



FIRST® LEGO®
League

Robot Design

Judge

Preparation Pack

All Tournaments

**CITY
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www.firstinspires.org

200 BEDFORD STREET ■ MANCHESTER, NH 03101



FOR INSPIRATION & RECOGNITION OF SCIENCE & TECHNOLOGY



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FIRST Core Values

We express the *FIRST* philosophies of *Gracious Professionalism*[®] and *Coopertition*[®] through our 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!*



10 Things to Know as a *FIRST*[®] LEGO[®] League Judge

Please be sure to check out www.firstlegoleague.org for additional information, including Judging Q & A from throughout the season:

FIRST LEGO League Challenge: www.firstlegoleague.org/challenge

Judging Questions: fljudge@firstinspires.org

Thank you for agreeing to be a judge with *FIRST* LEGO League. The information in this packet is designed to help you prepare as a judge this season. It is intended to offer background information that will be useful to review prior to your tournament. You should also participate in training sessions that may be offered through your local tournament organizer and/or *FIRST* LEGO League. We hope your experience as a judge is rewarding and enjoyable!

10. Have fun – you and the kids

The most important thing to know about a *FIRST* LEGO League tournament is that it is supposed to be **FUN**. The mission of *FIRST* is to get kids excited about science and technology. A competition is a celebration of what the children have accomplished throughout the season. It should be serious and competitive, but not so much that the fun is lost.

9. Exhibit Gracious Professionalism and honor *FIRST* Core Values

These are the basic foundations of *FIRST* LEGO League, and should always be at the forefront in everyone's minds. We offer specific awards to recognize Core Values excellence, but a significant concern can impact team eligibility in *any* award category.

8. Be a good role model for technology and engineering careers

Give the kids a chance to see what makes engineers, scientists, computer programmers and educators special. Share your experiences without sharing your agendas. Be professional – show the kids that what they have accomplished is appreciated and valuable. Show interest in their presentations and discussions, and be personable.

7. Respect the children

Please keep negative comments to yourself, away from the ears of the kids, parents, and coaches. All teams should be given the benefit of the doubt when questions arise about adult involvement. If you suspect the kids did not do the work, it is your job to probe further to prove it, rather than assuming the kids did not do the work. Remember that these are kids who worked hard all season to make it to the tournament. Treat their accomplishments with respect, and be sure that other judges do so as well. One negative comment from a judge can have a devastating effect on teams. Make it your goal as a judge to ensure that the teams know what they did well, and that they have a positive experience showcasing their achievements.

6. Respect the judging process

Stay on schedule. The kids have a more challenging schedule than you do. Remember the *FIRST* LEGO League

awards philosophy. Remember that the whole judging process is subjective. Concentrate on providing a great experience for the kids and try not to get caught up in the mechanics of the process. Do not share scores or awards discussions with the kids, coaches or parents.

5. Evaluate teams completely and fairly

Each rubric is designed to evaluate many areas of a team's performance, and gives equal weighting to several factors tied to specific awards. All Required Awards are of equal importance, except for our Champion's Award that recognizes all-around excellence. Be objective, both on a team-by-team basis and a total rubric evaluation basis. Familiarize yourself with the levels of achievement. Identify any conflicts of interest you have before the competition, and refrain from involving yourself in discussions about any team when you have a conflict.

4. Consider age appropriateness and experience

Consider age when evaluating teams. Certain skills, knowledge, and capabilities are more likely to be exhibited by the kids as they get older and more experienced in general and in *FIRST* LEGO League in particular. You may also see rookie teams that are more polished and understand *FIRST* LEGO League better than experienced teams.

3. Reward excellence and celebrate achievement

For a team to be considered for an award, they should be evaluated at an Exemplary level of achievement in that category whenever possible. Award distribution is spread as equitably as possible among the teams, with the goal of no team winning more than one judged award.

2. Provide specific and constructive feedback

Please be specific when providing feedback comments to teams. This will also help when it comes to awards deliberations – specific examples are very helpful when differentiating between teams. "This team's willingness to help other teams (by providing programming mentorship, for example) is exemplary" is more descriptive and helpful than "that team was so nice and polite and exhibited gracious professionalism." Take lots of notes if you need to!

1. See #10 again



Robot Design Judging Primer

Robot Design judging in *FIRST*® LEGO® League can be compared to an engineering design review in the “real world.” Design teams present their robots to panels tasked with selecting the robots that best meet the requirements (completion of missions) given constraints like size, parts usage and software. The natural inclination for engineers and technical people is to say, “There is an easy test to see which robots are best – the competition!” However, in *FIRST* LEGO League, and often in the “real world,” decisions are made based on how well a team can explain their design and all the things they considered while developing it. The *FIRST* LEGO League Robot Design rubric represents a set of criteria that we feel are important “takeaways” from participating in the design of a *FIRST* LEGO League competition robot. They are analogous to evaluation criteria used when selecting between competing designs. Judges gather information about teams’ mechanical design, programming and overall design process to evaluate a team and its robot.


As a Judge, here are some overall things to consider:

- The Robot Design judging session is more about the team's ability to present the robot and all the thoughts and considerations that went into their final product than it is about its performance. The performance is covered under the Robot Performance Award. The judging session is the time for the Judges to learn from the teams the design processes they used to make decisions and gain understanding; it also allows discussion so that Judges can be sure that the teams did the work.
- You may ask teams to perform missions with their robot on the Robot Game table, if one is provided in your judging room. Give teams the benefit of the doubt should these missions not work successfully all the time. Judging tables and field setup kits are not usually built or maintained to the same standards as competition ones. There is also a tendency for Murphy’s Law to rule in these sessions and for teams to be nervous and mistake prone when running missions in a judging setting.
- Teams may bring additional prototypes of their robot or attachments into a judging session. Sometimes these prototypes utilize additional electrical parts beyond those allowable in competition. Remember that electrical parts and software rules apply only to the robot used in the competition itself, and that extra parts or software used by teams to demonstrate designs are perfectly allowable.
- Simpler is usually better. Don’t be overly impressed with complicated robots. The complication must be used for a purpose.
- Remember that this is an engineering challenge for autonomous robots. Small imperfections in the field, mission models and environmental variations must be considered by Accomplished and Exemplary teams.

Mechanical Design

Durability – The robot should be able to withstand the rigors of the competition, for example it should be able to contact walls or mission models without pieces falling off or breaking. Attachments should be similarly robust. Long arms that delicately grip a lever aren’t very effective if they don’t stay attached to the robot.

Mechanical Efficiency – Here the Judges are looking for robot structures and attachments which show a judicious use of parts. For example, using six pins to tie two beams together is not as efficient as using one at each end. One note here: don’t over penalize the teams for adding small bits of “flair” or pieces that are fun for them to use to express their creativity. Remember the Core Value “We have fun!”



Mechanization – Judges look here for how the robot moves and operates. They look to see whether the robot balances speed and power.

Programming

Just as with Mechanical Design, simplicity is desired when it comes to programs. Teams can develop amazing programs that aren't necessarily better than simple programs that perform the same purpose.

Programming Quality – The robot's programs should work consistently, producing the same results every time. Examples of quality code could include audible checks or a simplified menu system that teams use to make sure they are running the appropriate section of code for a particular mission. Be careful to attempt to assess how the robot's programs would operate independent of mechanical faults.

Programming Efficiency – The goal here is to encourage teams to develop code that is modular, portable and flexible, so that it can be used in multiple situations. This criterion also addresses readability and documentation of code, both of which are good programming practices.

Automation/Navigation – Autonomy in *FIRST* LEGO League means that the robot operates with minimal driver intervention. Retrieving a robot and taking a touch penalty may be part of an acceptable strategy for a team, but it is still driver intervention. So for this instance, a team might have an Accomplished Mission Strategy, but only score Developing for Automation. This criterion also doesn't distinguish between sensor use/feedback and mechanical feedback. For example, it is valid for a team to use an aligning jig in base followed by a robot using the wall or a mission model to align itself before activating an attachment. It is also just as valid for a team to use a light sensor to follow a line to the same mission model. Teams should try to avoid just using driver aiming, motor rotations and timing to navigate the field, as these methods often become unreliable under variations in field or environmental conditions. Remember that lack of sensors isn't necessarily a bad thing. Lack of Automation, however, should be considered.


Strategy & Innovation

Remember that Strategy and Innovation can be seen in Mechanical Design or Programming, as well as the integration of both.

Design Process – Accomplished teams move beyond a trial and error approach to robot improvements to utilize testing cycles where systematic processes are used. Frequently you will hear teams say, "We tried a lot of different things and this one was the best." You are looking for more details and more organization to their process than that for teams who are Accomplished or Exemplary.

Mission Strategy – This is fairly straightforward. Judges can ask teams, "What is your strategy to complete the missions?" and "How did you make decisions to support that strategy when designing your robot?"

Innovation – This is often a hard area for Judges to judge. Things to be on the lookout for here include creativity, uniqueness, a cool attachment or programming trick, or something similar. Most competitions will have one or more robots that will have some feature that captures the Judges' attention. Remember that Innovation implies added benefit, so make sure that the team can state the benefits of their cool feature.





Robot Design

Team Number _____
Judging Room _____

For each Robot Design criteria, clearly mark the box that best describes the ability of the team to demonstrate or provide evidence (such as analysis or test data) that their robot and processes meet that level of achievement. If the team does NOT describe a particular criteria at all, then put an 'X' in the first box for Not Demonstrated (ND). Please provide as many written comments as you can to acknowledge each team's hard work and to help teams improve. Use the back for additional comments if needed.

		Beginning	Developing	Accomplished	Exemplary
Mechanical Design	Durability	Robot designed to maintain structural integrity and have the ability to withstand rigors of competition			
	N D	quite fragile; breaks a lot	frequent or significant faults/repairs	rare faults/repairs	sound construction; no repairs
	Mechanical Efficiency	Robot designed to be easy to repair, modify, and be handled by technicians			
	N D	excessive time to repair/modify	inefficient to repair/modify	appropriate time to repair/modify	streamlined time to repair/modify
Mechanization	Mechanization	Robot mechanisms designed to move or act with appropriate speed, strength and accuracy for intended tasks (propulsion and execution)			
	N D	imbalance of speed, strength and accuracy on most tasks	imbalance of speed, strength and accuracy on some tasks	appropriate balance of speed, strength and accuracy on most tasks	appropriate balance of speed, strength and accuracy on every task
	Programming Quality	Programs are appropriate for the intended purpose and should achieve consistent results, assuming no mechanical faults			
Programming	N D	would not achieve purpose AND would be inconsistent	would not achieve purpose OR would be inconsistent	should achieve purpose repeatedly	should achieve purpose every time
	Programming Efficiency	Programs are modular, streamlined, and understandable			
	N D	excessive code and difficult to understand	inefficient code and challenge to understand	appropriate code and easy to understand	streamlined code and easy for anyone to understand
	Automation/Navigation	Robot designed to move or act as intended using mechanical and/or sensor feedback (with minimal reliance on driver intervention and/or program timing)			
N D	frequent driver intervention to aim AND retrieve robot	frequent driver intervention to aim OR retrieve robot	robot moves/acts as intended repeatedly w/ occasional driver intervention	robot moves/acts as intended every time with no driver intervention	
Strategy & Innovation	Design Process	Developed and explained improvement cycles where alternatives were considered and narrowed, selections tested, designs improved (applies to programming as well as mechanical design)			
	N D	organization AND explanation need improvement	organization OR explanation need improvement	systematic and well-explained	systematic, well-explained and well-documented
	Mission Strategy	Clearly defined and described the team's game strategy			
	N D	no clear goals AND no clear strategy	no clear goals OR no clear strategy	clear strategy to accomplish well-defined goals	clear strategy to accomplish most/all game missions
	Innovation	Team identifies their sources of inspiration and creates new, unique, or unexpected feature(s) (e.g. designs, programs, strategies or applications) that are beneficial in performing the specified tasks			
N D	No original feature(s)	original feature(s) with some added value or potential	original feature(s) with the potential to add significant value	original feature(s) that add significant value	

Comments

Great Job...

Think about...



What to Expect as a Judge

Day of the Event

Before Judging Sessions

- Meet with the Judge Advisor to review
 - Event schedule
 - Judging procedures
 - Judging Deliverables
 - Last minute items
- Meet your judging partner(s) and the rest of the panel
- Attend the Opening Ceremonies

During Team Evaluations

- Interview teams
- Make sure sessions stay on schedule
- Evaluate each team according to rubric criteria and note constructive comments
- Keep additional notes of team specifics if needed
- Note and report:
 - cases of adult intervention
 - demonstrations of Core Values

During Deliberations

- Submit award nominations and rankings by your judging pair
- Participate with all area Judges to determine award candidates/merged preliminary ranking
- Work with Judges of other areas to determine the Champion's Award winner(s)
- Work with all Judges to finalize remaining awards and prepare scripts

During the Awards Ceremony

- Attend the Awards Ceremony (if possible)
- Help distribute medals, awards and other team recognition
- Join the high-five line, congratulate all teams and have fun!

The Judging Process

You will work with other Judges throughout the tournament using *FIRST* LEGO League's process to evaluate teams and determine awards

Note that you may work with different Judges at different times

Judging Pairs

Three Judging Areas

All Judges



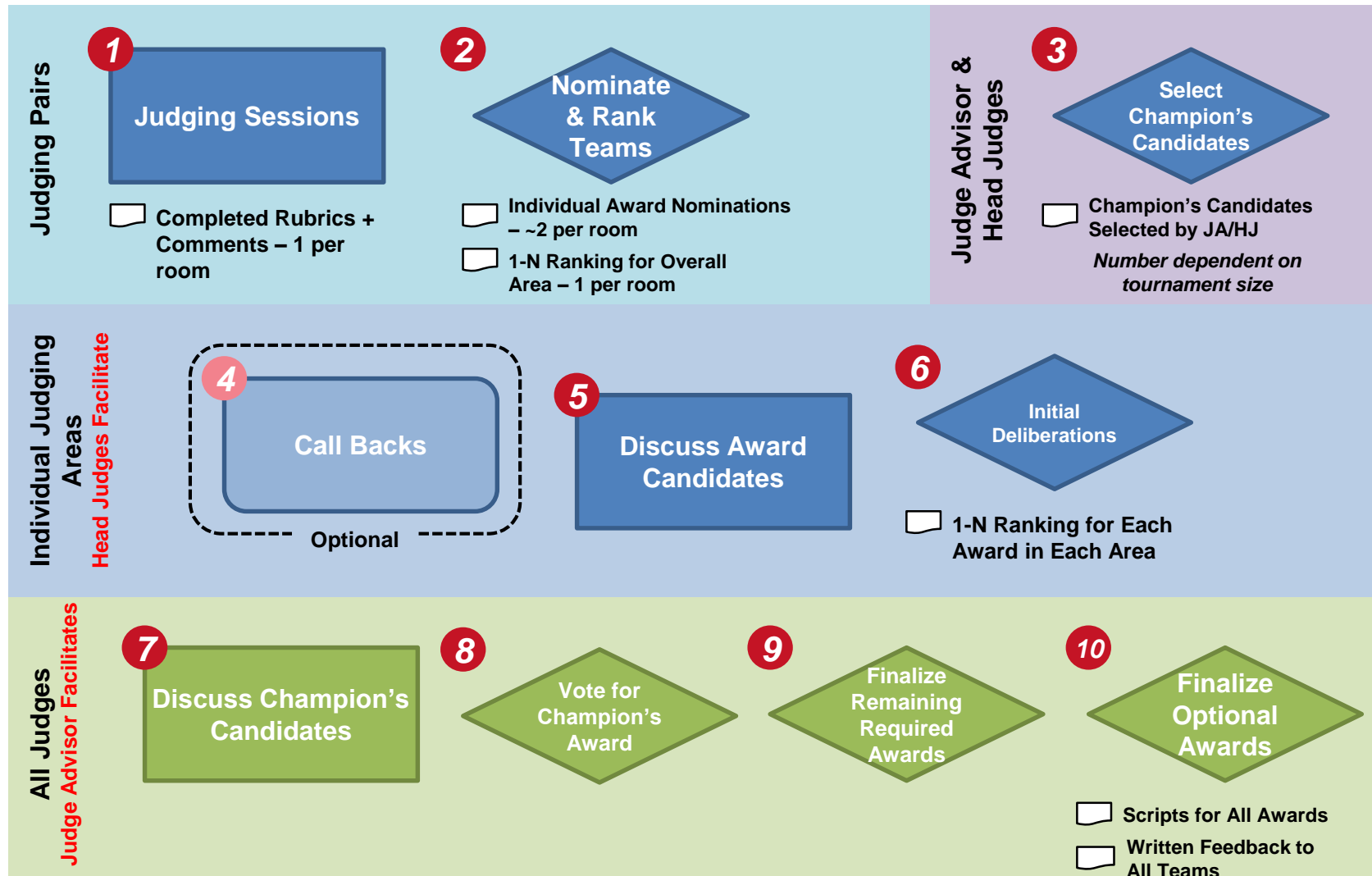
Team Evaluation and Feedback

Awards Deliberations

During Team Evaluation and Feedback, the Judges focus on evaluating each team and providing them with constructive feedback

During Awards Deliberations, the Judges focus on determining the teams worthy of awards and recognition

The Judging Process





FIRST[®] LEGO[®] League Awards

All Awards Structures

Champion's Award

This award recognizes a team that embodies the *FIRST* LEGO League experience, by fully embracing our Core Values while achieving excellence and innovation in both the Robot Game and Project. Considered the most prestigious, the Champion's Award is included in both approved awards structures.

Robot Performance

This award recognizes a team that scores the most points during the Robot Game. Teams have a chance to compete in at least three 2.5 minute matches and their highest score counts.

Judges Awards

During competition, the judges may encounter teams whose unique efforts, performance or dynamics merit recognition. Some teams have a story that sets them apart in a noteworthy way. Sometimes a team is so close to winning an award that the judges choose to give special recognition to the team. Judges Awards allow the freedom to recognize remarkable teams that stand out for reasons other than the Required Award categories. Examples include:

Against All Odds or Overcoming Adversity or Perseverance

This award goes to the team that improvises and overcomes a difficult situation while still making a respectable showing, with an attitude that shows, "We can overcome incredible odds if we never give up, no matter what!"

Rising Star

This award recognizes a team that the judges notice and expect great things from in the future.

Special Recognition Awards

Outstanding Volunteer Award

The *FIRST* LEGO League program would not exist without its volunteers. This award honors an extraordinary volunteer(s) whose dedication to *FIRST* LEGO League has a positive impact on the team experience.

Coach/Mentor Award

Coaches and mentors inspire their teams to do their best, both as individuals and together. This award goes to the coach or mentor whose leadership and guidance is clearly evident and best exemplifies the *FIRST* Core Values.



Full Awards Structure

Required for all Championship events; an option for qualifying tournaments

Core Values Awards

Inspiration

This award celebrates a team that is empowered by their *FIRST* LEGO League experience and displays extraordinary enthusiasm and spirit.

Teamwork

This award recognizes a team that can accomplish more together than they could as individuals through shared goals, strong communication, effective problem solving and excellent time management.

Gracious Professionalism®

This award recognizes a team whose members show each other and other teams respect at all times. They recognize that both friendly competition and mutual gain are possible, on and off the playing field.

Project Awards

Research

This award recognizes a team that utilizes diverse resources to formulate an in-depth and comprehensive understanding of the problem they have identified.

Innovative Solution

This award recognizes a team's solution that is exceptionally well-considered and creative, with good potential to solve the problem researched.

Presentation

This award recognizes a team that effectively communicates the problem they have identified and their proposed solution to both the judges and other potential supporters.


Robot Awards

Mechanical Design

This award recognizes a team that designs and develops a mechanically sound robot that is durable, efficient and highly capable of performing challenge missions.

Programming

This award recognizes a team that utilizes outstanding programming principles, including clear, concise and reusable code that allows their robot to perform challenge missions autonomously and consistently.





Strategy & Innovation

This award recognizes a team that uses solid engineering practices and a well-developed strategy to design and build an innovative, high performing robot.

Consolidated Awards Structure

An option for qualifying tournaments

Project Award

This award recognizes a team that excels across the Research, Innovative Solution and Presentation categories. This team utilized diverse resources for their Project to help them gain a comprehensive understanding of the problem they identified, develop a creative, well-researched solution and effectively communicate their findings to judges and the community.

Core Values Award

This award recognizes a team that excels across the Inspiration, Teamwork and Gracious Professionalism® categories. This team displays extraordinary enthusiasm and spirit, knows they can accomplish more together than they could as individuals, and shows each other and other teams respect at all times.

Robot Design Award

This award recognizes a team that excels across the Mechanical Design, Programming and Strategy & Innovation categories. This team uses outstanding programming principles and solid engineering practices to develop a robot that is mechanically sound, durable, efficient and highly capable of performing challenge missions.





Robot Design Sample Questions

Durability

- How did you get your robot to stay together?
- How often does your robot fall apart? What happens and have you thought about ways to fix this?

Mechanical Efficiency

- Would it be possible to use fewer pieces or components for your robot and still accomplish the same missions?
- If your robot has attachments, tell us about them.

Mechanization

- Tell us about how your robot uses attachments or other mechanisms to complete missions.
- Describe how your robot moves from place to place, or overcomes obstacles, and balances speed and power.

Programming Quality

- What program do you feel is your best? Why?
- Do your robot's programs achieve the same result every time? If not, why do you think this might happen?

Programming Efficiency

- What did you do to make your programs more understandable and easier to use?
- What mission is your favorite? Explain the steps in the program for that mission.

Automation/Navigation

- Would you explain how your robot turns (or travels a specific distance, or goes from base to a specific destination)? How satisfied are you with this?
- As your robot moves around the field, was there one area that was more difficult to navigate than another? If so, what did your team do to overcome this challenge?
- Would you explain which sensors you used, and how and why you used them?
- Would you explain how your robot knows where it is on the field? Note: Sensing includes not only touch and rotation sensors, but time (timers in the RCX) and passive sensing such as referencing to walls or other objects, etc.



Design Process

- What was the greatest design or programming difficulty you encountered? How did you solve that problem?
- How did you test your designs?
- Describe one way your robot got better over the course of the season.


Mission Strategy

- How did your team decide which missions to tackle?
- How many of the missions has this robot completed successfully in a single match (includes a tournament match, a tournament practice, or home practice)?
- We want to consider the overall strategy behind your robot's design. Tell us about your robot, its attachments and sensors and the missions the robot attempts so that we will understand your team's design strategy.
- Which attachments are most difficult to put on and/or take off?

Innovation

- What part of your design, program or strategy do you think is unique to your team?
- How did you come up with the idea?

Look For:

- Unusual strategy, programming or design.
 - Propulsion or steering methods or functional aspects that no one else has or you are surprised someone would try.
 - Robot is able to effectively perform the same task over and over.
 - Parts or functional aspects that make something difficult look very easy.
 - Parts or mechanisms that perform several functions.
 - Propulsion, steering methods or functional aspects that work, but children have no understanding how.
 - Children can describe what the robot will do based on the program.
 - Does the team look to the coach for answers or are they focused on the robot and Judges?
 - Noteworthy observations about Core Values to share with the judging team.
- 



Comment Starters

The best comments on *FIRST* LEGO League rubrics include at least one item the team did well and one challenge or item for improvement.

Use these starters and key words to help you write meaningful comments appropriate for *FIRST* LEGO League teams. Be sure ***cite evidence or examples*** and ***explain to teams why they received the levels you marked*** (Beginning, Developing, Accomplished, Exemplary).

Positive <i>Include at least one positive in each comment box.</i>	Improvement Needed <i>Include at least one item to improve in each comment box.</i>
<ul style="list-style-type: none"> • We liked how you... • Excellent job on... • Thanks for telling us about... • _____ was an innovative way to accomplish... • Your (diagram/poster/etc.) helped us understand your ... • We appreciated that you... • _____ was an effective way to... • _____ showed us how your team... • Your approach to... • _____ was an example of how your team... • Your team worked through... • Your _____ process helped your team... 	<ul style="list-style-type: none"> • We would have liked to hear more about... • Your (project/robot/etc.) could be even better if you... • How could you change your design to improve...? • It seemed like your team struggled with... • We were still a little confused by... • Consider changing... • Think about... • Maybe you could add... • One suggestion would be... • We noticed that... • We weren't sure how... • _____ could have been clearer.

Some words to inspire your comment writing:

- | | | |
|---------------------|-----------------|----------------|
| • Challenging | • Especially | • Solve |
| • Consistent | • Example | • Specifically |
| • Demonstrate | • Explain | • Strategy |
| • Decide / decision | • In particular | • Strength |
| • Describe | • Process | • Thorough |
| • Disciplined | • Resourceful | • Try |
| • Display | • Show | • Wonder |

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 **FIRST Core Values**:



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.



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.

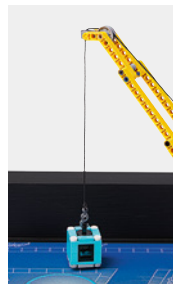


Mission 2 Crane (score all that apply)

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**

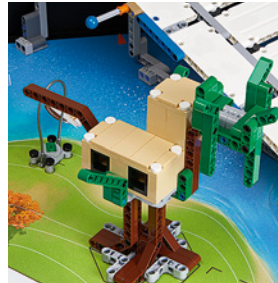


Mission 5 Treehouse (Score all that apply)

If a Unit is Independent and Supported by the Tree's

→ Large Branches: **10 Each Unit**

→ Small Branches: **15 Each Unit**



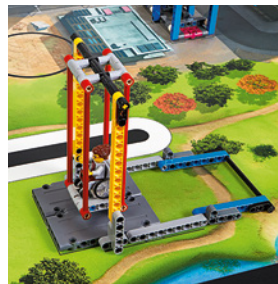
Mission 6 Traffic jam

→ 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**

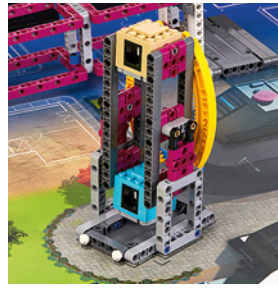


Mission 8 Elevator (Score one or the other)

If the Elevator's moving parts are Independent, and Supported only by its hinges as shown, in the following position

→ Blue Car Down: **15**

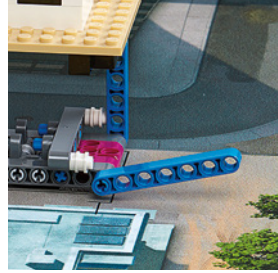
→ Balanced: **20**



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)

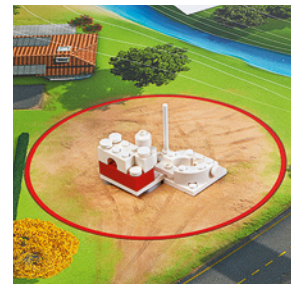
If there is a team-designed Structure clearly bigger than a Blue Building Unit, built only from your white LEGO bricks

→ 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:

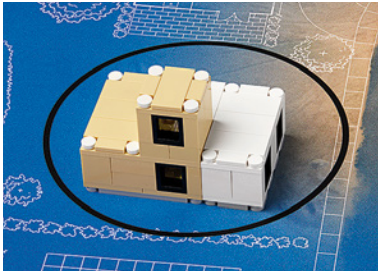
10 Each Circle

(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



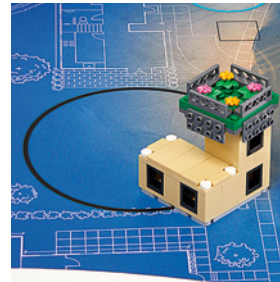
Color match = no
Bridged stack = 4 levels
20 points shown



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

Mission 13 Sustainability upgrades (only one counts per stack)

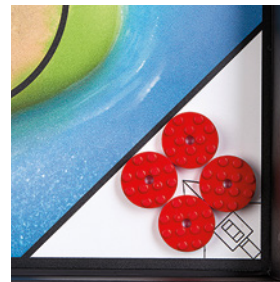
→ If an Upgrade (solar panels, roof garden, insulation) is Independent, and Supported only by a Stack which is at least partly in any Circle: **10 Each Upgrade**



Mission 14 Precision (only one score counts)

→ If the number of Precision Tokens left on the Field is 6:



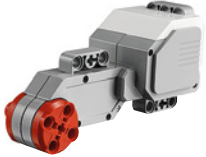




60 / 5: 45 / 4: 30 / 3: 20 / 2: 10 / 1: 5



Construction

Use any LEGO-made building parts in their original factory condition

YOU MAY	YOU MAY NOT
Cut LEGO string and tubing.	Use factory-made wind-up/pull-back “motors.”
Mark parts for identification on hidden areas.	Create or use additional/duplicate mission models.
<i>TIP – At tournaments you should expect, and design for, rare imperfections like changes in light, or bumps under the mat.</i>	

HARDWARE			
Required	Equipment	Number allowed	EV3 (also NXT and RCX equivalents)
X	Controller	1 per Match	
X	Motors	Any combination, maximum of 4 in total.	 Medium  Large
	Sensors	Unlimited	   
SOFTWARE			
You can use any software that allows the Robot to move autonomously – meaning it moves on its own.			
No form of remote control is allowed.			

Definitions

Here's what to know and expect, and how to get ready for a Match.

01. **ROBOT** – This is your LEGO MINDSTORMS **controller** and **all the Equipment you combine with it by hand**, which is **not intended to separate from it, except by hand**.
02. **EQUIPMENT** – This is anything **you bring** to a Match for Mission-related activity, including the Robot.
03. **MATCH** – When two teams play opposite each other on two Fields placed north to north. Your Robot Launches one or more times from the Launch Area and tries as many Missions as possible in 2-1/2 minutes.
04. **FIELD** – Includes Home, the Field Mat, the Mission Models, and everything else extending to include the inner sides of the Border Walls.
05. **MISSION MODEL** – Any LEGO object already at the Field when you get there.
06. **LAUNCH AREA** – This is the Mat's inner quarter-circle area and the black lines that form it. It extends to include the face of the south Border Wall, but no farther. It does not include the white band of sponsor logos.
07. **HOME** – Table surface west of the Field Mat that includes the faces of its Border Walls.



Field



Mat



Home



Large inspection area



Small inspection area



Launch area

08. **LAUNCH** – Whenever you're done handling the Robot and then you make it GO.
09. **INTERRUPTION** – The next time you interact with the Robot after Launch.
10. **PRECISION TOKEN** – These are six red discs on the Field, already worth points when the Match starts. Interrupting the Robot before it gets Completely Into Home causes the Referee to take them away.
11. **TRANSPORT & CARGO** – When something is purposefully/strategically being
 - taken from its place, and/or
 - moved to a new place, and/or
 - being released in a new place,
 it is being 'Transported' and is called 'Cargo'. When the object is clearly no longer touching whatever was Transporting it, Transport is ended, and the object isn't Cargo any more.

Tournament rules

Remember you have at least three Official Rounds, so don't panic if something goes wrong. Your best score is the one that will count.

Bring to the match	Leave behind at the pits
Your full competitive team (up to 10), including two designated technicians.	All other electronic items
Your Robot (only one if you have more than one) and all its Equipment, including:	Spare Robots
ONE controller's power pack or SIX AA batteries	Extra controllers
LEGO wires and converter cables, as needed	

- Teams, Coaches, Referees and all others are expected to model the *FIRST*® Core Values at all times.
- Remote control and/or data exchange with Robots (including Bluetooth) in the competition area is illegal.
- You can only safely touch the Robot while preparing to Launch, or when it's completely in Home.
- The thin line around any scoring area counts as part of the area.
- BENEFIT OF THE DOUBT** – If the Referee is faced with a very tough call, and no one can point to strong text to settle it, you get the Benefit of the Doubt, but don't rely on this as a strategy.
- Official Robot Game Updates override the Missions and Field Setup. Missions and Field Setup override the Rules. Your local Head Referee will make final decisions after a Match, when needed.

Before the match timer starts

- You have at least 1 minute to prepare. This is your chance to ask the Referee to check that Mission Model setup is correct, and/or calibrate light/color sensors anywhere you like.
- Show the Referee** that ALL your Equipment fits in either the Large or Small Inspection Area (your choice), under an imaginary ceiling 12 in. (30.5 cm) high. If it fits in the **Small** Inspection area, you get an advantage. The "Small Area" advantage for the City Shaper 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.
After passing Inspection, arrange your Equipment anywhere in Home for storage and adjustments, and/or the Launch Area for Launch.
Before the Match starts, you are allowed to calibrate sensors anywhere you like, and/or ask the Referee to check the correctness of Mission Models and setups.
- Decide on two technicians to begin play. Only two Technicians are allowed at the competition Field at once, but technicians can switch out at any time. The rest of the team must stand back as directed by tournament officials unless needed for emergency repairs during the Match.

During the match

- Launch sequence**
READY SITUATION: Your Robot and everything it's about to move or use is arranged as you like. It must fit **completely in the Launch Area** and measure no taller than 12 in. (30.5 cm).
 - When the Referee can see that nothing on the Field is moving or being handled, she/he will begin the countdown of the first launch.
 - The precise timing of the first Launch of the Match is at the beginning of the last word or sound in the countdown, such as "Ready, set, **Go!**" or **Beeeeep!**
- Don't interact with any part of the Field that's not **completely** in Home, except to Launch.
 - Except: If Equipment breaks off the Robot **unintentionally**, you may pick it up immediately from anywhere.
- Don't cause anything except the Robot to move or extend out of Home, even partly, except to Launch.
 - Except: If something accidentally crosses out of Home, you can take it back.
- Anything the Robot affects or puts completely outside the Launch Area **stays as is** unless the Robot changes it.
- Don't take Mission Models apart unless the Mission asks you to.

26. Do store all your Equipment and anything the Robot brings to Home in Home.
27. **INTERRUPTION PROCEDURE** – If you **Interrupt** the Robot, stop it instantly, then calmly pick it up for the next Launch.
Where was the Robot Interrupted?
→ **Completely** in Home: No problem.
→ **Not Completely** in Home: Lose a Precision Token.
28. **INTERRUPTION WITH CARGO** – If the Robot has Cargo when Interrupted,
Where was the Cargo acquired?
→ **Completely** in the Launch Area: Keep it.
→ **Not Completely** in the Launch Area...
Where was the Cargo at Interruption?
→ **Completely** in Home: Keep it.
→ **Not Completely** in Home: Referee takes it.
29. **STRANDED CARGO** – If the Uninterrupted Robot loses Cargo, let the Cargo come to rest.
Where did the Cargo come to rest?
→ **Completely** in Home: Keep it.
→ **Not Completely** in Home: Leave as is.
30. **INTERFERENCE** – Do not negatively affect the other team at the table except as allowed in a Mission description. If you, your team or your Robot prevents another team from completing a Mission, the Referee will award them the points for that Mission.
31. **FIELD DAMAGE** – If the Robot separates Dual Lock or breaks a Mission Model **and** clearly benefits from the damage, Missions benefitting will not score.

End of the match

32. As the Match ends, everything must be preserved exactly as-is.
→ If your Robot is moving, stop it ASAP and leave it in place. (Changes after the end don't count.)
→ After that, hands off everything until after the Referee has given the ok to reset the Field.

Keep these two special definitions in mind as you read Mission scoring requirements:

33. **INDEPENDENT** – Not touching any equipment.
34. **SUPPORTED** – 100% of its weight is held up **and** kept from falling.

Scoring

35. Only the final (end-of-Match) condition of your Field is evaluated for scoring.
36. The Referee discusses what happened and inspects the Field with you, Mission by Mission.
→ If the team and Referee agree, a team member signs the scoresheet, and it is final.
→ If the team and Referee disagree, the Head Referee makes the final decision.
37. Only a team's **best** score from regular Match play counts toward awards/advancement. Any playoffs held are just for fun.
38. Ties are broken using 2nd, then 3rd best scores. If still not settled, tournament officials decide what to do.

Your challenge set contains:

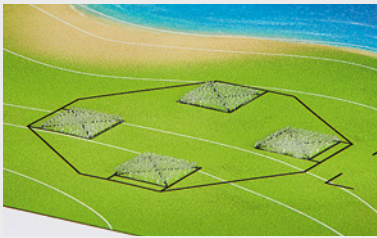
Field Mat, Mission Models, Dual Lock and White LEGO bricks that can be used to build your Innovation Project prototype

1. BUILD THE MISSION MODELS – Use the LEGO elements from your Challenge Set, and building instructions. Estimated time for 1 person = 6 hours. **Accurate Mission Model construction is essential. Double-check your builds, especially that all pieces are connected securely.**

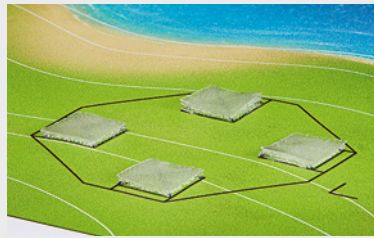
2. DUAL LOCK AND SECURE MISSION MODELS – Follow the instructions on the following pages.

Dual lock – Find the brown sheets of this material from 3M in your Challenge Set. It sticks Models to the Mat, but allows removal too.

SECURING MODELS – “X” Squares show where to Dual Lock Models to the Mat. Use it 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 structure instead of crushing the whole Model. Lift at that same structure if you need to separate the Model from the Mat.

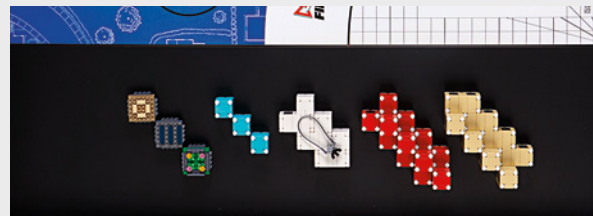
Loose models – Place as shown detailed here.



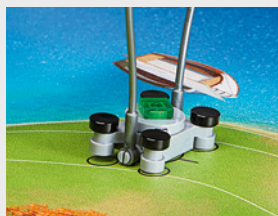
One blue unit w/flat roof



One white unit



In home, arranged any way you like:
Bat, sustainability upgrades (solar panels, roof garden, insulation), 14 units, your structure for mission 11



Inspection drone



Six precision tokens

Simple secured models

Secure and prepare as shown and detailed here.



Swing



Tree



Traffic jam

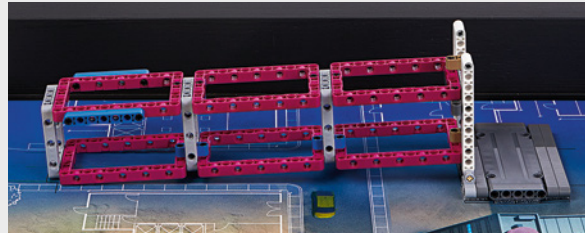


Elevator

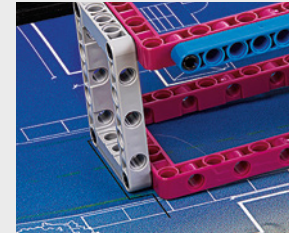
Multi-step secured models

Secure and prepare as shown and detailed here.

Steel construction:



Step 1



Step 2: Push East

Test building:



Step 1



Step 2

Crane:



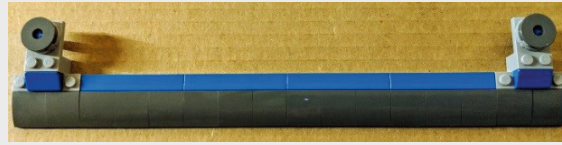
Step 1: Tie square knot near end of string



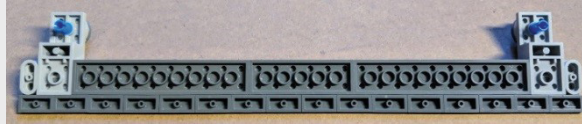
Step 2: Hook this blue unit and wind all the way up. Rotate arm all the way clockwise

Multi-step secured models (continued)

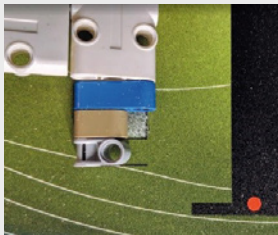
Bridge:



Step 1: Carefully remove the bridge's entrance



Step 1: bottom view



Step 2: Double-check all dual lock locations



Step 3: Reinstall the entrance



Step 4: Adjust dual lock to get corners on red dots



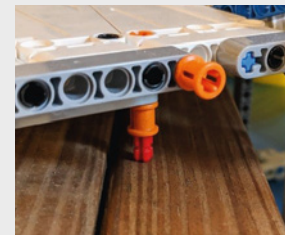
Step 5: Be sure flag moves freely and points down



Step 6: Be sure the bridge top is centered over the north wall and substitute wall (if you have a wall).



Step 7: Use the support axles under the bridge top so it can hold a heavy robot. Experiment to see which length makes the top most level



TIP - Use books for Bridge support if your Field has no walls.

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CITY SHAPERSM

Challenge Updates



Challenge Updates are posted throughout the season to answer the most common questions from teams. The Updates included here are likely incomplete by the time you're reading them. Review the most current Challenge Updates on firstlegoleague.org a few days before your event.

Week of 26 August 2019

Innovation Project Updates – 0
Robot Game Updates – 3

Robot Game Updates

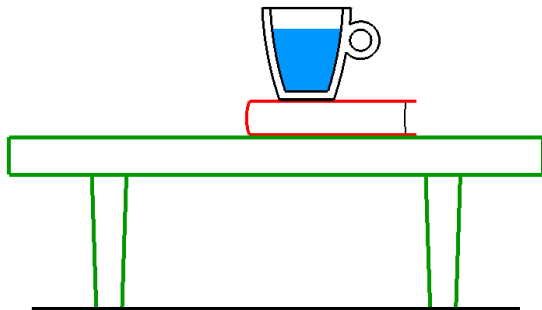
RG12 - BRIDGE BARRIERS NOT ALLOWED

The only way Robot X can stop Robot Y from scoring Flag points is to be faster or stronger at scoring Flag points. Robot clashes are expressly allowed in the text of Mission 1 by Rule 30's first sentence, but all other competitive action is governed by Rule 30's second sentence.

RG11 - SUPPORTED VS SUPPORTED "ONLY BY"

These two situations are scored differently. Remember the example below when reading Robot game text:

- The water is Supported by the cup, since 100% of its weight is held by the cup.
- The water is Supported by the book, since 100% of its weight is held by the book.
- Therefore, the water is NOT Supported "only by" the cup (nor the book).



RG10 - BOXES AND TRAYS

- You can carry your Equipment to the Field in any box or tray.
- When you get to the Field, place all your Equipment in one of the Inspection Areas and store the box/tray as directed by the Referee.
- After Inspection, all your Equipment is stored in Home, as directed by Rule 19.

Week of 19 August 2019

Innovation Project Updates – 0
Robot Game Updates – 1

Robot Game Update

(Update RG02 was clarified)

Week of 12 August 2019

Innovation Project Updates – 0
Robot Game Updates – 6

Robot Game Updates

RG09 - LAUNCH AREA STRANDING

Things Stranded partly or completely in the Launch Area *can be taken into Home if you wish. If that action clearly/directly produces a scoring condition, the score won't count.

*This exception to Rules 22 and 29 does not apply if the Stranded thing reaches out of the white/logo arc area.

RG08 - HAND USE FOR INSPECTION

Your hands can be used to restrain/confine Equipment within the volume of an Inspection Area.

RG07 - MIS-LAUNCH

If you Interrupt the Robot so soon after Launch that it hasn't yet reached a Launch Area perimeter line, you will need to re-Launch, but you will not lose a Precision Token. This is an exception to Rule 27.

RG06 - STRATEGIC/PRECISION STOP

If a new scoring condition is produced by the strategic timing of an Interruption (your eyes did the work of a timer or sensor), and this is obvious to the referee, Missions benefitting will not score.

RG05 - RULE 28 CLARIFIED

Here are the three possibilities and their outcomes:

- 1 - If the Cargo came with the Robot from the latest Launch: You get the Cargo back.
- 2 - If the Cargo was Completely in Home when the Robot was Interrupted: You get the Cargo back.
- 3 - Otherwise: The Referee takes the Cargo.

Week of 4 August 2019

Innovation Project Updates – 0
Robot Game Updates – 1

Robot Game Update

(Update RG01 was revised)

Week of 28 July 2019

Innovation Project Updates – 2
Robot Game Updates – 4

Innovation Project Updates

IP02 – MISSION 11 AND THE (MOSTLY) WHITE BRICKS

In your CITY SHAPERSM challenge set, you will find LEGO elements in the bags labelled “10” to make a team-designed model for robot game Mission 11. **The model can be of any design if it meets the requirements of Mission 11.** This model is supposed to represent your team’s Innovation Project in some way, but you will not be *required* to explain your model’s design or discuss your Project during your robot game matches. (You may *want* to share this information with others – and that’s fine – but it’s not required.) Please see the robot game missions, rules and updates for more information about Mission 11.

IP01 – YOUR COMMUNITY

The Innovation Project problem statement instructs teams to:

- Identify a problem with a building or public space in your community.
- Design a solution.
- Share your solution with others and then refine it.

For this year’s project, your team is free to define “your community” in the way that works best for you. This means your team could look at a problem in your local town or city, your country, or even in another part of the world.

Robot Game Updates

RG04 – MISSION 11 STRUCTURE SIZE

Some measure of your Mission 11 Structure needs to be at least as long as a four-stud LEGO element.

RG03 – ELEVATOR SETUP

The correct setup position for the Elevator is with the Blue Car UP, as shown here:



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RG02 – DRONE SHAPE AND SETUP (Clarified - Improved Building Instructions are available)

Per original Update RG02, the correct way to build the Drone is shown below, and now the Building Instructions have been revised to show this.

The correct way to place the Drone on the Mat is on its square mark, with the Loop parallel over its line marks (the open Loop faces the Launch Area).



RG01 – MAT PLACEMENT AND SETUP (Revised to correct the width of Home)

When placing your Field on an Official Table, slide the Mat gently until it meets up against the South and East Border Walls. When Table size and Mat placement are correct, Home will measure about 45" by 13-1/2" (1143mm by 342mm).

To hold the Mat in place, you may use a thin strip of black tape on the West edge as needed. Where the tape sticks to the Mat, it may cover the Mat's black border only.

What's new for CITY SHAPERSM?

Make sure you're up to date for the 2019-2020 CITY SHAPERSM FIRST[®] LEGO[®] League season:

- ❑ **Champion's Award and Advancement:** The formula to determine FIRST[®] LEGO[®] League Champion's Award and the criteria used to determine which teams advance from qualifying tournaments has been updated.
- ❑ **Rubric Updates:**
 - The **design layout** of all [FIRST LEGO League Rubrics](#) has been updated for the 2019 CITY SHAPER season.
 - Wording in the **Core Values and Robot Design Rubrics** have been updated.
- ❑ **Team Meeting Guide and Engineering Notebook:** The FIRST LEGO League Challenge now includes a Team Meeting Guide for coaches and one (1) engineering notebook per team member. Teams may bring these to the judging session as a talking point, but they are NOT a requirement for teams.
- ❑ **Innovation Project:** The project portion of the Challenge is now named "Innovation Project."
- ❑ **Robot Game Updates:** Read the [rules](#) for all updates, including:
 - New Mat size due to increased Home dimensions. When Table size and Mat placement are correct, Home will measure about 45" by 15-1/2" (1143mm by 393mm).
 - Robot/Equipment Inspection Area
 - Open Software: FIRST LEGO League teams can use any software that allows the Robot to move autonomously – meaning it moves on its own.

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