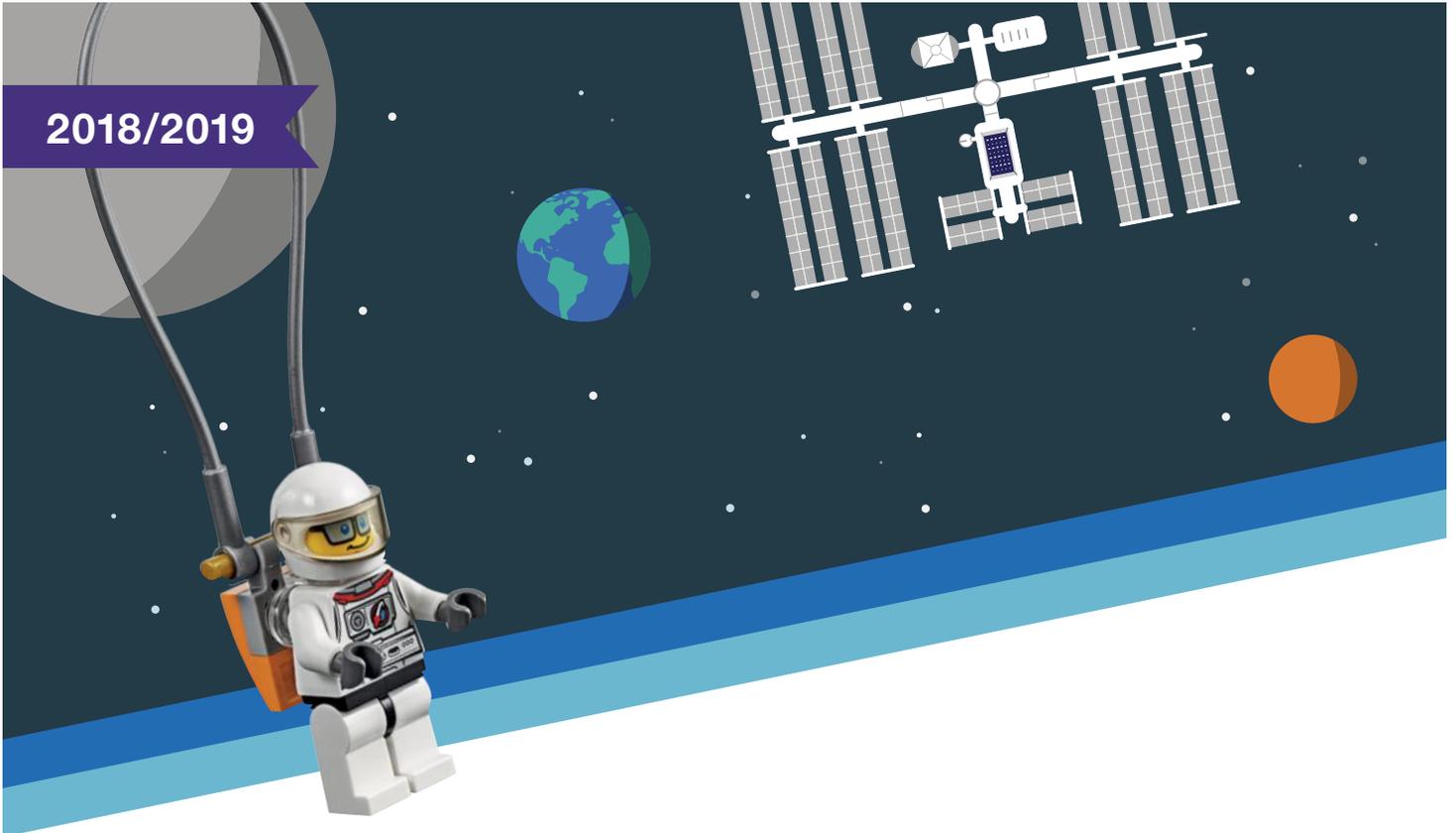


**FIRST  
LEGO  
LEAGUE**

# Field Setup

2018/2019



# INTO ORBIT<sup>SM</sup>



FIRST® LEGO® League is the result of an exciting alliance between FIRST® and the LEGO® Group.



## The Field is where the Robot Game takes place.

- It consists of a Field Mat, on a Table with Border Walls, with Mission Models arranged on top.
- The Field Mat and the LEGO® elements for building the Mission Models are part of your Challenge Set.
- The instructions for building the Mission Models are here:  
<https://www.firstinspires.org/resource-library/fll/into-orbit-challenge-updates-and-resources>
- The instructions for how to build the Table and how to place everything on it are below...

## Table Construction

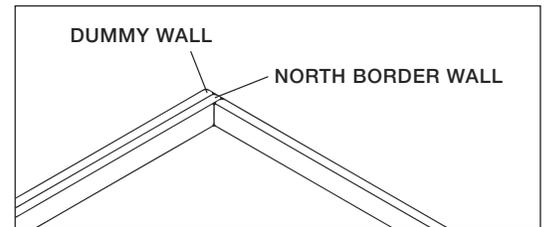
The Robot Game takes place on a Table with specific features, so you'll need to build one to practice on if you don't already have access to one. With weight, height, simplicity and cost in mind, a simple design is offered here, but as long as your surface is smooth, and your Border Walls are sized and located properly, how you build the understructure is up to you. The construction is simple, but does require some wood-working skill.

At a tournament, **two Tables are placed back to back**, but you only operate on one Table, so you only need to build one Table to practice on.

### Dummy Wall

Most Robot Games feature at least one Mission Model resting partly on your Table, and partly on the other team's Table. You don't need to build a second table to support the far side of such Models, but you do at least need to build the necessary part of the other team's Table, so the shared Mission Model(s) can be positioned correctly.

Here are the instructions to build one Practice Table, including a Dummy Wall:



## Materials

MATERIAL	QUANTITY
Challenge Set (Mission Model LEGO elements, Field Mat, Dual Lock™)	1
Sanded plywood (or other very smooth board) 96" X 48" X at least 3/8" (2438mm X 1219mm X 10mm)	1
Two-by-three*, 8' (2438mm) [actual cross-section = 1-1/2" X 2-1/2" (38mm X 64mm)]	6
Flat black paint	1 pt. (1/2 L)
Coarse drywall screws, 2-1/2" (64mm)	1/2 lb. (1/4 kg)
Saw horses, about 24" (610mm) high and 36" (914mm) wide	2

\*NOTE: Tables with "two-by-four" walls are legal and common, but we're slowly phasing them out at tournaments. You may make your Practice Tables with two-by-four walls, but **you must be prepared to play on Tables whose walls could range in height anywhere between 2-1/2" (64mm) and 3-15/16" (100mm), as shown in the diagram below.**

## Parts

PART	MAKE FROM	DIMENSIONS	PAINT	QUANTITY
Table surface (A)	plywood	96" (2438mm) X 48" (1219mm)	no	1
Long Border Wall (B)	two-by-three	96" (2438mm)	yes	3
Short Border Wall (C)	two-by-three	45" (1143mm)	yes	2
Stiffener* (D)	two-by-three	48" (1219mm)	no	4
Saw horse	purchase	H ≈ 24" (610mm) W ≈ 36" (914mm)	no	2

\*If you are using a table surface thicker than 1/2" (13mm) check for warpage/distortion – you may not need stiffeners.



## Assembly

**STEP 1** – See which face of the plywood (**A**) is least smooth, and consider that the bottom face. On the bottom face, clamp, then screw on the stiffeners (**D**) about every 18" (457mm). Be sure screw heads and splinters don't protrude.

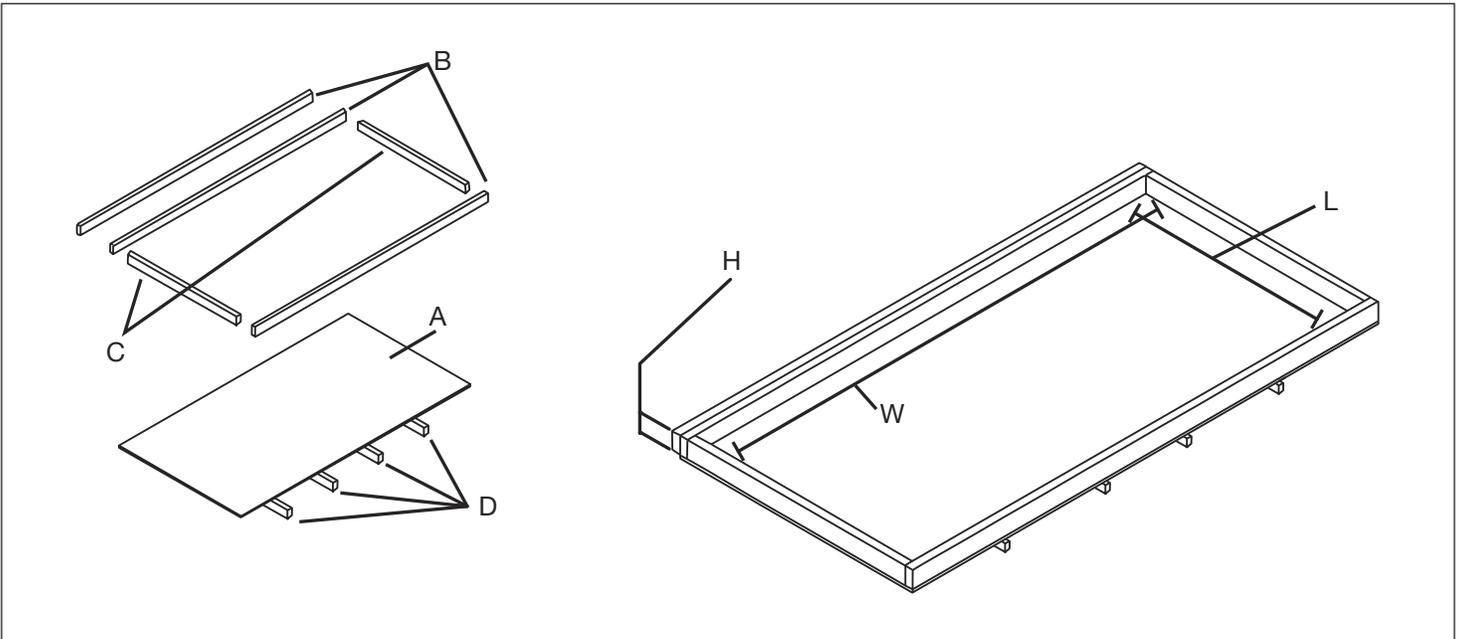
**STEP 2** – On the top face of the plywood, locate, clamp, and screw on the Border Walls (**B, C**) around the top perimeter.

• The inside wall-to-wall dimensions must measure **W** =  $93\pm\frac{1}{8}$ " by **L** =  $45\pm\frac{1}{8}$ " ( $2362\pm 3\text{mm}$  by  $1143\pm 3\text{mm}$ ).

• The height of **B** and **C** must measure between **H** =  $2\text{-}\frac{1}{2}$ " (64mm) and  $3\text{-}\frac{15}{16}$ " (100mm).

• All Border Walls must be the same height as each other on all Tables at a tournament. Border heights at a tournament may be different than those on your practice Table.

**STEP 3** – Place this table top on short saw horses (or milk crates, or anything else short and solid).





## Field Mat Placement

**STEP 1** – Vacuum the table top. Even the tiniest particle under the Mat can give the Robot trouble. After vacuuming, carefully run your hand over the surface and sand or file down any protruding imperfections. Then vacuum again.

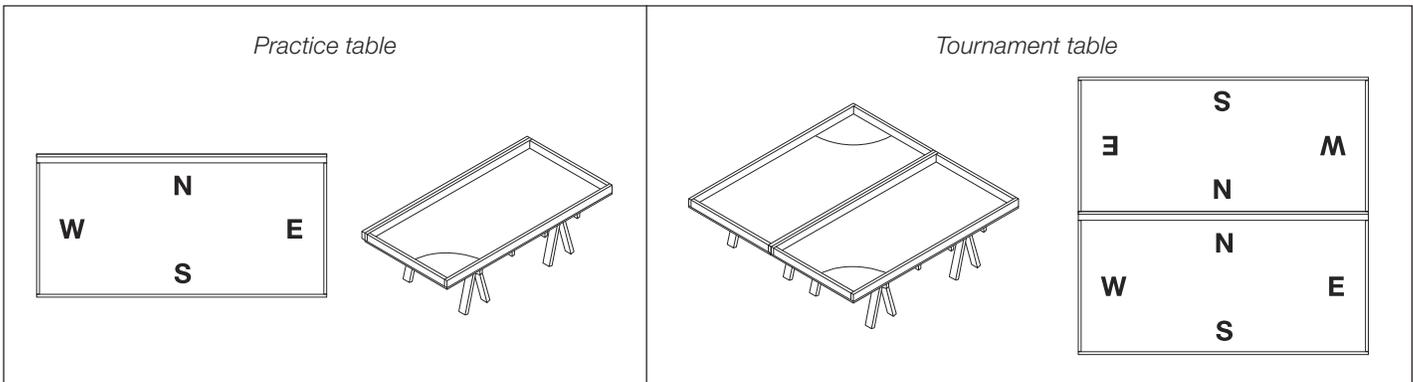
**STEP 2** – On the vacuumed surface (never unroll the Mat in an area where it could pick up particles), unroll the Mat so the image is up and its north edge is near the north/double Border Wall (note the location of the double wall in each Table sketch below). **Be very careful not to let the Mat kink from bending in two directions at once.**

**STEP 3** – The Mat is smaller than the playing surface by design. Slide and align it so that there is no gap between the south edge of the Mat and the south Border Wall, then **center the Mat east-west, with equal gaps at left and right.**

**STEP 4** – With help from others, pull the Mat at opposite ends and massage out any waviness away from the center and re-check the requirement of Step 3. It is expected that some waviness will persist, but that should relax over time. Some teams use a hair dryer to speed the relaxation of the waviness.

**STEP 5** – OPTIONAL – To hold the Mat in place, you may use a thin strip of black tape at the east and west ends. Where the tape sticks to the Mat, it may cover the Mat's black border only. Where the tape sticks to the Table, it may stick to the horizontal surface only, and not the Border Walls.

**STEP 6** – For a competition setup, Dummy Walls are not needed. Secure two Tables north-to-north. **The total span of Border between two Tables must measure between 3" (76mm) and 3-<sup>15</sup>/<sub>16</sub>" (100mm).**



## Mission Model Construction

### Build the Mission Models

Use the LEGO elements from your Challenge Set, and instructions from here, <https://www.firstinspires.org/resource-library/fill/into-orbit-challenge-updates-and-resources>. It will take one person at least six hours to do this, so it's best done in a team construction party. For any team members with little or no experience building with LEGO elements, Mission Model construction is a great way to learn. This step is also a nice time for new team members to get to know each other.

### Quality

The Models must be built PERFECTLY. "Almost perfect" is **not** good enough. Many teams make several building errors and practice all season with incorrect Models – when these teams later compete on Fields with correct Models, the Robot fails. The team incorrectly blames the Technicians, the Robot, the tournament organizers, or bad luck for the failure. Best practice is to please have several people check for correctness.



# Mission Model Placement and Setup

## Dual Lock

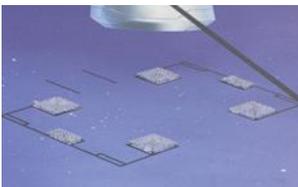
Some Models are “secured” to the Mat, while others are simply “placed” on the Mat. Each place on the Mat where a Model needs to be secured has a box with an “X” in it. The connection is made using the re-usable fastening material from 3M called “Dual Lock,” which comes with the LEGO elements in your Challenge Set. Dual Lock is designed to “lock” to itself when two faces of it are pressed together, but you can unlock it too. The application process for the Dual Lock is only needed once. Afterward, the Models can simply be locked onto the Mat or unlocked. To apply Dual Lock, proceed one Model at a time.

**STEP 1** – Stick one square, adhesive side **down**, on each box you see on the Mat with an  in it. For half-sized boxes, cut the squares in half.

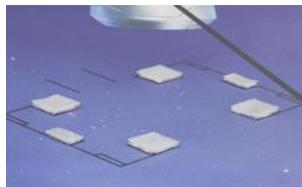
**STEP 2** – Press a second square on top of each of those, “locking” them on, adhesive side up.

**STEP 3** – Align the Model exactly over its marks, and lower/press it onto the squares.

 **TIP**  
*Instead of using your finger, use a bit of the wax paper the squares came on.*



Step 1



Step 2



Step 3

### CAUTION – Pay Attention:

- ❖ Some Models which seem symmetrical in fact have a directional feature somewhere.
- ❖ Be sure to place each square precisely on its box, and each Model precisely over its marks.
- ❖ When pressing a Model down, press down on its lowest solid part instead of crushing the whole Model. Pull on that same structure if later you need to separate the Model from the Mat.

 **TIP**  
*For large and/or flexible Models, apply only one or two pairs at a time. There's no need to do them all at once.*

## Mission Models

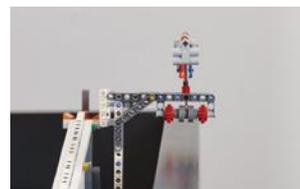
**Space Travel Ramp + Your Team’s Solar Panel** – These Models are built as one piece and secured to the Mat on their marks. Move your team’s Solar Panel into the middle-click position, not Angled.



Space Travel Ramp and your team's Solar Panel



Your team's Solar Panel



Your team's Solar Panel ready

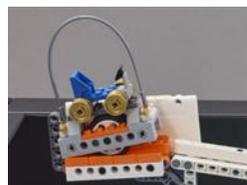
**Space Travel Payloads** – Place the Supply and Crew Payloads anywhere in Base, and place the Vehicle Payload on the orange section of the Space Travel Ramp, facing east, and leaning west.



Supply Payload



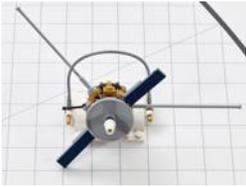
Crew Payload



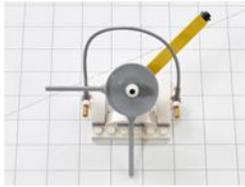
Vehicle Payload



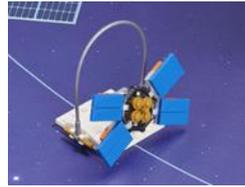
**Satellites** – Place Satellites V and C anywhere in Base, and place Satellite X loose on its marks as shown.



Satellite V



Satellite C

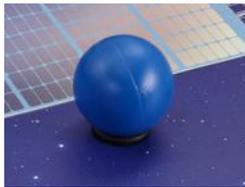


Satellite X

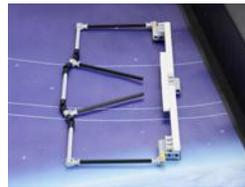
**Meteoroid + Meteoroid Ring + Meteoroid Catcher** – Place the Meteoroid Ring on its marks and place one of the two Meteoroids on the Ring. Place the other Meteoroid anywhere in Base. Secure the Meteoroid Catcher to the Mat on its marks.



Meteoroid Ring



Meteoroid



Meteoroid Catcher

**Habitation Hub + Habitation Modules + Astronaut** – Secure the Habitation Hub to the Mat on its marks, with the white beam extension at the north side. Insert the Astronaut as shown, with his visor down, his feet down, his forearms level, and his loop vertical compared to the Mat. Insert the Dock Module all the way into the port at the south side, with its studs facing up. Insert the Cone Module all the way into the port at the east side. Place the Tube Module anywhere in Base.



Habitation Hub



Astronaut: "Gerhard"



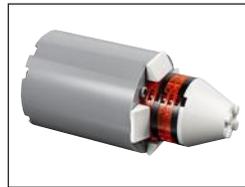
Insert As Shown



Dock Module



Cone Module



Tube Module



Habitation Ready

**Core Site + Core Samples** – Secure the Core Site to the Mat on its marks, with its axle pointing east. Load Core Samples onto the axle with their studs facing east, in the order shown: Regolith, Gas, Water, and Regolith last.



Core Site



Regolith Core Samples



Gas Core Sample



Water Core Sample



Core Site Ready

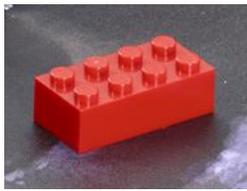


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**3D Printer + 2X4 Brick** – Secure the 3D Printer to the Mat on its marks as shown. Then load the 2x4 Brick onto its tray at the east side, pushing it all the way in.



*3D Printer*



*2X4 Brick*



*3D Printer Ready*

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**Penalty Discs** – Place the six Penalty Discs anywhere in the white triangle at the southeast of the Mat, for the Referee (Ref) to take.



*Penalty Discs*

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**Observatory** – Secure the Observatory to the Mat on its marks, and rotate it so the bottom of its pointer is centered over the black dot as shown.



*Observatory*



*Observatory Ready*

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**Launch Platform + Spacecraft** – Secure the Launch Platform to the Mat on its marks, with its spacecraft fallen/down.



*Launch Platform Ready*

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**Craters** – Secure the Craters Model to the Mat on its marks and raise the Gate as high as it will go.



*Craters*



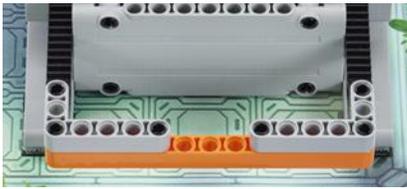
*Gate*



*Craters Ready*



**Food Growth Chamber** – Secure the Food Growth Chamber to the mat on its marks, with the Push Bar facing south and moved as far south as it will go.



*Food Growth Chamber Push Bar*



*Food Growth Ready*

**Lander** – Secure the Lander Release to the Mat on its marks. Assemble the Lander Parts as shown, with tan axles in gray holes. Clamp the Lander into the Lander Release as shown (hint: diagonal), and push the Lock Lever all the way down/east.



*Lander Release*



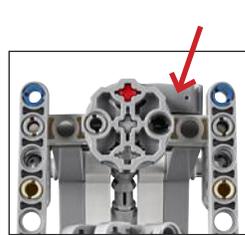
*Lander Parts*



*Lander*



*Lander Clamped*



*Lock Lever Down/East*



*Lander Ready*

**Exercise Machine** – Secure the Exercise Machine to the Mat on its marks. Rotate the Pointer northwest as far as it will go. Move the Strength Bar down as far as it will go.



*Pointer*



*Strength Bar*



*Exercise Machine Ready*

**Base** – As described above, place these six Models anywhere in Base: Tube Module, One Meteoroid, Crew Payload, Supply Payload, Satellite V and Satellite C.



*Base Ready*



## Field Ready



## Field Maintenance

### Border Walls

Remove splinters and cover holes.

### Field Mat

Make sure the Mat touches the south Border Wall, and is centered east to west. Don't clean the Mat with anything that will leave a residue. Any residue, sticky or slippery, will affect the Robot's performance compared to a new Mat (many tournaments use new Mats). Use a vacuum and/or damp cloth for dust and debris above and below the Mat. To remove marks, try a white-plastic pencil eraser. When moving the Mat for transport and storage, don't let it bend into a sharp kink point, which could affect the Robot's movement. Tournaments using new Mats should unroll the Mats as far in advance of the tournament day as possible. For control of extreme curl at the east or west edges of the Mat, black tape is allowed, with a maximum of ¼" (6mm) overlap. Foam tape is not allowed. **DO NOT PUT DUAL LOCK NOR ANY OTHER TAPE NOR ADHESIVE UNDER THE MAT.**

### Mission Models

Keep the Mission Models in original condition by straightening and tightening solid connections often. Ensure that spinning axles spin freely by checking for end-to-end play and replacing any that are bent. Frequently check for and fix any loop distortion.



*U-Loop*  
*Good*



*Droop-Loop*  
*Distortion Bad*



*Bell-Loop*  
*Distortion Bad*



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