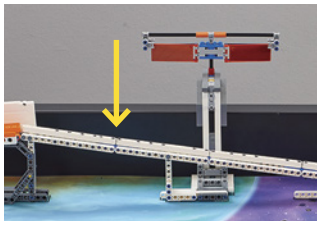
Missions

Scoring Requirement Signals

- Within the Mission descriptions, specific scoring requirements are written in **GREEN**.
- Methods with an asterisk "✱" must be the **ONLY** ones used, and must be **OBSERVED** by the referee .
- **Underlined RESULTS/CONDITIONS** must be visible at the END of the match.
- For each Mission, only the text following "**TECHNICALLY SPEAKING**" is used for scoring.

M01 - SPACE TRAVEL Incredible engineering accomplishments like space travel come about in steps. And many huge, progressive sub-goals need to be met before we can forever leave Earth and live to tell about it!

Simply Speaking: *The Robot needs to send Payload rockets (carts) rolling down the Space Travel Ramp. The first cart is pre-set and ready to go, but the Robot needs to load the other two from Base.*



FIRST TRACK CONNECTION

TECHNICALLY SPEAKING:

✱ **Start each Payload clearly rolling** down the Space Travel Ramp.

- For each roll, the cart must ✱ **be Independent by the time it reaches the first track connection**.
- Vehicle Payload: **22**
- Supply Payload: **14**
- Crew Payload: **10**

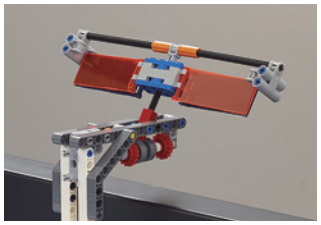
As a Mission requirement in any Mission, the word "Independent" means "not in contact with any of your Equipment."

As long as the cart clearly rolls Independently past the First Track Connection, it's OK if it doesn't roll all the way east.

Possible Scores: **0, 10, 14, 22, 24, 32, 36, 46**

M02 - SOLAR PANEL ARRAY Solar Panels in space are a great source of energy for a space station in the inner Solar System, but since things in space is always moving, aiming the Panels takes some thought.

Simply Speaking: *Solar Panels need to be Angled toward or away from you, depending on strategy and conditions.*



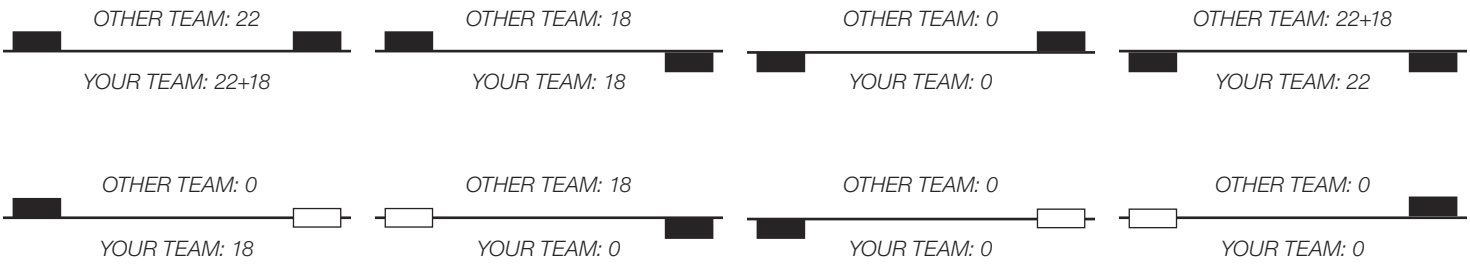
ANGLED

TECHNICALLY SPEAKING:

- **Both Solar Panels are Angled toward the same Field:** **22 For Both Teams**
- **Your Solar Panel is Angled toward the other team's Field:** **18**

In the diagrams below, as on your practice Field, "Your" Solar Panel is the one on your west end of the Table.

Possible scores **0, 18, 22, 40** are shown below, as seen from above your North Border, facing north.



M03 - 3D PRINTING It is amazingly expensive to send heavy stuff like construction material into space, so scientists and engineers are instead learning how to print what they need in space, using available extraterrestrial elements.

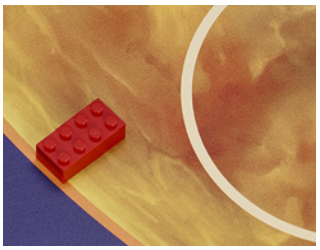
Simply Speaking: *The Robot needs to get a Regolith Core Sample and place it into the 3D Printer, which will cause the 2x4 Brick to pop out. The ejected 2x4 Brick can then be delivered elsewhere for more points.*

TECHNICALLY SPEAKING:

- Eject the 2x4 Brick * **by placing a Regolith Core Sample into the 3D Printer**.
- The 2x4 Brick ejected and **completely in the Northeast Planet Area**: **22**
- **OR** The 2x4 Brick **ejected and not completely** in the Northeast Planet Area: **18**

Possible Scores: **0, 18, 22**

NORTHEAST PLANET AREA



22

18

M04 - CRATER CROSSING For rovers in other worlds, getting stuck is definitely not OK! Teams of rovers can help each other, but a lone rover needs to be very careful.

Simply Speaking: *The Robot or whatever agent-craft it sends out needs to cross the Craters Model completely, by driving directly over it. Not near it. Not around it.*

TECHNICALLY SPEAKING:

- All weight-bearing features of the crossing equipment must cross * **completely between the towers.**
- Crossing must be * **from east to west, and make it completely past the flattened Gate: 20**

Possible Scores: **0, 20**

BETWEEN THE TOWERS

PAST THE GATE

M05 - EXTRACTION To live away from Earth, it would help if we were good at detecting and mining resources under the surfaces of other planets, moons, asteroids, and even comets.

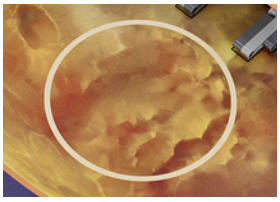
Simply Speaking: *The Robot needs to get all the Core Samples out of the Core Site Model, then it has options for what to do with them as described here, and in Mission M03.*

TECHNICALLY SPEAKING:

- Move all **four Core Samples so they are no longer touching the axle that held them in the Core Site Model**: **16**
- Place the Gas Core Sample so it is **touching the mat, and completely in the Lander's Target Circle**: **12**
- **OR** Place the Gas Core Sample **completely in Base**: **10**
- Place the Water Core Sample so it is **supported only by the Food Growth Chamber**: **8**

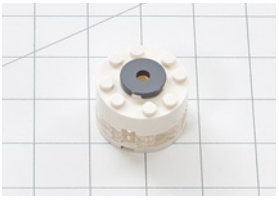
Possible Scores: **0, 16, 24, 26, 28, 34, 36**

16



LANDER'S TARGET CIRCLE

12



10

8

M06 - SPACE STATION MODULES Space Stations allow us to learn about and even practice living in space, but improved technology and new international partners require Modules to be easily interchangeable.

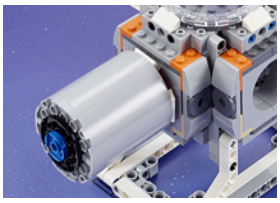
Simply Speaking: *The Robot needs to remove and insert Modules among the Habitation Hub's port holes.*

TECHNICALLY SPEAKING:

- Inserted Modules must not be touching anything except the Habitation Hub.
- Move the Cone Module completely into Base: **16**
- Insert the Tube Module into the Habitation Hub port, west side: **16**
- Transfer/Insert the Dock Module into the Habitation Hub port, east side: **14**

Possible Scores: **0, 14, 16, 30, 32, 46**

16



16

14

M07 - SPACE WALK EMERGENCY Space is quiet and beautiful, but with almost no heat, air, nor air pressure, it could freeze, suffocate, and boil you all at once! Help our spacewalking Astronaut "Gerhard" get to safety.

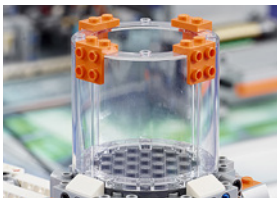
Simply Speaking: *The Robot needs to get Gerhard's body into the Airlock Chamber.*

TECHNICALLY SPEAKING:

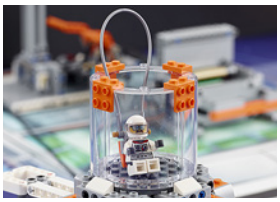
- Move Gerhard so his body is inserted at least partly into the Habitation Hub's Airlock Chamber.
- Completely In: **22**
- **OR** Partly In: **18**

For this Mission, the word "Body" includes all parts except the loop.

Possible Scores: **0, 18, 22**



AIRLOCK CHAMBER



22

18

M08 - AEROBIC EXERCISE Though spacecraft travel crazy-fast, even the shortest trips involve a lot of time for the traveler's body away from labor and recreation, which is bad for the heart and lungs.

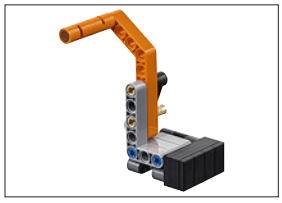
Simply Speaking: *The Robot needs to repeatedly move one or both of the Exercise Machine's Handle Assemblies to make the Pointer advance.*

TECHNICALLY SPEAKING:

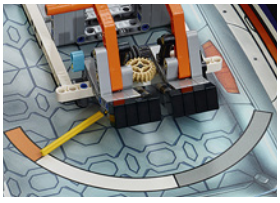
- Advance the Exercise Machine's Pointer along its Dial ✱ by moving one or both of the Handle Assemblies.
- Get the Pointer tip completely in orange, or partly covering either of orange's end-borders: **22**
- **OR** Get the Pointer tip completely in white: **20**
- **OR** Get the Pointer tip completely in gray, or partly covering either of gray's end-borders: **18**

The Handle Assembly is part of the Exercise Machine, but it is shown by itself here for clarity.

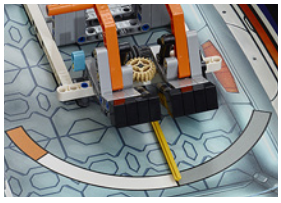
Possible Scores: **0, 18, 20, 22**



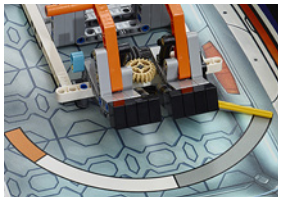
HANDLE ASSEMBLY



22 (BENEFIT OF THE DOUBT)



18



18

M09 - STRENGTH EXERCISE In zero-gravity, everything's easy to move, and you couldn't fall "down" even if you tried, so Astronauts need movement resistance - two hours a day in fact, just to keep muscle and bone density.

Simply Speaking: *The Robot needs to lift the Strength Bar to scoring height.*

TECHNICALLY SPEAKING:

- Lift the Strength Bar so the tooth-strip's 4th hole comes at least partly into view as shown: **16**

Possible Scores: **0, 16**

STRENGTH BAR

16

0

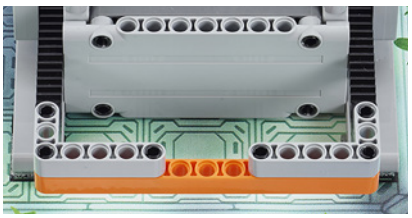
M10 - FOOD PRODUCTION Gardening is easy, right? You just need a truckload of rich soil, some rain, sun, fertilizer, helpful bugs, CO2 and a rake… but what if you were orbiting Neptune, in a room the size of a minivan?

Simply Speaking: *Move the Push Bar the right distance at the right speed, to get into the green scoring range.*

TECHNICALLY SPEAKING:

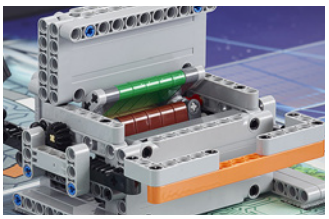
- Spin the Food Growth Chamber's colors so the gray weight is DROPPED after green, but before tan, * by moving the Push Bar: **16**

Possible Scores: **0, 16**

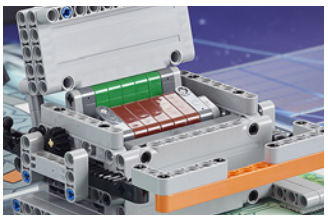


PUSH BAR

16



16



0

M11 - ESCAPE VELOCITY Soon after a launch, rocket engines often separate away from spacecraft by design, but that's long before the spacecraft leaves the pull of gravity. So why doesn't the spacecraft fall back to Earth?

Simply Speaking: *The Robot needs to impact the Strike Pad hard enough to keep the spacecraft from dropping back down.*

TECHNICALLY SPEAKING:

- Get the spacecraft to go so fast and high that it stays up, * by pressing/hitting the Strike Pad: **24**

Possible Scores: **0, 24**

STRIKE PAD

24

M12 - SATELLITE ORBITS If a Satellite doesn't have the correct velocity and distance from Earth, it can fall, drift away, fail to function, or get destroyed by debris. Propulsive adjustments need to be performed with precision.

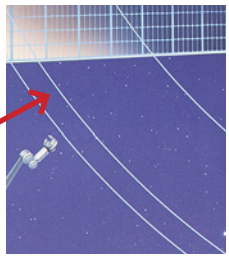
Simply Speaking: *The Robot needs to move one or more Satellites to the Outer Orbit.*

TECHNICALLY SPEAKING:

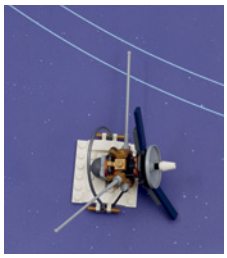
- Move any part of a Satellite on or above the area between the two lines of the Outer Orbit: **8 Each**

Possible Scores: **0, 8, 16, 24**

BETWEEN ONLY THESE TWO LINES



OUTER ORBIT



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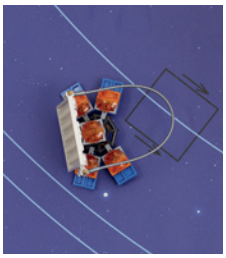


0

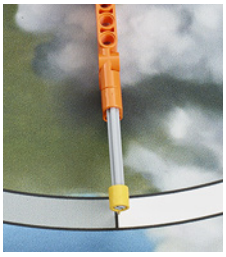
M13 - OBSERVATORY A space telescope is astonishing, but it can't beat the accessibility and simplicity of a college or science museum observatory - that is, if you know how and where to point it.

Simply Speaking: *Rotate the Observatory to a precise direction.*

TECHNICALLY SPEAKING:

- Get the pointer tip completely in orange, or partly covering either of orange's end-borders: **20**
- **OR** Get the pointer tip completely in white: **18**
- **OR** Get the pointer tip completely in gray, or partly covering either of gray's end-borders: **16**

Possible Scores: **0, 16, 18, 20**



16

16

0

M14 - METEOROID DEFLECTION The chance of a "serious" Meteoroid hitting Earth in our lifetime is extremely low, but it's not zero, and the devastation could truly wipe us out. How will scientists and engineers keep us safe?

Simply Speaking: *From west of the Free-Line, send one or both Meteoroids Independently to the Meteoroid catcher.*

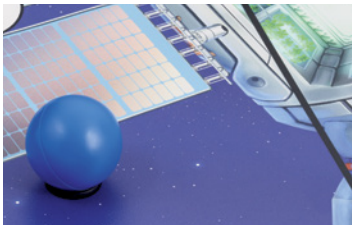
TECHNICALLY SPEAKING:

- Send Meteoroids * **over the Free-Line to touch the mat in the Meteoroid Catcher**.
- The Meteoroids must be hit/released while they are * **clearly and completely west of the Free-Line**.
- While between hit/release and scoring position, the Meteoroid * **must be clearly Independent**.
- Meteoroids in the Center Section: **12 Each**
- Meteoroids in Either Side Section: **8 Each**

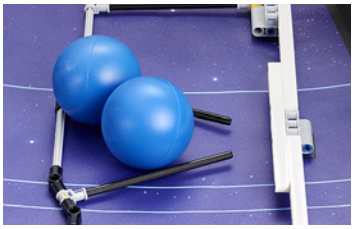
If ever the Ring-Set Meteoroid is off its Ring, you may remove the Ring from the Field by hand (this is a special exception to the Rules).

Possible Scores: **0, 8, 12, 16, 20, 24**

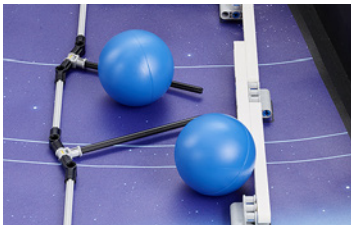
FREE-LINE



MUST BE INDEPENDENT WHILE EAST OF THE FREE-LINE



24



20

M15 - LANDER TOUCH-DOWN: Our Lander doesn't have working parachutes, thrusters, or cushions, but one important feature is realistic… it's very fragile.

Simply Speaking: *Get the Lander to one of its targets intact, or at least get it to Base.*

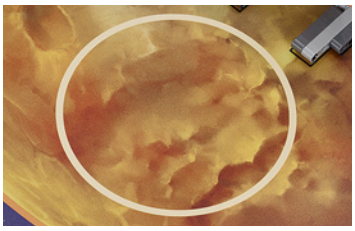
TECHNICALLY SPEAKING:

- Move the Lander to be intact, touching the Mat, and completely in its Target Circle: **22**
- **OR** Move the Lander to be intact, touching the Mat, and completely in the Northeast Planet Area: **20**
- **OR** Move both parts of the Lander completely into Base: **16**

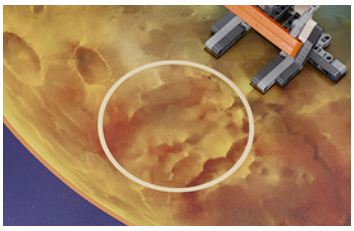
The Lander is "Intact" if its parts are connected by at least two of its four tan location axles.

Possible Scores: **0, 16, 20, 22**

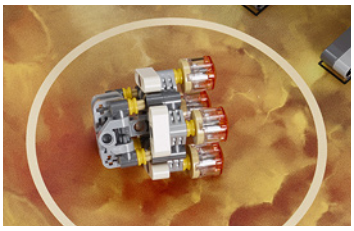
INTACT



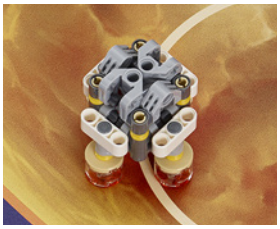
LANDER'S TARGET CIRCLE



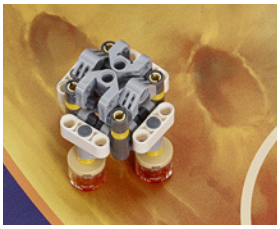
NORTHEAST PLANET AREA



22



20



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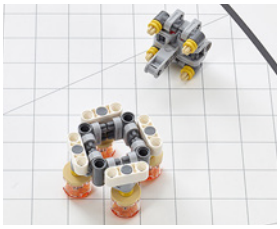
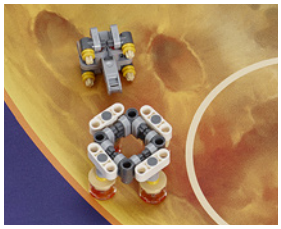


16



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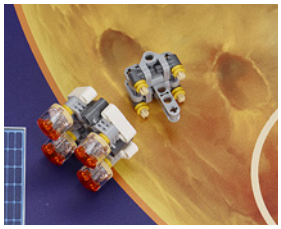


0

P01 – INTERRUPTION PENALTIES: Read the RULES carefully and often.

Simply Speaking: *FIRST* LEGO League *Mission Requirements need to be achieved by your Robot through its programs and its use of equipment. You're allowed to hand-rescue your Robot, but that does cause this Penalty. Be sure to pay extra attention to the Rules where they talk about "Interruptions."*

PENALTY DISCS

TECHNICALLY SPEAKING:

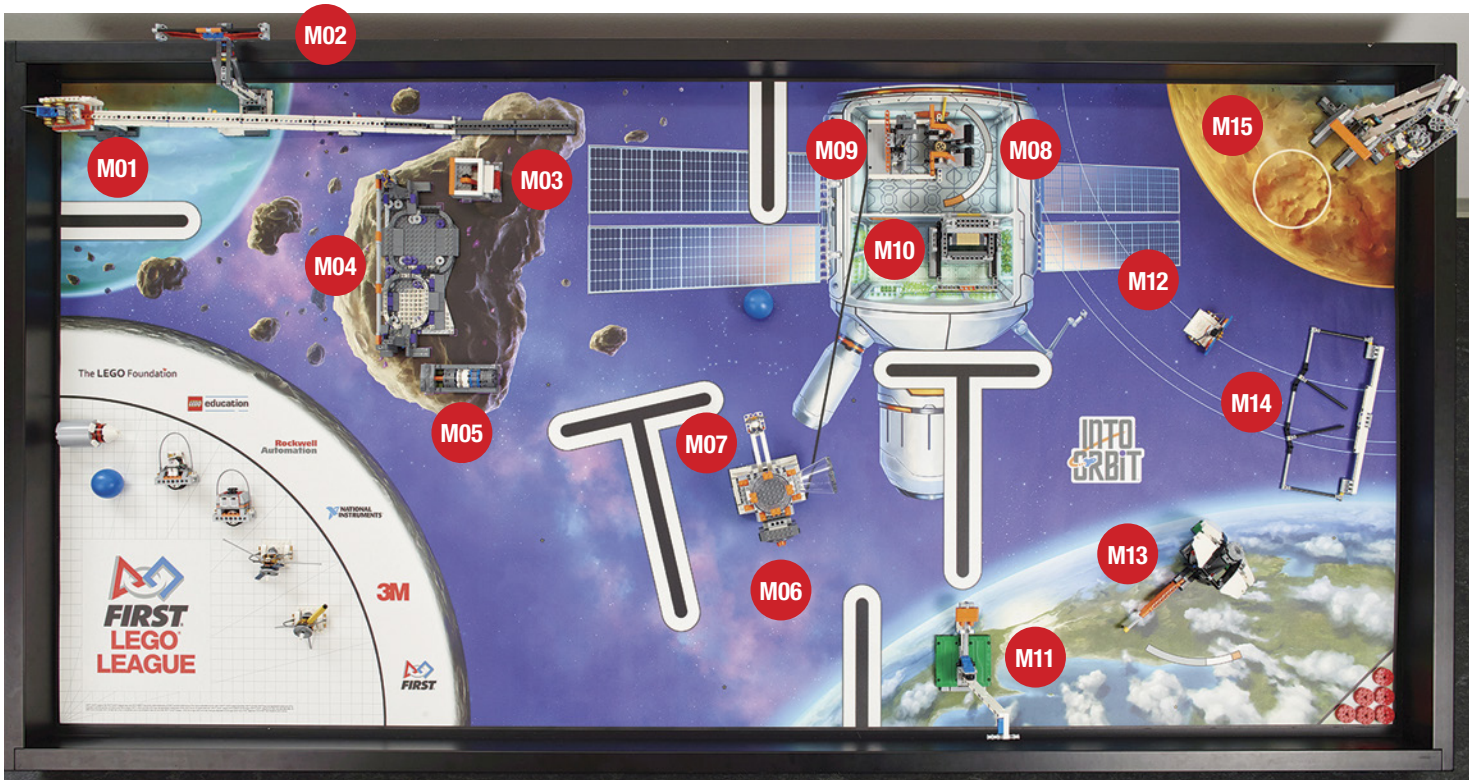
- If you **✱ Interrupt the Robot**: **Minus 3 Each Time**

Upon Penalty, the referee will place one Penalty Disc in the southeast triangle as a permanent Interruption marker.

You can get up to six such Penalties.

If a Penalty Disc comes off the triangle, it is simply returned, with no effect on score.

Possible Penalty Totals: **-18, -15, -12, -9, -6, -3, 0**


M01
M02
M03
M04
M05
M06
M07
M08
M09
M10
M11
M12
M13
M14
M15
The LEGO Foundation
education
Rockwell Automation
NATIONAL INSTRUMENTS
FIRST LEGO LEAGUE
3M
FIRST
INTO ORBIT