NATIONAL ROBOTICS COMPETITION

NRC 2023 REGULAR CATEGORY

Lower Primary

GAME RULES

Version: 24 April 2023

Organiser:

Science Centre Singapore

DUCK LEARNING opportunities in education

Sponsored by:

Ministry of Education SINGAPORE

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GLOBAL ROBOTICS GAMES

SP Singapore Polytechnic

RoboCup SINGAPORE

WOW Learning

NRC 2023 Regular Category - Lower Primary

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	10 March 2023	Official Challenge Booklet release
1.1	24 April 2023	Changed Size of Mascot and Updated Building Instruction

Contents

PART ONE – GAME DESCRIPTION

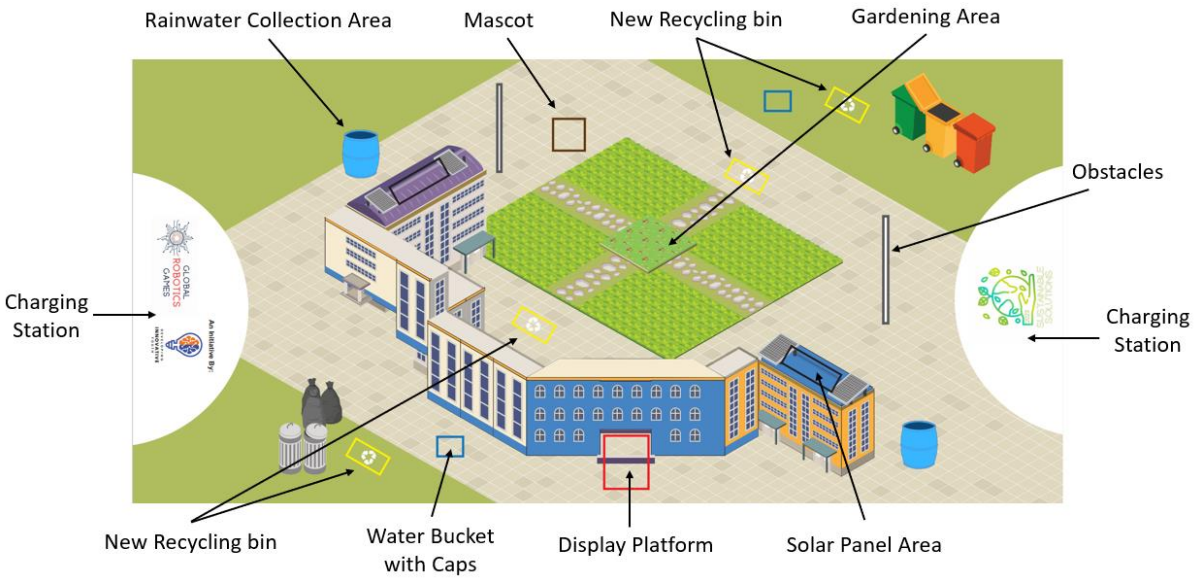
1. Introduction

To promote sustainability and its importance, it is crucial that sustainability efforts must be applied at the best place outside our homes, at school. Food security, proper water management, renewable energy sources and recycling are just some of the green practices that can be done in our schools. This is project Green School!

The robot takes on the task of planting edible seeds, collecting rainwater, activating solar panels, locating the recycling bin and even displaying the school's sustainability mascot! Remember the robot is operating in a school so it must be intelligent enough to avoid bumping into obstacles.

2. Game Field

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



For more information about the table and game mat specifications, please refer to NRC 2023 Regular Category General Rules.

3. Sub-Category Game Rules

If there is any uncertainty during the robot attempt, the judge will make the final decision. The judge should decide in favour of the team if no clear decision is possible.

3.1 Pre-run

- Robot and Construction Equipment will be inspected by referees according to the requirements prior to quarantine.
- The Robot must be placed in the starting area so that the entire robot on the game mat is completely within the start area.
- Teams are allowed to make physical adjustments to the robot in the starting area before the start of the run.
- Teams are not allowed to enter data to a program by changing positions or orientation of the robot parts or to make any sensor calibrations of the robot.

3.2 Start of Robot Run

- Time begins when the judge gives the signal to start.
- Each robot attempt is 2 minutes (120 seconds).

3.3 During Robot Run

Robot must always start/re-start from any start area.

Teams are allowed the following only when their robot is **completely within any start area**:

- To swap between autonomous and non-autonomous mode.
- To change the location of the starting point of the robot to any start area.
- To change and select the program file that they would like to execute to complete the particular mission.

Teams are not allowed:

- To touch the robot when the robot is moving.
- To reprogram and enter data into the robot their robot during robot run.
- When in autonomous mode, to control the robot using any form of remote or wireless control.

3.4 Ending of Robot Run

A robot attempt will end if…

- the robot attempt time (2 minutes) has ended.
- the robot has completely left the game table.
- the robot or the team violated rules or regulations.
- a team member shouts “STOP” and robot does not move anymore. If the robot is still moving, the robot attempt will only end once the robot stops by itself or is stopped by the team or judge.

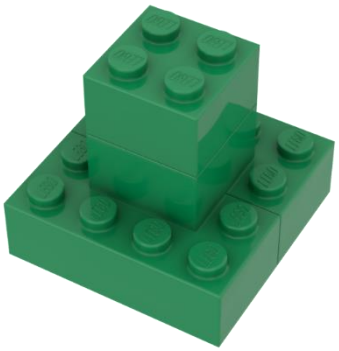
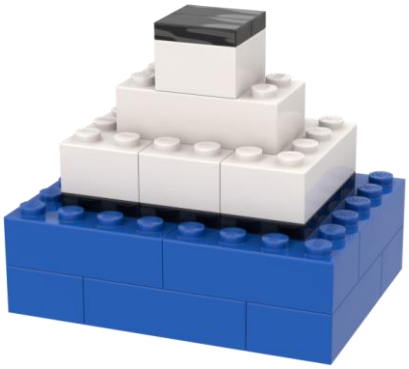
Once the robot attempt has ended, time is stopped, and the judge scores the attempt. The scores are noted on a scoring sheet (on paper or digital), the team need to sign off the scores (on paper or digital signature/checkbox). Once the score is signed off no further complaint is possible.

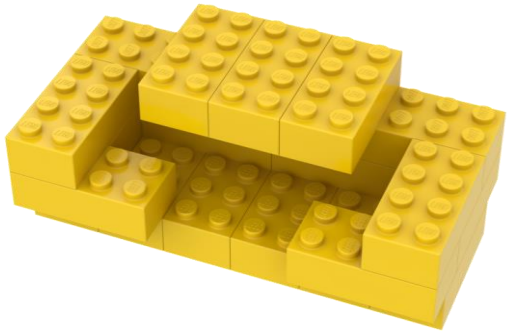
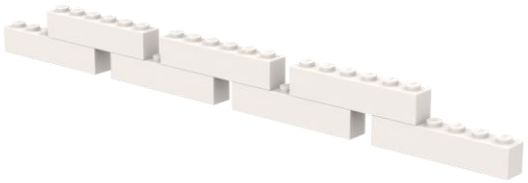
If a team does not want to sign off after a certain period, the judge can decide to disqualify the team for this round. It is not allowed for a team coach joins the discussion with judges on the scoring of the run. Video or photo proofs will not be accepted.

If a team finishes an attempt without having solved a (partial) task that yields positive points, the time of that run will be set at 120 seconds.

The ranking of teams depends on the overall tournament format. For example, the best attempt out of two rounds could be used and if competing teams have the same points, the ranking is decided by the record of time.

4. Game Objects, Positioning, Randomization

3 Edible Seeds There will be a total of three edible seeds. These edible seeds will begin with your robot at the start.	
2 Water Buckets with Caps There are 2 water buckets with caps placed in the 2 blue rectangles on the playfield.	
1 Solar Panel There is one solar panel placed inside one of two black rectangles on the playfield.	
1 Display Platform There will be 1 display platform placed in the parade square of the school.	

1 New Recycling Bin There will be 1 new recycling bin placed randomly in one of the four yellow rectangles in the playfield.	
2 Obstacles There will be 2 obstacles placed in the 2 rectangles on the playfield.	

5. Robot Challenge

For a better understanding, the missions will be explained in multiple sections. **The team can decide in which order they will do the missions.**
Scoring for each mission will either be: Final State (scoring is done when the Robot Attempt ends) or In State (scoring is done during the Robot Attempt i.e. Robot is moving).

5.1 Plant edible seeds in the school garden

The edible seeds will begin with your robot in the starting area. Your task is to transport and plant the edible seeds in the school garden. Your mission will be considered successful if your edible seeds are completely in the gardening area (defined as the centre green square surrounded by the 4 pavement).

Final State	**Points (Each)**
Edible seed is completely in the gardening area	10
Edible seed is partially in the gardening area	5

5.2 Collect rainwater using water buckets

We can reuse the rainwater collected for other cleaning purposes. Your task is to collect the rainwater by transporting the water bucket into the rainwater collection area. Your mission will be considered successful if you have transported the water bucket to the collection area, then removed the bucket cover. The collection area is defined as the blue water bucket image on the playfield.

In State	**Points (Each)**
Water bucket is upright and completely in the rainwater collection area and the bucket cover is completely removed by the robot after placing within the collection area.	15
Water bucket is completely in the rainwater collection area in any position other than upright. or the bucket cover is touching any part of the water bucket.	10

Water bucket is completely in the rainwater collection area, but the bucket cover fell off during the transportation process.	5

5.3 Activate the solar panel

Activate the solar panel in the designated area. Your task is to transport the solar panel from one of the black rectangles to the other rectangle and activate the lever of the solar panel. The position of the solar panel will be randomised. Your mission will be considered successful if the grey panel is facing upwards and the solar panel is completely in the designated area.

Final State	**Points (Each)**
Solar panel is completely in the designated area and the grey panel is facing upwards.	30
Solar panel is partially in the designated area and the grey panel is facing upwards.	20
Solar panel is completely in the designated area but grey panel is not facing upwards.	10

5.4 Display your Sustainability Mascot

Create a Sustainable Mascot using LEGO® bricks with a maximum size of 8cm x 6.5cm x 8cm. Your task is to display your mascot at the school's foyer. Your mission will be considered successful if your mascot is placed directly on the display platform and the platform is completely in the red box.

Final State	**Points**
Mascot is placed directly on top of the display platform and the platform is completely in the red box.	30
Mascot is placed directly on the display platform and the platform is partially in the red box.	10

5.5 Share the location of the new Recycling Bin

There is a new recycling bin placed somewhere in the school. Your task is to locate the new recycling bin by using an autonomous robot. Your robot will need to detect the recycling bin using either a colour sensor or motion sensor and to share its location by displaying an output using movement - do a 360^{o} turn on the spot.

In State	Points
Autonomous robot detected the recycling bin using a sensor (colour sensor or motion sensor) and share its location by displaying an output using movement (doing a 360^{o} turn on the spot).	40

5.6 Avoid the Obstacles

Avoid hitting the obstacles within the playfield. More points will be awarded if the obstacles are left untouched. If obstacles are completely outside of the white boxes, no points will be awarded. Teams can only score these if the robot has scored some points in the other sections 5.1 – 5.5.

Final State	Points (each)
Obstacle remains completely in the white box untouched	15
Obstacles is partially touching outside of the black outline	5

5.7 Park the Robot

Return your robot to its charging station before the timer runs out. Your task is to park it within the designated charging station. Teams can only score these if the robot has scored some points in the other sections 5.1 – 5.5.

Final State	Points
Robot is completely in the charging station	10

6. Competition Scores

Game field score is up to a maximum of 200 points scored as described in the table below.

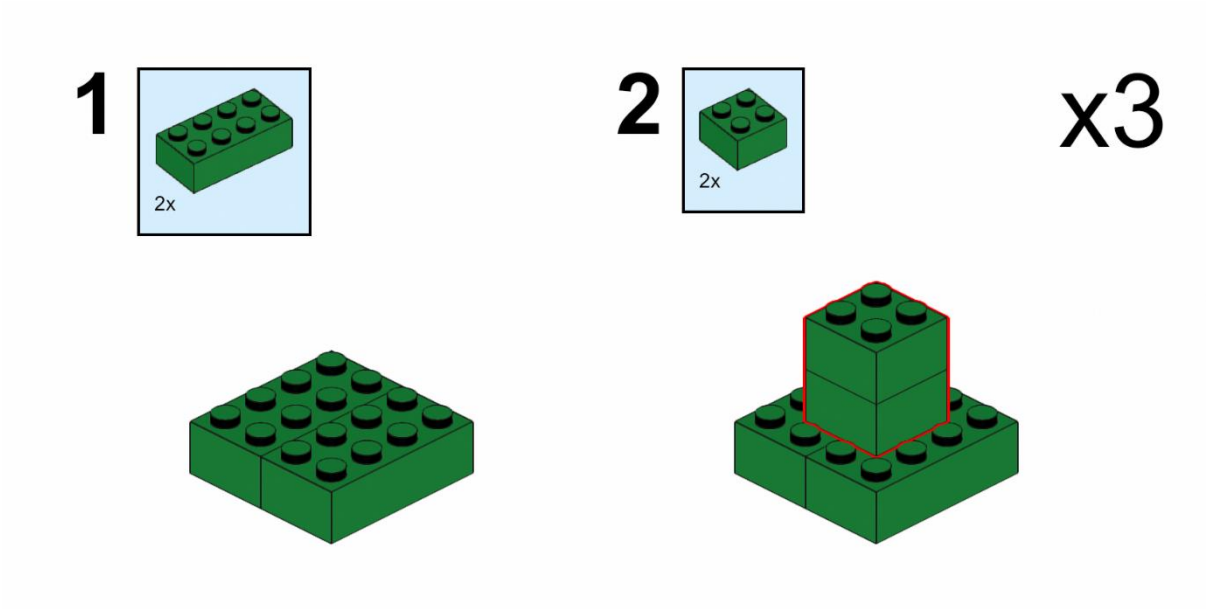
Tasks	Each	Total / Max
1. Plant the Edible Seeds in the School Garden		
Edible seed is completely in the gardening area	10	**30**
Edible seed is to partially in the gardening area	5	
2. Collect Rainwater using Water Bucket (In State)		
Water bucket is completely in the rainwater collection area and the bucket cover is completely removed	15	**30**
Water bucket is completely in the rainwater collection area with the bucket cover touching any part of the water bucket	10	
Water bucket is complete in the rainwater collection area, but the bucket cover fell off during the transportation process	5	
3. Activate the Solar Panel		
Solar panel is completely in the designated area and the grey panel is facing upwards	30	**30**
Solar panel is partially in the designated area and the grey panel is facing upwards	15	
Solar panel is completely in the designated area	10	
4. Display your Sustainable Mascot		
Mascot is placed directly on the display platform and the platform is completely in the red box	30	**30**
Mascot is placed directly on the display platform and the platform is partially in the red box	10	
5. Share the location of the New Recycling Bin (In State)		
Autonomous robot detected the recycling bin using a sensor (colour sensor or motion sensor) and share its location by displaying an output using movement	40	**40**
6. Avoid the Obstacles (only score if there are points given in 1 – 5)		
Obstacle is completely in the white box	15	**30**
Obstacles is partially touching outside of the black outline	5	
7. Park the Robot (only score if there are points given in 1 – 5)		
Robot is completely in the charging station	10	**10**
Maximum Score		**200**

6.1 Scoring Interpretation

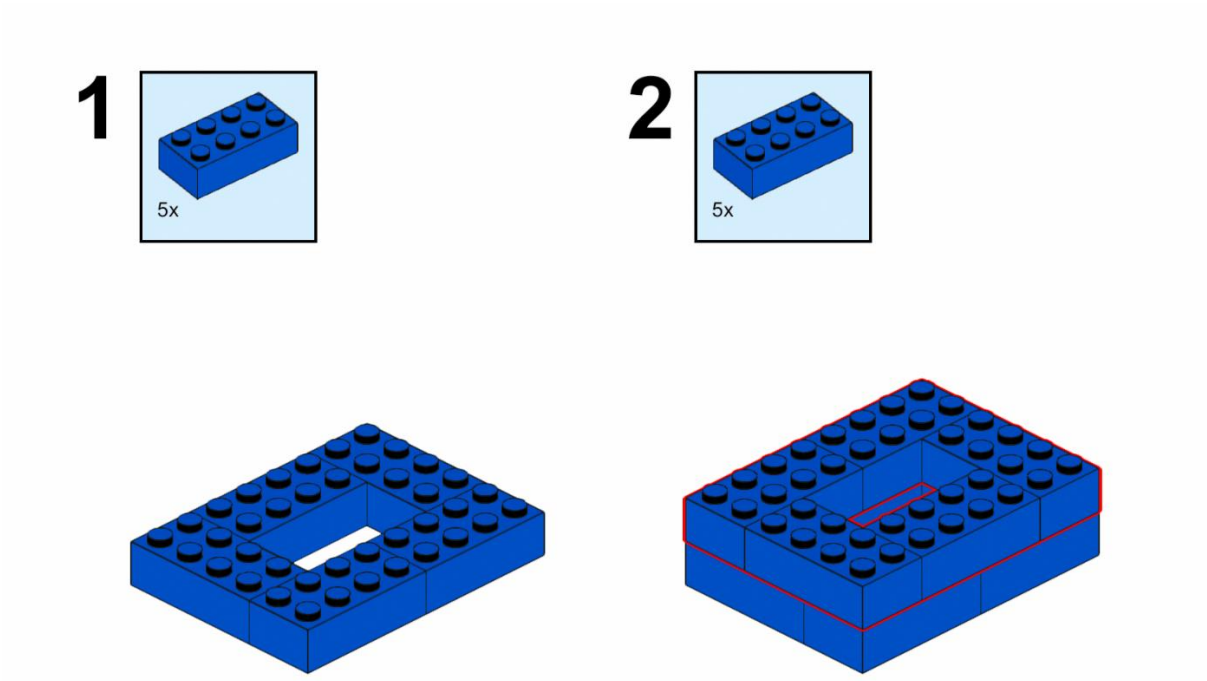
- Scoring Interpretation will be released at a later date -

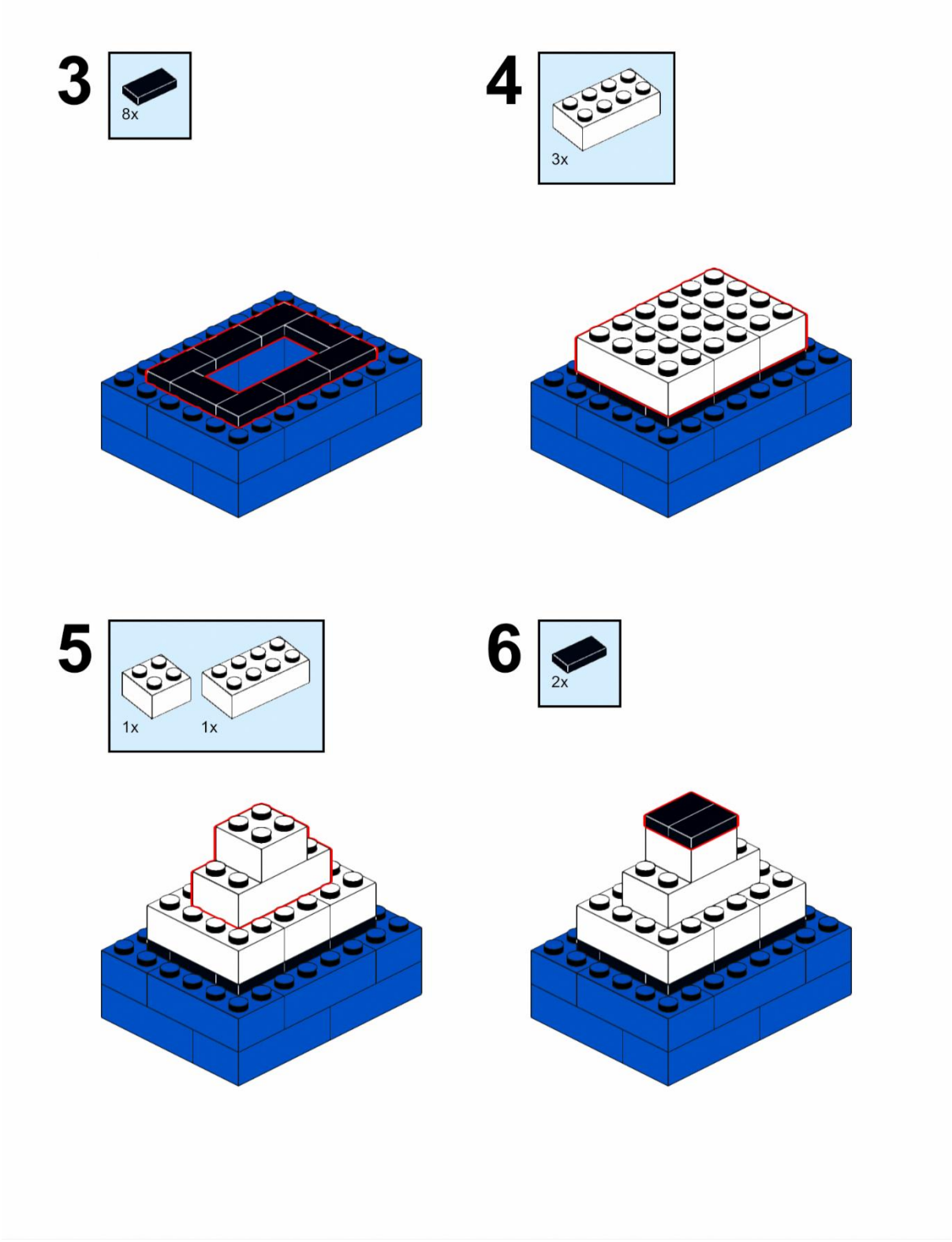
7. ASSEMBLY OF GAME OBJECTS

7.1 Edible Seeds (X3)

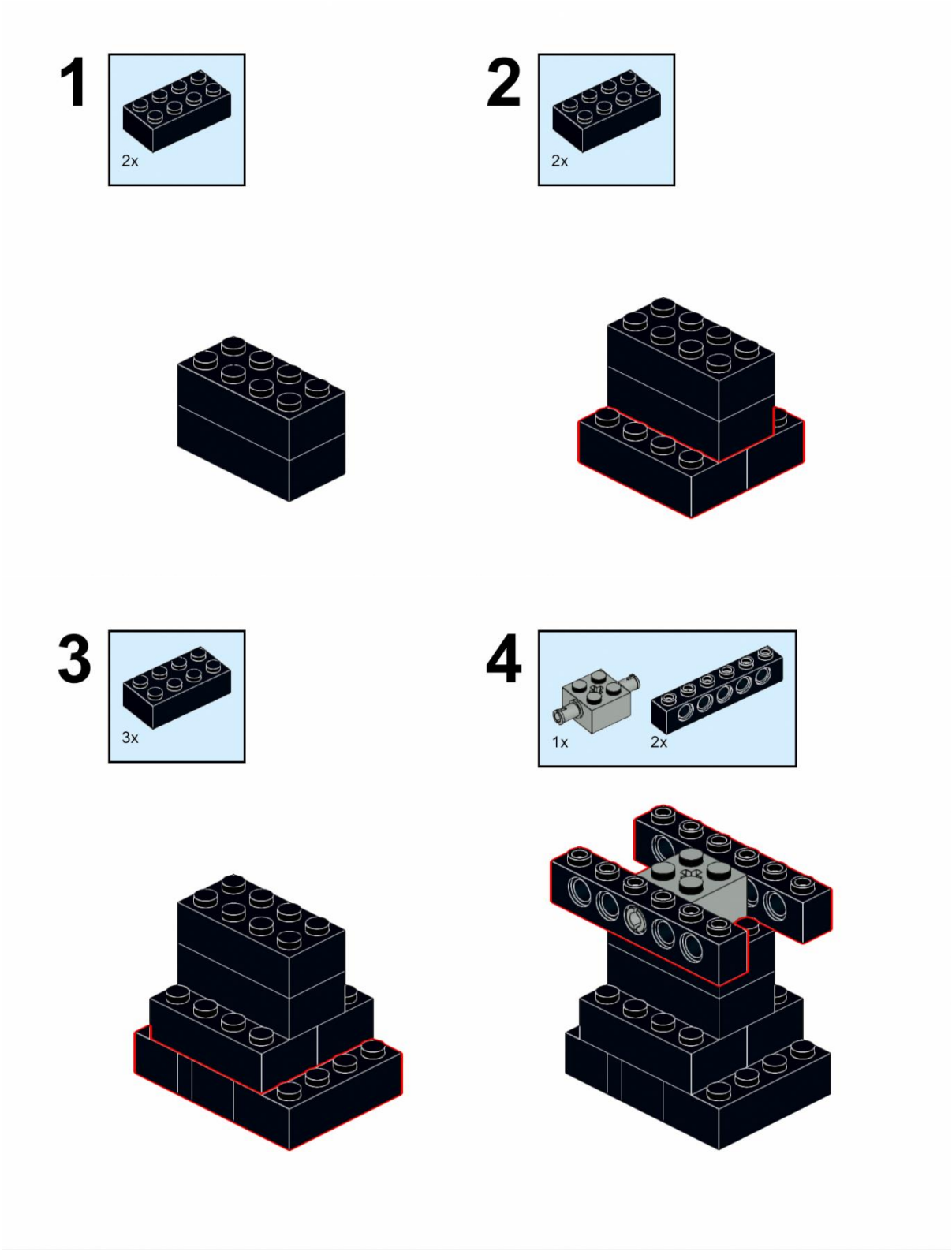


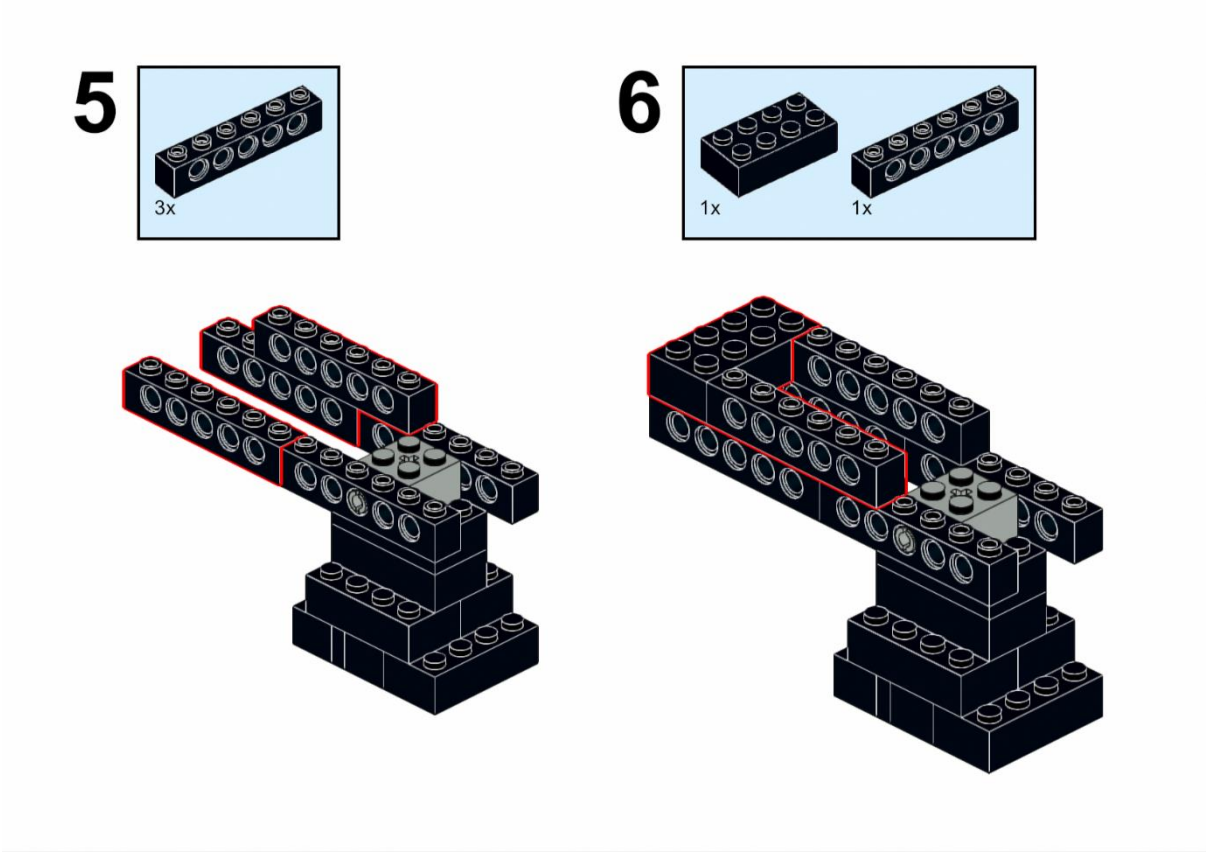
7.2 Water Bucket with Cap (X2)

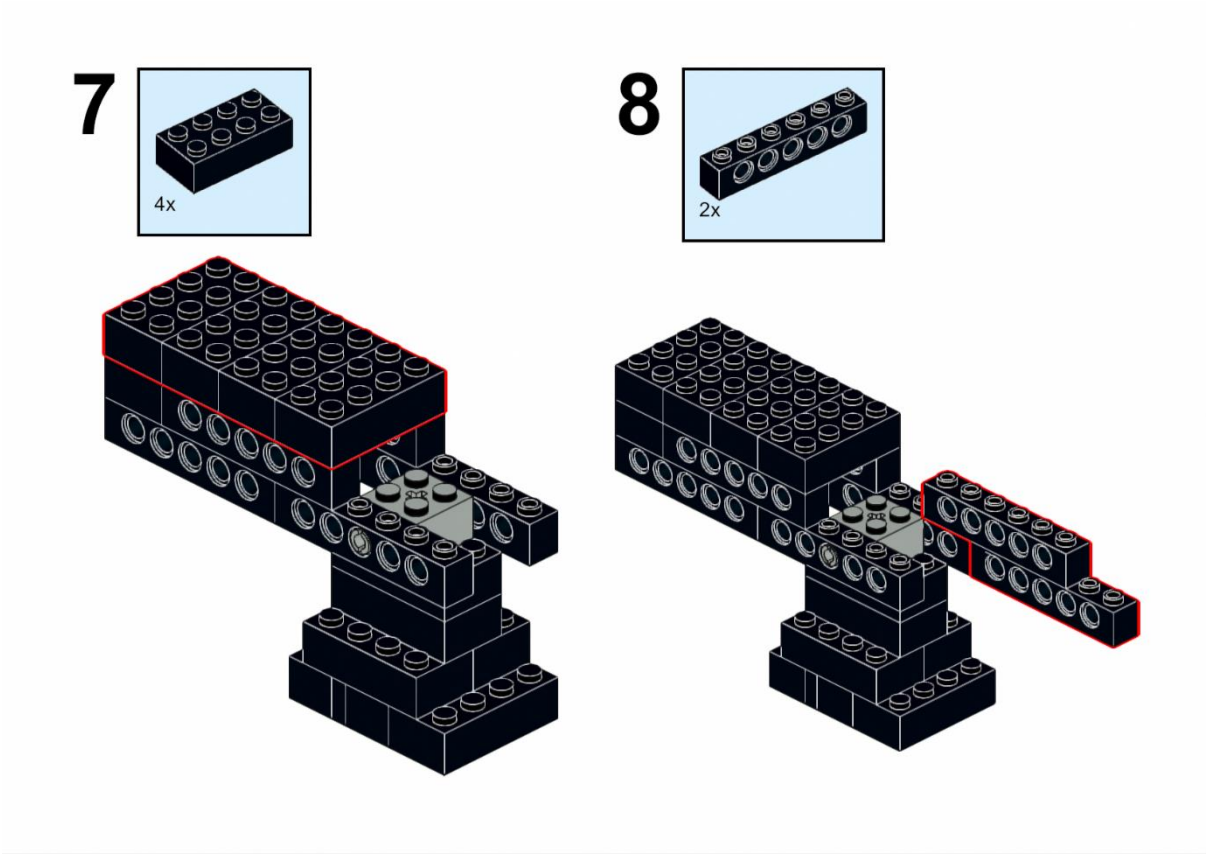


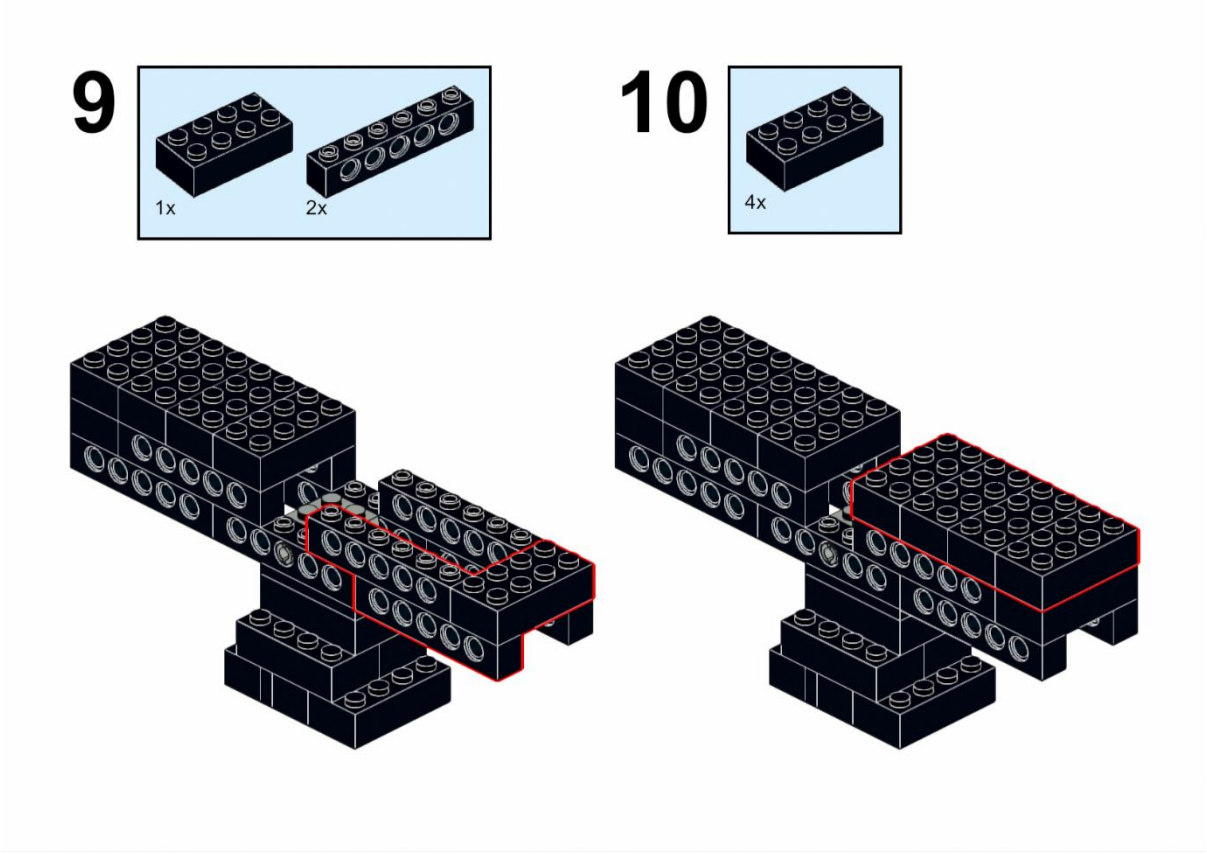

3
8x
4
3x
5
1x
1x
6
2x

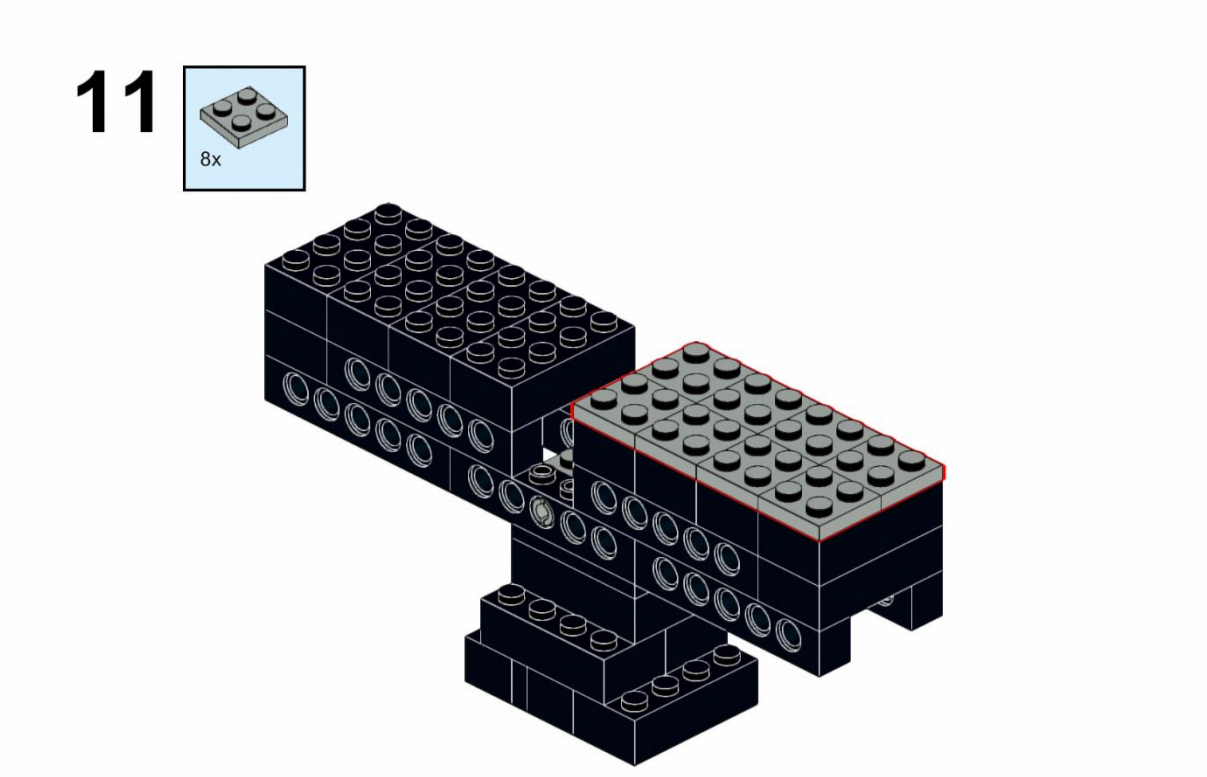
7.3 Solar Panel (X1)



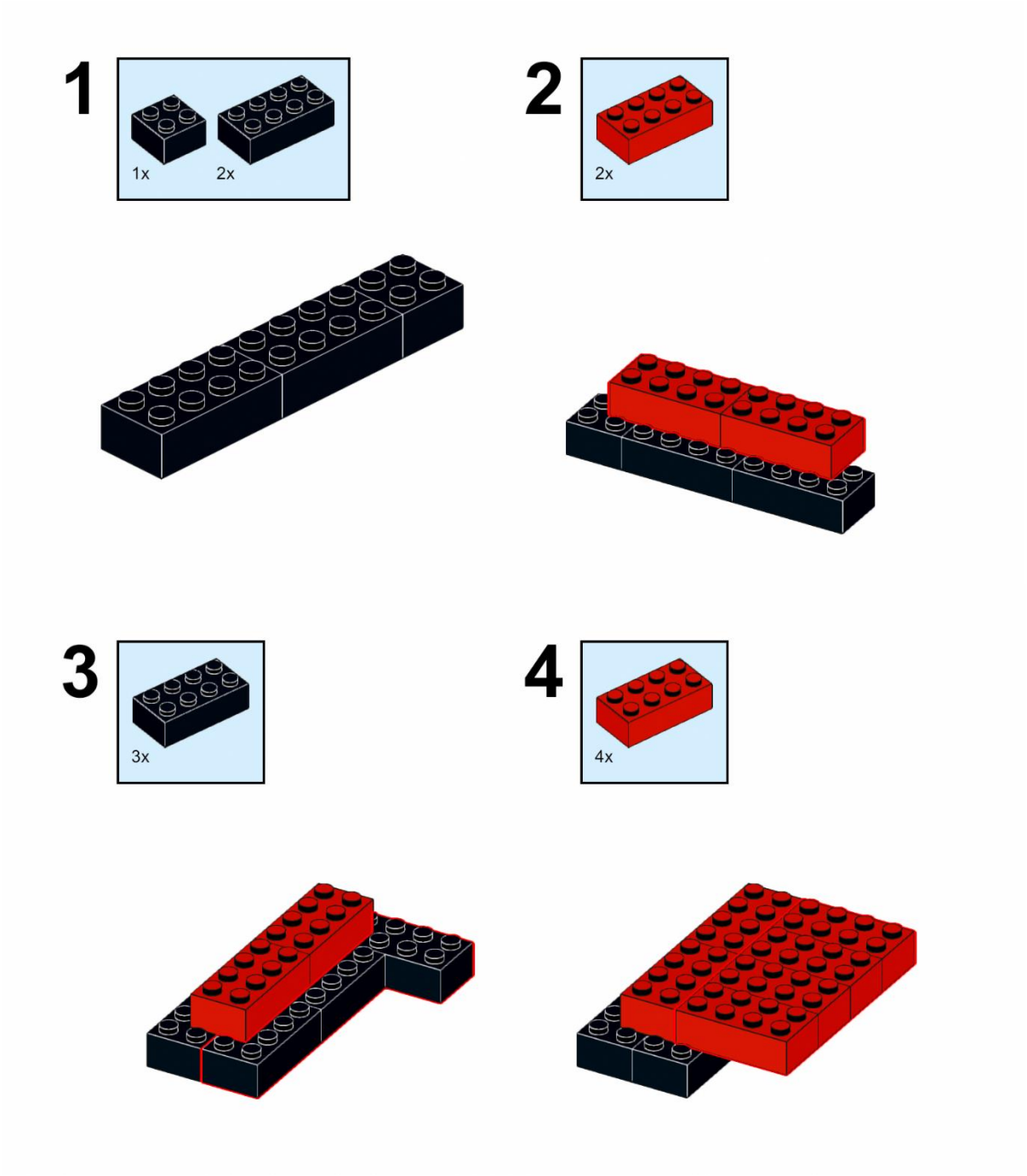

5
3x
6
1x
1x

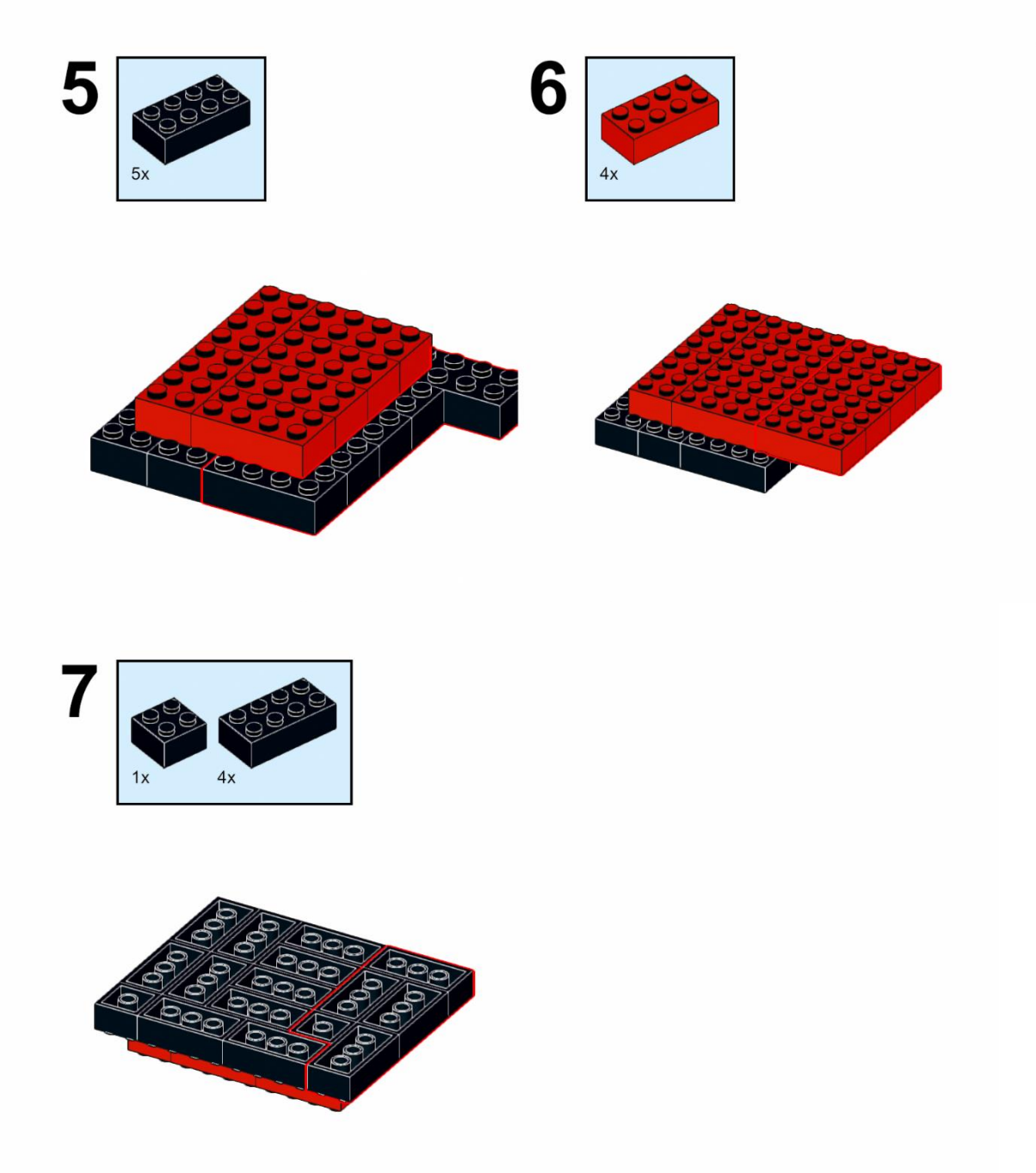

7
4x
8
2x


9
1x
2x
10
4x

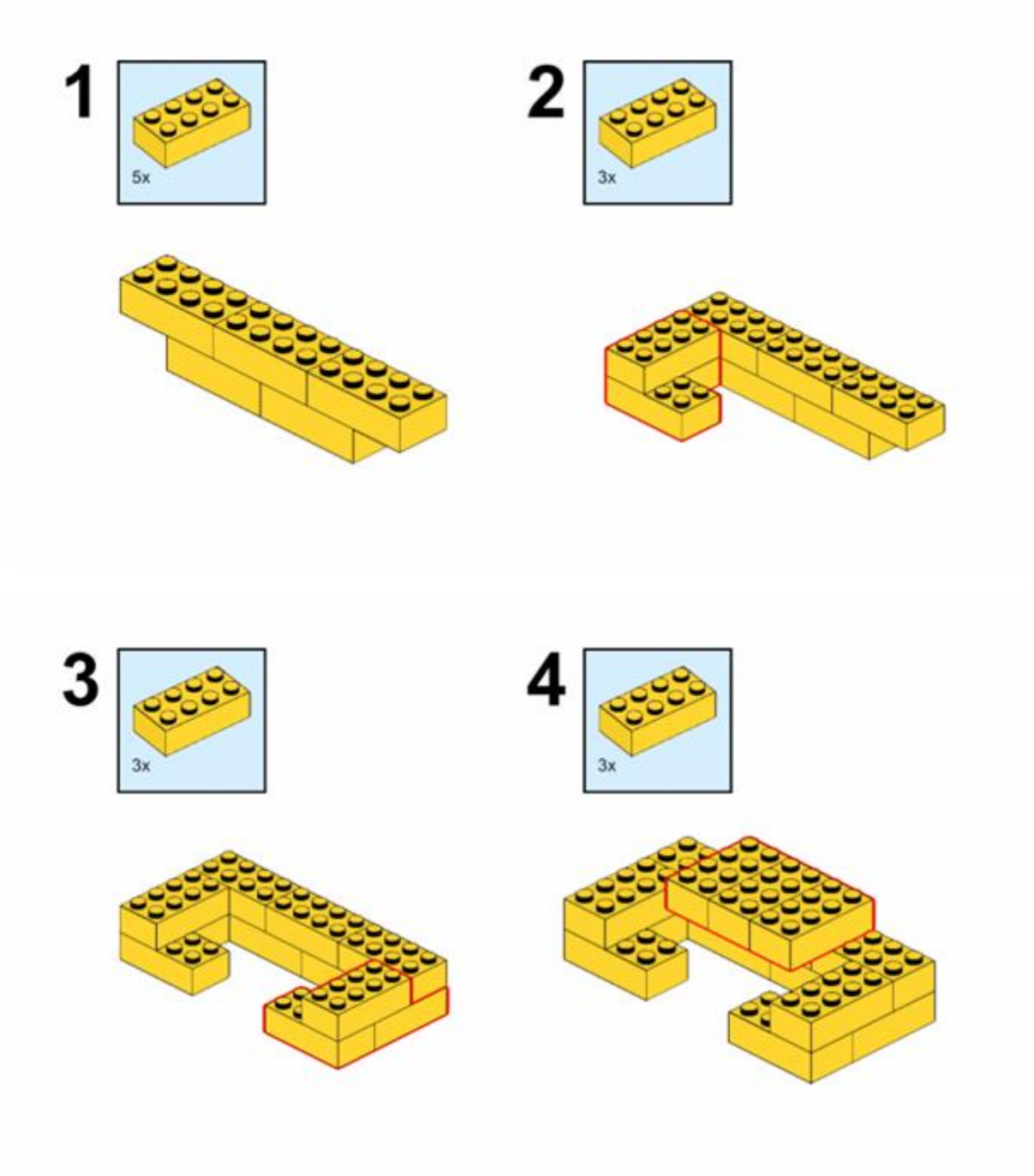

11
8x

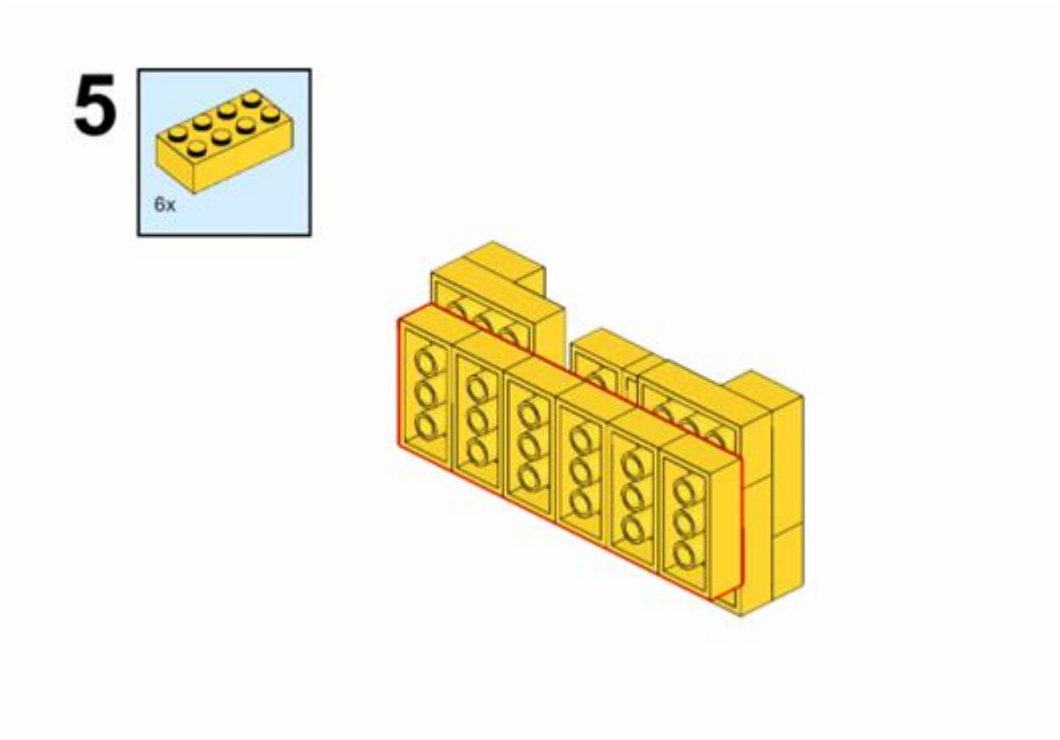
7.4 Display Platform (X1)



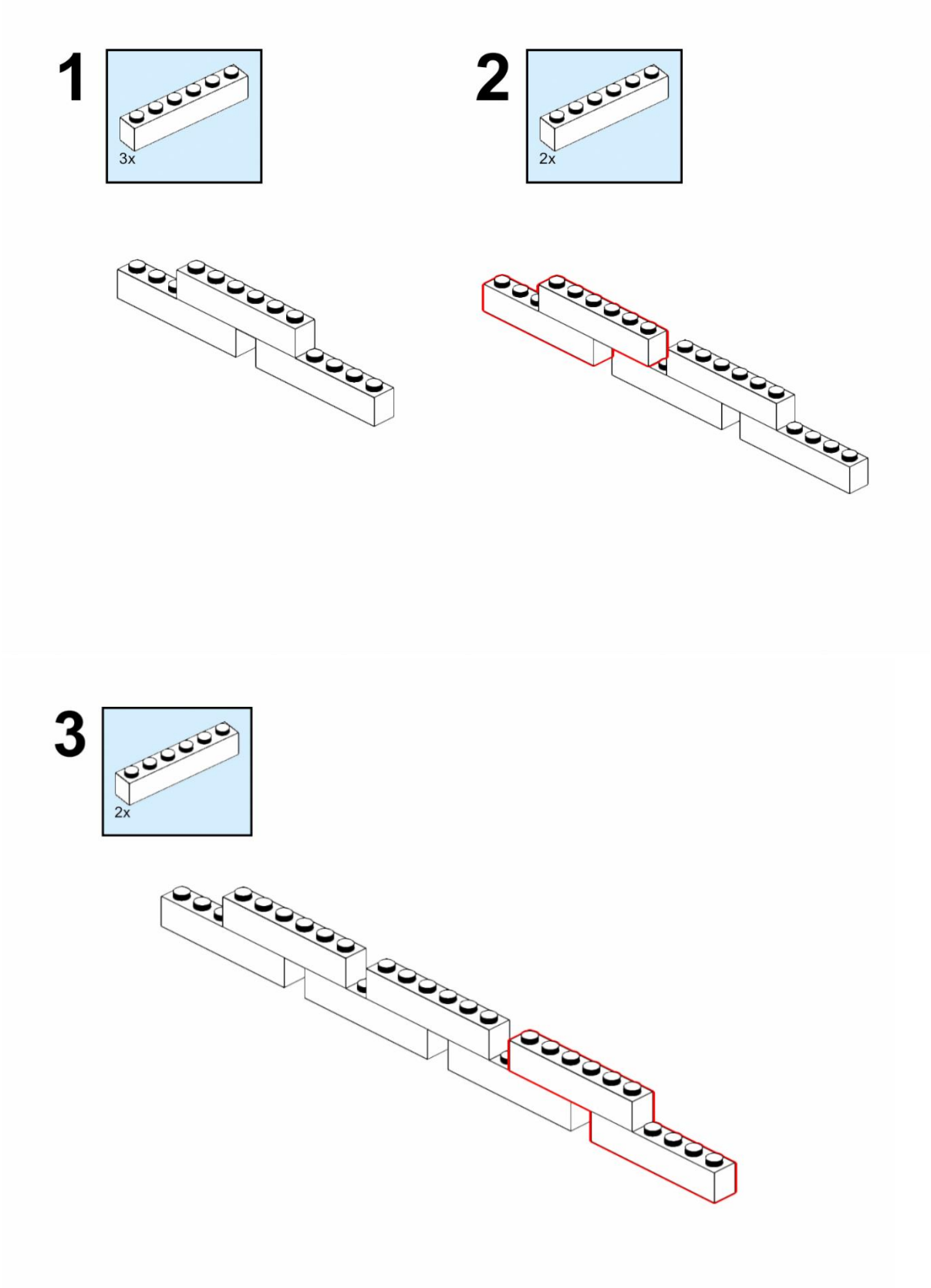

5
5x
6
4x
7
1x
4x

7.5 New Recycling Bin (X1)




5
6x

7.6 Obstacles (X2)



END