FIRST LEGO LEAGUE CHALLENGE

TEAM MEETING GUIDE

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Introduction to *FIRST*® LEGO® League Challenge

Friendly competition is at the heart of *FIRST*® LEGO® League Challenge, as teams of up to 10 children engage in research, problem-solving, coding, and engineering – building and programming a LEGO® robot that navigates the missions of the Robot Game. Teams also participate in an Innovation Project to identify and solve a relevant real-world problem.

FIRST LEGO League Challenge is one of three divisions by age group of the *FIRST* LEGO League program. This program inspires young people to experiment and grow their confidence, critical thinking, and design skills through hands-on STEM learning. *FIRST* LEGO League was created through an alliance between *FIRST* and LEGO® Education.

Welcome to *FIRST*® FORWARD℠ and CARGO CONNECT℠

Welcome to the *FIRST*® FORWARD℠ season. This year's *FIRST* LEGO League challenge is called CARGO CONNECT℠. Children will learn about how cargo is transported, sorted, and delivered to its destinations. As more demands are placed on transportation systems, the children need to rethink how cargo is transported from place to place. We have the power to build a path forward and invent the future of transportation. And it starts here, with you.

During the sessions, the team will experience the **engineering design process**. The team will identify, design, and create solutions and test, iterate, and improve them. The team will then share and communicate what they learned with others. The rubrics used in judging capture the engineering design process used to create both the robot and Innovation Project solutions.

Working as a Team

The team will create their robot to compete in the Robot Game and design their Innovation Project solution. Teammates should be encouraged to work with each other, listen to each other, take turns, and share ideas.

Team roles are outlined in the *Engineering Notebook*. Using roles helps your team function more efficiently and ensures that everyone on the team is involved.
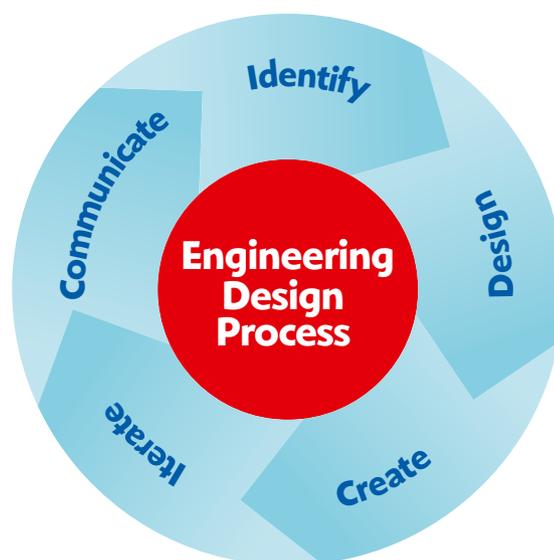
Overview

How to Use this Guide

The 12 sessions outlined give your team a guided experience in *FIRST*® LEGO® League Challenge. The sessions are designed to be flexible so that teams of varying experiences can use the materials. In general, plan for each session to last 120 minutes, but each session can be adjusted to meet your own implementation needs.

Your role is to facilitate and guide the team during the sessions to complete the team tasks. Besides the main tasks, there is an introduction and a very important share session, where the team meets around the mat to discuss what they have learned. Finally, the team will clean up and put away their materials. The tips within this guide are suggestions, and you may not want to follow all of them. Remember to do whatever is best for you and your implementation.

FIRST® Core Values

The *FIRST*® Core Values are the cornerstones of the program. They are among the fundamental elements of *FIRST* LEGO League. By embracing the Core Values, children use discovery and exploration of the theme in each session and learn that helping one another is the foundation of teamwork. It is important that the children have fun. The more playful the sessions are, the more motivated the children will be.

Gracious Professionalism® is a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community. The team's Core Values and *Gracious Professionalism* will be evaluated during Robot Game matches and during the judging session at the tournament. The team demonstrates *Coopertition*® by showing that learning is more important than winning and they can help others even as they compete.

Teamwork	We found we were stronger when we worked together.
Inclusion	We embraced our differences and ensured we all felt welcomed.
Innovation	We used creativity and persistence to solve problems.

Fun	We enjoyed and celebrated what we did!
Discovery	We explored new skills and ideas.
Impact	We applied what we learned to improve our world.

What Does the Team Need?

LEGO® Education Robot Set

Core set

Expansion set (recommended)

Core set

Expansion set (recommended)

Electronic Devices

Each team will need two compatible devices such as a laptop, tablet, or computer. Prior to starting Session 1, you need to download the appropriate software (LEGO® Education SPIKE™ Prime or LEGO®

MINDSTORMS® Education EV3 Classroom) onto the hardware device. To view system requirements and download software, visit legoeducation.com/downloads.

CARGO CONNECT℠ Challenge Set

This challenge set comes in a box that contains the mission models, challenge mat, and some miscellaneous pieces. The team should build the models very carefully using the building instructions. This is completed during Sessions 1-4: firstlegoleague.org/season#resources. The miscellaneous items include 3M™ Dual Lock™ Reclosable Fasteners, coach pins, and season tiles for the team members.

Challenge Mat and Table

Set up a table with the challenge mat in your classroom or meeting space. Even if you cannot build the whole table, building just the four walls will be useful. It is also possible to use the mat on the floor. Find out more, including how to build the table, at firstlegoleague.org/season#resources.

Session Layout

EVERY SESSION STARTS WITH AN INTRODUCTION AND ENDS WITH A SHARE ACTIVITY. DETAILS FOR THESE ACTIVITIES ARE GIVEN IN THE SESSION PAGES THAT FOLLOW, ALONG WITH NOTES AND TIPS TO HELP YOU RUN THE SESSION.

	Introduction (10 minutes)	Team Tasks (100 minutes)		Share (10 minutes)
Session 1	Introduction to Challenge	Robot Lesson 1	Efficiency Project Spark	Share
Session 2	Inclusion Examples	Robot Lesson 2	Safety Project Spark	Share
Session 3	Goals and Processes	Robot Lesson 3	Access Project Spark	Share
Session 4	Discovery Examples	Robot Lesson 4	Connections Project Spark	Share
Session 5	Team Name and Logo	Guided Mission	Identify Project	Share
Session 6	Teamwork Examples	Pseudocode and Mission Strategy	Project Planning	Share
Session 7	*Gracious Professionalism®*	Solve Missions	Develop Project Solution	Share
Session 8	*Coopertition®* Examples	Solve Missions	Evaluate and Test Project Solution	Share
Session 9	Innovation Examples	Iterate and Improve Robot Solution	Iterate and Improve Project Solution	Share
Session 10	Impact Examples	Iterate and Improve Robot Solution	Plan Project Presentation	Share
Session 11	Team Playing Card	Plan Robot Design Explanation	Practice Project Presentation	Share
Session 12	Fun Examples	Practice Robot Game Matches	Practice Full Presentation	Share

Pre-Session Checkpoint

Please read the student *Engineering Notebook*, *Robot Game Rulebook*, and this *Team Meeting Guide* before starting the sessions. They are full of very useful information to guide you through this experience. Use this checkpoint to help you get started and guide you toward success.

☐ You need at least two devices with Internet access and appropriate LEGO® Education app installed per team.

☐ Unpack the robot set and sort the LEGO elements into the trays.

☐ Make sure the controller is charged or has batteries in it.

☐ Explore the *FIRST®* Core Values. These are the essential foundation for your team.

☐ Watch the season videos on the *FIRST* LEGO League YouTube channel.

☐ If the team is new to using their LEGO Education robot set, it would be beneficial to take some time for them to get acquainted building and coding with the set. The team could complete the Getting Started activities in the relevant LEGO Education app.

☐ Have a location to place the mat and models after each session if they have to be stored.

ENGINEERING NOTEBOOK TIPS

• Read the *Engineering Notebook* carefully. The team will share the notebooks and work on them collaboratively.

• The notebook contains relevant information and guides the team through the sessions.

• The tips in this *Team Meeting Guide* will direct you how to support each session.

• As facilitator, help guide the team members in the performance of their roles during each session.

• Using the team roles outlined in the notebook can help your team function more efficiently and ensures that everyone on the team is involved.

See page 16 for more useful tips and resources.
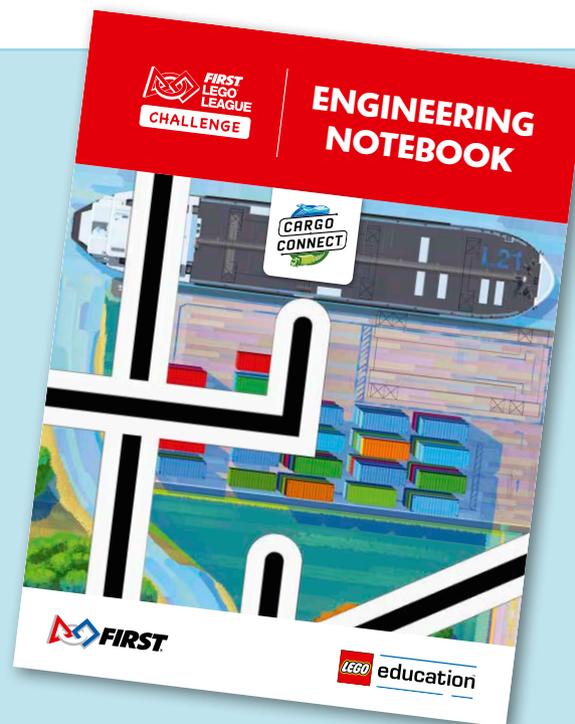
Session 1

Outcomes

• The team will learn how to connect and use the sensors and motors.

• The team will make connections from the mission models to the Efficiency Project Spark ideas.

ESTIMATED TIMES ARE PROVIDED FOR EACH PART OF THE SESSION.

1 Share the season videos on the *FIRST*® LEGO® League YouTube Channel with the team.

2 Two devices are suggested, one for the robot and one for project work. Additional devices for the mission model building are useful.

3 Activities in the sessions are for LEGO Education SPIKE™ PRIME app or MINDSTORMS® Education EV3 Classroom app.

4 Make sure the controller and device are plugged in and charging at the end of the session.

5 Robot Game Connection: Have the team plan for how to get the robot to a model or target area.

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1 ➜ **Introduction**
(10 minutes)

☐ Read pages 4-9 explaining how *FIRST*® LEGO® League Challenge works.

☐ Now that you have read about CARGO CONNECT℠, you are ready to get started.

2 ➜ **Tasks**
(50 minutes)

☐ Open the SPIKE™ Prime or EV3 Classroom app. Find your lesson.

3 **Robot Trainer Unit: Moves and Turns**
Complete the Getting Started activities before this session.

Getting Started: Start Here, Motors and Sensors

4 ☐ Identify the building and coding skills you learned in the lesson that will help you solve missions.

5

➜ **Reflection Questions**

• Can you use your fantastic coding skills to navigate your robot to a model on the mat?

• Can your robot already complete any of the missions?

Session 1

What are the four parts of *FIRST* LEGO League Challenge?

EVERY SESSION HAS AN INTRODUCTION PROMPT AND SPACE TO DOCUMENT THE TEAM'S RESPONSES.

Our Notes:

OPEN SPACE IS PROVIDED IN THE ENGINEERING NOTEBOOK EACH SESSION FOR THE TEAM TO COLLABORATIVELY CAPTURE THEIR THOUGHTS, IDEAS, DIAGRAMS, AND NOTES.

SOME SESSIONS WILL HAVE HELPFUL TIPS FOR THE TEAM.

Read over the *Robot Game Rulebook* for all the details on the missions.

Efficiency

SEE PAGE 3 IN THE ROBOT GAME RULEBOOK FOR A SUMMARY PAGE OF THE MISSION MODELS AND THEIR BAG NUMBERS.

Efficiency

Project Spark

Being more efficient with the way we transport cargo is beneficial for many reasons.
How can you make the journey of cargo more efficient?

Think about…
• The cost of transporting cargo.
• The time it takes to transport cargo.
• The energy used to transport cargo.
• Ensuring cargo arrives undamaged.

The models you built this session relate to missions in the Robot Game that represent improving the efficiency of transporting cargo.

Our Ideas:

PROJECT SPARKS PROVIDE THE TEAM WITH IDEAS FOR THEIR INNOVATION PROJECT AND HOW THE MISSION MODELS CONNECT TO THE THEME.

THE TEAM CAN USE THESE REFLECTION QUESTIONS DURING THE SHARE TIME. SHARING AT THE END IS AN IMPORTANT WAY FOR THE TEAM TO SUMMARIZE AND REFLECT.

Use the QR code on the mat to find the building instructions.

➜ Tasks
(50 minutes)

- [ ] Read the Project Spark.
- [ ] **6** Build the Efficiency models in Bags 1-4 using Building Instruction Books 1-4.
- [ ] **7** Check out the *Robot Game Rulebook*. This will be a great resource throughout the sessions.
- [ ] Review the missions that relate to the models you built.
- [ ] Discuss how the mission models are linked to the Project Spark.
- [ ] **8** Brainstorm and record your ideas that relate to this Project Spark.

➜ Share
(10 minutes)

- [ ] Get together at the mat.
- [ ] **9** Place each model where it belongs. Refer to the Field Setup section in the *Robot Game Rulebook*.
- [ ] Show the robot skills you learned.
- [ ] Show how the models work and explain how they relate to the Project Spark.
- [ ] Discuss the reflection questions.
- [ ] **10** Clean up your space.

➜ Reflection Questions
• Do any of the mission models make you think of good ideas for the Innovation Project?
• What could you create that would improve the efficiency of transporting a particular product?

6 Provide the digital building instructions Books 1-4 to the team. Find them at firstlegoleague.org/season#resources.

7 The team will need Bags 1-4 from the Challenge set. Larger pieces may be in an unnumbered LEGO® bag.

8 Have the team record their brainstorming ideas as a bulleted list in the *Engineering Notebook* or in another location.

9 Place the completed models on the mat with Dual Lock™ according to the field setup in the *Robot Game Rulebook*.

10 Allow time for cleanup and place any unfinished models and their pieces in a sealed plastic bag.

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Session 2

Outcomes

• The team will build a driving base and code it to move forward, move backward, and turn.

• The team will make connections from the mission models to the Safety Project Spark ideas.

1 At the tournament judging session, the team will provide examples of how they have used Core Values, so there are introduction activities for them to practice this.

2 Remind the team to save their programs often on their device.

3 After a program is downloaded onto the controller, it cannot be transferred back to be opened and edited.

4 Have the team practice their new skills by trying to drive the robot to a model and then returning to Home.

5 Robot Game Connection: Have the team code the robot to push an object and deliver it to a target area on the mat.

1 → **Introduction**
(10 minutes)

☐ Think about **Inclusion** and your team.

☐ Record examples of how your team makes sure everyone is respected and their voices are heard.

2 → **Tasks**
(50 minutes)

☐ Open the SPIKE™ Prime or EV3 Classroom app. Find your lesson.

Robot Trainer Unit: Objects and Obstacles

3

Competition Ready Unit: Training Camp 1: Driving Around

☐ Determine what coding and building skills you can apply in the Robot Game.

4

5

→ **Reflection Questions**
• How can you aim your robot toward a model?
• How can you make your robot go the right distance to reach a model?

Session 2

Inclusion: We respect each other and embrace our differences.

Our Notes:

How does a machine operator safely load and unload cargo?

Safety

Safety

Project Spark

How does safety affect how cargo is transported?
How can you make transporting cargo safer?

Think about…
• People driving different forms of transportation.
• Loading and unloading cargo.
• Different forms of transportation used to transport cargo.
• The infrastructure used in transportation.

The models you built this session relate to missions in the Robot Game that represent improving the safety of transporting cargo.

Diagram of our solution:

➜ **Tasks**
(50 minutes)

☐ Explore the Project Spark.

6 ☐ Build the Safety models in Bags 5-9 using Building Instruction Books 5-9.

7 ☐ Look over the missions that correspond to the models.

☐ Talk about how the mission models relate to the Project Spark.

8 ☐ Draw your solution for a piece of equipment or technology that could improve safety.

9 ☐ In your drawing, include how your solution works and label its parts.

➜ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Place each model where it belongs. Refer to the Field Setup section in the *Robot Game Rulebook*.

☐ Share the robot skills you learned.

☐ Show how the models work and explain their connections to the Project Spark.

☐ Chat about the reflection questions.

☐ Clean up your space.

➜ **Reflection Questions**

• Can you think of interesting ways to safely transport cargo?
• What are examples of transportation safety features in your community?

10 How would a safety specialist do a safety check before transporting large cargo?

6 Provide the digital building instructions Books 5-9 to the team. Find them at firstlegoleague.org/season#resources.

7 The team will need Bags 5-9 from the Challenge set. Larger pieces may be in an unnumbered LEGO® bag.

8 Have the team think about equipment or technology they could invent as a solution to the Project Spark.

9 The team can use visual aids to help explain their Innovation Project solution, so this gives them practice at creating a detailed diagram.

10 Check out Career Connections pages in the *Engineering Notebook* that link to jobs listed in the sessions.

Session 3

Outcomes

• The team will code their robot to avoid obstacles using a sensor and to power an attachment.

• The team will make connections from the mission models to the Access Project Spark ideas.

1 Goals should be tangible and something the team can achieve. The team can read over the judging rubrics for ideas.

2 Team planning and project management is important to achieve goals and be ready for the tournament.

3 Have the team check that the wires are plugged into the right ports and that the ports used match their program.

4 To make missions easier to complete, the team can build LEGO® attachments and fit them onto the robot.

5 Robot Game Connection: Have the team think about how to use the attachment from the robot lesson to complete missions.

1 ➜ **Introduction**
(10 minutes)

☐ Now that you're familiar with *FIRST®* LEGO® League Challenge, discuss the goals you want to achieve for the season.

☐ Talk about what processes your team will follow and determine responsibilities.

2

➜ **Tasks**
(50 minutes)

☐ Open the SPIKE™ Prime or EV3 Classroom app. Find your lesson.

3 **Robot Trainer Unit: Grab and Release**

Competition Ready Unit: Training Camp 2: Playing with Objects

4

☐ Recognize the skills you learned that will be beneficial in completing missions.

5

➜ **Reflection Questions**

• Can you code your robot to navigate to a model on the mat?
• What objects does your robot need to avoid?

Session 3

Our Team Goals:

Our Notes:

Access

Access

Project Spark

How can you ensure cargo is transported to where it needs to go, especially when the location is difficult to access? Well-maintained infrastructure and innovative ways to reach isolated areas should be considered.

Think about…
- Maintenance of roads, tracks, and transportation systems.
- Repair of infrastructure.
- Creation of new transportation networks to improve access.
- Innovative new forms of transportation.

The models you built this session relate to missions in the Robot Game that represent improving access to delivery destinations.

Our Ideas:

> How does a courier deliver packages to isolated areas?

➜ Tasks
(50 minutes)

- ☐ Look over the Project Spark.
- **6** ☐ Build the Access models in Bags 10-12 using Building Instruction Books 10-12.
- **7** ☐ Connect the missions to the models you built.
- **8** ☐ Discuss how the models are linked to the problem presented.
- **9** ☐ Brainstorm and record your ideas that relate to this Project Spark.
- **10** ☐ Create a list of your innovative ideas.

➜ Share
(10 minutes)

- ☐ Get together at the mat.
- ☐ Place each model where it belongs.
- ☐ Share how the models work and the robot skills you learned.
- ☐ Demonstrate the models' functions and how they connect to the Project Spark.
- ☐ Talk about the reflection questions.
- ☐ Clean up your space.

➜ Reflection Questions

- Are there any places in your community that would be hard to access to make a delivery?
- Can you think of ways to improve access to remote areas?

6 Provide the digital building instructions Books 10-12 to the team.

7 The team will need Bags 10-12 from the Challenge set.

8 Consider inviting an expert or someone who works in this area to talk about the Project Sparks.

9 The team will learn about four different Project Sparks to inspire their Innovation Project. Have them keep notes of their ideas.

10 The team can think of ways to improve existing solutions to the Project Sparks. Their ideas don't have to be brand new.

Session 4

Outcomes

- The team will build a driving base and code it to move and use the color sensor to follow a line.
- The team will make connections from the mission models to the Connections Project Spark ideas.

1 Plug in the controller and open the app periodically to check for software and firmware updates.

2 Have the team pick out lines on the mat that will help them navigate the robot to different mat areas.

3 Have the team follow the code on the screen to see how it matches the robot's actions. This will help them debug their programs.

4 Try to start the robot in the same or a very similar place each time in the Launch area.

5 Robot Game Connection: Have the team adapt and test out their line-following program on the mat.

→ Introduction
(10 minutes)

☐ Think about **Discovery** and your team.

☐ Record examples of how your team has learned new skills and ideas.

→ Tasks
(50 minutes)

1 ☐ Open the SPIKE™ Prime or EV3 Classroom app. Find your lesson.

2 **Robot Trainer Unit: Colors and Lines**

3 **Competition Ready Unit: Training Camp 3: Reacting to Lines**

4 ☐ Determine what building and coding skills will help you in the Robot Game.

5

→ Reflection Questions

- What attachment could you create for your robot?
- How would you code an attachment?

Discovery: We explore new skills and ideas.

Our Notes:

How does a warehouse worker ensure cargo is sorted correctly in the sorting center?

Connections

Connections

Project Spark **10**

Transporting cargo across different forms of transportation can have a great impact on the overall journey. How can we improve the connections between different forms of transportation?

Think about…
• Mechanisms for sorting goods.
• Devices for unloading or loading cargo.
• Tracking cargo on its journey.
• Communication with the consumer.

The models you built this session relate to missions in the Robot Game that represent improving connections between different forms of transportation.

Diagram of our solution:

➔ **Tasks**
(50 minutes)

☐ Read the Project Spark.

6 ☐ Build the Connection models in Bags 13-15 using Building Instruction Books 13-15.

7 ☐ Identify the missions that relate to the models you built.

8 ☐ Discuss how the Project Spark and models are linked.

☐ Draw your solution for a piece of equipment or technology that could improve how different vehicles make connections.

9 ☐ In your drawing, include how your solution works and label its parts.

➔ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Put each model where it belongs.

☐ Show how the models operate and their connection to the Project Spark.

☐ Show the robot skills you have learned.

☐ Discuss the reflection questions.

☐ Clean up your space.

➔ **Reflection Questions**
• Can you think of any ways to make better connections between different forms of transportation?
• What different connection points are used for transportation in your community?

How does a freight driver know what routes to use when transporting cargo?

6 Provide the digital building instructions Books 13-15 to the team.

7 The team will need Bags 13-15 from the Challenge set.

8 This is the last session for building models. Finish building all the models and placing them on the mat before the next session.

9 Make sure the team label their diagram with lots of details that explains how their solution works.

10 The four Project Sparks presented in Sessions 1-4 provided different ideas for the team for their final Innovation Project.

Management Tips

FACILITATOR TIPS

• Determine your timeline. How often will you meet and for how long? How many meetings will you have before your tournament?

• Set team guidelines, procedures, and expected behaviors for your meetings.

• Get into the mindset that the team should be doing most of the work and learning. You are there to facilitate their journey and remove any major obstacles.

• Guide your team as they work independently through the tasks provided in each session.

• Use the guiding questions in the sessions to provide focus and direction on what the team will do.

• Jobs are listed in some sessions that connect to the Career Connections pages in the back of the *Engineering Notebook*. Additional enrichment activities are also provided on these pages.

MATERIAL MANAGEMENT

• Place any extra or found LEGO® pieces in a cup.

• Have kids who are missing pieces come to the cup to look for them.

• Wait to dismiss your team until you look over their LEGO set.

• The lid of the LEGO set can be used as a tray to keep pieces from rolling away.

• Use plastic bags or containers to store any unfinished builds and their associated pieces or assembled models.

• Designate a storage space for the built mission models, challenge mat/table, and LEGO container.

• The role of the Material Manager is to help with the process of clearing away and storing materials.

Helpful Resources	
LEGO® Education Support	education.lego.com/en-us/support Phone: (800) 422-5346
Main Website	firstlegoleague.org
General Support Questions	fllchallenge@firstinspires.org
Equity, Diversity, & Inclusion Training	firstinspires.org/about/diversityinclusion
LEGO Education Teacher Community	community.lego.education.com
CARGO CONNECT℠ Resources	firstlegoleague.org/season
Educator Resources	info.firstinspires.org/curriculum
Hybrid Learning	education.lego.com/en-us/support/managing-todays-classroom#hybrid firstinspires.org/covid-19

Find additional digital resources here!

Checkpoint 1

- The team has bonded and are working well together. If they need more support to achieve this, do some extra team-building activities.
- New teams may want to summarize the new robot skills they have learned.
- All models must be built and placed on the mat, secured with the Dual Lock™ as needed.
- Extra time can be spent on the robot lessons before moving on.
- The team has explored and designed solutions for all the Project Sparks.
- The team has reviewed the missions and rules in the *Robot Game Rulebook*.

Tips for Sessions 5-8

CORE VALUES

- Remember the Core Values are about HOW the team behaves and works together. They should be demonstrated by all the team, all the time.

ROBOT DESIGN

- At the event, two mats will be set up next to each other. However, during the sessions, you will probably work with a single mat.

INNOVATION PROJECT

- Teams will have to select a final problem and solution to focus on, so thinking about this goal during each session is helpful.

ROBOT GAME

The team could look for missions that use basic robot skills like:

- Push, pull, or lift
- Models close to home
- Navigation with line following
- Easy access to return home

Session 5

Outcomes

- The team will apply coding principles to the guided mission.
- The team will research solutions and identify their Innovation Project problem to solve.

1 Provide supplies to create posters with their team names as logos.

2 If the team is sharing one robot, they can code on individual devices then take turns running their programs onto the robot.

3 The provided code for the guided mission will not only solve the Air Drop mission but also be helpful to use on other missions.

4 Show the Guided Mission portion of the season video again.

5 If an attachment is needed for a mission, keep it in a plastic bag labeled with the mission number.

➜ **Introduction**
(10 minutes)

1 ☐ Now that you have been working together as a team, create a team name!

☐ Design a poster of your team name as a logo.

☐ Be sure each person gets to contribute to the poster!

➜ **Tasks**
(50 minutes)

2 ☐ Open the SPIKE™ Prime or EV3 Classroom app. Find your lesson.

Robot Trainer Unit: The Guided Mission

3 **Competition Ready Unit: The Guided Mission**

4 ☐ Read over the guided mission.

☐ Have fun practicing this guided mission until it works perfectly!

5

➜ **Reflection Questions**

- What does the guided mission show you about *Coopertition*®?
- How do you plan to talk with the other team at the Robot Game about the guided mission?

Session 5

Logo Design:

Guided Mission:

Helicopters can be used to transport cargo to areas that are difficult to reach. They are used to help others, bringing important packages like food.

Like all the mission models on the *FIRST*® LEGO® League Challenge competition field, the Air Drop in Mission 8 (M08) might inspire you to think of a solution for your Innovation Project.

To help you learn about using the color sensor to follow lines on the mat, we have created a guided mission lesson.

In the app, you will:

- Download the program that solves this mission.
- Start your robot in the right position in the launch area.
- Run your robot and watch it complete the mission and score the points.
- Think about how to incorporate the Air Drop mission into one of your runs for the Robot Game.
- Continue to practice your new skills by revisiting previous lessons or moving onto the Advanced Driving Base lesson.

Investigations

Investigations

Research Findings:

➜ **Tasks**
(50 minutes)

☐ Revisit page 7 and review the Project Sparks.

6 Think about the great solutions you have come up with in the previous sessions.

7 Research the Innovation Project and different problems you have identified.

☐ Use this page to capture your research.

8 Identify the problem your team will solve.

9 Record your problem statement.

➜ **Share**
(10 minutes)

☐ Get your team together at the mat.

☐ Show how your robot scores points on the guided mission.

☐ Discuss the problem your team have identified and think about next steps.

☐ Discuss the reflection questions.

☐ Clean up your space.

➜ **Reflection Questions**

• Which transportation problem can you explain clearly?

• Is there someone you can talk to that is an expert on the problem?
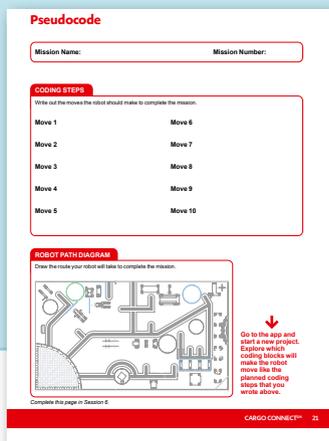
Problem Statement: **10**

6 Encourage the team to record all problem ideas they have identified for the Innovation Project.

7 Project resource examples include the Internet, books, magazines, personal stories, and experts (in person or virtual).

8 Each team member might not get their favorite problem chosen, but the team should choose something everyone supports.

9 The team can use a problem identified within one of the Project Sparks to develop their solution.

10 The team will write their final problem statement here. If they have multiple ideas, use a voting process to narrow it down to one.

Session 6

Outcomes

• The team will create a mission strategy plan and write pseudocode for a mission.

• The team will conduct research on their identified problem and start the Innovation Project Planning page.

1 The team should be able to describe what everyone's strong points are and why they like working with them.

2 Provide sticky notes and planning cards for team to place on the mat to map out their mission strategy.

3 Encourage the team to find the missions where points can be scored most easily and do these first.

4 More copies of the Pseudocode page can be photocopied. They can be used for each mission the team attempts.

Pseudocode

Mission Name:	Mission Number:

CODING STEPS

Write out the moves the robot should make to complete the mission.

Move 1	Move 6
Move 2	Move 7
Move 3	Move 8
Move 4	Move 9
Move 5	Move 10

ROBOT PATH DIAGRAM

Draw the route your robot will take to complete the mission.

Go to the app and start a new project. Explore which coding blocks will make the robot move like the planned coding steps that you wrote above.

Complete this page in Session 6.

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→ Introduction
(10 minutes)

1 ☐ Think about **Teamwork** and your team.

☐ Record examples of how your team has learned to work together.

→ Tasks
(50 minutes)

☐ Watch the Missions part of the season video again.

2 ☐ Start to think about your mission strategy.

☐ Design an effective work plan.

3 ☐ Discuss which missions your team will attempt first.

4 ☐ Complete the **Pseudocode** page.

☐ Think about how the program will make your robot act.

☐ Revisit the earlier lessons or do the optional lesson listed below.

☐ Amend the guided mission code so it works on the advanced driving base.

Robot Trainer Unit: Angles and Patterns

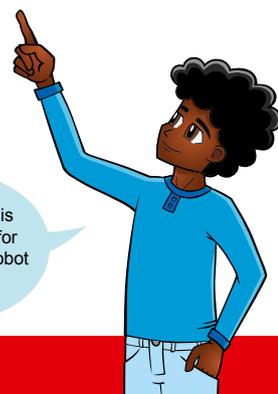**Competition Ready Unit: Assembling an Advanced Driving Base**

→ Reflection Questions

• What does your robot need to do to complete the first mission you have chosen?

• What is your Robot Game strategy to complete missions?

Session 6

Teamwork: We are stronger when we work together.

Strategy:

Pseudocode is written steps for your planned robot program.

Teamwork

→ Introduction
(10 minutes)

- ☐ Research the problem you chose and any existing solutions. **5**
- ☐ Generate solution ideas. Remember, your solution should be a piece of equipment or technology. **6**
- ☐ Make a plan for how you will develop your solution. Use the Planning page as a tool. **7**
- ☐ Be sure to use a variety of sources and keep track of them on **the Innovation Project Planning** page. **8**

→ Share
(10 minutes)

- ☐ Get together at the mat.
- ☐ Review your **Pseudocode** page. Make changes to the page if necessary.
- ☐ Explain what you discovered in your research. Discuss any solution ideas.
- ☐ Discuss the reflection questions.
- ☐ Clean up your space.

→ Reflection Questions

- Are there existing solutions to your identified problem that you could improve?
- Do you have brand-new solution ideas to your problem?

Session 6 continued

Teamwork

PROBLEM AND SOLUTION ANALYSIS

Record important information here.

Guiding Questions:

- What information are you looking for?
- Does this source have information relevant to your project?
- Can you use different types of sources such as credible Internet websites, books, and experts?
- Is this a good and accurate source of information?

5 Be sure the team collects their sources in a shared location, either online or on paper.

6 Take some extra time with the team if needed to explore all the solution ideas and narrow it down to one.

7 Make sure their solution has the potential to be developed and they can explain their solution clearly.

8 The Innovation Project Planning page can be completed over multiple sessions and helps the team document their process.

Innovation Project Planning

PROCESS
Describe the process you followed to develop your solution.

SOURCES
Write down where you got your information and details such as the title, author, and website.
1.
2.
3.

Complete this page in Session 6

CARGO CONNECT℠ 23

Session 7

Outcomes

• The team will create their project solution and complete the Innovation Project Planning page.

• The team will design and create a robot to complete Robot Game missions.

1 Give the team multiple copies of the Pseudocode page to plan out multiple runs.

2 Different members of the team can be responsible for specific missions and develop and own the robot run of those missions.

3 Once the team has a base robot, do a straight drive test. If it doesn't go straight, look at the robot's center of gravity and balance.

4 Have the team choose a starting position that is easy to find and leaves enough room for the whole robot to fit inside the Launch Area.

5 Encourage the students to explain the code as the robot moves.

→ **Introduction**
(10 minutes)

1 ☐ Think about *Gracious Professionalism®*.

☐ Write ways your team will demonstrate this in everything you do.

☐ Look over pages 21 and 31 in the *Robot Game Rulebook* to see how *Gracious Professionalism®* is evaluated during the tournament.

→ **Tasks**
(50 minutes)

2 ☐ Design and create your robot that can attempt the missions in the Robot Game. You can also improve the existing robot used in the previous sessions.

3 ☐ Create a program for each new mission you attempt. You could combine mission solutions into one program.

4 ☐ Test and improve your robot and its programs.

5 ☐ Develop your coding skills by revisiting the lessons in the app.

☐ Revisit previous lessons, advance through the rest of the unit, or work on solving the missions.

→ **Reflection Questions**

• Can you follow how the code on your device is making your robot move?

• How can you iterate and improve on the existing Robot Design used in previous sessions?

Session 7

Gracious Professionalism: We show high-quality work, highlight the value of others, and respect others and the community.

Robot Design:

You could modify the existing robot you've used in past sessions.

Solutions

Solutions

PROJECT DRAWING

PROJECT DESCRIPTION

➜ **Tasks**
(50 minutes)

6 ☐ Develop and create your project solution.

7 ☐ Sketch your solution. Label the parts and how it will work.

8 ☐ Describe your solution and explain how it solves the problem.

9 ☐ Create a prototype model or drawing of your solution.

10 ☐ Document the process you use to develop your solution on the **Innovation Project Planning** page 23.

➜ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Show the team any new coding skills you learned.

☐ Discuss your research and your project solution.

☐ Discuss the reflection questions.

☐ Clean up your space.

➜ **Reflection Questions**

- Can you describe your innovative solution and how it solves your problem?
- Does your solution involve a piece of equipment or technology?

6 Provide a variety of materials for the team to use to make a prototype model of their project solution.

7 A drawing can include a detailed annotated sketch or a computer-aided design (CAD) drawing.

8 Have the team think of people they would like to get feedback from on their solution.

9 Arrange a visit to look at transportation examples in your community that can be a focus of the project.

10 Consider inviting an expert to this session to share content about their identified problem.

Session 8

Outcomes

• The team will evaluate and improve on their Innovation Project solution.

• The team will design robot attachments and create programs to solve missions.

1 Have the team discuss how the Guided Mission is an example of *Coopertition*®.

2 The team should think about strategy when choosing missions to solve. Multiple missions can be completed on the same run to save time.

3 Encourage the team to discuss how their program works. Break the program into blocks that control one movement.

4 Treat the Robot Game like a sport. The team needs to practice, practice, practice to perform well in the Robot Game.

5 Where the robot starts strongly influences where it ends. Have team keep good notes about where the robot is placed.

→ Introduction
(10 minutes)

1 ☐ Reflect on *Coopertition*®.

☐ Note ways your team will demonstrate this at an event.

→ Tasks
(50 minutes)

2 ☐ Decide which mission to attempt next.

3 ☐ Think about your mission strategy and work plan.

☐ Build any attachments you need to complete missions.

4 ☐ Iterate and refine your program so your robot completes the mission reliably.

5 ☐ Be sure to document your design process and testing for each mission!

→ Reflection Questions

• Is the program for each mission saved on your electronic device?

• In what order will you run the missions in the Robot Game?

Session 8

Coopertition®: We show that learning is more important than winning. We help others even as we compete.

Design Process:

How would a robotic engineer design robots to make transporting cargo more efficient?

Planning

Planning

Plan to Share:

Our Improvements:

➜ **Tasks**
(50 minutes)

6 ☐ Make a plan to share about your solution with others!

7 ☐ Evaluate your present solution.

☐ Iterate and improve to make it better based on feedback.

8 ☐ Determine if you can do any testing of your solution.

9 ☐ Use the elements from Bag 16 to build a model that represents your Innovation Project solution.

10

➜ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Show any new missions you have been working on.

☐ Discuss how you will share about your solution with others.

☐ Discuss the reflection questions.

☐ Clean up your space.

➜ **Reflection Questions**

• How can you realistically implement your Innovation Project solution?

• Could your project solution be manufactured and what would it cost?

6 Keep the white brick model made by the team representing their Innovation Project solution.

7 Collect the remaining white bricks from Bag 16 in a sealed plastic bag. They do NOT have to use all the white bricks.

8 The team should iterate and improve their project solution following feedback from others.

9 The team can create a survey to evaluate their solution or ask for feedback from someone who is an expert on their chosen problem.

10 The team could go through multiple cycles of the Engineering Design Process as they test and improve their project solution.

Checkpoint 2

- ☐ The team has completed all the robot lessons outlined in the sessions.
- ☐ The team has selected an Innovation Project problem and solution and conducted research.
- ☐ Provide the team with the judging flowchart and judging rubrics.
- ☐ Visit the *FIRST*® LEGO® League Challenge Season Resource page to print copies of the rubrics (Core Values, Innovation Project, and Robot Design) and any other information that will help you prepare for your event.

Sessions 9-12 Tips

CORE VALUES

- Make sure the team can provide concrete examples of the Core Values in use by the team. Don't forget *Coopertition*® and *Gracious Professionalism*®.

ROBOT DESIGN

- The team should bring their robot, all the LEGO® attachments, and their computer or program printouts to their judging session when they provide their explanation to the judges. Remind the team to include their mission strategy.

INNOVATION PROJECT

- The team will need plenty of time to iterate, improve, and build a model or prototype of their idea. From Session 9 on, they should focus only on their final solution.

ROBOT GAME

- The team needs a well-practiced and reliable robot run that they know will score them points. If they have time, they can have additional runs to score more points.

Outcomes

• The team will code their robot to deliver their Innovation Project model and solve missions.

• The team will test, iterate, and improve their Innovation Project solution.

1 Discuss how the team members have been innovators and invented new solutions and designs for the robot and project.

2 The team can also have a backup of their programs on external drive like a USB stick or an online storage website.

3 Have a clear strategy for which programs to run and in what order during the Robot Game.

4 Provide the team with the Core Values rubric. Find it here: firstlegoleague.org/season#resources.

5 The Share tasks are important to keep the whole team updated on how the project and the robot are developing.

➡️ **Introduction**
(10 minutes)

1 ☐ Think about **Innovation** and your team.

☐ Record examples of how your team has been creative and solved problems.

➡️ **Tasks**
(100 minutes)

2 ☐ Code your robot to complete Innovation Project mission (M01) using the model you created.

3 ☐ Think about your mission strategy on the mat and the missions you will solve.

☐ Continue to create a solution for each mission as time allows.

☐ Test, iterate, and improve your robot and Innovation Project solutions. Be sure to document all this.

➡️ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Show the work completed on the Innovation Project and Robot Game.

4 ☐ Look over the Core Values rubric. Talk about how you will demonstrate Core Values at the event.

5 ☐ Clean up your space.

➡️ **Reflection Questions**

• What features on your robot show good mechanical design?

• Have you made changes to your project solution based on advice from others during sharing?

Innovation: We use creativity and persistence to solve problems.

Iterations and Improvements:

How does an engineer create innovative designs?

Session 10 Iterate

Outcomes

• The team will plan and create their Innovation Project presentation.

• The team will continue to solve missions for the Robot Game.

Impact: We apply what we learn to improve our world.

Presentation Script:

➜ **Introduction**
(10 minutes)

☐ Think about **Impact** and your team.

☐ Record examples of how your team has had a positive influence on you and others.

➜ **Tasks**
(100 minutes)

☐ **1** Plan out your project presentation. Refer to the Innovation Project rubric for what to cover.

☐ **2** Write out your Innovation Project presentation script.

☐ **3** Make any props or displays that you need. Be engaging and creative!

☐ Continue to create, test, and iterate on your robot solution.

☐ **4** Practice a 2.5-minute Robot Game with all your completed missions.

➜ **Share**
(10 minutes)

☐ **5** Get together at the mat.

☐ Share the project presentation work completed.

☐ Share what missions you have completed.

☐ Discuss how everyone will be involved in the presentation.

☐ Discuss the reflection questions and clean up your space.

How will your Innovation Project solution have an impact on others?

➜ **Reflection Questions**

• How did you decide which missions to attempt?

• How can your Innovation Project solution help your community?

1 Their presentation can be a slideshow, poster, play, or even a skit. Props can be used, such as costumes, shirts, or hats.

2 Scripts can be made for both the Innovation Project presentations and for explaining the robot. Provide copies for each team member.

3 The team may need more space to store all the materials they have created for their presentation.

4 Encourage the team to run their robot in practice 2.5-minute robot matches so that they get used to the time limit.

5 Provide the team with the Innovation Project rubric here: firstlegoleague.org/season#resources.

Outcomes

• The team will finalize their Innovation Project presentation.

• The team will finalize their robot for the Robot Game and create their Robot Design explanation.

1 Provide paper and art supplies for this activity. This activity helps the team to value the contribution made by each member.

2 Practicing how to communicate their Innovation Project solution and explain their Robot Design is important.

3 Provide the team with the Robot Design rubric. Find it here: firstlegoleague. org/season#resources.

4 Every team member should be involved in the presentation at the tournament.

5 The team should know who will run the robot during the matches. There can be only two members at the mat at one time.

1 → **Introduction**
(10 minutes)

☐ Create a sports playing card for each person on the team. You can use these to highlight each person on the team at your event.

☐ Explain about yourself and how you enjoy *FIRST*® LEGO® League Challenge!

→ **Tasks**
(100 minutes)

2 ☐ Continue working on your Innovation Project presentation.

3 ☐ Plan and write out your Robot Design explanation. Refer to the Robot Design rubric for what to cover.

4 ☐ Make sure everyone can communicate about your design process and programs.

☐ Determine what each person on the team will say.

☐ Practice your full presentation.

→ **Share**
(10 minutes)

☐ Get together at the mat.

☐ Discuss the presentation and each person's role.

5 ☐ Run a practice 2.5-minute match and explain what missions are done.

☐ Discuss the reflection questions.

☐ Decide what else needs to be done and clean up your space.

→ **Reflection Questions**

• Do you have a plan for what to do if one mission does not work?

• Does everyone have a speaking part in the presentation?

Session 11 Practice

About My Team:

Explanation Script:

Review the Judging Session Flow Chart to see how you will present your Robot Design and Innovation Project.

Session 12 Prepare

Outcomes
- The team will practice their Innovation Project presentation and Robot Design explanation.
- The team will run practice Robot Game matches.

Fun: We enjoy and celebrate what we do!

Presentation Feedback:

➜ Introduction
(10 minutes)
- ☐ Reflect on how your team has had **Fun**.
- ☐ Record examples of how your team has had fun throughout this experience.

➜ Tasks
(100 minutes)
1. ☐ Rehearse your full presentation communicating your robot and project solutions.
2. ☐ Demonstrate Core Values when you present!
3. ☐ Have practice 2.5-minute Robot Game matches.
4. ☐ Review the Prepare for Your Event page 32.
5.

➜ Share
(10 minutes)
- ☐ Review all the Core Values, Innovation Project, and Robot Game rubrics.
- ☐ Provide helpful feedback after the presentation to each other based on the rubrics.
- ☐ Discuss the reflection questions.
- ☐ Clean up your space.

➜ Reflection Questions
- Are all the different LEGO® pieces you need to attach to your robot for each mission ready?
- Is everyone ready to speak loudly, smile, and have fun?

> Have more time? Continue solving missions and working on your Innovation Project before your event!

1 Plan to split the time in this session equally among presentation practice and practice matches.

2 Encourage the team to practice their presentation before the event. They can practice by sharing their solution with others.

3 Have the team run their 2.5-minute robot matches. Make sure they practice running their programs in the right order.

4 If things don't go as planned during the Robot Game, the team might want a contingency plan for other missions they can run.

5 Remind the team about Core Values and how they will show them throughout the event including at every Robot Game match.

Final Checkpoint

Prepare for Your Tournament!

- [ ] The main goal of an event is for the team to have FUN and to feel that their work is valued.

- [ ] Remind the team that the event is also a learning experience and the goal is not to be an expert when they arrive.

- [ ] Encourage the team to engage with other teams to share what they have learned and to support each other.

- [ ] Determine what type of event you're attending and who the organizer of your event is. (If you purchased a class pack, the event will be your responsibility. Check out the *Class Pack Event Guide* for more details!)

- [ ] Check over the details and requirements for the tournament you are attending. They can vary depending on the type you plan to attend.

- [ ] Have the team prepare a checklist of materials that are needed for the event and where they will be stored.

- [ ] Review the time and location where you are meeting for the event and how long the team is expected to stay – share this with parents. Encourage parents to attend if this is possible.

- [ ] The team could progress to additional qualifying tournaments or the Global Innovation Awards by winning one of the top awards or being nominated by judges.

Events Complete and All Done?

Here are some tips for wrapping up after the last event your team will participate in:

- Clean up and take apart the robot and mission models.
- Allow time for the team to reflect on their experience.
- Inventory the LEGO® set to make sure all the pieces are there.
- Hold a team celebration!
- Share you experience with your friends and classmates.

Engineering Design Process

Identify · Design · Create · Iterate · Communicate