World Robot Olympiad 2020

Regular Category

Junior

CLIMATE SQUAD

Snowstorm

Version: January 15th

WRO International Premium Partners

Table of Contents

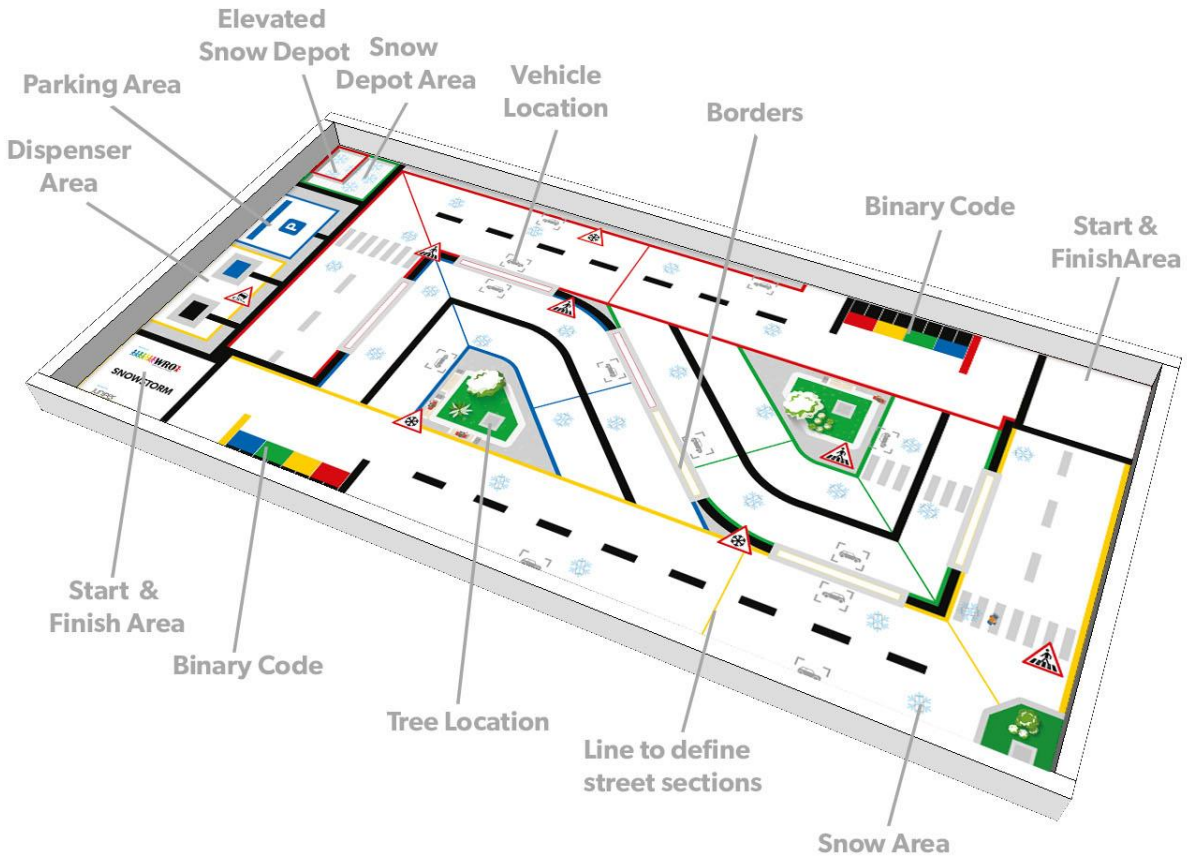
1. Introduction

A snowstorm just hit a city that has never encountered winter conditions. Its population is not ready for such an event - Vehicles are stuck on the streets and ice makes the streets slippery. The city authority just called your climate squad to help restore normal conditions.

This year, it is the Junior mission to design a robot that helps to restore normal conditions. Your robot will need to remove snow, two stuck cars and spread abrasive material on some of the streets. Pay attention - do not damage any trees along the way.

2. Game Field

The following graphic shows the game field with the different areas.



If the table is larger than the game mat, the mat will be centered in all dimensions. Possible space between the mat and the wall will be counted towards the area on the mat.

For more information about the table and game mat specifications, please look at WRO Regular Category General Rules, Rule 4. The printable file of the mat and a PDF with the exact measurements are available on www.wro-association.org.

Information about the start position:

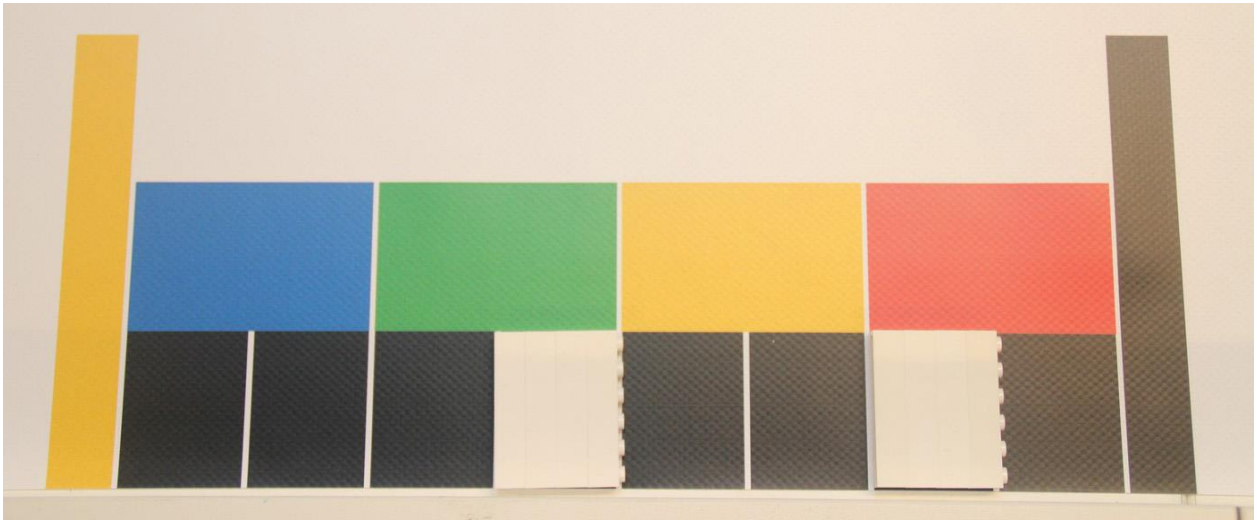
There are two start areas (one in the bottom-left and one in the top-right corner). Before each round, the start area is selected randomly and will be the same for all teams in this round. Before the start of the run, the robot must start completely in one start area (defined as mentioned above), the surrounding line is not included in the start area. At the start, the cables count toward the maximum size of the robot, so they need to be included in the start area.

3. Binary code

The city contains four streets (blue, green, yellow, and red). On two of the streets, you need to remove the snow and two vehicles. On the other two streets, you need to spread abrasive material and avoid parked vehicles. The messaging system will tell you what to do on each street.

At the beginning, the robots needs to read a binary code that tells the robot what to do. The binary code uses two bits per street to indicate if snow needs to be removed or if abrasive material needs to be spread. Each bit is 0 (black) or 1 (white). The background of the key is black meaning all zeros. **Two white tiles will be randomly installed on the binary code next to the start area of the robot.**

Code	Action for a given street
0-0	Remove snow
0-1	Spread **blue** abrasive material
1-0	Spread **black** abrasive material
1-1	*(not used*

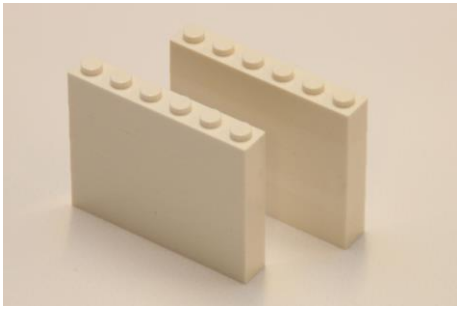


There will always be two streets with snow to remove and two streets where abrasive material is needed, one of each type. In this example, the binary code shows:

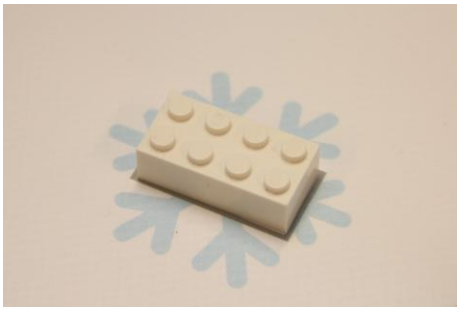
- Snow needs to be removed from the **blue and yellow street.** On these streets, cars need to be brought away as well (see details in the missions).
- **Blue** abrasive material needs to be spread on the **green street**
- **Black** abrasive material needs to be spread on the **red street**

4. Game Objects, Positioning, Randomization

White tiles

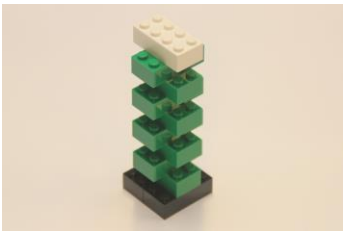
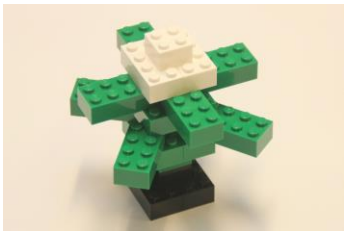
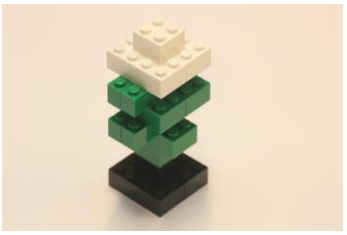
 Two white tiles are used to create the binary code	Two white tiles will be randomly installed in the key to complete the binary code, see page 4. The tiles will not be placed on the same color (maximum one per street color).

Snow

 Snow is made of 12 white 2x4 LEGO bricks.	 The snow pieces are placed on the little places in the streets where snow needs to be removed (0-0 in the binary code, 6 pieces per street).

Trees

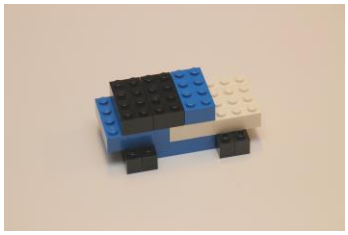
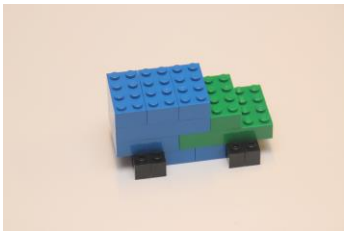
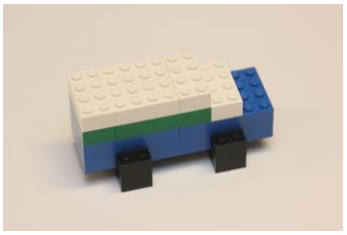
3 Trees have grown along the streets and should not be moved or damaged. There are three different tree models – A, B, and C. In each country, the National Organizer decides which model or models are used in their local competitions.

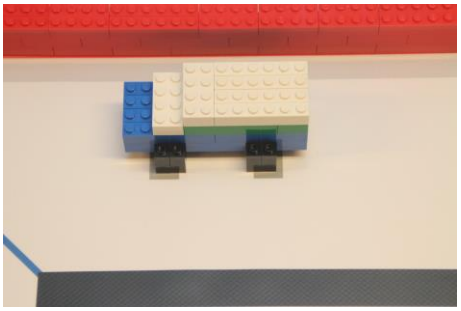
		
Model A	Model B	Model C

The trees are placed on the dark grey areas inside their tree areas.

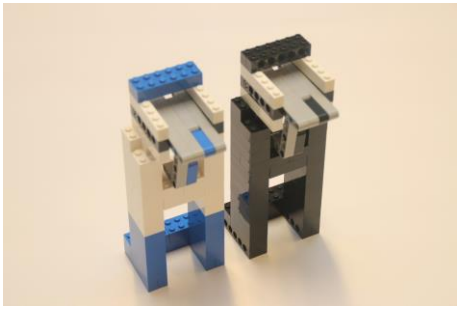
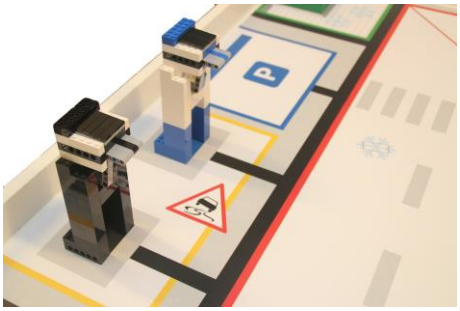
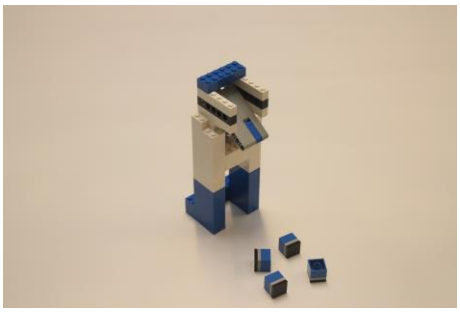
Vehicles

4 vehicles have been left on the streets, one per street. There are three different car models – A, B, and C. In each country, the National Organizer decides which model or models are used in their local competitions.

 Model A	 Model B	 Model C

 Vehicles are randomly placed, one per street in 1 of the 3 possible vehicle locations, the front of the car facing the direction of the car icon on the mat.	

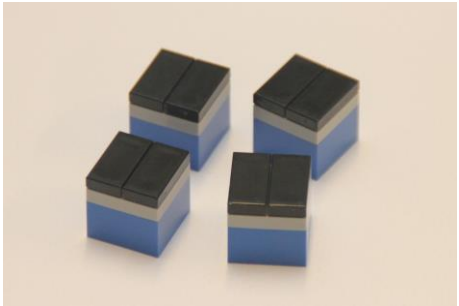
Abrasive material dispensers

<table>
<tr>
<td> 
There are two dispensers on the field.</td>
<td> 
Two abrasive material dispensers are placed in the dispenser area on the black / blue areas inside the light grey areas.</td>
</tr>
<tr>
<td> 
Abrasive material will fall from the dispenser when pushing the lever.</td>
<td>Note: To construct an abrasive material dispenser, some pieces of the EV3 Set are used in addition to the WRO Brick Set.

Please look at the building instructions at the end of this document.</td>
</tr>
</table>

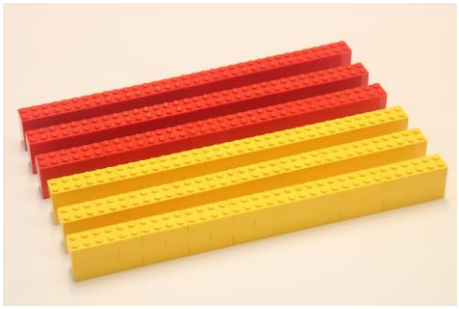
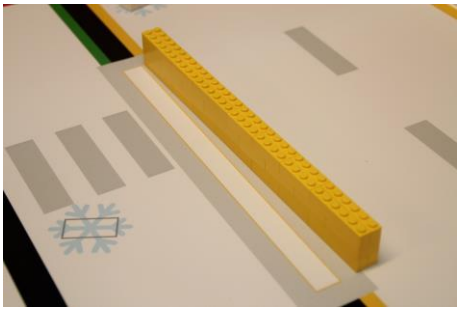
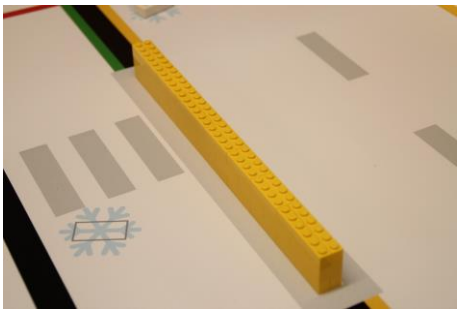
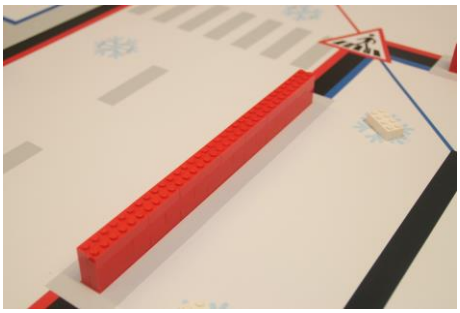
Abrasive material

Two types of abrasive material are available from the dispensers: 4 pieces made of mineral gravel (blue) and 4 pieces made of wood chips (black) which is a more sustainable and ecological solution. **At the beginning, the blue pieces are loaded into the blue dispenser and the black pieces are loaded in the black dispenser.**

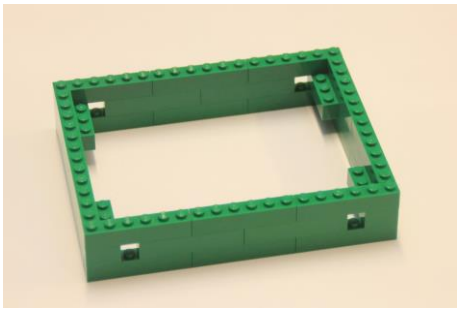
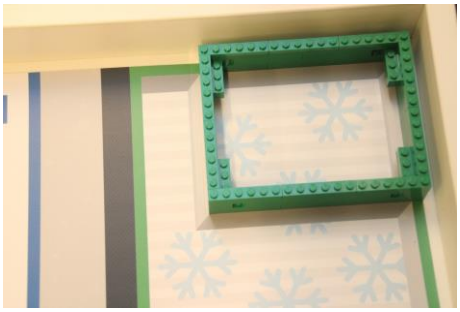
<table>
<tr>
<td> 
Blue abrasive material (mineral gravel)</td>
<td> 
Black abrasive material (wood chips)</td>
</tr>
</table>

Borders

Due to the bad weather, it is difficult to see lines on the some of the streets. 6 borders are available and can be used as guidelines by the robot. Borders are not attached to the surface.

<table>
<tr>
<td> 
6 Borders, 3 red, 3 yellow</td>
<td> 
Borders are placed on the areas between the streets – the yellow wall on the yellow marking, the red wall on the red marking.</td>
</tr>
<tr>
<td> 
Correct placement of a yellow border.</td>
<td> 
Correct placement of a red border.</td>
</tr>
</table>

Elevated snow depot

<table>
<tr>
<td> 
Elevated snow depot.</td>
<td> 
An elevated snow depot is placed on the red markers into the snow depot area.</td>
</tr>
</table>

5. Robot Missions

For a better understanding, the missions will be explained in multiple sections.

The team can decide in which order they will do the missions.

5.1 Clear snow and bring it to the snow depot

Snow needs to be removed from the streets, where it is needed (those with 0-0 key), and then brought to the snow depot. Full points are awarded if snow is lifted and dropped in the elevated snow depot.

5.2 Spread abrasive material

Abrasive material needs to be spread over the streets:

- Blue abrasive material on a street with 0-1 key
- Black abrasive material on a street with 1-0 key

The material should be spread evenly on the street, at least one piece of the material touching each of the street sections. Streets are divided by the colored lines, every street has three sections. You get points for only one piece of abrasive material per street section (counting the piece with the highest points).

5.3 Tow away vehicles to the parking area

There is one vehicle on each of the four streets.

On streets where snow has to be removed (0-0 key) the vehicles must be towed away to the parking area. Vehicles on the other two streets should not be moved or damaged.

5.4 Park the robot

The mission is complete when the robot returns to either one of the two start areas, stops, and the chassis of the robot is entirely (top-view) within the start area (cables are allowed to be outside of the start area).

5.5 Get bonus points and avoid penalties

Bonus points will be awarded for borders, vehicles and abrasive dispensers that are not moved or damaged. Penalties will be awarded for moving or damaging trees. Trees are moved if they are touching outside the light grey square. Penalties will never result in a negative score (see General Rules).

6. Scoring

Definitions for the scoring

- **"Completely"** means that the game object is only touching the corresponding area (not including the lines of the area). "**Partly"** means that the game object is at least touching the area with one part.
- Please note: For every street section only one piece of abrasive material (the one with the highest points) counts.

Tasks	Each	Total
Clear snow and bring it to the snow depot		
Snow element inside the red rectangle area, inside the elevated snow depot and the elevated snow depot is not damaged.	**5**	**60**
Snow element **completely** in the snow depot area but not in the elevated depot	3	36
Spread abrasive material		
Street sections **1-0** in contact with • **black** abrasive material	**9**	**27**
• **blue** abrasive material	4	12
Street sections **0-1** in contact with • **blue** abrasive material	**9**	**27**
• **black** abrasive material	4	12
Tow away vehicles to the parking area		
Vehicle placed completely within the parking area	**20**	**40**
Vehicle placed partially within the parking area	15	30
Park the robot		
Robot completely stops within either one of the Start & Finish Areas. *(only if points other points, not bonus, are assigned)*	**14**	**14**
Get bonus points and avoid penalties		
Border not moved / damaged	**2**	**12**
Dispenser not moved / damaged	**4**	**8**
Vehicle on streets with 0-1 or 1-0 not moved (no longer touching the frame of initial position) / damaged	**6**	**12**
Tree moved (touching outside the light grey square) or damaged (at least one piece broken).	-8	-24
Maximum Score		**200**

Scoring Sheet

Team name: _____ **Round:** _____

Tasks	Each	Max	#	Total
Clear snow and bring it to the snow depot				
Snow element inside the red rectangle area, inside the elevated snow depot and the elevated snow depot is not damaged.	5	60		
Snow element **completely** in the snow depot area but not in the elevated depot	3	36		
Spread abrasive material				
Street sections **1-0** in contact with • **black** abrasive material	9	27		
• **blue** abrasive material	4	12		
Street sections **0-1** in contact with • **blue** abrasive material	9	27		
• **black** abrasive material	4	12		
Tow away vehicles to the parking area				
Vehicle placed completely within the parking area	20	40		
Vehicle placed partially within the parking area	15	30		
Park the robot				
Robot completely stops within either one of the Start & Finish Areas. *(only if points other points, not bonus, are assigned)*	14	14		
Get bonus points and avoid penalties				
Border not moved / damaged	2	12		
Dispenser not moved / damaged	4	8		
Vehicle on streets with 0-1 or 1-0 not moved (no longer touching the frame of initial position) / damaged	6	12		
Tree moved (touching outside the light grey square) or damaged (at least one piece broken).	-8	-24		
Sum of Game Score		200		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

Signature Team

Signature Judge

Scoring Interpretation

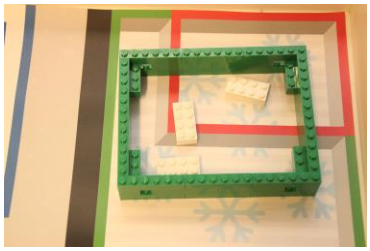
Snow element inside the red rectangle area, inside the elevated snow depot and the elevated snow depot is not damaged ➔ 5 points

3 snow elements, 15 points

3 snow elements are completely inside, one (the one on the border) is not completely inside the red rectangle area. 3x5 + 1x3 = 18 points.

If the table is larger than the game mat the elevated, snow depot can be moved to the wall, this is OK. Still 15 points.

It is OK to move the elevated snow depot inside the green area. But, it must be inside the green area.



The snow depot is moved, one snow element is still in red area (1 x 5 points) and two are outside / not completely in red area (2 x 3 points).

Here, the snow depot is moved and only two snow elements are inside the green area, none completely in red area. In this case:
2 x 3 = 6 points.

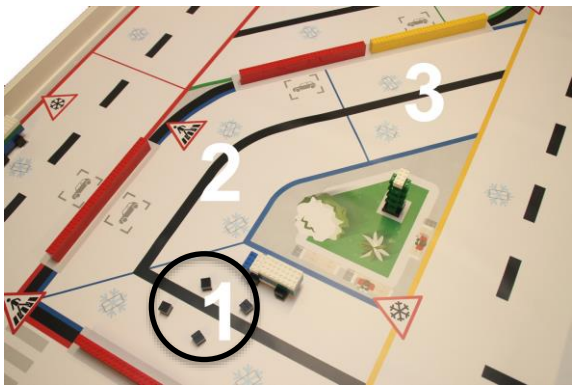
Snow element in the snow depot area but not in the elevated depot ➔ 3 points

5 snow elements in the green area (no matter if lying on bottom or not). 15 points.	4 snow elements in green area. The 5th element is not completely in the area.	The green line belongs to the area. Here, the 5th element is completely in the area because it does not touch the black line.

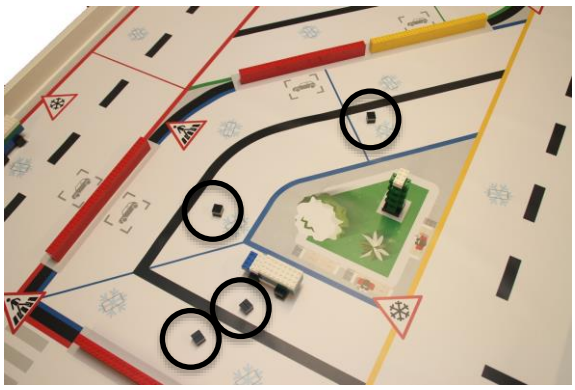
Spread abrasive material

For the black and blue abrasive material, we show one example for one street. The judging works in the same way for street sections on 0-1 or 1-0 streets.

In this example, the blue street is a 1-0 street. Black abrasive material should be spread (9 points), blue abrasive material could be spread for 4 points each. Each street has 3 sections, divided by the colored line in the street. See example for section 1, section 2, and section 3 in the following photo.

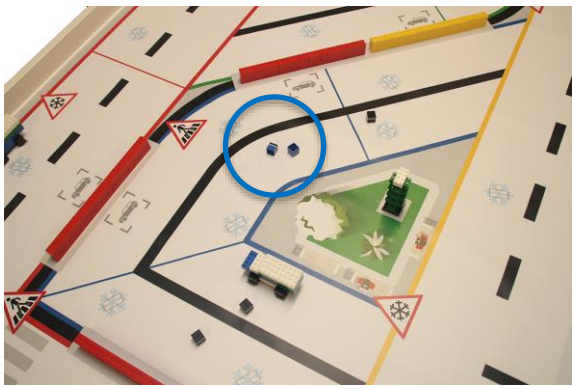


All 4 black abrasive materials are lying in SECTION 1 of the street:
9 points



Here, a black abrasive material is lying in EACH SECTION:
3 x 9 points = 27 points

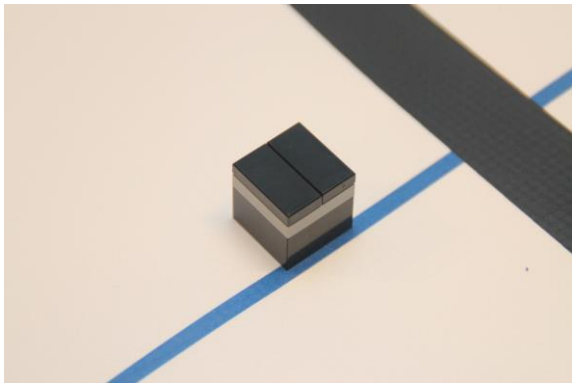
In this case, the blue abrasive material does NOT count, max. one piece (the one with highest points) counts. In this case:



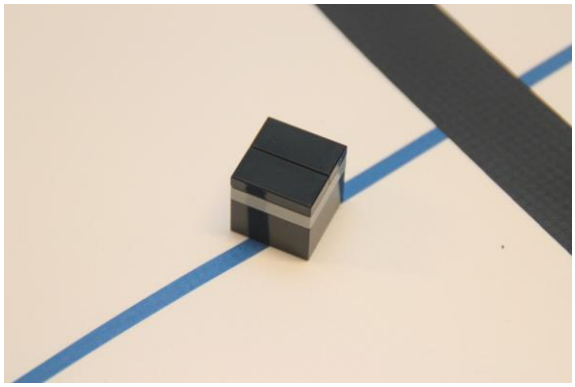
Here, we have 2 sections with a black abrasive material and one with only blue

3x9 points = 27 points (black)

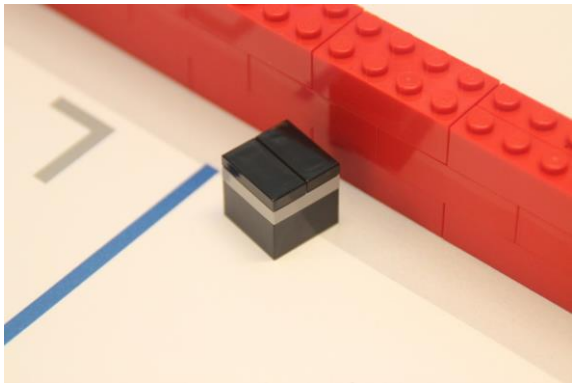
abrasive material. In this case you get:
2x9 + 1x4 = 22 points



In this case, the material is only touching the left section



In this case, the material is touching both sections but it only counts towards one section. It will count for the section that results in the most points.



It is OK if the material is not completely inside the street, but at least the material needs to touch the street.

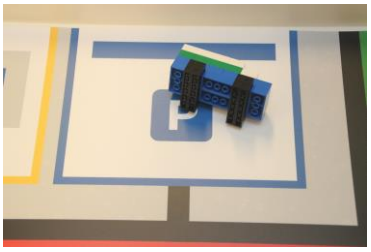
In this case, the material is still inside the blue street (the blue line decides in top-view).

In this case, the material is outside of the blue street and does NOT count.

Vehicle placed completely within the parking area ➔ 20 points

Both vehicles completely inside the parking area.

Vehicle inside area (blue line counts towards the area).



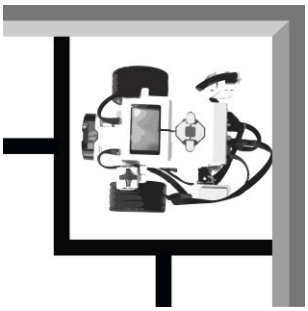
Vehicle can be on its side, as well.

Vehicle placed partially within the parking area ➔ 15 points

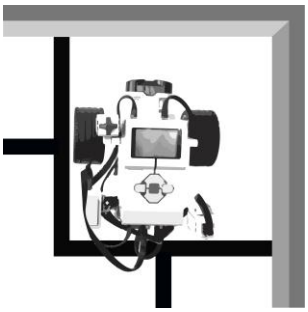
One vehicle completely, one vehicle partly in the area.

Vehicle partly inside the area.

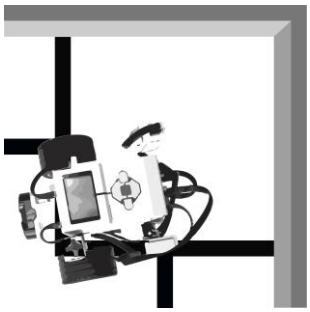
Robot completely stops within either one of the Start & Finish Areas ➔ 14 points



The projection of the robot is completely inside the start/finish area.

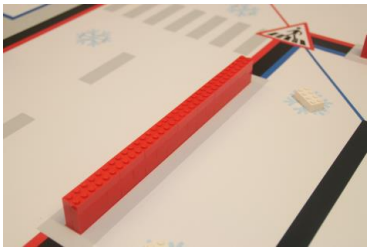


The projection of the robot is completely inside, and cables are out. That is still OK.

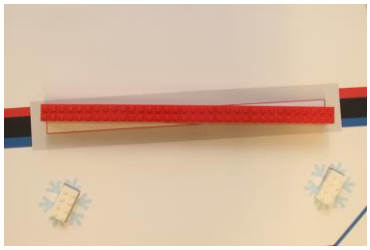


No points if the projection of the robot is not in the start/finish area.

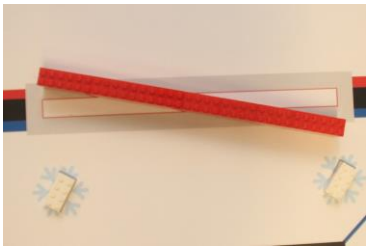
Border not moved / damaged ➔ 2 points



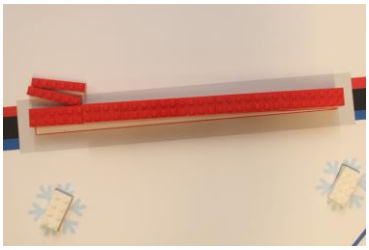
Not moved, 2 points



Moved, but inside light grey area, this is still OK. 2 points.

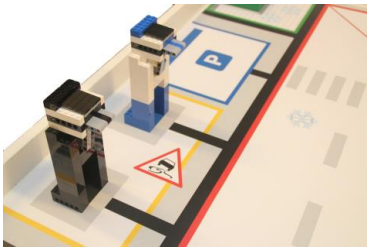


Moved outside light grey area, 0 points.

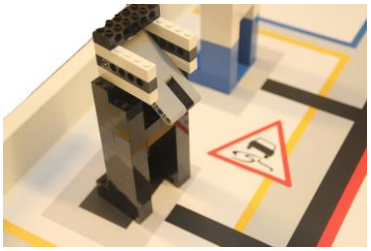


Damaged, 0 points.

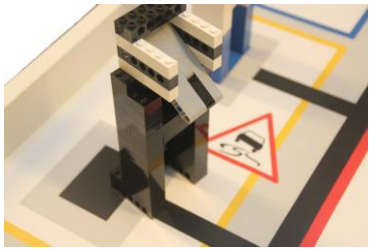
Dispenser not moved / damaged ➔ 4 points



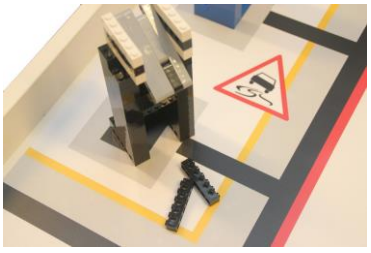
Not moved, 4 points each.



Moved, but inside light grey area, this is still OK. 4 points.

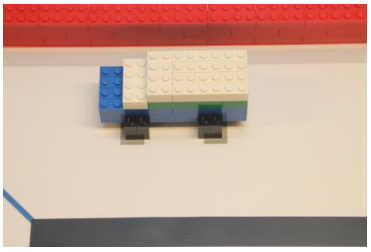


Moved outside light grey area, 0 points.

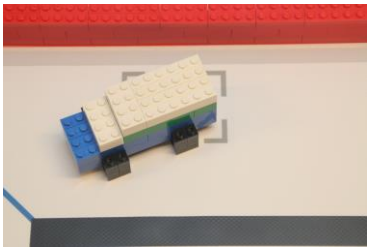


Damaged, 0 points.

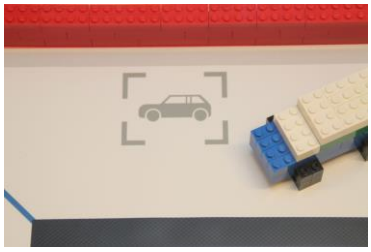
Vehicle on streets with 0-1 or 1-0 not moved (no longer touching the frame of initial position) / damaged ➔ 6 points



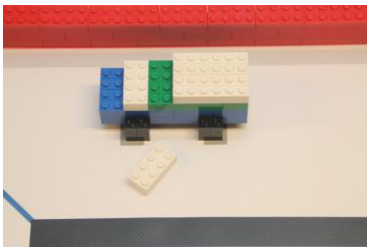
Not moved. 6 points.



Moved but still touching the grey rectangle start position. 6 points.

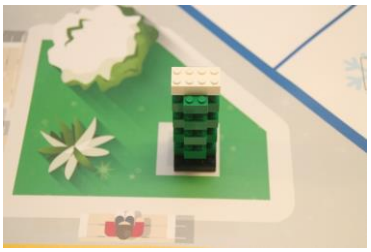


Moved outside. 0 points.



Damaged. 0 points.

Tree moved or damaged ➔ -8 points



Moved, but inside light grey area, this is still OK.

Touching outside light grey area, -8 points.

Damaged, -8 points.

7. Local, regional, and international events

WRO competitions take place in around 80 countries, and we know that teams in each country expect a different level of complexity. The challenge as described in this document will be used for international WRO events.

WRO feels that all participants need to be able to have a good experience in the competition. Teams with less experience should also be able to score points and succeed. This builds confidence in their ability to master technical skills, which is important for their future choices in education.

In every country, our National Organizers can decide to make the challenge easier for local, regional and / or national events. They can make their own choices, that fit their specific situation. Here we provide some ideas to make the challenges easier.

Ideas for simplifications

- The binary code is replaced by a color code. Not only white tiles will be placed, the following colors with the direct meaning will be placed:
  - Blue: Spread blue abrasive material on this colored street
  - Black: Spread black abrasive material on this colored street
  - 2x White: Remove snow on this colored street
- The start area is always on the lower left area.
- Only one type of abrasive material is used and can be spread on the two icy streets.

Special conditions at International Final

For the WRO International Final, there will be some special conditions:

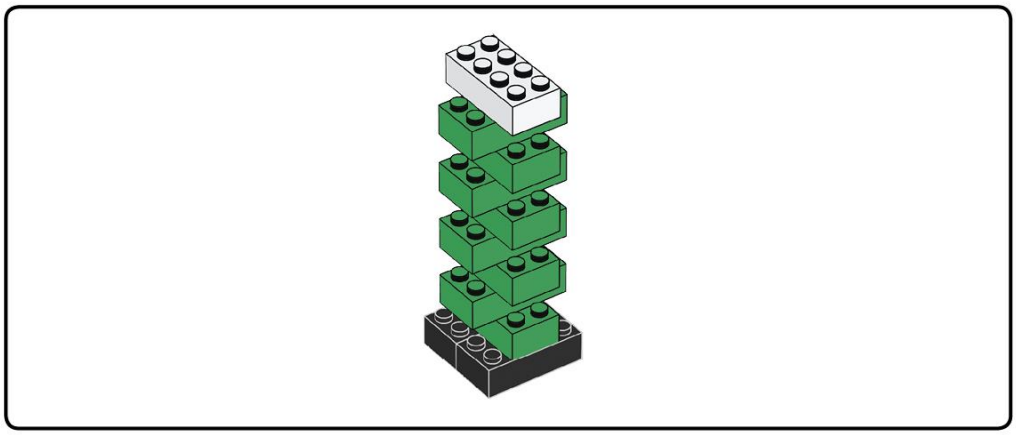
- Trees: At the international final, the model may be different, but will not exceed 10cm x 10cm x 10cm.

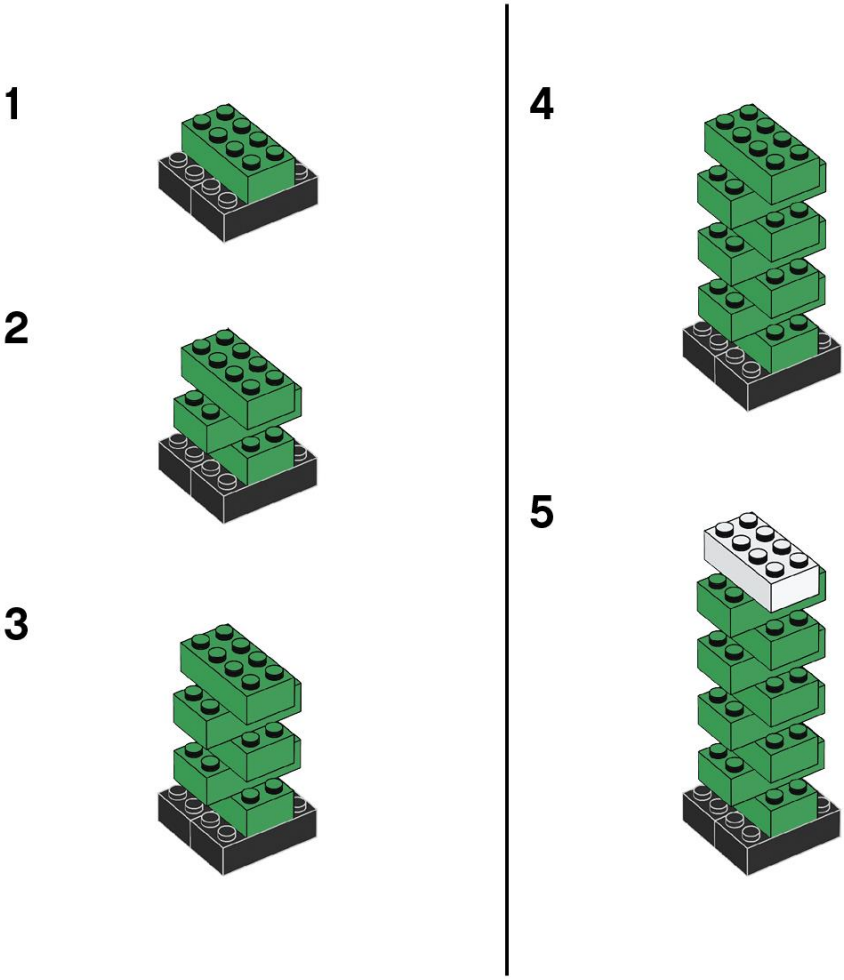
- Vehicles: At the international final, the model may be different, but will not exceed 10cm x 7cm x 6cm (length x width x height).

The Host Country will inform about these 3D elements no later than September 1st, 2020.

8. Assembly of Game Objects

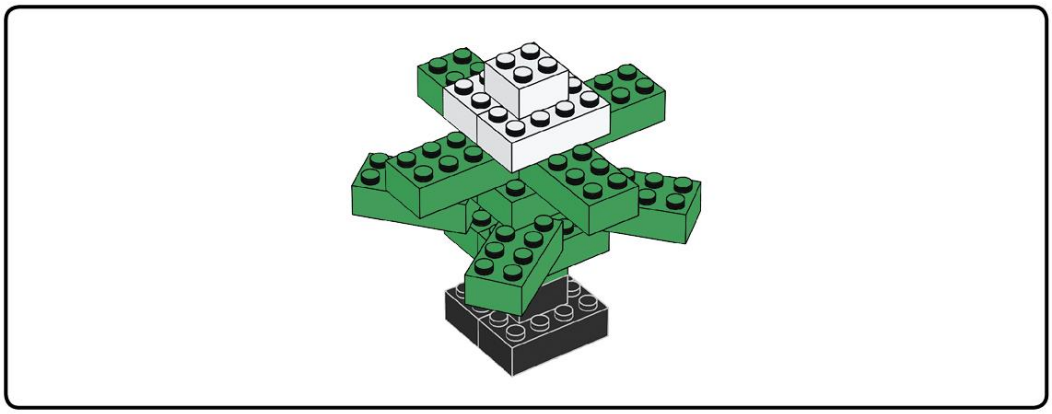
Tree model A that can be used at your local competition.





Tree model A that can be used at your local competition.

Tree model B that can be used at your local competition.



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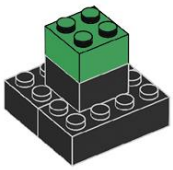

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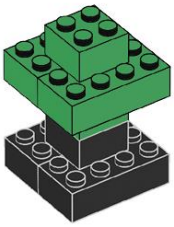

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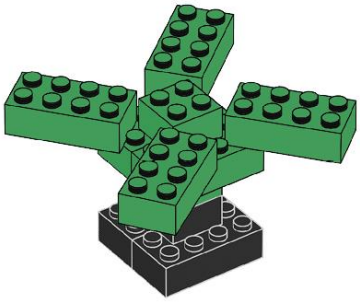

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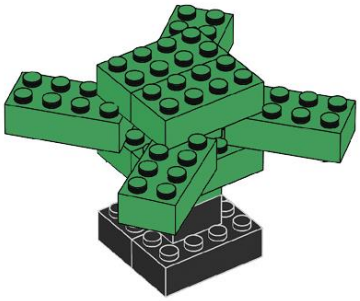

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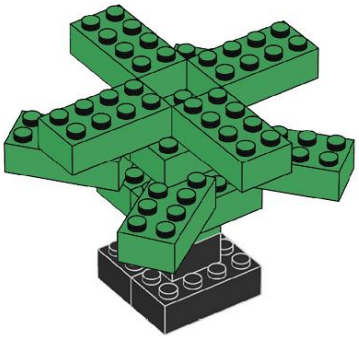

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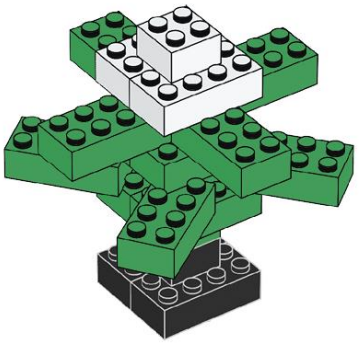
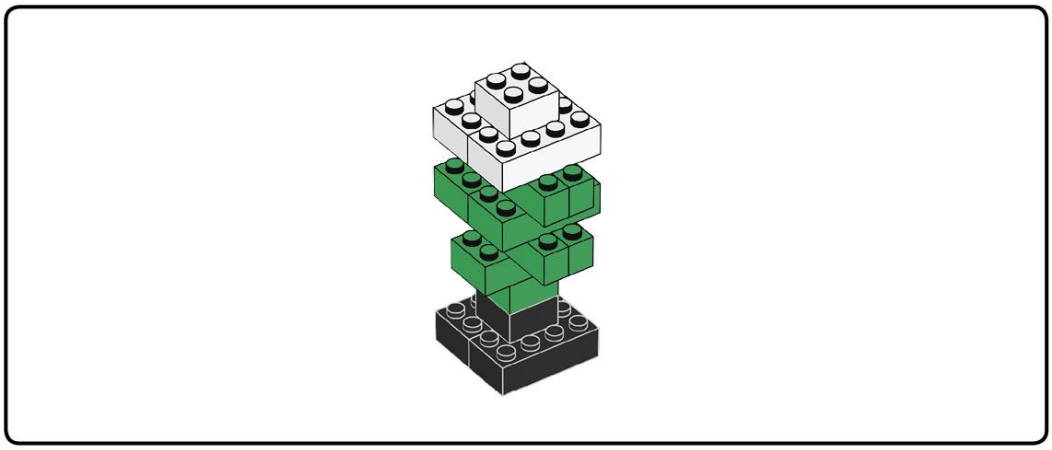


Tree model C that can be used at your local competition.



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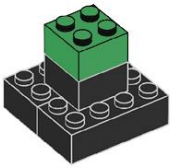

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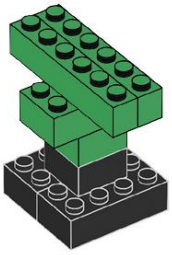

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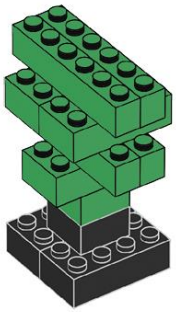

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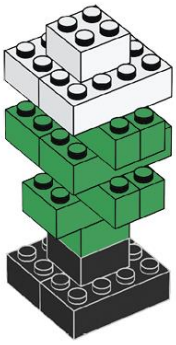
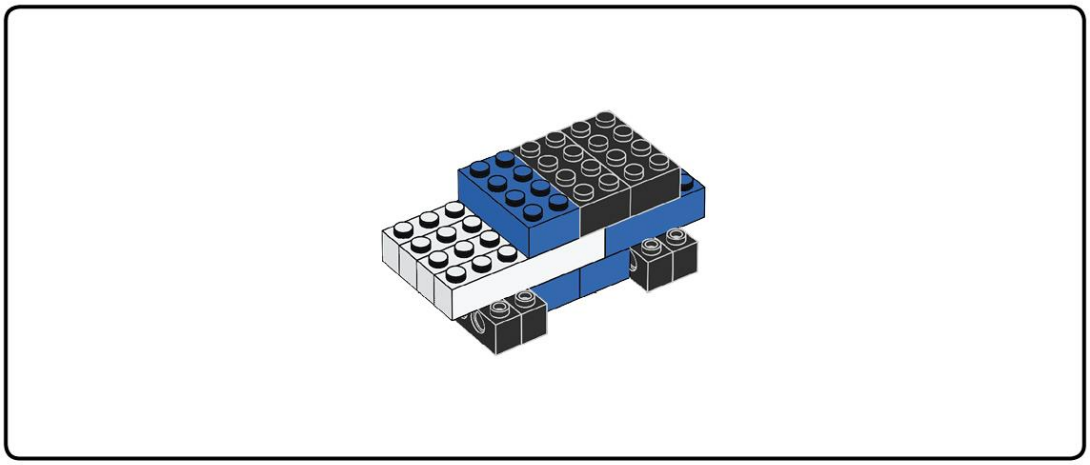


Car model A that can be used at your local competition.



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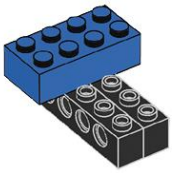

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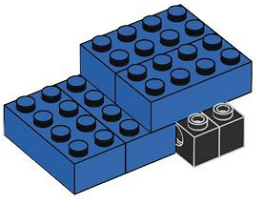

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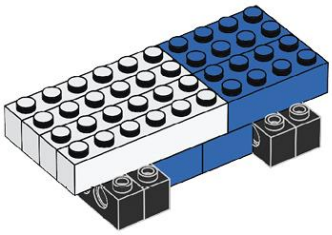

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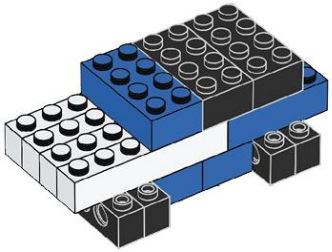
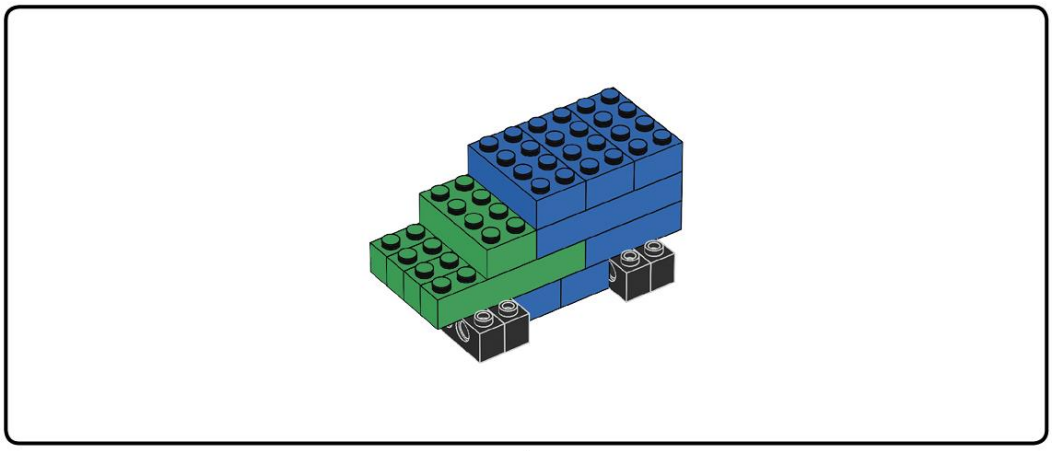


Car model B that can be used at your local competition.



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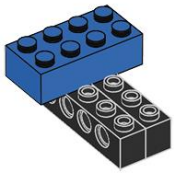

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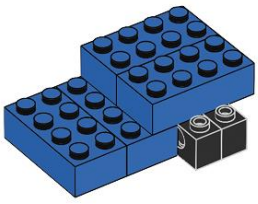

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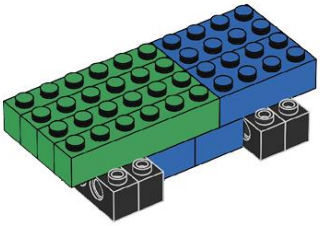

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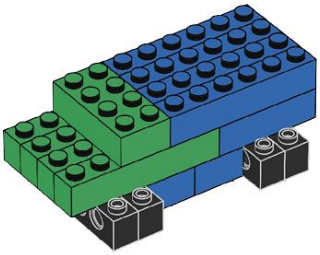

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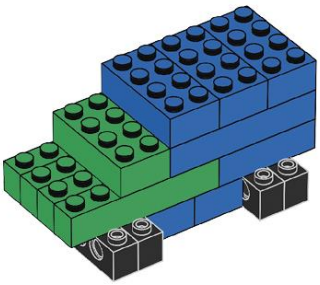
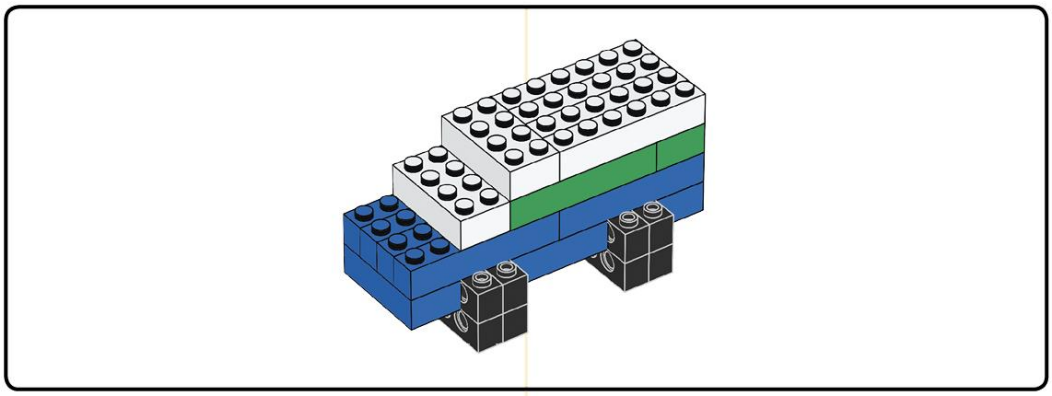


Car model C that can be used at your local competition.



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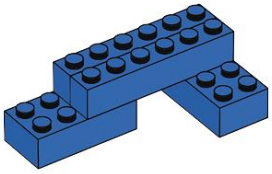

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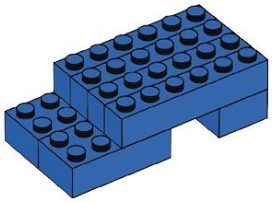

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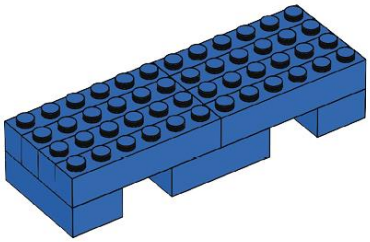

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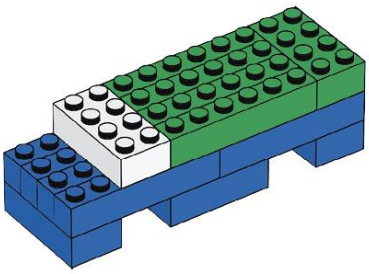

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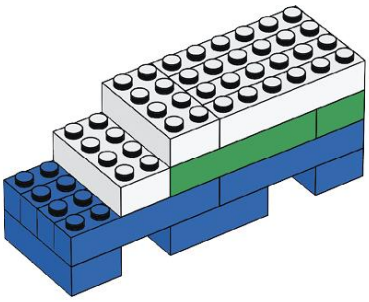

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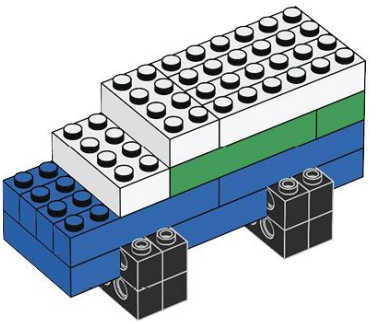

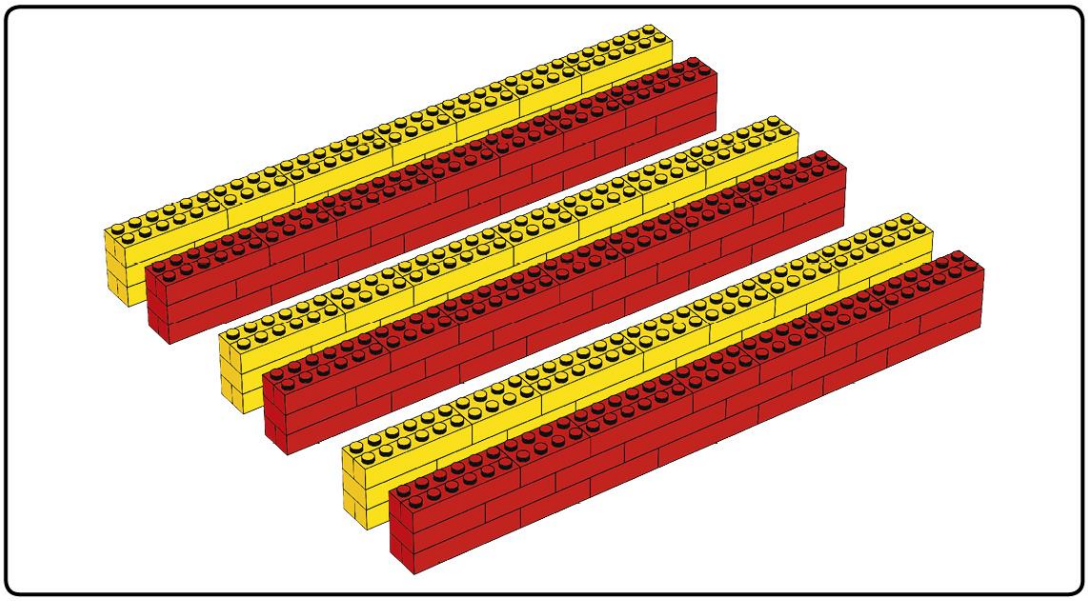

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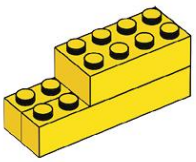

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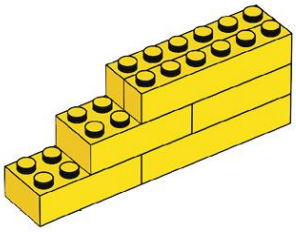

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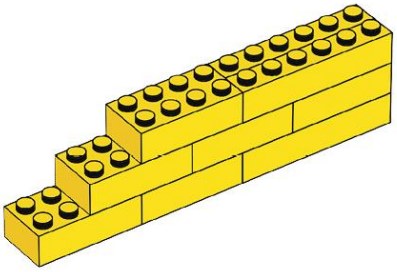

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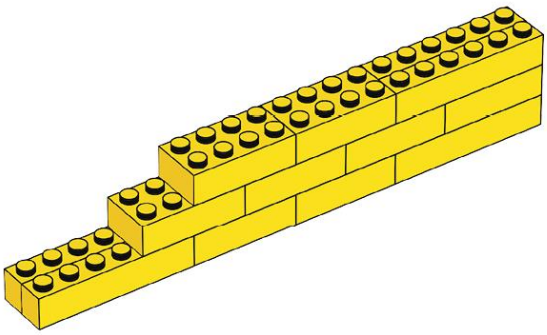

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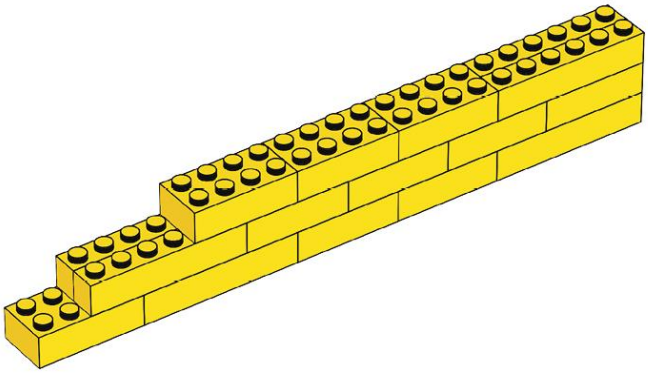

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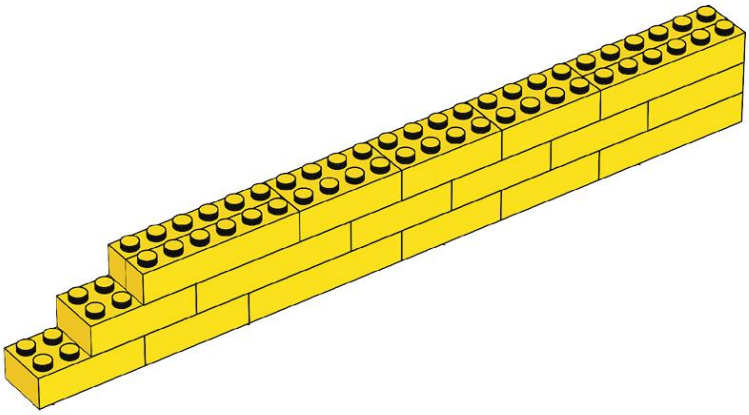

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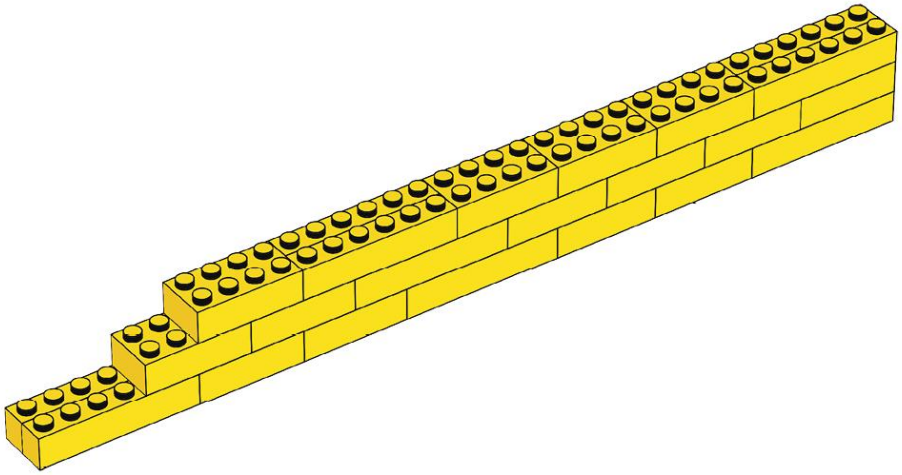

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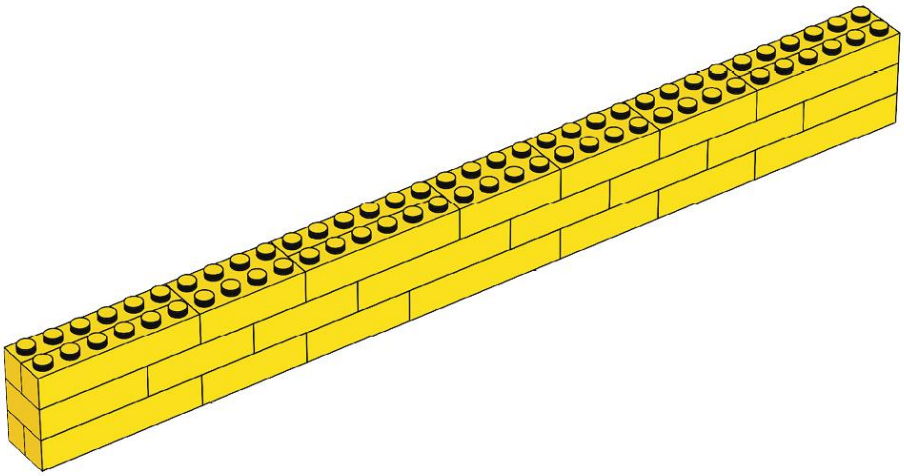

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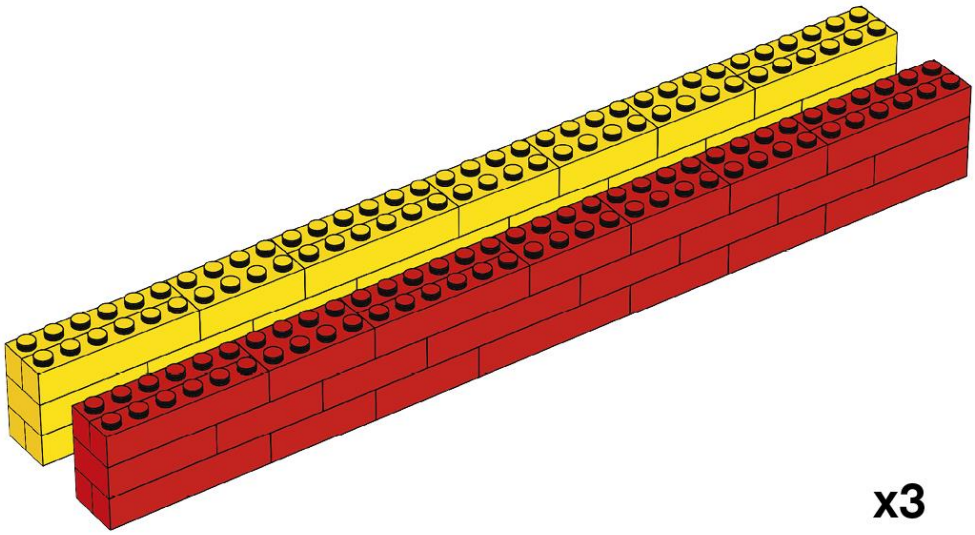

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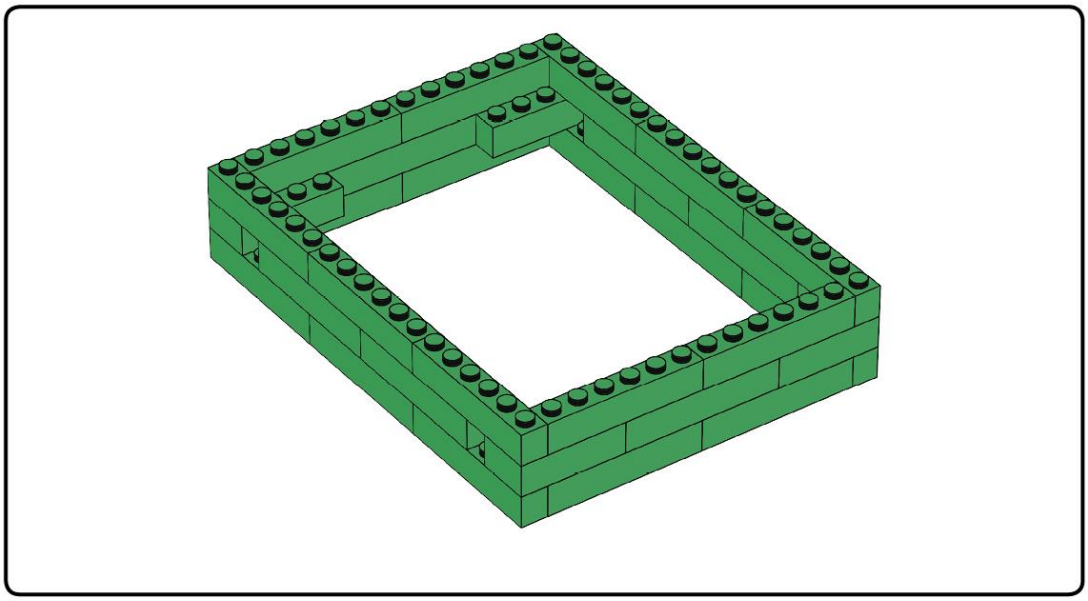

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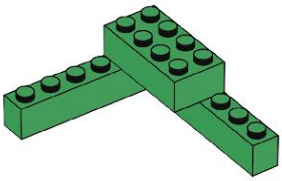

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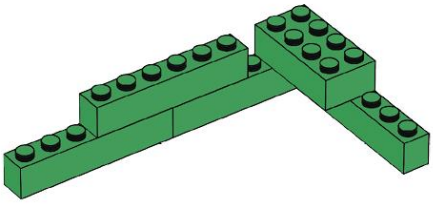

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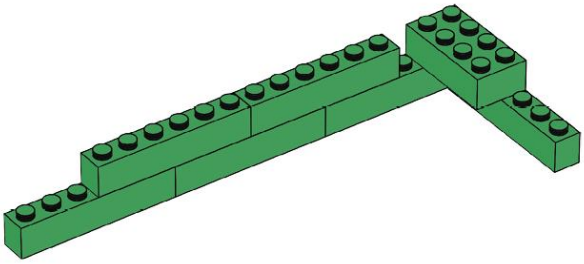

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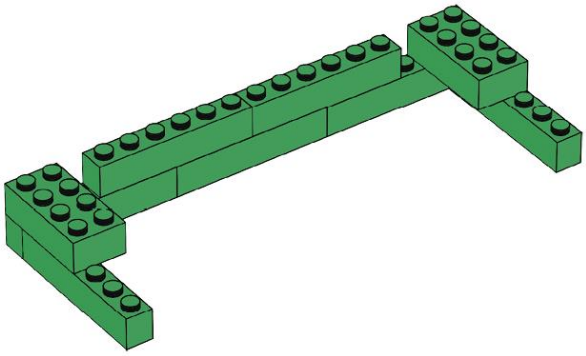

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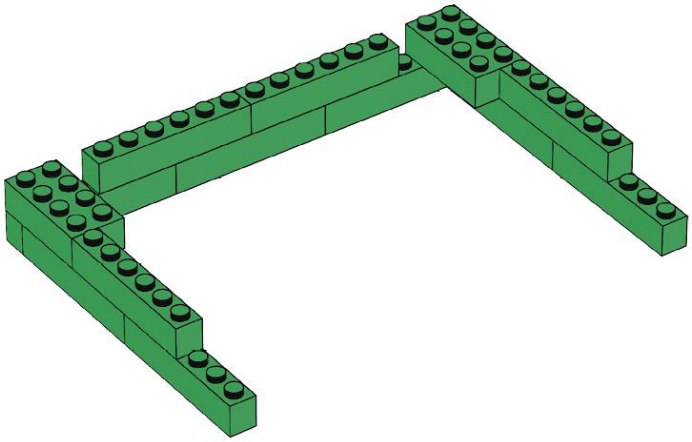

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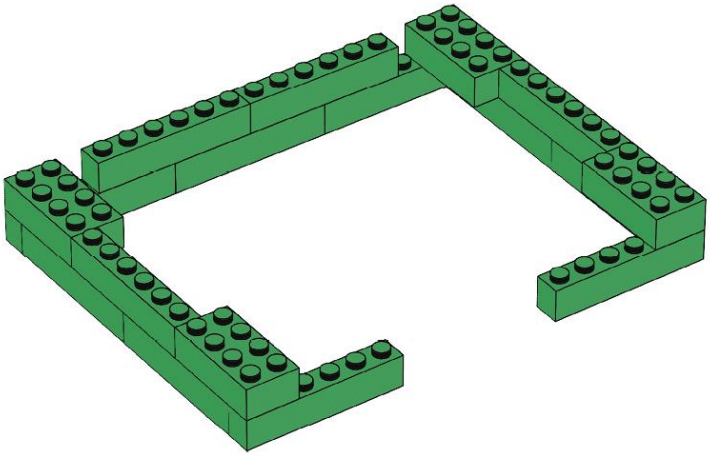

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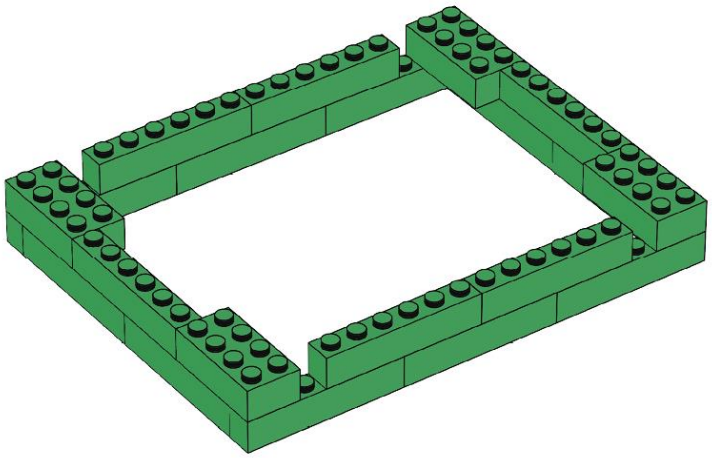

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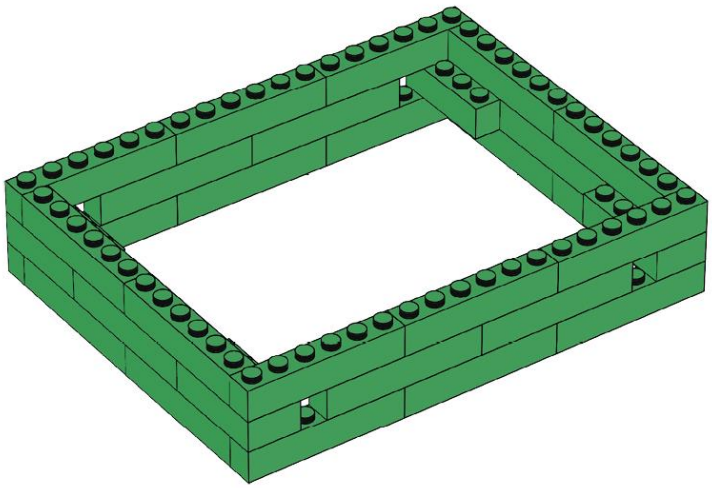
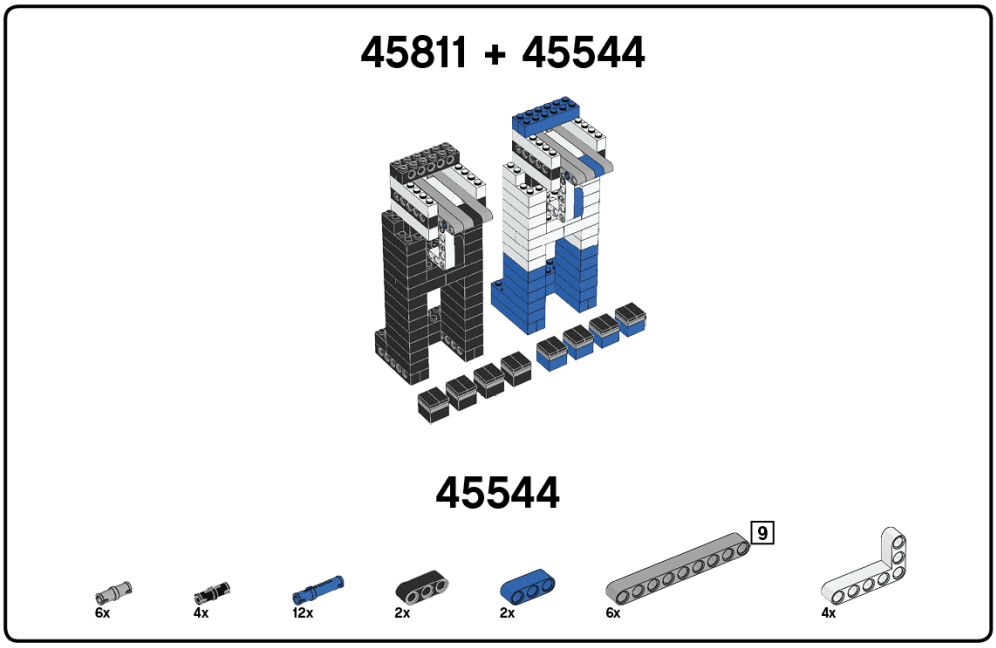
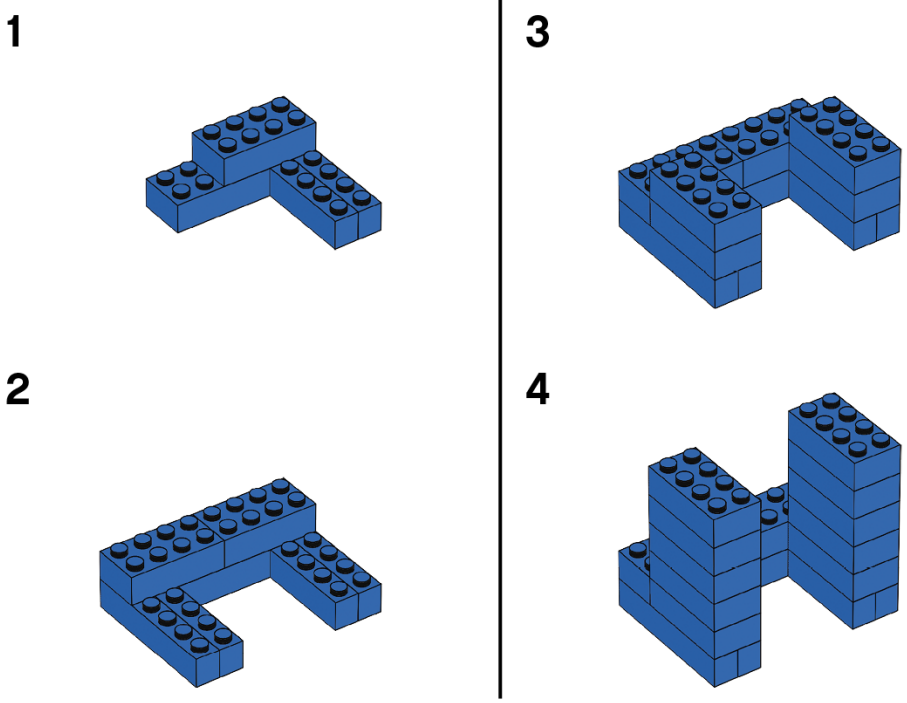


Please be aware that for the abrasive material dispensers you need additional bricks from the EV3 Core Set (45544). The bricks are listed in the following picture below.

If you have the technic beams only in different colors, you can use them as well. The color of these bricks is not important for the mission.





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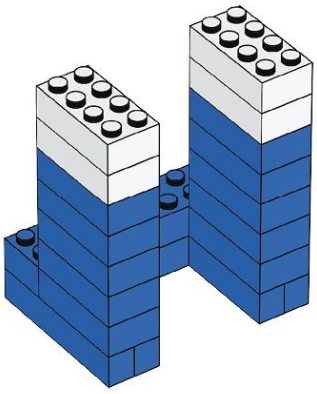

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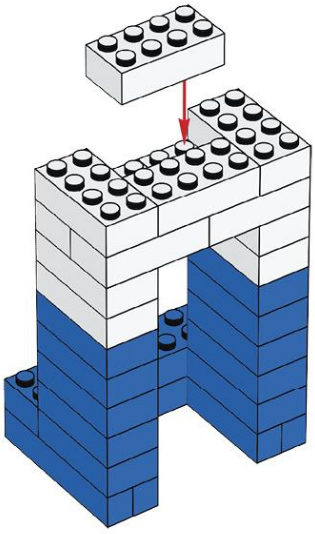

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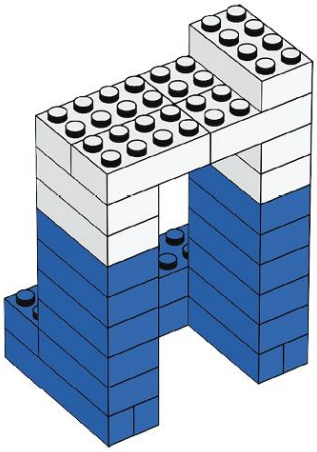

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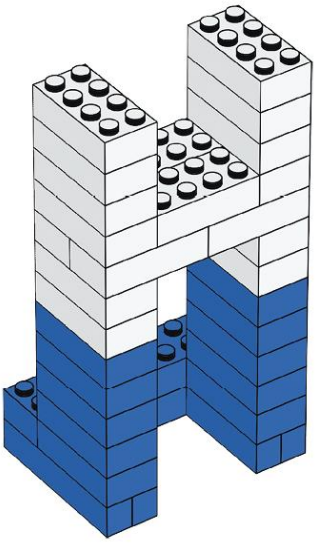

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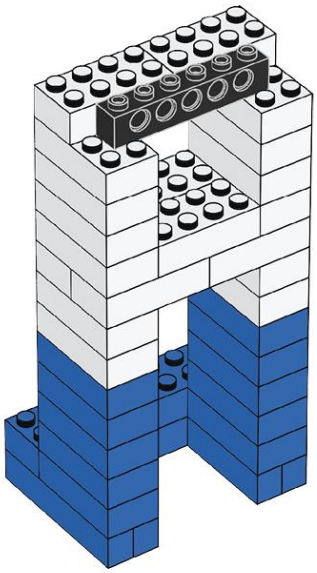

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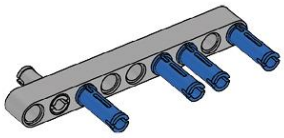

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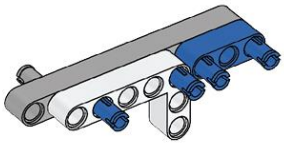

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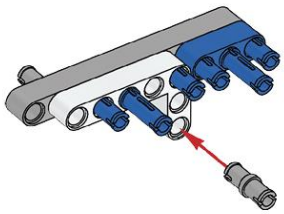

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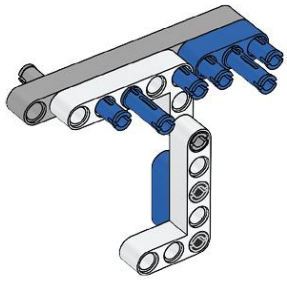

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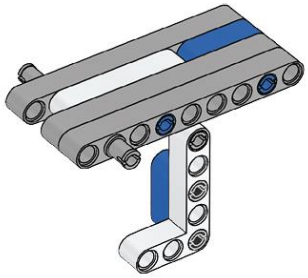

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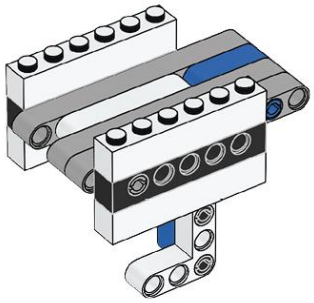

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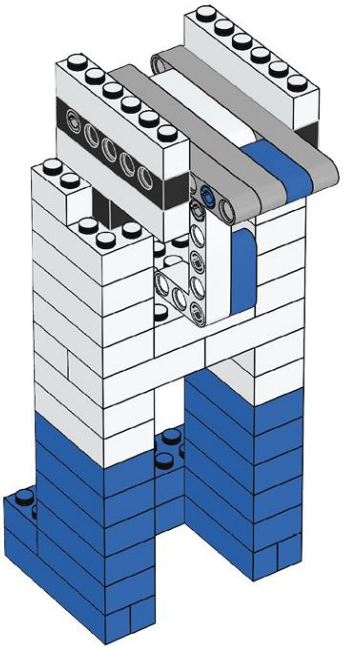

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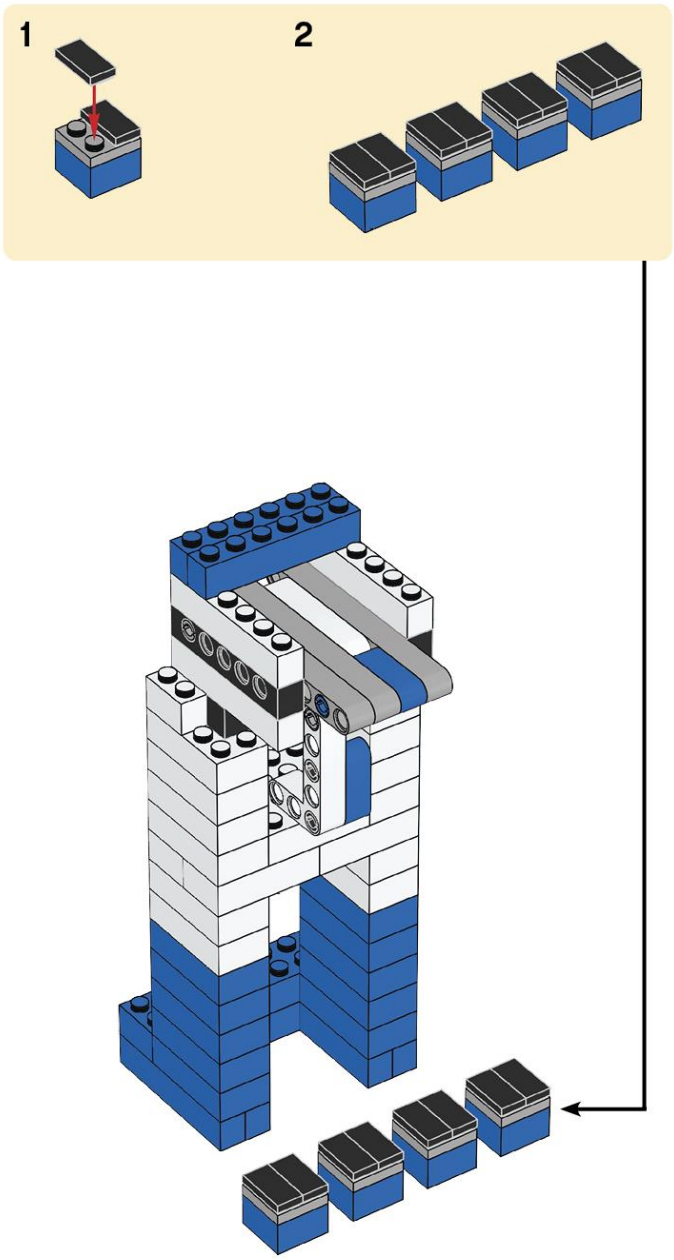

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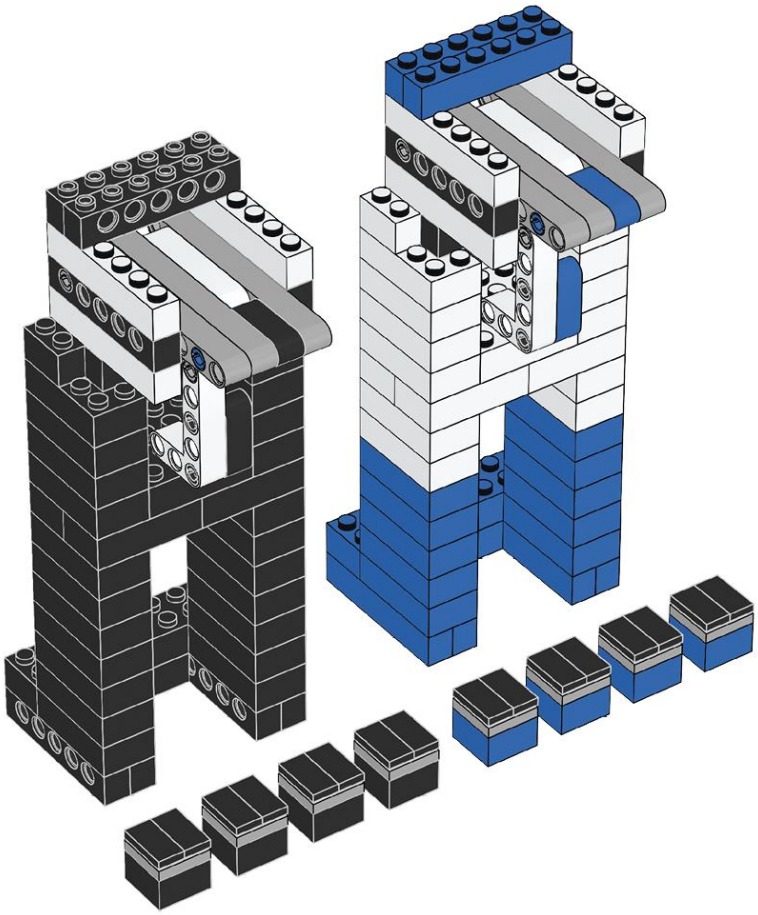

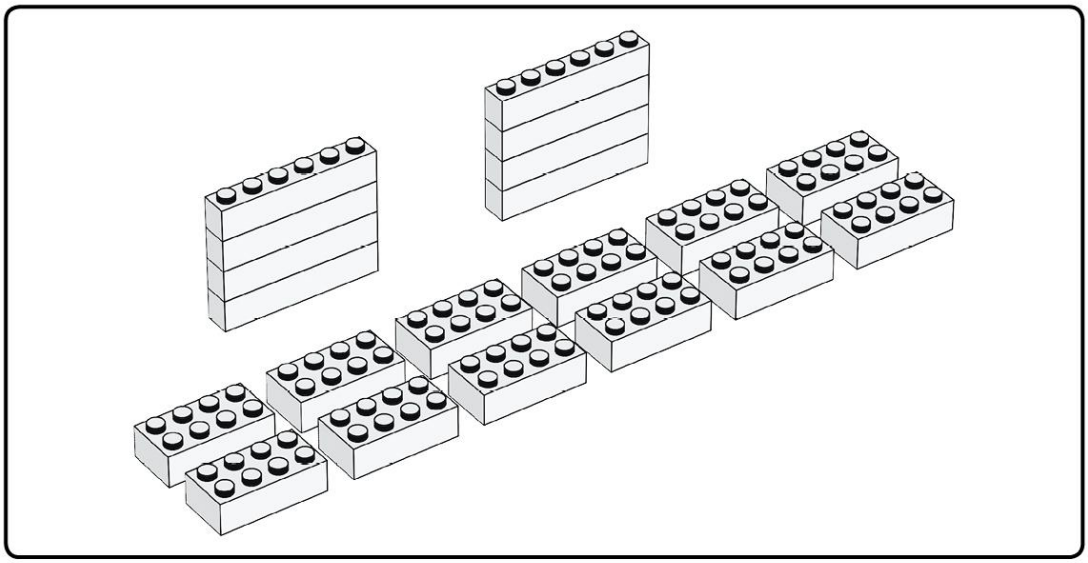

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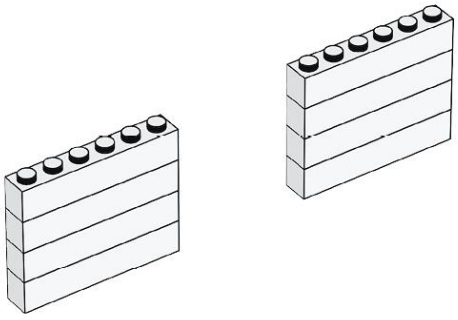

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