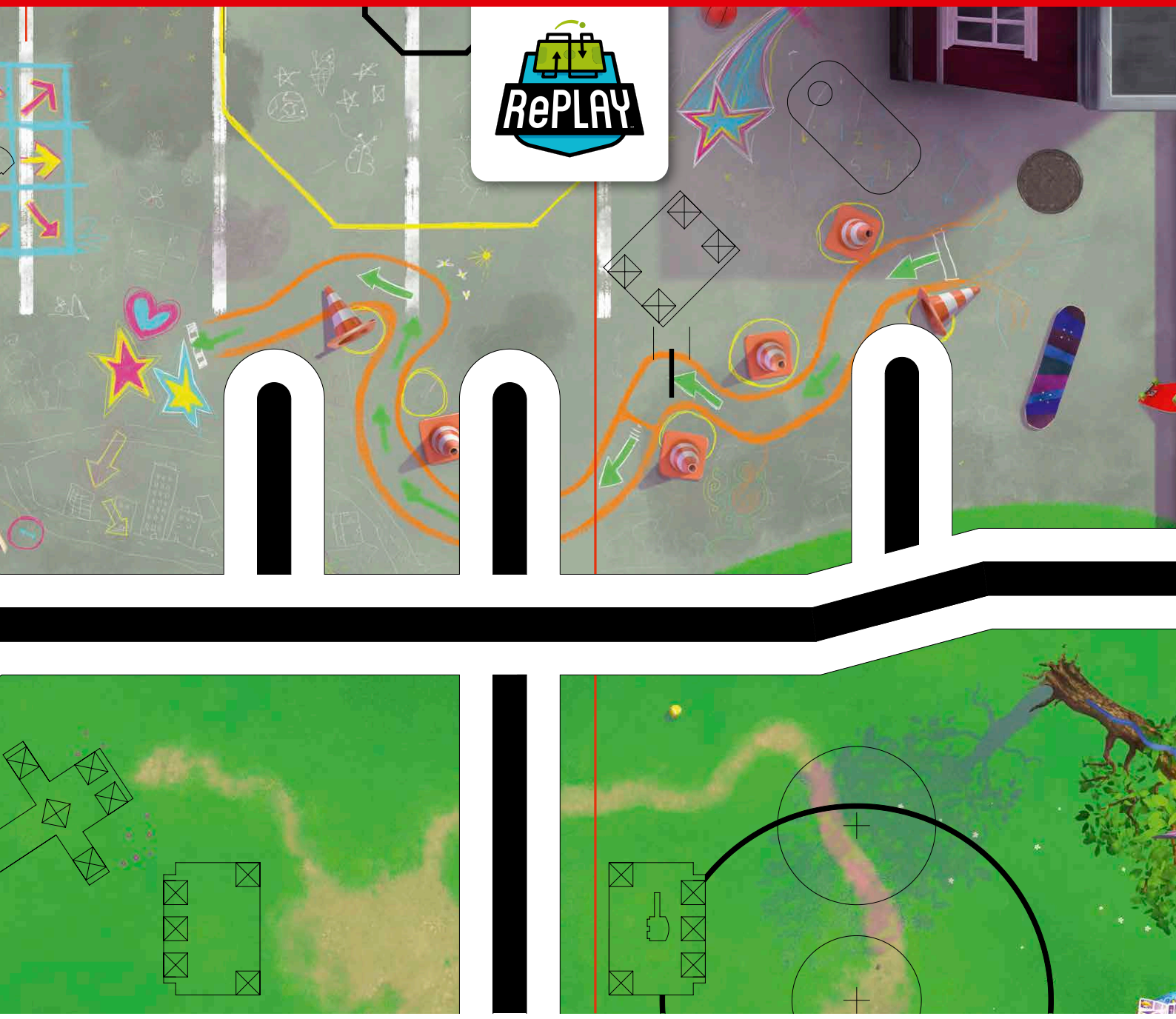
FIRST LEGO LEAGUE CHALLENGE

ROBOT GAME RULEBOOK



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RePLAY℠ Robot Game Rulebook

This rulebook contains all the information you will need for the RePLAY℠ *FIRST*® LEGO® League Challenge Robot Game.

TABLE OF CONTENTS

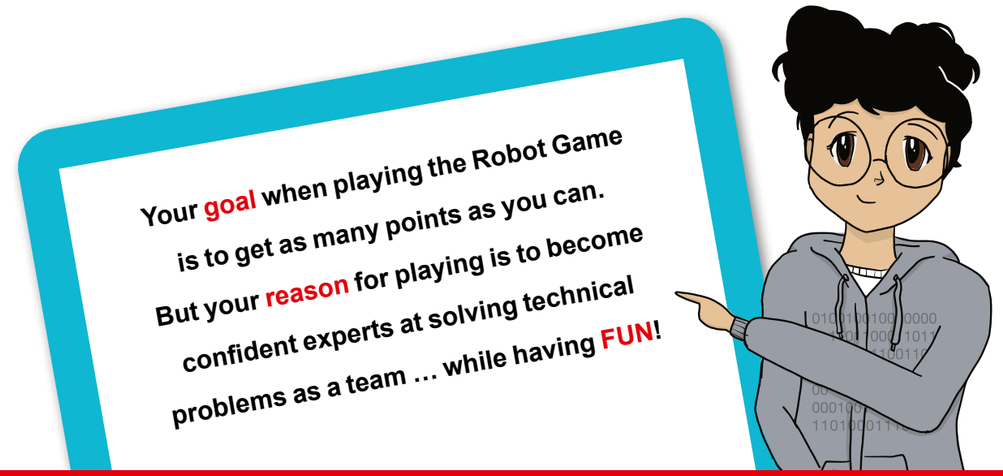
Field Setup . . . 4
- Mission Model Building . . . 4
- Field Mat Placement . . . 4
- Dual Lock™ . . . 5
- Mission Model Placement . . . 5

Robot Game and Field Layout . . . 7

Missions . . . 8
- M00 Equipment Inspection Bonus . . . 9
- M01 Innovation Project . . . 9
- M02 Step Counter . . . 10
- M03 Slide . . . 10
- M04 Bench . . . 11
- M05 Basketball . . . 11
- M06 Pull-Up Bar . . . 12
- M07 Robot Dance . . . 12
- M08 Boccia . . . 13
- M09 Tire Flip . . . 14
- M10 Cell Phone . . . 14
- M11 Treadmill . . . 15
- M12 Row Machine . . . 15
- M13 Weight Machine . . . 16
- M14 Health Units . . . 16
- M15 Precision . . . 17

Rules . . . 18
- **PREPARATION** | Definitions and Rules . . . 19
- **ACTION** | Definitions and Rules . . . 23
- **SCORING** | Definitions and Rules . . . 25
- New in the Rules this Year . . . 26

Robot Path Diagram . . . 27



Field Setup

The field consists of mission models on a mat surrounded by border walls. The mat and LEGO® pieces for building the mission models are in your Challenge set. The links and instructions needed for building and arranging everything are here.

MISSION MODEL BUILDING

The robot interacts with mission models on the field for points. The mission models are built in Sessions 1-4 in the *Engineering Notebook*. To build the mission models (models), use the LEGO pieces from your Challenge set and instructions from firstlegoleague.org/missionmodelbuildinginstructions. It would take one person about six hours to build all the models.

Models need to be built perfectly. "Almost perfect" is not good enough. If you practice with incorrect models, the robot will have problems at competitions. Best practice is for at least two people to check each other as they build.

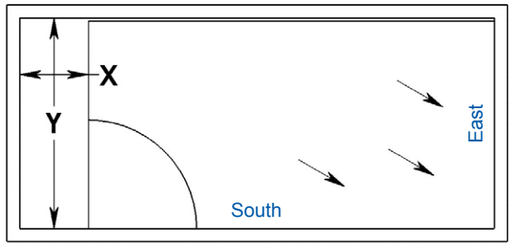
FIELD MAT PLACEMENT

STEP 1 – Check the table surface for bumps. Sand or file them away and then vacuum well.

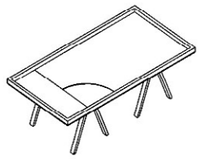
STEP 2 – On the vacuumed table only, unroll and place the mat as shown below. Never fold the mat, and never crush or bend a rolled mat.

STEP 3 – Slide the mat against the south and east border walls. When table size and mat placement are correct, the area west of the mat measures about **X** = 13.5 by **Y** = 45 in. (343 mm by 1,143 mm).

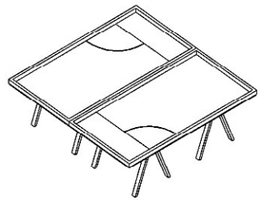
STEP 4 – Optional – To hold the mat in place, you can use thin strips of black tape, covering only the mat's east/west black borders.



Slide mat southeast



Practice



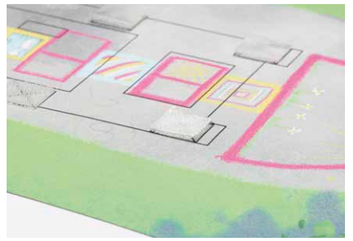
Competition

DUAL LOCK™

Find the tan sheets of this reclosable fastening material from 3M™ in your challenge set.

SECURING MODELS – "X" squares show where to Dual Lock models to the mat. Use the Dual Lock as in this example and be very exact.

Step 1: sticky side down



Step 2: sticky side up

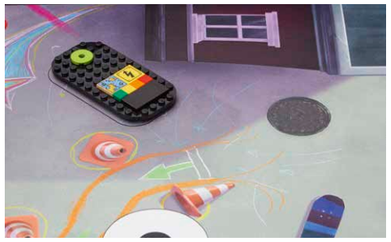
Step 3: align model, press down

MODEL STRESS – When pressing a model down, press on its lowest solid base instead of crushing the whole model. Lift that same part if you need to separate the model from the mat.

MISSION MODEL PLACEMENT

LOOSE MODELS – Place loose models as described or shown here. Models outside home need to be placed exactly within their outline marks and aligned with any directional marks.

Heavy and light tires

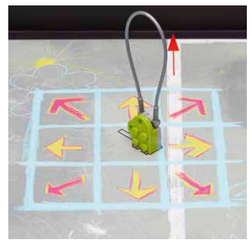


Cell phone

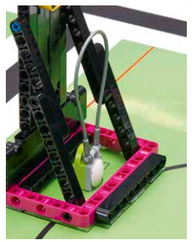
Home

HOME – Anywhere in home, place: 3 health units, 1 yellow cube, 2 red cubes, 2 blue cubes, 8 green cubes, and your Innovation Project (not shown here).

Health unit north west



Health unit dance floor



Health unit pull-up bar west

Health unit south center

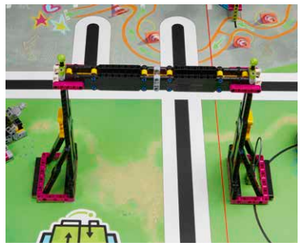
Health unit east center

Keep loops mostly symmetrical and vertical. Robots should be designed to encounter imperfect loops.

SECURED MODELS – Secure and prepare as described and/or shown here.

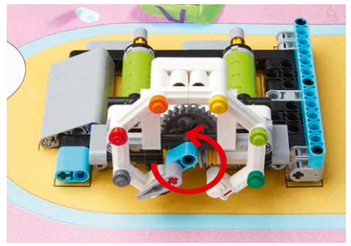
Step counter – green panel is all the way west

Weight machine – see mission M13



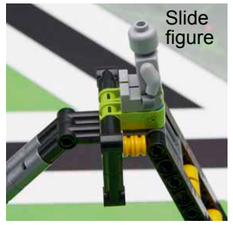
Pull-up bar

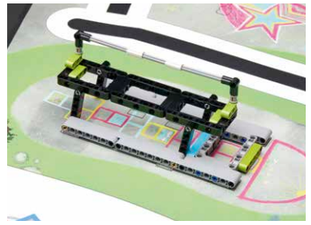
Row machine as shown



Treadmill – dial is all the way counterclockwise

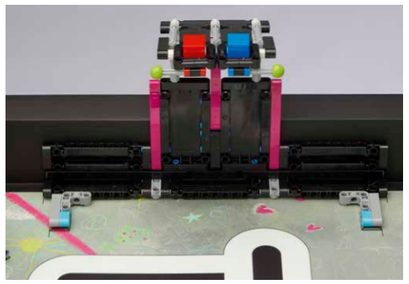
Basketball





Slide – slide figures are placed exactly as shown

Bench



Boccia share model and matching cube in each color

Boccia frame

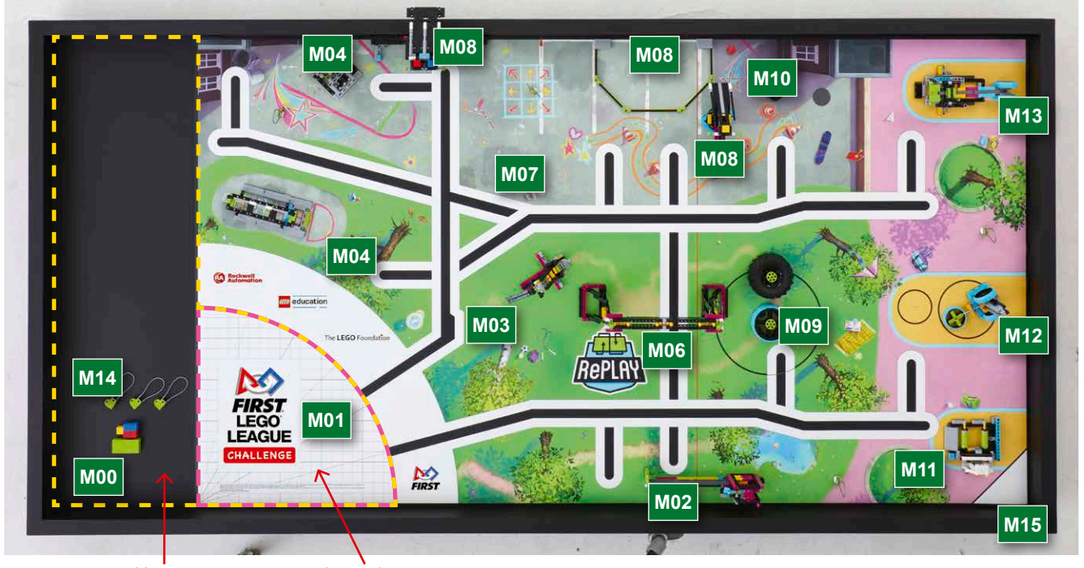
Boccia aim model and yellow cube

If you compete, remember that volunteers work hard to get the fields just right, but you should expect and design for rare imperfections, like bumps under the mat or changes in light.

Robot Game

The team will build a robot using LEGO® elements and technology. They program it to autonomously complete a series of missions in a 2.5-minute Robot Game to score points. The robot starts in the launch area, tries missions in the order chosen by the team, and then returns anywhere into home.

The team can modify the robot when it is in home before launching it again. If needed, the robot can be brought home by hand, but the team will lose a precision token. The team will play several matches but only the highest score matters.



Home: Launch area:

Field Layout

Missions

These are the tasks the robot can perform for points. The details are simple, but there are many of them. For full understanding, read and re-read them as a team, next to an actual field.

Below, example mission “MXX” tells you what each part of a mission’s text is for, based on its location and color.

MXX Example Layout

Model Picture

Basic description of each mission.

Not used for scoring.

• Regular black text under the mission description lists the main requirements: **XX points are in bold red**
• If the referee sees these things performed or completed: **XX points as described**

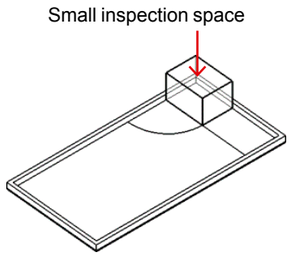
Blue italic text after the bullets is for very important added requirements, leniency, or other helpful facts.

Sometimes pictures teach you with an example score.

Sometimes the pictures have a description to help explain it.

The pictures may not show you all the scoring possibilities, just some examples!

M00 Equipment Inspection Bonus



“Doing the same with less” can save time and space.

• If all your equipment fits in the small inspection space: **25**

When you get to each match, remove all your equipment from any containers and show the referee you can fit it all in the small inspection space. See Rule 09 for details.

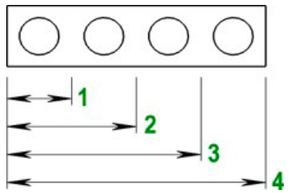
M01 Innovation Project

Example
Innovation Project

The robot moves your Innovation Project onto the RePLAY logo or the gray area around the bench (M04).

If your Innovation Project:
• Is made of at least two white LEGO pieces
• Measures at least as long as four LEGO studs in at least one direction
• Has any part of it touching either the RePLAY logo or the gray area around the bench: **20 max**

*Build and bring a single model that represents your solution to the Innovation Project. The one shown here is just an example. **CAUTION**: Your Innovation Project counts as equipment. Building of your Innovation Project model is suggested in Session 9 in the* Engineering Notebook. *Read rule R01 and all the rules carefully and often so you can avoid surprises at competitions.*

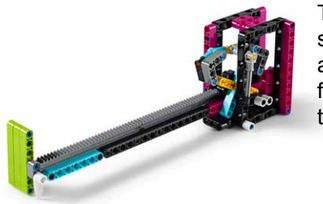


4-stud measure

20

20

M02 Step Counter



The robot slides the step counter slow and steady. The farther the "walk," the better.

• If the bottom of the pointer is on **magenta**: **10**, **yellow: 15**, **blue: 20**

Example pointer positions:

Magenta

Yellow

Middle – see rule R25
(Benefit of the doubt)

M03 Slide

The robot slides the people (called "slide figures") down the slide and moves them to other areas.

• If only one slide figure is off the slide: **5**
• If both slide figures are off the slide: **20**
• If a slide figure is completely in home: **10 max**
• If a slide figure is held completely off the mat by the heavy tire and is touching nothing else: **20 max**

"Off the slide" scores if the slide figure's black frame is past/ below the tip of the slide's gray slide part. Notice the score for two slide figures off is 20, not 25.

One off

Both off

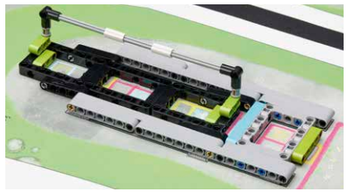
In home

Off mat, on heavy tire

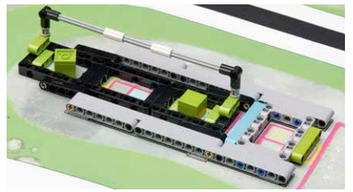
M04 Bench

The robot removes the backrest, flattens the bench, and gets cubes into the hopscotch spaces.

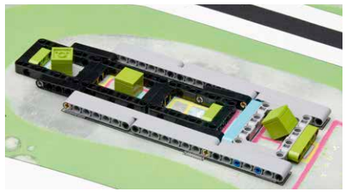
• If the bench is down flat: **10**
• If the bench is down flat and there are cubes touching the mat in hopscotch spaces: **10 each space**
• If the backrest is completely out of both of its holes: **15**



10 + 0 + 0



10 + 20 + 0



10 + 30 + 15

M05 Basketball

The robot raises the crate up the post and gets a cube into it.

• If there is a cube in the crate: **15**
• If the crate rests on the middle height's white stopper: **15**
• If the crate rests on the top height's white stopper: **25**

Only one cube can score in the crate. Score top height or middle height, not both.

15 + 15

0 + 15

0 + 25

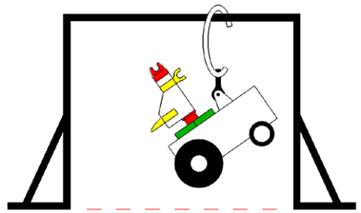
M06 Pull-Up Bar

The robot passes completely under the bar any time. Separately, it is held off the mat by the bar at the end of the match.

- If the robot passes completely through the pull-up bar's upright frame at any time: **15 max**
- If the pull-up bar holds 100% of the robot up off the mat at the end of the match: **30**

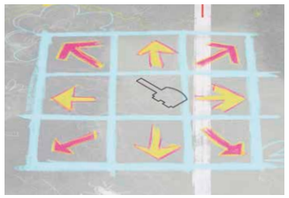
A "pass through" can score northward or southward, but only one way and only one time. A "pass through" scores at the time it happens. This is a rule R22 exception.

For the "held up" score, you cannot score this and M07 in the same match.



Held up

M07 Robot Dance



Dance Floor

The robot is dancing on the dance floor at the end of the match.

- If the robot's controller is at least partly over the dance floor in a "dancing" motion at the end of the match: **20**

Any silly or skilled repetitive action counts as dancing – do something fun! For M07, you cannot score this plus the "held up" score from M06 in the same match.

M08 Boccia

Boccia Share

Boccia Aim & Frame

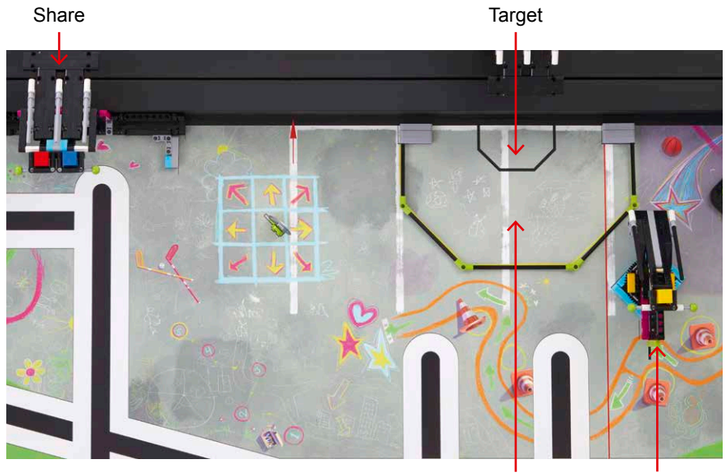
Boccia is an interactive mission with the opposing team. Talk with the other team so the robots send matching colored cubes onto the opposite field.

- If both share models have sent only one cube anywhere onto the opposing field and those cubes color-match each other: **25 for each team**
- If there are cubes completely in your frame or target: **5 each cube**
- If there is at least one yellow cube completely in your target: **10 added**

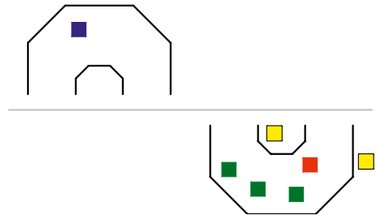
If there is equipment even partly in your frame, M08 scores zero for you (the opposing team is not affected).

If, like most teams, you have only your one practice table, your sent cube will simply go over your north wall during practice.

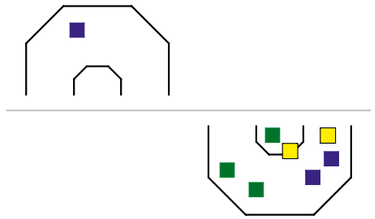
(Study the scoring examples as if both share models did share only one cube.)



Competition setup with view of the opposing field



0 + 25 + 10



25 + 35 + 0

M09 Tire Flip

The robot flips tires so their white centers face up and moves them into their large target circle.

- If the light (blue tread) tire is white center up: **10**
- If the heavy (black tread) tire is white center up: **15**
- If white-center-up tires are completely in the large target circle: **5 each**
- For all scores, the tire needs to be resting on only the mat.

If the heavy tire crosses the red flip line at any time, even partly, it scores zero.
The flip line runs all the way north to south. Only part of it is shown.

10 + 15 + 5

10 + 0 + 5

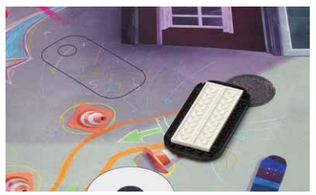
0 + 15 + 5

10+ 15 + 5 + 5

M10 Cell Phone

The robot flips the cell phone white side up.

- If the cell phone is white side up and resting on only the mat: **15**



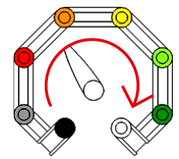
15

M11 Treadmill

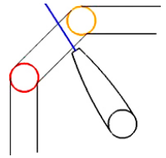
The robot spins the rollers to move the pointer as far clockwise as possible.

- If the robot spins the rollers so the pointer points to gray: **5**, red: **10**, orange: **15**, yellow: **20**, light green: **25**, dark green: **30**

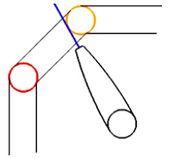
If a position is not clear, imagine a needle at the end of the pointer. The edge of a color counts as that color. If the robot moves the pointer by touching the pointer, M11 scores zero.



Not clear?



Score red

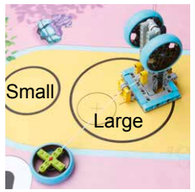


Score orange

M12 Row Machine

The robot moves the free wheel out of the large circle and into the small target circle.

If the free wheel is:
- Completely outside the large circle: **15**
- Completely in the small circle: **15 added**



15

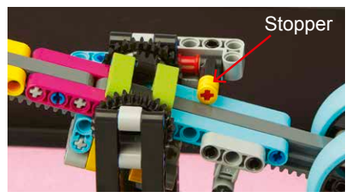
30

M13 Weight Machine

Before the match, you hand select the machine's lever setting.
During the match, the robot moves the lever until the little yellow stopper falls.

• If the stopper is under the lever and lever setting is blue: **10**, magenta: **15**, yellow: **20**

Before the match starts, you slide the lever where you want, with the stopper on top. This is an exception to rule R12. The lever setting is the color under the east face of the east green bar.



Example: lever set to blue

10

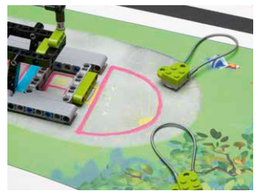
20

M14 Health Units

The robot collects health units from around the field and moves them to target areas.

If health units are:
• Touching either the RePLAY logo or the gray area around the bench: **5 each**
• Looped over a pull-up bar post as shown – maximum of four – and touching no equipment: **10 each**

10



10

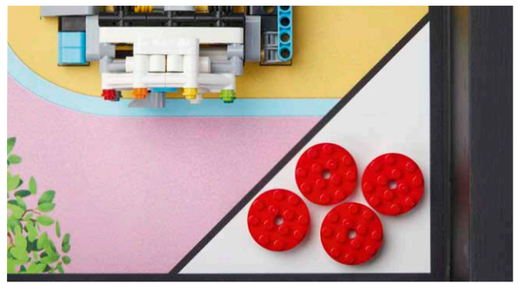
10

M15 Precision

The less often you interrupt the robot outside home, the more points you keep.

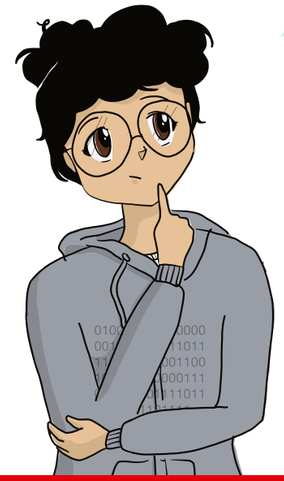
• If the number of precision tokens left on the field is 1: **5**, 2: **10**, 3: **20**, 4: **30**, 5: **45**, 6: **60**

See rules R05, R15, R16, and R19.



30

That's all the missions for the RePLAY℠ Robot Game. Remember, you can tackle them in any order, but you might not have time to complete them all, so BE STRATEGIC about the ones you choose!



Rules

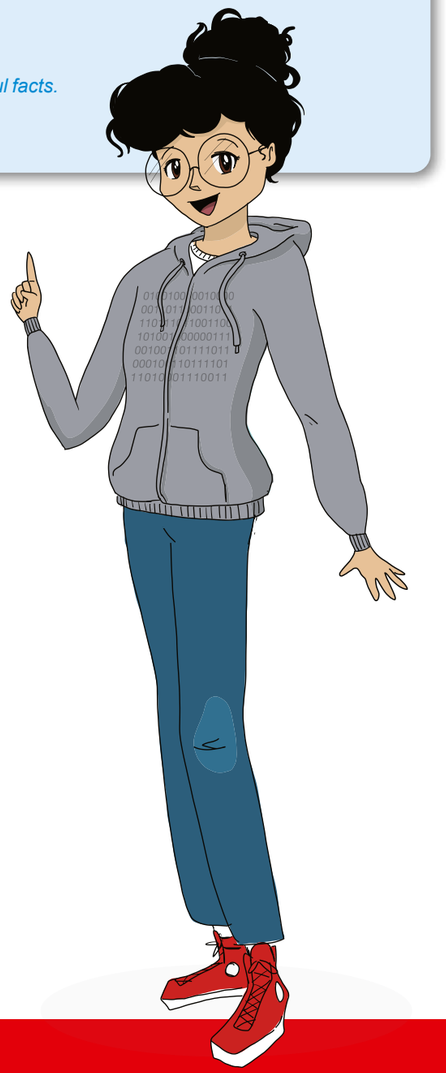
For the highest possible levels of confidence and fun at your competitions, be sure to read these carefully next to an actual field. Re-read them every week or so to catch the finer details and read the Robot Game updates too! You can find Robot Game updates at firstinspires.org/resource-library/fll/challenge-and-resources.

RXX Example Layout

***Purple** text introduces or summarizes rule context for faster understanding where helpful. It is not used for scoring.*

Black text under purple is for the main facts of the rule.

***Blue** text under black is for very important added facts, leniency, or other helpful facts.*



R01 EQUIPMENT

R01 tells you what the robot and its accessories can be made from.

Anything you bring to a match for mission-related activity. This includes your robot, any attachments, any strategic accessories, and your Innovation Project.

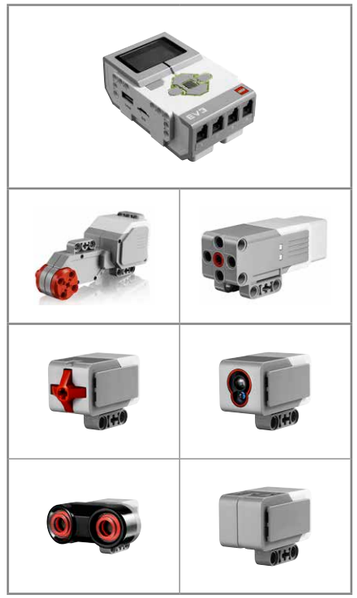
- All equipment needs to be LEGO made, in original factory condition.
  Exception 1: LEGO string and tubing can be cut to length.
  Exception 2: You can put identification marks in hidden areas.
- Factory-made wind-up/pull-back "motors" are not allowed.
- Additional/duplicate mission models are not allowed.
- Non-electric LEGO pieces are allowed from any set. You may use as many as you like.
  - Use only building pieces – not packaging, clothing, and so on.
  - Stickers are allowed only as originally shown in LEGO building instructions.
  - One sheet of notebook paper is okay for program notes only and does not count as equipment.
- Electric LEGO equipment is allowed only as described and shown here (LEGO Education SPIKE™ Prime and MINDSTORMS® EV3 shown, but equivalent NXT and RCX are also allowed).

Controller:
Maximum of one in any one match.

Motors:
Any mix, maximum of four in any one match.

Sensors:
Only touch/force, color, distance/ultrasonic, and gyro sensors are allowed in any mix and any number.

SPIKE Prime



EV3

If you have any extra controllers or motors, leave them in the pit area.

- You can also use LEGO wires, one controller's power pack or six AA batteries, and one SD card.

R02 SOFTWARE AND CONTROL

- Use any software that allows the robot to move autonomously (on its own), run only by programs that are loaded onto the controller.
- Remote control is not allowed in the competition area. Turn Bluetooth off.

R03 ROBOT

R03 defines the robot by what is added or removed from it at the moment.

Your controller and any equipment currently combined with the controller by hand and intended not to separate from it, unless by hand.

Example 1: A removable forklift attachment counts as part of the robot, but only while it is attached.
Example 2: A weight the robot is carrying out to drop on something is not part of the robot. That is cargo.

R04 MISSION MODEL

R04 defines and limits what you can do with the game objects on the field that are not your equipment.

Any LEGO object already on the field when you get there.

- You cannot take mission models apart, even temporarily.
- If you combine a model with anything (including the robot), the combination needs to be loose or simple enough that, if asked to, you could free the model in perfect original condition immediately.
- All parts of a model count as the model. Examples: frames, bases, and loops.

R05 PRECISION TOKENS

The six red disc models. They are worth free points when the match starts but can be removed by the referee one at a time until they are gone. See rules R15, R16, and R19.

R06 MISSION

One or more tasks the robot can complete for points. Try them in any order you like.

R07 MATCH

When two teams play opposite each other on two fields joined north to north. For 2.5 minutes, the robot launches, returns, and repeats, trying as many missions as possible.

R08 TECHNICIANS

The team members handling the robot during the match.

- Only two technicians are allowed at the field at once.
- Substitute technicians can switch with current technicians at any time.
- Other team members stand back as guided by competition officials.

R09 EQUIPMENT INSPECTION

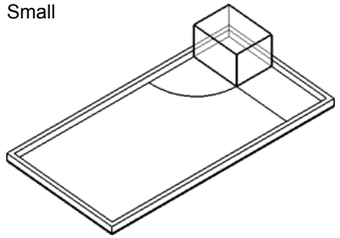
R09 tells you about equipment volume limits, when and how they are checked, and what happens if you pass or not.

When you get to each match, remove all your equipment from any containers and show the referee you can fit it all completely into one of two (imaginary) inspection spaces shown below. The spaces each have a ceiling 12.0 in. (305 mm) high.

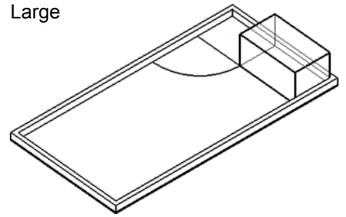
- If it fits in the large space, you pass. If it fits in the small space, you pass and get a mission point bonus.
- If it does not fit in the large space, break the excess down or send it to the pit area.
- After inspection, the inspection space no longer exists. Spread things out in home as you like.

Your hands can be used to help equipment fit in the inspection space.
If you compete with equipment that fails inspection or breaks rule R01, your score for that match does not count.

Small



Large

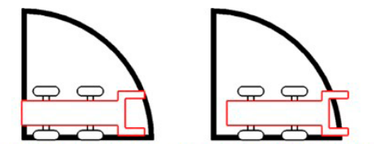


R10 COMPLETELY IN

100% contained in the airspace above the area and under the ceiling height if one is given.

- 100% includes every bit of something – not just the parts that touch the mat.
- Drawn lines that form an area are part of that area.

These examples shown are the launch area, from above:



R11 FIELD CHECKS

R11 helps prevent problems with optic sensor readings and mission model failure.

Between inspection and the first launch only, you can calibrate sensors anywhere you like, and you can ask the referee to check any field setups you are concerned about.

R12 HOME

R12 defines where the robot goes between missions and tells what other handling is or is not allowed.

The (imaginary) space labeled “Home” in R13. It has no ceiling and does not include the white sponsor logo band.

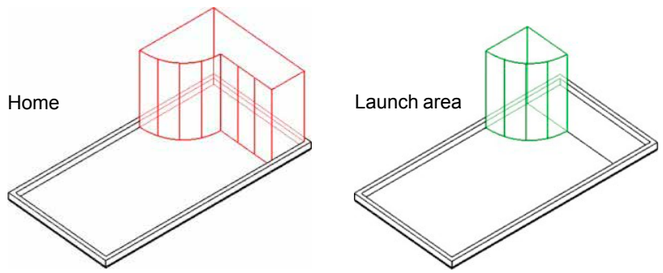
- Home is your space for handling and storing allowable things whenever you like.
- It is also the place for handling and preparing the robot before and between launches.
- After any launch, the robot needs to return completely into home if you want to handle it without losing a precision token.
- The robot can leave home only from the launch area, but it can return home anywhere.
- Do not interact with things outside home except by rules R15 and R19. Anything the robot affects or moves completely outside home stays as is unless the robot changes it (see rule R19).
  Exception 1: If something comes out of home by accident, grab it quickly so it does not upset the field.
  Exception 2: If equipment breaks off the robot unintentionally, you can pick it up as needed.
- You cannot strategically send or extend anything even partly out of home except by launching the robot.

R13 LAUNCH AREA

R13 defines what area of home the robot launches from and gives limits for that area during launches.

The (imaginary) space labeled “Launch area” below. It has no ceiling. The launch area is a part of home with special purpose – but only when launching.

- For every launch, the robot and anything it is about to move needs to fit completely in the launch area.
- Right after and between launches, the launch area is a regular part of home.



R14 LAUNCHING

R14 gives the conditions required for launch and then gives the launch procedure.

To launch, show the referee Checks 1 and 2 and then press a button, signal a sensor, or allow a timer to get the motors spinning.

- Check 1: The robot and everything it is about to move fits completely in the launch area.
- Check 2: You are not holding anything from moving, including motor torque or stored energy.
- Match start: The earliest time for the first launch of the match is precisely at the beginning of the last word or sound in the countdown, such as “3, 2, 1… LEGO!” All other launches can happen as soon as you show the referee Checks 1 and 2.

R15 INTERRUPTION

R15 defines and limits the action of you touching the robot after it is launched.

When you interact with a launched robot or any object touching it.

- You can interrupt the robot any time for any reason, but be sure to study rules R16 and R19.
- The best time and place to interrupt the robot is when it is completely in home (R12).
- Do not use the exact “perfect timing” of an interruption (your eyes doing the work of a timer or sensor) as a strategy to produce a new scoring result or advantage. Missions benefiting will score zero.
- Do not send or drop things to hit or land on the robot.

If the robot returns home and you do not interrupt it, it is free to interact with things you might have placed there for it, and it is free to leave from anywhere in home without a launch.

R16 INTERRUPTION PROCEDURE

R16 gives the procedure and consequences for interrupting the robot, depending on where it was at the time.

To interrupt the robot, stop it and carry it home if it is not there.

- If it was completely in home: No problem.
- If it was not completely in home: Lose a precision token.

Mislaunch exception: If you interrupt the robot so soon after launch that it has just barely reached the launch area arc line, you need to relaunch, but you will not lose a precision token.
Motor-saving exception: If the robot is stuck outside home straining its motors and you do not intend to launch again, you can shut it down and leave it in place without losing a precision token.
End-of-match exception: Stopping the robot at the end of the match does not count as an interruption.

R17 CARGO

R17 defines when things are under the robot's strategic control.

While something is purposefully/strategically being captured, kept, moved, or released, it counts as "cargo." When the robot is clearly no longer touching whatever thing it was controlling, that thing is no longer considered cargo.

R18 INTERRUPTION WITH CARGO

R18 gives the consequences for interrupting the robot with cargo, depending on where the cargo was at the time.

For cargo completely or partly outside home during an interruption: If the robot had it when launched, you can keep it. If not, the referee takes it.

R19 STRANDED CARGO

R19 gives the consequences for the robot abandoning cargo, depending on where the cargo comes to rest.

If former cargo is stranded outside home: If it is completely outside, it stays as is. If it is partly outside, you must take it into home and lose a precision token.

- The cargo needs to come to rest before this can be decided.
- If equipment being taken into home by hand has a mission model, the referee takes the mission model.

R20 INTERFERENCE

R20 gives the consequences for upsetting the opposing team, field, or robot.

A robot cannot interfere with the opposing field or robot unless there is a mission exception. Points failed or lost due to interference score automatically. Collaboration is okay.

R21 FIELD DAMAGE

R21 gives the consequences for harm to your own field.

If the robot separates Dual Lock or breaks a mission model, the field stays as is, and missions clearly made possible or easier score zero.

R22 END OF MATCH SCORING

R22 cautions you that if the robot's accomplishments are wrecked before the match ends, they will not score.

Mission requirements must be visible at the end of the match to count unless a method is required.

- Precisely as the match ends, everything needs to freeze in place for examination.
- Stop the robot, leave it as is, and then keep hands off everything as the referee scores the field with you.

R23 DIRECT WORDING

R23 limits confusion and cautions you against reading requirements that are not there.

Robot Game text means exactly and only what it says.

- If a word is not defined in the detailed game text, use its common conversational meaning.
- If a detail is not mentioned, it does not matter.

R24 INFORMATION RANKING

R24 pre-answers the question "what if two game facts disagree?"

Among all Robot Game information sources, the most recent Robot Game updates have highest authority, followed by the missions, the competition rules, and then the field setup. You can find Robot Game updates at firstinspires.org/resource-library/fll/challenge-and-resources.

- Within any one information source, text has authority over pictures.
- Videos, emails, and forum posts have no authority.

R25 BENEFIT OF THE DOUBT

R25 tells the referee how to rule in confusing or hard-to-tell situations.

If the referee's decision "could go either way," or if the referee's preparation, attention, vision, or memory cause an issue, you get the benefit of the doubt.

R26 FINAL RESULTS

R26 tells you how scores become official, including tie scores.

Once you agree with the score, it becomes official.

- If needed, the head referee makes final decisions.
- Only your best score from ranked matches counts toward awards/advancement. Ties are broken using second- and third-best scores as needed. If it's still not settled, competition officials decide what to do.
- Playoffs, if held, are just for extra fun.

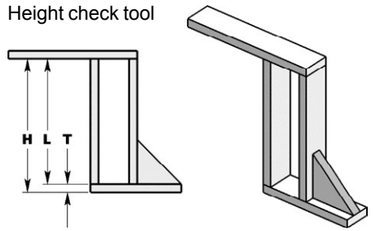
HEIGHT CHECK TOOL

To check the height of equipment at inspection, here is an idea for a simple tool you can slide around as needed.

H = 12.0 in. (305 mm)
T = Thickness of your material
L = H – T

This is optional.

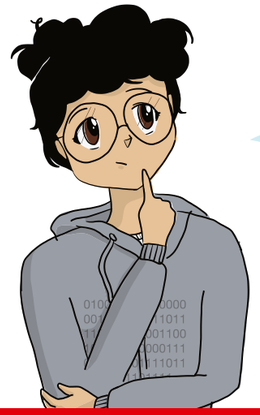
Height check tool



NEW IN THE RULES THIS YEAR

Caution to returning teams: The following list is not detailed. You still need to read the full competition rules carefully and often.

- The shape and use of home is changed and is now related to launching.
- Jigs can extend to the west wall.
- The LEGO Education SPIKE Prime robotics platform is available and allowed.
- The rule about combining things with mission models is back and is now based on time instead of gravity.
- The launch height limit is removed. Do not abuse this by making tall, dead gravity hammers instead of thoughtful designs, or the ceiling will be back next year.
- The requirement for things to be motionless before launch is gone.
- The words *transport*, *supported*, and *independent* are gone.
- The stranded cargo rule is easier to follow and apply. You now keep objects stranded partly outside home but lose a precision token instead of losing the object.



GOOD LUCK and have FUN!

Keep testing and improving your robot and your programs on the playing field.

Practice, practice, practice is the best way to prepare for your tournament!

Robot Path Diagram

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