

# **World Robot Olympiad 2016**

Regular Category

High School

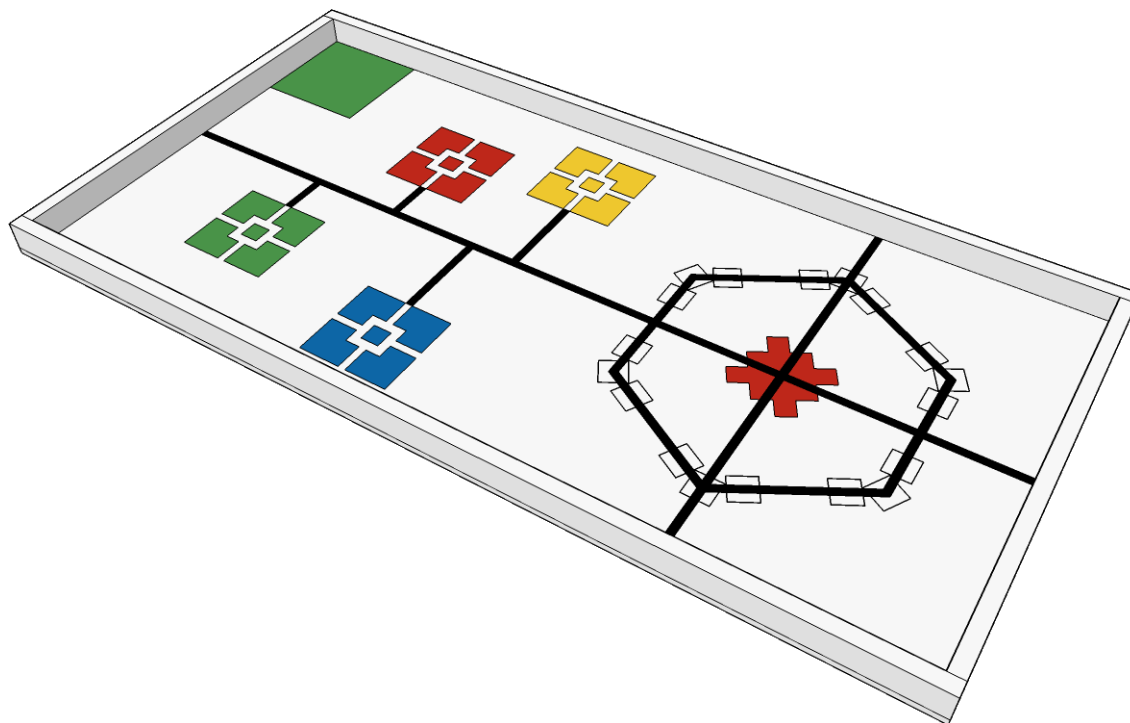
Game description, rules and scoring

## **Recycling Plant**

version: 15 January 2016

## Introduction

The challenge is to make a robot that brings sorted waste stored in recycling containers to the corresponding recycling tank at a waste recycling plant. Furthermore, the robot shall bring the recycling containers to their proper positions for the collection of more sorted waste. To complete the mission, the robot shall finish in a robot maintenance area.

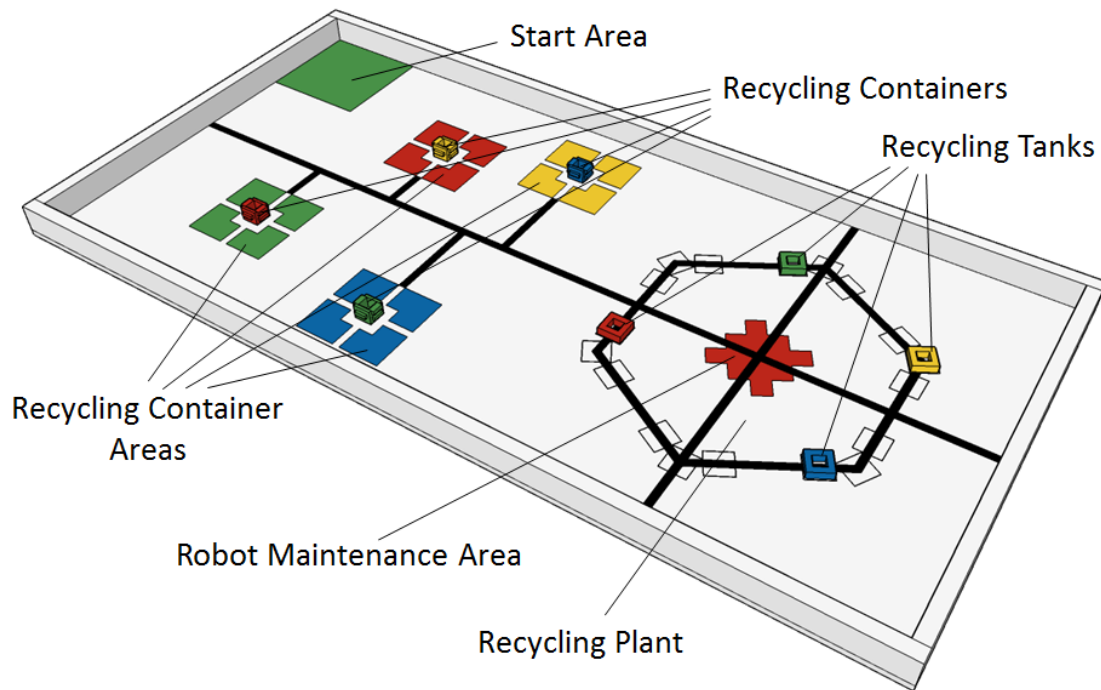


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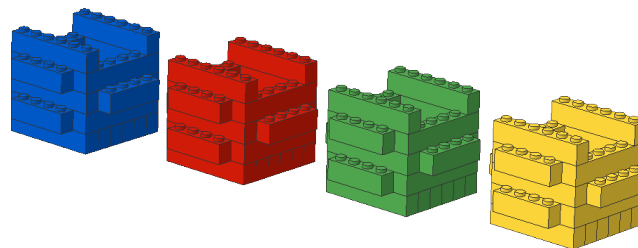
### Game Description:

The mission of the robot is to bring 4 pieces of sorted waste into 4 empty recycling tanks positioned at a recycling plant. The 4 pieces of sorted waste are represented by 4 2x2 LEGO bricks of the colors red, blue, green and yellow. The recycling tanks are represented by square hollow cuboids made out of LEGO bricks. The colors of the cuboids are red, blue, green and yellow. Each of the 4 LEGO brick representing sorted waste needs to be placed in its matching recycle tanks of the same color.



At the beginning of the game the 4 pieces of waste are in their proper recycling containers represented by red, blue, green and yellow LEGO boxes and these 4 boxes are positioned in 4 colored recycling container areas. However, the recycling containers will not be in their matching recycling container area of the same color, so the mission of the robot is also to bring the recycling containers to their proper position before the robot ends the mission by returning to the robot maintenance area.

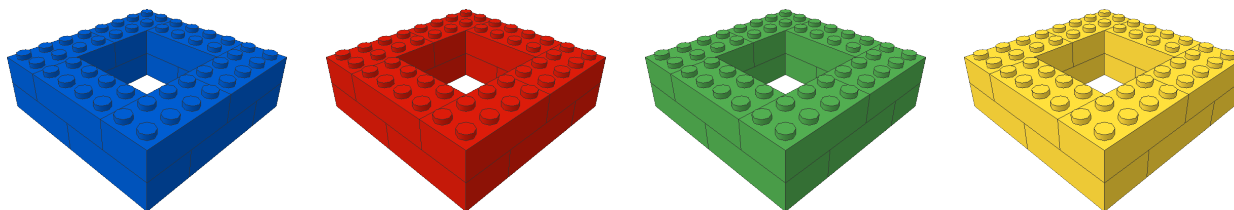
Recycling Containers:



Recyclable waste:



### Recycling Tanks:



The robot will start from within the start area (green square). 4 recycling containers represented by red, blue, green and yellow LEGO boxes are randomly placed in the 4 recycling container areas. Inside each recycling container is a piece of sorted waste represented by a LEGO brick of the same color as the container. 4 recycling tanks are randomly placed in recycling tanks positions in the Recycling Plant. The recycling tanks are square, hollow cuboids made out of red, blue, green or yellow LEGO bricks.

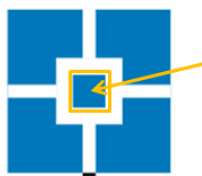
The time taken to do the mission is 2 minutes.

### Game Rules:

1. All teams must go to their designated pit area, be seated and wait for the announcement of the start of the assembly time.
2. The competition format for this challenge is:
  - a. Qualifying rounds (best score taken).
  - b. Quarterfinals (1 round).
  - c. Semifinals (1 round).
  - d. Finals (1 round).
3. Assembly time for this challenge is 150 minutes and will occur before qualifying round 1.
4. Maintenance time for each subsequent round is as follows:
  - a. For qualifying round 2, 45 minutes.
  - b. For qualifying round 3, 30 minutes.
  - c. For quarterfinals round, 15 minutes.
  - d. For semifinals round, 15 minutes.
  - e. For finals round, 10 minutes.
5. Before the robot is placed in the quarantine area for inspection the robot must have only one program with the name "run" in the "Software Files" folder on the NXT brick or only one project on the EV3 brick. The name of the project must be "WRO2016" and the main executable file must be named "run". The judge is allowed to do inspection of the brick before the robot is run. If more than one executable (on the NXT brick) or project (on the

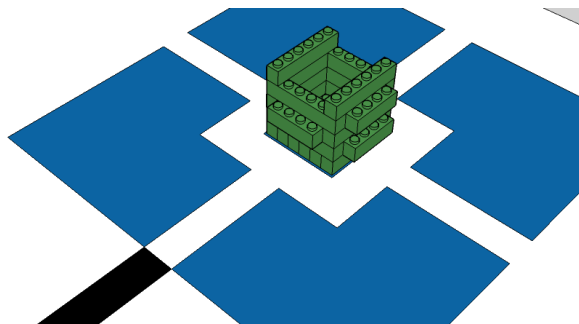
EV3 brick) is detected the participant must remove all files, which violates the requirement.

6. The robot will have 2 minutes to complete the challenge. Time begins at the point when the judge gives the signal to start. The robot must be placed in the starting area so the projection of the robot on the game mat is completely within the start area. The EV3/NXT brick is switched off. The participants are allowed to make physical adjustments to the robot in the starting area. However, data is not allowed to be entered to a program by changing positions or orientation of the robot parts. If a judge identifies that the team could be disqualified from the competition. Once physical adjustments have been made to the satisfaction of the participants, the judge will give the signal for the EV3/NXT brick to be switched on and a program to be selected (but not run). Participants must wait for the judge's signal to start before setting the robot into motion (run the program).
7. The robot's mission is to put the 4 2x2 LEGO bricks representing sorted waste completely inside the 4 empty recycling tanks represented by square hollow cuboids made out of LEGO bricks. Each of the 4 2x2 LEGO brick needs to be placed in its matching recycling tank of the same color. The robot also needs to place the 4 recycling containers in their matching recycling container area of the same color. The mission is completed when the robot is completely inside the maintenance area (red polygon) – all parts of robot touching the field are completely in the red area.
8. The 2x2 LEGO blocks can be placed by the robot in any orientation and any position inside the recycling tanks.
9. Before each round the 4 recycling containers with a 2x2 LEGO brick in each are placed randomly on the colored squares of the 4 recycling container areas. Each recycling container is placed in an area of a different color than the container.

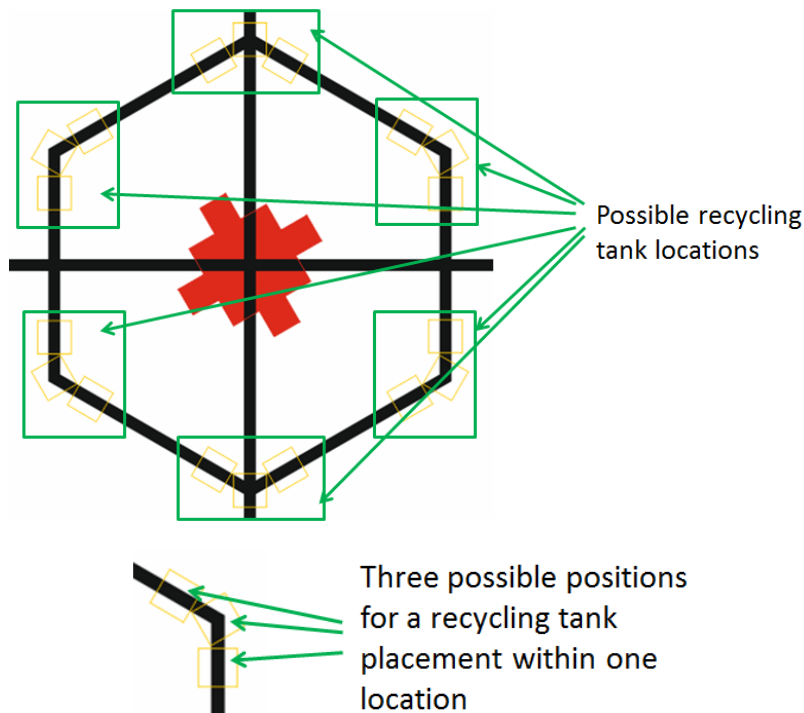


Starting position of recycling container within the recycling container area

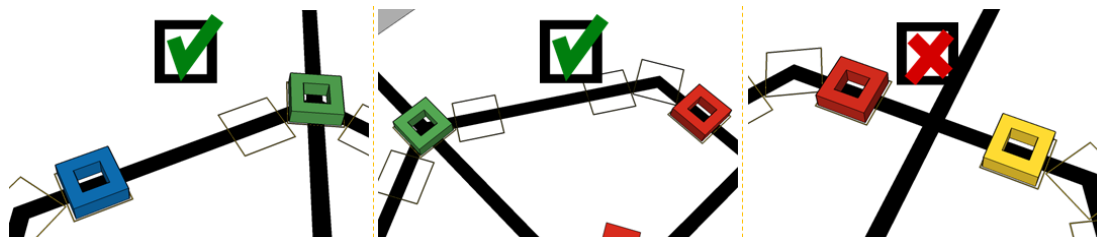
Orientation of the container should be as shown - the bottom of the container is touching the mat and the side with one handle is directed to the black line:



Furthermore, the 4 recycling tanks are also placed randomly on the 18 yellow squares in the Recycling Plant. However, there is only one tank placed in each of the 6 tank locations on the 6 vertices of the hexagon (inside the green squares on the picture below).



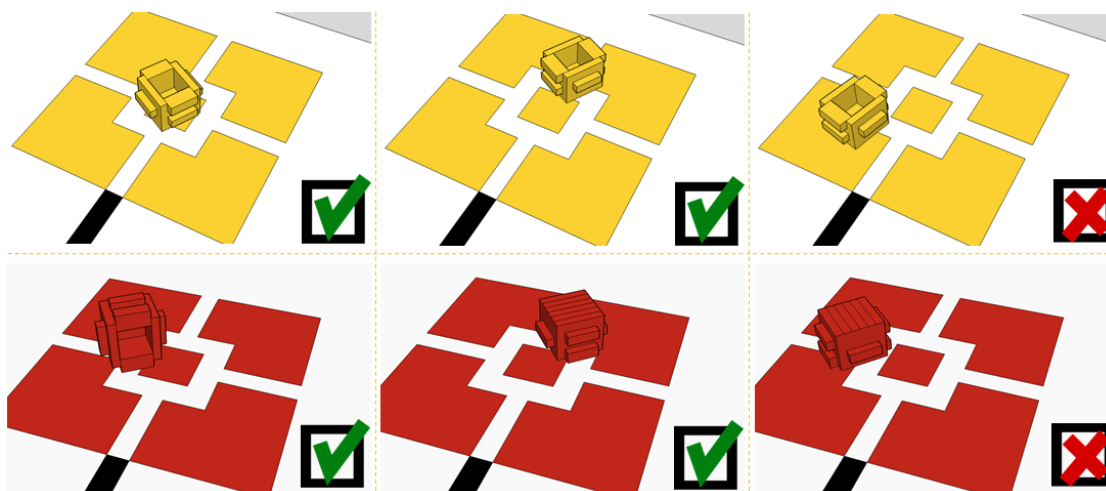
Two tanks cannot be set on next positions on two next tank location.



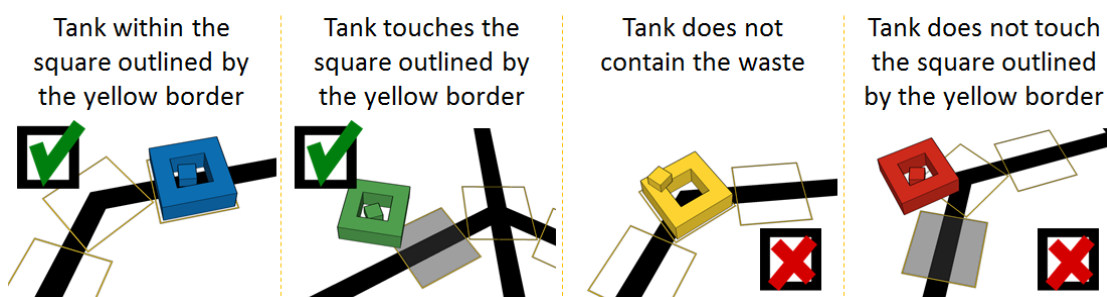
The random placement of the recycling containers can be done manually as follows: The 4 containers are placed in a non-transparent box. They are taken one by one from the box and put on the field on the colored squares within the 4 recycling containers areas in the order red area, blue, green and yellow. For each area containers are drawn from the non-transparent box until a container is drawn with a different color than the area. The random placement of recycling tanks can be done manually as follows: The 6 tank locations are numbered 1 to 6. Put 6 pieces of paper with the numbers from 1 to 6 written on them in a non-transparent box, draw 4 pieces of paper from the box and place the recycling tanks on these numbered locations in the order red, blue, green and yellow. Decide the yellow square placement inside the tank location for each recycling tank by numbering the 3 squares from 1 to 3 and draw a piece of paper from a non-transparent box with 3 pieces of paper with the numbers 1 to 3 on each. The chosen placements of the recycling containers and recycling tanks are kept constant through a round.

10. It is allowed to place a recycling container in its proper recycling container area without removing the recyclable waste inside the container.
11. Depending on the orientation of the recycling containers placed by the robot and its position in the color square different number of points will be given.

Recycling container with studs up or studs not up placed inside colored container area, there is a part of the container which touching the internal square of the area:



12. The robot is not allowed to move the recycling tanks from the squares outlined by the yellow border where it was located before the robot run. If a recycling tank is moved from its position – it is not within the square outlined by the yellow border and do not touch the border, the waste loaded in such a tank is not being taken into account during the scoring procedure.



13. The robot must not damage containers or tanks. If the robot damages a container or a tank zero points will be given for this item.
14. The robot can leave on the field any parts of the robot that are not containing main units (controller, motors, sensors) if needed. As soon as the part is touching the field or its game element and does not touch the robot it is considered as a free LEGO element not being part of the robot.
15. It is not allowed for the teams to touch the robot during the run.

16. If there is any uncertainty during the task, the judge makes the final decision. They will bias their decision to the worst outcome available for the context of the situation.
17. Your attempt and time will end if:
- Challenge time (2 minutes) has ended.
  - Any team member touches the robot during the run.
  - The robot has completely left the game table.
  - A team member shouts “STOP” to end the run.
  - Violation of the rules and regulations within.
  - When the task has been completed and the projection of the robot is completely in the maintenance area.

### Scoring:

- Score will only be calculated at the end of the challenge or when time stops.
- Maximum score = 300 points
- If teams have the same score, ranking is decided by the fastest time recorded.

### Scoring Table:

Particulars	Points Each	Total	Max Game Total
The waste is removed from the recycling container. The waste does not touch any part of any container.	20 points per waste	80 points max	
Waste is loaded to the tank of the corresponding color, i.e. the waste is touching the mat within the tank with the same color. There are no other waste bricks within the tank or touching it. The tank is completely within or touching the yellow square it was initially located at.	40 points per tank	160 points max	
Waste is loaded to the tank of the wrong color, i.e. the waste is touching the mat within a tank of the wrong color. There are no other waste bricks within the tank or touching it. The tank is completely within or touching the yellow square it was initially located at.	20 points per tank	80 points max	
The container is placed in the correct square, the studs are up and any part of the bin is touching internal square of the corresponding color.	10 points per container	40 points max	
The container is placed in the	5 points per container	20 points max	



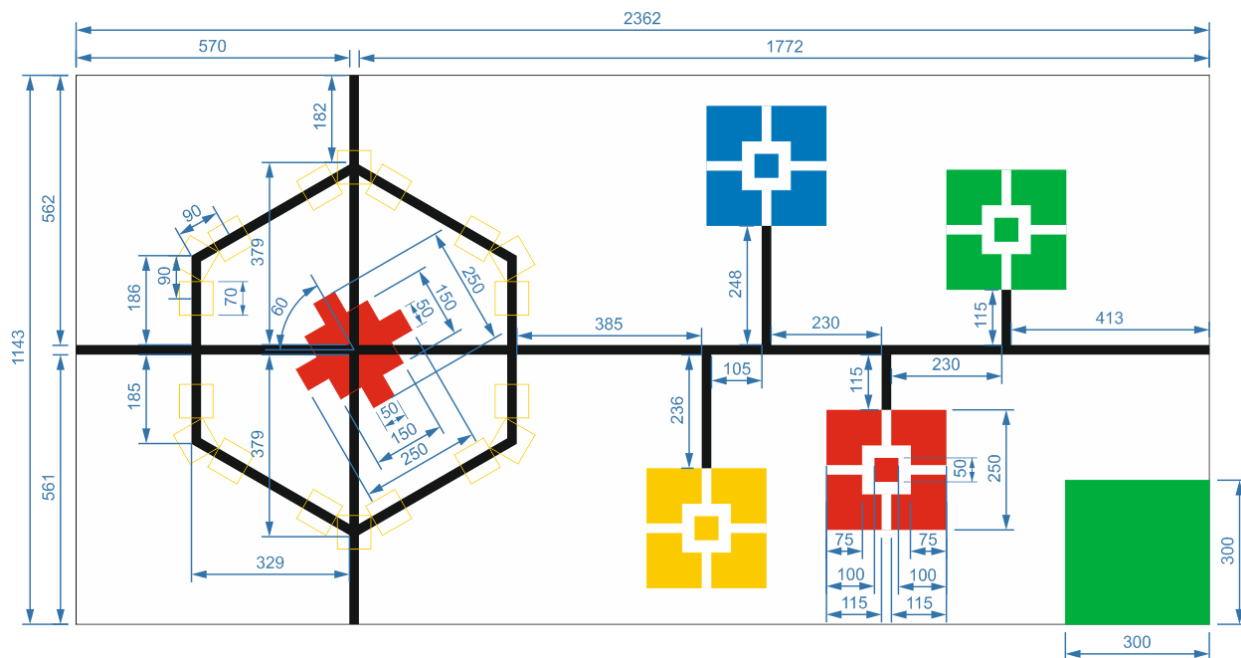
correct square, the studs are in any direction except up and any part of the bin is touching internal square of the corresponding color.			
Robot ends completely in the maintenance area. No part of the robot touching the field is outside of the red polygon in the center of the hexagon.		20 points	
Robot ends in the maintenance area. Some parts of the robot touch the field within the red polygon in the center of the hexagon. But some parts touch the field outside the red polygon.		5 points	
Total			300 points

If two situations are applicable to assign points, the situation with greater score is being accounted.

### Table Specifications:

1. The internal sizes of a game table are 2362 mm x 1143 mm.
2. The external sizes of the table are 2438 mm x 1219 mm.
3. Primary color of a table surface is white.
4. Height of the borders:  $70 \pm 20$  mm

### Game Mat Specifications:

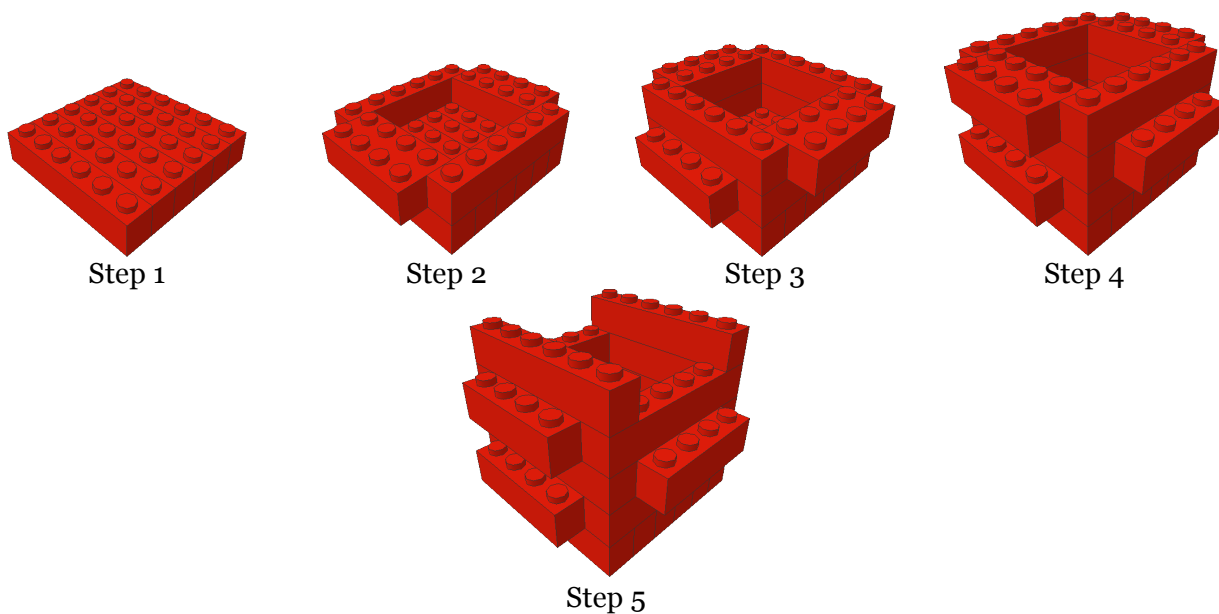


1. All lines are  $20 \pm 1$  mm

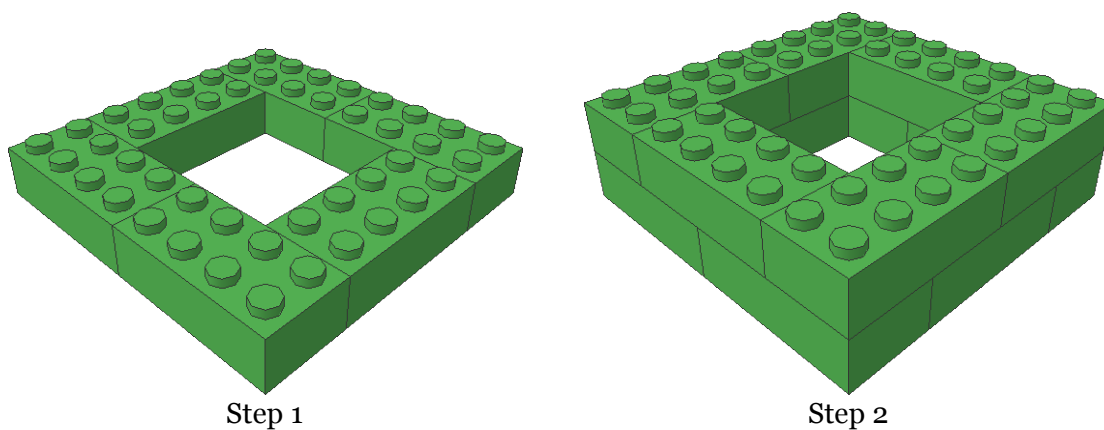
2. Dimensions may vary within  $\pm 5\text{mm}$
3. If the table is larger than the game mat the bottom edge and the right edge of the game mat should align with two walls on the table.

### Game Object Specifications:

Recycling Container:



Recycling Tank:



### Alternative Rules Suggestions

Some country organizers may wish to modify the game rules to simplify the challenge.

Here are a few suggestions.

1. Some organizers may simplify the challenge by removing the recycling tanks. The mission of the robot will be to put the recycling containers to specific positions on the hexagon. The position for every container could be defined by a color title placed within the corresponding yellow square.
2. Some organizers may want to put the recycling containers on the positions on recycling container areas matching with the color of the container. So participants will know that the red recycling container is on the red recycling container area, the green container is on the green area and so on.
3. Some organizers may want to put the recycling tanks only in the middle position on every vertices of the hexagon. It will simplify navigation on the hexagon.

