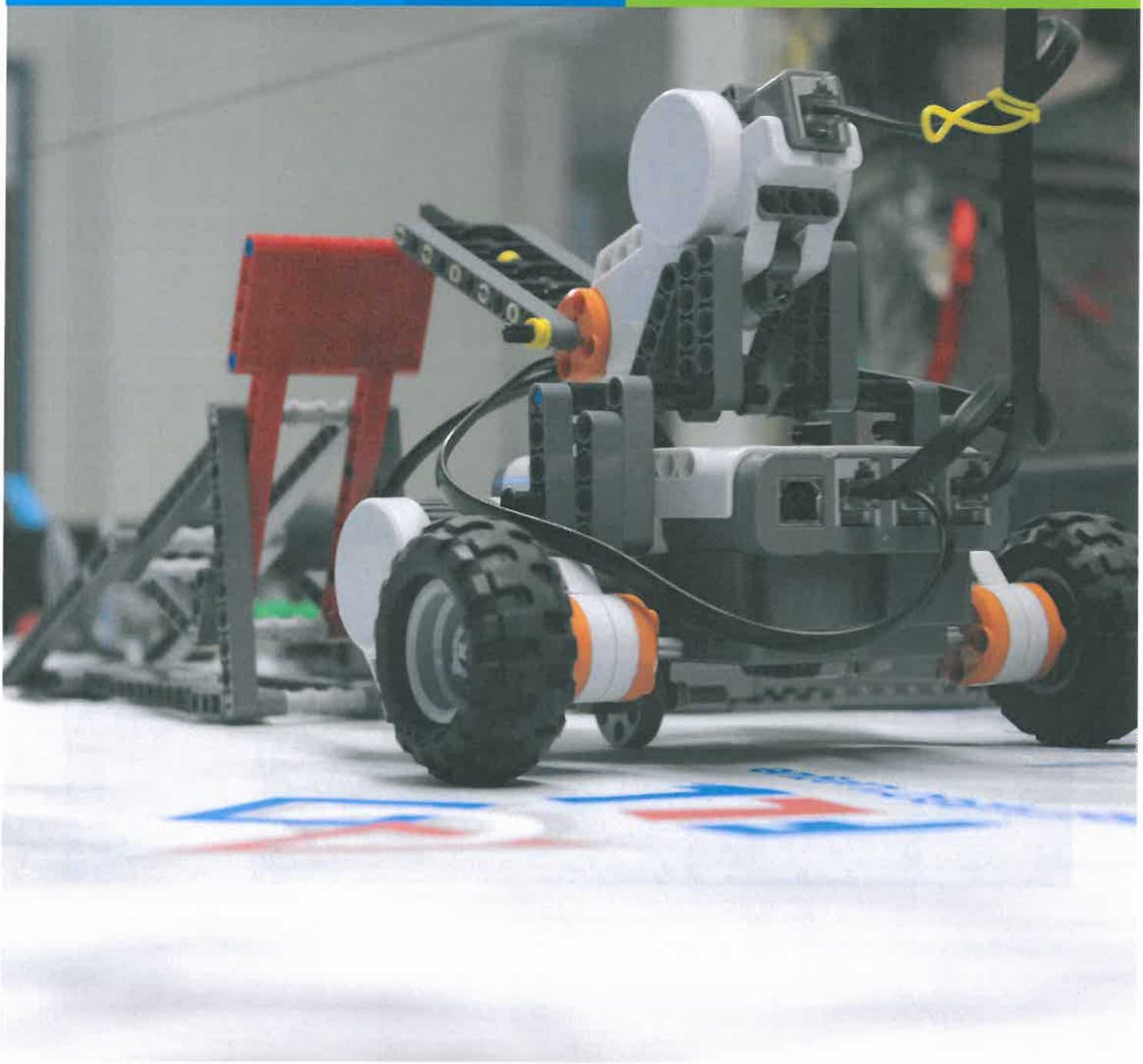
So You Want to be a Robotics Mentor?

A Guide for High School Students



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Are We Crazy?

Short answer: No! Our goal is to inspire younger students, of all backgrounds, to explore STEM (Science, Technology, Engineering and Mathematics) in a fun, challenging, engaging atmosphere – so that they feel empowered and enabled to pursue college degrees and careers in these areas.

Hello! Welcome! If you're reading this, I'm guessing it's because you are a high school student (or other curious individual) who might want to be a robotics mentor. If you're not, that's perfectly fine as well. Quick introductions are in order. My name is Isabel, and "So You Want to be a Robotics Mentor?" is my Girl Scout Gold Award Project. The Gold Award is the highest honor a Girl Scout can receive and involves the formulation, planning, and execution of a sustainable service project. For my project, I sought to combine my love of science, technology, engineering, and math (STEM) with my experiences as a former *FIRST* LEGO League (FLL) team member, Girl Scout, and FLL mentor with my high school's *FIRST* Robotics Competition team, Falkon Robotics, Team 589.

Merriam-Webster says that a mentor is "a trusted counselor or guide." On a high school robotics team- really any type for that matter- they're the people you look to for guidance on navigating design and strategy, time management, and interpersonal matters. In a Girl Scout setting, you call them "troop leaders." Mentors are role models, inspirations, confidants, and friends. They help us grow. As a high school student, most of the people you consider mentors are probably adults. But to an elementary or middle school student, you yourself can be a mentor.

Maybe you're not interested in robotics mentoring for all of the sentimental reasons I just mentioned. You could be here for a chance to share your passion for STEM, an excellent leadership and community service opportunity, resume or college application building, or because some enthusiastic friend roped you into it. Everyone has different reasons, and a fair amount of the time, similar results. Whether you intend to or not, for the length of the season, you're going to be looked at by ten kids as that trusted mentor and guide, and as they grow, you might too.

In case you haven't figured this out, I highly recommend the experience. As a person that was once in your shoes, I know it's not an easy one either, especially when coupled with school, sports, and other commitments. But that's what this guide is for!

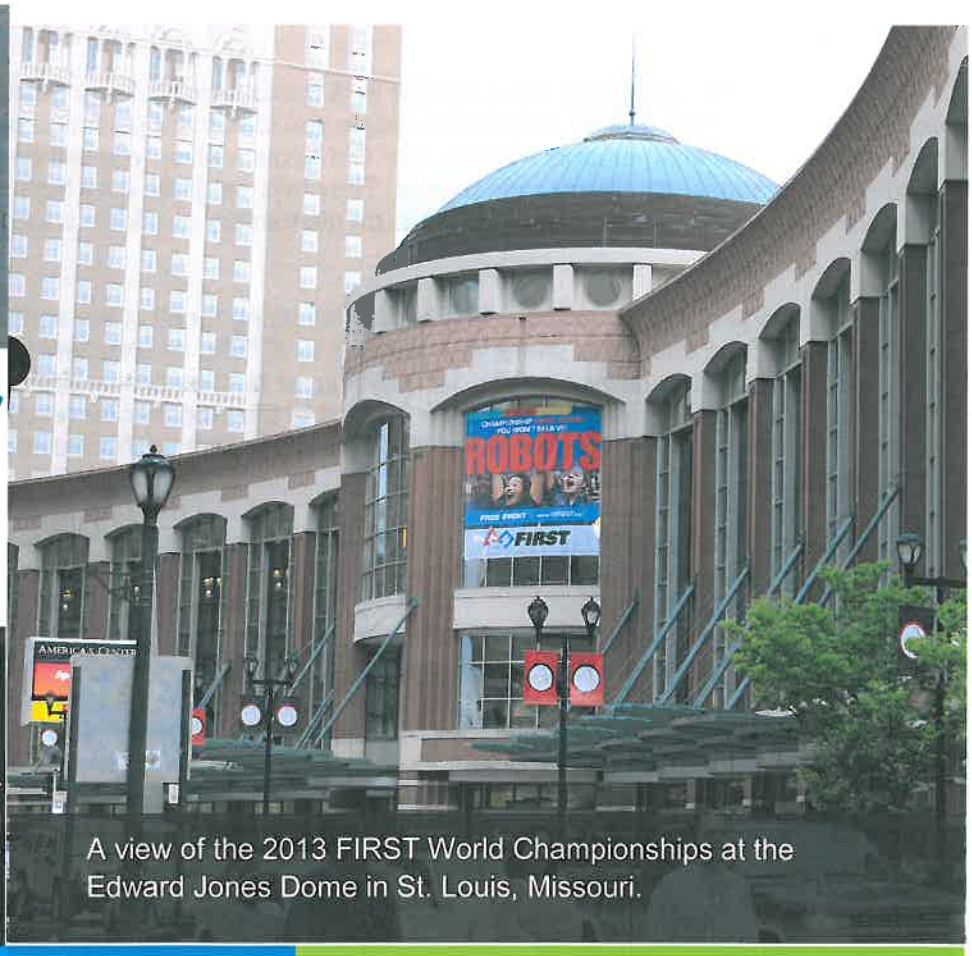
Being informed makes mentoring easier. Whether you already know a bit about how FLL works because you were on a team or have mentored before or are new to this role, it really helps to take the time to familiarize yourself with the program. "So You Want to be a Robotics Mentor?" is a supplement to existing sources aimed specifically at high school students interested in volunteering as youth robotics mentors. It covers relevant and helpful information with respect to the planning, leading, and troubleshooting of an FLL season. There are examples from the FRC team I was on as well as advice from high school Falkon team members- these are in neon blue. I hope that this guide of tips, tricks, and tested methods gathered from a high schooler's perspective will aid you in your understanding the roles and responsibilities of being a mentor and perhaps also see just how rewarding and impactful this experience can be.

What is.....*FIRST* and *FIRST* LEGO League?

FIRST, or For Inspiration and Recognition of Science and Technology, is an internationally recognized organization whose goal is to promote and foster youth interest in the fields of science, technology, engineering, math. As a high school student, you might be involved in one of *FIRST*'s programs such as the *FIRST* Robotics Competition (FRC) or the *FIRST* Tech Challenge (FTC). *FIRST* has a whole family of programs designed to inspire kids of all ages, from elementary all the way up to your high school level. Maybe you even participated in one of these when you were younger.

FIRST has developed a "progression of programs" starts with *FIRST* Junior LEGO League, for kids ages 6 to 9, or kindergarten to 3rd grade, moving on to *FIRST* LEGO League, for ages 9 to 14, equivalent to 4th to 8th grade, followed by FTC, for ages 12 to 18 and FRC, for ages 14 to 18. Each program is increasingly complex, and has to goal to challenge children to work collaboratively and create machines to engage in friendly competitions. It is this team-centered focus that makes the mentor role both challenging and critically important.

Regardless of age or previous participation, the aim of the programs and the impact are similar. From your position as a mentor, you'll notice parallels between what the team is working on in FLL and what you do in FRC. Sure, you both build robots. But just as you and your team program your robot to perform during the autonomous period, the kids will program their bot to complete missions autonomously. Most of all, you'll notice that a lot of the skill sets are the same. Approaches to design, code, strategizing, presenting, and working with others will be applied just as often on a LEGO team as they are during your build season. It's similarities like these that in part make *FIRST*'s mission so successful and that make mentoring more insightful and relevant for you.



A view of the 2013 FIRST World Championships at the Edward Jones Dome in St. Louis, Missouri.

Support Structure for Mentors

Even mentoring is a team effort. Working with others, including other high school students and adults, can create a less stressful and rewarding experience for you and a more fun and attentive experience for the FLL team members. Here's one example of a structure for organizing people, one my own team developed from our experiences as mentors.

FRC Team Coach and Mentors

FRC team coaches and mentors are like mentors for the mentors. Who better to turn to for advice than the folks that lead your own team? 589 has weekly meetings with our lead mentor where, during the FLL season, mentors and site leads can discuss what's happening with their teams and seek input from others on any problems that might be occurring.

Site Managers/Leads

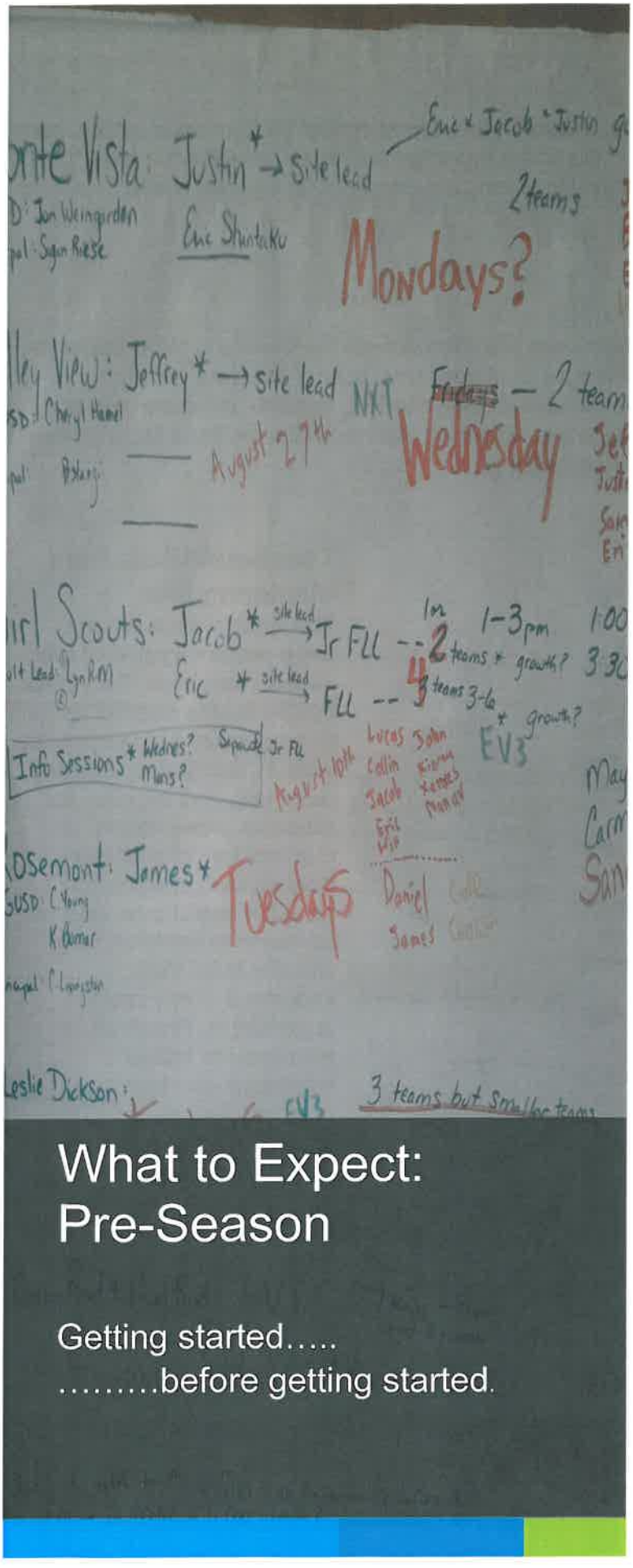
Each site where the high school team hosts an FLL team has one student designated as the site lead, or leader of the high school mentors. This individual's role lies in making things run smoothly. He or she coordinates the high school mentors, making sure that each team is getting the guidance necessary from their mentors. He or she also helps to resolve any disagreements between mentors, though will turn to an FRC team coach or mentor for extra help too. Site leads also work with the adults from the site, ensuring the teams have the right resources and turning to them as a resource if they need extra help with a kid.

Teachers/Adults from Mentoring Site

The adult(s) or teacher(s) are a necessary part of the support structure. They help get the teams needed items (for example, a classroom to work in, field set-up kits and robot kits, and supplies for research presentation, or markers for collaboration discussions) and provide valuable assistance when it comes to actually working with the kids. Very importantly, they provide *supervision*. These adults also provide critical interfaces with team member parents, FIRST tournament officials, and school or club site administrators.

Team Mentors

On the front lines, there are the team mentors. These high school students serve as the direct interface with the kids. They know everyone's names, teach new skills, answer questions, and help the team work together. Generally, teams will have two or three mentors working with them, depending on the experience the mentors have and the number of volunteers at that site. This provides a layer of stability too, since it ensures the team will not be left alone if one of the mentors can't make a meeting.



Welcome to the pre-season! This is the period of time where you and your teammates will take care of the groundwork needed to set up an FLL team and season. Taking care of these things will not only make your life later on less stressful, some of it is necessary.

At the end of your FTC or FRC season in April, you'll probably want a little bit of time off. After a couple of weeks though, it's time to start thinking about planning, advertising, and recruiting for FLL, since team registration begins in May. You'll want to get the word out to potential FLL-ers and their families before the school year ends and make a timeline or calendar for when the team will start meeting.

First up: potential FLL sites. What elementary and middle schools are close to you? Are there after-school programs, clubs, or girl or boy scout troops in your area? Will the team come to your location or will you go to them? It is important to consider geography, distance from your school to the proposed FLL site, and how easily your high school mentor team can get to that site if there is travel required.

If you have mentored before, where did your team mentor last year? Would they (and you) like to continue volunteering and supporting teams there? Would you like to expand or take some pressure off your mentoring program with fewer teams?

Either way, these are questions you'll need to answer first with **your** team (ex. FRC students who will serve as mentors and the adults who support you). It is also critical to make sure there are adults from the school or community organization to support your efforts. If this is your team's first year mentoring, it is important to not commit to more than you are able to support. Consider starting with one site and one or two teams and then grow the program from there. In other words, decide what you and your teammates are able to support for the upcoming year, then contact sites accordingly.

Example: Set up a meeting with adults at the mentoring site to discuss their needs and wants and your plans for the upcoming season.

Make connections! Then reach out to them! Contact your former elementary and middle school teachers, principals, after school program leaders, etc. Approach them with a thorough, detailed plan and explain what you and your team would like to help with.

If this is your first year your team will be helping FLL teams out, you're going to need to do a little more maneuvering. You might choose to set up a team on your own, find an existing team and help to offer to help, or approach a school or group and offer to create a team with them.

Example: On 589, we have found the last option to work particularly well at local schools and with scout troops.

Once you've identified a couple of potential sites, you'll need to ensure they have the right resources for this program (they'll probably want to know what they need to put into this deal too). You are going to need a **person from that site** who can stay and supervise meetings and come to competitions. At a school, for example, this could be a teacher or computer resource specialist.

Note: At some schools, teachers and administrators may receive a stipend for the extra time they'll be spending outside of class. Others may choose to volunteer their time. This is the kind of thing you'd want to cover at a meeting with principals and teachers.

Basically, you're going to need an **adult** who is connected to the kids you are leading. On your team's side, you are going to need **mentors** (high schoolers like yourself!), probably two to four per team depending on experience. The team needs **a place to meet**; examples include classrooms, scout or community centers, or even a person's house. If you opt for this last suggestion, try to make sure there's a place where the robot and other team materials can be stored where they won't be worked on outside of meetings.

Another essential resource is **a computer**, preferably one for each team and of the laptop variety. Multiple teams could share a computer for programming and research, but it will likely become tricky to ensure adequate access for both groups and share at a competition. And of course, you need **kids**.

Woohoo, children! FLL teams are made up of a maximum of ten, though you may find that a number lower than that (say, 7-8) is easier to manage and a more ideal team size. To join a team, kids can (well, their parents can) pay a fee, just like they would for a baseball team or an afterschool enrichment program. As a mentor, you can also look into grants to help reduce the cost for participants. There are required materials for every team that this money will cover, including registration, a robot kit, and a field kit.

Example: 589 once helped adapt a program at a middle school to still involve LEGOs, robots, and STEM, but didn't have teams competing officially in FLL. This was done because it better suited the needs of the site, but could also be used as an idea if funding becomes an issue.

Kids for a team come through recruiting. Host demos, send a flier home in the weekly school folder, leave fliers in an office, plan an informational meeting for interested families, send an email blast, put a notice in the local newspaper- get creative with your recruitment efforts. It's a cool program, so you may generate a lot interest. If you get a lot of responses-too many for the number of slots you have- you and your team may need to consider adding another FLL team, running it "first come, first serve", or implementing a simple application with the help of site adults.

Once you've got all these ducks in order, you can move on to planning and going through the actual season: setting up meetings, picking a team name, mentoring, oh, and that robotics stuff. :)

"This is all about the kids – make sure you stop and listen to their ideas. No matter how crazy those seem. Teach them to work together and be good humans."

- Coach Lyn

One of the hardest parts about FLL, indeed about all *FIRST* programs, is figuring out how to help manage the PEOPLE part of things. Let's face it – I can probably conceptualize a robot more efficiently alone. Most likely, I could do a pretty good job of building that robot by myself, not fighting anyone over the choice of wheels, the design of the drive system, or the placement of the motors. And just maybe I could so a passable job of competing with that robot on the mission playing field. As for the research project? Isn't it easier for me to go to the library and read by myself, posit a solution to a challenge, validate the math and physics and science of my proposed solution, and draw up a power point presentation outlining my process for the judges to read?

But in their wisdom, the program architects of *FIRST* have realized that in our professional world today, very little is accomplished by individuals entirely on their own. Even the smallest Silicon Valley start-up needs additional help in seed funding, crowdsourcing, and implementation. The working world today is a collaborative, communicative, sharing one – where we must engage with teams to achieve key milestones, architect solutions, and complete deliverables on time and within budget.

FIRST LEGO League's Core Values interweave this critical skill development throughout all parts of the program.

- We are a team.
- We do the work to find solutions with guidance from our coaches and mentors.
- We know our coaches and mentors don't have all the answers; we learn together.
- We honor the spirit of friendly competition.
- What we discover is more important than what we win.
- We share our experiences with others.
- We display Gracious Professionalism® and Coopertition® in everything we do.
- We have FUN!

What to Expect: The Season

A *FIRST* LEGO League season is constructed from three main parts: the Robot Game, the Project, and Core Values. The Robot Game and the Project serve to introduce the exciting fields of science, technology, engineering, and math (STEM), their applications, practices, and global problems that STEM is being applied to today. The Core Values are used to teach team members about how working together, attitude, actions, and ethics tie together to their experience on a team and the solutions they produce. As a mentor, your job will be to help the team balance between these activities, prioritize appropriately, and support them along the way.

To help keep your team on track, it is important to come up a schedule that provides time for the critical activity types required of each part of the FLL challenge. The following are just really basic examples of the activities required for each. It will be your call on how to divvy up time at meetings based on your assessments of where the team is at. Maybe the kids will ask for more time to work on programming, or they'll need to work on practicing the Project presentation - change up the meeting plan to fit the needs of your kids. Most of the teams we coach meet only one or two times a week.

Most of the FLL teams mentored by 589 meet only once a week for two to three hours. We often ask team members to do "homework" outside of team meetings, exploring research topics and researching solutions, explain the robot game to parents and siblings, and the like.

One thing we have learned is that no matter how busy the meeting, always remember snack! Especially during meetings longer than an hour, snack time provides a much needed mental and physical break for everyone involved. Hint: 589% of people love Goldfish as the perfect team snack.

Team Management

One of the most critical, unspoken elements of FLL is helping the team learn to be a team. Teams need to start their year by laying out a clear set of Management Principles (for example, how they want to negotiate decisions: open voting, paper or secret ballot, raising hands, etc. Also determine if agreement is 100% concurrence or two-thirds majority, how are appeals raised and handled, if at all, etc.) This is a good opportunity for a conversation about respectful discourse, what it means to be a good listener and a good speaker, and what practices will be followed when the team is working through the challenging nature of discussing robot strategy, design options, determining research topic and the like.

Team Identity

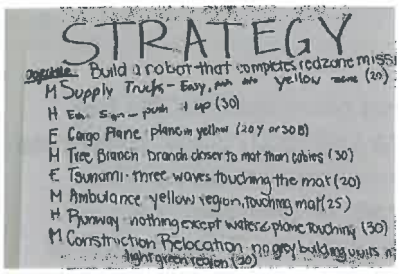
Development of a team identity is much more than a clever team name or silly headpiece. Ranging from chants the team shouts when moving from one competition area to another to unique handshake and "high five" routines, and from overall fashion statements (matching leggings, bow-ties, safety glasses and more) to colorful team banners, right down to inexpensive "giveaways" that the team presents to fellow competitors, this is the key to expressing team unity. When discussions relating to robot design or research strategy bog down, switching gears and asking the team to take a step back and focus on a different element of the FLL experience is a good way to ease tension and re-establish a sense of purpose.

Research Project

Work to have the team think outside the box – the goal of the research project is to approach the topic in new and different ways . Worry less about the "what is really possible" and have them focus on developing their argument in depth, whether that be through doing the math or building a model of the solution. It is critical that the team understand that the project presentation is a TEAM EFFORT – and that the judges hope to understand each team member's role in this core element of the FLL challenge.

Understanding the Robot Game

It is too easy to fall back on telling the team to watch the game video and read the rules and then let them charge off to build a robot. More often than not, a majority of the team will have an incomplete understanding of all of the missions and the movement that the robot much achieve to earn points (push? pull? place an item? retrieve an item? activate a lever?) Spending time studying the field as a team and in smaller groups is well worth the effort. If you are working with multiple teams, have them discuss across groups.



Planning Game Strategy

There is not one "right" solution when playing the FLL Robot Game. Once the team has examined each of the scoring missions, have them map a variety of routes to reach and achieve those missions. Can missions be grouped together? When should the robot return to base? How are in base mission pieces managed? Discuss mission sequencing, and be sure to talk about what happens in the event of robot failure, especially as this relates to field debris and robot rescues.

Robot Design and Programming

Team members will want to jump in to this first – but it is a good thing to slow down, take a deep breath, and have the team conduct a design review early on in the design phase. Have team members discuss the requirements – what do they expect the robot to DO? How do they expect it to DO THAT? One cardinal rule to follow: never purposefully de-construct what another person has built. Work to have subteams build and program together and then share ideas. Most of all, work to have every team member to have a voice and an opportunity to contribute to the final robot design.

Core Values

Discussing the FLL Core Values at each team meeting, asking team members to explain each CV in his or her own words, creating colorful posters of key CV terms and synonyms, designing word games, rhymes, skits, or songs to reinforce those CVs that the team wishes to highlight – all are pathways to deeply ingraining the Core Values into every day team practice. Consider drafting a contract based on the Core Values, and asking team members, mentors, and parents to sign, acknowledging their support.

Practice, Practice, Practice and Repeat, Repeat, Repeat

Not enough can be said for providing team members the time and opportunity to practice every element of the FLL challenge – not just the robot game, and not just the presentation! Ask team parents to step in as practice judges, have them review the rubrics, and set aside time at each team meeting for practice of the robot design and programming interview, the research presentation interview, and the core values interview. If you have more than one team, ask them to be judges for their fellow teams. Even if a team has only successfully programmed three or four missions, flawless execution of these will bring tremendous feelings of achievement.

Safety

While FLL does not specifically require safety glasses and close-toed shoes to maintain a safe environment, it is important to remind team members of safe practices at team meetings and competitions. More than one team has been undone by a last-minute unintended robot deconstruction (AKA dropped robot) or by missing critical elements (forgotten attachments and jigs). Have the team ALWAYS use a "port-a-robot" box to carry their robot from place to place, and remind team members to never lean on or climb on the robot competition table.

A unique melding of science, technology, engineering, and math (STEM) principles and the excitement of competition makes *FIRST* the ultimate **Sport for the Mind**™.

WHAT NOW?

AKA What to Expect: Competitions

You planned out your team's season, got them through the robot and the project and everything else in *hopefully* one piece, and now, drumroll please...it's time for competitions! Matches! Judging! Cheering! Spirit! Children running everywhere! If that sounds a little intimidating, don't worry. In this section we'll cover the different types of competitions, how to register for them, how to prepare for them, and what to do while you and your team are at an event.

First, it's helpful to understand the different flavors that *FIRST* LEGO League competitions come in. Imagine a pyramid, starting at the base. Here one can find **community**, also known as **unofficial**, **events**. These are optional tournaments that happen early on in the competition season (circa October) and generally happen locally and with a fewer number of teams than you'll see later on. Community tournaments are fantastic practice for your team; it's okay if the robot can only do two missions and the project isn't finished yet. They're fun, low pressure, and serve as an opportunity for your team to test out what they've been working on with judges, a field, and other teams. If you have the opportunity, go to one!

Moving up the pyramid, we find **regional qualifying tournaments**. As these are the first official level of competition, they're essentially mandatory for a competing team. Basically, your team is going to go to one of these. The key word in that sentence was "one." With input from your fellow mentors, site manager, the adults at the site, and team members' parents, your team will select one "QT" to attend. There, it's the real deal. The robots will run, the projects will be presented, the Core Values observed, and your team will have a lot of fun. And perhaps, at the end of the day, your team may be one of several to be selected to move on to the next level: the **championship tournament**. Qualifying for Championship tournaments differs by region. At some tournaments, advancement is based solely on robot field performance (points), at others it is based on a holistic score evaluating all three FLL aspects. However, the majority of tournaments (especially upper-level tournaments) require

teams to have robot field scores in the top 40%, in order to be considered for certain awards or advancement.

This is the top of the pyramid, other than the ultra-serious **open championship** and **FLL World Festival**. Very fun, very large, and very prestigious, these competitions will likely be the farthest your team goes-and congratulations on that. The FLL World Festival is like a showcase of FLL teams from all over the world that happens at the *FIRST* Championship. Teams must be invited, with geography being taken into account as different regions are eligible annually. Open championships are also by invitation (though the "open" comes from the invitations being sent to teams from different regions as well). Regardless of what level of competition your team makes it to, remember to focus on learning and having fun!

Registering for a competition is a process that takes care, research, and lots of input. It's helpful to reach out to the adults at the site and your mentors during this step, so all your bases are covered. Consider a tournament's date-will half your team be gone playing soccer on that day? Is it during a big holiday weekend when families might be out of town? Can your fellow high school mentors go that day? Also take into account location-is the venue so far away that we'll be getting up at 4 AM just to make opening ceremonies? How is your team going to get there? When you feel you've found the right one, pick a couple of alternates just in case, and then log in and sign up (here's where those adults might be extra helpful!). If your team is assigned to a tournament that is going to be impossible for you to attend (i.e. bad timing, faraway location), consider asking your adult coach to email the Region Director and explaining your situation. Heather's Protip: Offer a number of volunteers for the tournament you want. If you know other high school students who are not busy that day, ask them to volunteer at the tournament (for service hours!). You can also email blast parents with a request for tournament volunteers (offering shifts tends to be most effective with parents).

It's a couple of weeks before a competition, and it's go time. It's helpful to use the meetings leading up to an event as practice and prep time. On the robot side, have your team members practice, practice, practice. Polish up the most complete programs so that kids feel comfortable these will work every time. There will likely be a few missions that still need work, and that's okay too, consider these a bonus and keep chugging away. Have them do practice runs on the field just like the real thing, with a timer, two kids as robot operators, a score sheet, and teammates cheering (if they're comfortable with it). Sometimes only the reliable programs will work, sometimes even those won't. Help the kids understand that by rehearsing, they'll become better, faster, more efficient operators and more comfortable when it's time for the real thing. On the project side, it's the same- practice, practice, practice! Rehearse both the presentation and question and answer time after. If possible, it's helpful to invite others to serve as mock judges- at a tournament, it won't be you sitting across from them in the judging room. See if perhaps your high school mentors, the site adults, parents, or other high school mentors could sit down, listen to the team present, and ask questions. The questions are important! Remember to encourage all of the kids to try and answer one, and practice good answering skills: speaking clearly and audibly, not fidgeting too much, and taking turns responding. As for Core Values, competitions will have different protocols for the judging. Some tournaments might want a presentation, some will have the judges observe the kids working together on a puzzle or small challenge. Research and plan accordingly.

It's competition day! You and the site adults figured out transportation and food, everyone has arrived, what's next? You'll want to check your team in and pick up the tournament schedule (when are the team's matches, judging, etc). Make your way over to the designated pit area, which will generally have either part of or an entire lunch table to serve as your team's home base. Help the kids set up the laptop (cord not in a place where people can trip!) and go over the schedule and rules for the day (encourage the buddy system). Use any free time you have to let the team do more practice robot runs, rehearse presentations, mildly adjust any program that *actually, seriously* needs it. Again, remember to have fun! They'll make it to their matches and judging on time, and they're going to do great!

Tips from Current and Former High School FLL Mentors:

- Patience is your best friend. Your cell phone is your worst enemy.
- Get to know the kids.
- Kids are just adults without experience- try not to get too frustrated with them.
- If you're going to tell your kids to "read the rules," make sure you do too!
- Always listen to your mother.
- Observe other ways of mentoring.
- Dealing with parents is not your job- not even if you're the site lead. Forward your issues to the adults, you're there for the kids.
- Set up meetings with adults at the sites where your team is mentoring to discuss their needs and wants and your plans for the upcoming season.
- Before a tournament, go to the closest dollar store and buy as much colored, temporary hair spray in your team's color as possible. Apply liberally and watch the spirit grow!
- Have awesome team mascots like potatoes!
- Remember to take care of yourself too- if you've got 589 things to do, maybe going to that FLL meeting isn't a great idea. **Talk to your site lead and the FRC coaches and mentors.** They can help you make sure your team isn't stranded without a mentor, and that you have enough time to get what you need done.
- The kids do the work!
- Ask for help- sometimes one of the members of the team isn't going to agree with the team decision, won't want to settle down, etc. In these cases, the adults at the site are a fantastic resource, as your FRC coaches and mentors.
- Take advantage of the resources for mentors and coaches! This guidebook hopefully contains lots of useful information for you as a high school student, but there are dozens of books, Youtube videos, advanced programming and coaching workshops, *FIRST* "Coach Calls," and websites that can help you and your team find out more about robot design, strategy, programming the research project, team building, and much more! The *FIRST* LEGO League Coaches' Handbook, published by *FIRST* every year, has the most detailed explanations of what is expected of a team. Take a look at that, as well as the challenge materials released when the game comes out.

Crescenta Valley

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This book was written for my Girl Scout Gold Award, filed with Girl Scouts of Greater Los Angeles. My deepest thanks to Taylor Halsey, my advisor, Karen Lee and Lyn Repath-Martos, my troop leaders, Stephanie Verdugo, Girls LEAD advisor, Alana, Catherine, Celina, Heather, Jenna, and Rachel, my troopmates. And to Coach Mark, Coach Karen, Coach Carol, Dr. Neat, Mr. Wilton, Dr. Ferraro, Mr. Gordon, Mrs. Gordon, Mr. Gustafson, Mr.Miller, Thomas, Aimee, Santi, Caitlin, all of the 589-ers and kids I've had the opportunity to work with, **Dad, Mom, Lucas, and Heather**- this book wouldn't be what it is without your influence, nor would I be where I am today- thank you.