**Introduction**

*FIRST®* LEGO® League is a robotics competition for students ages 9-14 (age varies by country). The competition includes four parts: the robot game, a robot design presentation, a research project, and core values. This lesson plan is designed for coaches/mentors to better prepare their teams for the judged sessions.

**Disclaimers**

This resource is unofficial. That means that FIRST® and LEGO® have not overseen the creation of this resource and have not approved it. Additionally, judging requirements vary by region. This guide strives to be as comprehensive as possible but coaches should always consult the official documentation and requirements provided by FIRST® LEGO® League and by their region

**Getting help**

You can find official documentation at [firstlegoleague.org](https://firstlegoleague.org). You may also wish to contact your local operational partner to find out about any intricacies of your region. You can do that at [firstinspires.org/find-local-support](https://www.firstinspires.org/find-local-support). Additionally, unofficial resources are provided at [hub.jaredhk.com](https://hub.jaredhk.com) and you can contact Jared, the creator of this guide and those resources any time at [hub.jaredhk.com/contact](https://hub.jaredhk.com/contact).

**Contents**

**Day 1 – Project: Problem Identification**

*Today, you will focus on identifying a problem you wish to solve. In order to do this most effectively, you should consult a variety of sources. Since you may want to consult with experts, this step may take more than a single meeting. That is completely fine, just be sure to return to this page after hearing back from the experts.*

1. Read the challenge documentation, specifically the section defining the project. You may also want to watch the accompanying challenge videos.
   * **ACTIVITY** Turn to the person next to you and discuss: **describe the challenge in your own words**.
   * Then, students can raise their hands and share what they discussed with their partner. Call on several students and come up with a consensus on the problem. Write that definition on a whiteboard.
2. Brainstorm broad problems that fall within the purview of the challenge. At this point, don’t worry too much about the specifics of the problem or how to solve them.
   * **ACTIVITY** On a piece of paper**, write down at least three problems** in this area. You don’t have to know how to fix the problem right now. See Appendix A.
   * Put all of the ideas on a whiteboard. Be sure to save the ideas you brainstormed, even if they are not the ideas you go with. This will complement your judging nicely later.
   * Group together common ideas on the board.
3. Seek out the opinion of experts. Experts can provide insight that you may not have thought of. You do not necessarily need to talk to an expert in the specific field of problems that you brainstormed. If you can meet an expert in person, that would be ideal. Email and video conferencing are also options, though. Consider meeting multiple experts with various experience, too.
   * Tip: Try to find an expert who is willing to help you refine your ideas later down the line.
   * Using Appendix B, craft some interview questions for the experts and record their answers. Each student should do this to get the best information. Make sure to save the responses from the interview for later.
4. Using the research conducted both online and with experts, regroup and come to a consensus on the final problem you wish to solve. Write down that problem and consider sending it out to team members or positing it in your workspace so that everyone is on the same page.

**Day 2 – Project: Formulating Research Sources**

*Now that you’ve identified a problem, it is time to begin researching the details of the problem area. It’s equally important to have a good number of sources while also ensuring quality and diversity of the sources you use. Today, we’ll focus on picking sources and assigning them as homework for students.*

Today’s lesson focuses on research which is not unique to FLL. Therefore, there are lots of resources available for learning about conducting research. Be sure to check them out, especially with younger students who may not yet have experience conducting research for a class.

1. Begin by discussing types of sources: books, websites, videos, etc.
2. Next, identify what your research questions are. In other words, identify the information you don’t know yet. Aggregate research questions on a whiteboard. Then, assign questions to each student.
   * Students can work in pairs/teams or individually. With younger students, pairs might help. Consider using Google Docs or other online collaboration tools for this.
3. Each student should take their research question or area of interest and complete Appendix C. Make sure that students save this for the next meeting.
   * Students can do this as homework before the next meeting or they can do it during the remainder of the meeting.

**Day 3 – Project: Consolidating Research and Next Steps**

*Now that the students have gone off on their own and conducted research, it is time to consolidate it and identify any gaps in the research. You will then develop next steps for the team in proceeding with research. At this point, the timeline may differ from that in the lesson plan, depending on the complexity of the research and the experience of the students.*

1. Each student will share the research they conducted on their own. There are a variety of ways to do this, but we will recommend one method.
   * **ACTIVITY** Each student will have 30 seconds to one minute to summarize their findings to the group. Team members and coaches will then be able to ask the students clarification questions. Two lists should be put on the whiteboard. First, one list is “We learned…” which will aggregate the findings. The other list will be “I’m sill unclear on…” which will list any unanswered questions. The lists should be moderated by a coach or a more experienced student.
   * Be sure to save the contents of the list for the future.
2. Using the “I’m still unclear” list, assign items to students for further research. Have them complete the same sheet as last time, Appendix C.
   * It is recommended that students do this research during the meeting. However, if time constraints require, they can go home and work on it.
3. Repeat step one using the newly found information from step two. If necessary, do this at the next meeting.

**Day 4 – Project: Identifying Existing Solutions and Pitfalls**

*By now, students should be able to articulate the problem and explain much of the research surrounding the problem. It may be tempting to try and solve the problem now, but it will be most beneficial to the team to identify existing solutions first.*

This lesson is one of the last research heavy parts of the innovative project. With just a little bit more focus, the students will be on their way to developing solutions and flexing their creativity in no time!

1. Begin by discussing a few key terms:
   * Innovation: A new idea, product, or method for doing something
   * Practical: How realistic something is and how likely it is to succeed
   * Beneficial: Adds real value to solve the problem
   * Pitfalls: Danger, difficulty, risks, or problems
2. Now, students will go off on their own and identify existing solutions to the problem. Depending on your area of focus, there may be a few obvious solutions. If that’s the case, feel free to assign them to students. If existing solutions are not immediately clear, students can try to find these on their own. Have students complete Appendix D at home or during the remainder of the meeting to find existing solutions and identify their pitfalls.

**Day 5 – Project: Innovation Wish List**

*If you’ve been following this lesson plan from the beginning, you should now have a pretty good picture of what you want the innovation to look like. Today is the day to let that creativity shine and assemble all of your big ideas.*

1. Each student will share existing solutions they identified as well as the pitfalls. There are a variety of ways to do this, but we will recommend one method.
   * **ACTIVITY** Each student will have 30 seconds to one minute to summarize their findings to the group. Team members and coaches will then be able to ask the students clarification questions. A two-column list should be put on the whiteboard. The first column is “existing solution” and the second column is “pitfall(s).” Lists should be moderated by a coach or a more experienced student.
   * Be sure to save the contents of the list for the future.
2. Keeping that list on the board, you will now identify a “wish list” of all of the features of your project.
   * **ACTIVITY** On a piece of paper**, write down at least five features** that you believe the innovation should have. Ideally, this should be a mix of features available on existing solutions as well as those not yet available. See Appendix E.

**Appendix A – Brainstorming problems**

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You just discussed the purpose of this year’s challenge. Now that you know the area to focus on, think about problems which exist in that area. You don’t need to know all the details yet or have any idea how to solve the problem—that’ll come later. For now, just write three problems in that area:

1.

2.

3.

**Appendix B – Interviewing an expert**

Now that you know this year’s challenge, you may want to consult with experts to help define your problem. Follow the exercise below to prepare for and conduct your interview.

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name of expert: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Company/Organization: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

First, it’s important to understand what the expert does. Consider the types of questions you can ask to determine the expert’s area of expertise.

|  |  |
| --- | --- |
| Question to identify expertise | Answer |
|  |  |

Next, consider explaining FLL and the challenge to the expert. Now that the expert is familiar with what you are trying to do, ask them some questions to help identify the problem.

|  |  |
| --- | --- |
| Questions to identify a problem | Answer |
|  |  |
|  |  |
|  |  |

If the group agrees upon a problem (or a small list of possible problems), you can verify that this is a genuine problem with the expert. Once you refine it, **write down the problem here**:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The expert might have some feedback on this problem, or they might be able to help you identify existing solutions. Ask about that and record the answer.

|  |  |
| --- | --- |
| Questions to ask for feedback | Answer |
|  |  |

**Appendix C – Conducting initial research**

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now that you know about all different types of research, it’s time to go off on your own and learn more about it. Through this research, you will become your team’s expert on this area. Remember when researching that you should ensure your sources are credible and diverse.

|  |  |  |
| --- | --- | --- |
| I want to know… | I learned that… | Source |
|  |  | Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Author: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Publisher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date published: \_\_\_\_\_\_\_\_\_\_\_\_  Type of source (book, internet, etc.): \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  |  | Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Author: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Publisher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date published: \_\_\_\_\_\_\_\_\_\_\_\_  Type of source (book, internet, etc.): \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  |  | Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Author: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Publisher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date published: \_\_\_\_\_\_\_\_\_\_\_\_  Type of source (book, internet, etc.): \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
|  |  | Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Author: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Publisher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date published: \_\_\_\_\_\_\_\_\_\_\_\_  Type of source (book, internet, etc.): \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Feel free to use more than one sheet if you have more research. Or, follow the same template on the back.

Summarize what you learned in 2-3 sentences:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix D – Identifying existing solutions**

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You are now an expert in the area your team has been researching. Before you try to solve the problem, it’s a good idea to identify any existing solutions and any issues with those solutions. Remember from today’s lesson that a good innovation should be practical and beneficial with minimal pitfalls.

|  |  |  |
| --- | --- | --- |
| Existing solution description | How does it help?  *Why is this solution beneficial?* | Are there any problems/pitfalls? How can it be improved? |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Feel free to use more than one sheet if you have more research. Or, follow the same template on the back.

Summarize what you learned in 2-3 sentences:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Appendix E – Features Wishlist**

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now that you know about the existing solutions and their pitfalls, you can start to establish a list of the ideal features that you want in a solution. Think about a combination of features available and not available on the existing solutions.

1.

2.

2.

3.

4.

5.