



Coach's Manual

2009



"We want to change the culture by celebrating the mind. We need to show kids that it's more fun to design and create a video game than it is to play one." Dean Kamen, Founder, *FIRST*

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



Dean Kamen, Founder, *FIRST*

About FIRST

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

A volunteer-driven organization, *FIRST* is built on partnerships with individuals as well as businesses, educational institutions, and government. Some of the world's most respected companies provide funding, mentorship time and talent, and equipment to make *FIRST*'s mission a reality. As a team coach, you join over 80,000 committed and effective volunteers who are key to introducing close to 200,000 young people to the joy of problem solving through engineering.

FIRST provides four programs: the *FIRST* Robotics Competition (FRC) and the *FIRST* Tech Challenge (FTC) for high-school-aged young people, *FIRST* LEGO[®] League (FLL) for 9 to 14 year-olds, and Junior *FIRST* LEGO League for 6 to 9 year-olds. Also located at *FIRST* headquarters is the research and development facility called *FIRST* Place. *FIRST* Place is integral to game design, new program development, evaluation, and professional development of *FIRST* mentors.

Document Revision History

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FIRST Tech Challenge (FTC) Core Values

- We are a team.
- We do the work to get the job done with guidance from our coaches and mentors.
- We honor the spirit of friendly competition.
- What we learn is more important than what we win.
- We share our experiences with others.
- We display gracious professionalism in everything we do.
- We have fun.

FTC Coach's Promise

As the coach of a FIRST Tech Challenge (FTC) team, please read the information below for further understanding of FTC core values. As a coach, you are responsible for honoring and communicating FTC core values to team members, team volunteers, and others affiliated with your team.

FIRST expects all teams to abide by FTC rules and guidelines as they exist now and as they may be set forth during the season. This handbook provides details of team rules, guidelines, and policies and procedures. FTC coaches will receive updates, additions, participant consent forms, volunteer recruitment, screening, and supervision guidelines for the team via e-mail and/or postings on the FIRST website at www.usfirst.org.

MY PROMISE:

1. The students come first. FTC is about the students having fun and getting excited about science and technology. Everything my team does starts and ends with this principle.
2. The students do the work. This is their opportunity to learn and grow. The students on my team do all programming, research, problem-solving, and building. Adults can help them find the answers, but cannot give them the answers or make the decisions.
3. My team is comprised of ten or fewer members registered as an official FTC team. All team members are pre-college students.
4. FTC communicates with my team via my primary e-mail address and I am responsible for reading and relaying all aspects of FTC guidelines and rules to my team, other coaches, volunteers, and parents.
5. I will encourage my team members and team supporters to develop and practice a set of FTC values that reflect FIRST's goal to change culture in a positive way by inspiring others through our team's actions and words.
6. I will not make this about me. I will keep the focus on the students and what they can take away from this experience in the most positive manner.
7. By my actions and my words, I will strive to help the team remain gracious professionals, even in the face of adversity.

BUILDING A FOUNDATION

FIRST Tech Challenge relies on volunteers to run the program at many levels, from managing a region to coaching an individual team. FTC Affiliate Partners coordinate the program in each region or state. These FTC Partners fundraise, run tournaments, hold workshops and demonstrations, market FTC locally, handle public relations, and recruit volunteers and teams. They are a tremendous resource for you as a team coach, and FTC would not exist without them.

FTC VALUES

We ask all who participate in FTC to uphold the following values:

Respect each other in the best spirit of teamwork

Behave with courtesy and compassion for others at all times

Honor the spirit of friendly competition

Act with integrity

Demonstrate gracious professionalism

Encourage others to adopt these values

GRACIOUS PROFESSIONALISM

Dr. Woodie Flowers, National Advisor for FIRST, speaks about gracious professionalism in this way:

"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."

Gracious professionalism can and should mean different things to each of us. It is possible, however, to outline some of its meanings:

Gracious attitudes and behaviors are "win-win."

Gracious folks respect others and let that respect show in their actions.

Gracious professionals make a valued contribution in a manner pleasing to others and to themselves as they possess special knowledge and are trusted by society to use that knowledge responsibly.

In the long run, gracious professionalism is part of pursuing a meaningful life. One can add to society and enjoy the satisfaction of knowing that you have acted with integrity and sensitivity. That's good stuff!"

FTC is a student-centered activity and is about giving students a unique and stimulating experience. We want them to learn the value of teamwork and to respect everyone's ideas and contributions to the team. FTC values are about appreciating our differences and learning what those differences add to our lives. FTC succeeds most fully when team members bring the FTC values they learn back to their communities.

THE FTC GAME

FIRST Tech Challenge teams participate in a new game each year, requiring them to design, build, test, and program autonomous and driver-operated robots that must perform a series of tasks. Each tournament features alliances comprised of two teams, each playing against each other on the playing field. Teams work to overcome obstacles and meet challenges while learning from and interacting with their peers and adult mentors. Students come away with a greater appreciation of science and technology and how they might use that knowledge to positively impact the world around them. In addition, they cultivate life skills such as planning, brainstorming, collaboration, teamwork, as well as research and technical skills.

BUILDING A TEAM

Coaching an FTC team can be one of the most rewarding experiences of your life. Like any great reward, it involves a commitment of time and energy.

THE FOUNDATION

To succeed, both the coach and the team members must commit to the entire process. It's important to remember that the students need guidance, structure, encouragement, and most of all, a fun experience.

Teams require at least one adult coach. As the coach, you must be 18 years or older. Parents, teachers, engineers, college students, and scout leaders all make good coaches. It requires no special skill, just patience, dedication, and a willingness to learn alongside the team. You will need to direct the process the team follows to solve the yearly game challenge without providing the solution yourself.

In addition, you must be willing to acquire some basic knowledge of the programming environment and robot building. We encourage you to enlist the support of a technology teacher or technical mentor for additional assistance. We also recommend that you invite people with backgrounds in engineering and programming to share their knowledge and experience with your team.

ADVICE FOR COACHES

Don't take this too seriously! We want you to enjoy the experience. Our goal is for you to help your students have fun with robots while they get comfortable with technology. Whether or not your team is successful at a competition, team members win just for participating.

If it is your rookie year, enjoy it for what it is: a survey of the course. Your goal should be to simply take a lap around the block with FTC. With a fun experience and meeting realistic goals under your belt, you and the students will be brimming with ideas about what you plan to do next year.

As a coach, your behavior and attitude can and will influence how your team chooses to respond to the environment around them at an event. For example, if you do not agree with the referee's call, it is very important that you discuss the situation with your team and follow the Game Manual rules for questioning a call. Rude or abusive language or behavior towards a head referee will not earn your team a positive reputation and may negatively impact the students' experience at the competition. Repeated negative adult behavior may also lead to the disqualification of a team during a match, and the removal of the adult from the venue.

THE STUDENTS

Your FTC team will have up to 10 pre-college students. While there is no lower age limit for teams, students cannot be older than high school aged in order to be a participating team member. College students and others who have completed high school are welcome to participate in the role of mentor

or coach. Teams can be formed in any environment and need not come solely from a school environment.

THE MENTORS

A mentor is any person who works with the team in his area of expertise for at least one team meeting. Mentors help provide valuable one-on-one interaction and serve as resources in their specialties. Here are some possible mentor contributions:

- Engineer – Teaches the necessary skills for the robot's design while demonstrating the engineering design process.
- High school or college student, preferably a FIRST Robotics Competition member – Helps team work through a practice programming challenge, shares strategizing methods, serves as a role model.
- Graphic artist – Provides advice on the team logo and T-shirts.
- General volunteer – Schedules meetings, provides transportation and snacks, helps with fundraising, and provides carpentry assistance for field construction.
- Programmer – Teaches the team about programming principles and helps the team troubleshoot programs.
- Marketing expert – Teaches the students about marketing their team to others.

When recruiting a mentor, be sure to consider diversity. Youth from diverse backgrounds may be more comfortable if there are adults with backgrounds similar to their own. Below are just some of the sources to recruit a diverse group of mentors. You can visit their national websites to connect with someone from a local chapter:

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>

Local chapters of the American Society of Mechanical Engineers (ASME): <http://www.asme.org>

Leading corporations in your community

Senior Corps: <http://www.seniorcorps.org>

Mentors may also be found within the FIRST community. Many mentors from FLL and FRC would be happy to support an FTC team. Use the search engine on the FIRST website <http://www.usfirst.org> for a variety of mentor documents, resources, and links.

THE PARENTS

Encourage parents of team members to volunteer their assistance. Their cooperation and support are invaluable because they can help with fundraising, logistics, team building, mentoring, as well as a

number of other responsibilities. Sharing the workload makes your team more efficient, reduces stress, and increases team spirit and cohesion.

TEAM DYNAMICS

When organizing your team, consider team size, diversity, age and skill levels, and time commitment and scheduling.

TEAM SIZE

Every team is different, and there is no "ideal" number of students on a team. The minimum number of students is 1, and the maximum number of students is 10. Ultimately, the size of a team is based upon the coaches preference and the interest of the students.

AGE VARIATIONS

Coaches may find that it is best to stay within a four-year age-span for team members. Depending on the age and maturity level of your team, you may see social and developmental differences with mixed-age teams; this may work to your advantage but be prepared to deal with team members on a variety of levels.

TIME COMMITMENT

The time commitment will vary with coaching experience and team's dynamics. Creating a meeting schedule should be a team effort and should take into consideration the students' ages, school schedules, and their rookie level.

Schedule: A new team may need to have longer, more frequent meetings. Set your team's schedule according to its goals. We suggest starting with two meetings per week during the team-building stage. During the design and build phase you should probably meet more frequently as your team's needs indicate. Sessions lasting 2-3 hours are generally the most productive.

If you plan on a 6 - 8 week schedule, we recommend meeting for at least 10 hours per week. If your event is scheduled more than 8 weeks from the Kickoff date, you may be able to create a schedule that is less intensive, if necessary.

In preparation of the meetings, have available tools, snacks, brainstorming materials etc. Consider the parents when allocating meeting time. You will lose their enthusiasm and support if you do not begin and end on time. Don't make the parents wait. Allow 15 minutes at the end of the meeting for cleanup and summary time. Do not end a meeting without having the entries put into the Engineering Notebook.

Prepare: As the coach, you may need additional time each week to prepare for team meetings. Spend this time coordinating help, maintaining equipment, communicating with your sponsoring organization,

purchasing supplies, and registering for competition. Create a realistic meeting schedule and don't forget to consider major holidays and school events.

Some meetings will run like clockwork and others will be more challenging. After some meetings you may feel further behind than when you started. Productive meetings and challenging ones are both critical parts of the process. Encourage your team to learn from their mistakes and continue with a smile.

Stay Current: Be sure to keep up with the game-specific forum discussions on the web where you will find answers to many questions you may have. If you don't find the answers, post your own team questions there – <http://forums.usfirst.org>.

TIP - Do not accept procrastination – As the coach, you are the one who will suffer most from the stress when things come down to the wire. Be firm with your team 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 made up with team input and regularly remind them of deadlines.

Keep a team calendar posted in your work area and write in key dates, deadlines, and meetings. Entries in your Engineering Notebook should coincide with these. Have the team help select deadlines for certain parts of the project so that they will feel ownership of the process.

ROLES AND RESPONSIBILITIES

This section talks about the coach and team and the various hints to encourage a balanced team and avoid common pitfalls.

THE COACH

FIRST Tech Challenge teams and their members come from a variety of backgrounds. Do not expect to be like “every other team.” Let your team celebrate its own style. Do what makes sense for you. As a coach, you need to be involved, but you cannot allow yourself to take over the process, except when it comes to safety issues. Teach students to stop and think before they cut or bend metal, or do other similar tasks.

With that said, consider certain guidelines. As a coach, you may help everyone gain the most from this experience if you do not do the actual robot planning, building, and programming by yourself. As much as you might like to build the robot, the team must design and build the robot with only limited assistance from you or other adult mentors. For an adult to simply build the robot for the team would go against the very spirit of the FIRST program. Take advantage of this fact and allow them to take charge. Work with your students, instead of for your students.

Facilitate: Instead of telling the team to “use smaller wheels from the kit,” you could ask the team to brainstorm ideas to make the robot go slower. Or you could encourage the students to run an experiment that may lead them to explore other options. Coaches differ in how much instruction they

give their teams. Some give very little and others give much more. A successful FTC coach controls the process, not the content.

You are a facilitator, available to help your team complete its work and improve the way it works together. One useful coaching method is to reply to a question with another carefully considered question. The following examples force team members to use their knowledge of science and hypothesize logical outcomes:

“What would happen if . . .”

“How will that affect . . .”

Students become problem solvers by finding solutions themselves, but coaches can assist young people best by facilitating problem-solving and helping students to reach their own solutions. We understand that adults can be just as passionate about FTC as students, but adults must always remember that **THE STUDENTS COME FIRST.**

Guide: Finally, you are responsible for the planning and scheduling of meetings, visits, and trips. You are the liaison between team members, mentors, parents, and volunteers. It is important that you inform students and parents about what is expected of them in terms of their commitment to the team each step of the way.

Encourage students to politely question you and their teammates if they do not understand or agree with concepts. If students provide information concerning robot rules to the group, be sure they can pinpoint where they found it so that authenticity can be checked.

Different groups can work on different mechanisms at the same time that can be put together as a unit with some modification. Make sure the subgroups communicate changes to each other.

Challenge: As an engineering lesson, continually stress that a given mechanism cannot be both fast and powerful. If this idea is not accepted, challenge students to build two mechanisms, one that is geared “fast and powerful” and another that is slow and powerful. See which one is stronger.

If you cannot hold back your desire to build a robot, build your own to challenge the team during practice. Lead students to reasonable conclusions by answering questions with other questions that can lead them to a successful result.

THE TEAM

Discuss duties, time commitment, meeting times, and dates up front. If students cannot make a reasonable number of meetings, you need to know that. The level of commitment should be generally the same among all team members.

Diversity: Remember, diverse interests and team makeup are best. It is possible to have students with diverse interests who still want to work toward a common goal however, trying to force students to work together if they do not like each other’s company will usually not result in success. Students

should be on this team because it is a fun learning experience. They already spend plenty of time learning to get along with others in many other mandatory activities. . You do not need to have a team made up of cliques, but be aware of pre-existing conflicts.

It is suggested that each student be on at least 2 subgroups, one where he/she is strong and one where he/she can learn from others. Be cautious of stereotyping. For example, a girl should not automatically be handed the "Engineering Notebook" and be told that she is in charge of the writing.

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.

Encourage team members to push the limits of their own comfort level and make sure everyone understands and/or does more than one job. It may be beneficial to rotate roles so everyone has an opportunity to try different things. Students often discover that they enjoy a task they wouldn't have volunteered for on their own. This can also prevent boys and girls from falling into stereotypical gender roles.

Below are examples of the roles or sub-teams you may want to establish within your team. Remember, students should be on more than one sub-team. Do whatever works best for your team, but ensure balanced leadership.

During Build Season

Building:

- Make decisions about building, and work to achieve consensus among team members on the mechanical design.
- Use guidelines from team brainstorming to build a robot that can accomplish the team's desired missions.
- Work with other building subgroups so that all mechanisms will mesh together.

Programming:

- Write programs for the autonomous part of the competition.
- Make any changes that the drive team needs in order to be more efficient during the controlled portion of the match.
- Schedule time with the build team to test the chassis when others do not need it.
- Remember, a simple thing like changing wheel size will change the robot's speed. If your team is experienced, offer assistance to those teams new to autonomous programming.

Scheduler: This person manages the team schedule to arrive on time for Autonomous and Robot Competition Rounds.

Strategy/Rules and Quality Control:

- Discuss ways that your team can be most successful at the competition.
- Search the Internet for discussion by other teams as to things that work or do not work.
- Keep an active eye for rule updates.
- Study your team's robot to see other ways it can do different tasks with very simple modification.
- Make an organized sheet that will ease scouting other teams. It should include a drawing of the field to make it easier for "scouts" to describe what that team does. This is a very important document that will help your team choose your alliance for the elimination rounds. Use it to keep track of robot capabilities and strengths when you build an alliance.
- Robot Operators (2): Any two youth team members will operate the robot during each round at a tournament. Refer below to the "At the Competition" Section.
- Project Management: Get everyone focused, get everyone's ideas heard, find compromises, and keep everyone on schedule with a project timeline.
- Robot Quality Control:
- Conduct independent tests of the robot's performance to identify potential opportunities for improvement.
- Test for functions that do not work reliably and make recommendations for improvements.
- Remember: Design is an iterative, ever-changing process; tweak regularly to improve your robot's design.

Hardware/Tools Manager:

- Keep track of all your hardware and serviceability and the tools needed for building and maintaining the robot. This also includes all the wiring necessary to program the robot and the power strips and batteries needed for the robot.
- Manage the battery charging process. NOTE: Use a bonding agent to help secure the hardware.

Marketing:

- Design and create the team logo.
- Publicize your team in your school and community by taking pictures of the team working on projects, making a presentation board with pictures of your team in action, and writing a press release.
- Contact the local media, surrounding schools, or civic organizations to increase public awareness of the team and how the team benefits from the FTC experience.
- Communicate a weekly update on the team's progress to parents, sponsors, and organizations.
- Video/Photographer: Chronicle the compete build process, tournament activities, and the Championship Tournament for use in marketing, news media, and inclusion on a website to show your teams experiences.

- **Engineering Notebook Documentation:** Record and document the entire team's thoughts, actions, failures, and successes throughout the FTC season in the engineering notebook.

Fundraiser:

- Search for unique fundraising ideas.
- Recruit parents and other students in the thinking, planning, and doing processes.
- Help make the coach's job easier by turning in money on time.
- **Team Spirit:** Think of ways your team, families, and friends can show their spirit at the tournament. As part of your team's identity, consider designing T-shirts, making pins, writing a cheer, and inventing ways to showcase your spirit.

At the Competition

For more helpful hints about attending an FTC event, refer to the "Competition Best Practices" document which is available on the FIRST website.

Scouting: Watch other teams to determine their strategies, strengths, and weaknesses.

Pit crew: After each match, check that all nuts/bolts are tight, metal is not bent so as to not allow the correct motion, and that all wires are still firmly attached.

Make up a checklist and go through it after each match.

Programming: Your team may decide to alter the autonomous program during the day, so be ready to do this. A good idea is to have a hard copy of the program with you.

Team Spokesperson: It is good to have at least one student who leads the group when talking to judges or guests that go through the Pit. The Pit is a noisy place, so she/he must speak loudly and clearly and know the related subject matter.

Robot Operators (2): Operates the robot in competition rounds using a hand held remote control to "drive" or move a part of the robot.

Backup Robot Operators (2): In the case of illness or last-minute stage fright, someone else must be able to drive and operate your robot. Practice time should include both groups. The team that does best in practice "at home" may not do well at all in public because of a loud audience and music.

Coach (1) Adult or student:

The role of this person is to assist the drive team in following the predetermined strategy or change it if necessary.

This person cannot be a "screamer" or a person who speaks with her/his hands because drivers cannot watch hands while driving.

The coach must also watch for information from referees and communicate that to the drive team.

Coaching should not be so specific that it instructs the drivers about every object they touch or every motion they make.

Coaches can not touch the controllers or robot before or during a competition match. Doing so will lead to a disqualification of the entire team.

Team spirit: This group of people must encourage your drive team to do its best and cheer whether the team wins or loses.

TEAM GOALS

Early on, prepare to coach your team and set goals for the season. Include expectations for the group's success at functioning together as a team.

At an early meeting, brainstorm reasons for participating on the team. If you have a member who is interested in destroying or tipping other robots over, you need to work with him or her, provide insight as to the FIRST mission and goals to determine if this is the right program for the student.

Keep your team focused on their goals during the season and review after the competition. FTC events provide excitement and recognition and celebrate each team's accomplishments. The true goals of FTC have very little to do with winning medals or trophies. If you can look back at the end of the season and say even one of the following, you have achieved the most important goals:

We learned how useful and fun math and science can be.

We did something we didn't 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, or communicate ideas.

We had fun!

BUILDING A SEASON

For the pre-Kickoff timeframe, there are a number of things we recommend in this chapter to both new and returning coaches to prepare for a successful upcoming season. If there are any FTC events in your area, consider attending as a spectator. You will see the flow of the day, meet coaches, talk to teams about their experiences, and witness the high level of energy firsthand.

GROUNDWORK

Talk to your local FTC Partner, listed on the FTC website <http://www.usfirst.org>, to get answers to a lot of your questions and get in touch with experienced coaches in your area. Try building practice robots, both by yourself and with your team.

CHOOSING A FACILITY

Your team can meet wherever is appropriate. For a school-based program, the school itself is ideal. Schools usually have the computers and space to set up your playing field. You may also meet in a private home, a meeting hall, or a company conference room. Evening or weekend use of the building may require special authorization. Be sure to ask permission to use the site's computers to program the team's robot. Before installing software, inform the site host.

Before the season actually begins, there are a number of things that you can do to make the season run more smoothly.

Visit <http://www.usfirst.org>, and go to the FIRST Tech Challenge site and see pictures of previous competitions.

Find another local FTC team coach with whom you can compare notes, possibly share a playing field, or even set up late season scrimmages.

Choose a type of programming software for the kit and practice using it. Have a team member start learning to use it.

Ensure that you have a laptop that will meet the minimum specifications for the programming option you choose.

Find a competition that you will be able to attend. Be aware that your team members may have conflicts with the date of the event. Notify parents of the date ASAP, as students are not always aware of date conflicts.

Be sure that your planned activity and work hours do not conflict with the host of the work site. NOTE: A school could require background checks for any adults working in the school, which could take weeks to complete if not planned ahead. Ask your site to explain any adult supervision and child safety requirements to you and any team mentors.

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

Internet access

Enough space to host your entire team, the competition field, the computers, and all your kit parts. You also need a secure place to store the kit and partially assembled robot between team meetings. Note: space for at least a partial practice field is 12' X 12', plus you need room on the ends for driver space.

Work tables and chairs. At least one table should be one that can get "beat up".

Good lighting at least in the work table area.

Simple sets of tools for working with kit parts.

WORKING WITH YOUR HOST

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

ESTABLISH SAFETY STANDARDS

One of the first things a team should do is get everyone to think about safety in the "workplace," during team travel and at the events. Bring up the topic at your first meeting and mention that each person will be responsible for team and personal safety. Stress safety at each meeting!

Safety Concerns

The following points are from a PowerPoint presentation produced by a FRC team. Use these as a starting point for your safety discussions.

Mandatory, non-shaded safety glasses

Close-toed shoes

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

Trips and falls prevention

Protective equipment

Loose clothing and moving parts – hair, jewelry

Inappropriate emotional or physical behaviors/actions. This would include someone on the team made to feel uncomfortable, by an adult or student, by inappropriate innuendo. Establish a reporting procedure for this type of harassment and discuss it with the group.

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. Bring this information to the competitions. Judges are extremely interested in safe habits and safety education. This information can be included in your team's Engineering Notebook.

BUDDY SYSTEM

Begin the buddy system at your very first meeting, and ensure that the students have at least one partner at the work location, while traveling, and at the events. If an accident or problem occurs, there is help right at hand; and it can be less scary to be lost with someone else. When traveling to events, make sure the students also have the mentors' contact information and room numbers.

SAFETY EQUIPMENT

Safety Glasses: Right from the get-go, buy non-shaded safety glasses for all team members. Make sure each person:

- Labels them with name and team number, and have a specific place to store them.
- Wears them at all times when working on the robot or when in the vicinity of someone working on the robot.
- Wears the required side shields (because robot parts can be like flying missiles!).
- Wears safety goggles over corrective eyeglasses if they are not polycarbonate or similar safety material.
- Is especially careful when near grinding or machining.

FIRST has strict requirements for non-shaded safety glasses/goggles use in the pit area and on or within 5 feet of the playing field. It's best to get the team to work responsibly right away -- at all times. Each must consider safety glasses as required equipment because they are a must at all FRC and FTC competitions.

Fire Extinguisher: Be sure to have a fire extinguisher at your workplace, and make sure everyone knows how to use it and where it is.

First Aid Kit: For obvious reasons, have one of these handy near your work area. It is important to include disinfectant and bandages. Bring it to your events.

FUNDING A TEAM

We know many teams will need to do some form of fundraising to pay for participation. Team fundraising builds unity and develops enthusiasm for success, and aside from the obvious monetary benefit, it fosters a sense of ownership in the team. Brainstorm with your team members for creative fundraising ideas; they'll surprise you with some fresh ideas.

There are many ways to fund your team. Obviously, you could write a check from your personal funds or divide the costs between the team members. Contributing to the team's costs may be a large expense for some families, and you run the risk of excluding students if you use this method. Seeking a sponsor and doing other fundraising can spread awareness and support of FTC.

Look for a company in your community to sponsor your FTC team. Many companies that support FTC recognize how it encourages a talented future workforce. To help win them over, offer to put the company logo on your banner or T-shirts to thank them for their generous donations. Update donors or sponsors regularly, and remind them how their contribution helps inspire a life-long appreciation for science and technology, as well as lasting intellectual and life skills. Visiting local businesses and companies can be an excellent way of growing the program in your area and bringing community awareness for your team. \$100 from ten businesses might be easier to attain than \$1000 from one sponsor.

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

FUNDRAISING IDEAS

Choosing a fundraiser that is appropriate for your team and your community can be the difference between a mediocre result and a great one. Google "fundraising ideas" and you will find numerous traditional and innovative ideas. Always be sure that your host organization approves your chosen fundraiser. To be more original, make and sell items that complement your community. Make it fun! The more fun you have holding the fundraiser, the more donors will want to be part of that excitement.

When raising money for your team, be sure to ask community groups to support you in any way they can. Think of fundraising ideas that don't require additional volunteers or a greater time commitment. A number of major retail franchises match money raised at their sites, while others offer community groups free or discounted products. Be sure to call local businesses and ask them what they might do to help you. Every little bit you raise is helpful!

SAMPLE BUDGET

Below is a sample of estimated expenses, based on estimated 2009 costs and assuming no in-kind donations such as goods or services. Most of these will vary based on individual team situations.

Sample Line Items	Cost	Comments
FTC team registration fee	\$275	
FTC Competition Kit	\$999	
Tournament registration fee	\$0 - \$300	Cost determined by the FTC Partner
Regional travel, lodging, food	\$500	Costs will vary with distance and event
Supplies, storage containers, cart	\$500	Costs will vary
Practice field and game elements	\$TBD	
Championship registration fee	\$TBD	
Championship travel, lodging, food	\$1500 - \$2000	Costs will vary
Team t-shirts	\$150 - \$200	Optional

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

MEETINGS

CHALLENGE KICKOFF MEETING

The Kickoff date for the FIRST Tech Challenge season is September 12, 2009. At Kickoff, you can access all materials related to the new Challenge. You can download manuals and graphics, access the rules of the new robot game, and view the season's playing field drawings.

Contact your Affiliate Partner for information pertaining to Kickoff events in your 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! Make your team as aware as possible ahead of time about the build excitement and where to find information during the build season.

EARLY SEASON MEETINGS

It's time to get started. Use the following list of suggestions to help organize your team meetings at the beginning of the season.

Start and end on time – If you have parents wait around for meetings to finish, they will show up later and later. If students rush to get to a meeting on time and then sit around being non-productive, they are less likely to show up on time.

If a meeting is right after school, have a snack ready at the start. (This also may help ensure that students will show up on time.) Make clear rules about eating and drinking near the robot, tools, and playing field.

Have some team-building activities to help all members of the team get to know each other and some of their key interests.

Teach members how to organize the tools and parts according to your system or have the team agree on a system of its own. Label the locations for storing different items.

Provide key printed information. Put student names and distribution date on each copy.

Build a model of the field if there will be a delay in building the key parts of the real field.

Discuss the Engineering Notebook. Students will be proud of the contents because they will be sharing them with judges. Have a suitable notebook ready at the beginning of the season. Refer to that section.

Prepare for brainstorming activities, being sure to teach the rules of proper brainstorming. Do not evaluate ideas until the session is over. Even “bad” ideas could trigger a great idea from someone else.

Schedule approximately 15 minutes at the end of every meeting for cleanup. If some team members are going to stay and work longer, cleanup 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 cleanup, teams should be encouraged to pick up after themselves. The coach should do nothing more than lock doors when the team is done.

MEETING REMINDERS

Keep students aware of deadlines.

Take pictures of team events. Use a checklist of team members so that you ensure that there are at least some pictures of every student.

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.

TEAM BUILDING

Team building exercises allow members to communicate feelings in a positive and healthy way and encourage gracious professionalism as they work together toward a common goal. They are also fun. Sometimes letting students have fun together allows them to develop communication and respect, leading to smoother progress when work resumes.

PROBLEM SOLVING

Keep it Simple, Silly — KISS

Introduce KISS to your team, “Keep It Simple, Silly.” 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 KISS principle, asking the team to distill its ideas down to make the solution as simple as possible. Driving and operating a robot can be challenging with a variety of obstacles on the playing field. At times like this, a simple robot is far easier to use than one that requires many complex steps to perform a task.

SUPPORTIVE LEARNING ENVIRONMENTS

Once the Challenge is unveiled, the students will often drive the goals of the team. This is perfectly acceptable and gives you a chance to step back and watch their progress. Encourage the students to continue to brainstorm. It's an important part of a team's planning process, and brings out creative ideas and produces better-thought-out solutions.

Let them lead. Remember that FTC offers students a chance to learn in a fun way. Students have frequent, daily opportunities at school to listen to teachers. This is their chance to lead. That does not mean that you cannot teach them, but watch the clock for the amount of talking that you do and the amount of “doing” that they do. For some learners, this chance to be a leader is difficult, and they may sit there waiting for you to tell them what to do step by step.

Listen, watch for cues, and facilitate. When you lead discussions or make suggestions, give choices to the team members. Facilitate the process the team follows to reach its goal, but allow choices within that process. One way to do this is to offer options to the team where every outcome is acceptable. That way, there will be no wrong answers. As coach, you then help the team reach consensus in a fair way.

Encourage thought and discussion. 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, maybe it will open up discussion. Do not scare away your quiet members. They have a lot to offer and a lot to gain from the team.

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 your role is to listen to team members and keep lines of communication open. While you may not be able to use every idea or suggestion, hear him or her out. Expressing a clear concept or idea is a great learning experience.

Be aware of verbal and non-verbal cues. You might need to interpret the conversation to facilitate teamwork through communication difficulties. If you validate team members' feelings, they are more likely to discuss problems. Sometimes acknowledgement or positive feedback may be all the response a team member needs.

A frustrated student might cross arms over chest and refuse to face teammates. It is your job to help this student re-join the team. We all deal with stress differently. One student might feel the need to walk away to reclaim personal space and another might attack the conflict head on. While neither approach is inappropriate, be sure to keep an eye on situations that may become heated or overly charged.

GROUP AWARENESS

The coach must be aware of and help regulate group dynamics. Again, students have joined your team to have fun, not work with others with whom they have a history of conflicts. Watch for this and be sensitive to the situation. Be conscious of personalities and interactions between team members.

If a dispute arises, help the team resolve it and then re-focus everyone on a productive task. Effective coaches use the similarities and differences of team members as assets to help the team get work done. Given lots of time and the excitement of the activity, you may find that they will willingly work together on their own.

MATERIALS AND MECHANICS

In this chapter, you'll find an overview of the key hardware and software components for the FTC program. You will learn what each element does, why it is important, and how it can help your team.

GENERAL INFORMATION

PLAYING FIELD

The playing field consists of the FIRST Tech Challenge Game Pieces set up on a foam-mat surface surrounded by a metal and Lexan field frame. This frame can alternately be constructed from lower-cost materials. You can find all the details for the setup of your playing field on the FTC website after the yearly game challenge kickoff.

This field typically sits directly on the venue floor, though sometimes it may be on an elevated platform to aid audience visibility. Every effort will be made at the event to ensure the field is placed on a level and even surface.

2009 MINIMUM REQUIRED PARTS

FTC Competition Kit (available after team completes registration)

ADDITIONAL RECOMMENDED TOOLS

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

SOFTWARE

There are three programming software options that your team can use to program its robot for competition in the FIRST Tech Challenge. These packages, Labview, RobotC, and NXT-G, vary in functionality and cater to users of different levels. You and your team will need to determine/select a programming package based on personal preference.

Occasionally a software vendor might make changes to their programming package. Make sure to check the www.usfirst.org web site for software update advisories and software update links. Programming software information can be located at <http://www.usfirst.org/roboticsprograms/ftc/content.aspx?id=>

For more information, please visit <http://www.usfirst.org>.

PROGRAMMING

We chose to omit programming tutorials from this text because there will be separate guides available from FIRST and our commercial partners at www.ftctraining.com website.

It is always a good idea to have more than one team member responsible for the programming and 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 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.

TIP: It is better to have team members who are not intimate with the code do the testing, following only the simple set of instructions.

The testing team will provide feedback to the programming team on what worked well and what they think needs improvement.

When the program and test cycles are complete and improvements in place, have the programming and testing team prepare the final set of instructions using the remainder of the group as test subjects. The final step in the programming process is to archive the completed work. Save the work in both printed form and on CD and store them both in a safe place.

ROBOTIC DESIGN

It is important to remember that:

1. Design is an iterative, ever-changing process.
2. Effective design involves making compromises.

What? When designing your robot there are many things to take under consideration. The first is “What will the robot do?” This is directly tied into brainstorming about “What should the robot do to win the game?” and “What objects could the robot manipulate?” These discussions all involve tradeoffs and compromises; maybe it is impossible to do everything at once. Your team will need to decide what is most important.

How? Once you have decided “what” the robot will do, you need 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 tough to figure out a feasible way to do it within the FIRST Tech Challenge restrictions. This is where experimentation is important.

Prototyping: The FTC Competition Kit provides for an infinite number of design possibilities; it is easy to build something, test it, and then rebuild it into something else. When faced with a challenge, start by searching for outside inspiration. Look for things in real life that would accomplish your task, and then try to find ways to duplicate these things using Kit parts. Brainstorm a multitude of ways to accomplish your goals, and then test them to see what works best. This is called prototyping. Once you have something your team is comfortable with, don't be afraid to tweak it so it works better -- then don't be afraid to tweak it again! Remember: design is an iterative, systematic process. It's okay to try things again and again to improve your machine and increase your results.

You can divide FTC robot design 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 a great many 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, and you achieve turning 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 doesn't matter what your drive train looks like so long as it is capable performing the following specific tasks.

Move the robot at a “reasonable” speed without overloading the motors.

Turn/Maneuver at a “reasonable” rate without overloading the motors.

Overcome any required field obstacles. (Climb stairs, etc).

Your team ultimately determines what defines acceptable performance. You need to experiment and determine what works best. There are ways to tweak your drive train to enhance performance in several areas, but like most aspects of design, you will have to make tradeoffs and compromises.

ROBOT MECHANISM DESIGN

Manipulation: In addition to moving around the playing field, an FTC robot has to manipulate various objects. Manipulation is perhaps the hardest aspect of the FIRST Tech Challenge, especially for newer teams. What looks simple to humans can be extremely difficult for a robot. In the early stages of the yearly game challenge, coaches often hear the team say, “We will simply pick up the gizmo and zoom over there and dump it.” Reality quickly sets in after the team begins to experiment with the game and begins to understand the difficulty involved.

Most years, the FTC games include several different methods of scoring. Each team must decide which methods of scoring are most important and how they will accomplish them. Often it is impossible to design one system to do everything, and this is where every team must make design compromises. Prioritize your robot functions, design as many as possible, and attempt to build mechanisms that perform multiple tasks. Try to create an elegant system that effectively utilizes the available resources to accomplish as many tasks as possible. It is often better to be very good at one thing than mediocre at everything.

Helps: Once you decide what to do, figure out how to best accomplish the task. The biggest challenge with mechanism design is the team members’ lack of experience with this sort of thing. Here are some ideas to aid in brainstorming:

Look at past FRC robots (try www.chiefdelphi.com).

Make a field trip to the local hardware store to look at their forklift trucks and scissor jack platforms. If you call ahead, they may give you a demonstration.

While at the hardware store, look for other gizmos to inspect and wander the aisles with an open mind.

Look at cranes, dump trucks, backhoes, and front loaders for inspiration. If you meet in a library, look through books that deal with machines or check out a few books and bring them to your team meetings.

There is inspiration in the world around you, take those ideas that apply to the task at hand, and work to convert them to the challenge. After the team researches mechanisms for a while, brainstorm, then prototype the ideas the team selects. Don’t waste time trying to get a perfect working model right away. What you learn from the quick and rough prototype may completely change your approach. Try to get multiple sub-teams working on various solutions simultaneously. Competition and learning can be effective motivators.

Try to minimize the weight and complexity of the 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 your team to look hard for simple solutions that will work consistently at the event and will be better in the long run.

THE ENGINEERING NOTEBOOK

This chapter describes the requirements for creating the Engineering Notebook, including formatting guidelines, judges' tips, and the use of various forms of engineering support. It also provides sample pages from an award-winning FIRST Tech Challenge Engineering Notebook.

WHAT IS AN ENGINEERING NOTEBOOK

One of the goals of FIRST and the 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 your robot, you will come across obstacles, lessons learned, and the need to draw things out on paper. This is where you and your team will use an engineering notebook, which will follow your team from kickoff throughout the competitions. Judges will review your Engineering Notebook to better understand your journey, design, and team.

For the first time since the inception of the FTC program, online and electronic Engineering Notebooks will be allowed for consideration. The guidelines for these Notebooks are below.

THE NOTEBOOK ITSELF

Electronic/Online: Teams may choose to use electronic or online programs to create their Engineering Notebook. For the purposes of judging, teams must print out their Engineering Notebooks and place them in a binder, no larger than 1”. All pages must be electronically numbered and in order. Only one copy is required per team. Online videos or demonstrations cannot be considered this year.

Written: Laboratory or documentation notebooks are available through your school or local stationery supply store. There are many different types to choose from, using the following criteria:

Use a notebook with a stitched binding.

DO NOT use a loose leaf or spiral bound notebook.

Numbered pages are recommended, but not necessary, so pages cannot be substituted or deleted.

Only **one** Engineering Notebook will be required per team.

GUIDELINES AND FORMAT

The FIRST Tech Challenge Engineering Notebook is a complete documentation of your team's robot design. It should include sketches, discussions from team meetings, design evolution, processes, the “AHAs!,” obstacles and resolutions, and each team member's thoughts throughout the journey. Here are the guidelines:

- Document everything!
- Organize your Engineering Notebook so an outsider will understand your team and journey.
- Make entries in **permanent ink**, not pencil.
- Start your notebook by introducing each team member and mentor with a brief paragraph.

TIP: Pictures with the bios are a great visual for judges to recognize each team member.

At the start of each meeting day, start a fresh page and record your team number, date, and start/stop times. Start each day/page with two columns:

COLUMN NAME	RECORDINGS
1. Tasks	What team is doing and discovering.
2. Reflections	Thoughts on what's happening and questions that need answering.

Every team member should make entries with initials and dates.

Record all designs and changes to your robot directly into your notebook. Include elaborate details and sketches if possible. Make notes and calculations in your notebook, NOT on loose paper.

TIP: A judging panel is always interested to see a unique design or playing strategy, so make sure you record the substance to support its reasoning.

Draw a single line through the errors/incorrect data. Do NOT erase or use correction fluid. Initial and date all corrections.

Use both sides of a page. Never leave any white space: "X" out or Crosshatch all unused space, and don't forget to initial and date.

To insert pictures or outside information into your notebook, tape the picture into your notebook and outline with permanent ink. This will indicate that something was there if it falls out.

TIP: Use pictures or sketches of your robot designs as part of a thorough documentation.

JUDGES' TIPS

Every notebook should be a work in progress, forever changing and developing.

Judges do NOT want to see a "final" copy notebook; they want the real thing complete with misspellings, stains, worn edges and wrinkled pages. Just remember to keep it real!

When turning notebooks into the judges at your event, place sticky tabs at the top of the page on your top 10-12 best moments as a team. Judges will use these pages as their preliminary review of your notebook. The more interaction your team has with mentors, engineers, or virtual engineers (see below), the better!

Remember to note each discussion or on-line discussion that your team has with a Virtual Engineer.

Don't be afraid to customize your Engineering Notebook to reflect your team's personality! At the end of the season, this notebook will be a great piece of memorabilia for your team.

NOTEBOOK EXAMPLES

The following examples were taken from Team 74 Overdrive from Bridgewater, New Jersey. They were the Amaze Award winners at the 2007 FTC World Championship, as well as members of the winning alliance.

TITLE 11/6/07 Meeting **Project No.** _____ **29**
Book No. _____

Start Time: 6:00pm **End Time:** _____
 We are getting ready for a scrimmage this Saturday-11/10/07.

Tasks	Reflection	Event-Dequise CALLED
1) Mount & adjust RRG - Rapid Ring Catcher	1) Required some additional mounting changes	\$5000.00
2) Tighten conveyor system	2) Tension rollers, Sealed	Donation
3) Test Catcher system	3) Could not test because gear links were not fully implemented	THANKS
4) Put v-system on bot	4) Postponed to next meeting	Uwe Holman
5) Mount electronics controller/AC	5) Guide to RRG successfully installed	
6) Wire robot	6) To be decided next meeting	

Problems:
 1) Ideas for autonomous

After our James worked on getting of conveyor system working. The most important part of our design is getting the ring gathering mechanism to work in tandem with the conveyor.

Recorded by: Minna Seiler Date: 11/6/07 Verified by: Erica Seiler Date: 11/6/07

TITLE Overview of Robot **Project No.** _____ **13**
Book No. _____

Here is an overview of the robot.

This is the gear rack/pinion system that we call the lift. It lifts the delivery cage.

Flip out deliver. This is the flip out deliver. It stores inside the robot by hooking the robot. When the lifts go up and the peg disengages, and it flips out.

Ring sorter. This is the ring sorter. It uses a servo motor and pushes out ring sorters. This hides under the cage system.

Drive train. This is the drive system. It uses a 84 tooth gear, one 32 tooth gear, and two 60 tooth gears. The 84 tooth sits on drive wheel. Both 60 tooth gears are powered by motor. 32 tooth gear is used as an idler.

LOCK AND LOAD

Recorded by: Tyler Noel Date: 4/14/08 Verified by: James With Date: 4/14/08

102 Project No. _____ TITLE Build Meeting 2/19/08
 Book No. _____




From Page No. _____

Task	Reflection
1 Update Lab notebook	1 Update
2 Test 4 intake	2 Pick up rings new
3 Build Claw design	3 Sensors & claw programming
4 Top-intake delivery	4 No Progress
5 Test Max 4	5 Tested intake & claw trial
6 Ring Sorter	6 No Progress
7 Decide on claw design intended to design both	

It realized that our prototypes for gear grabbing designs were good but still prototypes. We felt like we hadn't decided on a design yet, and we needed to begin building a final design. We talked about advantages & disadvantages and we also did a House of Quality diagram. This is what it looked like:

	Weight	Value
Fast Speed	5	5
Power (Strength)	3	5
Travel Distance	4	5
Ease of Use	4	4
Programming	5	3
Lock-to-load	4	4
Ability to hold	4	5
Ability to launch	4	3
Build Ease	4	3
	50	27

Key:
 5+ best
 4+
 3+
 2+
 1+ worst

We agreed that ~~the~~ the sensors & claw were equal in Fast Speed, Ease of Use, Lock-to-load/Ability to grab both rings. We were representing the best quality possible of both the sensors & claw in ~~all~~ all categories. Sometimes we don't agree and took a vote, averaging the results to get a specific number. The results came within one point. We decided that it was the case & we felt like the team was split down the middle on the issue. In the end, we decided to do a side-by-side build of both designs. We just didn't have enough process detail.

David, Nicolas & Henry working on the robot. When they tested it out, we could not pull the sensor out.

Recorded by: _____ Date: _____ Verified by: _____ Date: _____ To Page No. _____

THE TOURNAMENTS

It is virtually impossible to describe an FTC Tournament and no adequate way to prepare you for what is in store. Expect the unexpected and focus on creating a fun experience for your team members. Talk to them well in advance of the tournament regarding awards, and remind them that their season is about more than one day's results and not all teams can win an award.

FTC Partners and volunteers plan, coordinate, and run the tournaments. These events allow team members to come together to celebrate their accomplishments. Most events have opening and closing ceremonies, wonderful trophies and medals, teams with personalized T-shirts, hats, banners, and even some costumes.

For many FTC teams, the tournament is the reward for all their hard work throughout the season. While there are several types of FTC events, they all offer a fun and exciting way for teams to demonstrate the result of their efforts. Teams are recognized for excellence in various aspects of the Challenge and associated teamwork.

Another team's award takes nothing away from your team's achievements, and those accomplishments should be the focus of you, the students, and the parents. Sometimes parents unintentionally put pressure on their children to win. As coach, set the tone for the whole team.

EVENT TYPES

The FTC season culminates with several event types: Local events (including scrimmages and leagues), Qualifying Tournaments (qualifiers), and Championship Tournaments. Team saturation generally dictates the number and type of events in a region. Encouraging others to become involved in forming FTC teams is a good way to encourage more events.

Local Events

These competitions are generally, but not always, smaller than other tournaments. They are run by volunteers or teams who have the freedom to choose the format, judging guidelines, and awards. Local tournaments do not qualify a team to attend a Championship Tournament.

Qualifying Tournaments

These events usually follow judging guidelines and a similar format to Championship Tournaments, but have some flexibility in format and awards. Anywhere from one to twelve winning teams from these tournaments advance to that region's Championship Tournament. Qualifying tournaments do not qualify a team to attend the FIRST-sponsored FTC World Championship event.

Championship Tournaments

These tournaments abide by specific standards in format, judging, awards, and overall quality. The key volunteers responsible for a Championship Tournament are usually FTC Partners. Some Championship

Tournaments require that teams win at a qualifying or regional tournament in order to advance to the Championship. For many FTC teams and regions, a Championship Tournament is the highest level of FTC tournament participation. Championships may include teams from a geographic region, province, state, country, or several countries.

The FIRST-sponsored FTC World Championship event, held in conjunction with the FIRST Championship and the FLL World Festival, is a global celebration of FTC teams from around the world. The selection process for the FTC Championship event may change from year to year, depending upon the number of spaces available and the number of teams participating in FTC.

One or more teams from the Championship Tournament may be invited to attend the FIRST-sponsored World Championship Event, but this may not occur every year due to space restrictions.

TOURNAMENT REGISTRATIONS

Most FTC events are open and free to the public. We recommend that you encourage parents, siblings, sponsors, and friends to attend the tournament and cheer on your team!

CHAMPIONSHIP REGISTRATIONS

There will be a listing of confirmed Championship Tournament sites on the FTC website beginning in late September or October. In October, teams apply either online or directly with the tournament organizer for most Championship Tournaments. Many FTC Partners coordinate their own registration process, so check the FTC website to determine how your team can apply. In order to receive FTC updates during the season, be sure that your team's team profile contact information is up-to-date and complete before registering for a tournament.

REGISTRATION PROCESS

Due to limited site capacity at some tournaments, a registration does not ensure acceptance at an event. Your team will only be eligible for a spot at the FTC World Championship at the first three Championship Tournaments you attend during the season.

Once the registration period ends, confirmed teams receive detailed information from the FTC Partner hosting the event. This information includes specific details about the site, special instructions, forms, and schedule information. Teams can expect to pay a fee to attend a tournament. The tournament coordinators will inform you of the fees and the payment procedures.

For tournament information, go to the FTC website (<http://www.usfirst.org>) under Events.

The event schedule may not be complete until the season is well underway. Consequently, the tournament registration process is entirely separate from the on-line team registration process.

If you are applying for a Championship Tournament, determine whether you need to attend a qualifying or regional tournament first by checking the tournament information. If so, confirm what criteria determine advancement to the Championship Tournament.

Confirm event start and end times, parking details, what to bring, food service, etc.

Obtain "Consent and Release" forms and complete and return them to your FTC Partner prior to the event. Remember that students under 18 must have a parent or legal guardian's signature on the form.

Critical: Any team members lacking the completed "Consent and Release" forms at the event will be ineligible to participate.

TOURNAMENT LOGISTICS

Once you register for a tournament, either through the FTC website or with your local tournament organizer, it's a good idea to check the tournament website regularly for changes and updates. Every tournament is different in some way. *FIRST* gives latitude to tournament organizers to adjust the format to match their conditions.

If you have specific concerns, always double check with the tournament organizer. If you need to travel to a competition, follow your school or other sponsor's procedures. Make sure each driver is properly insured and you have any relevant, completed paperwork, such as school permission slips and the *FIRST* "Consent and Release" forms.

ADULT SUPERVISION AND SAFETY

Adult supervision is a critical factor for a successful tournament. Whether the team is in the Pit, moving about the site, or performing competition rounds, make sure all team members are supervised. Remind each person attending with you that the team is expected to demonstrate FTC values at all times. This includes other mentors and team parents. You do not want the inappropriate and/or non-GP behavior of an adult with your team to 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.

ROOKIE TEAMS

Participating in an FTC tournament is the best way for your team to learn! Take part in at least one competition. Students learn from seeing other teams' robots, and they usually leave an event with great ideas for next year. You will too. You may even discover that the students accomplished more than they thought, and they always have fun. That's what FTC is all about!

AWARDS ELIGIBILITY

To ensure fairness to all teams and provide equal opportunity for teams at a FIRST Tech Challenge Championship Tournament, teams are only eligible to win an award at the initial 3 Championship Tournaments that they attend for the season. Those teams who compete in 4 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.

TOURNAMENT AREAS

This section will describe the various areas of the competition site.

REGISTRATION

Upon arrival at the tournament, your team must check in. Tournament hosts require that every attending team member and volunteer bring a signed "Consent and Release Form". Find the form for download on the FTC website.

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. To make the process smooth and reduce the wait, keep your forms organized and ensure that you have all the necessary paperwork when you arrive. You will also have to submit your Engineering Notebook and a new signed "Consent and Release Form" during registration at *each* tournament you attend.

The Registration Table tournament volunteers will tell you where to find your pit station, the competition area, judging rooms, and where you may eat lunch. They will also give you a schedule for your team.

THE PIT

The Pit will be your home for the day. You may be assigned a specific location to set up your station when you register, 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 your station, be gracious and keep your team within the confines of your allotted space.

Generally, teams will have a table provided in their pit area so you can set up a display for other teams to see, show off your robot, and make minor repairs. Some, but not all venues will provide chairs. If your team has any posters or banners, set them up to showcase your teamwork and team spirit. Bring additional chairs as needed.

Electricity may be provided at the Pit, but if you choose to bring a laptop, make sure it's fully charged. Some venues have no power other than a few scattered laptop-recharging stations, so plan accordingly. You may want to bring along a heavy-duty extension cord and a power strip. Be sure you arrive with

everything you need. Many tournaments send out lists of “Must Bring,” “Should Bring,” and “Thou Shalt Not Bring.”

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 you may have to reserve field time. Please remember to use gracious professionalism when sharing the practice fields with other teams.

COMPETITION AREA

The competition area is where you will find the official robot competition playing fields. Referees score the rounds in this area.

TECHNICAL JUDGING ROOMS AND EQUIPMENT

Judging for the technical awards generally, but not always, takes place in rooms separate from the rest of the competition. Your team will report to each of these rooms at some point during the day, so make sure you know where they are and when you need to be there. Always show up a few minutes early for your scheduled interview time. If you have a schedule conflict for judging and one of your competition rounds, please inform an event volunteer to ensure the judges can be notified.

HOW THE DAY WORKS

Be flexible, and check in with the pit administration or registration table if you have questions about the day or your team's schedule.

TIME MANAGEMENT

After you set up your pit station, review the day's schedule with your team members. Competition schedules are usually very tight, so it's important that you are ready and on time. Don't miss your round or judging session. If the schedule for the day does fall behind, the tournament organizer may juggle your team's interviews to accommodate the changes. Be sure to allow plenty of time for inspection. It is best to have your robot inspected early to ensure that your team is not standing in line for inspection when your first match is scheduled to begin.

As the coach, you will concentrate on getting to scheduled judging appointments and rounds on time. Delegate the responsibility of keeping your team together to other volunteers. Some events hold a coach's meeting where you receive up-to-date information and have an opportunity to discuss any robot rule clarifications.

OPENING CEREMONY

Usually, the opening ceremony is very high energy and sets the tone for the day. At most tournaments, teams have about an hour for registration, setup, inspection 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. Judges and special guests are introduced, the Challenge and scoring are explained, and the national anthem is played. 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 or prepare to meet with the judges.

QUEUING AND ROUNDS

During the day, your team 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 loss of points.

Listen carefully for queue calls. You will line up for rounds or judging sessions in the designated queuing area for each part of the program. 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. The tournament organizers are volunteers, just like you.

When your round begins, the driver team will be on the playing field while you get your team settled in the team seating/standing area. Your robot operators should follow the Field Manager's instructions on the playing field. Before starting, have them scan playing field and their robot to make sure everything is set up properly. Once the match starts, team operators may not handle the robot. Keep in mind, you are **never** to handle the robot before or during the match.

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 your students question the score, you may send one **student** to speak to the referee. 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. Graciously accept the referee's decision. For game-specific FTC rules, policies, and practices, please refer to the game manual as posted on the FIRST website each year.

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

ADULT INTERVENTION

Remember that this is the team's opportunity to shine. Your role is to facilitate, and adult interference during the judging process will reflect negatively on your 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 your team's score. **Remember, the students come first!**

It is often difficult for judges and event organizers to determine if the adults accompanying a team are coaches, parents, or both. Be sure that you communicate FTC's rules on adult intervention and gracious professionalism to all of the adults and students accompanying your team. The behavior of one person reflects on everyone associated with the team. When there are disappointments at a tournament, students take their cue from the adults around them. Please remember to model FTC values, honor what the students achieve, and help them focus on those achievements.

Some tournaments have restrictions on the number of adults that accompany students into the sessions. Please recognize that these rules are not designed to make the judging or performance process secret, but to ensure fairness. Your team should be proud of all it has done in FTC, and you and other adults must trust the students to represent themselves.

Sometimes teams assume that another team could not have done the work they present without the direct involvement of adults. Remember that students are remarkably creative, and some are highly sophisticated at programming or software applications. Don't assume that you know what a team is capable of, and don't let your team members make assumptions either. Participate in the FIRST Tech Challenge for the benefit of your students, and set a good example.

FTC JUDGING

In addition to robot matches, teams are also eligible to win several judged awards. During scheduled interview sessions, judges will ask questions, and team members will need to articulate and demonstrate various aspects of their FTC experience. Also important to the judges is your team's knowledge of your robot, teamwork, demonstration of FTC values, and the influence of the team's mentors. The focus is on the team members and their ability to express what they have learned.

Usually, teams meet with judges regarding awards for a designated time period. Some teamwork judging is simply observing teams in action. Judges may also evaluate teams during conversations and observations in the Pit and competition areas. These informal conversations are a wonderful opportunity for judges to hear unique stories and uncover exceptional qualities not readily apparent during the more formal judging. The process is not meant to overwhelm the students, and you should encourage them to feel comfortable speaking with the judges because judges understand the interview process is stressful for some students.

Check with your tournament organizer to find out what judging format will be used. To keep the schedule on target throughout the event, teams should arrive five minutes before their scheduled judging appointment. 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 sessions remain on schedule.

HOW JUDGING WORKS

At Championship Tournaments, FTC judges use a set of guidelines that represent qualities FTC considers important and useful for evaluating team performance. You can find the guidelines in the Appendices section. Judges also refer to a list of judging questions and may even add their own. The judges are volunteers, and they receive training from FIRST or from the local FTC Partner before the event.

Awards Determination Process

Choosing the award winners is, by far, the most difficult job of the day, and the 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 make a great effort to be as fair as possible. Be patient during the deliberation period.

To pack or not to pack: This can be an ideal time for your team to pack up your table and displays and load up the cars in preparation for departure after the awards ceremony. Your tournament may choose to do a demonstration, have a special guest speaker, or run an exhibition round on the playing field to keep the crowd occupied during judges' deliberations. In case your team will participate in an exhibition round, be sure that you don't pack up your robot!

If your team doesn't receive special recognition with an award, remind the students of all the success and achievement that they have experienced over the season. Not every team can win an award. FTC is about an entire season, not just one day. Showing support for other teams is an important part of Gracious Professionalism and teamwork.

THE CLOSING CEREMONY

Teams should return to the main competition area for the closing ceremony. 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.

INFORMATION, PLEASE!

This chapter provides teams with necessary information for contacting FIRST Tech Challenge staff, accessing technical support, and using the FIRST and FIRST Tech Challenge logos.

FIRST CONTACT INFORMATION

You can reach the FIRST Tech Challenge staff by phone at (800) 871-8326 or email at FTCteams@usfirst.org. The office is open Monday through Friday from 8:30 a.m. to 5:00 p.m. Eastern Time. Be sure to provide your FTC team number in your message. Refer to the information below for the appropriate help resource.

GETTING ANSWERS TO YOUR GAME QUESTIONS

Only registered teams may post questions to the FTC Game Forum. Your team login and password to the forum can be found in the team registration site. Log into the registration site and go to the main page for your team. Your login and password will be displayed on the right hand side of the screen.

Log on to the forums

Click "General Discussion"

Click "FIRST Tech Challenge"

Use the following guidelines when submitting your questions to the FIRST Tech Challenge Forum.

- Only team leaders can email questions.
- Please submit one question at a time.

TECHNICAL AND TEAM SUPPORT

For detailed information on the FIRST Tech Challenge program, robot kit and accessories, playing field, etc., visit the following websites:

Website	Support Description
FTCteams@usfirst.org	General info and questions about the FIRST Tech Challenge
http://www.usfirst.org	FIRST Tech Challenge information, registration, FAQs, and team resources

www.ftctraining.com	Online tutorials for RobotC, NXT-G, and Labview. The bulletin boards at the site will be managed daily by Robotics Academy staff.
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TEAM DEVELOPMENT SUPPORT

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

Regional Directors assist with team-related needs such as finding a team sponsor. To find out the name of the Regional Director in your area, send an email request to ftcteams@usfirst.org.

FIRST Senior Mentors and VISTA Volunteers, a corps of 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 your area, send an email to ftcteams@usfirst.org.

USING THE FIRST AND FTC LOGOS

We encourage teams to develop and promote team identity. It's a great way to help FIRST judges, announcers, and audiences recognize your team at the competition, and it is also a way to help you create a "buzz" about your team in your community.

You have incredibly creative opportunities in terms of designing your own identity. You can find examples of how teams "brand" their efforts through incredible team logos on robots, t-shirts, hats, team websites, banners, fliers, and giveaways.

Download the FIRST and FTC logos and Logo Standards information from the FIRST Tech Challenge website at <http://www.usfirst.org>. Keep in mind the following when working with the FIRST and FTC logos:

Positive Promotion: Use FIRST and FTC logos in a manner that is positive and promotes FIRST.

Unmodified: Use the FIRST and FTC logos without modification. This means that you will use our name and the circle, square, and triangle as you see it on our website or letterhead. You can use it in red, blue, and white, or in black and white.

Modification Permission: If you have an interest in modifying the FIRST and FTC logos, you must first request permission. FIRST is happy to talk with you about modifications after you submit a written request letting us know why you want to modify the logo, how you plan to do it, and where you plan to apply it. Send an email request to Marian Murphy, mmurphy@usfirst.org, Marketing and Promotion.

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 Marian Murphy at mmurphy@usfirst.org.

CELEBRATING YOUR FTC SEASON

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

It's important to recognize what you've done together. Many teams celebrate at tournaments; others celebrate in their own way. Do what works best for your team, but be sure to think ahead and include a plan for celebration in your schedule.

HOST A LOCAL EVENT

One option you might want to consider is hosting your own unofficial local event. Invite other teams in the area to attend and participate. You may do this in addition to subsequent FTC competitions or the Championship event. Visit the Events section of the FTC website for more information.

If you host an unofficial local event, you may see team members learn new skills and take more responsibility for their work because they are running the event. Students 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.

You can customize local events to suit your team's needs and resources. The flexible format for local events allows you to include elimination rounds, special robot challenges, teamwork activities, and demonstrate other special components/subassemblies that your 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 your team chooses to do, let other participating teams know what they can expect.

RECOGNIZE YOUR TEAM MEMBERS

Plan your own celebration, and invite family and friends to see what your team has accomplished. Ask your school to hold a special assembly or ask your 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 your team to write down what each member contributed, then present each student with a certificate showing the contributions that other team members recognized. You could also 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 translate to the professional world.

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

A certificate presentation could be part of a larger ceremony with your team. Take a picture of each student with his certificate. You could hold this ceremony as part of a celebration dinner or pizza party. No matter what you do, make it special!

APPLAUD YOUR SPONSORS, MENTORS, AND VOLUNTEERS

Be sure your 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. If you want 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.

ACKNOWLEDGE EACH PERSON

Whether or not you attend 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 your most important job as a coach, so take time and be thoughtful about what you say to each student.

SALUTE THE GROUP

Tell the group how their accomplishments as a team were special, innovative, or unique. Tell them what they did that changed you, or changed the way that you think about them. Sometimes it's difficult to say the words, but it's important that the team understands what coaching them has meant for you. Recognizing the entire team, as well as praising each student individually in front of his teammates, will create a lasting memory of working with you and your team on the *FIRST* Tech Challenge.

Now pat yourself on the back. You have had an influence on the lives of these students and expanded their horizons.

Congratulations on a job well done!