



RoboMission ミドル競技  
Junior Game Rules  
Ver. 1.0



# CONNECTING THE WORLD UNDERWATER INFRASTRUCTURE

Official Game Rules for the WRO International Final. Version: January 15th 2023

*(Note: Rules for local WRO events may vary!)*

WRO International Premium Partner



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## 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)

※ このルールブックは、WRO 2023 RoboMission Juniorのルールをもとに、WRO Japan RoboMission 競技委員会がWRO 2023 Japan決勝大会 ミドル競技 Junior 部門用に一部を修正し、作成しています。

# 1. Introduction

After the invention of the telegraph, it was suddenly possible to send long distance messages in a much faster way than ever before but sending a telegraph requires cables and, initially, sending a message to overseas still needed to be done by boat. This changed when the first telegraph cable was laid on the bottom of the sea between England and France in 1850. Plans were made soon to install a cable that would cross the full Atlantic Ocean. After many setbacks the submarine cables became a great success, and more were installed all over the world.

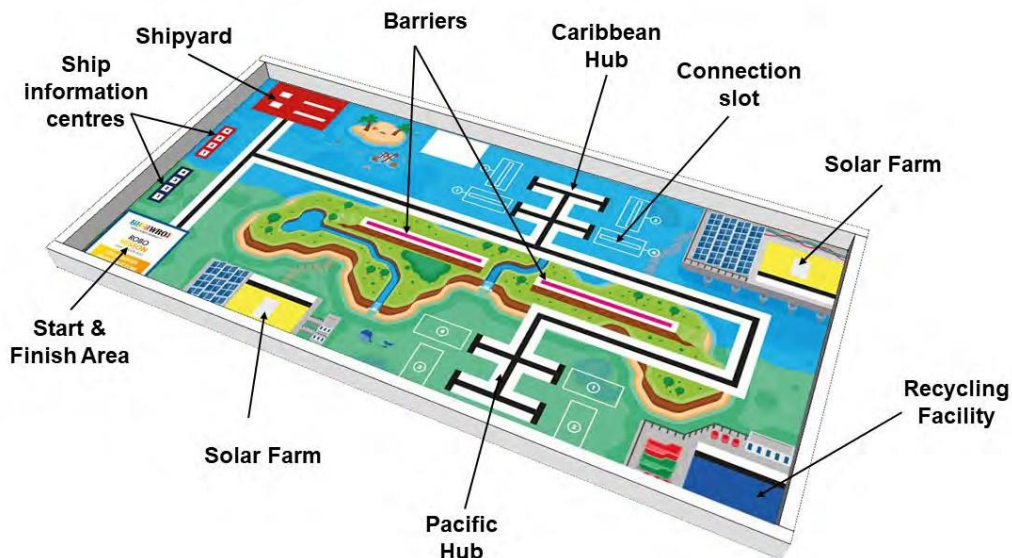
You might think that submarine cables are no longer necessary, with modern day satellites and Wi-Fi, but they are still crucial for communication, and they are the backbone of the internet. Modern fiber-optic cables can transmit data much faster than satellite connections. Sending a signal across the Atlantic Ocean by cable is around eight times faster than sending it by satellite\*. A place where submarine cables interconnect with each other is called a submarine cable hub. Panama is one of these hubs, where cables from the Caribbean Sea and Pacific Oceans connect. Underwater vessels and robots can help maintaining this infrastructure and help with new technical solutions at sea such as offshore solar farms and even submarine data centres.

\* Source: <https://www.submarinecablesystems.com/history>

**On the Junior game field, the robot will help to install and repair submarine cables, install submarine server farms, and activate offshore solar panels.**

# 2. Game Field

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



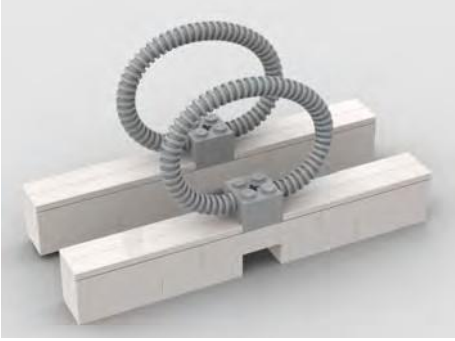
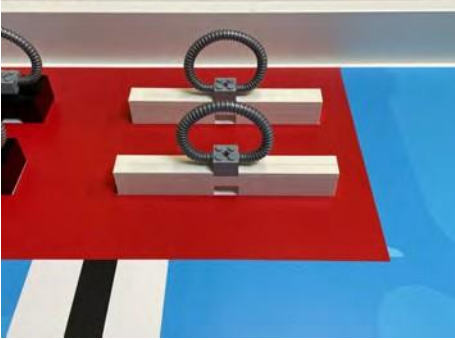
If the table is larger than the game mat, place the two sides of the start area against the walls. **For more information about the table and game mat specifications, please take a look at WRO RoboMission General Rules, chapter 6.**

### 3. Game Objects, Positioning, Randomization

#### Submarine Cables (2x white)

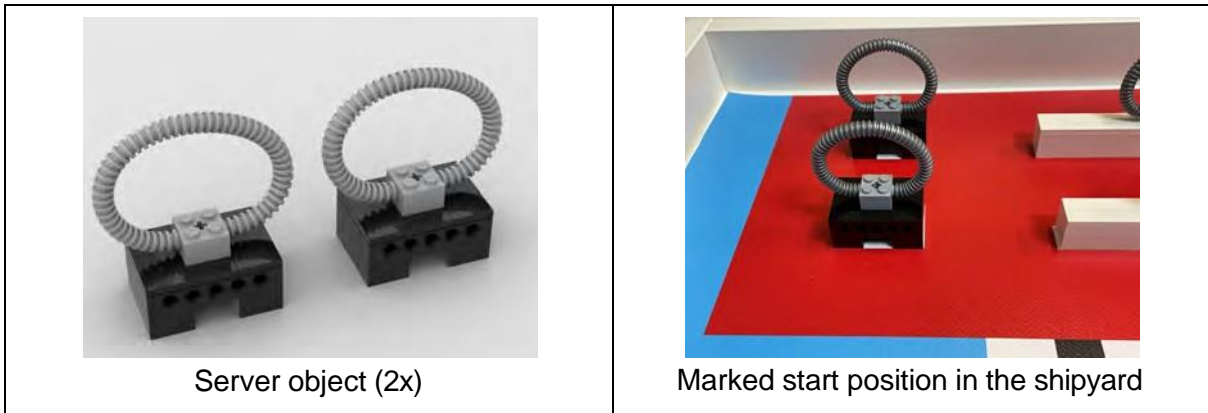
In every round there are two submarine cables on the game field:

- Two white submarine cables are placed on the two positions in the shipyard.
- 

 <p style="text-align: center;">White cable (2x)</p>	
 <p style="text-align: center;">Start position in the two marked areas in the shipyard</p>	

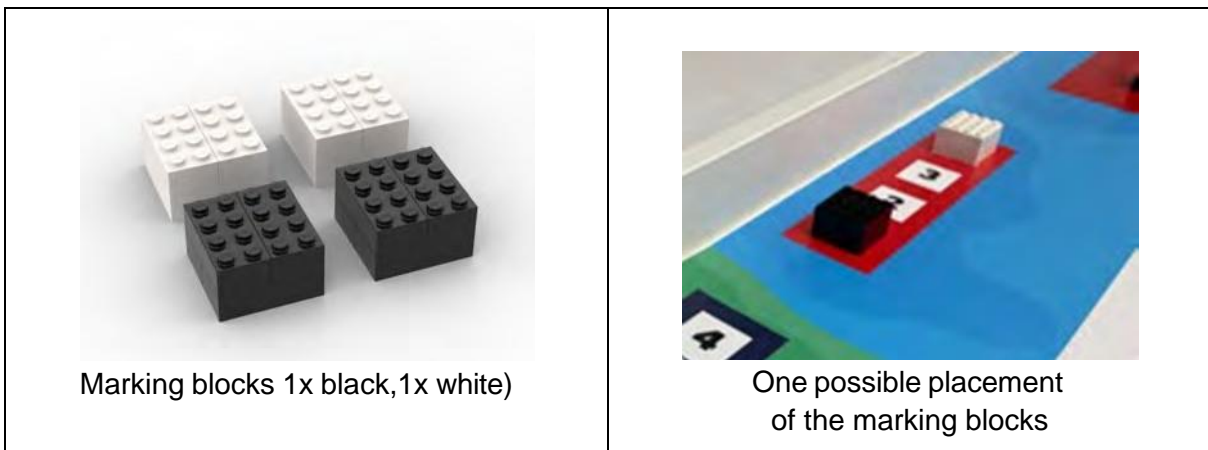
**Server objects (2x)**

There are two black objects that represent materials that are needed to setup an underwater server farm. At the beginning, these objects are placed on the two positions in the shipyard.



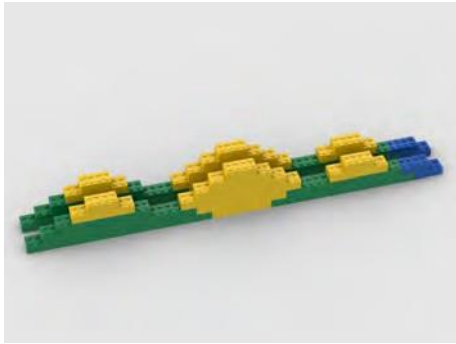
**Marking blocks (1x white, 1x black)**

The marking blocks are placed in the ship information centre. They are used to determine the placement where the robot should bring the server objects (black marking blocks) and submarine cables (white marking blocks).. One white and one black marking block are randomly placed on the little areas marked 1.- 4. on the Caribbean side.



### **Barriers (2x)**

There are two barriers on the field that divide the field into the Caribbean and Pacific area, both barriers are not allowed to be moved or damaged.



Barriers (2x)



Placement of the barriers at the beginning of each round, they are placed with the blue part looking towards the centre of the field.

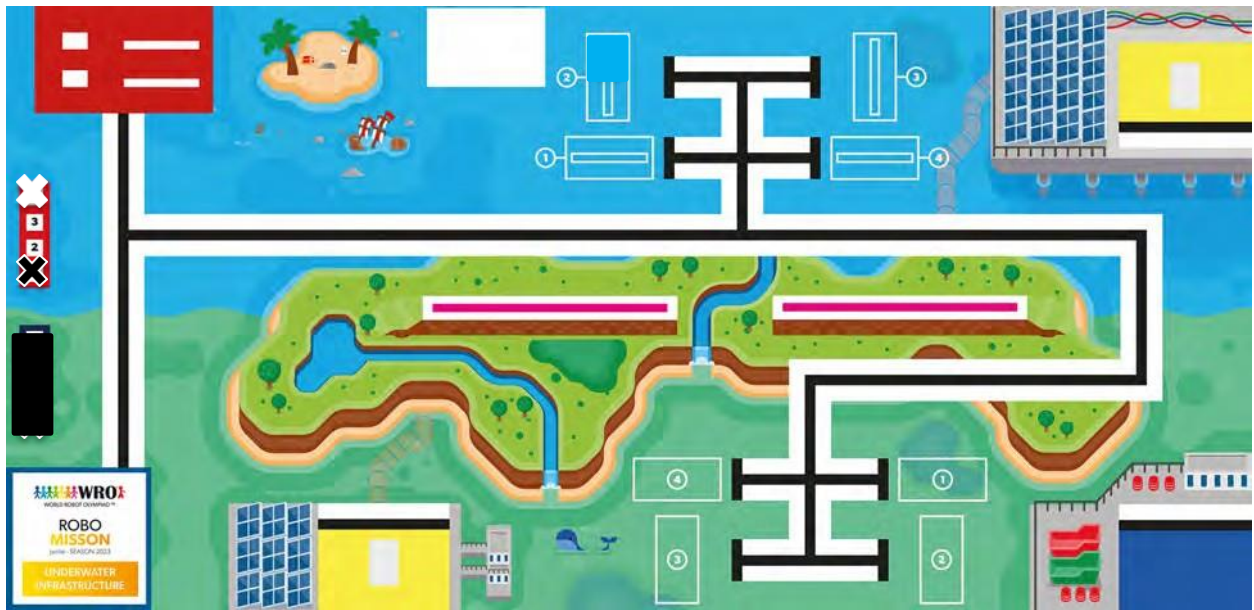
### Summary randomization

On this field, the following objects are **randomly placed in each round**:

- 
- One white and one black marking block on the 1-4 area on the Caribbean side.
- 

One possible randomization you can see here:

- 
- White marking block Caribbean No. 4, Black marking block Caribbean No. 1
- 



## 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 Underwater deployment

The robot should help to install underwater infrastructure for the world-wide internet data network. For that, the robot should transport the submarine cables and server objects from the shipyard to the connection slots.

The connection slots are determined by the marking blocks in the ship information centres for the Caribbean side, for example: a white marking block on Caribbean no. 4 **and a black marking block is placed on Caribbean no. 1** means that a submarine cable should be placed in the connection slot no. 4 **and the server object on connection slot no. 1**.

Full points are awarded if an object is completely inside one connection slot.

### 4.2 Bonus points

Bonus points will be awarded for not moving or damaging the barriers on the field.

### 4.3 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

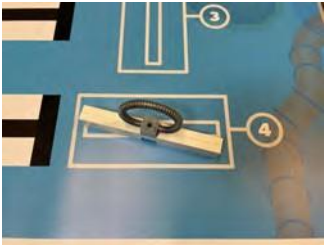

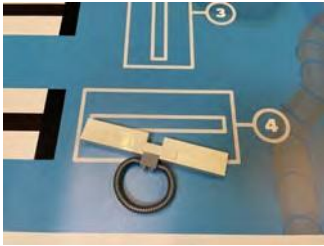
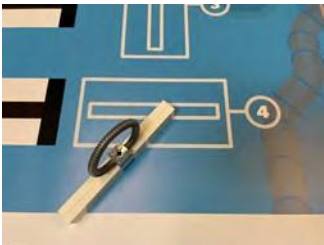
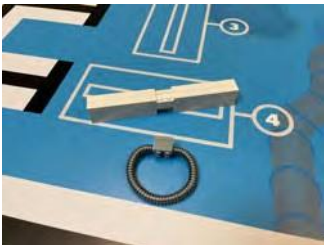
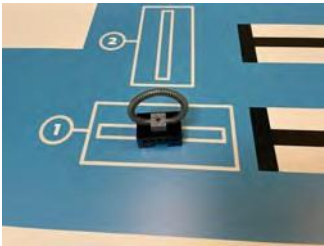

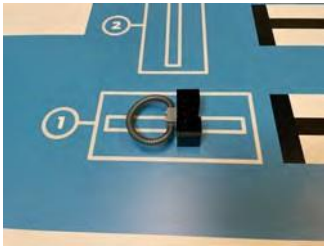

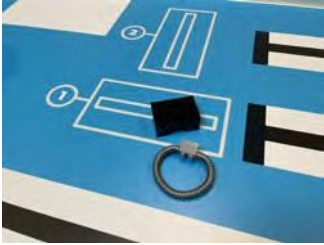
### Definitions for the scoring

“**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.
<b>Underwater deployment</b>		
Submarine cable is <u>completely</u> inside the correct connection slot	20	20
Submarine cable is <u>touching</u> the correct connection slot	10	
Server object is <u>completely</u> inside the correct connection slot	20	20
Server object is <u>touching</u> the correct connection slot	10	
Server object or Submarine cable is <u>touching or inside wrong the</u> connection slot (max. one object per connection slot)	5	
Additional: Both the submarine cable and the server object of the Caribbean side are completely inside the correct slot	10	10
<b>Get bonus points</b>		
Island barrier is not moved or damaged	10	20
Unused server and submarine cable are not moved from their original position. (Only if at least one server or submarine cable is outside of Shipyard. Only one server and one submarine cable are counted each.)	10	20
<b>Park the robot</b>		
Projection of the robot is partly in the Start & Finish Area ( <i>only if other points, not bonus, are assigned</i> )		10
<b>Maximum Score</b>		<b>100</b>

## Scoring Interpretation

**Please note:** The scoring interpretation for the cables and server objects follow the randomization of marking blocks from page 7 as an example!

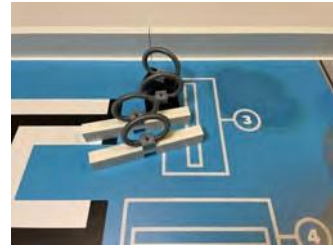
<p>Submarine cable is <u>completely</u> inside correct connection slot → 20 points          Submarine cable is <u>touching</u> correct connection slot → 10 points</p>		
 <p>20 points (completely inside)</p>	 <p>20 points (completely inside, white line counts as inside)</p>	 <p>10points (only touching)</p>
 <p>10 points (only touching)</p>	 <p>0 points (object damaged)</p>	
<p>Server object is <u>completely</u> inside correct connection slot. → 20 points          Server object is <u>touching</u> correct connection slot → 10points</p>		
 <p>20 points (completely inside)</p>	 <p>20 points (completely inside)</p>	 <p>20 points (completely inside)</p>
 <p>10 points (only touching)</p>	 <p>0 points (object damaged)</p>	

Server object or Submarine cable is touching or inside wrong connection slot → 5 points.



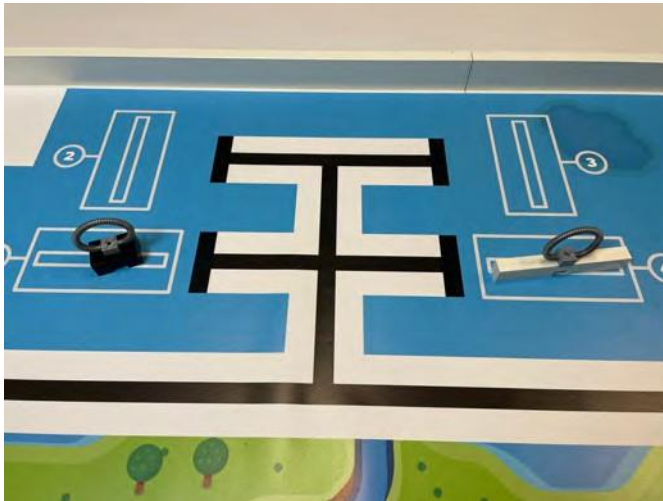
5 points

*Note: This example follows the randomization on page 7 where the cable should be brought in connection slot no. 4. That means that a placement in connection slot no. 3 needs to be considered as a wrong slot.*



No, no, no 🙅 only one object per connection slot counts, 5 points.

Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot. → 10 points.



*Note: This example follows the randomization on page 7 where the cable should be brought in connection slot no. 4 and the server object in connection slot no. 1.*

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Island barrier is not moved or damaged. → 10 points.

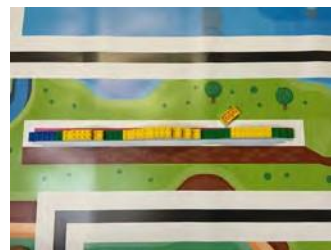
*Please note: The barrier is considered to be moved if it is moved outside of the white area, it is considered as damaged if even just one brick has come loose.*



10 points, OK, still in white area.



0 points, not OK, moved outside white area.



0 points, not OK, damaged.

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Projection of the robot is partly in the Start & Finish Area  
(only if other points, not bonus, are assigned) → 10 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, 10 points.



The projection of the robot is completely in the area, 10 points.

## Scoring Sheet

Team name: \_\_\_\_\_

Round: \_\_\_\_\_

Tasks	Each	Max.	#	Total
<b>Underwater deployment</b>				
Submarine cable is <u>completely</u> inside the correct connection slot	20	<b>24</b> <b>20</b>		
Submarine cable is <u>touching</u> the correct connection slot	10			
Server object is <u>completely</u> inside the correct connection slot	<b>20</b>	<b>20</b>		
Server object is <u>touching the</u> correct connection slot	10			
Server object or Submarine cable is <u>touching or inside the wrong</u> connection slot (max. one object per connection slot)	5			
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot	10	<b>10</b>		
<b>Get bonus points</b>				
Island barrier is not moved or damaged	10	<b>10</b>		
Unused server and submarine cable are not moved from their original position. (Only if at least one server or submarine cable is outside of Shipyard. Only one server and one submarine cable are counted each.)	10	<b>20</b>		
<b>Park the robot</b>				
Projection of the robot is partly in the Start & Finish Area (only if other points, not bonus, are assigned)		10		
<b>Maximum Score</b>		100		
<b>Total Score in this run</b>				
<b>Time in full seconds</b>				

## 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.

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.

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.

**WRO 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 the randomization only for one part (Pacific or Caribbean).
- Have no randomization and place the marking blocks always in the same position in the ship information centres.
- Have a fixed position for the red cable in one of the connection slots.
- Take out one or both barriers (in this case adjust the scoring for bonus points)