FIRST LEGO LEAGUE
CHALLENGE

ROBOT GAME RULEBOOK

SUBMERGED

Robot Game Mission Video

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Welcome!

Welcome to *FIRST*® DIVE℠ presented by Qualcomm season. This year's *FIRST* LEGO® League challenge is called SUBMERGED℠. Your team will work together on many different tasks in preparation for an incredible experience at your event.

This *Robot Game Rulebook* will be your guide in understanding and playing the robot game. Contained in this guide are the missions, rules, and links to the resources you need to be successful in the robot game.

In addition to the *Robot Game Rulebook*, we recommend teams use the *Engineering Notebook*, which can be used as a guide for your team's journey throughout the season. It also provides inspiration for the innovation project and can be a helpful judging resource.

Engineering Notebook

FIRST® Core Values

We explore new skills and ideas.

Discovery

We respect each other and embrace our differences.

Inclusion

We use creativity and persistence to solve problems.

Innovation

We are stronger when we work together.

Teamwork

We apply what we learn to improve our world.

Impact

We enjoy and celebrate what we do!

Fun

FIRST® LEGO® League Challenge Overview

At an event, your team's performance will be evaluated based on four equally weighted components, each accounting for 25% of your total score. The three components of **Core Values**, **Robot Design**, and **Innovation Project** will be evaluated during the judging session. Your robot's performance will be evaluated separately during the **Robot Game**.

CORE VALUES

Your team will:

Demonstrate *FIRST*® **Core Values** in everything you do. Your team will be evaluated during the robot game and the judging session.

- Apply **teamwork** and **discovery** to explore the challenge.
- **Innovate** with new ideas about your robot and project.
- Show how your team and your solutions will have an **impact** and be **inclusive!**
- Celebrate by having **fun** in everything you do!

ROBOT DESIGN

Your team will:

Your team will prepare a short explanation on your robot design, programs, and strategy.

- **Identify** your mission strategy.
- **Design** your robot and programs and create an effective plan.
- **Create** your robot and coding solution.
- **Iterate**, test, and improve your robot and program.
- **Communicate** your robot design process and everyone's contributions.

ROBOT GAME

Your team will:

Your team will have three 2.5-minute matches to complete as many missions as possible.

- Build the mission models and set up the field mat.
- Review the missions and rules.
- Design and build a robot.
- Explore building and coding skills while practicing with your robot on the mat.
- Compete at an event!

INNOVATION PROJECT

Your team will:

Your team will prepare a live, engaging presentation to explain the work you have done on your innovation project.

- **Identify** and research a problem.
- **Design** a new solution or improve an existing one based on your selected idea, brainstorming, and plan.
- **Create** a model, drawing, or prototype.
- **Iterate** on your solution by sharing it with others and collecting feedback.
- **Communicate** your solution's potential impact.

The Robot Game

Here's a general overview of how the *FIRST®* LEGO® League robot game is played:

1. Your team works together to design and build a LEGO® robot. The robot operates autonomously, meaning that it will will follow pre-programmed instructions that your team writes to complete missions on the robot game field. The goal is to earn as many points as possible within a 2.5-minute match.

2. During a match, your team earns points as your robot completes missions, or tasks. Missions are represented by LEGO® models, referred to as mission models, that are positioned around the field. Missions can challenge the robot to manipulate objects, activate mechanisms, or move items to designated areas.

3. Your team launches your robot from one of the launch areas, contained in home. The robot should be programmed and prepared with the necessary attachments to accomplish the mission(s) your team is attempting.

4. It's your job to strategize and determine the order and approach your team will use to complete missions and maximize your score. You may choose to focus on specific high-scoring missions or aim for a combination of missions to accumulate points.

5. Mission requirements must be visible at the end of the match to score, unless otherwise stated in the mission.

6. In competitions, you will have three matches to show what your robot can do. Each round offers an opportunity to improve your score and your strategies. Only your team's best score of the three official matches counts toward awards and advancement. Ties are broken using second and third best scores.

7. *FIRST* LEGO League cares about not only the robot's performance but also how you express Core Values through *Gracious Professionalism®*. Referees at the event will evaluate your *Gracious Professionalism* at every official match.

For a full understanding of the robot game, please review the robot game rules found at the end of this guide.

| Home | Left Launch Area | Right Launch Area | Home |

SUBMERGED℠

Get ready to dive deep into the oceanic abyss, as this year's robot game will take you through a thrilling adventure of varying habitats found in different ocean layers. Starting from the sunlight zone, your team will plunge headfirst into a coral reef that is in dire need of restoration. As you venture farther down into the twilight and midnight zones, you'll retrieve an artifact from a sunken ship, which will surely put your skills to the test.

The real challenge awaits you in the deepest trenches of the abyss where you'll explore a mysterious cold seep. Finally, you'll return to the twilight zone to further your research and uncover the secrets lurking beneath the ocean's surface. Get ready to embark on an unforgettable journey of discovery!

Inside the Challenge Set

Inside your annual challenge set, you will find a challenge mat, 3M™ Dual Lock™ Reclosable Fastener, and your team's mission models. The mission models will come in numbered bags and must be built by your team using the Mission Model Building Instructions.

3M™ Dual Lock™ Reclosable Fastener

Field Mat

LEGO® Mission Models

Caution: The robot interacts with mission models on the field for points, so it is important to build the models exactly as shown in the building instructions. Practicing with incorrect models can be problematic and affect your gameplay experience. Work as a team to build the models and check each other's work as you build.

Use the link on the next page to begin building your mission models.

1. Build your mission models using the **Mission Model Building Instructions**. The mission models are the official objects the robot interacts with as part of the game.

2. Decide whether to put your field mat on a table or on the floor. You can use the **Optional Table Building Instructions** to build your own table.

3. Set up your field by following the **Field Setup Video**.

4. Read the Missions and Rules sections of this guide, found on the following pages, and watch the **Robot Game Mission Video**.

   The Missions section describes each mission model and how your team can earn points during the game by interacting with them.
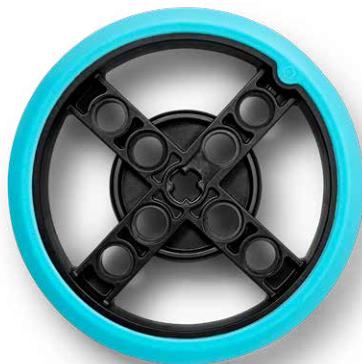
   The Rules section describes how to play the game, including how a match is run, what a team can and cannot do, and how to score!

5. Check for **Updates**. This is a running list of official rules, clarifications, and amendments. Refer to the Updates often and carefully.

6. Track your score throughout the season using the **Official Scoring Calculator**.

7. Check out our other helpful resources, such as the **Event Preparation Video**, the **Robot Path Diagram**, and the **Classroom Scoresheet**!

   For additional help building and coding your robot, check out the LEGO® Education SPIKE™ App. Within the app, a guided mission is provided, where you will learn how to program and complete Mission 10: "Send over the Submersible".

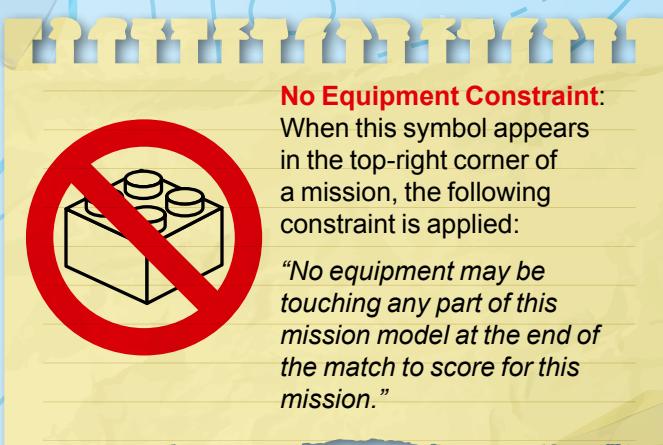Scan the QR code to access the bold resources listed above.

Missions

ARE YOU READY TO PLAY THE SUBMERGED℠ ROBOT GAME?!

Complete as many missions as you can to score points! The missions are explained here.

No Equipment Constraint:
When this symbol appears in the top-right corner of a mission, the following constraint is applied:

"No equipment may be touching any part of this mission model at the end of the match to score for this mission."
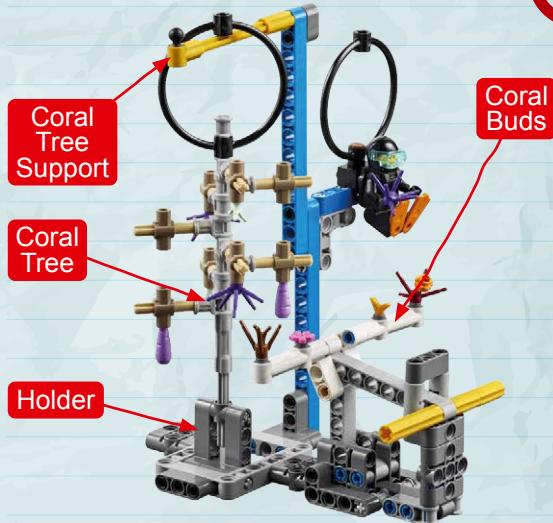
Equipment Inspection

• Before the match, there will be an equipment inspection. If your robot and all equipment fit completely in one launch area and under a height limit of 12 in. (305 mm) during this inspection **20**

01 Coral Nursery

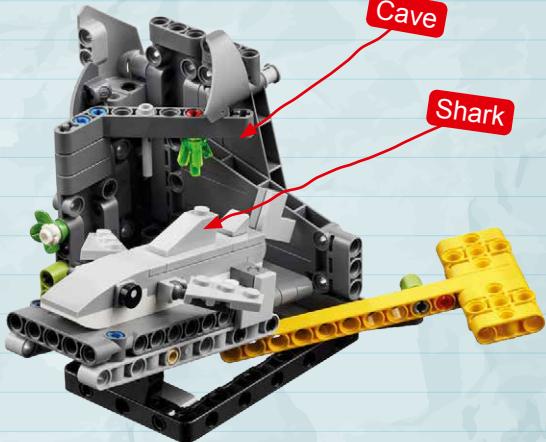Coral Tree Support

Coral Buds

Coral Tree

Holder

Secure new coral structures to grow in the nursery until they are strong enough for transport to the reef.

- If the coral tree is hanging on the coral tree support **20**
  - **Bonus**: and the bottom of the coral tree is in its holder .... **10 added**
- If the coral buds are flipped up **20**

02 Shark

Cave

Shark

The shark was just tagged for research - release it back into its habitat.

Shark Habitat

- If the shark is no longer touching the cave......... **20**
- If the shark is touching the mat and is at least partly in the shark habitat.......................... **10**

03 Coral Reef

Coral Reef Support

Reef Segments

Coral Reef

Carefully mount the new coral structure without damaging other nearby reef segments.

- If the coral reef is flipped up, not touching the mat **20**
- If a reef segment is standing upright, outside of home, and touching the mat........................ **5 each**

04 Scuba Diver

Scuba Diver

Help the scuba diver transport new coral from the nursery to the reef.

- If the scuba diver is no longer touching the coral nursery **20**
- If the scuba diver is hanging on the coral reef support **20**

The "coral nursery" includes any part of the Mission 1 mission model.

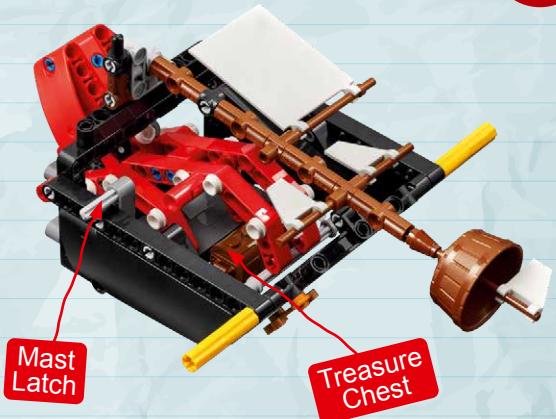## 05 Angler Fish

Angler Fish

Latch

Guide the angler fish back to its unexpected home within the shipwreck.

• If the angler fish is latched within the shipwreck **30**
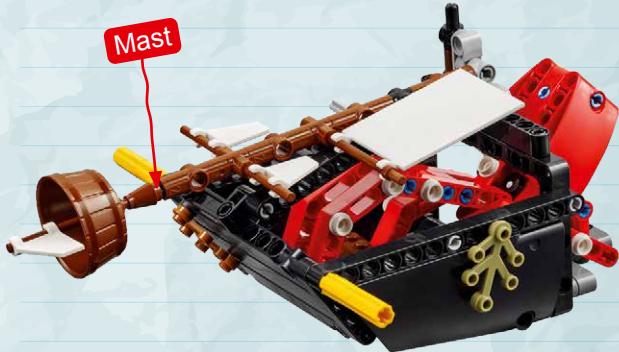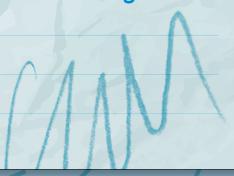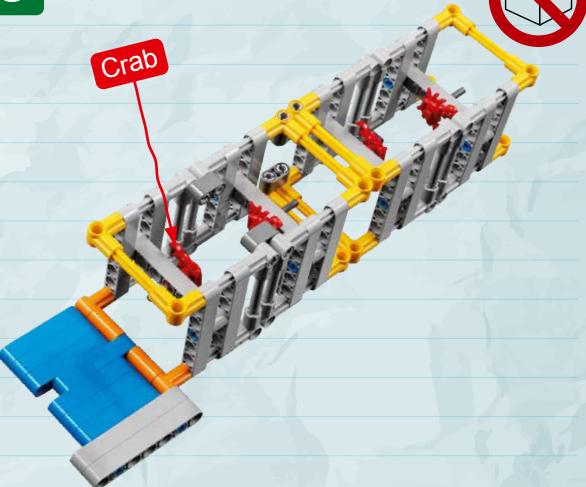
06 Raise the Mast

Mast

Raise the mast to restore the sunken shipwreck and explore what is inside.

• If the shipwreck's mast is completely raised **30**

The shipwreck's mast is considered raised when the latch prevents it from returning to its starting position.

07 Kraken's Treasure

Mast Latch

Treasure Chest

Retrieve the chest from the shipwreck to reveal the history and treasure it holds.

• If the treasure chest is completely outside the kraken's nest................ **20**

Kraken's Nest

08 Artificial Habitat

Crab

Rearrange the artificial habitat stacks to create safe homes for the crabs and other sea creatures in this area.

• If an artificial habitat stack segment is completely flat and upright .... **10 each**

There are four segments of the artificial habitat stack, each defined by its yellow base. A segment is considered upright when the crab is above its yellow base.

09 Unexpected Encounter

Unknown Creature

An unknown creature has attached itself to the AUV! Safely release it and deliver it to the cold seep.

Cold Seep

• If the unknown creature is released **20**

• If the unknown creature is at least partly in the cold seep **10**

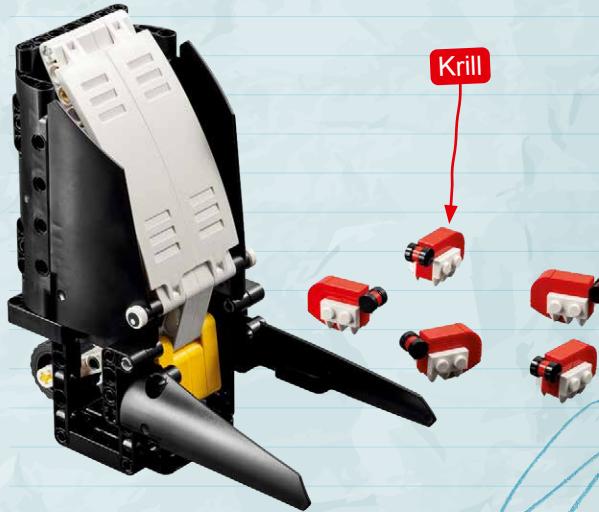## 10 Send over the Submersible

Yellow Flag
Submersible

Some waters are too difficult to reach with larger ships. Send the submersible to explore the opposing field's waters.

• If your team's yellow flag is down **30**

• If the submersible is clearly closer to the opposing field **10**

Teams may not block the opposing team.
It is not possible to earn the bonus in remote competitions or if there is no opposing team.

11 Sonar Discovery

Whales

Use the ship's sonar technology to scan the surroundings for nearby objects or animals.

• If one whale is revealed **20**

• **Bonus**: If both whales are revealed .... **10 added**

12 Feed the Whale

Krill

Krill are a whale's favorite food! Collect the krill and feed them to the hungry whale.

• Krill at least partly in the whale's mouth .... **10 each**
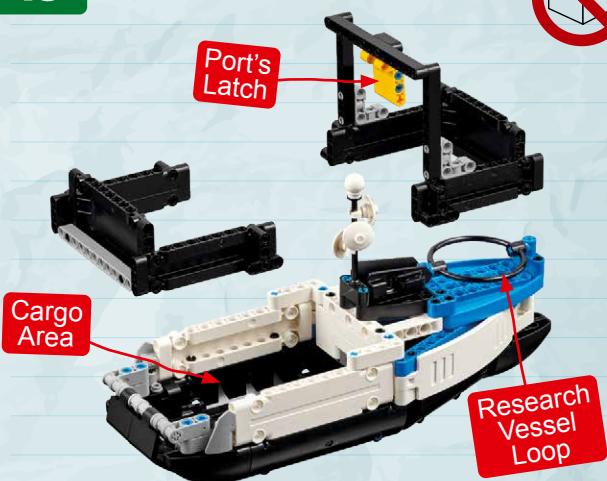
13 Change Shipping Lanes

Adjust the cargo ship's route to safely avoid whale migration routes by moving to another shipping lane.

- If the ship is in the new shipping lane, touching the mat.. **20**

14 Sample Collection

Water Sample

Seabed Sample

Kelp Forest

Seabed

Trident

Plankton Sample

Collect samples and artifacts from around the mat so they can be analyzed by scientists in the lab.

- If the water sample is completely outside the water sample area **5**
- If the seabed sample is no longer touching the seabed **10**
- If the plankton sample is no longer touching the kelp forest **10**

Water Sample Area

If a piece of the trident is no longer touching the shipwreck................. **20**

Bonus: If both pieces are no longer touching the shipwreck................. **10 added**

15 Research Vessel

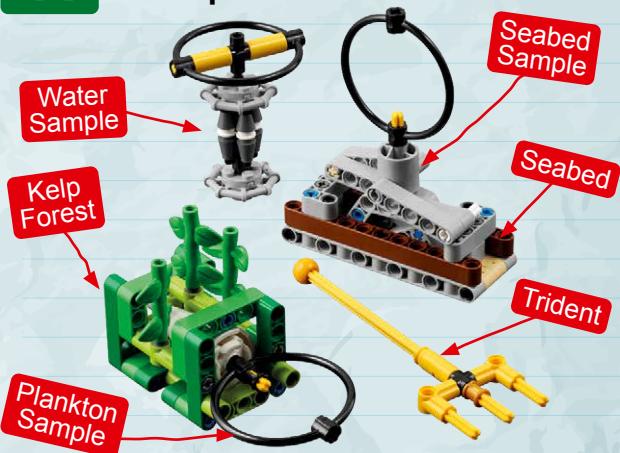Port's Latch

Cargo Area

Research Vessel Loop

Securely dock the ship that contains the samples and artifacts your team has collected.

If any of the following are at least partly in the research vessel's cargo area:

- Sample(s) .... **5 each**
- Trident Part(s)... **5 each**
- Treasure Chest **5**
- If the port's latch is at least partly in the research vessel's loop **20**

Precision Tokens

You begin the match with six precision tokens worth 50 points. If you interrupt the robot outside of home, the referee will remove one token. You earn points for the number of tokens remaining at the end of the match. If the number remaining is:

(See Rules 17 and 18.)

1: **10**, 2: **15**, 3: **25**,
4: **35**, 5: **50**, 6: **50**

Rules

IMPORTANT!

- All robot game wording means precisely and only what it says. Don't overthink it!

- If a detail is not mentioned, it does not matter.

- If a situation arises that makes the referee's decision unclear or hard to call, you get the benefit of the doubt.

- If rules, missions, or the field setup needs adjustment or clarification, a Challenge Update will be issued during the season superseding previous materials. It's important to note that updates will apply only to events occurring after their release and should not be used to alter the results of past events.

- At an event, your head referee makes the final decision. Text always has authority over pictures. (Videos and emails have no authority when scoring.)

Gracious Professionalism® displayed at the robot game table

DEVELOPING	ACCOMPLISHED	EXCEEDS

Gracious Professionalism points will be added to the total Core Values score from judging. Every team starts each match with an **ACCOMPLISHED** score (3 points), and this is the score most matches will yield. The score changes only if a referee observes above-and-beyond sportsmanship, awarding an EXCEEDS score (4 points), or lesser sportsmanship, awarding a DEVELOPING score (2 points).

If a team does not show up for their match, they will score no points for *Gracious Professionalism*. However, if a team arrives and does not run the robot but does explain what has happened, they can get a *Gracious Professionalism* score of 2, 3, or 4 points depending on the *Gracious Professionalism* they demonstrate.

Glossary

- **Equipment**: Everything teams bring to the match. (See **Rules, Before the Match** for more details.)

- **Field**: This consists of the border walls and everything inside them. The mat, the mission models, and the home areas are all part of the field.

- **Interruption**: When technicians interact with the robot, or anything touching it, after launch.

- **Launch**: When technicians activate the robot from completely within a launch area to cause it to move autonomously.

- **Match**: The 2.5 minutes when the robot completes as many missions as possible to earn points.

- **Mission**: One or more tasks that can be completed for points. Teams may try missions in any order or combination.

- **Robot**: Your controller and any equipment combined with it and intended to not separate from it, unless by hand.

- **Technicians**: Team members standing at the table who are handling the robot during a match.
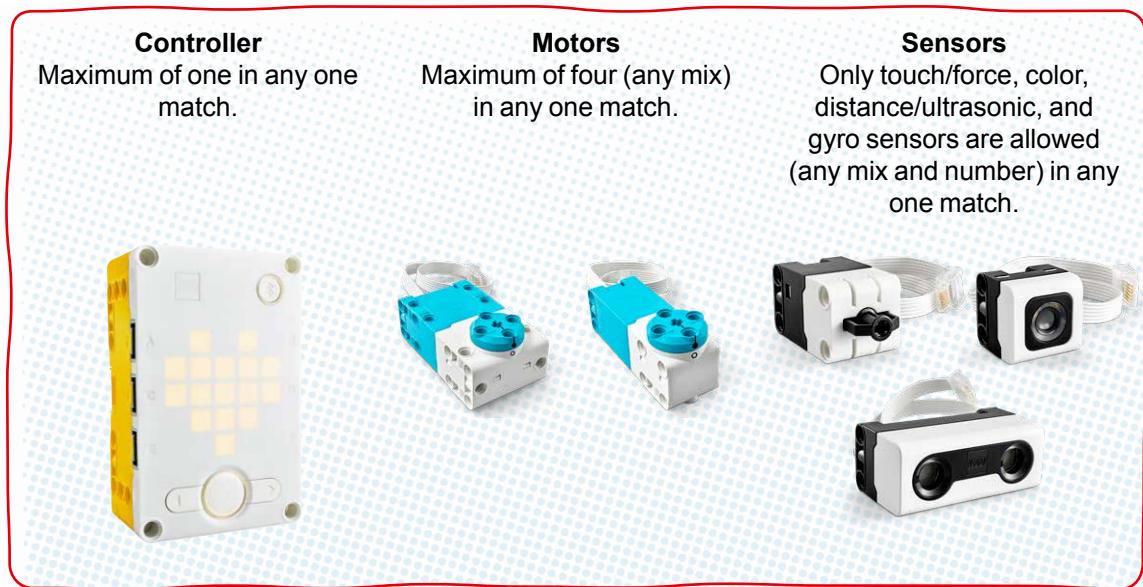
BEFORE THE MATCH | EQUIPMENT

The equipment a team brings to the robot game field, such as the robot and its attachments or accessories, must meet the following guidelines:
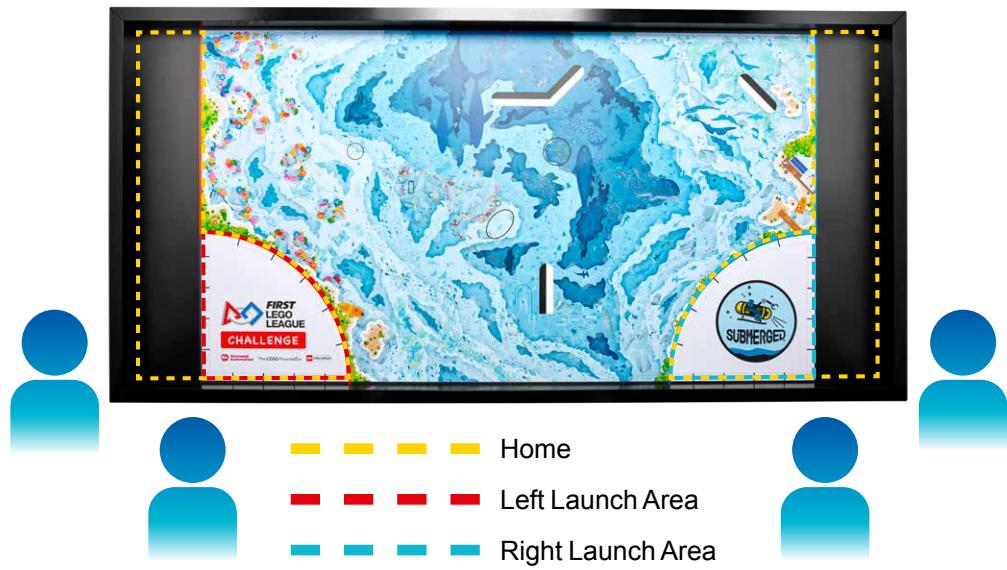
1. All equipment must be LEGO® building pieces, in original factory condition.
Exception: LEGO string and pneumatic tubes may be cut to length.

2. Teams may use as many non-electric LEGO pieces from any set as they'd like.

3. Electric LEGO equipment is allowed only as described and shown below. (The LEGO® Education SPIKE™ Prime is shown, but LEGO® Education SPIKE™ Essential, MINDSTORMS® EV3, MINDSTORMS Robot Inventor, Powered Up, and equivalent NXT and RCX are also allowed.)

Controller
Maximum of one in any one match.

Motors
Maximum of four (any mix) in any one match.

Sensors
Only touch/force, color, distance/ultrasonic, and gyro sensors are allowed (any mix and number) in any one match.

4. Teams can also use LEGO wires, one controller's power pack or six AA batteries, and one microSD card.

5. Teams can use any software or programming language. Robots must be autonomous during the match. No remote controllers of any type are allowed.

6. Teams may bring one sheet of notebook paper per home area for program notes. This does not count as equipment.

7. Additional or duplicate mission models are not allowed.

- – – – Home
- – – – Left Launch Area
- – – – Right Launch Area

BEFORE THE MATCH | MATCH SETUP

At events, matches will be played on official tables. Before the match begins, teams will need to pass the pre-match inspection and set all their equipment in place.

8. All the team's equipment must fit into the two launch areas and fit under a height limit of 12 in. (305 mm). However, if the team can fit all their equipment into just one launch area under a height limit of 12 in. (305 mm), they will earn 20 points.

9. Teams will not be given additional storage space. Storage tables or trolleys are not allowed. Everything must stay on the table or in the hands of the technicians. The areas to the left and right of the mat can be used to store equipment and measure approximately 6.75 in. (171 mm) by 45 in. (1,143 mm) (actual measurements may vary). Equipment stored on the table may extend past the left and right walls only, as needed.

10. After the team has passed inspection, they will be given a couple of minutes to set up. They start by distributing their equipment and loose mission model(s) between the two home areas. (Sometimes, mission models must start in a specific home area. See **Field Setup** for more details.) Next, they place their robot into the launch area they wish to start from. Any remaining time should be used to adjust the robot and equipment for the first launch, to calibrate sensors using any part of the mat, and to ask the referee to check anything on the field.

11. Team members must then divide into two groups and position one group on each side of the field (left and right). These members cannot switch sides during the match. Teams of:

- Four or more: Position two technicians at each home area. All other team members must stand back. Teams may never have more than two technicians at a single home area, but team members may swap places with technician(s) from the same side at any time.
- Three: Position two technicians on one side and one on the other (team choice).
- Two: Position one technician on each side.

DURING THE MATCH | INSIDE HOME

12. Home is split into two areas. Each home area contains its own launch area.

13. Technicians may use their hands on the robot, equipment, and mission models when these are completely within their home area.

14. Technicians may not:

- Hand anything from one home area to the other.
- Touch anything outside of their home area, except for interrupting the robot.
- Cause anything to move or extend outside this area, except for launching the robot.

Points scored in these ways will not count.

15. When launching:

- Technicians may not keep anything from moving.
- The robot and anything it is about to move must fit completely inside the launch area.

16. After any launch, technicians should allow the robot and anything it is in contact with to return completely into home before interrupting it. (See **Rules, Outside Home** for more details.)

17. If technicians interrupt their robot, it must be relaunched. If the robot or anything it was in contact with at the time of the interruption was outside home (even partly), the team loses one precision token.

If the robot or any object(s) it was in contact with were:

- **Partly outside home**: They must be brought into that home area.
- **Completely outside home**: Teams may hand them to either home area.
  - Any returned object that was obtained outside home after the robot was last launched must be given to the referee for the remainder of the match.

Exception: If the team does not plan to launch again, they may stop their robot in place without losing a precision token. The robot and anything it is in contact with should remain in place where it was interrupted.

18. If a piece of equipment or a mission model is dropped or left outside of home by the robot, wait for it to come to rest. If it rests:

- **Completely outside home**: It stays as is unless the robot moves it.
- **Partly inside home**: It stays as is unless the robot moves it. Alternatively, at any time, the technicians may remove it by hand. If the object removed by hand is a mission model, it must be given to the referee for the remainder of the match. If the object is equipment, it must be taken into that home area, and the team will lose one precision token.

19. Teams may not interrupt their robot in such a way that they earn points from it. Points scored in these ways will not count.

20. Teams may not separate the Dual Lock, take models apart, or break a mission model. If a mission model is combined with anything (including the robot), the combination must be loose or simple enough that, if asked to, a technician could free the mission model in perfect original condition in a single motion. Points scored using combinations that fail this test will not count.
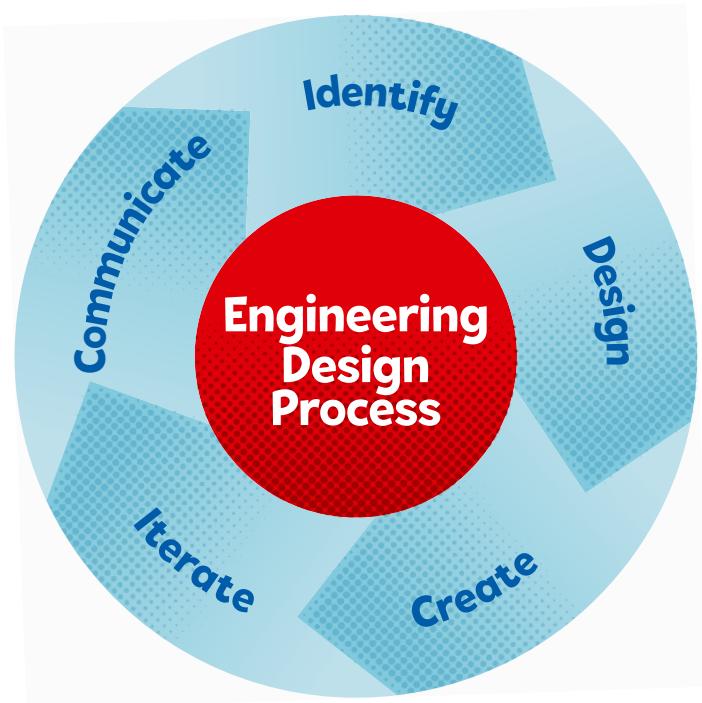
21. Teams may not interfere with the opposing field or robot unless there is a mission exception. Points failed or lost due to interference will score automatically for the other team.

AFTER THE MATCH | SCORING

22. After 2.5 minutes, the match ends. Technicians must stop their robot and touch nothing else. This is when scoring begins.

23. For scoring, all mission requirements must be visible at the end of the match unless a method was required in the mission.

24. When something is required to be "completely in" an area, the lines and airspace above that area count as "in" unless otherwise mentioned.

25. If a team cannot run their robot, they can still gain *Gracious Professionalism®* points by explaining the situation or being present at the match.

26. The referee will document the results of the match with the team. When there is agreement on the results, it becomes official. If no agreement is reached, the head referee makes the final decision. Only the team's best score of the three official matches counts toward awards and advancement. Ties are broken using second and third best scores. In the case of a three-way tie, local tournament officials will decide what to do.

Engineering
Design
Process

Identify

Design

Create

Iterate

Communicate

FIRST DIVE
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