engineers and explores the opportunities available in the world of engineering, science and technology. This Team has a clear Business or Strategic Plan and has identified steps to achieve their goals.

Required criteria for the Connect Award:

- **Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a FIRST Tech Challenge Event.**
- **An Engineering Notebook must be submitted and must include 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, outreach, and community service goals.**
- **Team provides clear examples of developing in person or virtual connections with individuals in the engineering, science, or technology community.**
- **Team actively engages with the engineering community to help them understand FIRST, the FIRST Tech Challenge, and the Team itself.**

Rockwell Collins Innovate Award

Bringing great ideas from concept to reality.

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 *FIRST* Tech Challenge 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.

Required criteria for the Rockwell Collins Innovate Award:

- **Team must demonstrate respect and *Gracious Professionalism*® towards everyone they encounter at a *FIRST* Tech Challenge Event.**
- **Team must submit an Engineering Notebook with an Engineering Section that documents the design process and how the Team arrived at their design solution.**
- **Robot or Robot sub-assembly must be elegant and unique in its design.**
- **Creative component must be stable, robust, and work reliably.**
- **Robot design is efficient and consistent with Team plan and strategy.**

PTC Design Award

Industrial design at its best.

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 Robot 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 *FIRST* Tech Challenge student Teams for these software products to help them with their designs.

Required criteria for the PTC Design Award:

- **Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a *FIRST* Tech Challenge Event.**
- **Team must submit an Engineering Notebook with an Engineering Section that includes detailed Robot design drawings.**
- **Team demonstrates industrial design principles, striking a balance between form, function, and aesthetics.**
- **Robot differentiates itself from others by its aesthetic and functional design.**
- **Basis for the design is well considered (i.e. inspiration, function, etc.).**
- **Use of PTC’s Creo is not required to be eligible; however, Teams that use them in their design are given extra consideration for this award.**

Motivate Award

Spark others to embrace the culture of *FIRST*!

This Team embraces the culture of *FIRST* and clearly demonstrates what it means to be a Team. This judged award celebrates the Team that exemplifies the essence of the *FIRST* Tech Challenge competition through Team building, Team spirit and exhibited enthusiasm. This is a Team who makes a collective effort to make *FIRST* known throughout their school and community, and sparks others to embrace the culture of *FIRST*.

Required criteria for the Motivate Award:

- Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a FIRST Tech Challenge Event.
- An Engineering Notebook must be submitted and must include 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, outreach, and community service goals.
- The Team is an ambassador for FIRST programs.
- Team can clearly demonstrate the successful recruitment of new Teams, mentors, coaches and volunteers who are not otherwise active within the STEM community.
- Team can articulate the individual contributions of each Team member, and how these attribute to the overall success of the Team.

Strongly suggested criteria for the Motivate Award:

- All Team members participate in their presentation, and actively engage with the judges.
- Team shows a creative approach to materials that market the Team and FIRST.

Control Award

Mastering Robot intelligence.

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 must contain details about the implementation of the software, sensors, and mechanical control.

Required criteria for the Control Award:

- Team must demonstrate respect and *Gracious Professionalism*® toward everyone they encounter at a FIRST Tech Challenge Event.
- Team must apply for the Control Award by filling out the Control Award Content Sheet, located in Appendix D of the Game Manual Part 1 (will be released 9/10/2016).
- The Engineering Notebook must include an Engineering Section that documents the control components.
- Control Components must enhance the functionality of the Robot on the Playing Field.

Strongly suggested criteria for the Control Award:

- Advanced software techniques and algorithms are encouraged.
- Control Components should work reliably.

Promote Award (Optional)

This judged award is optional and may not be given at all Tournaments. Please contact your Tournament director 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. Teams must submit a one-minute long public service announcement (PSA) video based on the PSA subject for the season.

Teams may win the Promote Award only once at a Championship level Event and only once at a qualifying level Event.

PSA Subject for 2016 – 2017 Season:

“This is how I plan to pay *FIRST* forward...”

Required criteria for the Promote Award:

- **Video must meet the following criteria:**
 - **Video cannot be longer than 60 seconds.**
 - **Video must be of a high quality, as submissions may be used at a later time to promote *FIRST*.**
 - **Team must have rights to music used in the video.**
 - **Video must have strong production value.**
 - **Video must be submitted by the designated deadline.**
- **Team must present a thoughtful and impactful video which appeals to the general public.**
- **Creativity in interpreting the annually assigned theme is required.**
- **Follow video award submission guidelines in Game Manual Part 1.**

Compass Award (Optional)

A beacon and leader in the journey of the *FIRST* Tech Challenge.

The Compass Award recognizes an adult Coach or Mentor who has provided outstanding guidance and support for a Team throughout the year, and demonstrates to the Team what it means to be a Gracious Professional. The winner of the Compass Award will be determined from candidates nominated by *FIRST* Tech Challenge Team members, via a 40-60 second video submission, highlighting how their Mentor has helped them become an inspirational Team. We want to hear what sets the Mentor apart.

Required criteria for the Compass Award:

- **Video must meet the following criteria:**
 - **Video cannot be longer than 60 seconds.**
 - **Video must be of a high quality, as submissions may be used at a later time to promote *FIRST*.**
 - **Team must have rights to music used in the video.**
 - **Video must be submitted by the designated deadline.**
- **Video highlights the mentor’s contribution to the Team and demonstrates what sets the mentor apart.**
- **Follow video award submission guidelines in Game Manual Part 1.**

Judges’ Award

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, *FIRST* offers a customizable Judges Award. The judging panel may select a

Team to be honored, as well as the name of the Judges' Award. The Judges Award recognizes a Team for their outstanding efforts, but does not factor into the Advancement Criteria.

Winning Alliance Award

This award will be given to the winning alliance represented in the final Match.

Finalist Alliance Award

This award will be given to the finalist alliance represented in the final Match.

Appendix N: Sample Business Plan

What is it?

A Strategic Plan or Business Plan is documentation of the process through which an organization defines priorities and develops the process they will undergo to achieve their goals. It helps the organization (in this case, your Team) determine a course of action and a measure by which to make decisions about how they will gather and use resources. That information can then be shared within the Team to keep everyone focused, as well as outside of the Team, such as with parents, school administrators, Sponsors, and other groups to articulate the Team's purpose and impact.

How to Write It

Forbes recommends a five step approach to developing your strategic plan:

Determine the current status of the team – being honest, assess the current state of the Team. Are you a Rookie Team? Are you a five-year Veteran Team with more than half the Team brand new to FIRST Tech Challenge? Whether Rookie or Veteran, brainstorm the following: what do you know, what do you need, and what are your season goals?

Identify What Is Important – after you brainstorm a list of goals for the season, narrow it down to one to three that are manageable within this one season. Identify which ones can be achieved the following or later seasons.

Define What You Must Achieve – With your goals in mind, determine what you need to do to accomplish those goals. Don't forget that you also need to build a Robot, compete with it, fundraise, and keep an Engineering Notebook, at the very least. Your goals and the steps needed will be in addition to or work with these tasks.

Determine Who Is Accountable – this is where it will be good to identify Team Roles and the role of the Mentors in supporting Team members at accomplishing the goals.

Review – review the plan once it is written. Refer back to it whenever making a big Team decision, and do a thorough review at the end of each season/before the next season.

Additional Resources

FIRST Tech Challenge Fundraising Resources – A variety of resources and examples, including:

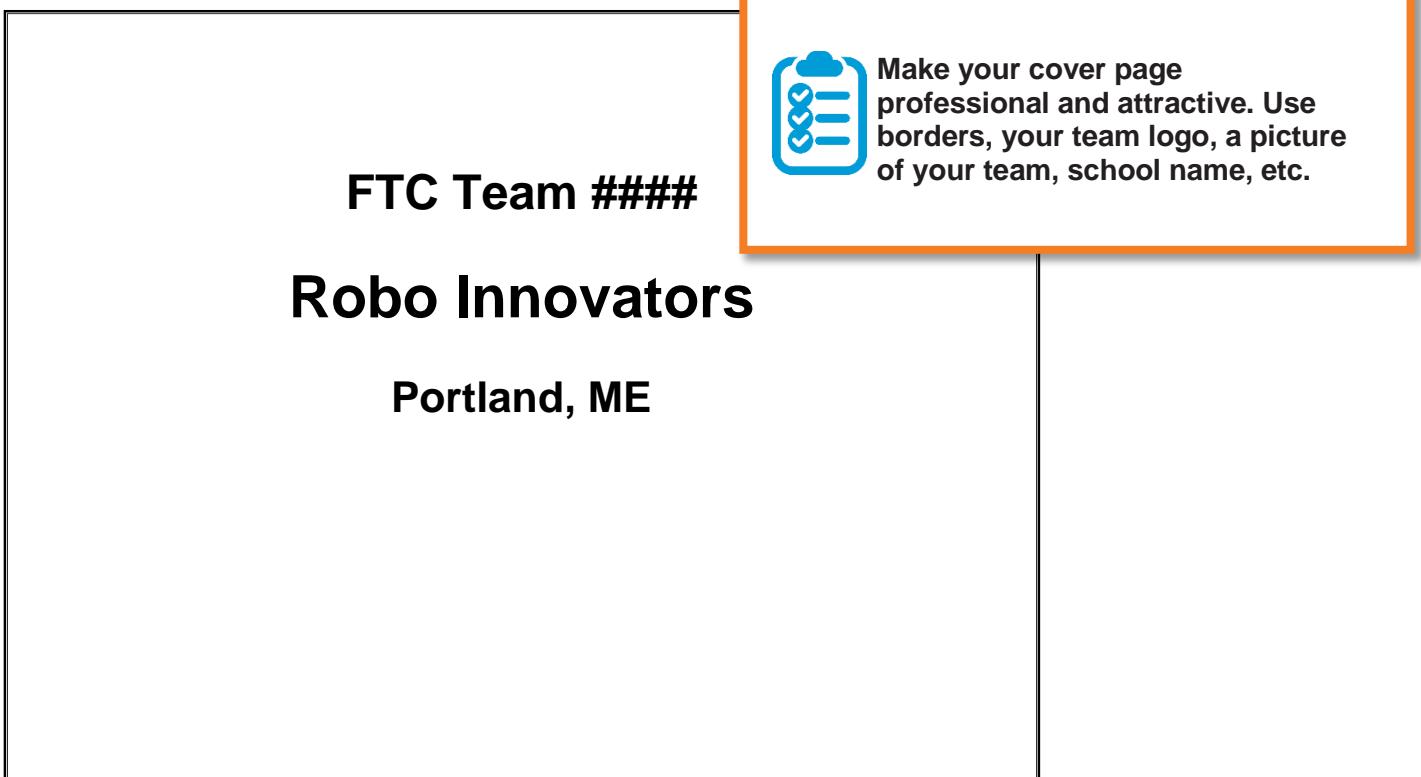
- Business Plan Webinar

FIRST Tech Challenge Team #5096 Monkey Madness Business Plan – just one of many examples on the web.

Sample Strategic/Business Plan

The following is a plan crafted for a fictional Team. Download the Word version and you can input your Team's information.

Cover Page



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- 1.3 Program Summary
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2.0 Team Impact and Goals

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- 3.1 Team Action/Implementation Plan
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4.0 Outreach and Recognition

- 4.1 Outreach
- 4.2 Recognition

5.0 Resources

1.0 Executive Summary

1.1 Team Mission Statement

To inspire ourselves and others to develop a life-long love of learning and engagement in our community by building a strong team that is known and respected throughout Portland and beyond.

1.2 FIRST Description

The mission of *FIRST* is to inspire young people to be science and technology leaders, by engaging them in exciting mentor-based programs that build science, engineering and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership.

FIRST was founded in 1989 to inspire young people's interest and participation in science and technology. Based in Manchester, NH, the 501 (c) (3) not-for-profit public charity designs accessible, innovative programs that motivate young people to pursue education and career opportunities in science, technology, engineering, and math, while building self-confidence, knowledge, and life skills.

1.3 Program Summary

FIRST Tech Challenge is designed for students in grades 7-12 to compete head to head, using a sports model. Teams are responsible for designing, building, and programming their robots to compete in an alliance format against other teams. The robot kit is reusable from year-to-year and is programmed using a variety of languages. Teams, including coaches, mentors and volunteers, are required to develop strategy and build robots based on sound engineering principles. Awards are given for the competition as well as for community outreach, design, and other real-world accomplishments.

1.4 Team Origin, Description, and History

The Robo Innovators began in 2012 as an afterschool program for four girls very interested in learning about robotics. Eager to share the experience, once the Team was registered with *FIRST* Tech Challenge, they opened the team up to interested parties and the team quickly grew to twelve. Team Mentors included two parents and the high school physics teacher. Currently the team has 15 members from grades 7-12, both boys and girls.

In 2013 the Team attended the Massachusetts State Championship and the robot had a good showing on the field. They were honored with a nomination for the Motivate Award.

In 2014 the Team again attended the Massachusetts State Championship. The team won the Think Award and the robot was selected to be part of a Semi-Final Alliance.

1.5 Team Organizational Structure

The Team is managed by the physics teacher and a parent volunteer. In addition, there are three technical Mentors from local businesses who coach the students on engineering principles, computer programming, and construction. Team members take on the responsibility of managing the Team, deciding roles, and completing project tasks, including fundraising.

1.6 Team Relationships

2014 Sponsors: Swell Middle High School, Eden Electrical Corp, and Wilson's Metalworking.

Swell Middle High School provides funding for all after school clubs and organizations. In addition, they allow the team to use a school computer, space in the shop to store the robot, to work on the robot, and use of the shop tools.

Eden Electrical Corp provides two Mentors and annual funding for the Robot materials.

Wilson's Metalworking also provides Mentor support and funding in the amount of \$600 annually.

2.0 Team Impact and Goals

2.1 Team Use of Resources

Robo Innovators have taken their robot to local events, providing information about the program, team, and inviting guests to touch or drive the robot.

2.2 Team Future Plans

In 2015 the team plans to start a second *FIRST* Tech Challenge team to allow more students access to the creative process of building a robot and the rewarding experience of being on a team. In addition, the team is planning to run a summer robo camp for children ages 6 – 12 to encourage more students to get involved in robotics at a young age.

3.0 Sustainability

3.1 Team Action/Implementation Plan

The team has identified the following actions for growth and sustainability:

Strategy	Actions	Responsibility	Planned Completion
Transition six team members into a leadership/mentoring role to support the new team	<ul style="list-style-type: none"> • Develop a leadership training program • Select and develop team members to transition to a mentoring role for the new team. 	Team Mentors	January 2015
Prepare the team to transition to Java	<ul style="list-style-type: none"> • Develop training materials to teach the team Java programming language 	Technical Mentors	June 2015
Raise funds to support the start of a new team and Robo Camp initiative	<ul style="list-style-type: none"> • Craft amended budget • Strategize a fundraising plan • Identify and implement one large fundraiser • Identify and implement a small, long-term fundraiser 	Fundraising Committee	March 2015
Robo Camp	<ul style="list-style-type: none"> • Develop budget • Develop Marketing plan to recruit campers • Outline schedule for the camp. 	Outreach Committee Mentors	January 2015
Identify six sub-committee members to become Leadership ?committee members by the end of the season.	<ul style="list-style-type: none"> • Identify six members • Develop targeted training to prepare them for the roles 	Leadership Committee	April 2015

3.2 Team Financial Statement

Item	Budget Amt.	Actual Cost	Category	Rationale/Explanation
Expenses				
Registration	275.00		Registration	Season registration fee (required).
Parts & Supplies	700.00		Robot Supplies	Annual parts and new technology
Kit of Parts	1500.00		Robot Supplies	For the new team
Sub-Total	2475.00			Projected total expenses for the 20XX season.
Monies				
Rollover Amount	1700.00			Money left over from the previous season
School Allocated Club Funds	425.00		Income	Annual amount
Wilson's Metalworking	600.00		Income	Annual sponsorship amount
Eden Electrical Corp	500.00		Income	Annual sponsorship amount
Car Wash	300.00		Fundraiser	Planned team fundraiser with ideal amount raised.
Sub-Total	3525.00			Anticipated amount of money coming in throughout the season. Actual amount may be lower/higher, but it's best to over-plan ways to raise money.
Bottom Line				
Credit/Deficit	1050.00			Current money still left/ Money owed that still needs to be raised (marked in red)

3.3 Team Fundraising Opportunities

Fundraiser Idea	Projected Income		Category	Notes
Pizza & Dodgeball Fundraiser	500.00		Fundraiser	One large event, and if the pizzas are donated, we could potentially double our profit.
Shirt Sales	300.00		Fundraiser	Small, on-going fundraiser that can continue year after year.

3.4 Team Risk and Opportunity Analysis

We have outlined the following concerns that might impact our current goals and strategies:

Risk 1 - Advance to the East Super-Regionals: While we will work with our mentors and resources toward this goal, we cannot guarantee our success, especially since we cannot control the other teams and their robots. However, we hope that by learning Java programming right away, as outlined in section 3.1, we will be able to get started on our goal.

Risk 2 - Start and Mentor an *FIRST* Tech Challenge Team: We cannot guarantee that a second team is viable for our school. We have a dozen students who have expressed interest, but until the school and the students' parents approve, we cannot move forward with the second team. Mentors and team members have been building leadership capabilities and documenting the progress of our team for over a year. We hope that this will prepare us to mentor the new team to success. Our fundraising and leadership plans are also outlined in 3.1 and 3.2 and we think this will convince the school and parents we are prepared to start and support this team.

Risk 3 - Implement Robo Camp: We feel strongly that there is an interest and a need in our community. We have no guarantee that the camp will meet the full desired enrollment of 20 campers, but we have a plan for promotion in the works as outlined in 3.1, so we think we are prepared.

Our team has identified the following opportunities that we plan to take full advantage of:

Opportunity 1 - Fundraising – Eden Electrical Corp has provided funding for robot materials for our team for the past two years. We plan to approach them with our idea to start a second team and see if they will be willing to sponsor that team as well. The two mentors who work at Eden Electrical feel strongly that the company is willing and able to do so, we just need to finalize our proposal and present it to the CEO. If we are able to do so, we will continue to have a budgeting surplus, even with the new team, which ensures our team longevity.

Opportunity 2 – A new T-shirt business has opened up and we think if we approach them and ask them to partner with us on T-Shirt sales that they will agree as a way to promote their business. The owners are young and liked the idea, we just need to finish our formal proposal. Having a long-term fundraiser will be really useful for budgeting purposes each year.

4.0 Outreach and Recognition

4.1 Outreach

Currently the team attends a lot of local events, such as the First Night and 4th of July celebrations, and showcases the club and the robot. We are excited about starting Robo Camp which will be our first foray into running our own event.

4.2 Recognition

- Think Award, Massachusetts State Championship, 2014
- Swell Middle High School Club of the Year, 2013 and 2014

5.0 Resources

5.1 Photos and Other Supplemental Materials

For more information about the team and our outreach, please check out the following materials:

- Team brochure (insert URL)
- Team Engineering Notebooks (insert URL)

5.2 Team Contact Information

Lead Mentor: Jesse Teacher, email address

Lead Mentor: Ricky Parent, email address

Team Email address

Team website: insert URL

Team Instagram page

Appendix O: Robot Order of Operations

This is a short and easy checklist of the necessary steps to creating a Competition-ready Robot:

- Step 1: Design the Robot
- Step 2: Build the Robot frame
- Step 3: Attach the Android phones
- Step 4: Lay out the wiring and draw a wiring diagram.
- Step 5: Wire the Robot. Connect the
 - 1. Motors to the Motor Controllers
 - 2. Power Switch to the Motor Controllers
 - 3. Power Switch to the Battery
 - 4. Motor Controllers together
 - 5. Android phone to the DC Motor Controllers
 - 6. Battery to the DC Motor Controller
- Step 6: Program the Robot
- Step 7: Test and Measure
- Step 8: Make adjustments to the design & build
- Step 9: Ad Infinitum: Repeat step 7

Appendix P: Case Studies for Training

Instructions

To use these case studies for training Mentors, Team Members, or Team parents and Volunteers, gather the participants together and explain the goal of the exercise as well as how the process will work. Goals might include teambuilding, training, or Gracious Professionalism coaching.

It would be best not to do more than two or three case studies at a time as the discussions might start to sound redundant or people might begin to mentally check-out. You can add additional discussion questions to the list, but remember the goal is to keep them open-ended to generate lively discourse. The facilitator of the exercise should try to keep from interjecting their opinion and/or outlining the right/wrong outcome.

A typical training scenario involves people first forming groups of two or three then being presented with a case study. Each group has five minutes to discuss the situation, after which everyone regroups and discusses together. Repeat this process for each case study that will best help the participants better understand the principles of FIRST and FIRST Tech Challenge.

Case Study #1 – Recruiting Team Members

The team is going to have a booth at their high school's student activities fair. The goal is to recruit new team members and also gain support for the team. The booth will include some information about the team, the previous season, and a sign-up sheet for new members. The only students who want to work in the booth are the two programmers: they are both sophomores, best friends, spend a lot of time on their cell phones playing games, and are generally shy, but really uncomfortable around the girls on the team.

Questions for discussion:

What do you think of the team's plan for the booth?

Do you foresee any issues?

Do you think the team will recruit a lot of new members?

Case Study #2 – Teambuilding Conflict

Your team has been struggling with internal conflict between two members: Ricky and Omar. They both have strong personalities and like to voice their opinions loudly in group discussions, often talking over teammates in a battle to have their opinion heard over others. Quiet team members feel uncomfortable talking in the group when Omar and Ricky are around, and even more outgoing students are drawing inward as a result. The mentors decide that, instead of involving the boys' parents or even speaking to them about their behavior, the entire team needs to do some teambuilding to help Omar and Ricky realize they are part of a group and the value of everyone's voice in the group. They also hope it will temper the conflict between the two students.

Questions for discussion:

How would you handle this situation?

Do you agree with the mentor's decision that teambuilding will solve the problem? What are the pros and cons of their decision?

What teambuilding activities would be good for addressing this situation positively?

Case Study #3 – Parent Question

The team is competing at a tournament when their alliance is penalized for knocking over the scoring goal. A parent of one of the team members recorded the match which clearly shows the other alliance knocking over the goal. After reviewing the video, the parent runs on to the field demanding the adult volunteers watch the video and either correct the score or replay the match.

Questions for discussion:

Is the parent's behavior justified?

How should a score be challenged appropriately?

How could the mentors or team have better prepared the parent for competition?

Case Study #4 – Defining Team Roles

In an early team meeting, two team members, Jill and Becca, want the role of Lead Programmer. The mentor explains that everyone should explore all of the roles and that after two weeks each team member will get to identify their top role and a vote will be taken by the entire team as to who will get each position. During the two weeks, Becca studies the training materials and programming language in her spare time. She realizes she has a strong passion for coding and may have identified her future career. Jill, meanwhile, spends a lot of the two week window exploring all of the roles on the team and making friends with each of her teammates. Both girls mark Lead Programmer as their first choice and during the team vote, Jill is selected by the team members.

Questions for discussion:

Who is the best candidate for the job?

If you were the mentor and disagreed with the team's decision, what would you do?

Could the assignment of roles be handled differently?

Case Study #5 – Good or Bad Idea?

During robot design brainstorming, one student member throws out a wild design idea and everyone laughs. Someone in the group says, "That will never work!"

Questions for discussion:

What should the mentor/team do with the idea?

How could the mentor facilitate discussion in this moment?

What follow-up discussion or conversation should the mentor have and with whom?

Case Study #6 – The Question Box

Team RoboSpheres realizes the scorekeeper reversed the results of their recent match (they were the Red Alliance). The Red Alliance, including their robot, did not perform well on the field, but the results scored the Blue Alliance lower. The RoboSpheres' drive team decides to stand in the Question Box and point out the issue to the referees.

Questions for discussion:

What do you think will be the outcome of the conversation with the referees? Should the scores be switched?

Did the RoboSpheres do the right thing? Is this gracious behavior?

Case Study #7 – Taking Pictures

The RoboBots have a large cheering section at the competition. One of the mentors is a journalist/photographer for the local newspaper and brought their camera and media badge. The competition field is roped off, allowing only drive teams, volunteers, and official event media up close to the field. Flashing her media badge at the volunteers, the mentor ducks under the rope to stand next to her team while taking pictures. After bumping into her several times while trying to referee the match, the referee staff ask her for her team's number before requesting she leave the room. She complies.

Questions for discussion:

Did the mentor use her professional media pass appropriately?

Should event staff have handled the situation differently? How?

Did the mentor act in a gracious manner? If yes, how so; if no, why not?

Case Study #8 – Help the Alliance Partner

Team RoboBug is paired with Team RoboTank. The drive team for RoboBug stops by RoboTank's Pit to strategize prior to the match. They share that the scouts for their team have identified the RoboTank robot as weak and likely to affect the match score. They ask RoboTank to focus on using their robot to bump into and block the other alliance's robots during the match, and leave the RoboBug robot to do all the scoring.

Questions for discussion:

How should the RoboTank team respond?

Is this a good strategy and do you think it will yield successful results?

Is this allowed by FIRST Tech Challenge rules and expectations?

Is this gracious behavior? If yes, how so; if no, why not?

Case Study #9 – Ungracious Mentor

Your team's pit neighbor is the RoboHawk. After a match where the RoboHawk robot didn't function well, the drive team is very upset, even crying in the pit. You are in the midst of a conversation with the Judges who have stopped by your pit, when a RoboHawk mentor arrives at the pit booth and begins yelling. She yells at the drive team for the poor match results, and even yells at the programmer for what she maintains was a coding problem. When her team members try to explain, she refuses to listen and complains about how they slack off in meetings and says that if they tried harder, this wouldn't have happened. Another mentor arrives and tries to calm her, but the angry mentor just walks away. You see the Judge write down the RoboHawk's name and team number, and then scribbles a few notes underneath.

Questions for discussion:

How should the RoboHawks mentor have handled the situation differently?

Should this mentor's behavior affect the team's Judging scores?

How should you, a member of the team in the next pit over, respond?

Case Study #10 – Bad Winner, Sore Loser

At the competition, the top-ranked team after qualifying rounds is team RoboPresidents. Their drive team celebrates the announcement with loud yelling and screaming, fist-pumping, and a crazy dance right on the field. RoboGears, an opposing alliance team who was not ranked as high, loudly complain about their showing celebration, asking a Judge who is observing matches and taking notes if that is appropriate and gracious.

Questions for discussion:

Was the RoboPresidents behavior acceptable or gracious? What, if anything, could they have done differently?

Was the RoboGears behavior acceptable or gracious? What, if anything, could they have done differently?

What is the judge required to do? What should the judge do?

Appendix Q: Sample Press Release

FIRST Tech Challenge teams are encouraged to issue press releases to local media regarding their participation and accomplishments in the program. Below please find some tips and resources to help you incorporate appropriate FIRST messaging in your release.

Online Press Room

The [FIRST online Press Room](#) has many useful resources, including published FIRST press releases and concise information about FIRST programs: how the program works, season statistics at-a-glance, game description, award descriptions, and links to event and team listings. Feel free to use materials from the Press Room or direct the media there for additional information about FIRST.

Content Elements

Your release title and two opening paragraphs should address the who/what/when/where/why/how of what you are announcing (e.g. forming a team or winning an award). The rest of the release can be used to provide background or backup information, such as:

FIRST and FIRST Tech Challenge description and scope (recommended):

Founded by inventor Dean Kamen, FIRST® (For Inspiration and Recognition of Science and Technology) was created to inspire young people's interest and participation in science and technology. The FIRST Tech Challenge is an intermediate robotics competition that provides students in grades 7-12 with a challenging, technology-rich, exciting program that inspires them to get into science, technology, and engineering.

FIRST® Tech Challenge is a widely-accessible robotics program for grades 7 through 12 that promotes project-based learning. Using a proven formula to engage student interest in science, technology, engineering, and math (STEM), FIRST Tech Challenge is one of the fastest-growing programs of its kind. FIRST Tech Challenge is highly-scalable and easily integrates into the classroom with measurable results. FIRST teams collaborate with business, engineering, and science professionals, and working together, become a focal point of the community in which they live.

During the 2015-2016 season, approximately 5,000 FIRST Tech Challenge teams competed around the globe in the FIRST Res-Q™ game challenge. Advancing from four Super-Regional events and internationally, 128 teams competed for top rankings on the field and awards at the FIRST Tech Challenge World Championship Tournament, April 27-30, 2016 at Union Station in St. Louis, Missouri. FIRST Tech Challenge participants are eligible to receive over to \$16 million in scholarships from some of the finest science and engineering schools in the country and Canada.

Game description (optional – and should be Season specific):

Example: The 2015-2016 game, FIRST® RES-Q™, is modeled after rescue situations faced by mountain explorers all over the globe. Played by two Alliances of two robots each, robots will score points by: "resetting" Rescue beacons; delivering Rescue Climbers to a shelter; parking on the mountain; and parking in the Rescue beacon repair zone or floor goal. Robots may also score points by retrieving debris from the playing field and placing them in mountain or floor goals, and also by hanging from a pull-up bar during the last 30-seconds of a match.

Contact information:

Provide a way for readers to learn more about your team or FIRST Tech Challenge, such as web address, social media accounts, or contact information.

Other Tips

Be sure to acknowledge your team sponsors in your press release.

Include quotes to add a personal touch.

For award announcements, include the name and a concise description of the award (available in the Award Descriptions document in the *FIRST* Tech Challenge section of the [FIRST Press Room](#)). Add details of how/why your team won the award.

Include 2-3 pictures, but be aware that they might not be included in the published piece.

Sample Press Release for Teams

FOR IMMEDIATE RELEASE

Robotics Team has an AwesomeBot Season!

July 10, 2015

What's better than a ball game? Adding robots. Step it up a level by getting girls to design, build, and program the robot and you have a recipe for awesome. Actually, you've got AwesomeBot, an all-girls *FIRST*® Tech Challenge team. Started in 2014 by Tracy Allen and Kym Smith, both in ninth grade at the time, Team AwesomeBot was the result of a dare. Tracy's older brother Bill was competing in an online programming game and told Tracy she couldn't play along, because he didn't have the time to teach her how to code. Tracy said she'd learn on her own and do even better. His reply? "I dare you," Tracy said. "So I looked into ways to learn coding and I found *FIRST* Tech Challenge. I invited Kym and we quickly found six other girls to join up."

Founded by inventor Dean Kamen, *FIRST*® (For Inspiration and Recognition of Science and Technology) was created to inspire young people's interest and participation in science and technology. The *FIRST* Tech Challenge is an intermediate robotics competition that provides students in grades 7-12 with a challenging, technology-rich, exciting program that inspires them to get into science, technology, and engineering. *FIRST* Tech Challenge participants are eligible to receive close to \$16 million in scholarships from some of the finest science and engineering schools in the country and Canada.

In the 2014-2015 *FIRST* Tech Challenge game CASCADE EFFECT™, robots developed and executed both offensive and defensive strategies. Using a combination of motors, controllers, wireless communications, metal gears, and sensors, including infrared tracking (IR) and magnet seeking, students will program their robots to operate in both autonomous and driver-controlled modes on a specially designed field. The object of Cascade Effect is to score more points than an opponent by placing balls into rolling goals and then moving goals into scoring areas. Points can also be awarded when balls are shot into a center goal.

Ten months, one robot, three competitions, and one award later, and Team AwesomeBot definitely succeeded. At the Nashua Qualifying Tournament in December, the team's robot was "one of the few that survived qualifying matches, so we got pulled into one of the alliances," said Kym, laughing. "It wasn't a great robot, but it was strong, and at that event, that's all it took." The team was able to advance to the Massachusetts Championship in January as a result.

"We spent all of January redesigning the robot to be more effective at scooping up balls and scoring goals," Tracy said. "We knew we would need to have a more competitive robot if we were going to have a chance at the Championship." The robot performed better, but they weren't picked for an alliance. However, in *FIRST* Tech Challenge, teams advance through competition and merit, and the team received the Think Award, which

earned them a spot at the East Super-Regional event held in Pennsylvania in February. According to the FIRST Tech Challenge website, “The Think Award 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.”

“We were so shocked! We’d worked hard on our Engineering Notebook and practiced our Judging Interview and everything, but really, it was quite a surprise to us. And then we realized we had a lot of fundraising to do if we were going to be able to get the whole team and the robot out there in less than a month,” said Coach Diane Allen. Due to the generosity of local metal fabrication company Weld It, the team was able to rent a school bus and attend the Super-Regional event where 72 teams from the eastern United States competed for one of 25 advancement spots.

“We weren’t the best robot on the field, but we weren’t the worst,” said Kym.

“But that didn’t even matter to us,” chimed in Tracy. “We had such a good time meeting all the other teams and we learned so much! We are already planning much more sophisticated elements for next year’s robot.”

What started out as a dare has become an obsession. “All of the girls are committed to the team, to the robot, and are really getting into the science and engineering aspects,” said Coach Allen. “They work so hard and it’s all on them – no one is making them do any of it.”

“Our goal for next year is to start and mentor another team,” said Tracy. “Every kid should do this! We learned so much about technology and had so much fun!”

“We want to get to Super-Regionals again next year,” added Kym. “And we want to really grow our team and the program in the community. FIRST gives you a chance to learn real world skills, compete with robots, and meet lots of great people.”

To learn more about Team AwesomeBot, check out their website: www.awesomelobot.org or email the coach Diane Allen at diane@awesomelobot.org. Go to www.firstinspires.org/robotics/ftc to learn more about FIRST Tech Challenge and how to start a team in your area.

Appendix R: Build a Booth

FIRST is driven by a mission to engage every student in STEM learning. Yet, somehow, there are still many people who have not heard of FIRST. We need to change that and Teams are our greatest spokespersons! There are lots of opportunities to spread the word about FIRST and promote your Team in the community. Outreach can help you: find new Team members, find additional Mentors/Coaches, find Sponsors, and mentor young people – maybe even help start other FIRST Tech Challenge Teams! This document will provide brief instructions on where and how.

Find an event in your area. Anything that is going to appeal to young people or educators is good, and there are a lot of conferences out there where you could probably set up a display, including events for families, including fairs, as well as places with lots of people, such as malls. The bigger the turnout for the event, the more people you can reach, so don't only look into small events.

Once you are where the people are, you need to have a display of some kind. Make it eye-catching. You have to draw folks over to you. The number one way to do this is with a working Robot and your Team. Catch people walking by with a simple "Want to drive the Robot?" or "Have you heard of FIRST?" or "Do you like Robots (or Science or Engineering, etc)?"

Have a large poster (tri-folds work great for this) with a little text and lots of pictures. Make the text big so it can be easily read from three or four feet away. Include how your Team got started and why, Team goals, the Team working on the Robot, including design ideas or CAD drawings, and maybe outreach the Team has engaged in. Include awards and honors the Team has won. If there's too much text, focus on the message you want people to get most, or consider sharing information in other ways (ie: have a brochure about the Team and the poster can be about the Robot. Or hand out a Team business card with the link to the Team website to see photos of the Robot design and build process while the poster focuses on the Team).

Consider having something for people to write down their contact info so you can keep in touch with them, and definitely have a handout with Team info on it, a one-page overview or even a Team business card. Other recommendations and a sample display are shown on the following pages.

Resources to help you promote FIRST are available in [Appendix T - FIRST and FIRST Tech Challenge Promotional Materials.](#)

Spread the word about FIRST



Provide FIRST and FIRST Tech Challenge literature for folks to take and read later. You can download and print many documents from FIRST and FIRST Tech Challenge.

Get the FIRST and FIRST Tech Challenge name and logo out there big and bold! Whatever large signs you have, keep the font big and the number of words small – too much text is overwhelming.



Share information about the [FIRST Scholarship Program](#). This is a huge draw for many parents, schools, and students!



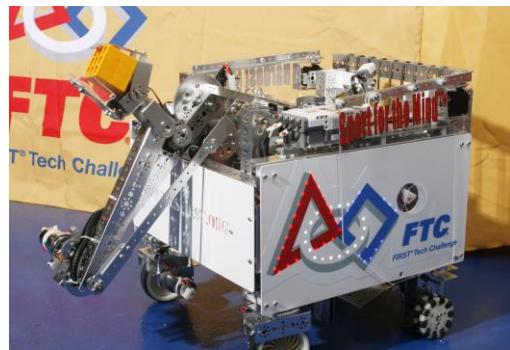
Have a computer playing FIRST and FIRST Tech Challenge videos – you can even run multiple videos in a loop. We recommend “What is FIRST? Video”, the FIRST Scholarship Video, and the annual “FIRST Tech Challenge Game Animation Video.” Or make your own Team video!



Booth Design Tips



Have a Robot! A Team and their Robot is best, but just having a working Robot that folks can drive is a sure-fire way to draw people over to your table and generate interest in FIRST.



If you can set up a playing field, that's awesome; if not, have the current Game One-Sheeter and a few Game Elements for folks to check out.



Use plastic sign holders to stand your literature upright on the table. This makes it more visible to the casual passerby, versus requiring someone to stop and look to see what the stacks of info are all about.

Appendix S: FIRST and FIRST Tech Challenge Promotional Materials

Hand-Outs

- [Game 1-Page Document](#)
- [FIRST Tech Challenge Promotional Flyers, Posters, and handouts](#)

Media and Press Tools

- [FIRST Marketing and Press Tools](#)
- [FIRST Tech Challenge Outreach and Marketing Resources](#)

Presentation Materials

- [FIRST Tech Challenge PowerPoint Presentation template](#)
- [What's FIRST? video](#)
- [FIRST Tech Challenge Promo video](#)
- [Game Animation video](#) - changes each season
- [Gracious Professionalism video](#)
- [FIRST Scholarship Video](#)
- [Youth Protection Program video](#)

Appendix T: 2016-17 Rookie Team Resource List

Listed below are all pages that FIRST® Tech Challenge Teams may require both throughout their competition season, and during their off-season. Make sure to bookmark the pages you feel would best help you and your Team! If you still find that you require additional help, feel free to reach out to the FIRST® team at ftcteams@firstinspires.org.

Overview Pages	
FIRST® Webpage	www.firstinspires.org
FIRST Tech Challenge main page	www.firstinspires.org/robotics/ftc
Regional Contacts Search Portal - Find your Regional FIRST Contact.	http://www.firstinspires.com/node/2546
Game Materials - Includes all the season materials, including the Game Manuals, link to the Forum, Forum Answered Questions, Field instructions, and link to buy field element.	http://www.firstinspires.org/resource-library/ftc/game-and-season-info

Getting Started	
Starting a Team Resources - Includes step-by-step resources for starting an FIRST Tech Challenge team.	http://www.firstinspires.org/node/5281
Fundraising Resources - Includes resources for budgeting and fundraising, including grants and resources from the FIRST and FIRST Tech Challenge Fundraising Toolkits.	http://www.firstinspires.org/node/5406
Resource Library - The location of all FIRST and FIRST Tech Challenge Resources. Organized in “articles”, resources are grouped together by subject and can be saved to your personal Resource Library by clicking on the heart when signed in	http://www.firstinspires.org/node/1586

Team, Robots, and Technology!	
Team Management Resources - Includes all the resources for Mentors and Teams on running the team: the Mentor Manual, fundraising, training, Engineering Notebook, preparing for competition, Awards, and more.	http://www.firstinspires.org/node/5226
Robot Building Resources - Includes all of the resources for building the robot, including the PushBot Build Guides, Robot Wiring Guide, PTC design resources, and new technology resources.	http://www.firstinspires.org/node/5181
Technology Resources - Includes all resources for the new Android-based technology, including programming resources, Troubleshooting Guides, link to the Forum, etc.	http://www.firstinspires.org/node/5291

Competition	
Preparing for Competition Resources - Includes a checklist of items and resources to ensure your team is prepared for competition.	http://www.firstinspires.org/node/5261
Events Search Portal - Find local events (from tournaments to workshops and scrimmages).	http://www.firstinspires.org/team-event-search
FIRST Tech Challenge Dean's List - Every registered FIRST Tech Challenge Team is able to nominate 2 students (10 th or 11 th grade) to be recognized for their leadership and dedication to FIRST. Learn more about this amazing award!	http://www.firstinspires.org/robotics/ftc/deans-list
Volunteer Resources - Includes all volunteer training manuals and instructions for accessing the Schoology training.	http://www.firstinspires.org/node/5146
Super-Regional Championships - Information regarding the four U.S. based Super-Regional Championships.	http://www.firstinspires.org/robotics/ftc/super-regional-championship-tournaments

Outreach and Social Media	
Outreach & Marketing Resources - <i>Includes resources and links to resources, virtual badges, marketing materials and team recruitment resources.</i>	http://www.firstinspires.org/node/5246
Links to Social Media - All FIRST and FIRST Tech Challenge Social Media pages.	http://www.firstinspires.org/node/4511
World Championship Results & Hall of Fame - <i>Location of all previous World Championships winners.</i>	http://www.firstinspires.org/node/5356

Beyond the Competition	
FIRST Tech Challenge in the Classroom Resources - Many FIRST Tech Challenge Mentors and Coaches are also teachers in the classroom. Find additional resources here	http://www.firstinspires.org/node/5231
FIRST Scholarships - Be proactive and start looking at what scholarships are available!	http://www.firstinspires.org/node/1556
FIRST Alumni & Internships - FIRST participants are able to search out internships made available for students who have participated in high school level FIRST programs. Network with the FIRST Alumni page and ensure you are always connected even after graduating from FIRST Tech Challenge.	http://www.firstinspires.com/alumni-and-internships