CONNECTING THE WORLD
MARINE LIFE PRESERVATION

Table of Contents

Information on how to use these game rules in countries:

We deliberately have a mix of simple and more difficult tasks in the game rules. These rules are also used for the WRO International Final, where we expect to see many teams that can solve all missions. At a local, regional or national level however, there will be many teams that do not have the experience, knowledge or time to solve everything. This is intentional. By offering simple and more complicated tasks all teams will be able to solve parts of the challenge and can keep trying to improve their work. (Also see chapter 6)

1. Introduction

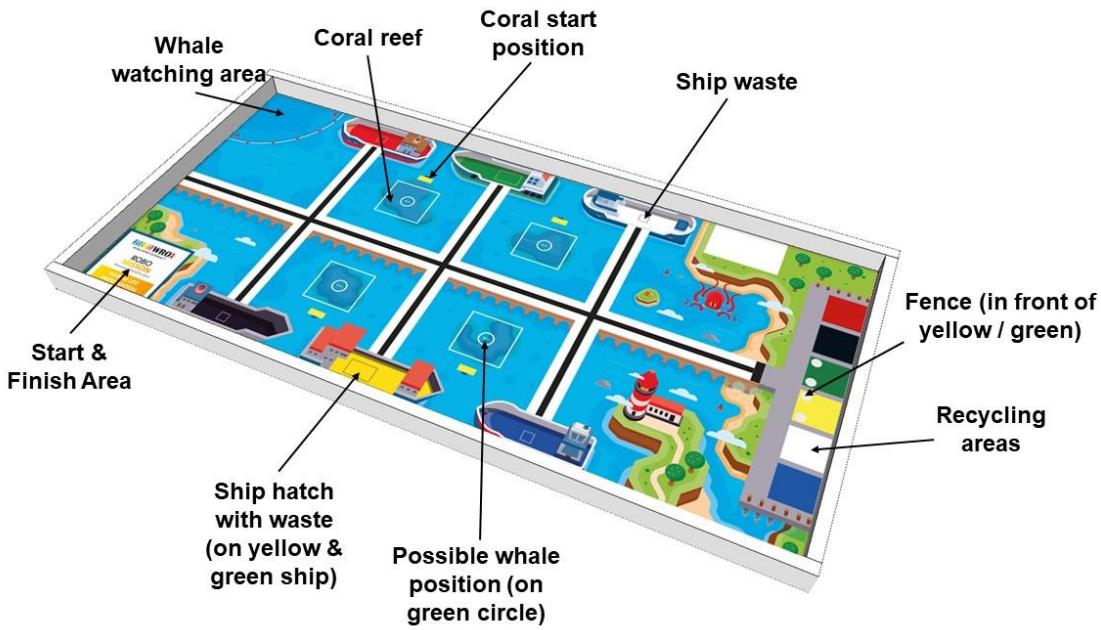
Life underwater is important and humans depend on it for food, clean drinking water and even for protection against flooding. That is why it is important that we protect the water against pollution and that we protect and restore the underwater eco-systems.
To protect our oceans, we have the “MARPOL convention.” It is an agreement between countries worldwide that ships cannot pollute the water and throw their waste overboard. This means that ships will need to save all their waste until it can be collected.

There are also many initiatives that help to restore underwater areas. One of the most important is the protection and restauration of coral reefs. Many other underwater animals find food and protection there and these reefs also reduce the risk to coastlines from flooding.
But the coral reefs are damaged in many places. Researchers are working hard on finding ways to restore the coral reefs. One solution is growing corals in an aquarium and then bringing them to the existing reef.

On the Elementary game field, the robot will help managing ship waste, restore coral areas and rescue a whale from a shallow area in the sea.

2. Game Field

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



If the table is larger than the game mat, place the two sides of the start area against the walls.

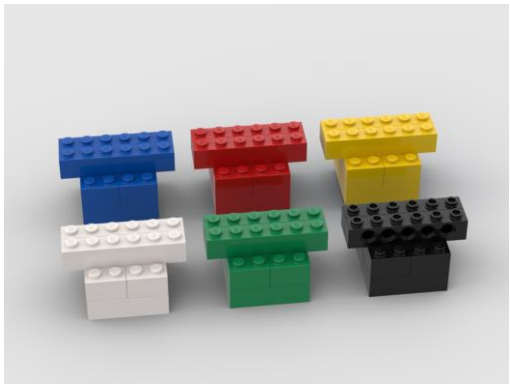
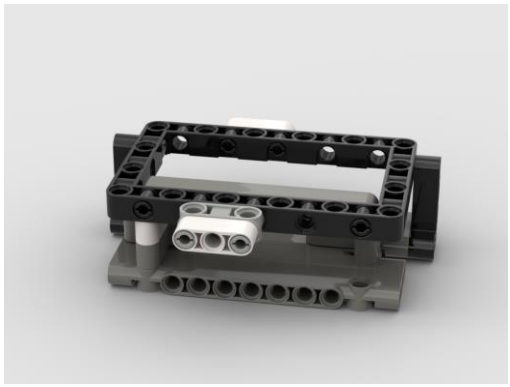
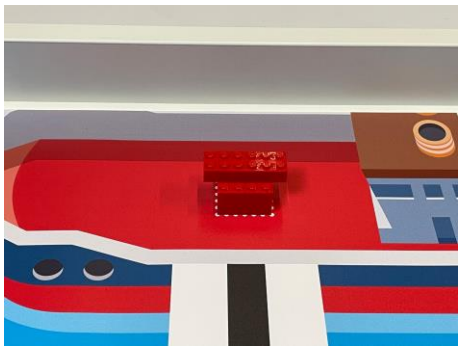
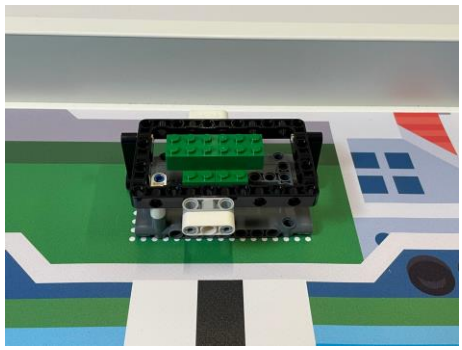
For more information about the table and game mat specifications, please take a look at PRO RoboMission General Rules, chapter 6.

3. Game Objects, Positioning, Randomization

Waste (4x, 2 times in ship hatch)

In every round there are four waste objects on the field:

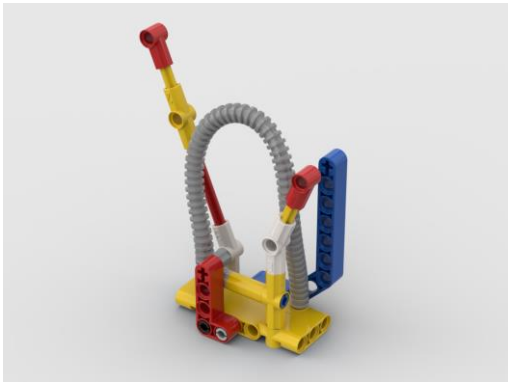
- The green waste object is always placed in the ship hatch on the green ship
- The yellow waste object is always place in the ship hatch on the yellow ship
- **Two of four other** waste objects are **randomly selected in each round**, they are placed on the ship of their colour.

<table>
<tr>
<td> 
Waste objects
(one red, one black, one white, one blue)</td>
<td> 
Ship hatch
(one with green, one with yellow waste)</td>
</tr>
<tr>
<td> 
Start position of waste
(on a ship, always in this orientation with the long side parallel to the wall.
Possible ships:
red, black, white and blue)</td>
<td> 
Start position of waste in ship hatch
(on yellow and green ship, inside the hatch - the waste is always placed to the front)</td>
</tr>
</table>

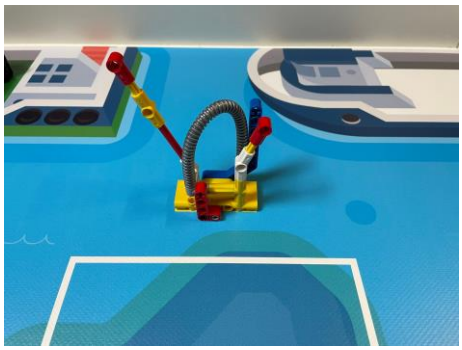
Please note, that the ship hatches on the yellow and green ship are fixed on the field (see General Rules, chapter 6).

Coral (4x)

The four corals are always placed on the little yellow areas on the field. They are placed exactly on the yellow and blue markings following the bricks of the model.



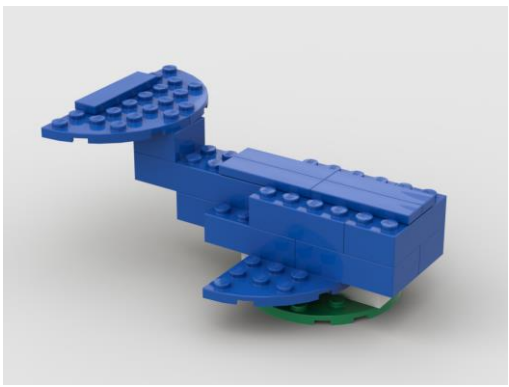
Coral (4)



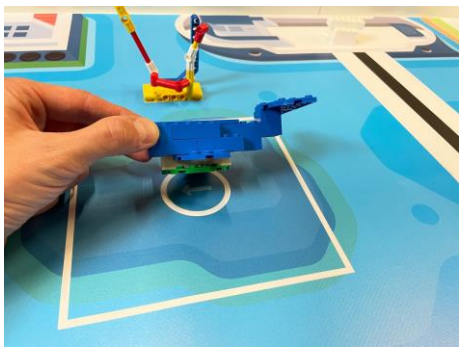
Start position of object on the field

Whale (1x)

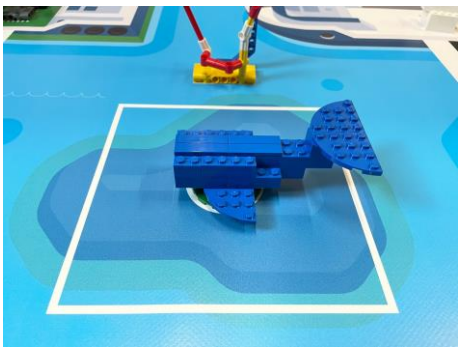
There is one whale on the field. The whale is **randomly placed in each round** on one of the white circles on the field. The whale is always placed looking in the direction of the little arrow on the game field, see the following photos.



Whale (1)



Place in orientation of the arrow

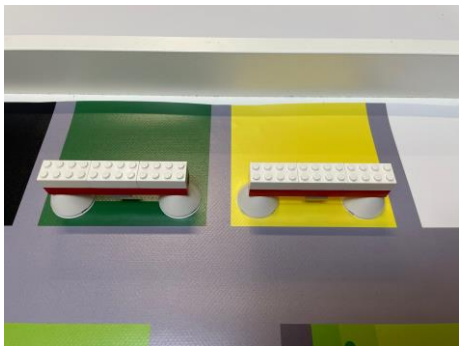


Start position of object on the field
(one possible start position)

Fence (2x)

Two fences are placed in front of the yellow and green recycling areas.

Fence (2)



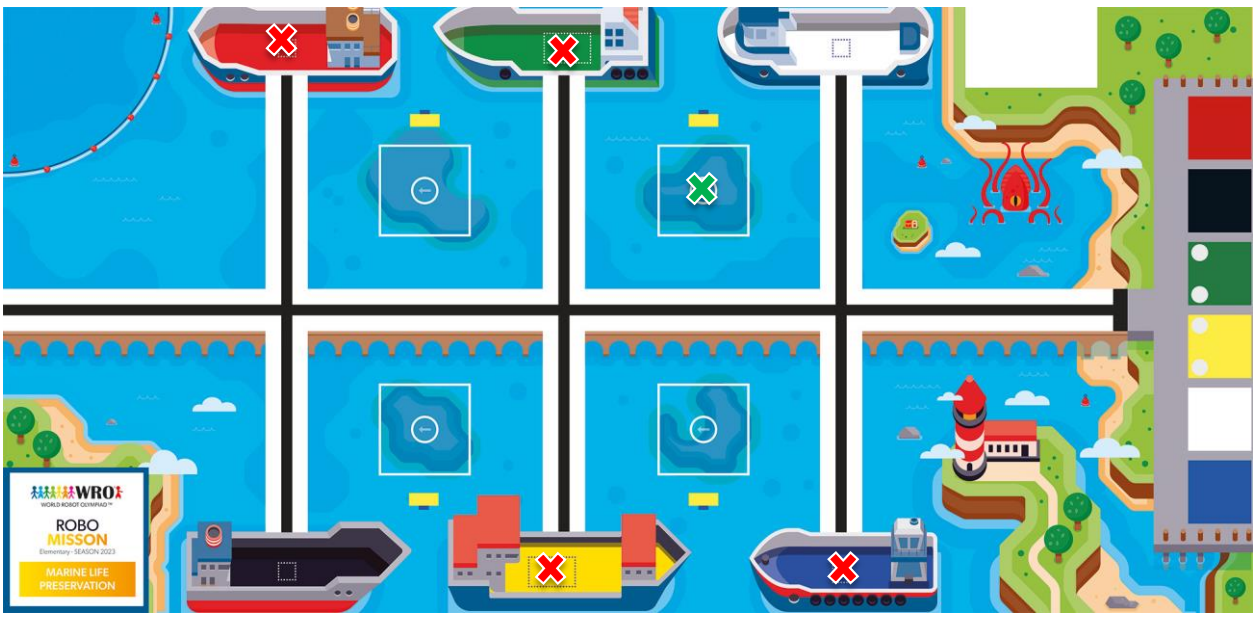
Start position of the fences

Summary randomization

On this field, the following objects are **randomly placed in <u>each round</u>**:

- Two waste objects on ships that are not the green or yellow ship
- The whale on one of the white circles

One possible randomization you can see here: green X for the whale, red X for waste objects (here on blue and red.)
You will also see the red X on the yellow & green ship, where there is always a waste object.



4. Robot Missions

For greater clarity, the missions will be explained in multiple sections. The team can decide which parts of the missions they will do and in which order. Final scoring will be based on the situation on the field at the end of the run.

4.1 Manage Ship Waste

The robot should bring the waste from the ships to the recycling areas on the game field, therefore, the robot needs to collect the waste from the ships. Collecting the waste from the yellow and green ship is a bit more difficult and the teams will get more points for that.

Full points are awarded if the waste is in the corresponding-coloured recycling area (e.g. the green waste in the green recycling area).

4.2 Rescue the Whale

A whale has been spotted in one of the coral reefs. The sea is shallow there and it is not the best place for this big animal. It might be lost. There is a whale watching area in the open ocean where people can see these animals in their natural environment. The robot should bring the whale from the coral reefs to the whale watching area in the open ocean.

Full points are awarded if the projection of the whale is completely inside the whale watching area. The whale watching area is defined by the dark blue line in the top-left corner. The dark blue line itself does not belong to the whale watching area. It is not allowed to damage the whale game object.

4.3 Restore the Coral Reefs

The life under water is important for our overall eco-system. That is why we want to restore the coral reefs. In these areas the corals and other marine life are all part of an eco-system. They depend on each other for food and shelter. The robot should bring the new coral to the coral reefs next to it.

Full points are awarded if the coral is completely inside one coral reef (the rectangle square near the coral start position). Maximum one coral per coral reef counts.

4.4 Get bonus points

Bonus points will be awarded for not moving or damaging the fences. A fence is moved if at least one pillar of the fence is no longer touching the grey circle where it is placed at the beginning.

4.5 Park the robot

The mission is complete when the robot returns to the Start & Finish area, stops, and the projection of the robot is **partly (top-view) within the Start & Finish area**.

5. Scoring

Definitions for the scoring

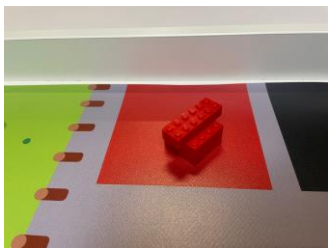
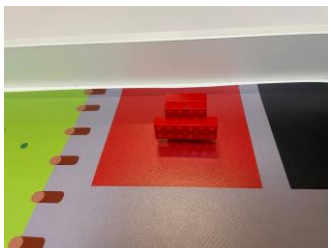
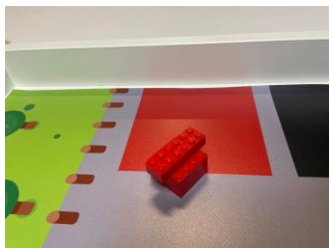
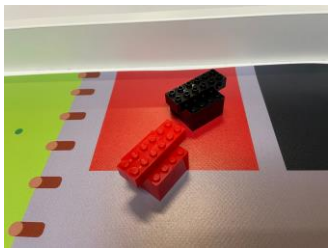
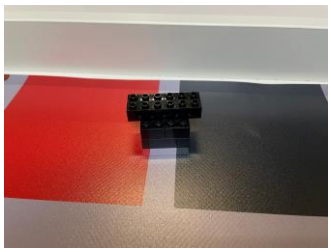
"Completely" means that the game object is only touching the corresponding area (not including the black lines).
Please note that there is a new rule about damaged game objects in the RoboMission General Rules (Rule 6.8).

Tasks	Each	Max.
Manage Ship Waste		
Red/Black/White/Blue Waste is completely inside the recycling area of the corresponding colour.	**10**	**20**
Red/Black/White/Blue Waste is touching the recycling area of the corresponding colour.	5	
Yellow/Green Waste is completely inside the recycling area of the corresponding colour and fence in front not moved or damaged.	**16**	**32**
Yellow/Green Waste is touching the recycling area of the corresponding colour and fence in front not moved or damaged.	12	
Yellow/Green Waste is outside the hatch (no longer touching the hatch object).	**4**	**8**
Rescue the whale		
The projection of the whale is completely in the whale watching area and the whale game object is not damaged.	**19**	**19**
The projection of the whale is partly in the whale watching area and the whale game object is not damaged.	8	
Restore the Coral Reef		
A coral is completely inside in a coral reef. (max. one per area)	**6**	**24**
A coral is touching a coral reef. (max. one per area)	3	
Get bonus points		
Fence pillars are touching the gray circles and fence is not damaged	**3**	**6**
Park the robot		
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**15**
Maximum Score		**124**

Scoring Interpretation

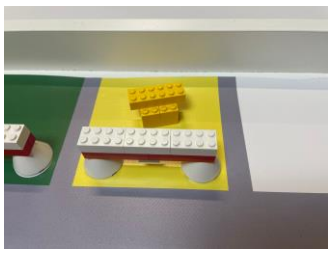
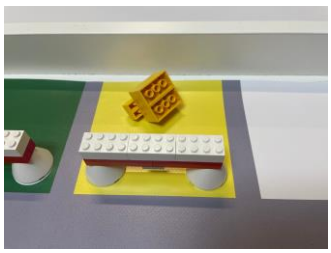
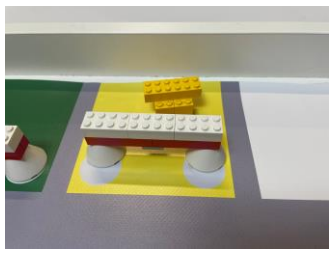
Red/Black/White/Blue Waste is <u>completely</u> inside the recycling area of the corresponding colour. ➔ 10 points

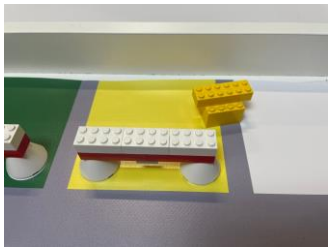
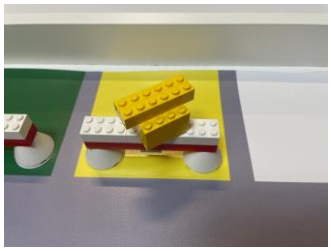
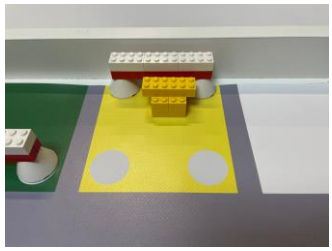
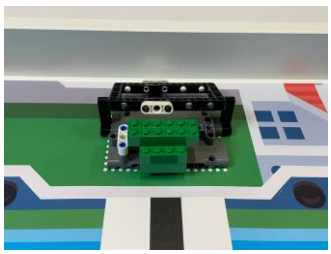
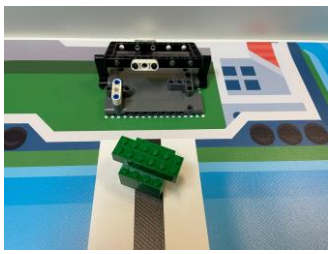
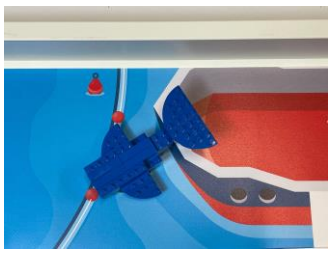
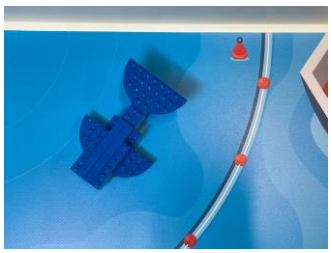
Red/Black/White/Blue Waste is <u>touching</u> the recycling area of the corresponding colour. ➔ 5 points

 10 points (completely inside)	 10 points (ok if lying)	 5 points (only touching)
 5 points for red object (only touching)	 5 points (in this case it counts as touching the correct black area)	

Yellow/Green Waste is <u>completely</u> inside the recycling area of the corresponding colour and fence in front not moved or damaged. ➔ 16 points

Yellow/Green Waste is <u>touching</u> the recycling area of the corresponding colour and fence in front not moved or damaged. ➔ 12 points

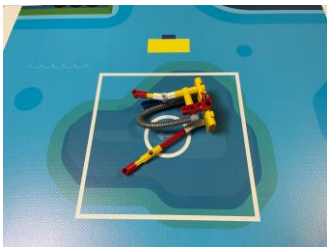
 16 points (completely inside) + 4 points for being outside the hatch	 16 points (ok if lying) + 4 points for being outside the hatch	 16 points (both fence pillars touching a grey circle) + 4 points for being outside the hatch

<table>
<tr><td> 
12 points
(touching the area)
+ 4 points for being outside the hatch</td><td> 
0 points (not inside)
but 4 points for being outside the hatch</td><td> 
0 points
(fence moved too far)
but 4 points for being outside the hatch</td></tr>
<tr><td colspan="3">Yellow/Green Waste is outside the hatch (no longer touching the hatch object).
➔ 4 points.</td></tr>
<tr><td> 
Waste object still touching hatch, 0 points.</td><td> 
Waste object outside the hatch (somewhere on the field), 4 points.</td><td></td></tr>
<tr><td colspan="3">The projection of the whale is completely inside the whale watching area and the whale game object is not damaged. ➔ 19 points
The projection of the whale is partly the whale watching area and the whale game object is not damaged. ➔ 8 points.
Note: The whale watching area is defined by the dark blue line in the top-left corner. The dark blue line itself does not belong to the whale watching area.</td></tr>
<tr><td> 
8 points (projection partly)</td><td> 
19 points (projection completely)</td><td> 
0 points (whale damaged)</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

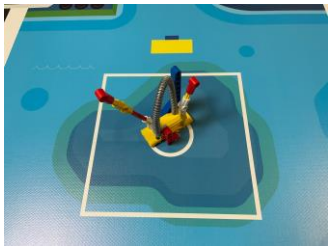
A coral is completely inside in a coral reef. (max. one per area)➔ 6 points.
A coral is touching a coral reef. (max. one per area)➔ 3 points.

3 points (touching the area)

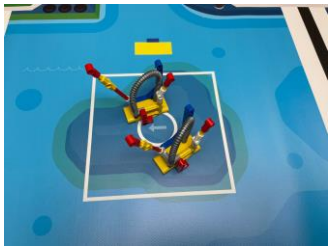
3 points (not completely in)



6 points (completely in)

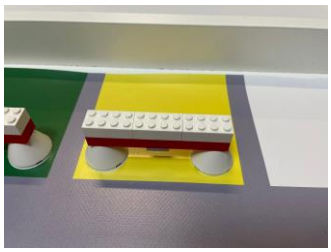


6 points (completely in)

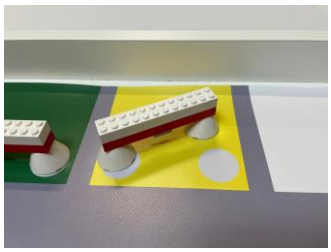


6 points (points only for one

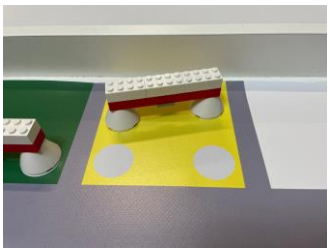
Fence that is not moved or damaged. ➔ 3 points.
Note: A fence is moved if at least one pillar of the fence is no longer touching the grey circle where it is placed at the beginning.



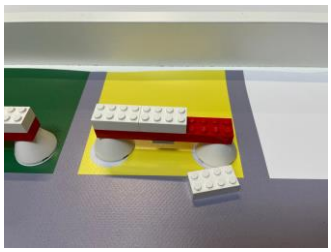
3 points, OK not moved.



0 points, not OK moved.



0 points, not OK moved.



0 points, damaged.

Projection of the robot is partly in the Start & Finish Area
(only if other points, not bonus, are assigned) ➔ 15 points.

Please note: The blue line surrounding the area does not belong to the area, the project has to be over the white inner area. Cables only do not count for the projection of the robot.

		
The projection of the robot is not in the area, 0 points.	The projection of the robot is partly in the area, 15 points.	The projection of the robot is completely in the area, 15 points.

Scoring Sheet

Team name: _____ **Round:** _____

Tasks	Each	Max.	#	Total
Manage Ship Waste				
Red/Black/White/Blue Waste is completely inside the recycling area of the corresponding colour.	**10**	**20**		
Red/Black/White/Blue Waste is touching the recycling area of the corresponding colour.	5			
Yellow/Green Waste is completely inside the recycling area of the corresponding colour and fence in front not moved or damaged.	**16**	**32**		
Yellow/Green Waste is touching the recycling area of the corresponding colour and fence in front not moved or damaged.	12			
Yellow/Green Waste is outside the hatch (no longer touching the hatch object).	**4**	**8**		
Rescue the whale				
The projection of the whale is completely in the whale watching area.	**19**	**19**		
The projection of the whale is partly in the whale watching area.	8			
Restore the Coral Reef				
A coral is completely inside in a coral reef. (max. one per area)	**6**	**24**		
A coral is touching a coral reef. (max. one per area)	3			
Get bonus points				
Fence pillars are touching the gray circles and fence is not damaged	**3**	**6**		
Park the robot				
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**15**		
Maximum Score		**124**		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

6. Local, regional, and international events

WRO competitions take place in around 90 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. This is the last stage of the competition, where the teams with the best solutions participate. That is why the game rules are challenging.

PRO 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.

We deliberately have a mix of simple and more difficult tasks in the game rules. This means that all teams will be able to solve parts of the challenge and can keep trying to improve their work.

PRO Association recommend that our National Organizers consider the situation in their country. They can adapt the rules for events in their country even further. They can decide to make the challenges easier for local, regional, and national events, so that all participants have a positive experience.
All National Organizers can make their own choices, so each competition fits their specific situation and ideas. Here we provide some ideas to make the challenges easier.

Ideas for simplifications:

- Have a fixed position of the whale (communicated before or selected at the start of the competition day
- Have two fixed colours of the waste objects that are placed on the mat (communicated before or selected at the start of the competition day)
- Take out one or both fences (in this case adjust the scoring for bonus points)