FIRST LEGO LEAGUE

TEAM MEETING GUIDE

CITY SHAPER

2000468

FIRST

LEGO education

Table of Contents

Architects design and construct **buildings.** They combine science and art to make buildings and **structures** for their **clients.** Sometimes they make new buildings and sometimes they redesign old ones.

They work as part of a larger team, just like yours. **Structural, civil and environmental engineers** make sure a project suits its **site.** Construction workers like electricians, plumbers and carpenters, and **project managers** make sure the job stays on time and within budget. Every role is important to get the job done.

Our cities and towns face big issues, like transportation, **accessibility** and even natural disasters. How can we shape a better future for everyone? It will take teamwork and imagination. Are you ready to build a better tomorrow together?

Throughout your season, you'll be guided by the... *FIRST*® Core Values

We express the *FIRST*® philosophies of *Gracious Professionalism*® and *Coopertition*® through our Core Values:

Discovery: We explore new skills and ideas.

Inclusion: We respect each other and embrace our differences.

Innovation: We use creativity and persistence to solve problems.

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

Teamwork: We are stronger when we work together.

Fun: We enjoy and celebrate what we do!

In the Robot Game, your team will:
- **Identify** Missions to solve.
- **Design,** build and program a LEGO Robot to complete the Missions.
- **Test** and refine your program and design.

Your Robot will have to navigate, capture, transport, activate, or deliver objects. You and your Robot will only have **2½ minutes** to complete as many Missions as possible. So, be creative!

In the Innovation Project, your team will:
- **Identify** a problem with a building or public space in your community.
- **Design** a solution.
- **Share** your solution with others and then refine it.

At official events, your team will present your Project, including the problem, your solution, and how you shared it, in a 5-minute presentation.

ROBOT GAME	PROJECT

CORE VALUES

How to Use the Team Meeting Guide

There are 12 sessions outlines in the CITY SHAPER^{SM} Team Meeting Guide. In general, plan for each session lasting 90 minutes. Each session is organized as follows:

A. The **Objectives** outline what each team should accomplish during the session.

B. The **Materials** list outlines the resources needed for the session. For more information on the materials you will need for your team, in a later section.

C. Each session has a series of **Tasks** that provides a step-by-step list of what the team should do during the session. These tasks include:

   a. **Getting Started:** Allow time at the start of each session for team(s) to gather their materials and get logged onto their devices.

   b. **Group Activities:** Each team will be split into two teams. They will alternate between experiences in the Innovation Project and Robot from session to session.

   c. **Share:** This occurs at the end of the session for groups to share what they accomplished within their teams.

   d. **Cleanup:** Time should be allotted at the end of each session for cleanup.

   e. **Next Session:** This section provides information at the end of each session to get them excited about what is coming up next.

D. The sidebar offers additional information to help you lead each session as successfully as possible. This section includes important instructions, requirements and tips.

Working as a Team

In this program, each team works together with their materials to create their Robot and design their project solution. Each team should be encouraged to work with their teammates, to listen to each other, take turns, and share ideas.

Each group will be asked to share at the end of each session. Each group should communicate what they've done, and record results and information learned from the other group as well. Sharing is an important way for teams to practice Core Values and have a complete understanding of their team's Robot and Innovation Project solution to the Challenge.

During each session, teams will experience the engineering design process. There is no set order for this process, and they may go through each part several times in a single session.

Working in Groups

For each session, each team will be divided into two groups. We call them Group 1 and Group 2, but you could call them by any name you want. Each group should complete only the sections which they are assigned since they are alternating between the project and Robot experience each session.

What Materials Do I Need for My Team?

The materials for the 12 sessions outlined in the Team Meeting Guide are listed at the start of each session. Below are notes about some of the specialized materials.

Challenge Set

The Challenge Set comes with models for the various missions of the Robot Game. These missions must be constructed using the instructions found online at www.firstlegoleague.org/missionmodelbuildinginstructions. The teams will complete this in Session 1.

It's important that all mission models be built to the exact specifications given. You will want to build the models with a careful eye for detail.

Challenge Mat

You will need an area where your team(s) meet to set up the challenge mat. You can place it on the floor or on top of a table. The challenge models need to be placed on their specific locations on the mat and secured with dual-lock. Follow the instructions provided.

LEGO Education MINDSTORMS EV3 Set

Each team should have one MINDSTORMS® EV3 set. Both the core set and expansion set are recommended to build the Robot.

Electronic Device

Each team will need a compatible hardware device like a laptop, tablet, or computer. Prior to starting session 1, you need to download the appropriate software onto the hardware device. To view system requirements and download the software, visit LEGOeducation.com/downloads.

It will be beneficial for each team to have access to the internet for their project research. If internet access isn't available, you could provide printed resources and books on the project topic.

Competition Table

You may not need to set up a table to use in a classroom. However, it is recommended that you and the team(s) are familiar with the table that will be used at a competition event.

You can find out more, including how to set up the table, in the School Event Guide found online at www.firstinspires.org.

Innovation Project Materials

Each team will need a variety of materials to create prototypes of their project ideas. Specific materials aren't required. Here's a list of potential materials you can provide:

➔ LEGO® bricks and elements (could include past *FIRST®* LEGO League Challenge Sets)

➔ White bricks found in the Challenge Set
   • If you are sharing a challenge set, you will need to split the white bricks into equal sets (one for each team).
   • Each team's white bricks will be used to create a prototype model of their final team Project.
   • This model can be used for the Innovative Architecture Mission in the Robot game. Refer to the Robot Game Missions and Rules for more details.

➔ Other material examples:
   • Recyclable materials like cardboard, boxes, and bottles
   • Wood products (balsa, bass, toothpicks, craft sticks)
   • Styrofoam and plastic
   • Paper products (cardstock, construction paper, tissue paper)
   • Electronics (motors, LEDs, batteries, wires)
   • Craft supplies (string, yarn, pipe cleaners, glue, tape, straws, rubber bands)
   • Office supplies (scissors, hole punch, wire stripper)

Engineering Notebooks

Each team member will need an *Engineering Notebook*. The sessions in the *Engineering Notebook* correspond directly to the sessions in the *Team Meeting Guide*.

The notebook serves as a proof of learning and is a great resource for teams to use when presenting the process they went through to create their Robot and project solution. Encourage them to document core values concepts demonstrated throughout their experience.

The engineering notebooks are intended to provide direction to each team on what tasks to complete. These tasks are listed in checklist format by Group 1 and Group 2. Teammates can mark off each task as they complete them.

Here are some ideas of what could be captured:

• Sketches

• Designs

• Notes

• Calculations
      • Processes
      • Thoughts
      • Pseudocode
      • Programs
      • Discussions

Available Resources

Resource Library

The *FIRST*® LEGO® League Resource Library has many resources to help you be as successful as possible. To access these resources, visit the *FIRST*® website at firstinspires.org, and select "*FIRST* LEGO League" Then select "Resource Library" from the "Quick Links" menu. The "Challenge and Resources" page within the Resource Library includes links to the Challenge, Multimedia Connections, LEGO® Education resources, FAQs, and more.

Email assistance

Watch for email blasts from *FIRST* headquarters with Challenge Updates and news about grants, trainings and other opportunities.

Websites

Main Website:
www.firstlegoleague.org
www.firstinspires.org/fll

Find Local Support by Country and Region:
www.firstlegoleague.org
https://www.firstinspires.org/about/contact-us

Diversity & Inclusion training:
https://www.firstinspires.org/resource-library/training-equitydiversity-inclusion

Team Management downloads:
https://www.firstinspires.org/resource-library/fll/team-managementresources

Fundraising Toolkit:
https://www.firstinspires.org/resource-library/fundraising-toolkit

Youth Protection Program:
https://www.firstinspires.org/resource-library/youth-protection-policy

Find Us on Social Media

Contacts

LEGO Support
Replacement LEGO® parts

Web: http://service.lego.com

Phone: 1-800-422-5346

LEGO® Product Support:
https://www.lego.com/enus/mindstorms/support

Email Support
FIRST® LEGO® League Robot Game questions:
fllrobotgame@firstinspires.org

FIRST LEGO League Project questions:
fllprojects@firstinspires.org

FIRST LEGO League Judging questions:
flljudge@firstinspires.org

FIRST LEGO League General Support questions:
fllteams@firstinspires.org

Software Installation and Robot Lessons

➔ **Identify** at least 1 computer or device each team may use (must have internet access).

➔ **Install** Robot programming software on the computer(s) your team(s) will use.

➔ **Make sure you have your Robot sets unpacked and LEGO pieces in appropriate locations.**

During the first few sessions, teams will use a specially curated set of LEGO MINDSTORMS Education EV3 tutorials. In the Team Meeting Guide and Engineering Notebook, we refer to these as Robot Lessons. The tasks for these lessons are found in the EV3 Lab software for Windows and Mac. We strongly recommend using this EV3 Lab software downloaded from legoeducation.com/start for the full experience.

If your teams are using Chromebooks or other tablets, they will need to use the compatible EV3 Programming app. They will then need to follow the route shown in the app version. This is different to the EV3 Lab route described above.

A poster showing an overview of Robot Lessons 1-6, and a detailed outline of Robot Lesson 7 (the Crane Mission), and the building instructions PDF, can be found on the *FIRST* LEGO League Resources page on firstinspires.org.

The seven Robot Lessons cover the following basic, and more advanced (*) concepts:

1. Learn the basics and build your first robot driving base.

2. Program your robot to move in different ways. Students are encouraged to test their robots on the Robot Game Field.

3. Program your robot to move and stop in different ways, including stopping at an object.

4. Program your robot to interact with game objects. Students are encouraged to interact with the Building Units from Mission 12.

5*: Learn to use sensors in more advanced ways, including using programming loops and sensor blocks.

6*: Learn to stop at and follow lines, including encouraging ideas to follow lines on the Robot Game Field and calibrating the color sensor.

7: The Crane Mission. See the Robot Lesson overview poster for a more detailed guide to solving your first mission on the Robot Game Field!

* Robot Lessons 5 and 6 are more advanced. Should you wish, you can have your teams repeat what they have learned in previous lessons. However, this guided set of EV3 tutorials leads the students towards understanding and trying the Crane Mission in Robot Lesson 7.

As teams advance, or for more experienced teams, we recommend the following lessons in EV3 Lab:
      Tutorials > Basics > Configuring Blocks
      Tutorials > Beyond Basics > Loop
      Tutorials > Beyond Basics > Math - Basic
      Tutorials > Beyond Basics > Color Sensor - Calibrate
      Tutorials > Beyond Basics > Logic

Missions

The object of the game is to shape your growing city with more stable, beautiful, useful, accessible and sustainable buildings and structures. Solve the real-world problems represented in the Missions to score points. You can also score by building new units on the field. New unit point values depend on their height and location.

Remember: Each official match lasts 2-1/2 minutes. You may not have time to complete all the Missions, so be strategic about which ones you choose.

NOTE: If your Robot and all of its equipment fit in the 'Small Inspection Area', the advantage for this game is 5 points added to each Mission where you score ANY points. Exceptions: Mission 14 doesn't apply, and for Mission 2, you get 10 added instead of 5.

Mission 1 Elevated places (Score all that apply)
➔ If the Robot is Supported by the Bridge: **20**
➔ If one or more Flags are clearly raised any distance, only by the Robot: **15 Each Flag**

You can only get Flag points if you get Bridge points.
Rule 31 allowance: *It is okay and expected for Robots to collide while trying to earn Flag points.*

When clearly only one Robot is holding a Flag raised, only that Robot scores for that Flag.

Mission 2 Crane (score all that apply)
If the Hooked Blue Unit is
➔ clearly lowered any distance from the Guide Hole: **20**
➔ Independent and Supported by another Blue Unit: **15**
  and Level 1 is Completely in the Blue Circle: **15**
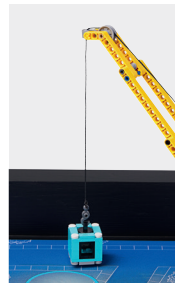
Mission 3 Inspection drone
➔ If the Inspection Drone is Supported by axle (A) on the Bridge: **10**

Mission 4 Design for wildlife
➔ If the Bat is Supported by branch (B) on the Tree: **10**
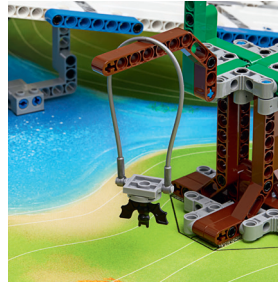
Mission 5 Treehouse (Score all that apply)
If a Unit is Independent and Supported by the Tree's
➔ Large Branches: **10 Each Unit**
➔ Small Branches: **15 Each Unit**

Mission 6 Traffic jam
➔ If the Traffic Jam is lifted, its moving part is Independent, and it is Supported by its own hinges as shown: **10**

Mission 7 Swing
➔ If the Swing is released: **20**

Mission 8 Elevator (Score one or the other)

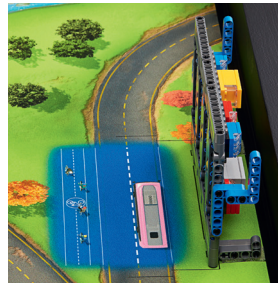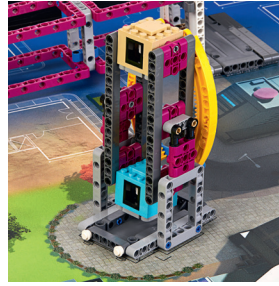If the Elevator's moving parts are Independent, and Supported only by its hinges as shown, in the following position
➜ Blue Car Down: **15**
➜ Balanced: **20**

Mission 9 Safety factor

➜ If the Test Building is Independent and Supported only by the blue beams, and some beams have been knocked out at least half way:
10 Each Beam
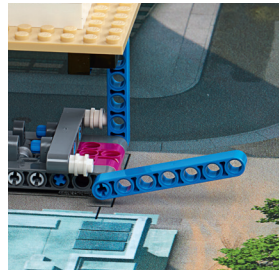
Mission 10 Steel construction

➜ If the Steel Structure is standing, and is Independent, and Supported only by its hinges as shown: **20**

Mission 11 Innovative architecture (score one or the other)

If there is a team-designed Structure clearly bigger than a Blue Building Unit, built only from your white LEGO bricks
➜ Completely In any Circle: **15**
➜ partly in any Circle: **10**

Random Structure shown. Design and build your own Structure before you compete, then bring that to each Match. You don't build it during the Match.

Your mission 11 Structure needs to be built from Bag 10 elements only. It can include the red and gray elements. Not all of the Bag 10 elements need to be used.
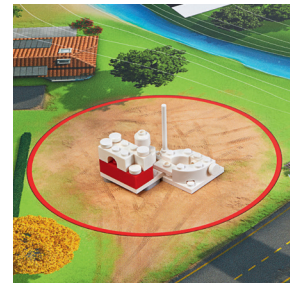
Mission 12 Design & build (Please take the needed time to understand the scoring examples)

➜ LOCATION - If there are any Circles with at least one color-matching Unit Completely In, and Flat Down on the Mat: **10 Each Circle**

(Note: The Blue Circle is not Part of Mission 12).

➜ HEIGHT - If there are Independent Stacks at least partly in any Circles, add all of their heights together: **5 Each Level**

(Note: A Stack is one or more Building Units with Level 1 touching Flat Down on the Mat, and any higher levels touching Flat Down on the level below).
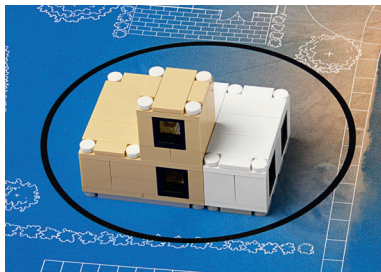
Color match = no
Tan stack = 2 levels
White stack = 1 level
15 points shown

Color match = no
Bridged stack = 4 levels
20 points shown

Color match = red
Red stack = 2 levels
Other stack = 4 levels
40 points shown

Mission 13 Sustainability upgrades (only one counts per stack)

➜ If an Upgrade (solar panels, roof garden, insulation) is Independent, and Supported only by a Stack which is at least partly in any Circle: **10 Each Upgrade**
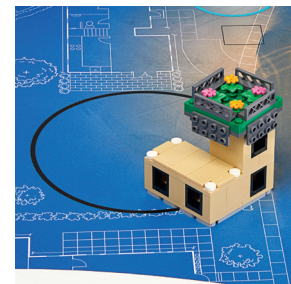
Mission 14 Precision (only one score counts)

➜ If the number of Precision Tokens left on the Field is 6: **60** / 5: **45** / 4: **30** / 3: **20** / 2: **10** / 1: **5**

SESSION 1:
The Architect

Objectives
Team members will:

➔ Explore the *FIRST®* Core Values.

➔ Learn about the Challenge.

➔ Build the Challenge Mission Models.

Materials
➔ Engineering Notebooks

➔ Challenge Mission Models and Field

➔ LEGO MINDSTORMS Education EV3 Set

TASK 1: Introduction (15 minutes)
➔ Have everyone review the Challenge. Show the Challenge video. (1)

TASK 2: Core values (10 minutes)
➔ Present the team(s) with a list of the core value words (no definitions).

➔ Split the team(s) into two groups: Group 1 and Group 2. (2)
   • Each group within team will stay in the same group for all sessions.

   • Each group will alternate their experiences in the Innovation Project and Robot Game. Core Values are integrated within all their experiences.

➔ Assign each group a set of Core Values and ask them to create their own explanations for the words. (3)
   • Core Values are listed on the Challenge page. (4)

➔ Have each group share their explanations with their team.

➔ It is important that everyone understands each of the Core Values. They will apply these Core Values throughout the season. (5)
   • You can find more Core Value activity ideas online!

   • Think about a plan of what you will do if someone is struggling with maintaining core values.

1. Want to spend more time to learn about the program? Add some time to this session to review the program and its associated videos and explore the challenge more in-depth.

2. In a classroom setting, place the students into teams of 4- 6.

3. Teams could draw pictures to represent what each core value means to them.

4. Teams could describe actions that would demonstrate the core values.

5. Teams could decide how they want to recognize someone demonstrating core values.

6. In a classroom setting, assign each team models to build. Have each group within a team build 1-2 models.
   • Team 1: Models 1-2
   • Team 2: Models 3-4
   • Team 3: Models 5-6
   • Team 4: Models 7-8
   • Team 5: Models 9-10
   • Team 6: Models 11-12

7. Note: Mission Models take varying amounts of time to build, depending upon the number of people working, and their experience level. You may find that your team needs to set aside more time to complete the Mission Models, or that you allocate time outside of the normal session to complete this activity.

TASK 3: Group activities (50 minutes)

Group 1

➔ Assign a specific model or models for this group to build. (6)

➔ Provide teammates with the build Instructions link online or a printed version of the build instructions. (7)

Group 2

➔ Assign a specific model or models for this group to build. (8, 9)

➔ Provide teammates with the build Instructions link online or a printed version of the build instructions. (10)

> **Engineering Notebook Connection**
> Each teammate should complete page 22.

TASK 4: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks. (11)

➔ Have the groups work together to create a team name. Allow the additional time later if they can't decide on one yet. (12)

TASK 5: Cleanup (5 minutes)

➔ Have the students place the assembled Mission Models in a designated location. (13)

➔ If the students haven't finished building the models, place the pieces for each model in their own storage container or bag.

Next session

➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will explore and create a solution for their project spark.

8. During the building time, you could show these videos:
   a. Season Challenge
   b. What is *FIRST*® LEGO® League
   c. Core Values
   d. What is *FIRST*®

9. During the building time, you could discuss these topics:
   e. Challenge
   f. Core Values
   g. Robot Game Rules
   h. Robot Missions
   i. Project theme
   j. Team names

10. The models need to be completed before proceeding to the next session.

11. You may want to provide additional grid paper to teams that they could use as extra engineering notebook pages.

12. The naming of a team is an early opportunity to set the tone and reinforce Core Values.

13. You may want to set up a Robot practice area and storage for equipment between sessions.

> **The outcome of these 12 sessions is each team will present their Robot and project at a final event.**

The Client

Objectives

Team members will:

➔ Complete their assigned LEGO Robot lesson.

➔ Explore and create a solution for the project spark scenario.

Materials

➔ Engineering Notebooks

➔ LEGO MINDSTORMS Education EV3 Set

➔ Innovation Project prototyping materials

TASK 1: Getting started (5 minutes)

➔ Gather project materials for Group 1 to use. (1)

➔ Assign each team a Robot set. (2)

> The LEGO sets should already be set up following the top card in the bin. Make sure the batteries are charged, software is loaded on each device.

TASK 2: Group activities (70 minutes)

Group 2

➔ This group will complete the EV3 Robot Lesson 1. (3, 4, 5, 6, 7)

Group 1

➔ This group will answer questions about the Project Spark 1 (Treehouse) in their Engineering Notebook. They will then brainstorm, sketch and label their own solution to the problem, and create a prototype using the materials you provide. They have only this session to create their solution for Project Spark 1. (8, 9, 10).

- You will need to provide the materials for them to use to create their prototype solution.

- Encourage groups to use various resources like the library, internet, and suggested Challenge-specific links.

1. See the list of suggested materials to use for Project prototyping. Teams can always use any additional LEGO bricks you have.

2. In a classroom setting, number and label the Robotic sets and assign each team one to be their responsibility for the entire season.

3. The Engineering Notebook and overview poster show the tasks.

4. Make sure each team member gets to control the tablet or device while going through the Robot lessons.

5. You could place members of the Robot group into roles:
   a. Programmer
   b. Builder
   c. Inventory Specialist

6. Have teams name their controllers and Robots.

7. Have teams use specific names on their individual programs.

8. You could place members of the project group into roles:
   a. Communicator
   b. Researcher
   c. Project Manager

> ### Engineering Notebook Connection
> Each teammate should complete page 23.

TASK 3: Share (10 minutes)
➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group). (11)

TASK 4: Cleanup (5 minutes)
➔ Have Group 2 move their Robot and LEGO set to a designated storage area.

➔ Have Group 1 place their solution prototype in a designated display location or have them disassemble after sharing if the materials will be needed for the next session.

Next session
➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will explore and create a solution for their project spark.

> ### Sharing Prompts
> **For the Robot group...**
> • Describe main idea of the lesson.
> • List / describe new programming blocks.
> • Point out any new sensors used.
> • Demonstrate / run the Robot to show actions.
>
> **For the Project group….**
> • Describe Project Spark (if applicable). Be sure to include the "Model, Expert, Client, Site" information for each Spark.
> • List / Define new vocabulary.
> • Show sketches and prototypes.
> • List / describe the problem(s), constraint(s), solution(s) for each Project activity.

9. Groups should keep track of different problems and ideas they discussed and used. They will have to select a final problem to focus on, so thinking about this goal during each session is helpful.

10. Be sure the Project group fills out the 'Model, Expert, Client, Site' table. It's OK if they select more than one expert for a Project Spark, and if they select an expert not featured in the Project Sparks.

11. If the team talks over each other, try using one of the following approaches:
    a. Appoint one leader who goes around the circle listening to each idea one person at a time.
    b. There is one key - anything such as a paperclip- and only the person with the key can talk.

Discovery:
We explore new skills and ideas.

Site Survey

Objectives

Team members will:

➔ Complete their assigned LEGO Robot lesson.

➔ Explore and create a solution for the project spark scenario.

Materials

➔ Engineering Notebooks

➔ LEGO MINDSTORMS Education EV3 Set

➔ Prototyping materials

TASK 1: Getting started (5 minutes)

➔ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 2

➔ This group will answer questions about Project Spark 2 (Playground) in their Engineering Notebook. They will then brainstorm, sketch and label their own solution to the problem, and create a prototype using the materials you provide. They have only this session to create their solution for Project Spark 2.

• You will need to provide the materials for them to use to create their prototype solution. (1)

• If time allows, the group could research the project spark further using different digital and print resources. (2)

Group 1

➔ This group will complete EV3 Robot Lesson 2. (3)

> **Engineering Notebook Connection**
> Each teammate should complete page 24.

1. The Innovation Project group could write down potential project ideas based on what they learned in this session.

2. Ask the project group if they can think of how to make a different piece of playground equipment more accessible.

3. The Engineering Notebook and overview poster show the tasks.

TASK 3: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➔ Have Group 1 move their Robot and LEGO set to a designated storage area. (4)

➔ Have Group 2 place their solution prototype in a designated display location or have them disassemble after sharing if the materials will be needed for the next session.

Next session

➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will create a solution for their project spark scenario based on the criteria.

4. Here are specific tips on managing LEGO sets.
   • Place any found LEGO pieces in a cup. Team(s) with missing LEGO pieces come to the cup to look for them.
   • Wait to dismiss team(s) until you look over their kit.
   • If you need to replace lost pieces, visit the LEGO site and other sites for spare parts for purchase.
   • The bin lid of their Robotics set can be used as a tray, so pieces don't roll off.
   • Speak with custodian about pieces on the floor so they don't get thrown away.

Fun:
We enjoy and celebrate what we do!

SESSION 4:
Foundations

Objectives

Team members will:

➔ Complete their assigned LEGO Robot lesson.

➔ Choose their criteria and create a solution for the project spark scenario.

Materials

➔ Engineering Notebooks

➔ LEGO MINDSTORMS Education EV3 Set

➔ Prototyping materials

TASK 1: Getting started (5 minutes)

➔ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 2

➔ This group will complete EV3 Robot Lesson 3. (1)

Group 1

➔ This group will answer questions about Project Spark 3 (Building Units) in their Engineering Notebook. They will then brainstorm, sketch and label their own solution to the problem, and create a prototype using the materials you provide. They have only this session to create their solution for Project Spark 3.

  • You will need to provide the materials for them to use to create their prototype solution. (2)

  • If time allows, the group could research the project spark further using different digital and print resources. (3)

Engineering Notebook Connection

Each teammate should complete page 25.

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1. The Engineering Notebook and overview poster show the tasks.

2. The Innovation Project group could write down potential project ideas based on what they learned in this session.

3. Ask the project group if they can think of other problems that could be solved with modular construction.

TASK 3: Share (10 minutes)
➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)
➔ Have Group 2 move their Robot and LEGO set to a designated storage area.

➔ Have Group 1 place their solution prototype in a designated display location or have them disassemble after sharing if the materials will be needed for the next session.

Next session
➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will create a solution for their project spark scenario based on their chosen criteria.
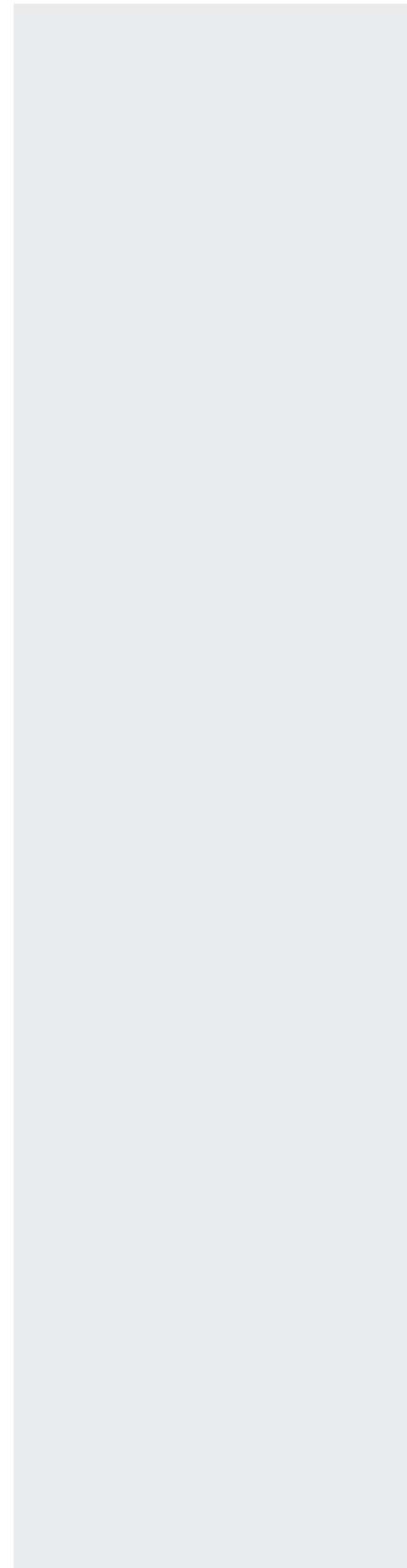
Vitruvius

Objectives

Team members will:

➔ Complete their assigned LEGO Robot lesson.

➔ Choose their criteria and create a solution for the project spark scenario.

Materials

➔ Engineering Notebooks

➔ LEGO MINDSTORMS Education EV3 Set

➔ Prototyping materials

TASK 1: Getting started (5 minutes)

➔ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 2

➔ This group will answer questions about Project Spark 4 (Inspection Camera Drone) in their Engineering Notebook. They will then brainstorm, sketch and label their own solution to the problem, and create a prototype using the materials you provide. They have only this session to create their solution for Project Spark 4.

  • You will need to provide the materials for them to use to create their prototype solution. (1)

  • If time allows, the group could research the project spark further using different digital and print resources. (2)

Group 1

➔ This group will complete EV3 Robot Lesson 4. (3)

> **Engineering Notebook Connection**
> Each teammate should complete page 26.

1. The Innovation Project group could write down potential project ideas based on what they learned in this session.

2. Ask the project group if they can think of other building, construction and maintenance problems that could be solved with aerial drones.

3. The Engineering Notebook and overview poster show the tasks.

TASK 3: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➔ Have Group 1 move their Robot and LEGO set to a designated storage area.

➔ Have Group 2 place their solution prototype in a designated display location or have them disassemble after

Next session

➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will brainstorm ideas and create a plan for their solution for their final project.
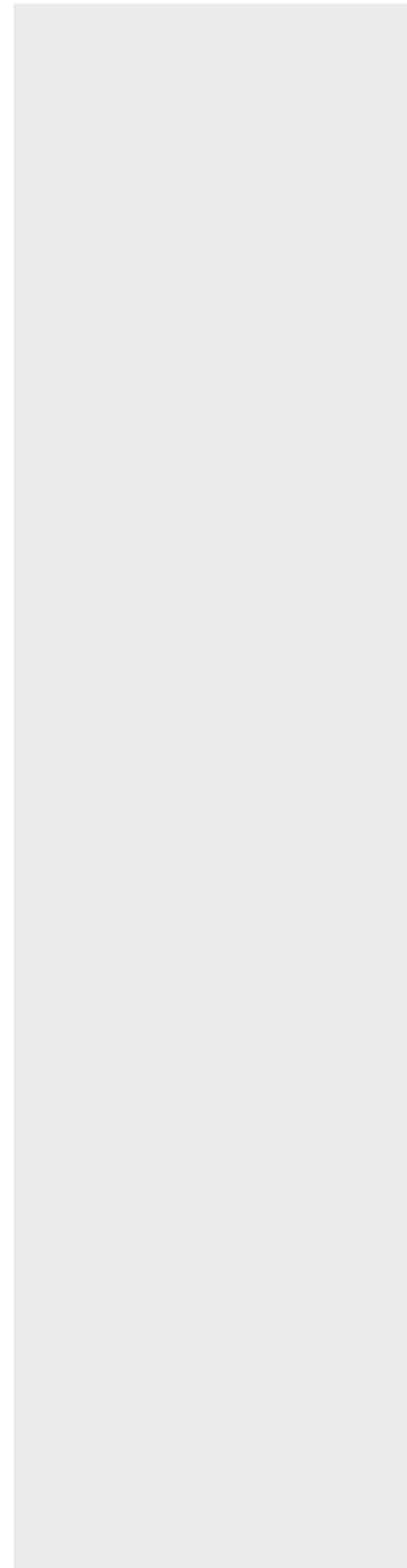
SESSION 6:
Blueprints

Objectives

Team members will:

➔ Complete their assigned LEGO Robot lesson.

➔ Brainstorm ideas and create a plan for their project solution.

Materials

➔ Engineering Notebooks

➔ Challenge Models

➔ LEGO MINDSTORMS Education EV3 Set

➔ Prototyping materials

TASK 1: Getting started (5 minutes)

➔ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 2

➔ This group will complete EV3 Robot Lesson 5 (1, 2)

Group 1

➔ This group will identify a problem with a building or public space in your community. (3, 4) They will then brainstorm solutions and determine the constraints for each solution. (5)

  • Group 2 will also get an opportunity to go through this same process in Session 7.

  • You may want to provide additional paper for the group to write down their ideas and solutions.

➔ Here are some guiding questions you can ask the group on their project:

  • What are interesting facts you learned about your problem?

  • Are there any solutions that currently exist for this problem? What doesn't work in these solutions?

  • How could you improve an existing solution?

  • Do you have a completely new solution to the problem?

1. The Engineering Notebook and overview poster show the tasks.

2. Teams can add or remove an attachment when the Robot is at home during a match.

3. You could have each team pick a problem that has some sort of personal connection they can get excited about.

4. You can decide how to define 'community.' If it makes sense for your team to just look at problems in your school or town, then that's fine. If you would like to allow students to explore problems in a larger area, that's great too.

5. Before brainstorming, remind the students of brainstorming guidelines:
   • No idea is a bad idea.
   • Say any and every idea that pops into your head. Even a crazy idea might lead to something else.
   • Keep a list of all the ideas.

➔ Visit the *FIRST* LEGO League resource page for specific links and resources related to the Challenge. Groups may need additional time beyond this session to conduct their research and answer these guiding questions. (6, 7, 8, 9)

> ### Engineering Notebook Connection
> Each teammate should complete page 27.

TASK 3: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have the team discuss the problems and solutions identified by Group 1 for the project.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➔ Have Group 2 move their Robot and LEGO set to a designated storage area.

➔ Have Group 1 place their created solution to the project in a designated display location.

Next session

➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will create a solution for their final project.

6. Be sure the team members collect the references in a shared location, either online or on paper.

7. Teams could use these resources for their project:
   • Internet
   • Books or magazines from the library
   • Current events
   • Personal stories
   • Experts

8. For sessions 6 & 7, each group will have the chance to identify a problem in their own community and brainstorm a solution. This will help you decide on a final team Project.

9. Remind Group 1 that they will use the LEGO white bricks set to create a model of their project solution.

Building Code

Objectives

Team members will:

➜ Complete their assigned LEGO Robot lesson.

➜ Determine materials needed to create their final project.

➜ Work on the creation of their project solution.

Materials

➜ Engineering Notebooks

➜ Challenge Models

➜ LEGO MINDSTORMS Education EV3 Set

➜ Project resources

TASK 1: Getting started (5 minutes)

➜ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 2

➜ This group will identify a problem with a building or public space in your community. They will then brainstorm solutions and determine the constraints for each solution. (1)

• Group 1 went through this same process in Session 6.

• You may want to provide additional paper for the group to write down their ideas and solutions.

➜ Here are some guiding questions you can ask the group on their project: (2)

• What are interesting facts you learned about your problem?

• Are there any solutions that currently exist for this problem? What doesn't work in these solutions?

• How could you improve an existing solution?

• Do you have a completely new solution to the problem?

1. Tell the students that the team might not choose their favorite problem, but they will choose something that everyone can support.

2. The following questions may help the team think through the project options:
   • Which solution best satisfies our problem?
   • Which solution are the most people interested in?
   • Which solution would have the biggest impact on our community or world?
   • Which solution can we state very clearly?
   • Consider if the solution is something you or others could realistically implement.

➔ Visit the *FIRST* LEGO League resource page for specific links and resources related to the Challenge. Groups may need additional time beyond this session to conduct their research and answer these guiding questions. (3)

Group 1
➔ This group will complete the EV3 Robot Lesson 6. (4)

> **Engineering Notebook Connection**
> Each teammate should complete page 28.

TASK 3: Share (10 minutes)
➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have the team discuss the problems and solutions identified by Group 1 for the project. (5)

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)
➔ Have Group 1 move their Robot and LEGO set to a designated storage area.

➔ Have Group 2 place their materials and created model in a designated storage area.

Next session
➔ Tell them that in the next session, they will complete their assigned LEGO Robot lesson. They will continue to create a solution for their final project.

3. Encourage the team members to use a variety of internet resources such as journal articles, books, and periodicals.

4. The Engineering Notebook and overview poster show the tasks.

5. Have your team(s) read over the rubric when evaluating their solution.

Inclusion:
We respect each other and embrace out differnces.

SESSION 8:
Construction

Objectives
Team members will:

➜ Complete their assigned LEGO Robot lesson.

➜ Work on solutions to Challenge Missions on the field.

➜ Select their final team Project problem and solution and begin working on a prototype using the materials.

Materials
➜ Engineering Notebooks

➜ Challenge Models

➜ LEGO MINDSTORMS Education EV3 Set

➜ Project resources

TASK 1: Getting started (15 minutes)
➜ Make sure you have project materials, Robot sets, and devices ready for team use.

➜ The entire team needs to decide on a final team Project and solution. You may need to help guide each team on how to make their final decision on the project.

TASK 2: Group activities (70 minutes)
Group 2

➜ This group will complete the Crane Mission Robot Lesson 7 with MINDSTORMS EV3. (1)

➜ The team should look back at the Missions and rules for the Challenge. (2, 3, 4)
   • Be sure the team looks at the Robot game parameters like Robot size and playing time. (5, 6)

Group 1

➜ This group will work on creating the final Innovation Project. They will start by conducting research and listing all the constraints for their solution, and then they will brainstorm how they might test their solution. They should sketch and label their solution in their Engineering Notebook, and then build a prototype that incorporates the white LEGO bricks that will also be used in Mission 11 in the Robot Game. (7)

1. The Crane Mission tasks can be found on the Robot Lesson overview poster.

   The building instructions and an example program can be downloaded from the same place as you downloaded the poster.

2. Make sure each team member understands what needs to be accomplished for each mission.

3. Here are some suggested Missions for teams to start with:
   a. Crane
   b. Swing
   c. Innovative architecture
   d. Elevator

4. Teams could look for Mission(s) that utilize these introductory skills like:
   a. Push, pull, or lift
   b. Model that is close to home or wall
   c. Navigation using the wall
   d. Navigation using line following
   e. Easy access to the Return Zone

5. It is recommended that the teams practice their Missions on the actual game table.

6. As an alternative, you can place the mat on the floor or on a large table.

> **Engineering Notebook Connection**
> Each teammate should complete page 29.

7. You may use one of the Project ideas from sessions 6 & 7 or come up with something completely new. If you would like to let teams vote on the Project problem nd solution, that's great. But it's also OK for you to decide on the topic that's best for your team(s).

TASK 3: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have Group 2 share which Mission(s) they have worked on a solution for.

➔ Have Group 1 share what work they have completed for the final project.

➔ Allow time for both groups to discuss Robot game strategy related to the Missions they will pursue.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➔ Have Group 2 move their Robot and LEGO set to a designated storage area.

➔ Have Group 1 place their materials and created model in a designated storage area.

Next session

➔ Tell them that in the next session, they will complete their final LEGO Robot lesson and work on solving a Robot Mission. They will test a solution for their final project.

Inspection

Objectives

Team members will:

➔ Work on solutions to Challenge Missions on the field.

➔ Create their final team Project presentation.

Materials

➔ Engineering Notebooks

➔ Field with Challenge Models

➔ LEGO MINDSTORMS Education EV3 Set

➔ Robot prototype

➔ Project resources

TASK 1: Getting started (5 minutes)

➔ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (70 minutes)

Group 1

➔ This group will work on solving Mission(s). Remind this group to review the Robot Game Rules. (1)

➔ Here are some guiding questions you can ask the group on their Robot game strategy: (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)

  • Which missions are located near each other on the field?

  • Which missions could be grouped together for maximum points?

  • Which missions are located near home?

  • Which missions have similar mechanisms?

  • What is the difficulty level of each mission?

Group 2

➔ This group will begin creating the presentation for the final team Project. Determine in advance what opportunities are available for your team(s). (13)

➔ Group 2 will need to make a list of what needs to be completed by Group 1 in the next session.

1. Each team should think about strategy and choose what Missions that the team will attempt.

2. You could also have each group working on separate Missions to provide continuity on the work done on the Robot game.

3. Your team will be able to add or remove attachment when the Robot is in home during a match.

4. Don't worry about score. Focus on having fun. Start with a basic Robot design and build out from there. You will be surprised by what a basic Robot that goes straight can do.

5. Once you have a base Robot, do a straight drive test. If the Robot does not go straight, look at the Robot's center of gravity and balance.

6. The Robot group could create a list of everything that needs to be done to complete the Robot programming.

7. The Robot group could decide which tasks to complete and set specific deadlines.

8. Where the Robot starts strongly influences where it ends. Keep good notes about where the Robot is placed in home prior to leaving to attempt a Mission. Consistency in starting position is very important.

TASK 3: Share (10 minutes)

➔ Have each group share their progress and record notes in their Engineering Notebooks.

➔ Have Group 1 share which Mission(s) they have worked on a solution for.

➔ Allow time for both groups to discuss Robot game strategy related to the Missions they will pursue.

➔ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➔ Have Group 1 move their Robot and LEGO set to a designated storage area.

➔ Have Group 2 place their materials and created model in a designated storage area.

Next session

➔ Tell them that in the next session, they will work on solving a Robot Missions and improve on their solution for their Innovation Project. Both groups will prepare for their final project and Robot presentations.

9. Teams should save their programs often! Teams could make dated back-ups of their programs stored in different locations.

10. Teams shouldn't try to program too many steps at once. They should check for accuracy as they go.

11. Teams can use the comments feature to document each section of their programs.

12. There are always improvements that can be made when programming a Robot. Teams should test their Robots and improve any errors, inefficiencies, or inconsistencies in its performance.

13. There are numerous ways for a team to present their Innovation Project. They may create a slideshow, a poster, or even a play or skit.

SESSION 10:
Renovations

Objectives
Team members will:

➜ Work on solutions to Challenge Missions on the field.

➜ Prepare for Robot design and Robot game presentations.

➜ Complete their final team Project presentation.

Materials
➜ Engineering Notebooks

➜ Field with Challenge Models

➜ LEGO MINDSTORMS Education EV3 Set

➜ Robot prototype

➜ Project resources

TASK 1: Getting started (5 minutes)
➜ Make sure you have project materials, Robot sets, and devices ready for team use.

TASK 2: Group activities (60 minutes)
Group 1

➜ This group will finish creating the presentation for their final Innovation Project. (1, 2, 3, 4, 5, 6)

Group 2

➜ This group will work on solving Mission(s). (7, 8, 9, 10)

➜ They will also prepare for their Robot presentation.

Remind each team to use the judging rubric to prepare their final presentations.

> **Engineering Notebook Connection**
> Each teammate should complete page 31.

1. Teams may use posters, slideshows, models, video clips, props, costumes and more in their project presentations.

2. Teams could create t-shirts, hats, or costumes to wear during their presentations or at an event.

3. Some teams split up the five minutes and incorporate different approaches into the presentation.

4. Teams should think about what is realistic to do in five minutes. That includes setup time and introductions.

5. Provide the judging rubric for each team to review the expectations of their presentations.

6. A list of topics to cover in the Innovation Project and Robot presentations are provided in the engineering notebook.

TASK 3: Share (10 minutes)

➜ Have each group discuss what they've accomplished in this session. They should also discuss the final presentations of their Robots and projects. They will present on each part as a team.

➜ Have each group identify Core Values demonstrated by team members (in own group or another group).

TASK 4: Cleanup (5 minutes)

➜ Have Group 2 move their Robot and LEGO set to a designated storage area.

➜ Have Group 1 place their materials and created model in a designated storage area.

Next session

➜ Tell them that in the next session, they will practice and present their final projects.

7. Mission planning is best done using visual and tactile activities around the field. Post-it notes, and Mission planning cards work great.

8. Keep in mind 2.5 minutes goes by fast and you need to build in time for trips back to home.

9. The Robot group will continue to program the Robot, test it, and make changes repeatedly.

10. When designing attachments, teams should try to keep it simple. Make sure the attachment affixes securely to the Robot, but can also be easily changed between runs, if necessary.

SESSION 11:
Grand opening

Objectives
Team members will:

➔ Present their final projects.

➔ Review the judging rubric.

➔ Provide peer feedback on presentations.

Materials
➔ Engineering Notebooks

➔ Final project materials

TASK 1: Getting started (20 minutes)
➔ Each team will need to gather the materials they need to do their Innovation Project presentations. (1)

➔ Allow time for teams to prepare for their presentations. (2)

TASK 2: Project presentations (50 minutes)
➔ Each team will present their Innovation Project solutions. (3)

➔ Allow time at the end of each presentation for questions to be asked. (4)

TASK 3: Feedback (10 minutes)
➔ Record your feedback for each team on the judging rubric and provide to each team to review. You will use this rubric again in Session 12. (5, 6)

Engineering Notebook Connection
Each teammate should complete page 32.

---

1. You could ask teams how Core Values were used in the creation of the project.

2. You might want to assign a talking point to each team member, so each person participates.

3. Each team should be given up to 5 minutes to present their solutions, but their presentation can be shorter BUT not longer.

4. Encourage peer evaluation.

5. You could have teams share their project presentations with:
   • Other teams
   • Topic experts
   • Others who could benefit from their solution

Innovation:
We use creativity and persistence to solve problems.

TASK 4: Cleanup (10 minutes)

➔ Have each team place their project solution in a designated display space or storage area.

- If the project solution won't be used in any future events or placed on display, have each team determine if any materials could be reused and return materials to their appropriate locations.

Next session

➔ Tell them that in the next session, they will present their Robot solutions and demonstrate their Robot on the Challenge field solving Mission(s).

6. Rubric Connection - did the team:
- Clearly define and analyze their problem and use a variety of sources?
- Present an innovative solution with thoroughly developed ideas?
- Give a creative presentation?
- Clearly communicate their problem and solution?
- Explore different ideas and show problem solving skills?
- Use creativity and persistence?
- Show consideration and appreciation in their teamwork?

SESSION 12:

Grand opening

Objectives
Team members will:

➜ Present their Robot design and program solution.

➜ Review the judging rubric.

➜ Demonstrate the Robot solution on the field.

➜ Provide peer feedback on presentations.

Materials
➜ Engineering Notebooks

➜ Field with Challenge Models

➜ Finished Robot

TASK 1: Getting started (10 minutes)
➜ Each team will need to gather the materials they need to do their Robot presentations.

➜ They will do their presentations at the challenge table. You will need a large space set up for this demonstration. (1)

TASK 2: Robot presentations (60 minutes)
➜ Each team will present their Robot solutions. They will present in two parts:

   • presentation on their Robot design.

   • demonstration of their Robot on field. (2)

➜ Allow time at the end of each presentation for questions to be asked. (3, 4)

TASK 3: Feedback (10 minutes)
➜ Record your feedback for each team on the judging rubric and provide to each team to review. (5)

> **Engineering Notebook Connection**
> Each teammate should complete page 32.

1. Each team should be given up to 5 minutes to present their Robot design.

2. They have 2.5 minutes to demonstrate their Robot on the field.

3. You could ask teams how Core Values were used in the creation of the Robot.

4. Encourage peer evaluation.

5. Rubric Connection - did the team:
   • Clearly plan out their design and components in the Robot?
   • Present an innovative Robot and game strategy?
   • Give a detailed presentation that communicated their Robot design and game strategy?
   • Explore different ideas and show problem solving skills?
   • Use creativity and persistence?
   • Show consideration and appreciation in their teamwork?

TASK 4: Cleanup (5 minutes)

➔ Have each team place their Robot solution in a designated display space or storage area.

Next session

➔ Tell them that in the next session, they will compete a small event or qualifier with their Robot and project solutions.

6. AFTER the event(s) are complete, here are some tips for wrapping up after the last event the teams will participate in:
   - Have teams clean up and take apart Robots and project models.
   - Inventory the Robot sets to make sure they have all their parts.
   - Allow times for teams to reflect on their experience.
   - Have teams complete self-evaluations.
   - If teams aren't competing in an event after this session, hold a celebration of their accomplishments.

EVENT!
See the School Event Guide for specific information on running a school event.

Appendix

Robot Path Diagram

Program name _____

Create one Robot path diagram for each program you plan to run. Sketch the path the Robot will take as it executes the program. Each time the Robot stops or takes an action, use the diagram to show what the Robot is doing.
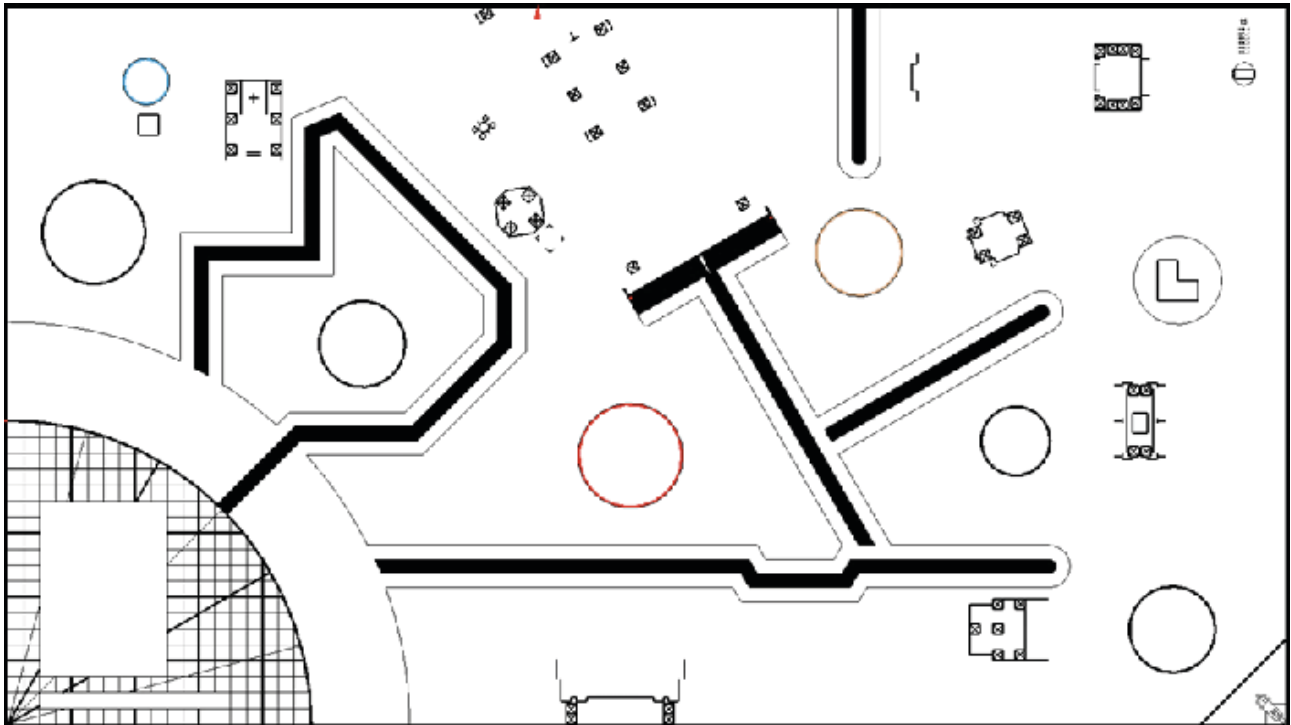
Program Description

Explain each path diagram by showing and explaining your code, pseudocode (written outline),
flow chart or some other way.

_____

_____

_____

_____

_____

_____

Note: Make copies of this page as needed for teams.

Appendix

Robot Design Summary

Mechanics Summary

Robot Features What is your favorite? What is most innovative?	
Attachments Describe each one and its purpose.	
Motors What motors are on your Robot? What purpose do they serve?	
Sensors What sensors are on your Robot? What purpose do they serve?	
Strategy How did you choose the missions you worked on?	
Design Process What processes did you use to design your Robot?	
Core Values How were Core Values used throughout the creation of the Robot?	

Program Summary

What can your Robot do? List every program you plan to run during an event. Attach additional pages if needed.

Program Name	Mission(s) Accomplished	Programmed Robot Actions	Mission Success Rate
What is this program called in your Robot?	List the mission(s) your Robot will accomplish in the program.	List the types of actions performed in the program. List any programming commands like loops and functions.	How often do you achieve the mission(s)?

Note: Make copies of this page as needed for teams.

Appendix

Innovation Project Summary

Problem What is the challenge that needs to be solved?	
Potential Solutions Can you make a solution better? Do you have an innovative approach?	
Constraints What limitations are there on your solution?	
Research Findings What information did you find on your problem?	
Sources These could include print and digital resources and information from an expert.	
Solution What did you choose as the solution you will present?	
Design Process What processes did you use to design your project solution?	
Design Presentation How will you present your problem and solution for the project?	
Core Values How were Core Values used throughout the creation of the project solution?	

Note: Make copies of this page as needed for teams.

Appendix

Core Values Summary

How did your team use core values throughout the creation of the Robot and project? Describe and provide examples of how you demonstrated these core values.

Discovery We explore new skills and ideas.	
Innovation We use creativity and persistence to solve problems.	
Impact We apply what we learn to improve our world.	
Inclusion We respect each other and embrace our differences.	
Teamwork We are stronger when we work together.	
Fun We enjoy and celebrate what we do!	
Gracious Professionalism® We encourage high-quality work, emphasize the value of others, and respect all.	
Coopertition® We learn from and teach our teammates. When competing, we assist and enable others when we can.	

Note: Make copies of this page as needed for teams.

Appendix

Innovation Project Support Page

In the Innovation Project, your team will:

Identify
After selecting a problem, research solutions that we are already using to try to fix it. Ask:

➔ Why is this problem hard to solve?

➔ Can you think of a new solution?

➔ Can you imagine a way to improve a current solution?

Design
Think about possible solutions to your problem. The goal is to design an innovative solution that solves your problem by:

➔ Improving something that already exists.

➔ Using something that exists in a new way OR

➔ Inventing something totally new.

Share
➔ Share your idea with at least one person.

➔ Present your solution to people who have an interest in the challenge or a professional in that area.

➔ Ask for feedback from anyone with whom your team shares.

Prepare
Prepare a 5-minute presentation to share your work at an official event. Your presentation must be live. It may include posters, slideshows, models, multimedia clips, props, costumes, and more. Be creative, but make sure you introduce your problem, solution, and how you shared your idea.

Note: Make copies of this page as needed for teams.

Appendix

Core Values Support Page

The Core Values are the heart of *FIRST.* By embracing Core Values, teams learn that friendly competition and mutual gain are not separate goals, and that helping one another is the foundation of teamwork. Use the Core Values where appropriate to encourage the teams. To celebrate the teams learning these important values, you could reward examples of these principles being demonstrated by the teams.

Core Values in action

➜ Discoveries not focused on just gaining an advantage or winning an award.

➜ Integrates new ideas, skills and abilities learned into everyday life.

➜ Listens and considers ideas from everyone in team.

➜ Each team member feels like a valued member of team.

➜ Team helps or receives help from another team.

➜ Have fun in all things they do.

Activities

Find instructions for these suggested teambuilding activities in the Resource Library. These allows teams to not only practice the *FIRST*® Core Values, but also learn more about the Engineering Design Process and project management strategies.

➜ Teamwork: Engineering Design Process

➜ Discovery: Goal Setting

➜ Inclusion: Assigning Roles

➜ Innovation: Creating a Timeline

➜ Teamwork: Building Bridges

➜ Impact: Communication

➜ Impact: Identifying Outreach Opportunities

➜ Fun: Creating a Team Cheer

Note: Make copies of this page as needed for teams.

Appendix

Judging Sample Questions

INNOVATION PROJECT EXAMPLES

Discovery
- What problem did your team choose to solve?
- What sources did you use?
- Did you adapt an existing solution or create your own solution?
- Did you consult with an expert to solve the problem?

Innovation
- What is original and innovative about your solution?
- Did you improve on someone's solution?
- How did you develop and test your idea?
- How did you evaluate your solution and improve upon it?

Communication
- How would your solution help others?
- Who have you shared your solution with?
- How would your solution help the world?
- How did your team work together to create your presentation?

ROBOT DESIGN EXAMPLES

Discovery
- How did you test your Robot design?
- Describe your programs. Did they work consistently?
- How did you evaluate your Robot design?
- What advanced programming concepts did you use?

Innovation
- Is your Robot design original or did you model it from something existing?
- Are your programs unique or did you modify them from something existing?
- What is your strategy for solving game missions?
- What is innovative about your Robot design?

Communication
- How did your team collaborate on the Robot design?
- How did your team work together to test the Robot?
- How were the programs created by the team?
- How did you act as a team to determine the game strategy?

CORE VALUES EXAMPLES

Discovery
- How did each person participate in each part of the Challenge?
- How did you explore and apply core values?
- How will your team expand Core Values and participation beyond this season?

Innovation
- How did you use Core Values to overcome challenges?
- How independent was your team?
- How much did you use your coach for help?
- What is your team identity?

Communication
- How did you demonstrate respect and inclusion within your team and beyond it?
- How did you learn and display *Coopertition*, fairness, and integrity within your team and beyond it?

Note: Make copies of this page as needed for teams.

Appendix

School Event Judging Rubric

This is the judging rubric to be used at school organized events. If your school or organization has signed up for a Class Pack, you will receive a School Event guide separately.

Team Number _____   Team Name _____

		Developing	Achieved	Exemplary (Achieved + the following)
PROJECT	Discovery	Limited development of problem and solution. No sources or experts identified.	**Adapted existing solution and clear problem. Identified sources for innovation project ideas.**	Well defined problem and unique solution. Used a variety of sources including an expert.
	Innovation	Solution identified already exists. Limited testing and development of idea.	**Created an original and innovative solution. Developed, tested and improved their idea.**	Well defined testing and evaluation of solution. Results were used to improve their idea.
	Communication	Presentation doesn't always flow well. Not clear how the solution would help others.	**Creative and engaging presentation by team. Showed how the solution would help others.**	Shared presentation with experts. Showed how the solution would help the world.
ROBOT DESIGN	Discovery	Limited testing of Robot design. Basic programs that worked inconsistently.	**Clear testing of Robot design. Effective use of basic programs.**	Well defined testing and evaluation of Robot design. Effective use of advanced programs.
	Innovation	Design, programs, and strategy are unoriginal, and have not been improved or modified.	**Modified or improved Robot design or programs. Clear strategy for solving game missions.**	Innovative Robot design and programs. Well-defined strategy for solving game missions.
	Communication	Limited understanding of Robot design. Unclear or limited game strategy.	**Clear understanding of Robot design. Clear strategy for 1-2 game missions.**	Clear understanding of Robot design and testing process. Clear strategy for most/ all game missions.
CORE VALUES	Discovery	Some team members participated. Team only beginning to explore Core Values.	**Full participation of team in entire Challenge. Clear exploration of Core Values.**	Participation extends beyond team and season. Application of Core Values during season and beyond.
	Innovation	1 or no Core Values used to overcome a challenge. Limited team autonomy with a lot of coach help.	**Used some Core Values to overcome challenges. Self-directed team with minimal coach guidance.**	Applied all Core Values to overcome challenges. Developed own team identity and autonomy.
	Communication	Respect and inclusion being developed. Developing fairness, integrity, and *Coopertition*.	**Demonstrated respect and inclusion of team. Understanding of fairness, integrity and *Coopertition*.**	Displayed inclusion and respect beyond team. Displayed *Coopertition*, fairness, and integrity.

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APPENDIX

➔ **Architecture** – the art and science of planning, designing, and constructing buildings, structures and spaces

➔ **Engineering** – the use of mathematics, science and technology to create products and systems to improve the world

➔ **Vitruvius** – one of the first architects to develop a systematic approach to design – advised that building designs should strive for strength, usefulness, and beauty

➔ **Building** – a human-made assembly with a roof and walls intended as a place for people to live, work or play

➔ **Structure** – a system of connected parts used to support a weight or a load that is not designed for continuous human use

➔ **Public space** – an area or place that is open and accessible to all people
Examples: plazas, squares and parks, and connecting spaces like sidewalks and streets

➔ **Site survey** – the process of selecting and developing the best available location for a building or structure
Example factors: topography, landforms, drainage, community and environmental impact

➔ **Infrastructure** – the fundamental services that supply a place with modern the facilities necessary for its society to function
Examples: roads, bridges, tunnels, waterways, water and sewer; electrical grids, and telecommunications (including Internet)

➔ **Modular building** – a design and build process that involves creating sections of a building away from the construction site, and then delivering the sections to the site for permanent construction

➔ **Inspection drone** – a small remotely-operated unmanned aerial vehicle (UAV) that can be employed to inspect bridges and infrastructure using high-definition cameras and other sensors; can serve as a cheaper and safer way to conduct some inspections

➔ **Tree house** – a structure or building constructed adjacent to or among a tree or trees; can be designed for play or leisure, or give people a more authentic experience when visiting forest areas for "eco-tourism"

➔ **Accessibility (in architecture)** – ensuring that building design and construction addresses the needs of potential users, with special emphasis placed on meeting the requirements for people of all levels of physical, cognitive, emotional and health abilities

➔ **Architect** - a professional skilled in the art and science of the design and construction of buildings and structures; architects decide how buildings will look
Example factors: client needs, energy and cost efficient, strong and durable

➔ **Client** – the customer or user for whom a building or structure is designed and built

➔ **Civil engineer** – a professional who designs and constructs public and private infrastructure projects
Examples: roads, buildings, airports, tunnels, dams, bridges, and systems for water supply and sewage treatment

➔ **Structural engineer** – a professional who use math, science and engineering principles to make sure that forces won't damage or destroy a building or structure

➔ **Environmental engineer** – a professional who protects people from negative environmental effects
Examples: reduce air and water pollution, and improve recycling, waste disposal, and overall public health

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