15-Week Coach's Guide to *FIRST* LEGO League Challenge

2024-25 SUBMERGED Season
to be updated August 2024

You are welcome to modify and use any part of this guide or any worksheets. Please credit FLLTutorials for the original work. Always check with your regional partner about what is required for judging in your region. Some regions may have variations in requirements as well as judging formats. [Last update: 10/05/23 - Broken links fixed]

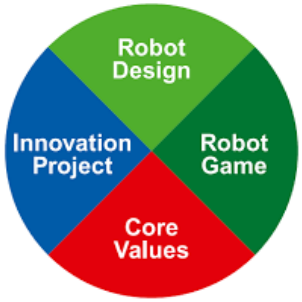
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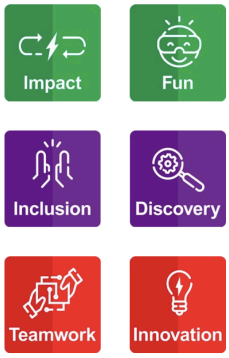
Getting Started

Congratulations! You just signed up to coach a team. Now what? This guidebook will help you understand the key requirements of the program and your key steps as a coach across a 15-week period. You can feel free to modify the weekly tasks as you need based on the experience level of your team or how many hours you plan to meet each week.

FIRST LEGO League Overview



FIRST LEGO League Challenge consists of four parts that are evaluated equally: Core Values, Innovation Project, Robot Design, and the Robot Game. Each of these components contributes 25% when evaluating your overall rank in a competition which determines if you will advance to another level. Judging is generally conducted as one 30-minute block. This includes time for setup and time for the judges to ask questions. Rubrics are provided to all teams in advance.



Core Values: Core Values are the cornerstone of the *FIRST* LEGO League program. It is about building teamwork, inclusion, integrity, decision-making skills, etc. While there is no required presentation during judging, judges will ask questions and Core Values will be evaluated throughout the session. Core Values is also evaluated at your robot game matches in the form of a “Gracious Professionalism” score. Students should not just learn the Core Values, but integrate them into every team meeting and every opportunity. Students will be expected to talk about Core Values and give specific examples of their use. “Kids do the work” is an unwritten rule at the core of the program.

Innovation Project: The team will create a solution to a real world problem of their choice that fits within an overall theme. The best problems are the ones that are the most meaningful to the students. Students can develop new solutions or improve an existing one in some way. They will share that solution with others and iterate the design. The students will have 5 minutes to give a presentation about their project during judging. They will also create a prototype or model for the solution. Having documentation of their progress and research will help the team.

Robot Design: The team will build and program a robot to autonomously solve up to about 15 “missions”. Most teams will not solve all the missions. The team decides which missions to solve, their strategy, design, and programming. The students will present their work to the judges and be evaluated on their engineering design process. Preparing a 5 minute presentation and having documentation for this part of the judging session can be very helpful to the team.

Robot Game: The team has 2.5 minutes to complete as many missions as possible on a themed challenge mat using an autonomous LEGO robot. They will be allowed at least three rounds and only the team's top score counts. *FIRST* provides a detailed Robot Game Rulebook to help students understand what they need to do. However, how they choose to solve the missions is up to them. A referee will score the students at their game table. The students will go over the score with the referee and advocate for themselves if they need to. Knowing the rules well and being Gracious Professionals will help them greatly here.

Team Registration

All teams must have between 2 and 10 students. You can read the Participation Rules here (updated at the end of August 2023). There are age restrictions, but there is variation between regions. Some regions will not allow a student less than age 9 into the Challenge program. You should always contact your local organizers to discuss individual situations. In North America, all teams must register on the FIRST Inspires website to create a Team Dashboard. A coach or team administrator can make an account and register a team. You must have two team coaches and both will have to have passed FIRST's Youth Protection Program (YPP) standards. This can be done through their individual Dashboard when they register to be a coach.

Once you have two coaches, you can invite students to this team by entering a parent's email address. Parents will have to sign electronic consent forms for their child to be on your team. Parents can find this process of registering to be troublesome. You might have to set up a computer at one of your meetings and help them through it. You can get more information about the *FIRST* registration system on this page. Note that in most regions, you can add students all the way up to the day of your event. However, in some regions, you are required to have a completed roster before you can register for local events.

You can order your Challenge Set, Robotics set, and Engineering Notebook bundles via the Products tab on your team Dashboard once you register.

Once you have registered at the National level, you will be contacted by your regional organizer (the Program Delivery Partner). This may not happen for months (some time in the fall). Do not worry. They will only contact you once they have established information for the season. You can look up who this contact person is by using the "Find Local Support" link at the very bottom of the FIRST Inspires website. Some regions have their own regional website with more information.

Costs vary by county and individual region. The US National pricing is available here. Local competition costs vary dramatically from $50 to almost $1000 for the season. Plan ahead.

Roles and Responsibilities

In *FIRST* LEGO League, the kids on the team do the work. Only the work of the students may be shared at a competition. Understand the role of the coach, mentor, and parent before getting started.



Role of the Coach: Guide the process, but don't do the work. The coach is not meant to have all the answers. You are a guide through the process. You facilitate meetings and help find resources. You can teach students skills but you do not solve the Challenge for them. The best coaches ask a lot of questions to help students find their own answers.



Role of the Mentor: Provide expertise in a specific area. Mentors are experts in a field - it could be an expert related to programming, building a prototype, creating a webpage, or something else. Like a coach, their role is to provide knowledge when needed, but not to complete the work. Youth mentors (especially those with prior *FIRST* LEGO League experience) should also know the difference between doing the work and mentoring.



Role of the Parent: Encourage and support the team as needed. Parents might provide snacks, get tshirts printed, buy poster boards, or organize transportation on a field trip. They support the student and the coach. Parents can advocate for their student, but also need to trust the coach. Parents may also be able to help facilitate if there are conflicts or any discipline/performance issue with regards to their child on the team.

Role of the Student: Make decisions, work as a team, and do the work. Students on the team must do all the work related to the challenge. This includes making decisions about the robot and project, building, and programming. Everything presented at the competition must be the work of the students on the team. If you use material not created by your team members, you must cite your sources in your presentation.

Selecting Team Members

Some teams will accept all students who apply until they reach their maximum number of students. Others will have try-outs or an application process. The application will include short essays as well as recommendation letters. You can read about the different ideas here. One thing you should not do is have extra students (beyond 10) on the team who work on the Challenge (even if you think that some will drop out later). The most important aspect of creating a team is good communication between you and the families/students. Discuss your expectations for behavior, attendance, and contributions ahead of time. Also make sure that they understand that *FIRST* LEGO League is made up of four parts and that it is not an after-school LEGO building club. Students will be working hard and learning building, programming, communication, teamwork, research and life skills. They will be expected to participate in all aspects of the program.

Gather Everything You Need

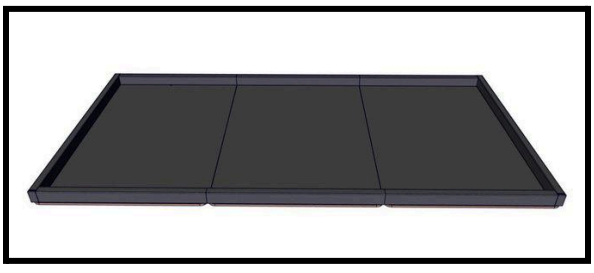
Ipad/Laptops/Desktops:

The SPIKE Prime software should be the same experience across all compatible devices. Choose the one that works for you. Please note that Chromebook users have had some complaints, but we are not able to test this.

You are allowed to use any software, but we will only focus on the officially supported LEGO software in this document. Download and install SPIKE Prime or EV3 software from LEGO Education's website. Note that you are allowed to use SPIKE Prime or any previous product including MINDSTORMS Robot Inventor, EV3, etc. Make sure you follow LEGO's instructions and update both the software on your computer and the firmware on your brick/hub. Make sure you also establish a backup method so that your team's programs can be backed up to a USB stick/Google Drive, etc. at the end of each team meeting.

FIRST LEGO League Table:

Construct a FIRST LEGO League Challenge table according to specifications. We strongly recommend that you create an official table as this will help your students have the best experience at a competition. Tables that are as close as possible to competition tables will serve you best.



You can also purchase a portable table from AndyMark (image on left). We do not recommend any light-weight portable table topper (made of foam board or corrugated plastic) for regular practice as they are too far from an actual competition table and will not give

teams a reliable table. Teams who use these tables are likely to find that their robot performs even more differently at a competition compared to teams who use wooden tables.



Challenge Set:

You will need to purchase a Challenge set for the year once you register. In the US, these sets start shipping in mid-to-late July. The set contains a rolled-up mat as well as all the LEGO to build the mission models for the year. Instructions for building the models are only released on the day of the challenge launch (usually August 1).

Each team is only able to purchase 1 set. Teams are expected to learn to work together to share that space. In some years, *FIRST* did offer a second Challenge set or extra mats (no LEGO). However, teams should not rely on having this every year.

Robotics Kit:

You will need a LEGO robotics set. The most recent set is SPIKE Prime. The *FIRST* LEGO League Dashboard in North America sells this set as a bundled item with the SPIKE Prime Expansion Set. The Expansion Set has useful parts for teams including additional motors and sensors. You do not have to buy the set from *FIRST*. You are also allowed to use prior systems such as MINDSTORMS Robot Inventor, MINDSTORMS EV3, etc.





Only one robot is needed for each team. Teams who can afford more than one set may purchase more. However, you are only allowed to bring one robot to a competition table. Having a second robot can help more students have time to program and build. It can also help a team by letting them design more robots before selecting one. In addition, having a duplicate robot can act as a spare for a competition in case something goes wrong that day.

Organize Your Space

Keep your robotics room as organized as possible. If you have to pack up every day, that is okay too.





1. Sorting your LEGO brick by element type (or group of elements) can be helpful. This way, students on the team can go pick the parts they need. At the end of the day, leave 10 mins for students to sort their unused elements back into the bins. Students might build at an empty table or even on the floor.

2. A "do not take apart" area is very important to have in order to prevent another team member from accidentally taking apart something that needs to be saved. Also remember to take photographs of progress/versions before taking them apart to add to an engineering journal. A "please take apart" bin can be helpful as well for place builds that may be taken apart and sorted.

3. Have a table and one or more computers/devices for students to use to program their robot and to do research. Make sure that students can easily charge their robots at the end of the day.

4. Have a white board/brainstorming area for students to take notes. If you do not have a board, you can use giant post-it papers and stick them on the wall too. Post these brainstorming ideas and a team calendar on the wall.

5. A reminder of the Core Values is useful to have. Having Core Values posters and a blank poster of some kind where students can write down an example of core values will help them remember specifics for judging later in the season.

6. Keep your *FIRST* LEGO League table and mission models clutter free and dust free. When not using the table, consider covering it up with a bedsheet or similar. You can also take off the mission models easily and put them away if you need to.

WEEK 0: Before Your First Meeting

Getting a Head Start

Some teams do meet all year round and some teams will get started early in the summer. The Pre-Season Guides on FLLTutorials have some ideas on what you can do before the challenge is launched. If you have time to meet, you can practice building different robots and learning to program. You can talk about the theme and even do some preliminary field trips.

If your team does not get formed till August or September or you do not have plans to meet in the summer, do not worry about it. Majority of teams only start in the Fall.

Collect Official Challenge Documents

Once the challenge is released (on August 1), you will have access to all the important documents for the season. All the documents below can be found here.

Robot Game Rulebook (RGR): This book contains information about the robot game and also has information about how to set up the field. Read this document carefully multiple times!

Judging Documents: Download the Judging Session Flowchart and the Rubrics. These will be your guide as your team sets goals, creates presentations, and prepares for judging.

Challenge Updates Document: There are almost always some updates to the Robot Game and/or Innovation Project. Sometimes, there are updates even on the season launch day! It is very important to check for updates weekly. Update: In 2023, FIRST also started issuing Project updates via their blog site.

Engineering Notebook (EN): This is a notebook for students to use and fill in. It is not required. Students can document their work any way they want to.

Team Meeting Guide (TMG): This is a guidebook for the team coach/facilitator. You are not required to follow the weekly schedule.

Typical Team Meeting

Team meetings can vary in length and style, but this might give you an idea of where to begin.

Many teams will ask students to do the majority of their Innovation Project background research at home and only discuss updates and make decisions together during meetings. This will give more time for the Robot which has to be done wherever the game table and LEGO pieces are.

Some teams will organize team meetings so that they focus only on one area - e.g. Wednesday is only for the Robot and Friday is only for the Innovation Project. This allows the students to focus on one topic each meeting and give stretches of time to work on the robot..

Please note that you will find that it does take a considerable amount of time to complete missions reliably, etc. Be prepared to adjust schedules and even add more sessions. Teams usually add additional meeting times or lengthen their meeting times as they approach an event.

Sample Schedule based on 2.5 hours/meeting:

15 Mins - Meet as a group. Students should come up with their goals for the day and decide on who will work on what. Go over overall deadlines and help students keep on track to have everything done by their tournament date. Students can also go over their findings from their homework assignments during this time.

45 Mins - Robot Work time. Coaches/Mentors will circulate to ask questions, answer questions, and keep the team on track.

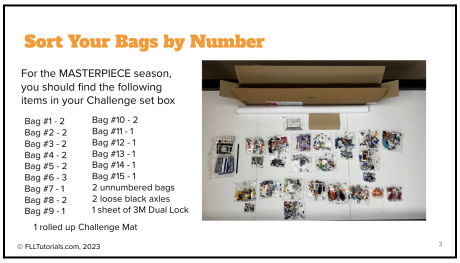
15 Mins - Core Values exercise and discussion. Snack break.

45 Mins - Innovation Project work time. Coaches/Mentors will circulate to ask questions, answer questions, and keep the team on track.

15 Mins - Meet as a group to discuss what was completed and to-dos for next time. Discuss homework assignments. Students should document their progress from the day as they are evaluated on their process during judging. Keeping an Engineering Notebook can be useful.

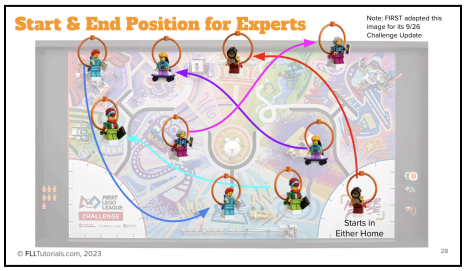
10 Mins - Clean up the room. Make sure that things you wanted to save are saved (LEGO builds and code files). Students can demonstrate what they accomplished to parents/visitors picking them up.

WEEK 1: Your First Meeting



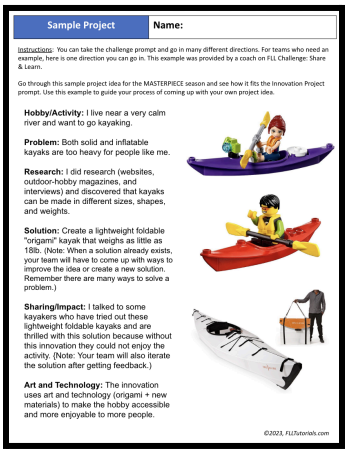
Robot Game:

1. Watch the Season Launch Videos on the *FIRST* LEGO League YouTube channel.
2. Build mission models using only the Build Instructions provided by *FIRST*. Budget about 2 hours for building mission models and placing them on the mat. There is a useful Building & Setup Guide on the FLLTutorials Resources page with tips that is kept up-to-date during the season.
3. Read the entire Field Setup section of the Robot Game Rulebook (pg. 25) to attach the models to the challenge mat. You can also watch the video from FLLTutorials under Building & Setup Guide.
4. Learn the missions - Download Mission Tent Cards to place on your table
5. Check for Challenge Updates.



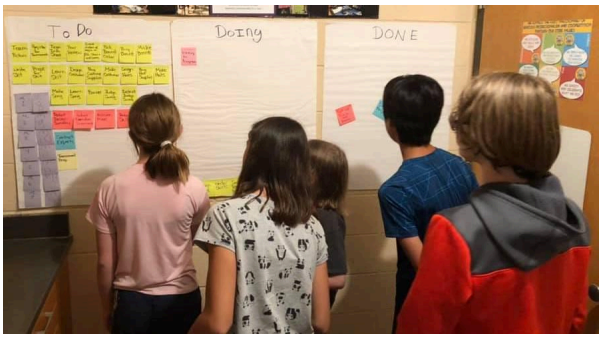
Innovation Project:

1. Read the Engineering Notebook (pg. 6) to learn what the topic is this year and what the requirements are for the season. Identify some key words or requirements for this year's Innovation Project. Look at the Innovation Project Worksheets. Two sample projects have been added to these worksheets.
2. Check for Challenge Updates.



Core Values:

1. Develop a team Identity: Pick a team name. Come up with a logo. Design a team shirt. (Core Values Worksheet: Team Goals
2. Decide on Team Goals. Use the Rubrics available on the *FIRST* LEGO League website as your guide. (Core Values Worksheet: Team Goals)
3. Learn the *FIRST* Core Values (Core Values Worksheet: Learn Core Values
4. Consider setting up a Kanban board for the team. A team checklist may also be helpful. (Core Values Worksheet Team Checklist)



Homework:

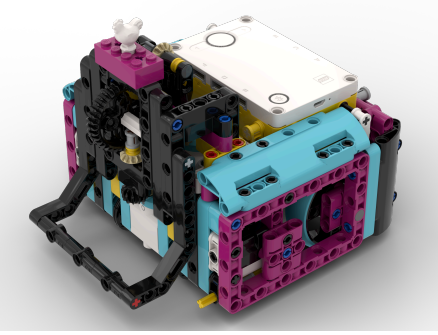
1. Brainstorming: What ideas do you have related to the season's prompt? What are your hobbies (things you like to do)? How do you currently learn or participate in these hobbies? Are there any problems you noticed with regards to learning or participating in this hobby/activity? Bring your ideas to the next session.
2. Download and read all the rules in the Robot Game Rulebook

Useful Resources: There are many useful articles in the Coach's Corner.

WEEK 2: Learning to Program

Check for Challenge Updates.

Robot Game:



1. If you are a rookie team, we recommend COR3 for EV3 (available on EV3Lessons.com) or DroidBot M (primelessons.org). If you are an experienced team, you can try the new SPIKE Prime Coop Bot. You can select any base robot you want.
2. Learn to move forward and turn
3. If you have some programming experience, you can skip ahead to learn more advanced coding (see EV3Lessons.com or PrimeLessons.org) or start to build your team robot.

   Recommended Programming Lessons on EV3Lessons.com: Introduction to Brick and Software, Port View, Moving Straight, Turning
   Recommended Programming Lessons on PrimeLessons.org: Units 2-3. Remember that you will have to modify the code to work for the robot you build based on its ports, wheel size, etc.

Innovation Project:

1. Look at the mission models for inspiration. What topics do you think the models represent? (Innovation Project Worksheets). The Engineering Notebook also has discussions about different possible topics (“Sparks”)
2. Discuss the homework assignment.
3. Watch Project-related videos from the Rookie Webinar playlist. Although these were recorded for prior seasons, they can still help you.

Core Values: Do a teamwork activity to get to know each other. Decide how you will make decisions this season (Voting? Team leader?).

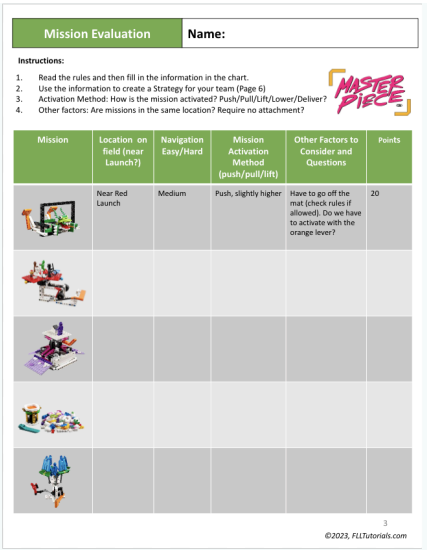
Sample activities can be found here: Core Value Activities
Recommended Lessons: Introduction to Core Values, Making Decisions

Homework:

Take your brainstorming ideas and develop them into Innovation Project topics. You should do enough research on your topic so that you can explain it in detail to your team members the following session. (Innovation Project Worksheets: Project Identification, Research, Research Notes)

WEEK 3: Developing a Team Strategy

Check for Challenge Updates.


Mission Evaluation | Name:

Instructions:
1. Read the rules and then fill in the information in the chart.
2. Use the information to create a Strategy for your team (Page 6)
3. Activation Method: How is the mission activated? Push/Pull/Lift/Lower/Deliver?
4. Other factors: Are missions in the same location? Require no attachment?

Mission	Location on field (near Launch?)	Navigation Easy/Hard	Mission Activation Method (push/pull/lift)	Other Factors to Consider and Questions	Points
	Near Red Launch	Medium	Push, slightly higher	Have to go off the mat (check rules if allowed). Do we have to activate with the orange lever?	20

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Robot Game:

1. Discuss the rules and Challenge Updates that may change the rules.
2. Watch Robot Strategy-related videos from the Rookie Webinar playlist. Come up with a team strategy. If you are a rookie team, pick two or three missions to start with and divide them amongst your team. Missions near launch or near lines are easier to navigate to. Missions requiring simple activation can require no attachments or a simple arm to activate. (Complete Robot Design Worksheet: Mission Evaluation and Robot Strategy)
3. Think about what mechanism could solve the mission(s) and who will work on them.
4. Learn to use the Color Sensor this week so you can make use of any lines. (Recommended Lesson: EV3Lessons.com: Introduction to the Color Sensor and PrimeLessons.org: Unit 5)

Innovation Project: Based on the homework, decide as a team what problem to work on and split the topic equally among the team members for homework. This time everyone is working only on one topic that the team picked.

Team Tip: "Always pick a project that is meaningful to the team members and something that interests them."

Core Values: Learn what pseudocode is and the importance of giving accurate instructions. Pseudocode Peanut Butter Worksheet. (Recommended Lesson: Pseudocode)

Homework:

1. Different students should research different aspects of the chosen problem in order to divide the work among the group. Go into more detail this week using the same worksheets.
2. Collect Background information on the problem (where does this problem exist), Possible Field trips/Experts, Existing Solutions for this problem.
3. Different students can fill in different sections of the worksheets.
4. Document all your research. (Innovation Project Worksheet)

WEEK 4: What's our Problem?

Check for Challenge Updates.

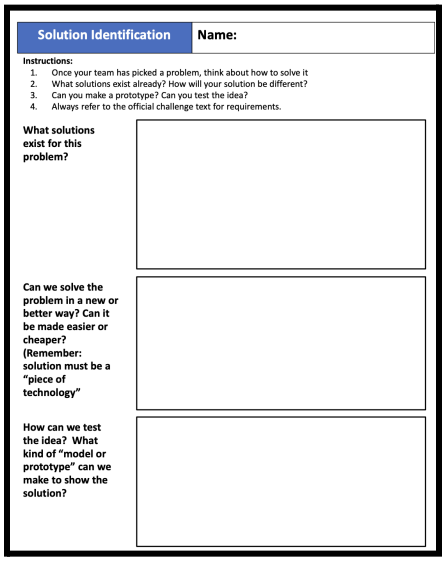
Robot Game:

1. Learn to Line Follow. (Recommended Lessons: EV3Lessons.com: Loop, Switches, Basic Line Follower. PrimeLessons.org: Units 6 and 7)
2. Test your line follower out on the actual challenge mat
3. Document your tests. Can you make the line follower smoother/faster?

Team Tip: "Learning to use sensors can help your team be more reliable. It is worth the effort, even if you are a rookie team. Start with sensors such as Touch and Color."

Innovation Project:

1. Discuss findings from the homework. Decide where to go on field trips and whom to talk to and contact people.
2. Start to think of possible solutions. (Innovation Project Worksheet: Solution Identification)
3. At the end of this week, team members should be able to clearly articulate the problem your team is studying. It should fit the innovation project criteria. You should have some idea of what a solution might be.



Solution Identification | **Name:**

Instructions:

1. Once your team has picked a problem, think about how to solve it
2. What solutions exist already? How will your solution be different?
3. Can you make a prototype? Can you test the idea?
4. Always refer to the official challenge text for requirements.

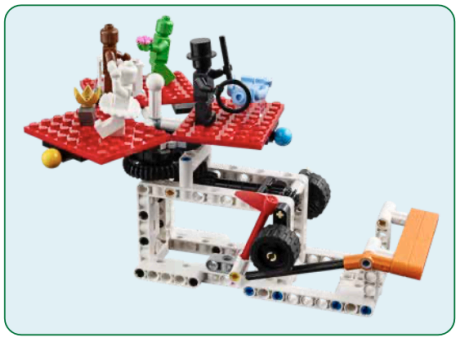
What solutions exist for this problem?	
Can we solve the problem in a new or better way? Can it be made easier or cheaper? (Remember: solution must be a "piece of technology"	
How can we test the idea? What kind of "model or prototype" can we make to show the solution?	

Core Values: Do a Core Value Activity that might require coordination among members.

WEEK 5: First Mission

Check for Challenge Updates.

Robot Game:



1. Finish the last programming lesson: Move an Object (Programming Lesson: EV3Lessons.com: Move an Object)
2. Look at the Guided Mission for Theater Scene Change provided by FIRST in the Engineering Notebook (p.18). The SPIKE Prime App was updated in September 2023 and the Guided Mission is now part of the Competition Ready Unit. FLLTutorials also provides an alternative approach to the guided mission called Guided Mission with Reliability Techniques that helps to make this mission more consistent. Read the lesson, download the code, and watch the video that is linked.
3. Review programming lessons such as moving, turning, and using the color sensor as needed to complete the missions you selected using the strategy you decided upon.

Team Tip: "Don't be afraid to change, adapt or improve a solution you see. Sometimes, you can come up with something better."

Innovation Project:

1. Develop questions for any interviews/field trips you may have scheduled. Experts like it when students are prepared. (Innovation Project Worksheet: Expert Interviews)
2. It might be useful for you to develop a short presentation to be able to explain to your experts what you are working on and also include what FIRST LEGO League is and this year's challenge is about.

Core Values: If you have time this season, you can share your progress/work with the community. You might also be able to reach out to another team for help. (Recommended Lesson: Outreach in FIRST LEGO League)

Homework:

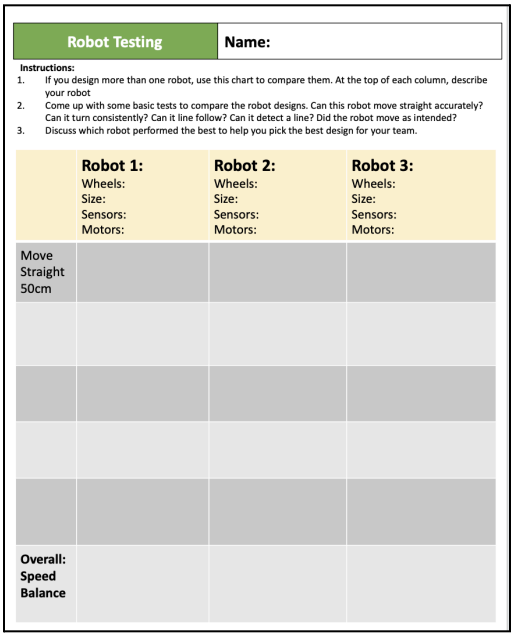
1. Watch Robot Design-related videos from the Rookie Webinar playlist.

WEEK 6: Let's Build a Competition Robot

Check for Challenge Updates.

Robot Game:

1. Build your team's robot. Keep it simple. Focus on "sturdy and reliable". If you start with a basic robot design, think about how to modify it. What does the robot need based on the mission strategy and missions you picked? (Complete Robot Design Worksheet: Robot Design)
2. Once a basic team robot is ready, test it out to make sure it is balanced and accomplishes what you want it to. Refer to the Robot Design Rubric to see what criteria is used in judging. (Complete Robot Design Worksheet: Robot Testing)
3. Brainstorm how you might solve the missions you picked
4. Start to build attachments to solve missions. Write pseudocode for your programs. (Complete Robot Design Worksheet: Pseudocode)



Robot Testing	Name:		
Instructions: 1. If you design more than one robot, use this chart to compare them. At the top of each column, describe your robot 2. Come up with some basic tests to compare the robot designs. Can this robot move straight accurately? Can it turn consistently? Can it line follow? Can it detect a line? Did the robot move as intended? 3. Discuss which robot performed the best to help you pick the best design for your team.			
	Robot 1: Wheels: Size: Sensors: Motors:	**Robot 2:** Wheels: Size: Sensors: Motors:	**Robot 3:** Wheels: Size: Sensors: Motors:
Move Straight 50cm			
Overall: Speed Balance			

Alternative Robot Designs for inspiration: FLLTutorials Robot Designs. If you use any designs for inspiration, be sure to cite your sources and let your judges know.



Innovation Project: Go on a field trip and/or meet an expert this week.

Team Tip: "Experts can provide very valuable advice. Think outside-the-box for experts. They don't even need to be near you. You can contact them by phone, email or Google Hangouts."

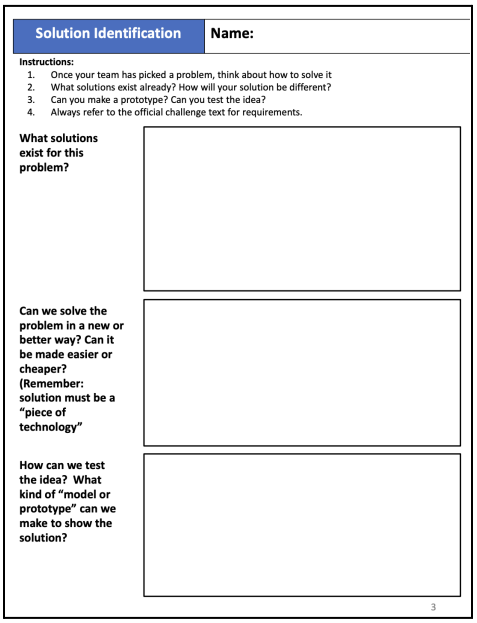
Core Values: Do a Core Value Activity that teaches coming to a consensus.

WEEK 7: Developing Solutions

Check for Challenge Updates.

Robot Game:

1) If you didn't finish building a base robot last week, keep working on this.
2) Keep building attachments and keep working on programming missions.
2) Keep recording changes and testing ideas. (Complete Robot Design Worksheet: Attachment Evolution)
3) Save your program often and backup your code at the end of every meeting (onto a USB drive or Google Drive, email a copy to your coach/yourself, etc)



Solution Identification | **Name:**

Instructions:
1. Once your team has picked a problem, think about how to solve it
2. What solutions exist already? How will your solution be different?
3. Can you make a prototype? Can you test the idea?
4. Always refer to the official challenge text for requirements.

What solutions exist for this problem?

Can we solve the problem in a new or better way? Can it be made easier or cheaper? (Remember: solution must be a "piece of technology"

How can we test the idea? What kind of "model or prototype" can we make to show the solution?

3

Innovation Project:

1) Go on any field trips and/or conduct expert interviews.
2) Develop your Innovative Solution for your problem. What makes it innovative? (Innovation Project Worksheet: Solution Identification)

Core Values:

1) Do any team building activity. How about building a City together?

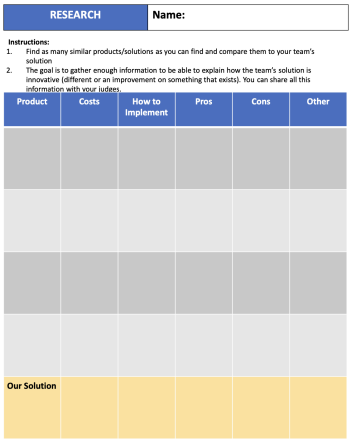
Team Tip: "Remember to involve others in coming up with ideas. Be willing to listen to each other and help each other. Incorporate the Core Values into every practice."

WEEK 8: Testing, Testing, Testing

Check for Challenge Updates.

Robot Game:

1. Keep building attachments and keep working on missions. Keep recording changes and testing ideas. (Complete Robot Design Worksheet: Attachment Evolution and Attachment Testing.)
2. Remember to backup your code onto a USB stick, google drive, etc.. You cannot retrieve code from your brick/hub.
3. Always comment your code so that others can understand it or if another team member needs to work on the code the following week.



RESEARCH	Name:				
Instructions: 1. Find as many similar products/solutions as you can find and compare them to your team's solution 2. The goal is to gather enough information to be able to explain how the team's solution is innovative (different or an improvement on something that exists). You can share all this information with your judges.					
Product	Costs	How to Implement	Pros	Cons	Other
Our Solution					

Innovation Project:

1. Develop a prototype or find a way to test or evaluate your solution. Refer to the rubric.
2. Compare your solution with existing solutions. (Innovation Project Worksheet: Research)

Core Values:

1. Remember that it is important to incorporate core values into your team. Talk about how you used the Core Values today.
2. If possible, share what you have done with other classes or your community. Share with another team or help another team.



We are stronger when we work together.



We respect each other and embrace our differences.



We apply what we learn to improve our world.



We enjoy and celebrate what we do!



We explore new skills and ideas.



We use creativity and persistence to solve problems.

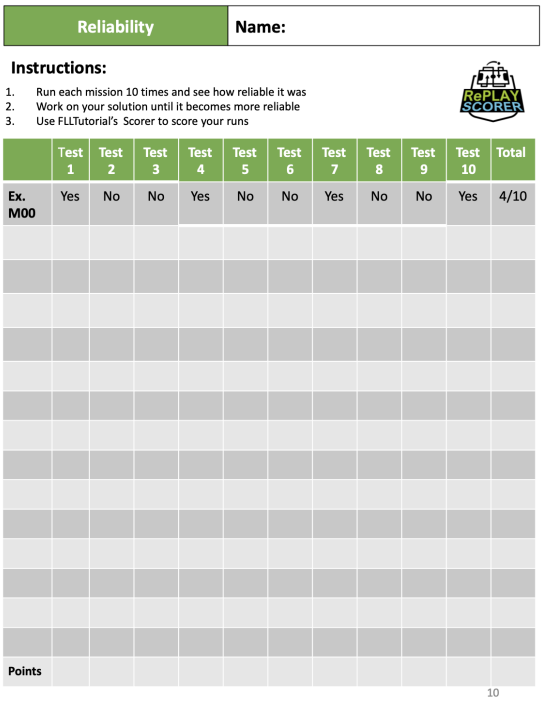
WEEK 9: Reliability is Key!

Check for Challenge Updates.

Robot Game:

1. Keep working on missions and making them more reliable. As you complete missions, run your robot 10 times and see how reliable your solutions are. If your solutions do not work well enough, think about how you can improve them. Take a look at the eight Robot Reliability Lessons for ideas.
2. Record how you tested your ideas and changes you made. (Complete Robot Design Worksheet: Attachment Evolution and Attachment Testing.)
3. Track how many points you are able to score and how reliable your missions are. Complete Robot Design Worksheet: Reliability.

Team Tip: "It is more important that a few missions work well, rather than trying to do all the missions."



Reliability	Name:

Instructions:

1. Run each mission 10 times and see how reliable it was
2. Work on your solution until it becomes more reliable
3. Use FLLTutorial's Scorer to score your runs

	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Total
Ex. M00	Yes	No	No	Yes	No	No	Yes	No	No	Yes	4/10
Points											

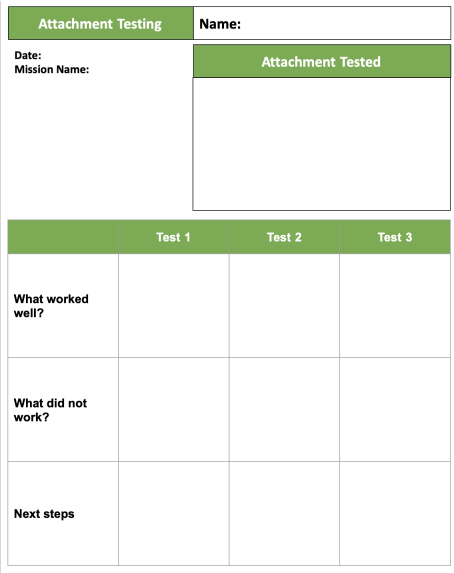
10

Innovation Project: Share your solution and get feedback on your ideas.

Core Values: Do a teamwork activity that helps you learn the value of working together. Activities can be found here: Core Value Activities

WEEK 10: Keep Improving!

Check for Challenge Updates.



Attachment Testing	Name:
Date: Mission Name:	Attachment Tested

	Test 1	Test 2	Test 3
What worked well?			
What did not work?			
Next steps			

Robot Game:

1. Keep working on improving missions or adding a new one if the first few are working well.
2. Remember to record your thought processes, tests and always back up your code. Well-commented code can help you in judging.

Innovation Project: Improve your project solution based on feedback received.

Team tip: "The biggest lesson from FIRST is to keep improving. Failure is part of the process. And there are always ways to improve."

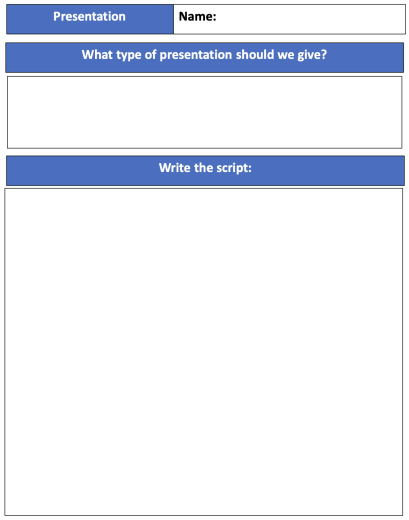
Core Values:

1. Do a Core Values Activity to describe your team identity.
2. Can each of your team members give examples of how the Core Values have impacted each of them? Review the Core Values if needed.

Homework: Brainstorming: How do you want to present your project to the judges? Game Show? Advertisement? You can watch some YouTube videos of specific project presentations for inspiration. There are several linked on the last page of this lesson. Note that these videos are from past seasons (requirements and rubrics were different) and these are from very experienced teams (World Championship teams).

WEEK 11: Starting to Wrap Things Up

Check for Challenge Updates.



Robot Game:

1. Keep improving missions.
2. Make sure missions you worked on before are still working reliably as you add more.

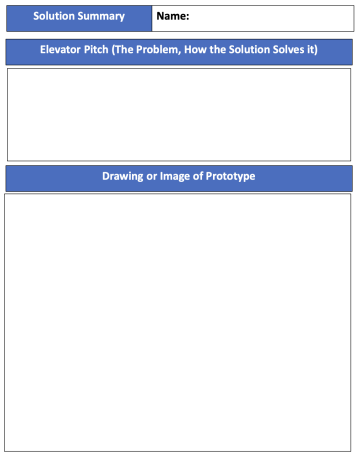
Innovation Project:

1. Finalize your Innovative Solution.
2. Decide on a presentation style and develop your presentation for your judges. (Recommended Lesson: Project Presentation), Please note that this year's rubric may be slightly different from the one in older tutorials. Always use the most current rubric.)
3. Complete the Innovation Project Worksheet: Presentation

Core Values: Do a Core Values Activity to learn the importance of giving good instructions. Some regions may ask for a Core Values Poster. If one is required, start a Core Values poster. Some teams may make one even if not required to help them remember specific examples and to serve as a visual aid. Some regions may specifically ask you *not* to bring a poster, so check in advance.

Homework: Start thinking about your judging presentations for all three areas. What do you want to communicate to the judges and what do you want to show them? Always look at the rubrics.

1. Complete the Innovation Project Worksheet: Elevator Pitch.
2. Complete the Robot Design Worksheet: Judging Preparation.



WEEK 12: Finalizing

Check for Challenge Updates.

Take a close look at the Judging Session Flowchart. Notice that your team will have the opportunity to give presentations for Innovation Project and Robot Design. Judges will ask questions to help them fill in the rubric. Make it easy for them to score you by directly addressing all aspects of the rubric in your presentations. There are several lessons on FLLTutorials with Judging tips.

Robot Game:

1. Finalize your robot game
2. Start to practice robot runs. Who will run the robot? How will you switch in and out?
3. What features do you want to highlight in robot design judging? Recommended Lesson: Robot Design Judging. Please note that this year's rubric may be slightly different from older tutorials. Always use the most current rubric.)

Innovation Project:

1. Finalize the presentation script and any other materials (poster, props, handouts, etc).
2. Make sure that all students have a role and practice the presentation.



Core Values: Finalize any presentation/poster board. Do a Core Values activity that lets everyone know you appreciate their contribution. Compliments or We are a Team are great choices.

Image Credit: Girls of Steel FRC Team. Activity by Droids Robotics.

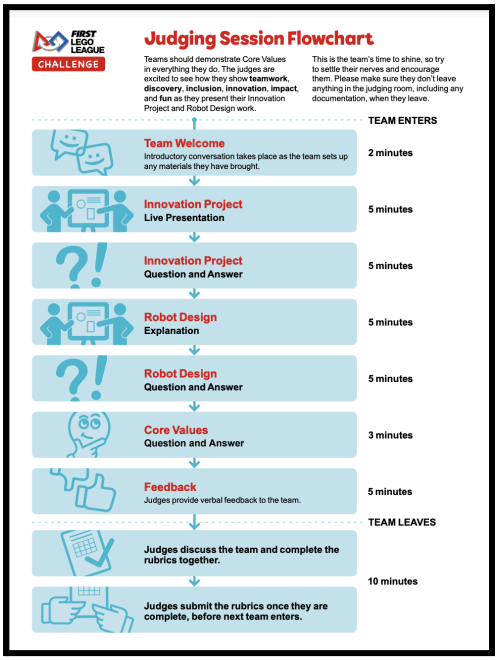
Homework: Practice your presentation lines.

Useful References for Coaches: Tips from Robot Design Judges, Tips from Project Judges, Tips from Core Values Judges, Competition Day Tips, Dare to Prepare

Team Tip: "Remember that your time starts when you enter a judging room. It includes any setup time. So, set up quickly so that judges can hear your story."

WEEK 13: Practice, Practice, Practice

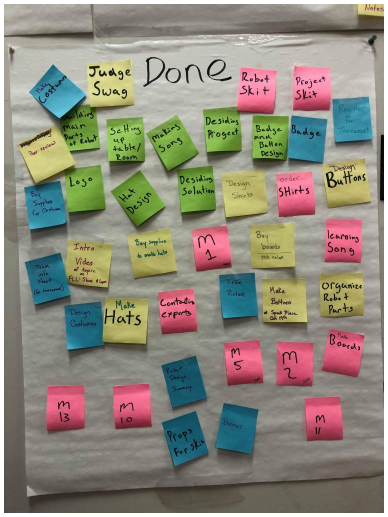
Check for Challenge Updates.



Make sure every student understands the flow of the judging session. Download the Judging Session Flowchart. Practice transitioning from one judging topic to the next. As you practice, use the rubrics to score yourself/have parents score you and see where you can improve.

Robot Game: Practice Robot Runs. Practice presentations. Get all your worksheets together for an Engineering Notebook. Have your coaches/parents ask you questions about your robot design and code. Don't forget to take the M04 MASTERPIECE LEGO art piece model that you built as a team if you are completing that mission.

Innovation Project: Practice Presentations. Get all your worksheets/background research, etc together for a Research Notebook. Have your coaches/parents ask you questions about your project.



Core Values: Have your coaches/parents ask you questions about your season. (Recommended Lesson: Core Values Judging. Please note that this year's rubric may be slightly different from one in an older tutorial. Always use the most current rubric.).

Homework: Pack for the tournament and practice your presentation lines.

Team Tip: "Judges are there to celebrate your season. You should not be intimidated by them. Share what you know and what you accomplished."

Useful Reference for Coaches: Tournament Tips.

WEEK 14: Competition Day

Sample Schedule

This is a high-level example. There will be variation based on the number of teams, the location, and your tournament organizer's preferences.

8:00 Teams can register and receive their schedules
9:00 Coach Meeting with Head Referee and Head Judge (this is a good time to ask questions)
9:30 Opening Ceremonies
10:00 Thirty-minute Judging Sessions begin/Robot Matches begin
12:00 Lunch
1:00 Judging/Robot Matches Continue
3:00 Clean-up Pits
4:00 Award Ceremony

What to Take to the Event



1. Robot, Charger, spare parts, USB Cable, Extension cord
2. Props, Notes, Code printouts, tri-folds, etc for Judging
3. Pit decoration (as permitted) - The pit is your home base for the day. Usually it is a 5-6ft table.
4. Poster boards (as needed) - Poster boards are not required but can be useful visuals.
5. Team giveaways (as needed) - Not required, but many teams give away trinkets
6. Mission Models (some regions ask teams to bring non-dual locked models for use at practice tables) - Ask ahead of time.
7. You should not have to bring a robot game table. In fact, most organizers will tell you not to. Your team is expected to take turns at practice tables provided by the organizers.
8. Snacks and drinks (as permitted) - Check what the food policy is at your event
9. Downtime activities - Card games and other games will help pass some of the time
10. Gracious Professionalism - Be nice to each other, other teams, and volunteers. Things can go wrong.
11. Copy of the Robot Game Rulebook - Kids advocate for themselves at matches.
12. Make sure everyone knows what they are taking to the event and nothing is left behind.
13. Team shirts/hats/costumes, banners/flags (all optional)
14. Some bandaids/small first-aid kit
15. Wagon/Cart/storage box to transport items from car to pit
16. Any model required in a particular season (e.g. your Art piece)

Tips for Competition Day for Students

1. Print out a handy mini-schedule that you can keep in your lanyard or pocket for easy reference
2. Know your Team Number. Judges and referees use it to verify that you are the correct team.
3. The day is long and tiring. Remember to stay hydrated and eat (a parent can be designated to provide food)
4. Make time to meet other teams. You can learn a lot from each other.
5. Bring something for the down-times (card games are a good idea)
6. Don't panic if you forget your lines (check your notes, say what you would like to say in your own words, get help from your teammates)
7. Don't panic if the robot does not work (It happens. Only your highest score counts.)
8. Don't panic if something else does not go the way you expected (e.g. time change, room change, no table in the room for a poster board, etc.). Adapt to the situation.
9. If you don't understand the question from the judge, ask for it to be reworded. If you do not know the answer, ask your teammates to help you.
10. Don't look to your coach for help during judging or robot runs. Get help from fellow students.
11. Students should not touch the mission models on the competition table. The referee is the only one who can check models for you. If you think a model is built incorrectly or set up incorrectly, ask the referee to check the model before you start the match.
12. Follow along as the referee scores your match. If you disagree with a referee's score at the end of a match, talk to them graciously (students, not the coach). Make sure you have a copy of the Robot Game Rulebook and that a team member can show the rule and explain why a mission should be scored differently. Once you sign off on the score, it cannot be changed.
13. Thank the volunteers. Without them, there would not be an event for you to attend. Even if some things are not as you expected, all the volunteers are trying hard for you.f
14. If you need help with something or your team needs some extra support your coach can talk to the Judge Advisor or Tournament Director.
15. Not every team will get an award. Remember: "What you discover is more important than what you win!" Take the lessons learned and come back again next season.
16. Be a gracious professional and make sure everyone affiliated with your team is one too.



WEEK 15: Post-Competition

Congratulations! You made it through the qualifiers! If your team advanced, congratulations! As veteran coaches will tell you, it is important not to base your team's success on an award and you should not compare yourself to other teams. Instead, think about where your team was at the beginning of the season or the previous season. What did they learn new? Did they achieve growth? Did they enjoy the program enough to return again next year?

"*FIRST* LEGO League is about playing the long game. The foundation you build now with the kids will serve them well in the future." - Heather B, veteran coach

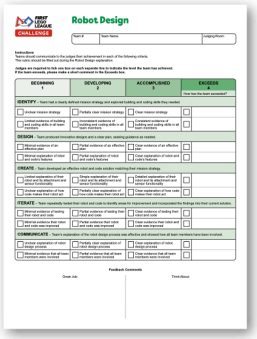
Celebrate the season

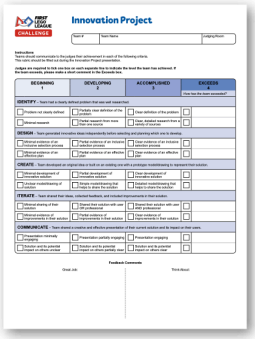
Whether or not your team won a trophy or advanced to another level, it is important to celebrate the season. Some teams will have a pizza party or go to an Escape Room. Some coaches will create season mementoes (mini-trophies, team photos in frames, etc.) for each student. Think about what would excite your team members.

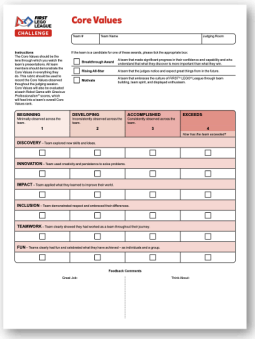
Evaluation and Self-Reflection

It is important to also reflect upon your season before the students forget all the details of competition day. This is true whether you advanced or not.

1. Create a survey for your team members to collect information about what went well, and what could be improved.
2. Have the students discuss what their goals for next season might be and how they can get there.
3. Go over their team rubrics and see how the judge's scored them. Discuss areas for improvement.
4. If there were any issues from the competition about referees, judges, or other volunteers, reach out to your Program Delivery Partner to provide feedback.







APPENDIX

Useful Resources

FIRST RESOURCES:

Season Content

BOOKS:

The Unofficial LEGO Technic Builder's Guide, 2nd Edition by Pawel “Sariel” Kmieć

LEGO Technic Non-Electric Models: Clever Contraptions by Yoshihito Isogawa

The LEGO MINDSTORMS EV3 Idea Book by Yoshihito Isogawa

The Art of Lego Mindstorms Programming by Terry Griffin

Classroom Activities for the Busy Teacher: EV3 by Damien Kee

Classroom Activities for the Busy Teacher: SPIKE Prime by Damien Kee

LEGO MINDSTORMS EV3 Discovery Book by Laurens Valk

LEGO MINDSTORMS Robot Inventor Idea Book by Yoshihito Isogawa

LEGO MINDSTORMS Robot Inventor Activity Book by Daniele Benedettelli

PROGRAMMING TUTORIALS:

EV3 Lab Programming by W.A.F.F.L.E.S Robotics
Beginner, Intermediate, Advanced, Expert

EV3 Lab Programming by Carnegie Mellon University Robot Academy (Possibly only accessible in USA)

SPIKE Prime Programming by Carnegie Mellon University Robot Academy

EV3-Lab and EV3 Classroom Programming by Droids Robotics - EV3Lessons.com

SPIKE Prime and Robot Inventor Word Blocks and Python Programming by Droids Robotics - PrimeLessons.org

FIRST LEGO LEAGUE SKILLS

ORTOP - Oregon FIRST
FLLTutorials.com
FIRST LEGO League Rookie Webinars

FIRST LEGO LEAGUE APPS

Official App provided by *FIRST* LEGO League is available on the Event Hub
FLLTutorials Scorer

CODE BACKUP TOOLS

Github
Google Drive
EV3Hub (only for EV3-Lab)
Dropbox
EV3 Online Tree Visualizer (EV3-Lab)

ENGINEERING NOTEBOOK/NOTE TAKING

Google Science Journal
Google Docs/Drive
Redbooth
OneNote and OneDrive
Engineering Notebooks and Coach Guidebooks by FIRST
Engineering Notebooks by FLLTutorials
Dropbox
Google Classroom
Microsoft Teams

TEAM COMMUNICATIONS

Some apps may be for ages 13+. Please consult parents.

Google Hangout
Skype
GroupMe
Facebook Messenger Kids
Google Classroom
Remind.com
Kakao
WhatsApp Groups
Microsoft Teams
Google Calendar
Google Group
Fleep
Whatsapp
Discord (common among older FIRST teams)

Slack (common among older FIRST teams)

PROJECT MANAGEMENT

Trello
Slack
Basecamp

VIDEO-MAKING TOOLS

iMovie
TouchCast (App)
Animot
Camtasia
OBS

VIRTUAL ROBOT

EV3 (CMU)
CMU SPIKE Prime (paid license)
Virtual Robotics Toolkit (paid license)
GearsBot (free, block-based)

BUYING EXTRA LEGO/SPARE PARTS

LEGOEducation.com
LEGO.com
Brickowl.com
Brickset.com
Bricklink.com

LEGO CAD TOOLS:

LEGO LDD (Note: Out-of-date, no new parts):
Studio (can import in SPIKE Prime/Robot Inventor):

PARTS LIST/INVENTORY:

Brickset.com - Enter any set number (see below)
MINDSTORMS Robot Inventor - 51515
MINDSTORMS EV3 Retail Set - 31313
MINDSTORMS EV3 Education Set - 51515
SPIKE PRIME - 45678
SPIKE PRIME Expansion V.2.0 - 45681
SPIKE Prime Element Overview
SPIKE Prime Expansion V.1 Element Overview

Useful Contacts

- ❏ FIRST LEGO League Questions
- ❏ LEGO Education for order status or missing parts: 1-800-422-5346 or education.lego.com/en-us/support
- ❏ Facebook Group for getting support from other coaches - FLL Challenge: Share & Learn
- ❏ EV3 Programming Lessons (EV3-Lab and EV3 Classroom) from Beginner through Advanced: EV3Lessons
- ❏ SPIKE Prime/Robot Inventor Lessons from Beginner through Advanced: PrimeLessons
- ❏ Guides specific to *FIRST* LEGO League: FLLTutorials
- ❏ Challenge Documents and Updates or
- ❏ Questions or suggestions for the authors: team@flltutorials.com