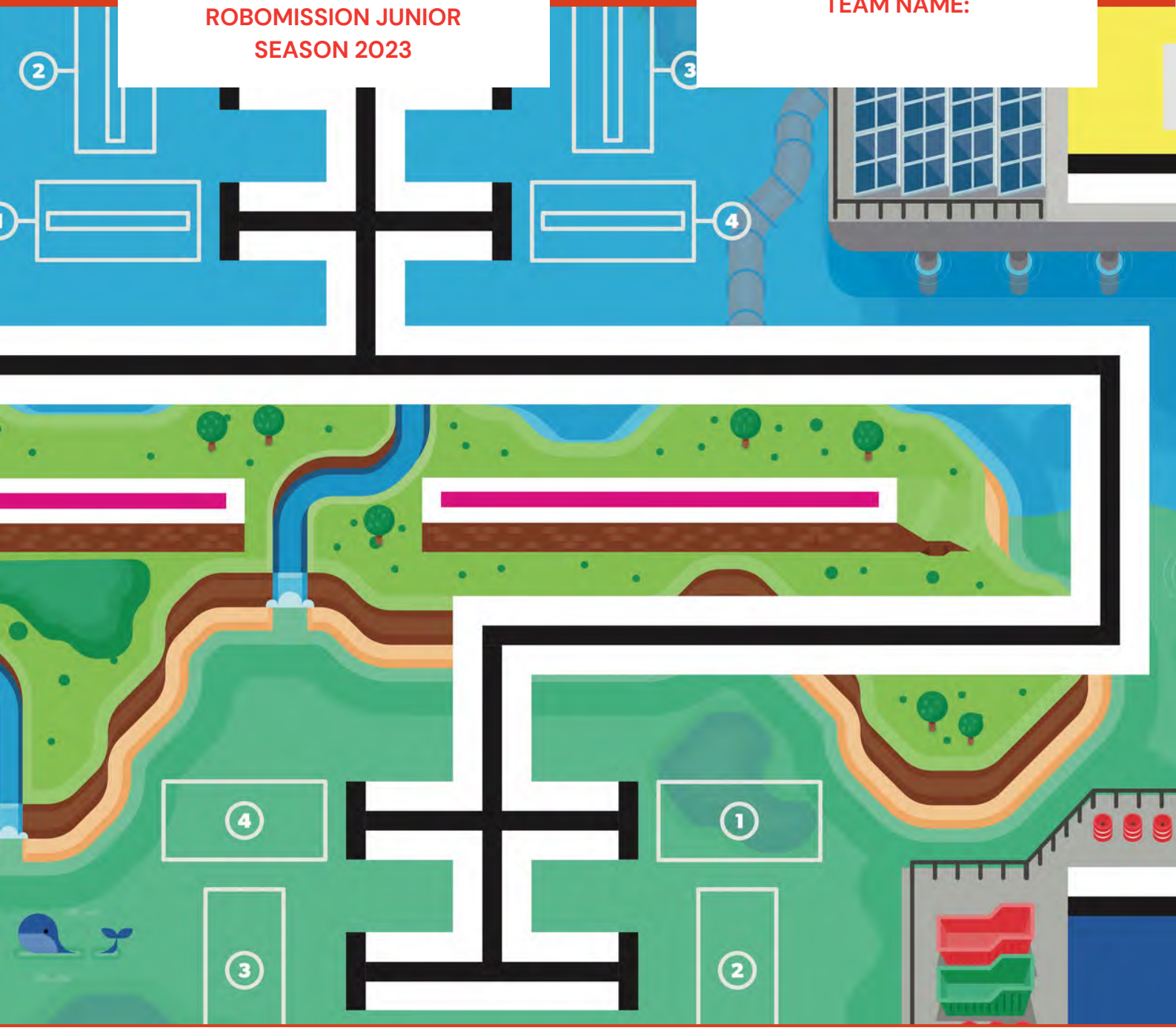
WORLD ROBOT OLYMPIAD 2023

ENGINEERING NOTEBOOK

ROBOMISSION JUNIOR
SEASON 2023

TEAM NAME:



CONNECTING THE WORLD

ROBO-G®
Learn to Build, Design and Program Robot

WORLD ROBOT OLYMPIAD 2023

ENGINEERING NOTEBOOK

ROBOMISSION
JUNIOR
SEASON 2023

CONNECTING THE WORLD

UNDERWATER INFRASTRUCTURE

This **World Robot Olympiad** tutorial is created by **ROBO-G.**

HARDWARE: LEGO MINDSTORMS EV3
SOFTWARE: EV3 LAB

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ROBO-G, a robotics learning solution company was founded in 2015 to bridge the gap between the traditional approach of classroom coaching and learning to attain a deeper understanding of subjects in children. We use LEGO Education kits which are already widely researched and used worldwide. the emphasis is always on a playful learning experience.

The curriculum focuses on STEM education (Science, Technology, Engineering, and Maths) while delivering robotics knowledge. Children are motivated and encouraged to become learners by observing and working in teams. We try to ignite their minds by actively engaging all their senses simultaneously.

Since 2015 our students are participating in World Robot Olympiad (WRO), standing in the top 5 positions at Regional Championship, and progressing to the National round Championship every year.

ROBO-G programs help children step into the world of Robotics technology at an early age.

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About the Tutorial

Dear Students, Coaches, and Parents,

I have tried to keep the WRO Ethics Code intact while creating this tutorial. This tutorial is divided into 9 parts i.e., **WRO Categories, Get Ready for WRO, WRO Ethics Code, Game Description, Developing the Strategy for the Game, Robot Chassis, Programming Concepts, Creating Digital Building Instructions, and Practice Game Mats & Score Sheets.** This will help you to prepare for the competition step by step. It is suitable for the teams participating first time in World Robot Olympiad.

In this tutorial, I have used the LEGO Mindstorms EV3 Robotics Set and EV3 Lab software. But if you are using Spike Prime and any other software platform, this course may be useful for you because the strategy to solve the challenge and programming concepts remains the same. **The only thing you should not expect from this course is a direct solution to the challenge.**

Regards,
Vishnu Agarwal
Coach, WRO | Founder, ROBO-G

Part 1: WRO Categories

WRO® offers challenging competitions for students in the age range from 8 up to 19. There are four competition categories, each with their own characteristics.

- **Robo Mission:** Build and program a robot that solves tasks on a field.
- **Robo Sports:** Teams compete with 2 robots in an exciting game.
- **Future Innovators:** Work on a project and design and build a robot.
- **Future Engineers:** Advanced robotics following current research trends.

Robo Mission

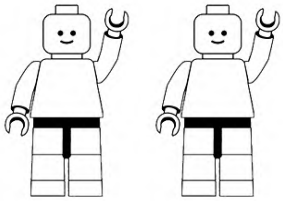
Age: Elementary: 8-12 | Junior: 11-15 | Senior: 14-19
Team size: 2-3 people guided by a coach
Hardware: LEGO® based
Software: Free choice
Maximum size: Max. 25 x 25 x 25 cm
Characteristics: Build and program a robot that solves challenges on a field.

WRO® RoboMission is a challenge-based competition. Students must design, construct and program an autonomous robot to solve specific field challenges. Because the field is set up randomly each round, the robot needs to be able to make its own decisions during the run.
All robot parts, including the controller, motors, and sensors must be from LEGO® (MINDSTORMS® NXT or EV3, SPIKE PRIME or Robot Inventor).

For all specific rules and regulations refer to the General Rules for this category,
visit: https://wro-association.org/competition/2023-season/

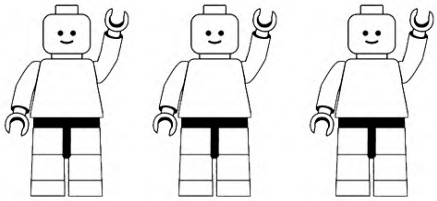
In this WRO coursebook, we have focused only on the Robomission Junior category.

Part 2: Get Ready For WRO



Make a team of 2 students

or



Make a team of 3 students

One Coach

One LEGO Mindstorms Education EV3 Core set and Expansion set

or

One LEGO Education Spike Prime set and Expansion set

WRO Brick Set

WRO Game Mat

WRO Game Table

To register your team, contact your National organizer in your country. Visit the link to find your National Organizer in your country: **https://wro-association.org/about-wro/association/member-countries/**

Part 3: WRO® Ethics Code For Teams

"It is not whether you win or lose, but how much you learn that counts."

We are participating in a competition. We like to win. We want to learn. And we also want to have fun.

We want to play fair. We design our own robots and we write our own software. It is not fair if someone else does that for us.

We can only learn if we try things ourselves. Our coach can teach us things and guide us. And we can also get inspired by others.

But our coach should not do the work for us. And we do not simply copy a robot or software from someone else.

We use the examples we find to design our own robot and program.

Sometimes we fail and that is OK. Original ideas come from failing.

WINNING IS NICE BUT FAILING IS PART OF OUR JOURNEY.

Part 4: Game Description

In this part, you will learn about the theme of the WRO Robomission Elementary category.

4.1 Connecting The World WRO 2023 -Theme

The WRO® theme for 2023 is Connecting the World.

In 2023 teams will learn about shipping logistics and about the infrastructure for our digital technology. They will investigate how robots can help both shipping and digital technology infrastructure to be safer, more sustainable, and more efficient.

4.2 Game Introduction

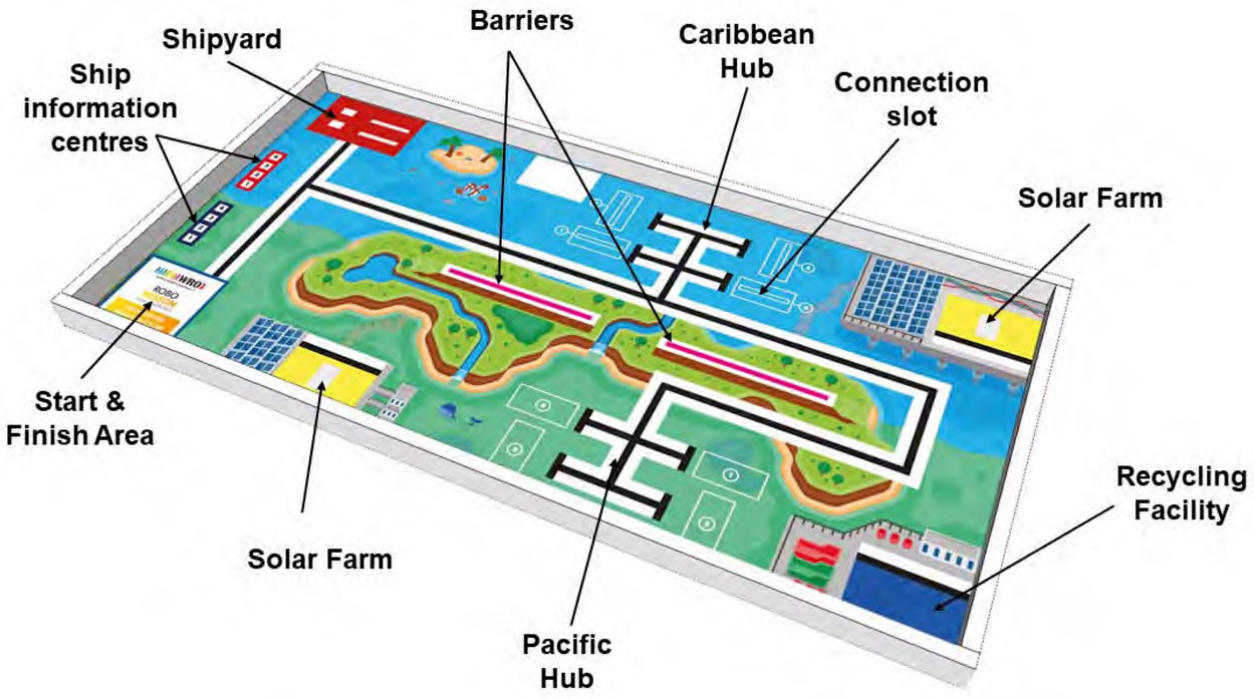
Modern fiber-optic cables can transmit data much faster than satellite connections. Sending a signal across the Atlantic Ocean by cable is around eight times faster than sending it by satellite*. A place where submarine cables interconnect with each other is called a submarine cable hub. Panama is one 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.

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

***Game description details have been taken from the WRO official website. For any updates on the game description please visit https://wro-association.org/competition/2023-season/.**

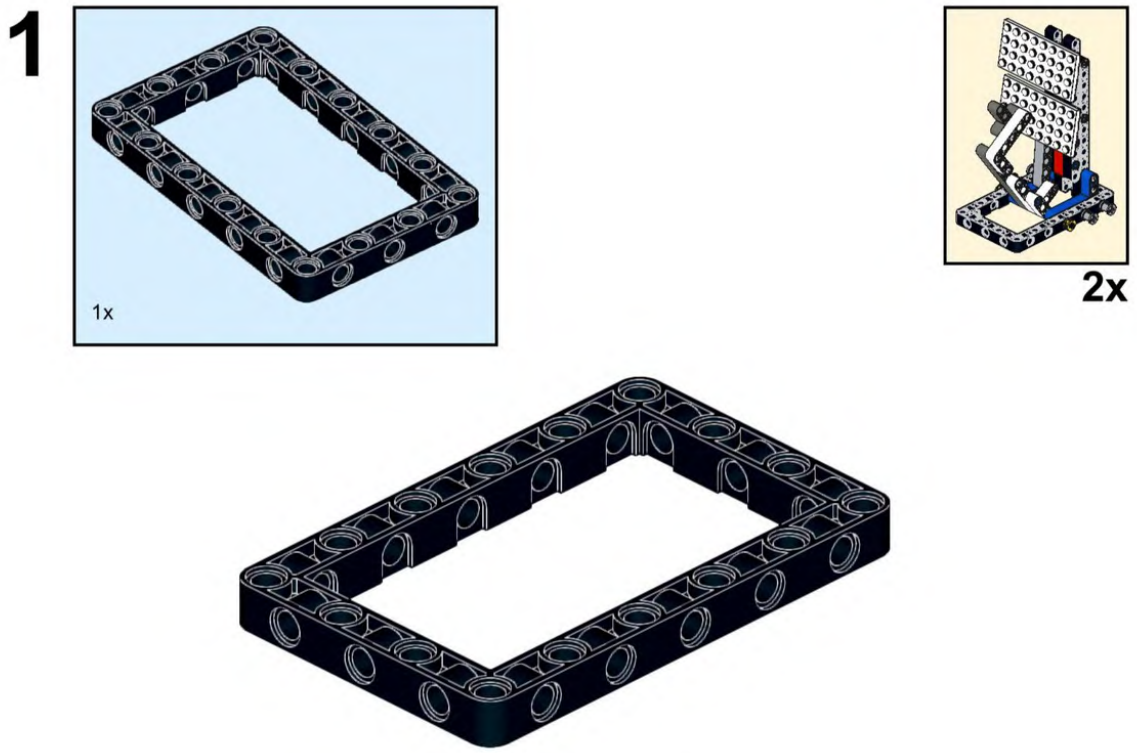
4.3 Game Field

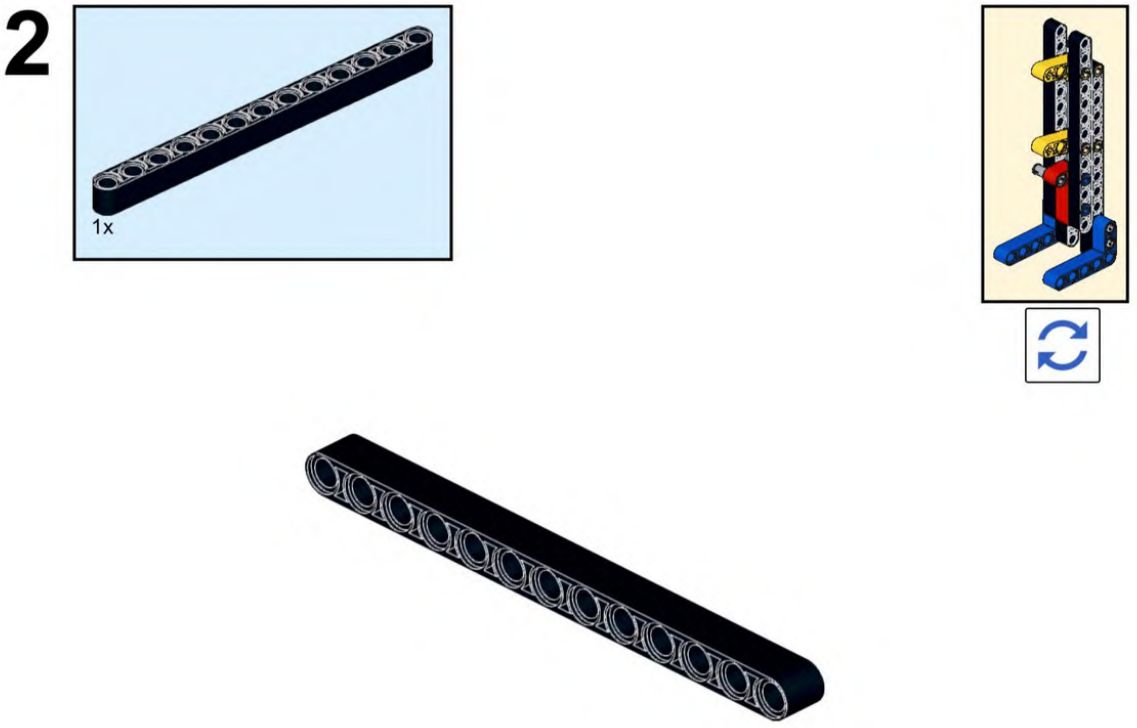
The following graphic shows the game field with the different areas.



If the table is larger than the game mat, place the mat on the wall with the two sides of the start area.

4.4 Assembly of Game Objects





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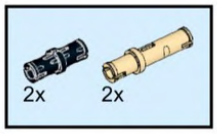

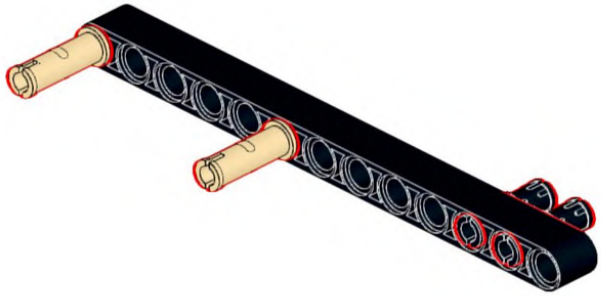

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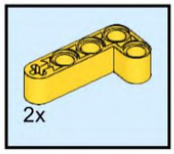

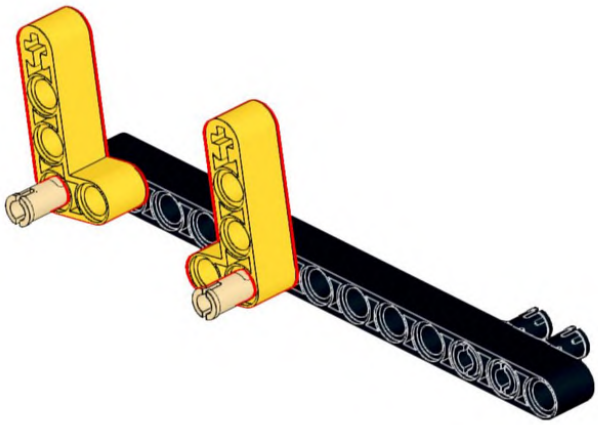

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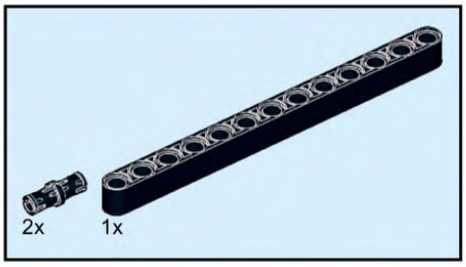

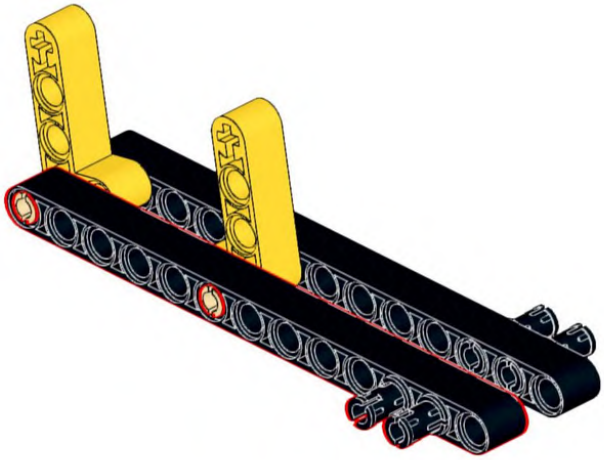

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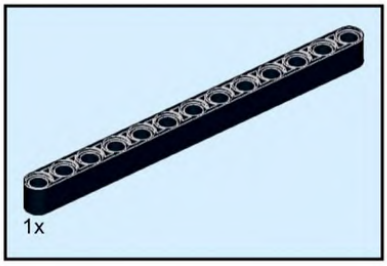

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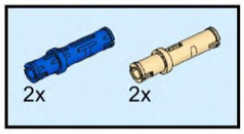

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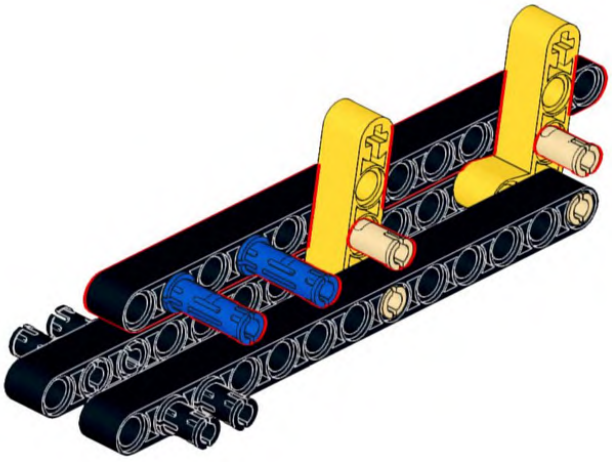

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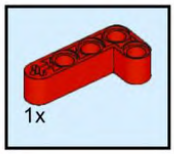

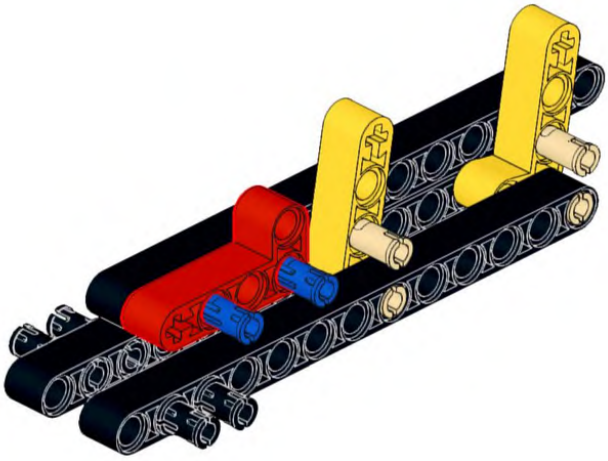

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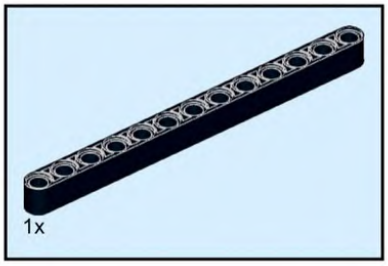

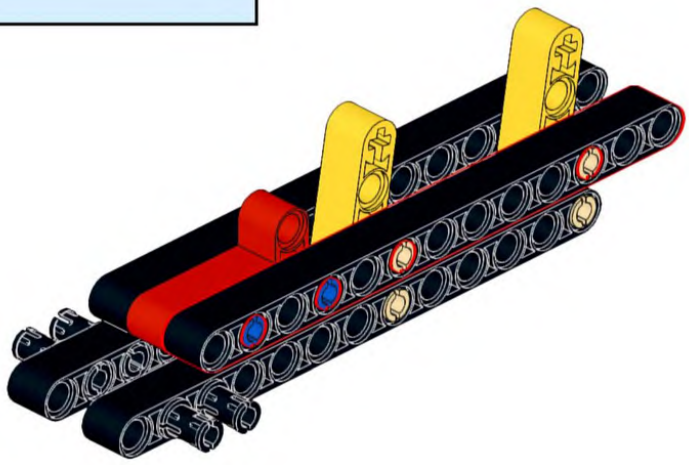

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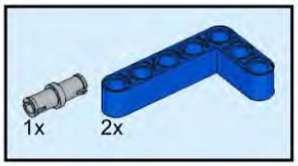

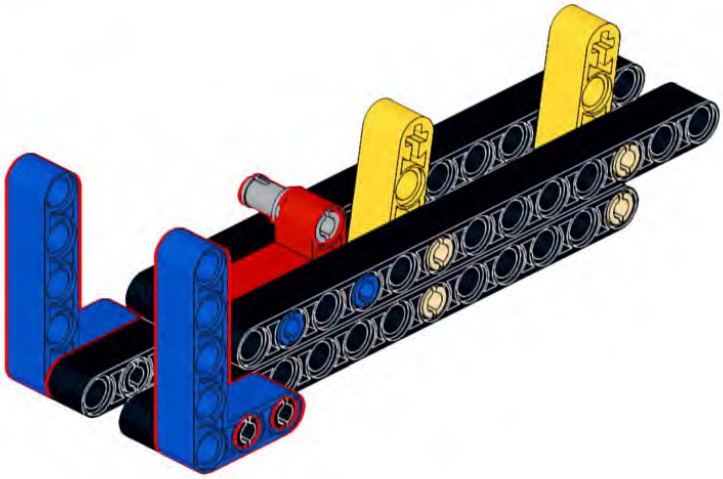

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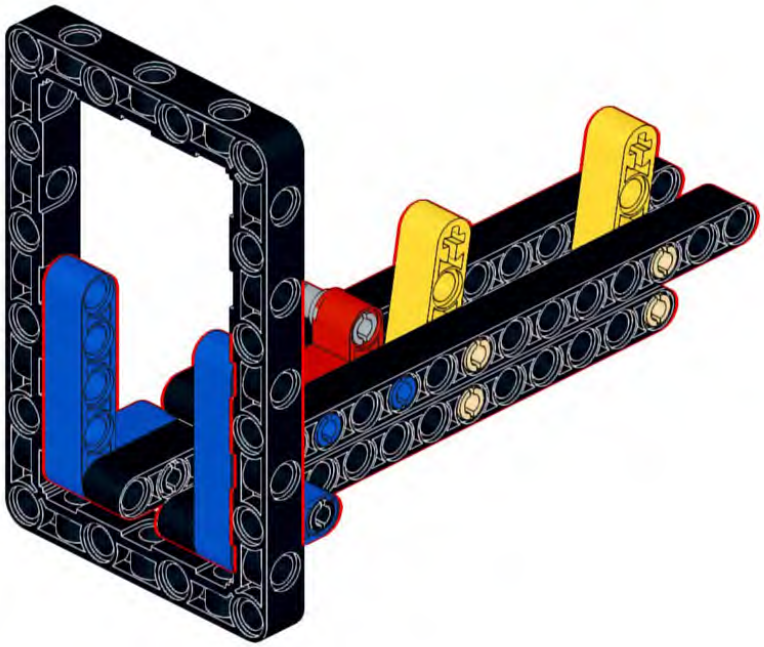

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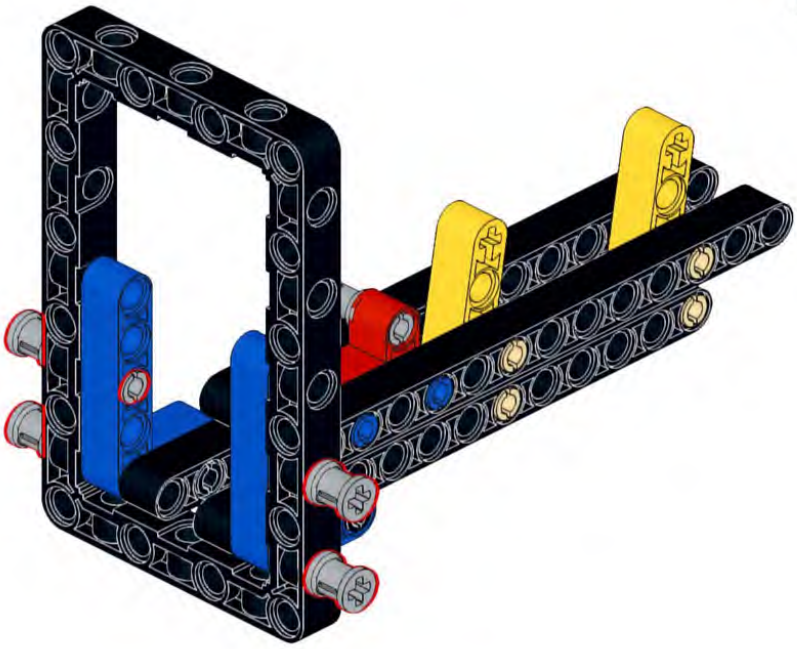

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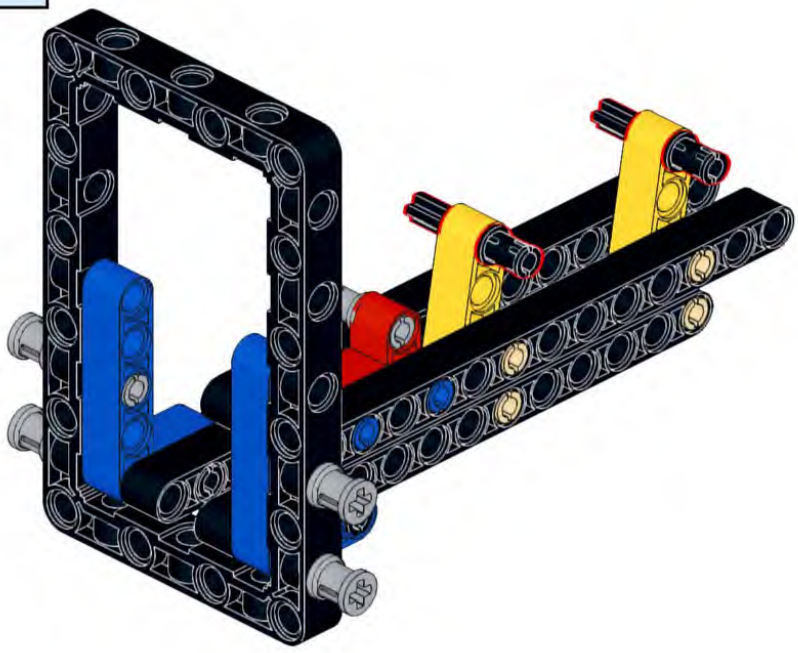

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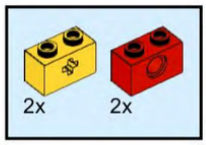

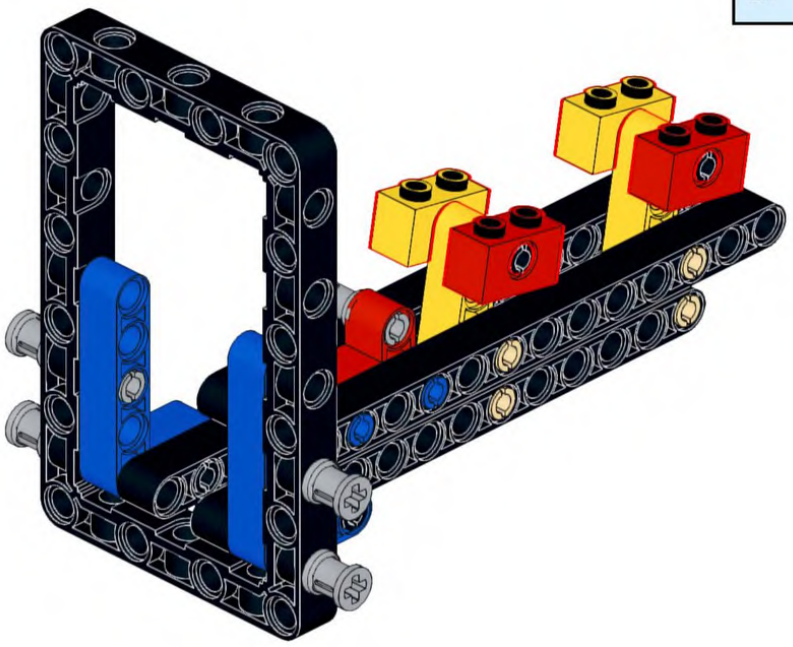

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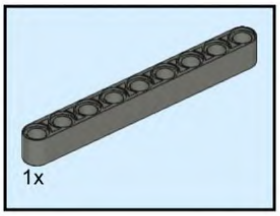

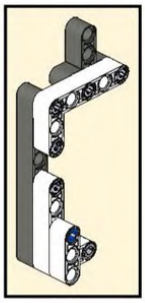

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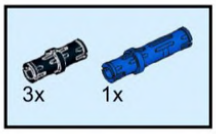

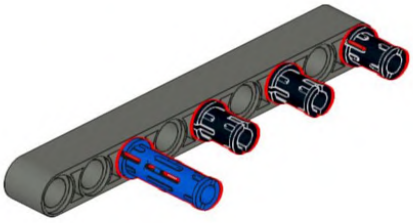

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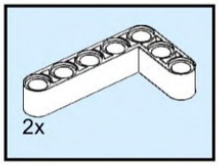

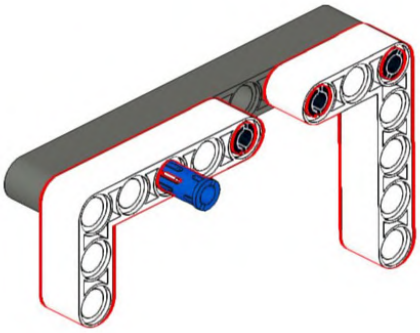

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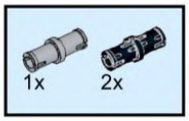

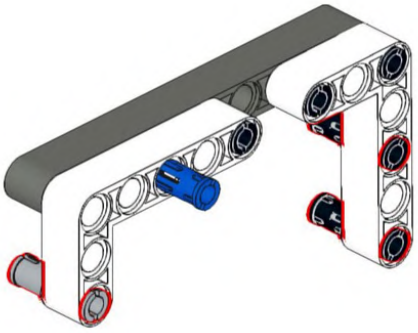

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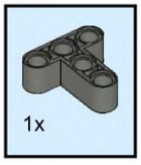

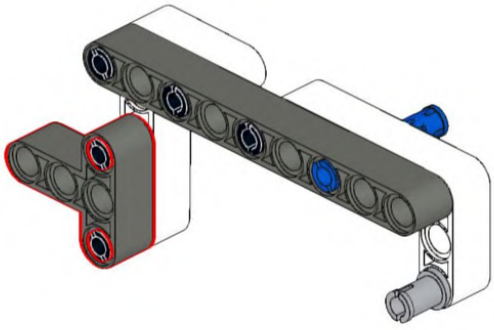

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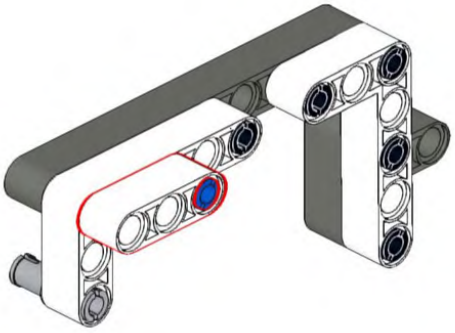

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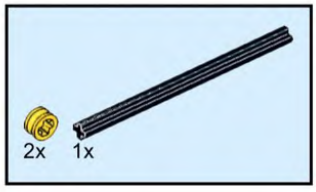

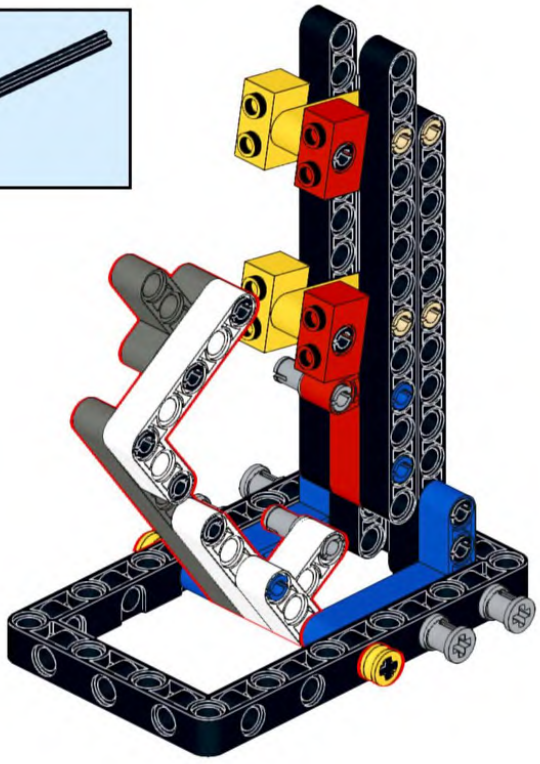

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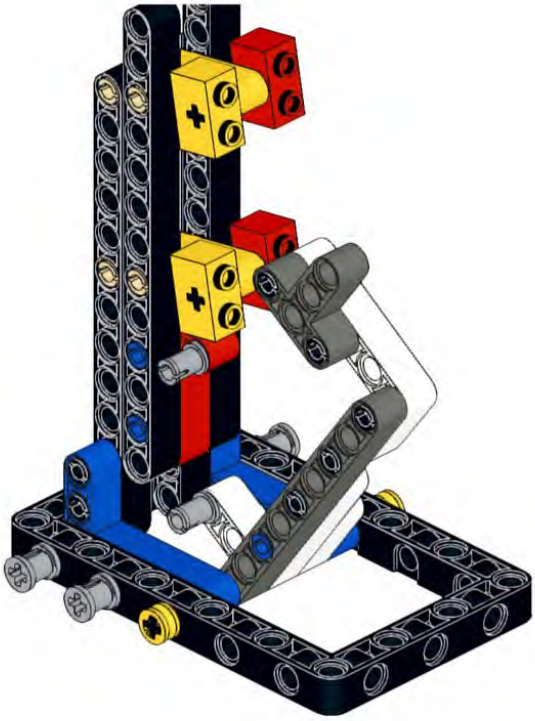

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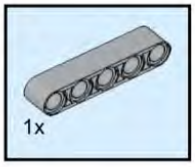

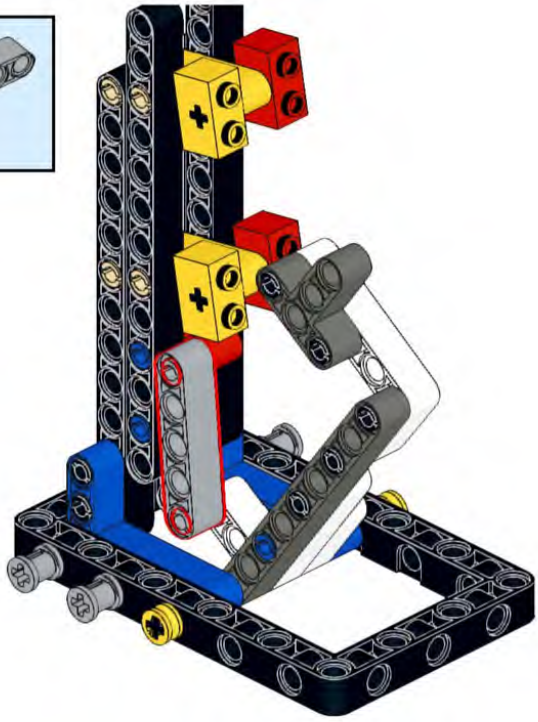

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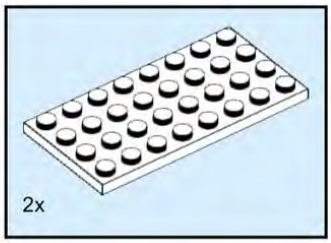

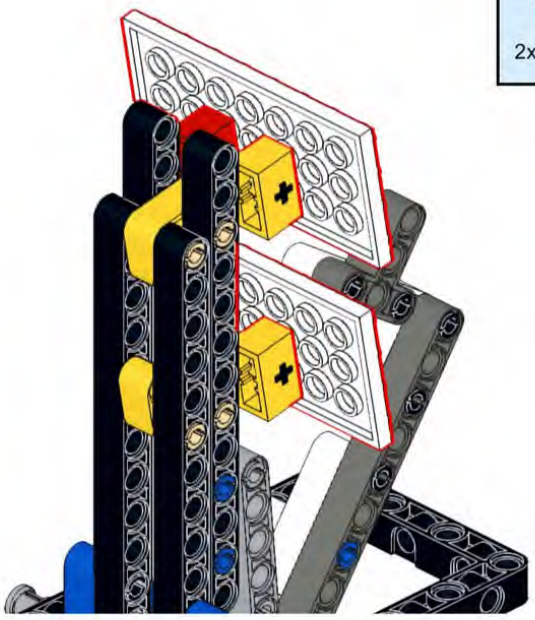

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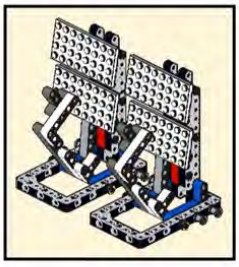

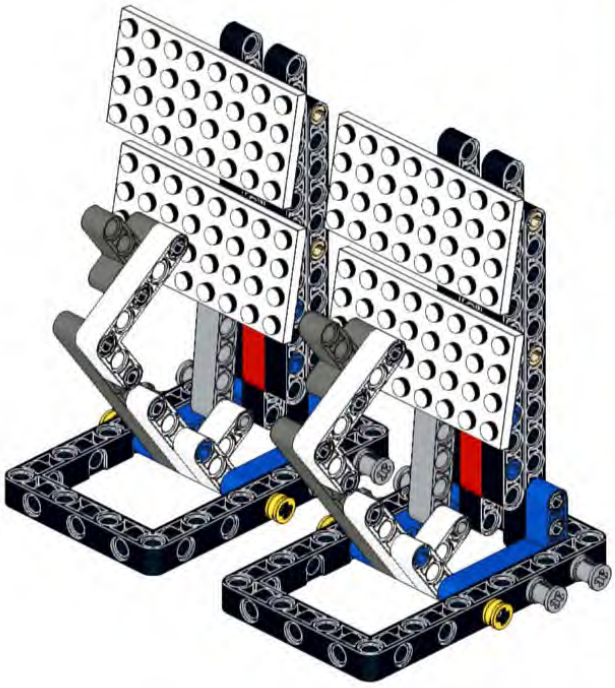

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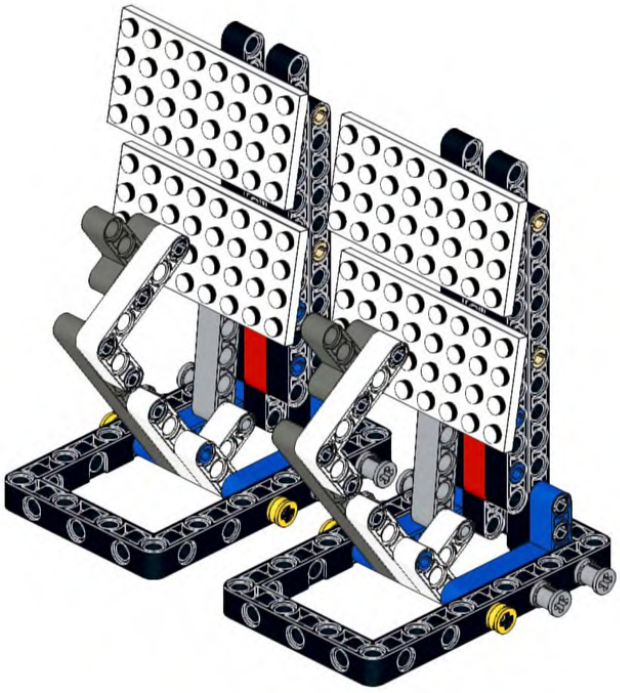

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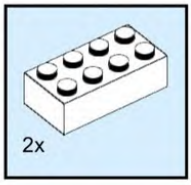

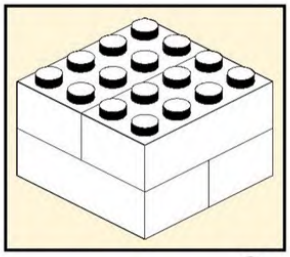

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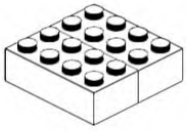

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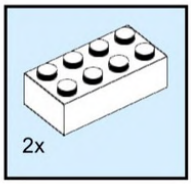

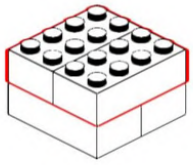

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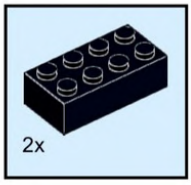

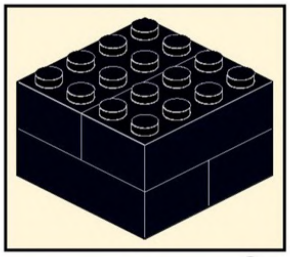

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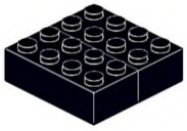

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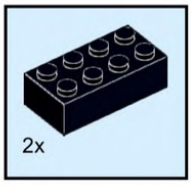

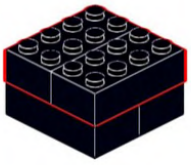

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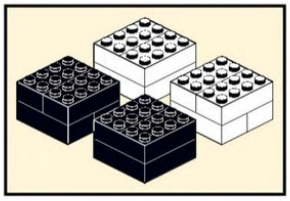

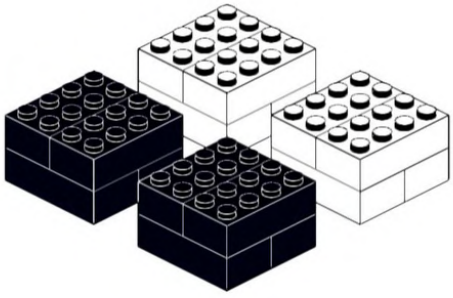

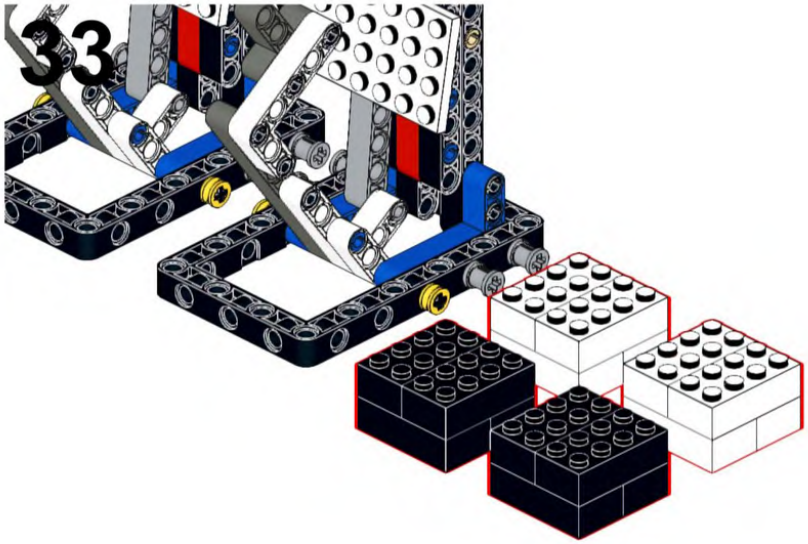
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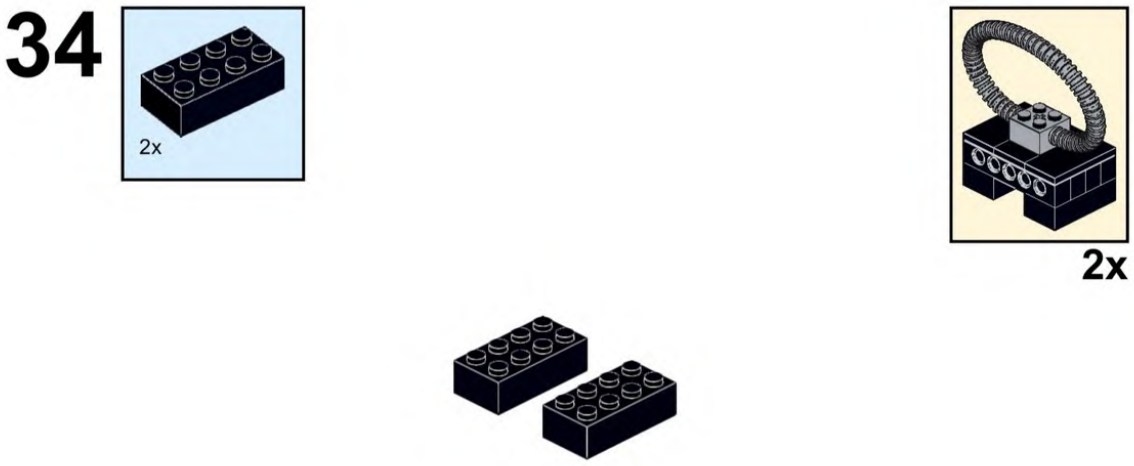
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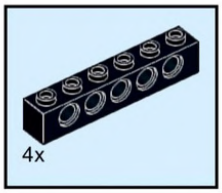

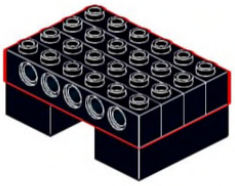

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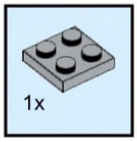

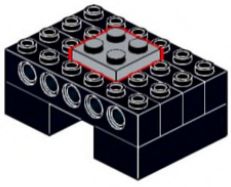

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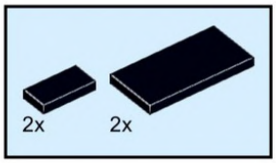

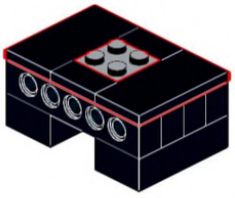

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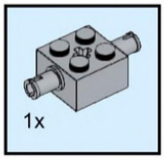

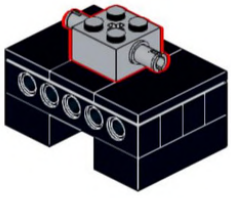

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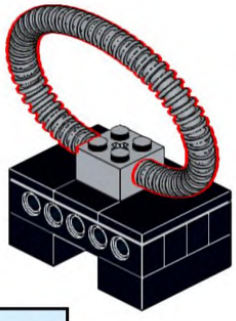

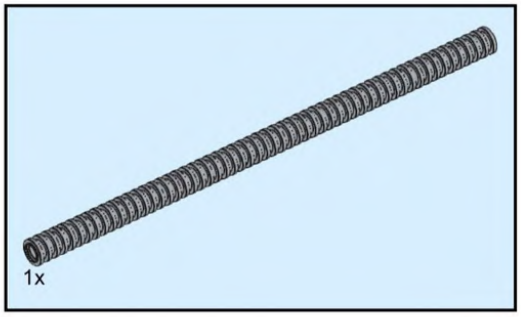

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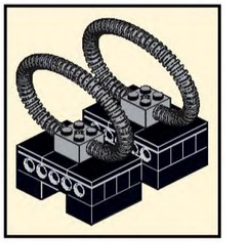

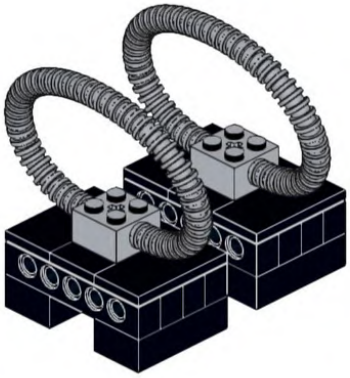

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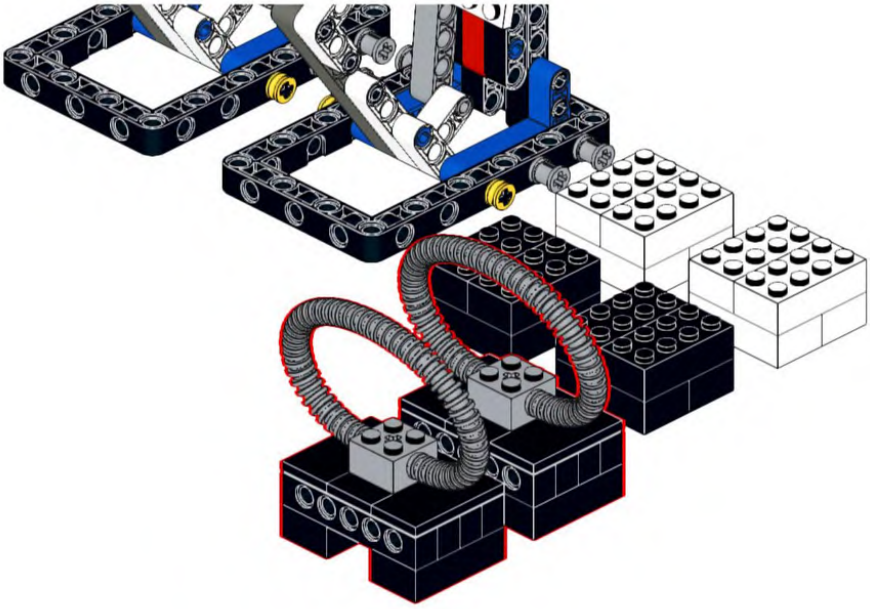

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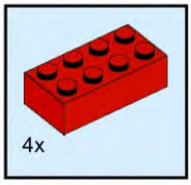

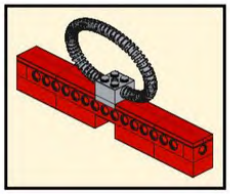

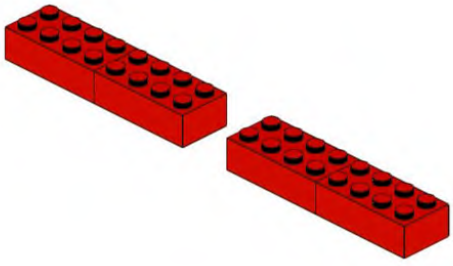

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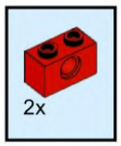

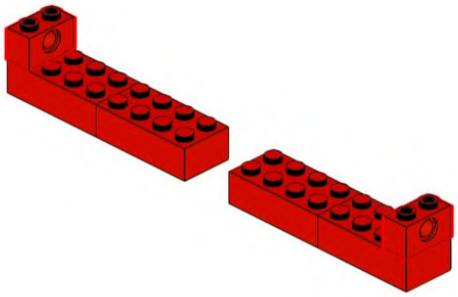

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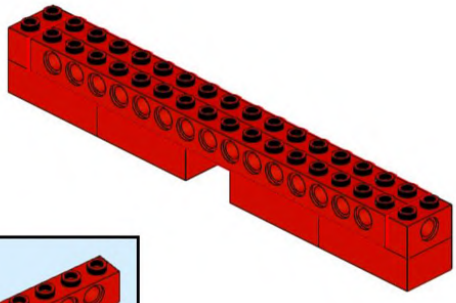

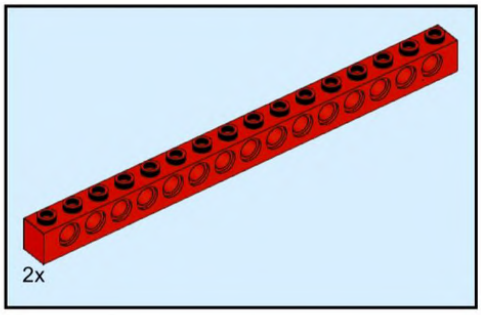

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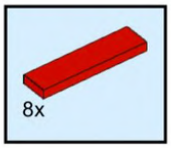

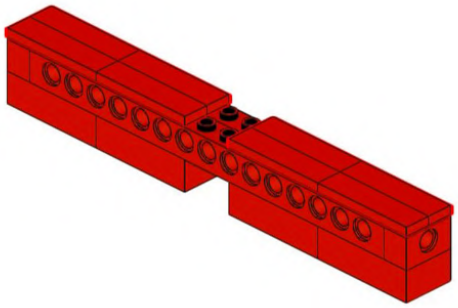

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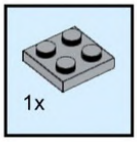

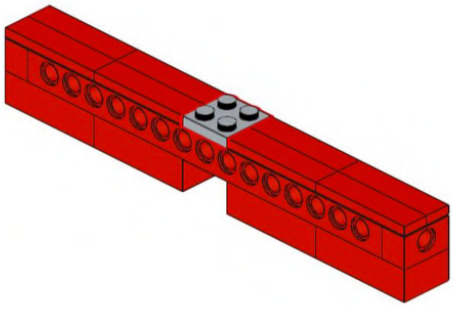

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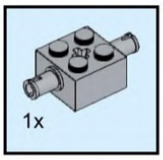

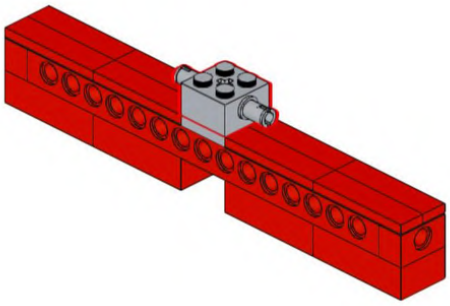

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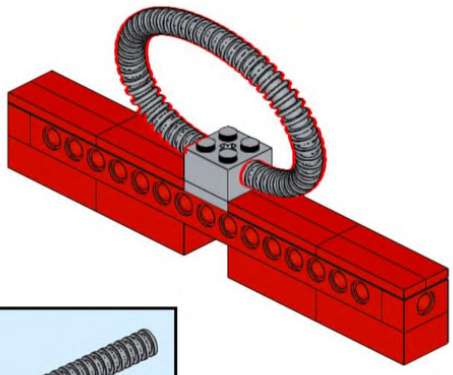

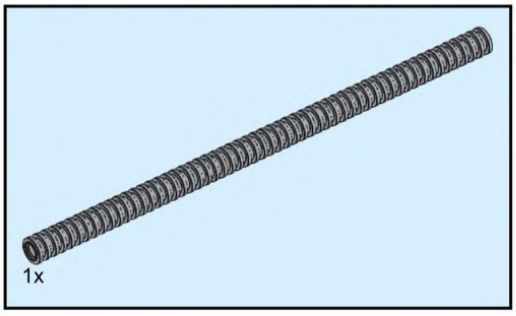

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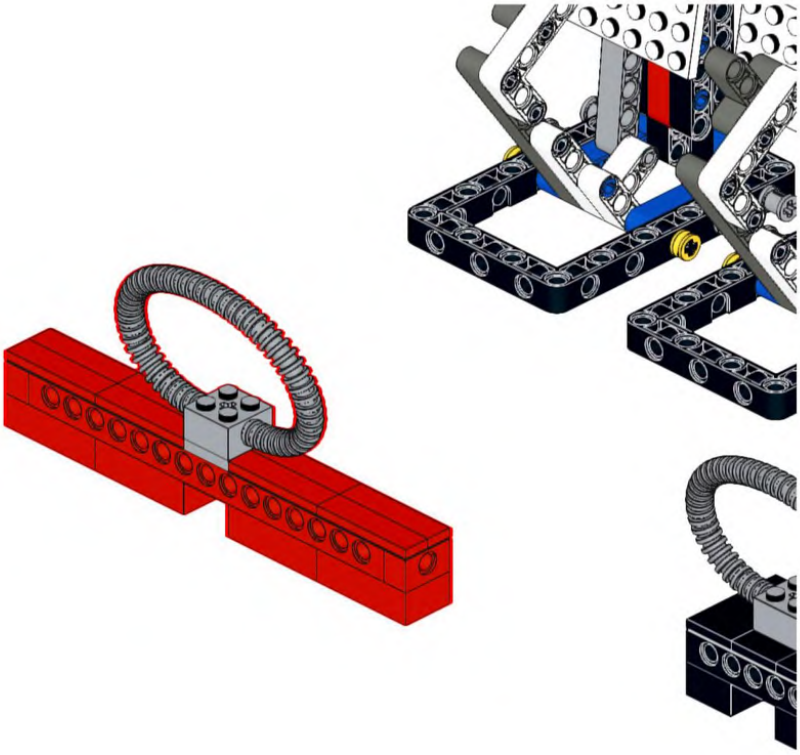

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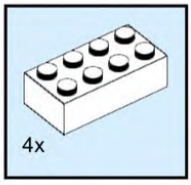

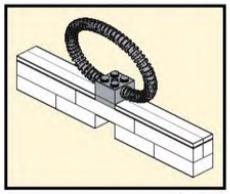

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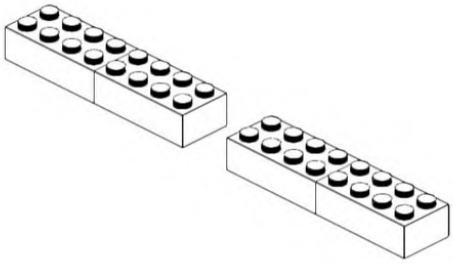

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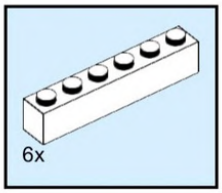

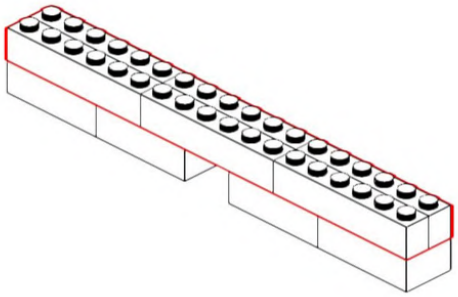

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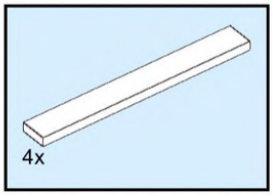

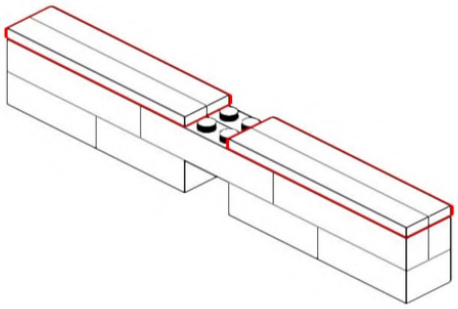

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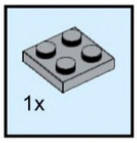

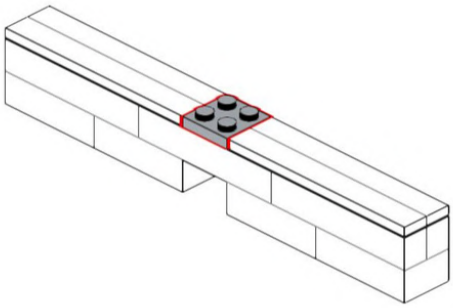

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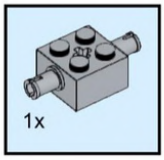

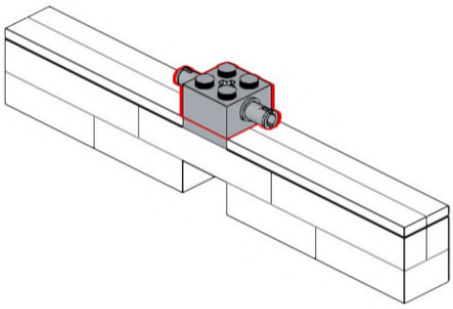

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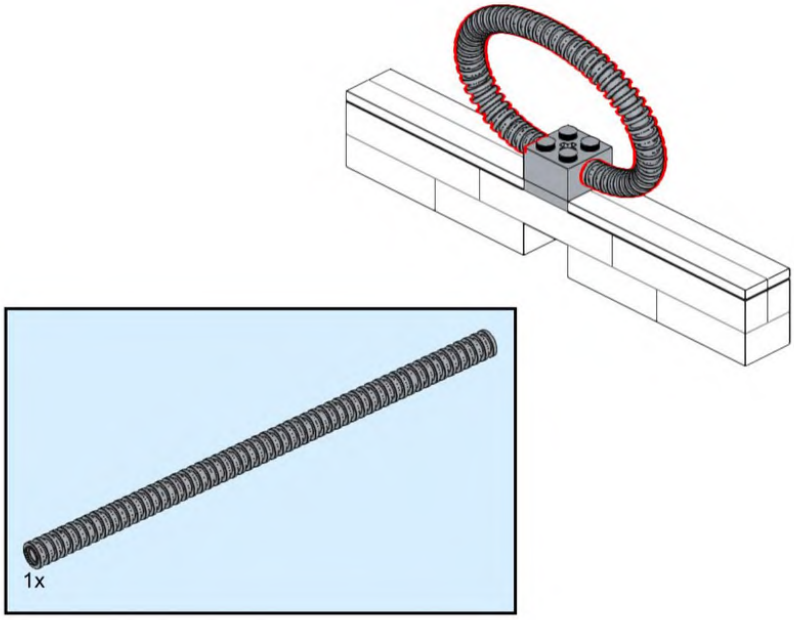

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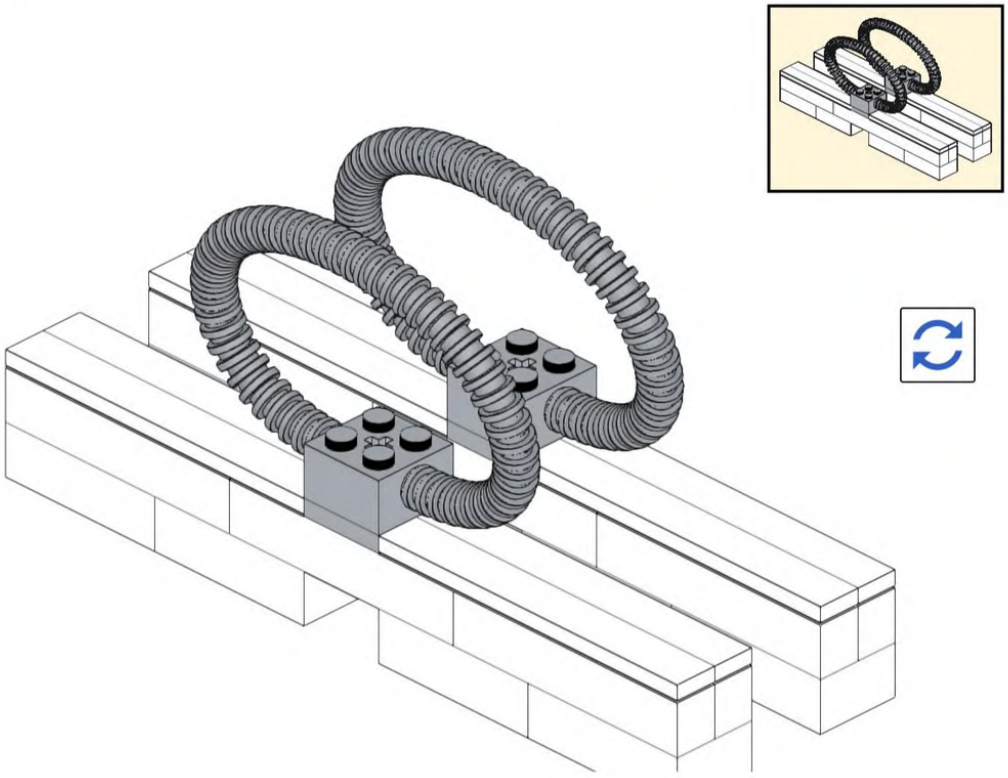

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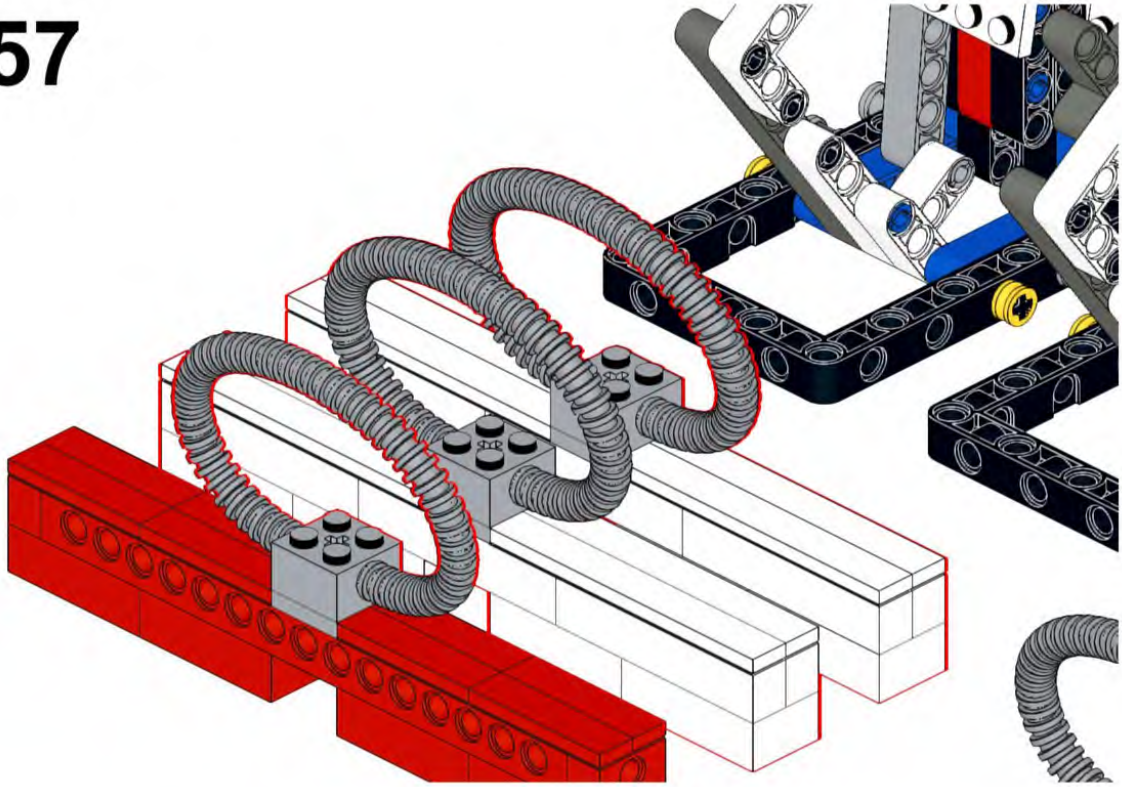

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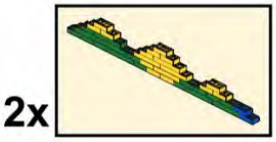

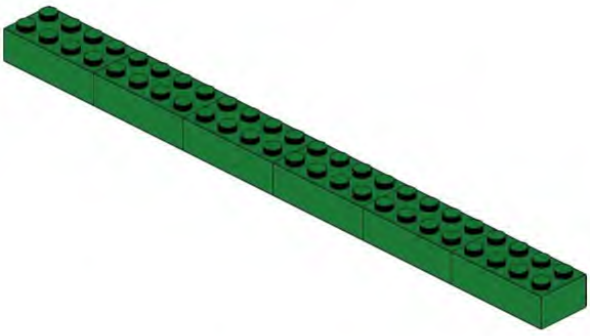

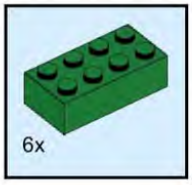

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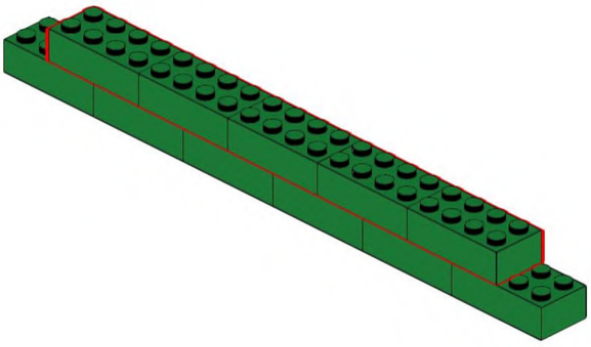

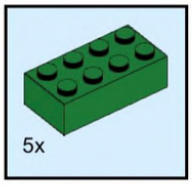

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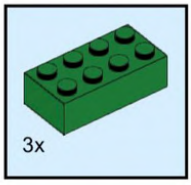

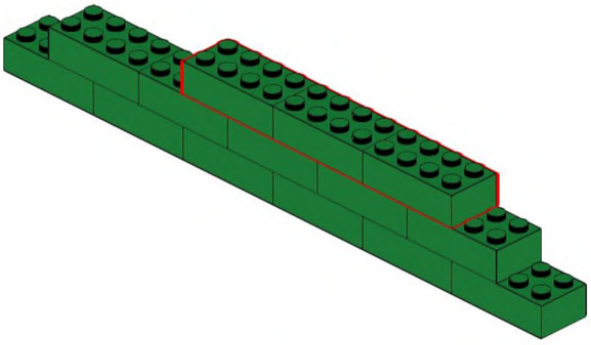

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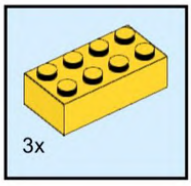

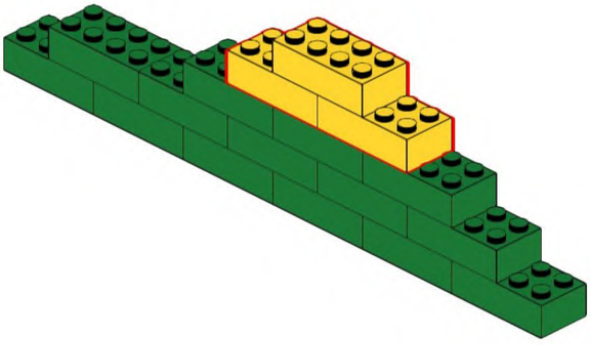

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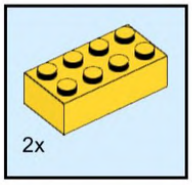

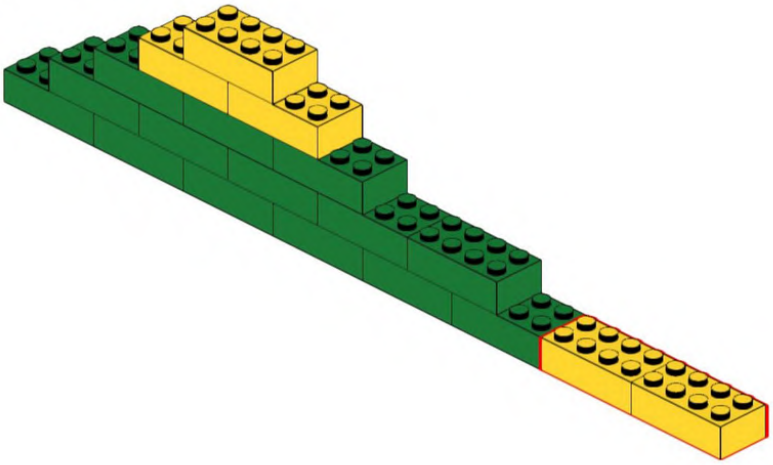

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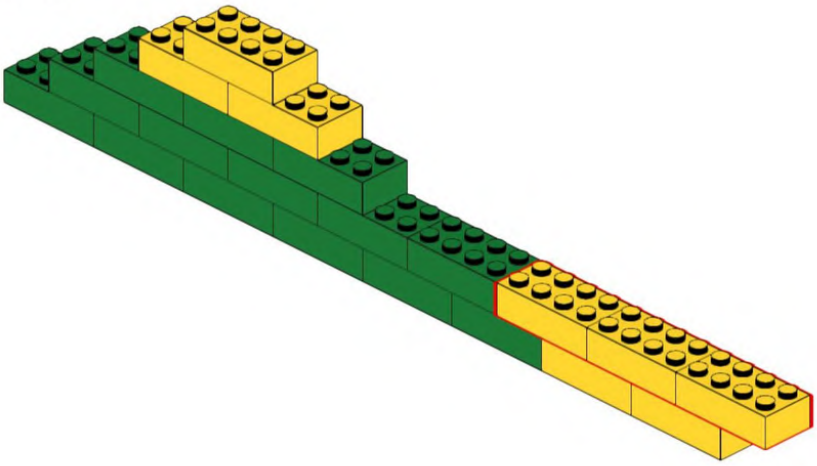

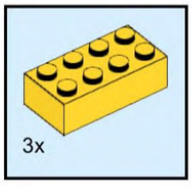

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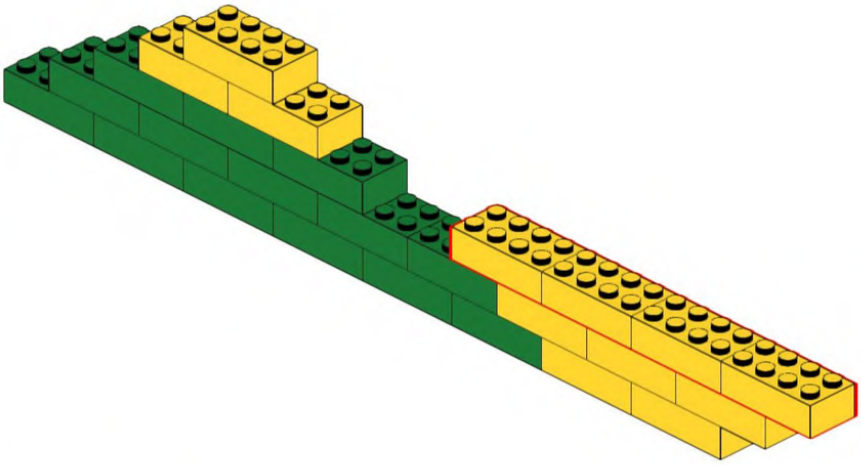

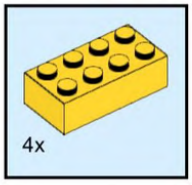

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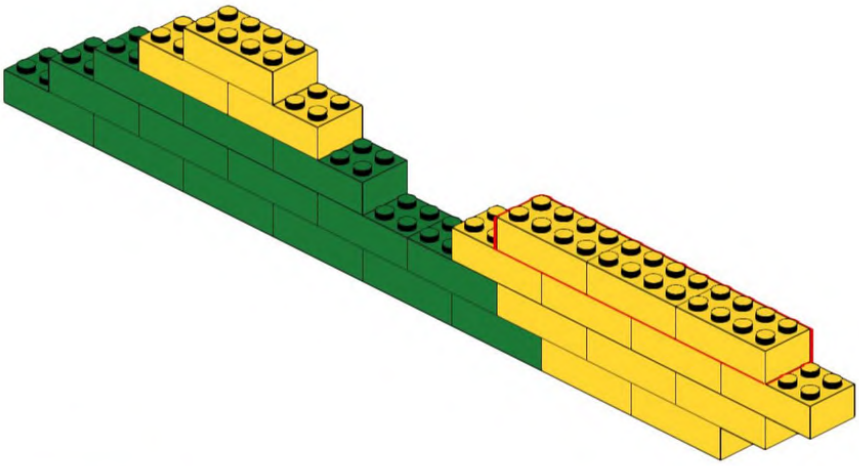

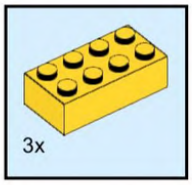

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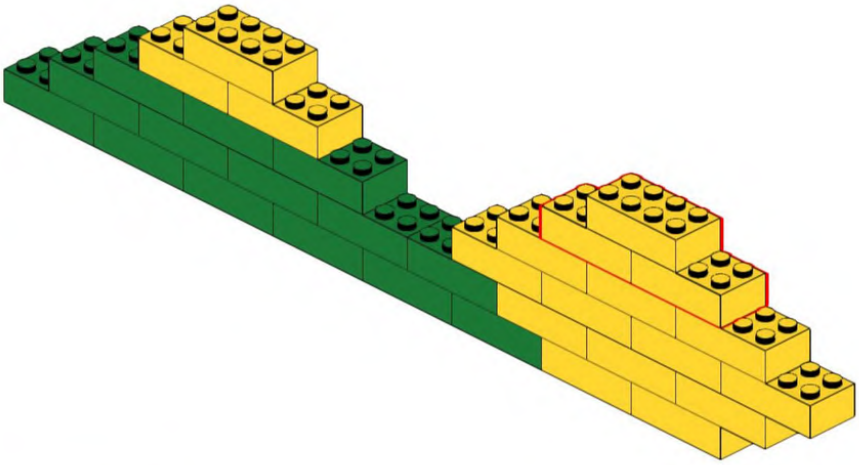

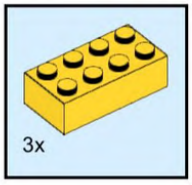

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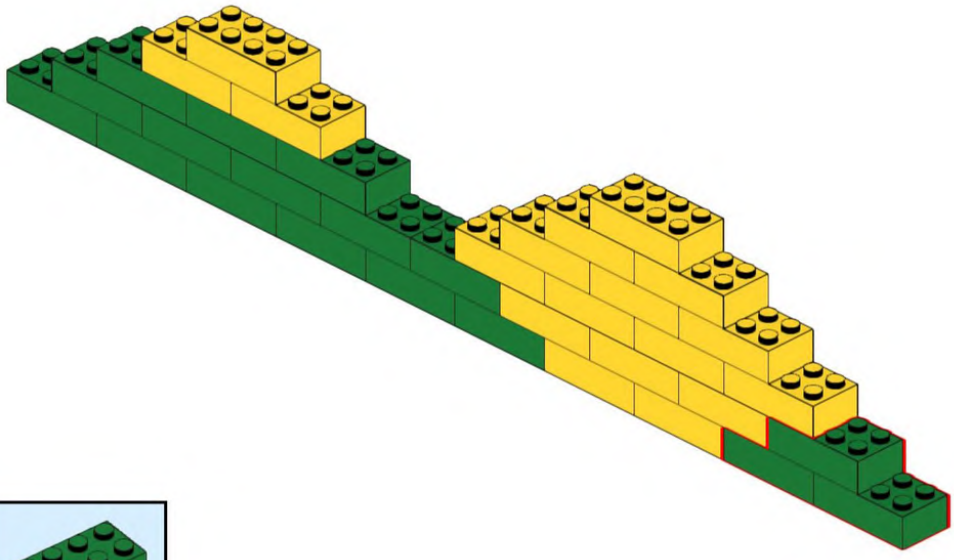

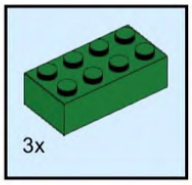

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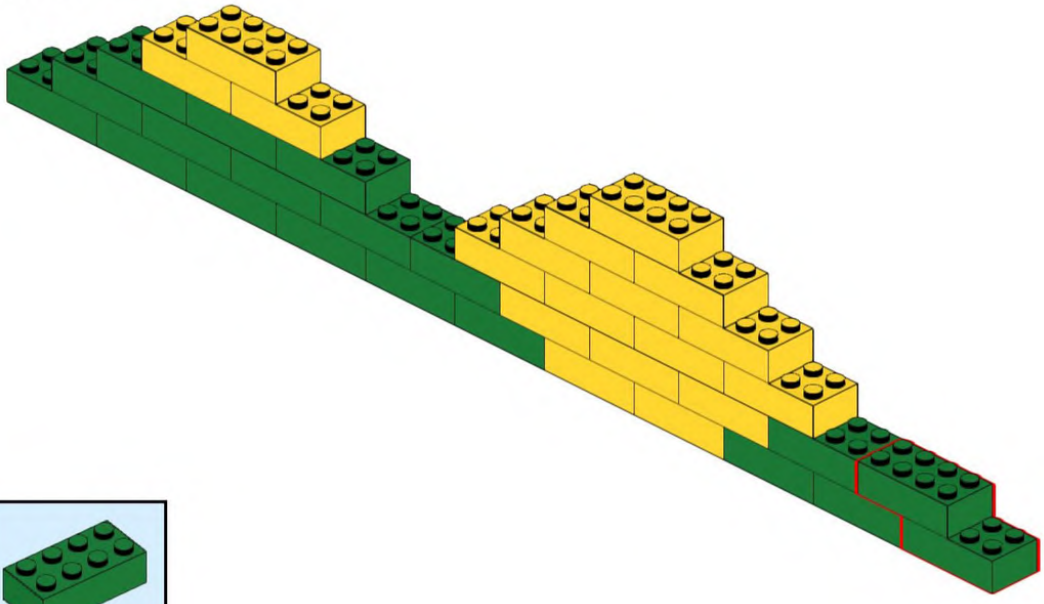
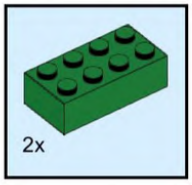
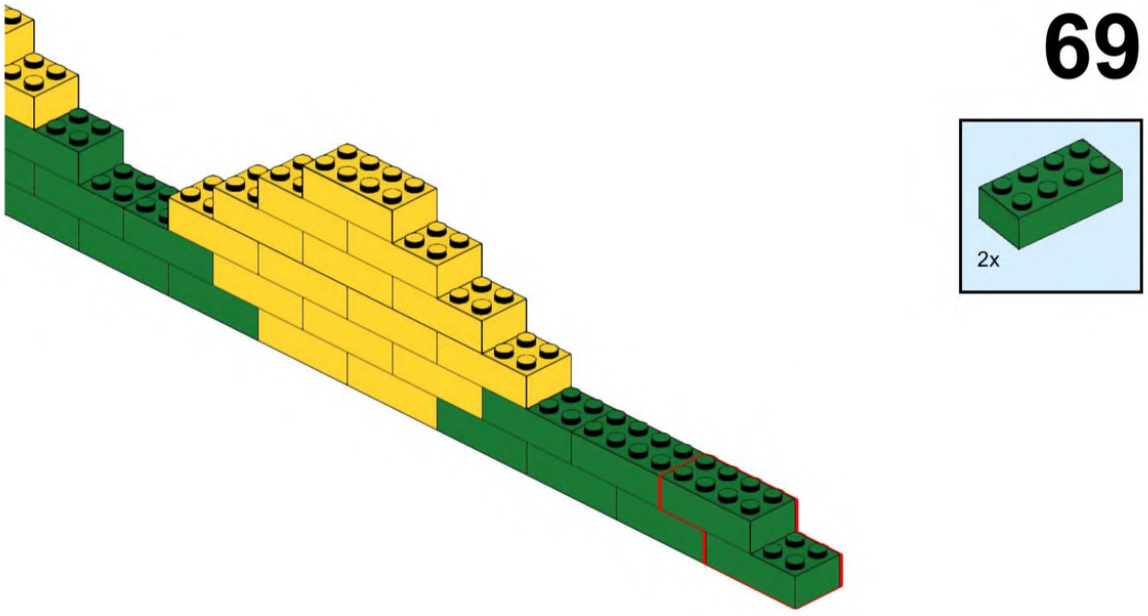
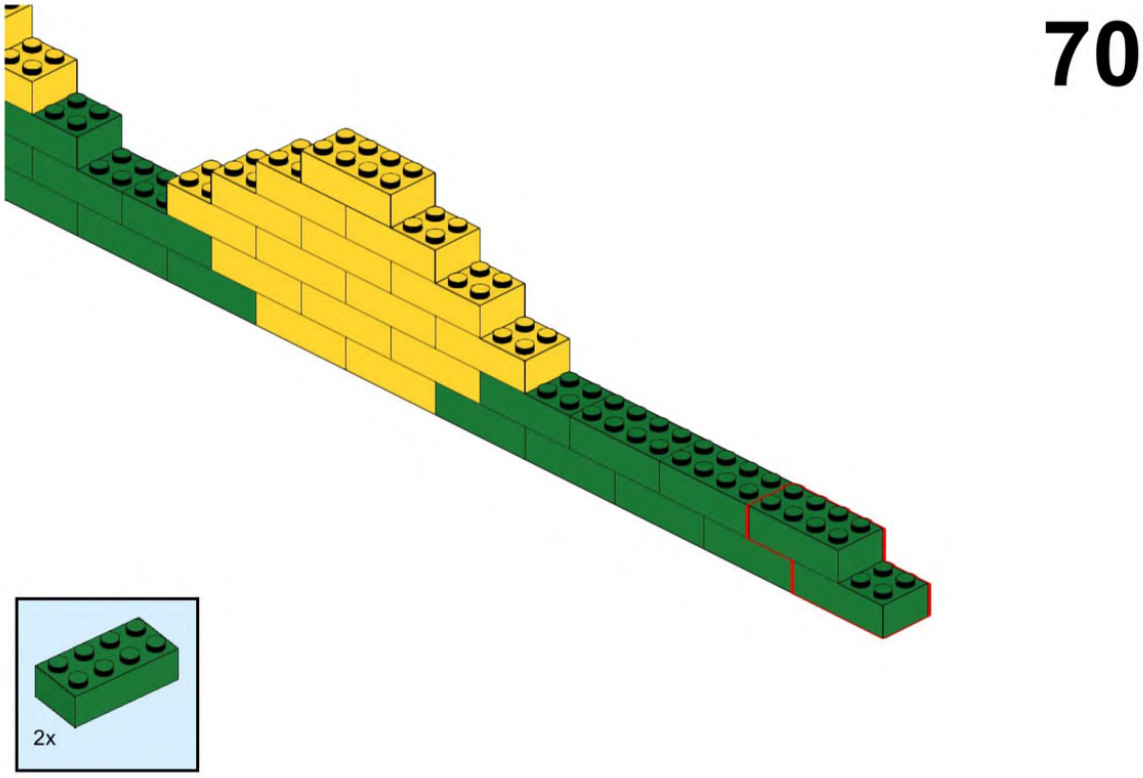





69
2x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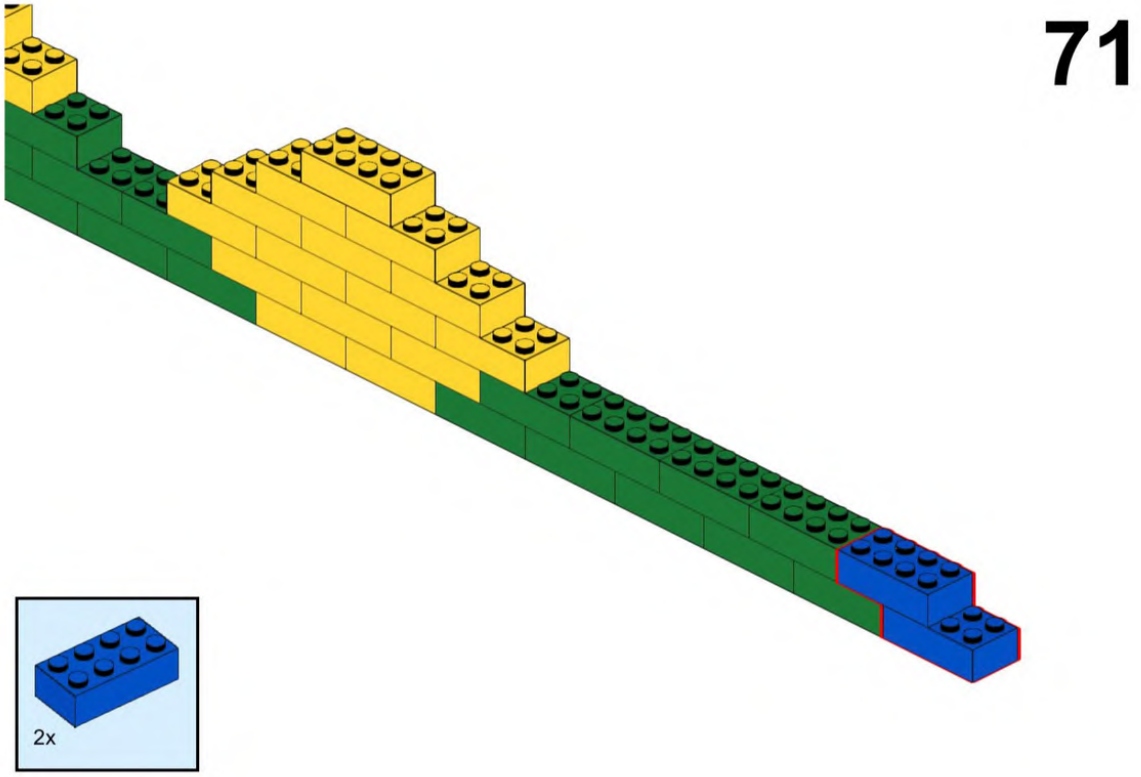
2x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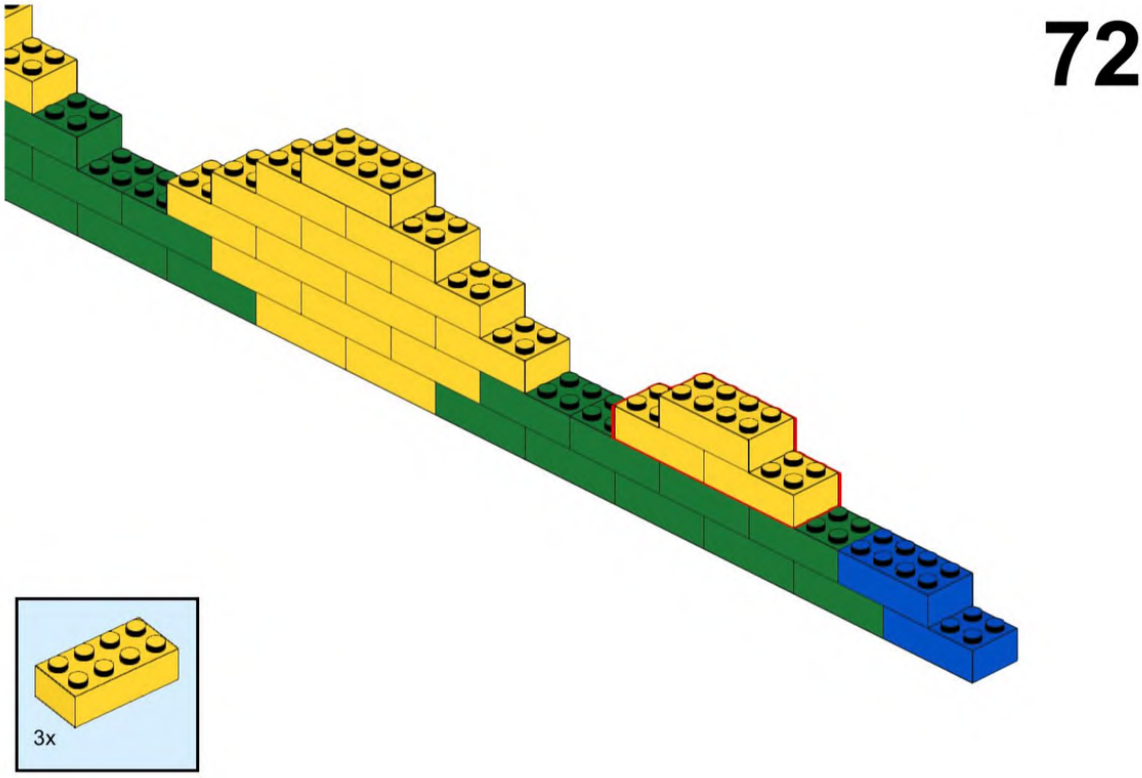
2x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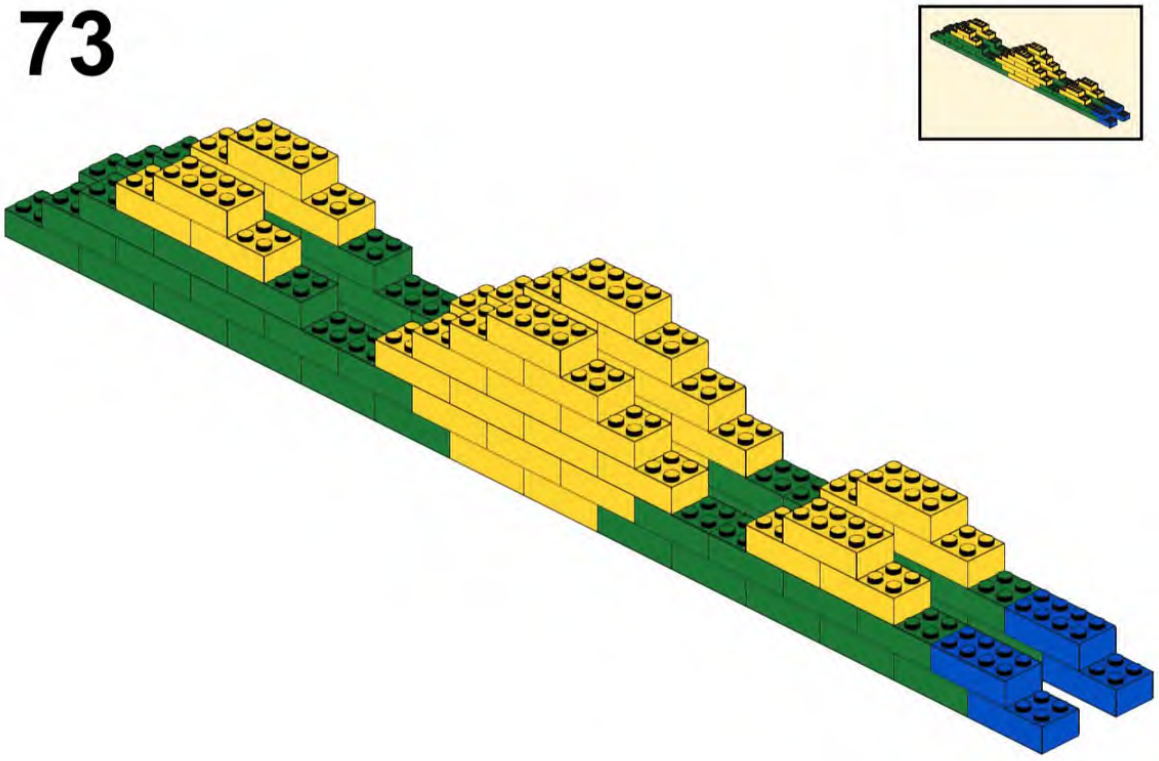
3x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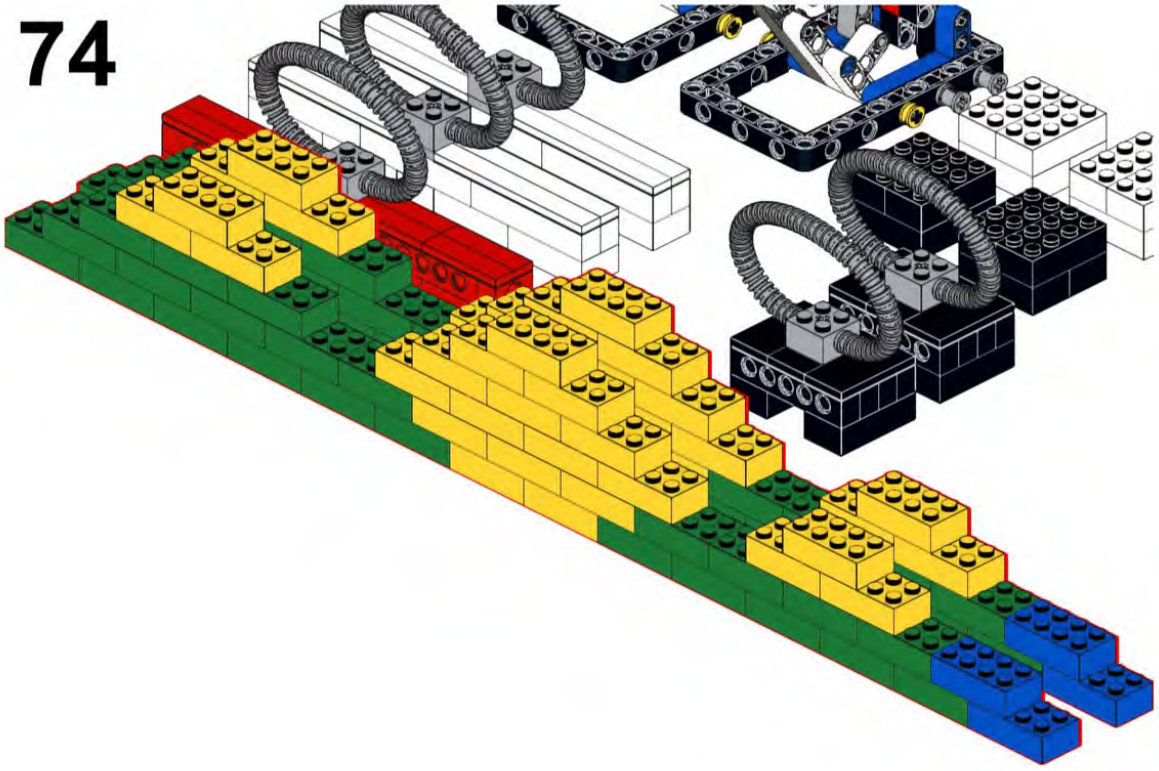
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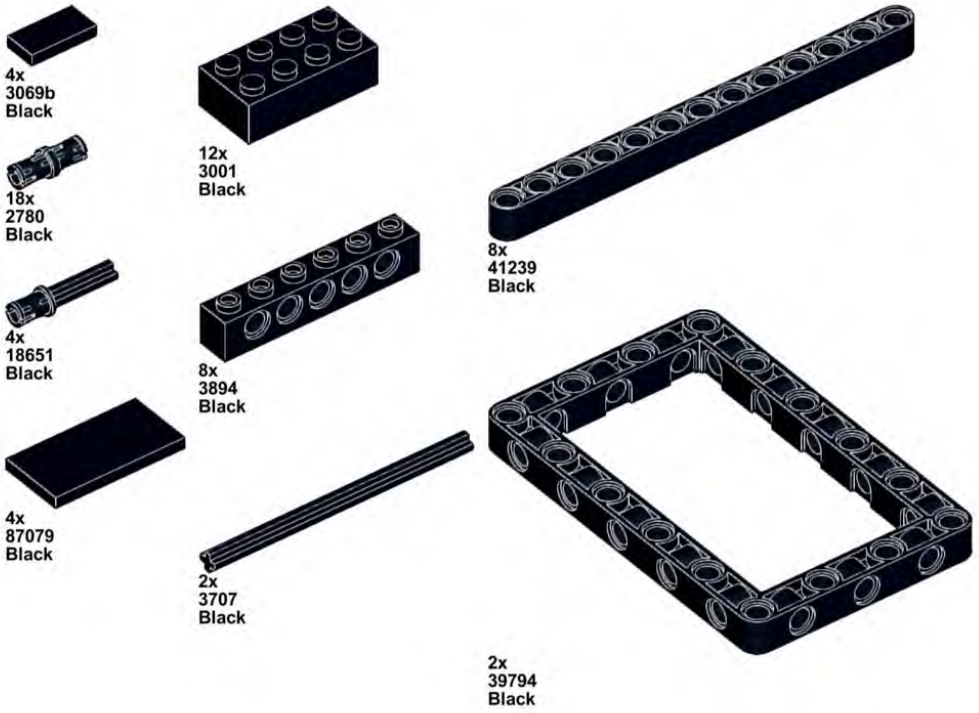
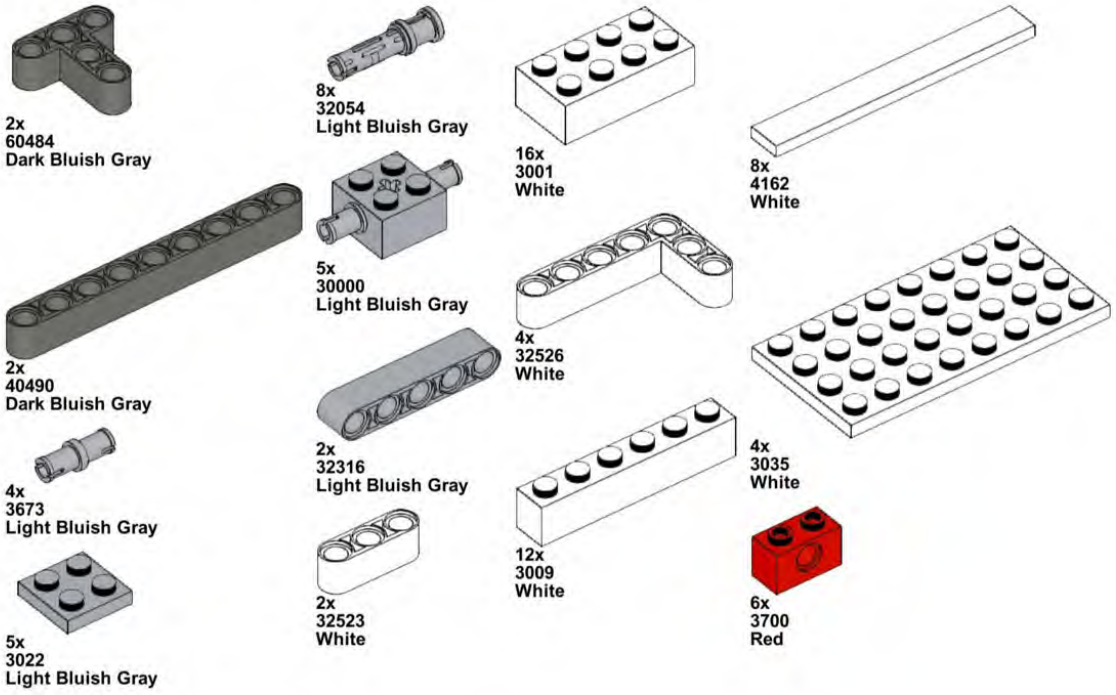
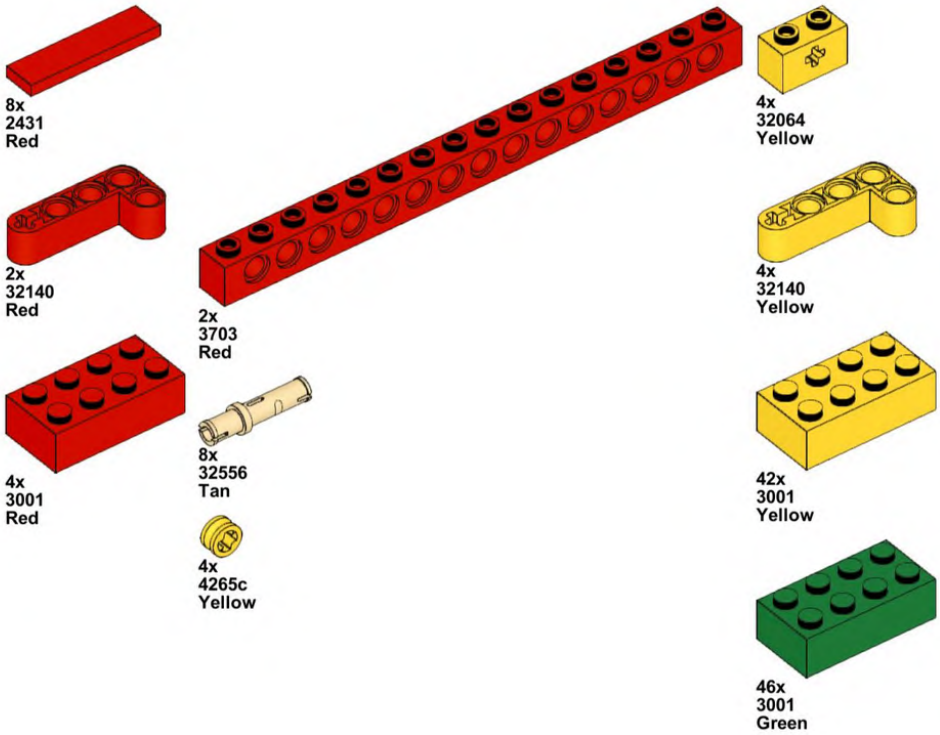
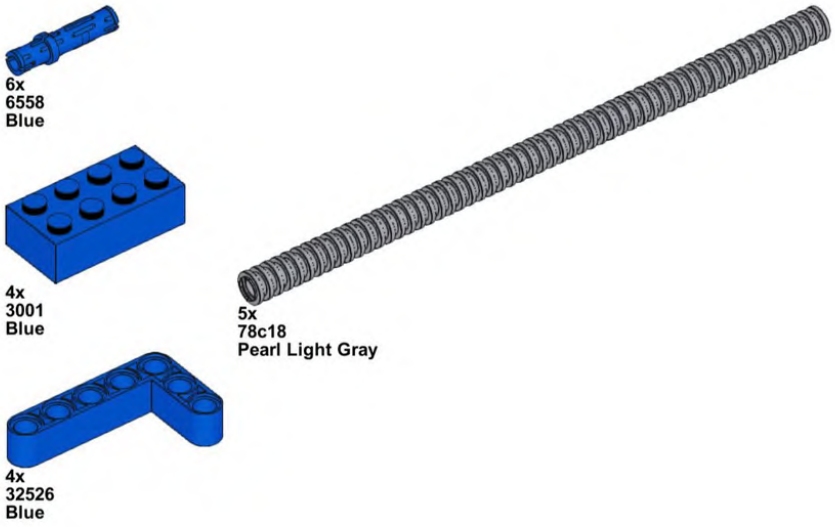

4x
3069b
Black
12x
3001
Black
18x
2780
Black
8x
41239
Black
4x
18651
Black
8x
3894
Black
4x
87079
Black
2x
3707
Black
2x
39794
Black


2x
60484
Dark Bluish Gray
8x
32054
Light Bluish Gray
16x
3001
White
8x
4162
White
5x
30000
Light Bluish Gray
2x
40490
Dark Bluish Gray
4x
32526
White
2x
32316
Light Bluish Gray
4x
3035
White
4x
3673
Light Bluish Gray
12x
3009
White
2x
32523
White
6x
3700
Red
5x
3022
Light Bluish Gray


8x
2431
Red
2x
32140
Red
4x
3001
Red
2x
3703
Red
8x
32556
Tan
4x
4265c
Yellow
4x
32064
Yellow
4x
32140
Yellow
42x
3001
Yellow
46x
3001
Green

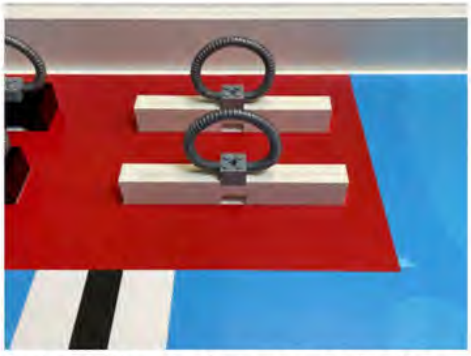

6x
6558
Blue
4x
3001
Blue
4x
32526
Blue
5x
78c18
Pearl Light Gray

4.5 Game Objects, Positioning, Randomization

Submarine Cables (2x white, 1x red)

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

- Two white submarine cables are placed on the two positions in the shipyard.
- The red 'broken' submarine cable is randomly placed on any of the four connection slots in the Caribbean hub

White cable (2x)	Red Cable (1x)
 Start position in the two marked areas in the shipyard	One possible start position in one of the four connection slots in the Caribbean hub

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.

Server object (2x)	Marked start position in the shipyard

Marking blocks (2x white, 2x black)

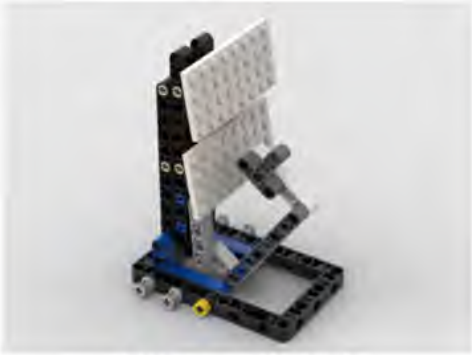
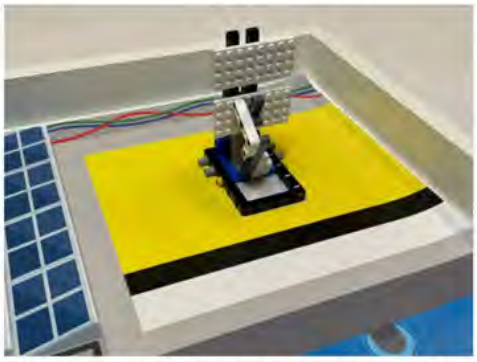
The marking blocks are placed in the ship information centre. They are used to determine the placement where the robot should bring the server objects (black marking blocks) and submarine cables (white marking blocks).. One white and one black marking block are randomly placed on the little areas marked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

The other white and black marking block are randomly placed on the little areas marked 1.- 4. on the Caribbean side.

Marking blocks (2x black, 2x white)	One possible placement of the marking blocks

Solar panels (2x)

There are two game objects that represent solar panels for an offshore solar farm. These objects need to be fixed on the game field (see General Rules, chapter 6) and are placed in the yellow offshore solar farm areas (one in each)

 Solar panels (2x)	 Placement of the solar panels in the offshore solar farm areas.

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.

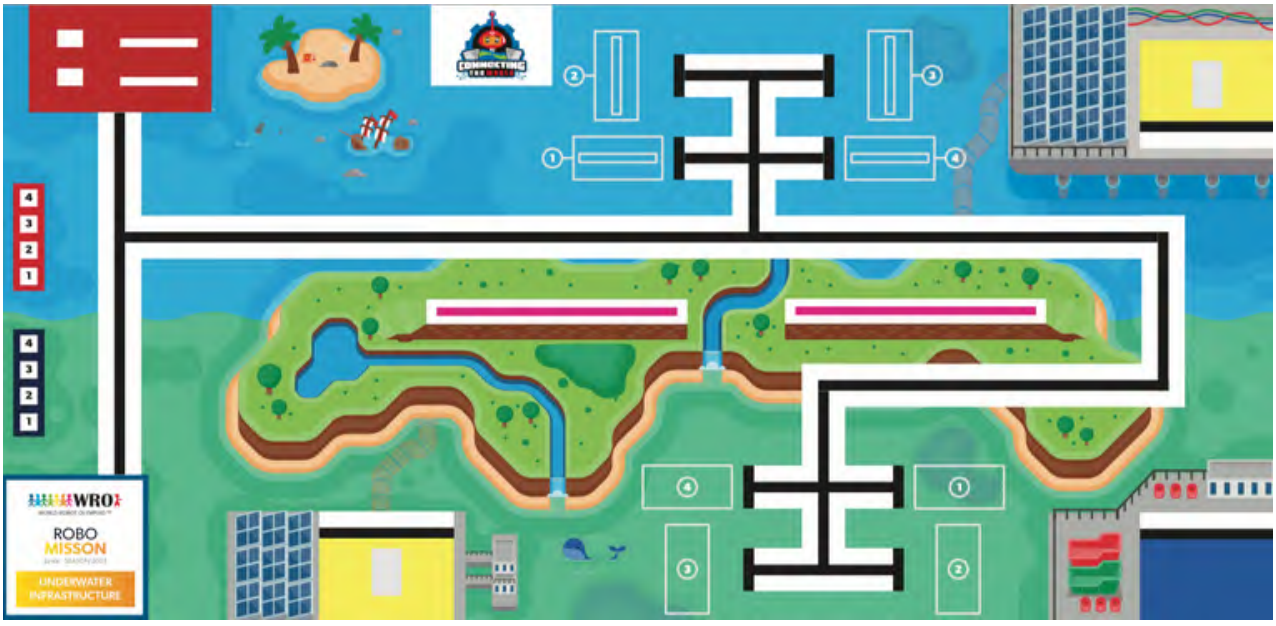
Summary randomization

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 Pacific side.
- One white and one black marking block on the 1-4 area on the Caribbean side.
- Red 'broken' cable on one of the 4 connection slots in the Caribbean hub

One possible randomization you can see here:

- White marking block Pacific No. 3, Black marking block Pacific No. 1
- White marking block Caribbean No. 4, Black marking block Caribbean No. 1
- Red 'broken' cable on connection slot No. 2 on the Caribbean side



4.6 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 and Pacific side, for example: a white marking block on Pacific no. 1 and a black marking block is placed on Pacific no. 3 means that a submarine cable should be placed in the connection slot no. 1 and the server object on connection slot no. 3.

Full points are awarded if an object is completely inside one connection slot. Extra points are awarded if both objects on one side (Caribbean or Pacific) are installed.

4.2 Find broken cable

The existing submarine infrastructure must be maintained, and an underwater robot vessel should help identifying broken and old elements (the red object). In this case, the robot should find the red object and bring it to the repair facility that is above the water. There it can be repaired or recycled.

Full points are awarded if the broken element is completely inside the repair facility (blue area).

4.3 Activate offshore solar farm

IT infrastructure, if underwater or on land, requires a lot of energy. And worldwide we use more and more digital tools and IT infrastructure. Therefore, it is important to have a sustainable approach when it comes to energy usage. Offshore solar farms can help with this.

The robot should help to setup offshore solar farms and activate the first solar panels of this farm. Full points are awarded if the level of the model is pulled and the solar panels are standing upright.

4.4 Bonus points

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

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**.

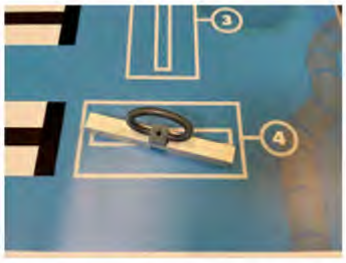
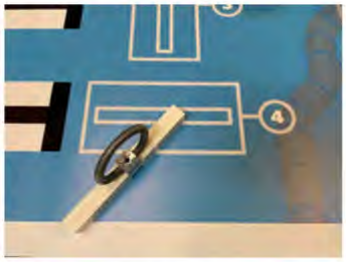
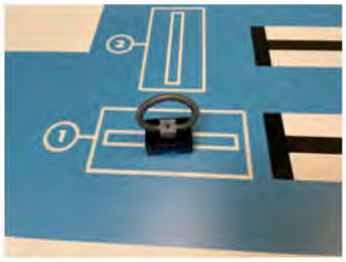
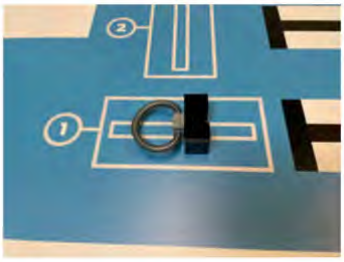
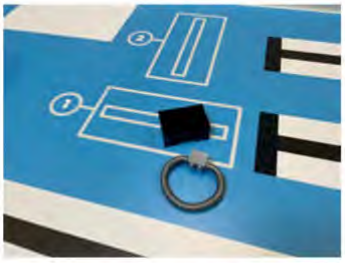
4.7 Scoring

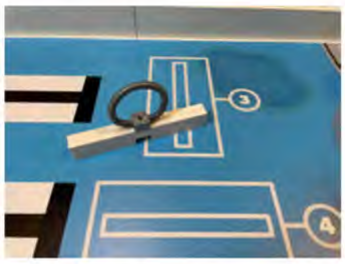
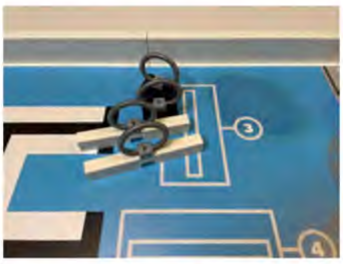
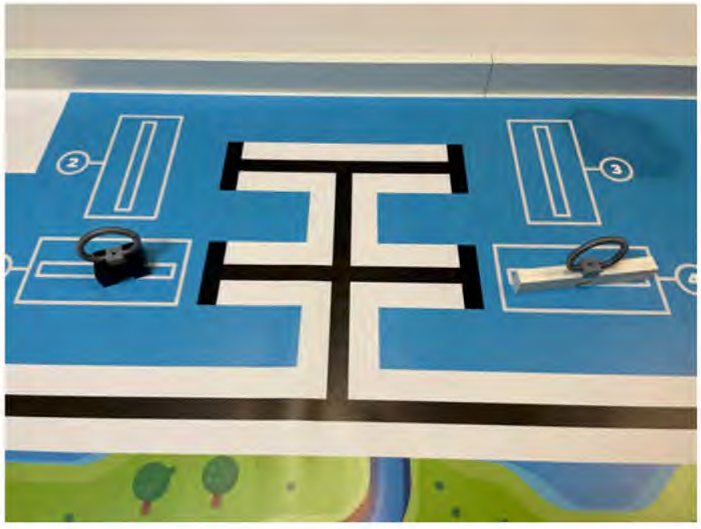
"Completely" means that the game object is only touching the corresponding area (not including the black lines).
Please note that there is a new rule about damaged game objects in the RoboMission General Rules (Rule 6.8).

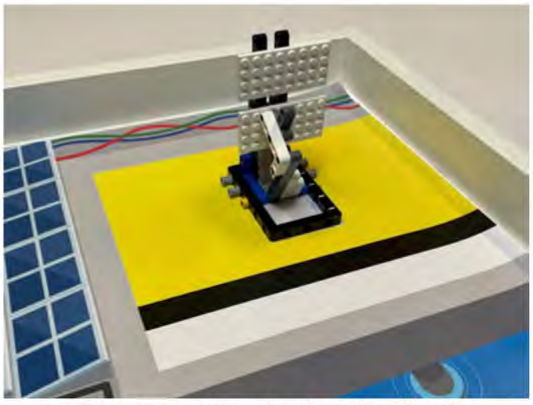
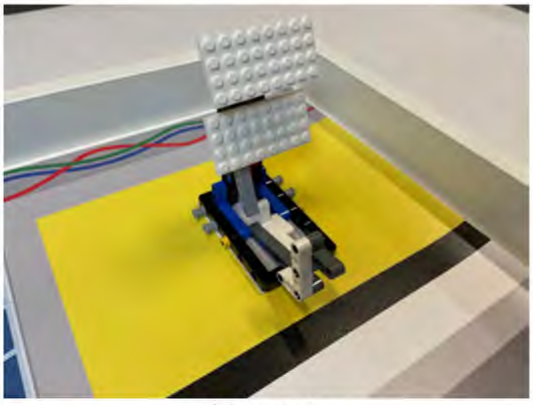
Tasks	Each	Max.
Underwater deployment		
Submarine cable is completely inside the correct connection slot	**12**	**24**
Submarine cable is touching the correct connection slot	7	
Server object is completely inside the correct connection slot	**12**	**24**
Server object is touching the correct connection slot	7	
Server object or Submarine cable is touching or inside wrong the connection slot (max. one object per connection slot)	4	
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot	6	**12**
Find broken cable		
Broken cable completely inside the repair facility		**13**
Broken cable touching the repair facility		9
Activate offshore solar farm		
Solar panel of solar farm is activated	11	**22**
Get bonus points		
Island barrier is not moved or damaged	6	**12**
Park the robot		
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**13**
Maximum Score		**120**

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!

Submarine cable is completely inside correct connection slot ➔ 12 points Submarine cable is touching correct connection slot ➔ 7 points		
 12 points (completely inside)	 12 points (completely inside, white line counts as inside)	 7 points (only touching)
 7 points (only touching)	 0 points (object damaged)	
Server object is completely inside correct connection slot. ➔ 12 points Server object is touching correct connection slot ➔ 7 points		
 12 points (completely inside)	 12 points (completely inside)	 12 points (completely inside)
 7 points (only touching)	 0 points (object damaged)	

Server object or Submarine cable is <u>touching or inside wrong</u> connection slot ➔ 4 points.		
 4 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, 4 points.
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot. ➔ 6 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.*
Broken cable <u>completely</u> inside the repair facility ➔ 13 points. Broken cable <u>touching</u> the repair facility ➔ 9 points. *Please note: The repair facility is considered to be the blue area only.*		
 13 points (completely inside)	 13 points (completely inside)	 9 points (touching)

 9 points (touching)	 0 points (object damaged)	
Solar panel of solar farm is activated. ➔ 11 points.		
 Start position (not activated)	 11 points (activated, the lever of the model is pulled)	
Island barrier is not moved or damaged. ➔ 6 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.*		
 6 points, OK, still in white area.	 0 points, not OK, moved outside white area.	 0 points, not OK, damaged.

Projection of the robot is partly in the Start & Finish Area (only if other points, not bonus, are assigned) ➔ 13 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.

Part 5: Developing the Strategy for Game

In this stage, you will learn to develop different strategies to solve the **"Underwater Infrastructure"** challenge. Try to come up with at least three different strategies. After that select the best strategy and start working on that.

Strategy 1

Discuss the first strategy to solve the game with your teammates and write the Robot's movement planning, Robot chassis requirements, and programming concept requirements below.

Robot's movement planning:

Robot chassis requirements:

Programming concept requirements:

Strategy 2

Discuss the second strategy to solve the game with your teammates and write the Robot's movement planning, Robot chassis requirements, and programming concept requirements below.

Robot's movement planning:

Robot chassis requirements:

Programming concept requirements:

Strategy 3

Discuss the third strategy to solve the game with your teammates and write the Robot's movement planning, Robot chassis requirements, and programming concept requirements below.

Robot's movement planning:

Robot chassis requirements:

Programming concept requirements:

Part 6: Robot Chassis

According to the **WRO-2023-RoboMission-General-Rules**, the construction of the robot may be done only by the team. So I have covered a few robot-building ideas required to solve the "**Underwater Infrastructure**" challenge but not the direct robot-building solution.

6.1 Building a Robot Base

Design a basic robot model and start working on it. You can take reference from my robot model as shown in Figure 6.1-1 or you are free to design your own robot.

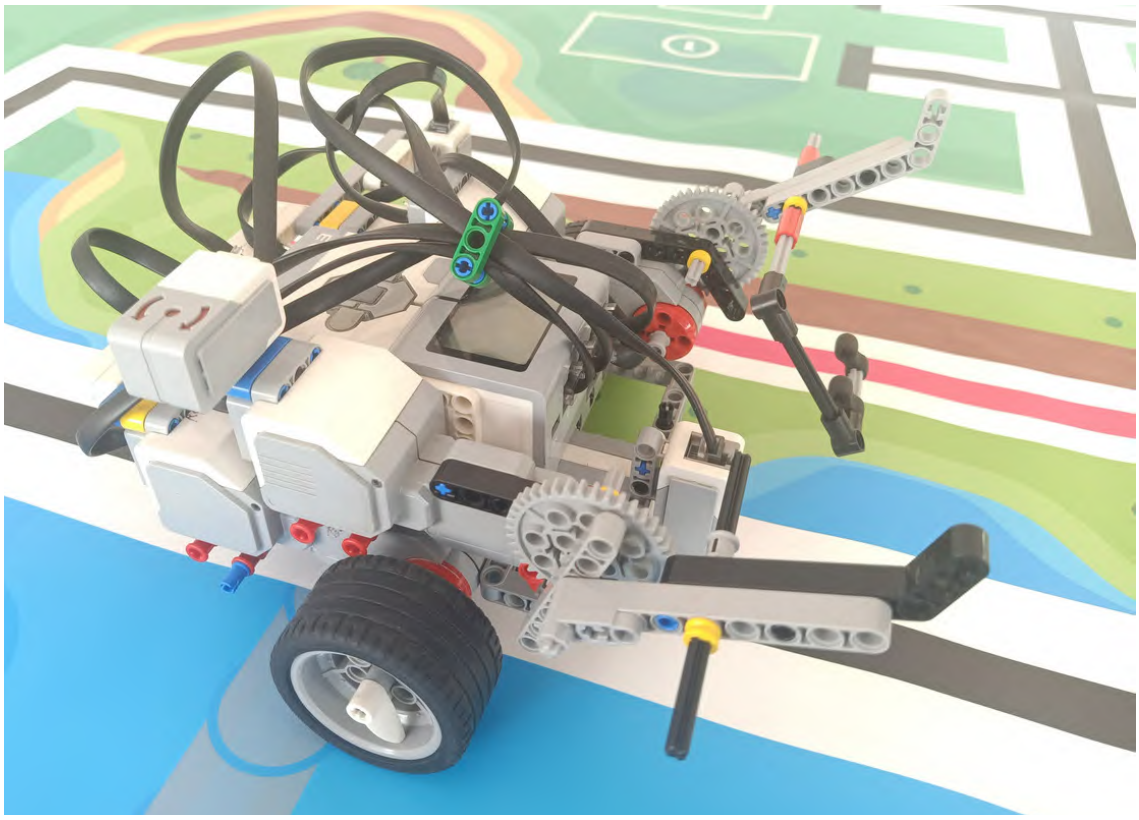


Figure 6.1-1. Basic Robot Model

Notes:

6.2 Lifting Mechanism

You need a lifting arm for cables and server objects. I have used two large motors to lift them as shown in Figure 6.2-1. You can also use medium motor or design your own lifting mechanism.

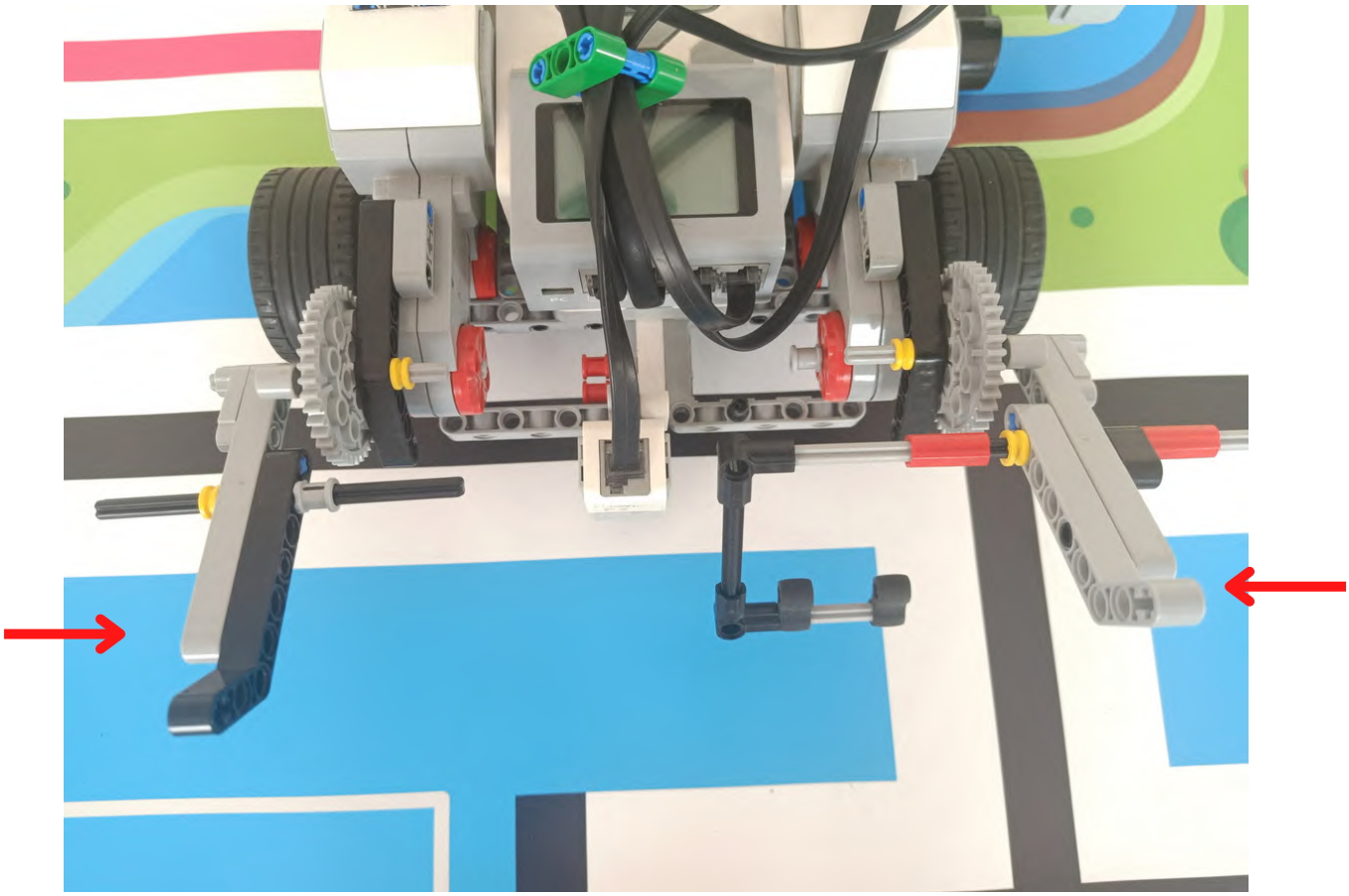


Figure 6.2-1. Color sensor attachment

Notes: _____

6.3 Color Sensor to Follow Black Line

If you plan to follow the black line or take a reference of any color on the mat then you need to attach a color sensor facing downwards as shown in Figure 6.3-1. I have used only one color sensor to follow the line but you can also use two color sensors to follow the line.

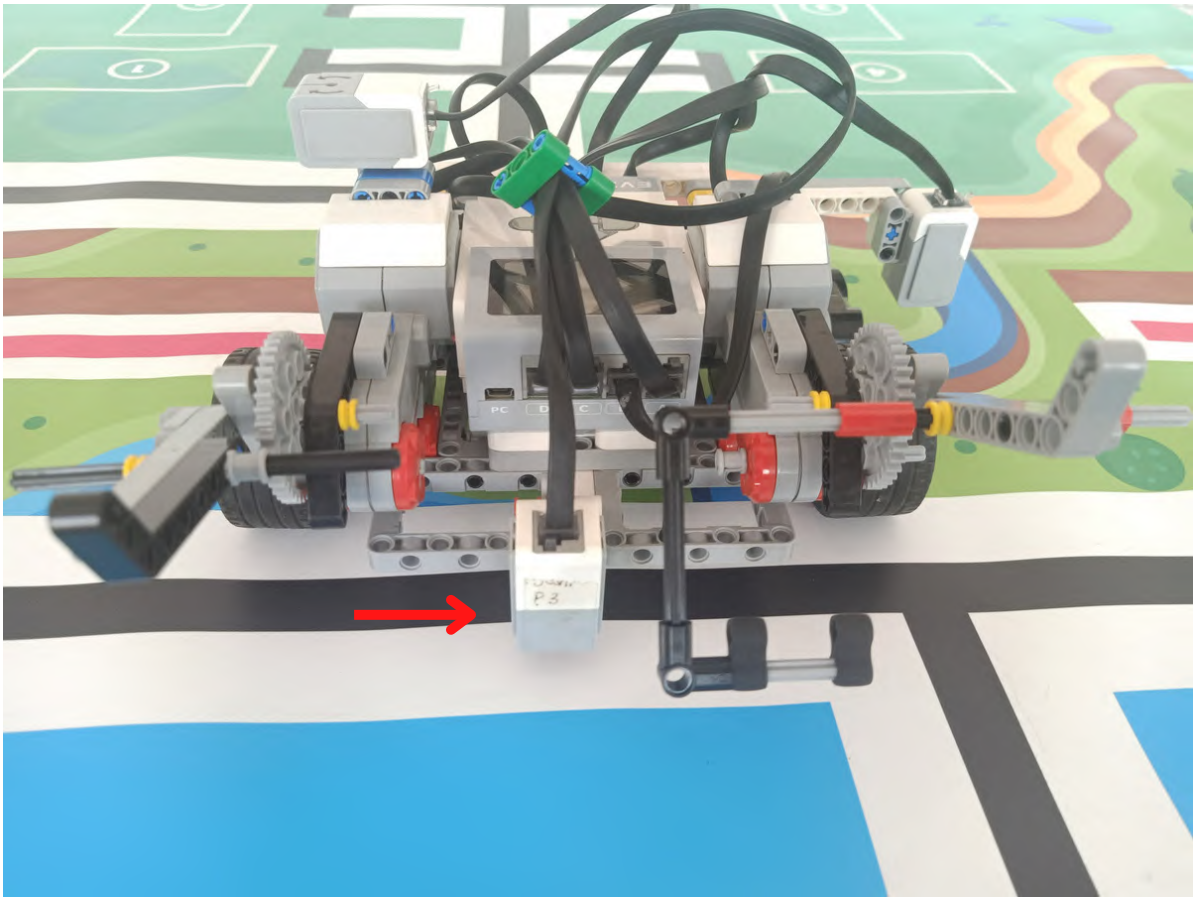


Figure 6.3-1. Color sensor attachment to follow black line

Notes:

6.4 Gyro Sensor

For turning the robot precisely at different angles you need a Gyro sensor. I have attached one Gyro sensor to the robot as shown in figure 6.4-1.

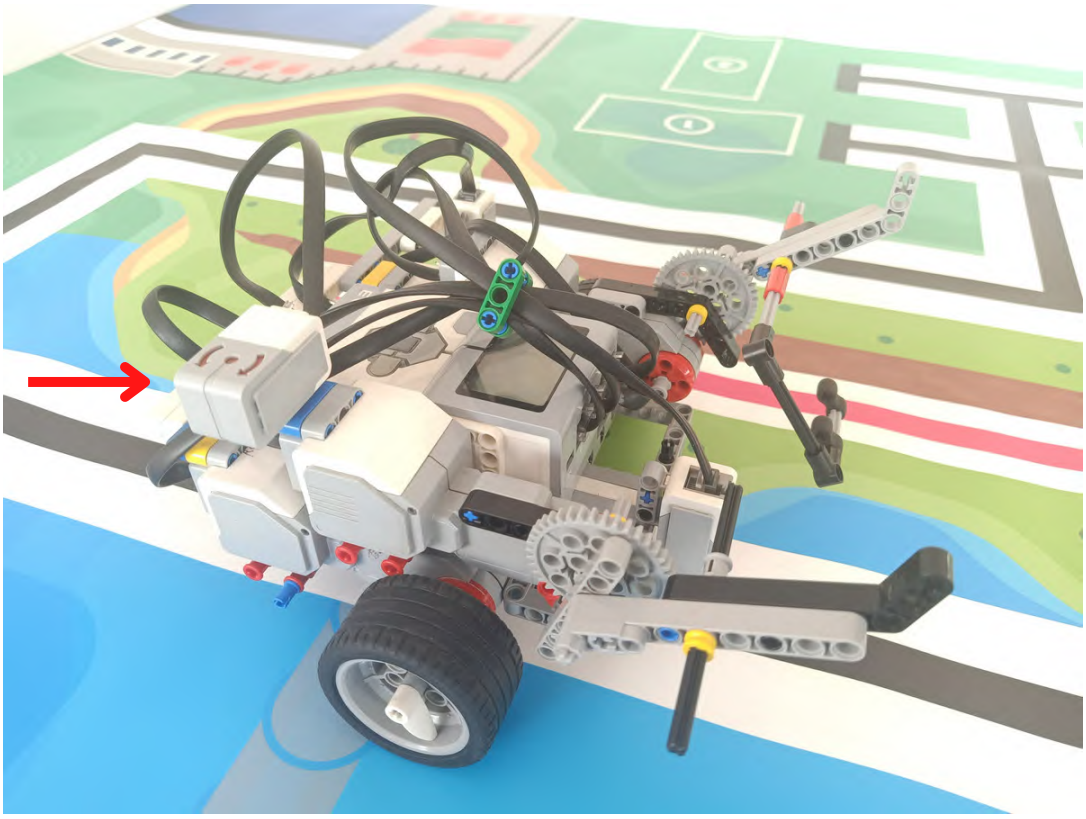


Figure 6.4-1. Gyro sensor attachment

Notes:

6.5 Ultrasonic Sensor

I have attached an Ultrasonic Sensor to detect the red wire as shown in Figure 6.5-1. You can also use any other sensor to detect the red wire based on your strategy.

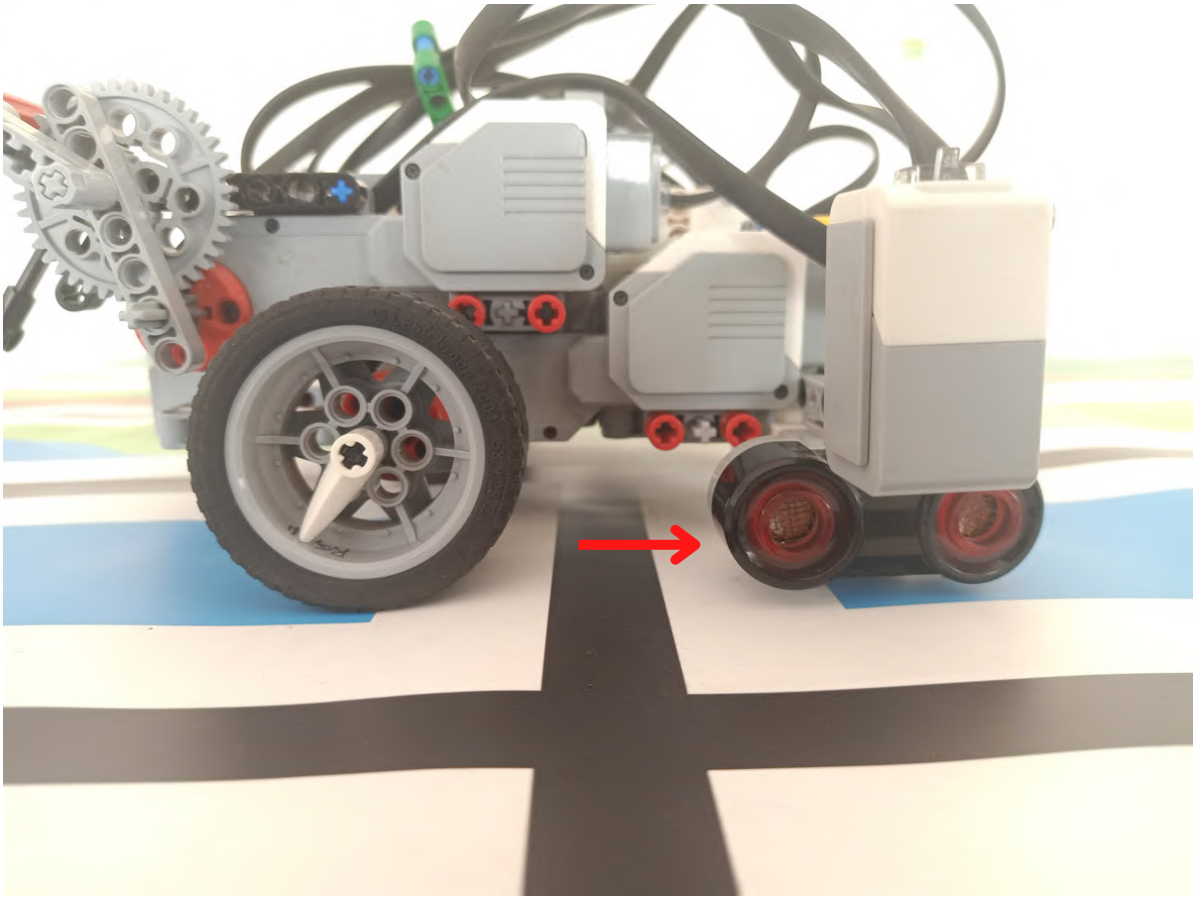


Figure 6.5-1. Ultrasonic sensor attachment

Notes:

6.6 Color Sensor to Detect the Marking Blocks

I have attached a Color Sensor facing upside down to detect the marking blocks in the ship information center as shown in Figure 6.6-1.

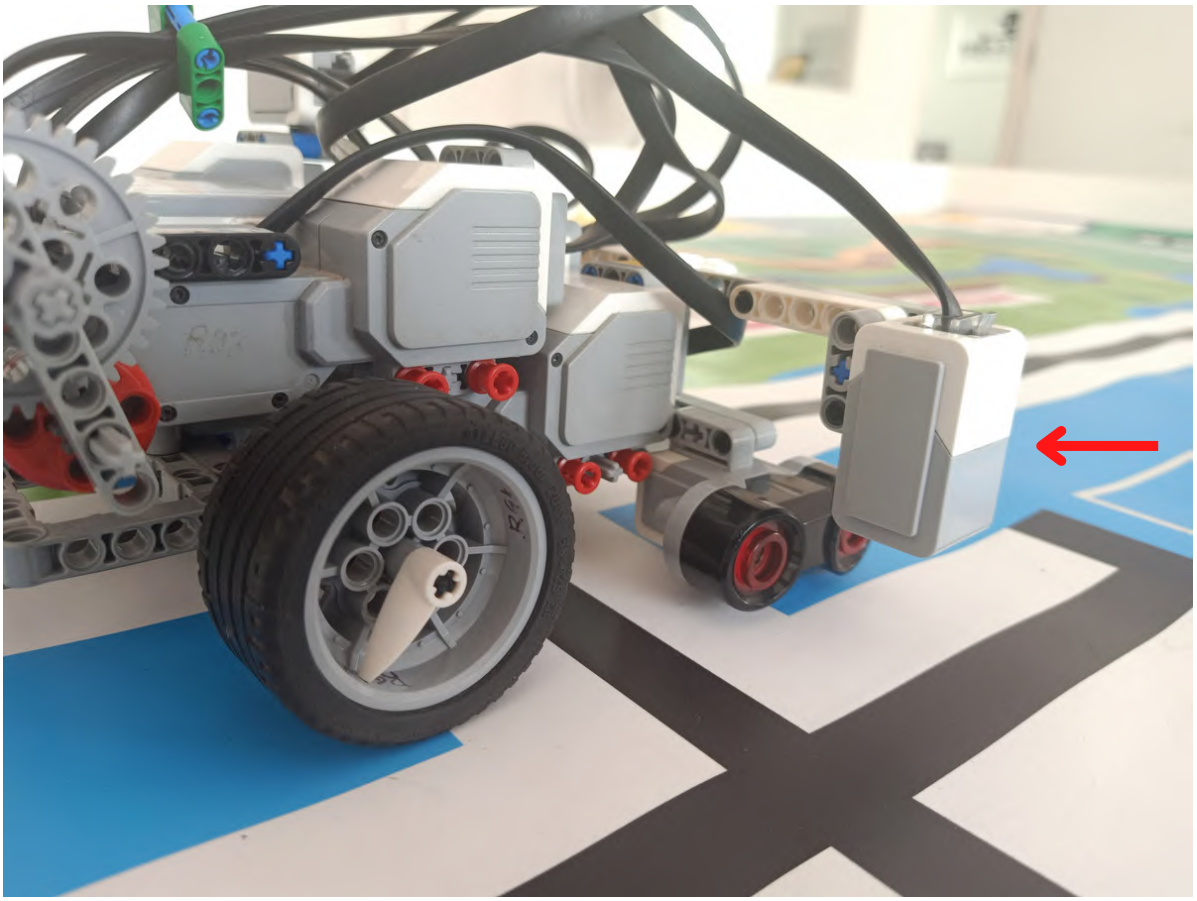


Figure 6.6-1. Color sensor to detect the marking blocks

Notes:

6.7 Lever to Activate the Solar Panel

I have attached an extended lever to one of the arm of the robot to activate the solar panels as shown in Figure 6.7-1. You can take reference from my design.

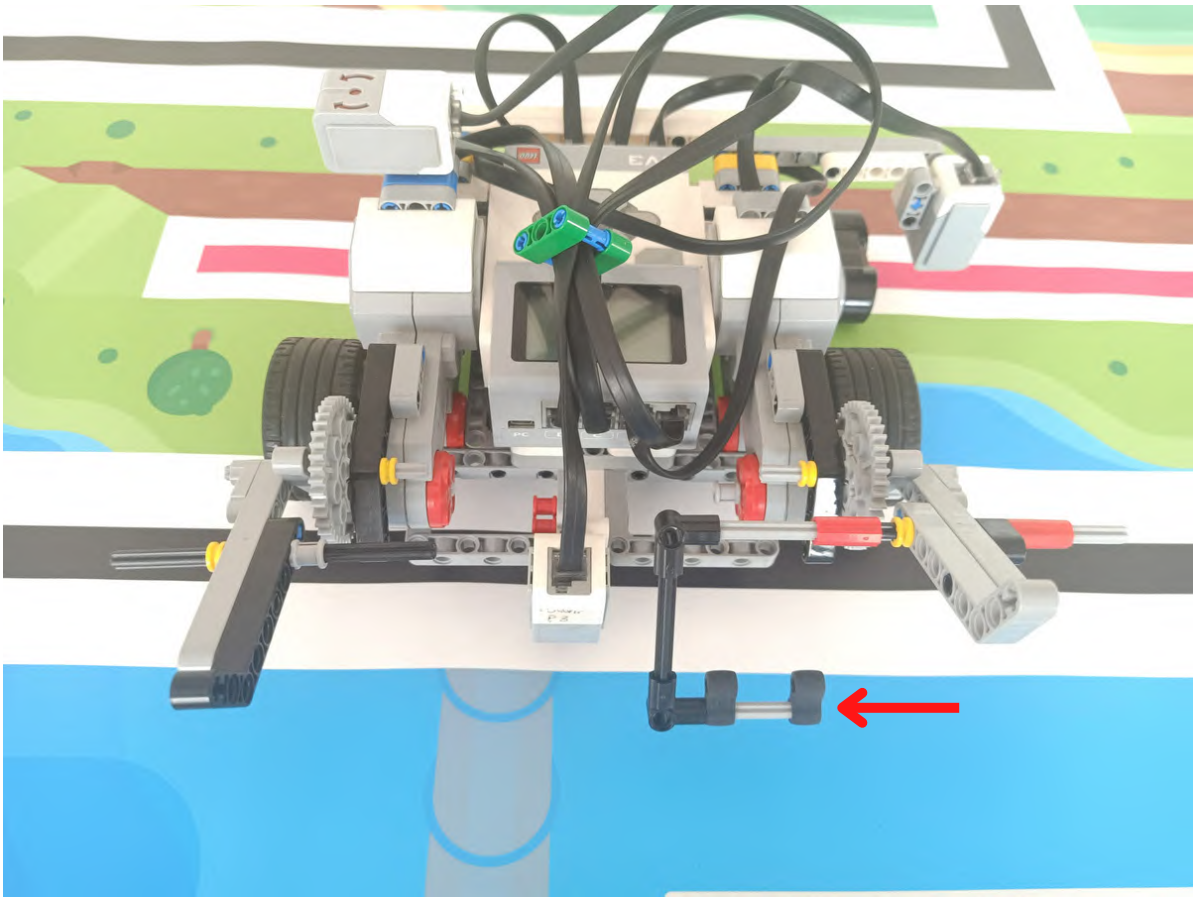


Figure 6.7-1. Extended lever to activate the solar panel

Notes:

Part 7: Programming Concepts

According to the WRO-2023-RoboMission-General-Rules, coding of the robot may be done only by the team. So I have covered most of the programming concepts required to solve the "**Underwater Infrastructure**" challenge but not the direct programming solution.

7.1 My Blocks

Sometimes you make a great mini-program that you want to use again in another Project or Program.

The My Block Builder helps you take this mini-program, which is a number of blocks you select in the work area, and group them together to create a My Block as shown in Figure 7.1-1.

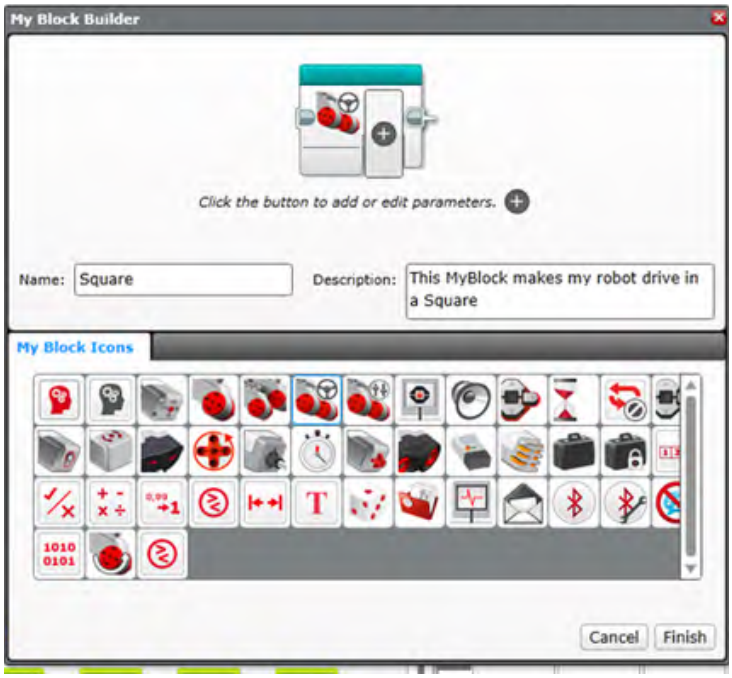


Figure 7.1-1. My block builder

Notes:

7.2 Precise Straight Move

Moving the robot using rotation or degree will be a little time taking sometimes. So we will use the "Precise straight move" program as shown in Figure 7.2-1. Also, converting that program into a My Block as shown in Figure 7.2-2 will make your work easier.

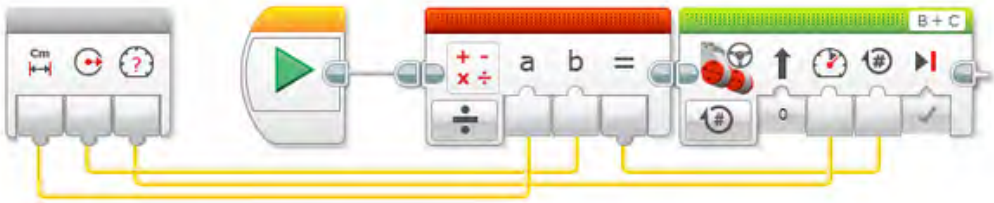


Figure 7.2-1. Straight move program

Figure 7.2-2. Program My Block

Notes: _____

7.3 Different Types of Turnings

You will learn about three different types of turning: **Point Turn, Single Motor Turn, and Curve Turn.** You can perform these turns using Move Steering and Move Tank as shown in Figures 7.3-1 and 4.3-2 respectively.

Figure 7.3-1. Turnings using Move Steering program

Figure 7.3-2. Turnings using Move Tank program

Notes: _____

7.4 Precise Turning using Gyro Sensor

For solving any challenge turning the robot plays a very important role. And turning precisely is more important. Using the precise turn program as shown in Figures 7.4-1 and figure 7.4-2 you can reduce the turning error and get an accurate value.

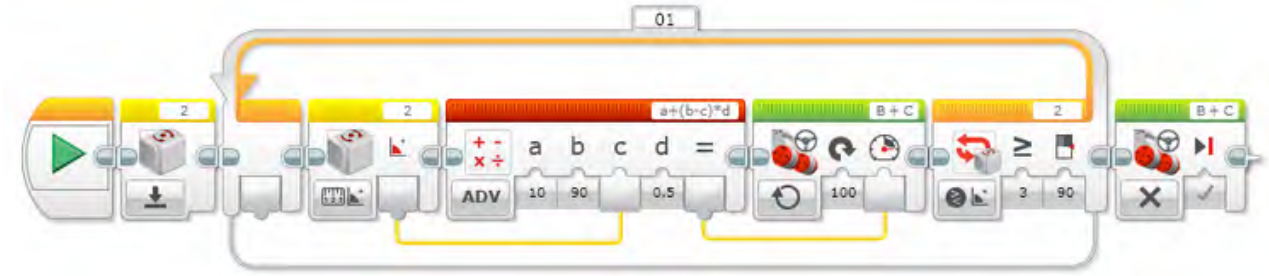


Figure 7.4-1. Turning right ninety degrees program

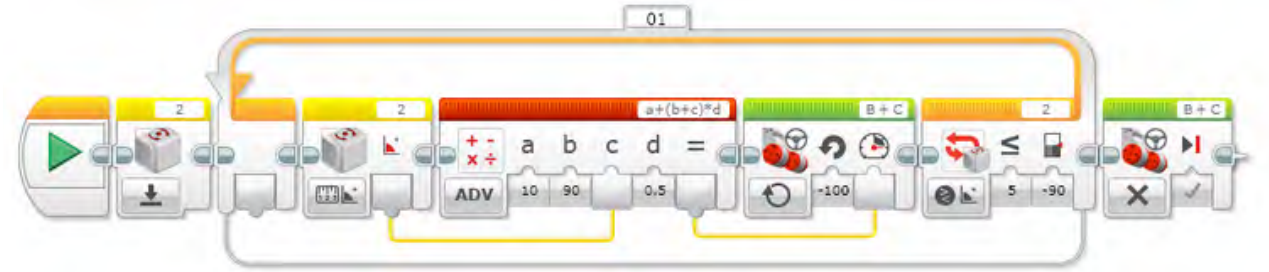


Figure 7.4-2. Turning left ninety degrees program

Notes: _____

7.5 Detecting Objects using Ultrasonic Sensors

If you want to perform any action based on the presence of any object then an Ultrasonic sensor is a good option. The ultrasonic sensor could be helpful in detecting the red wire. You can make the object detecting program and rotating the medium motor as shown in Figure 7.5-1.

Figure 7.5-1. Detecting the object using an Ultrasonic sensor program

Notes:

7.6 Calibration and Proportional Line Follower

Whenever you use the Color sensor in the reflected light mode in different light intensities then it's a good idea to run the Calibration program once. The calibration program will teach the color sensor what is "Black" and what is "White" as shown in figure 7.6-1.

After calibration, you will create a proportional line follower program as shown in figure 7.6-2. Using this program your robot can follow the line smoothly.

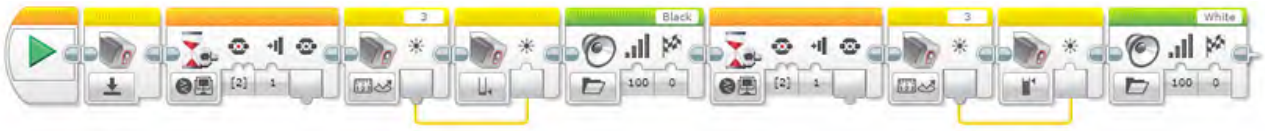


Figure 7.6-1. Calibration program

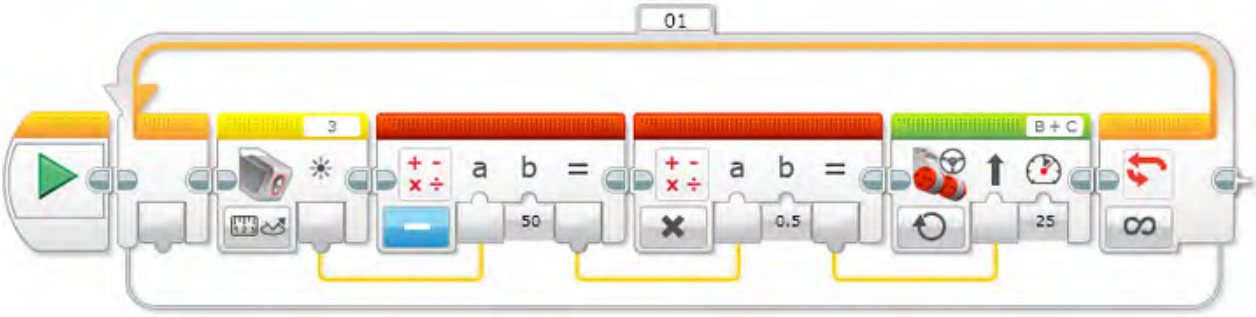


Figure 7.6-2. Proportional line follower program

Notes: _____

7.7 Line Following at Sharp Turns

While following the line if the line is having a turn of ninety degrees then what will you do?
You need to take some references to turn the robot at ninety degrees and again start to follow the line as shown in figure 7.7-1.

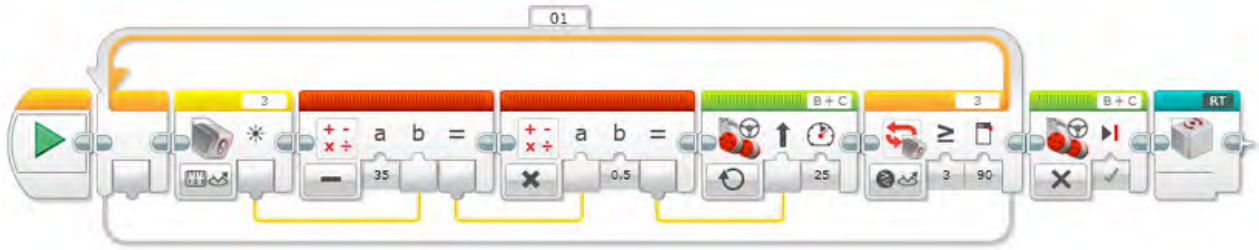


Figure 7.7-1. Following the line at sharp turns

Notes: _____

Part 8: Creating Digital Building Instructions

In this part, you will learn to create digital building instructions for your Robot using Studio 2.0 software. This software is widely used by LEGO designers to create LEGO models virtually.

8.1 Introduction to Studio 2.0

You will learn about:

- How to download and install the Studio 2.0 software.
- User interface introduction

as shown in Figure 8.1-1.

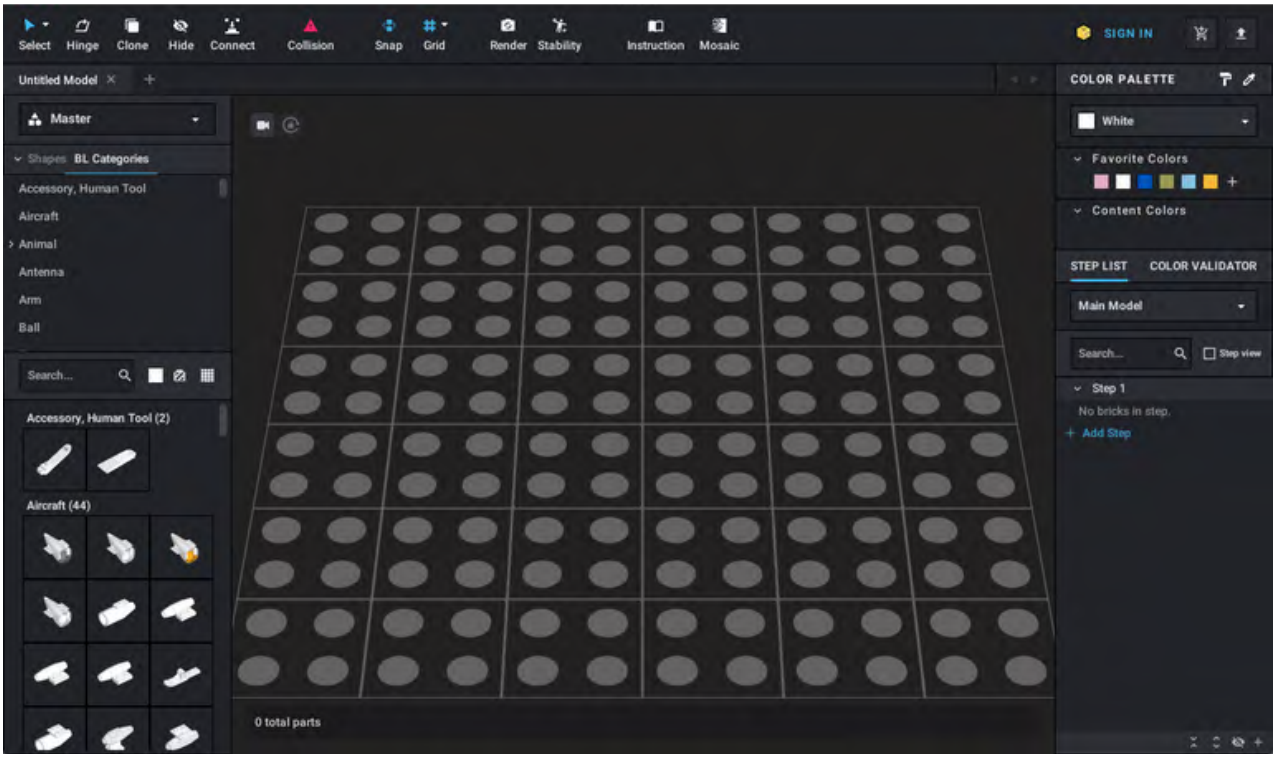


Figure 8.1-1. Studio 2.0 user interface

Notes: _____

8.2 Building Tools & Palettes

You will learn about:

- Select, Hinge, Clone, Hide, Connect, Collision, Snap, and Grid tools
- Master Palette
- Importing official LEGO sets
- Color Palette

as shown in Figure 8.2-1.

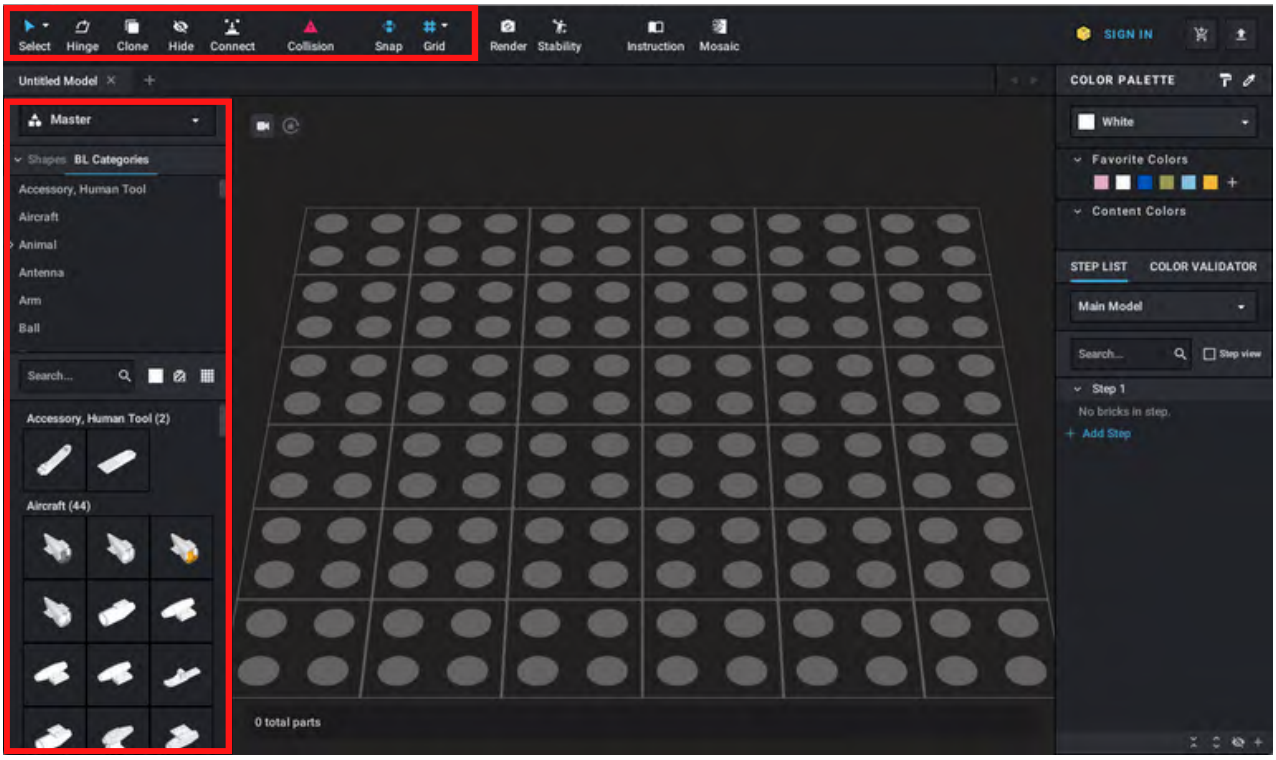


Figure 8.2-1. Studio 2.0 building tools & palettes

Notes: _____

8.3 Designing a Basic Robot Model

You will learn to build a basic robot model using Studio 2.0 as shown in Figure 8.3-1.

Figure 8.3-1. Building a basic robot model

Notes: _____

Creating Building Instructions

You will learn to create building instructions for your Robot model which will be very helpful in building practice as shown in Figure 8.3-2.

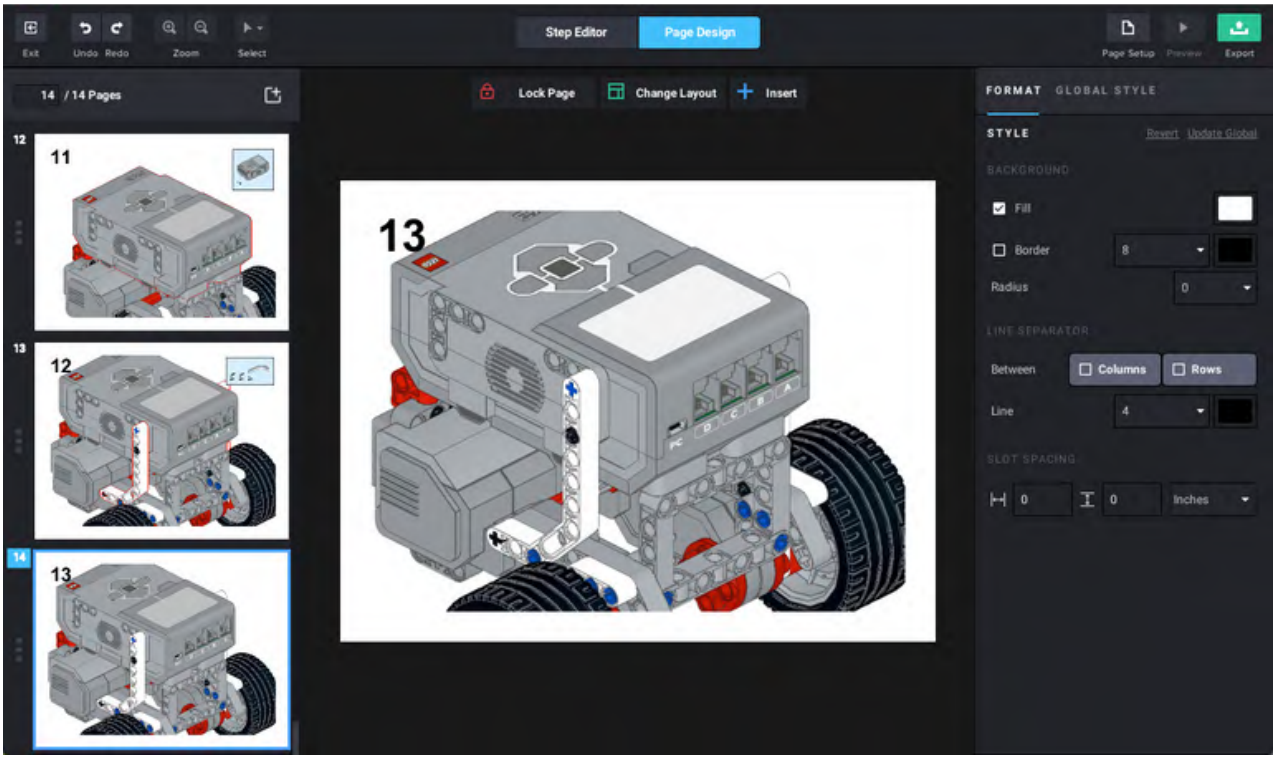


Figure 8.3-2. Step editor and page design

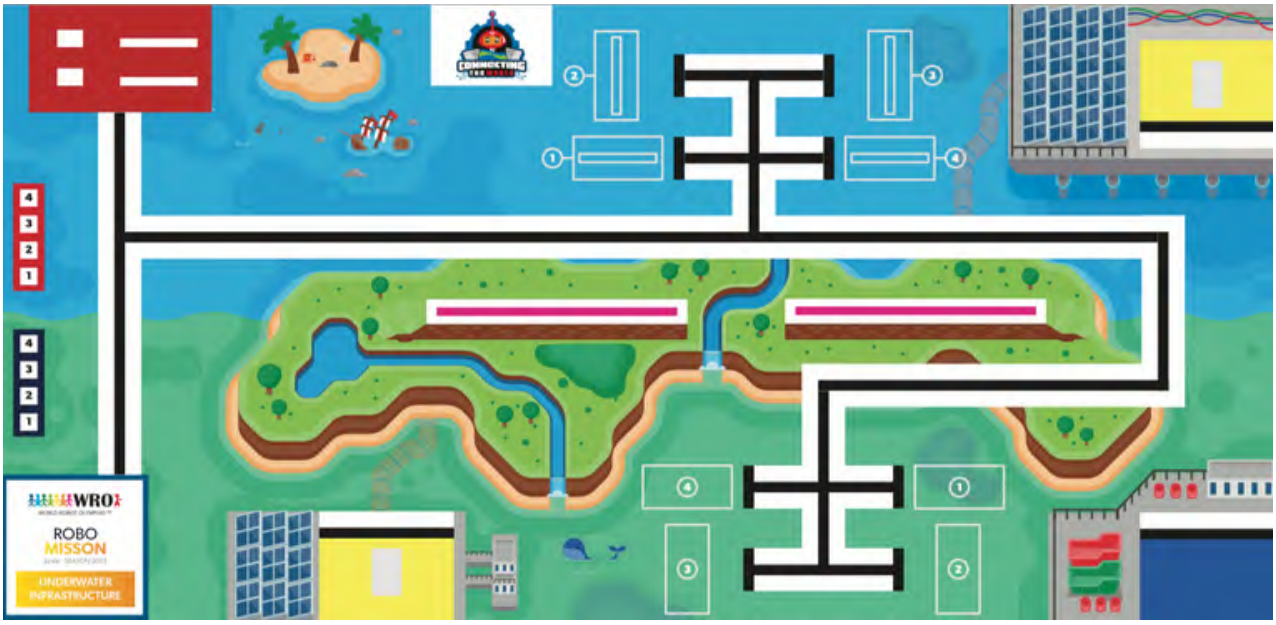
Notes: _____

Part 9: Practice Game Mats & Scoring Sheets

In this part, you will get six game mats and four scoring sheets for your practice.

Practice Game Mat

Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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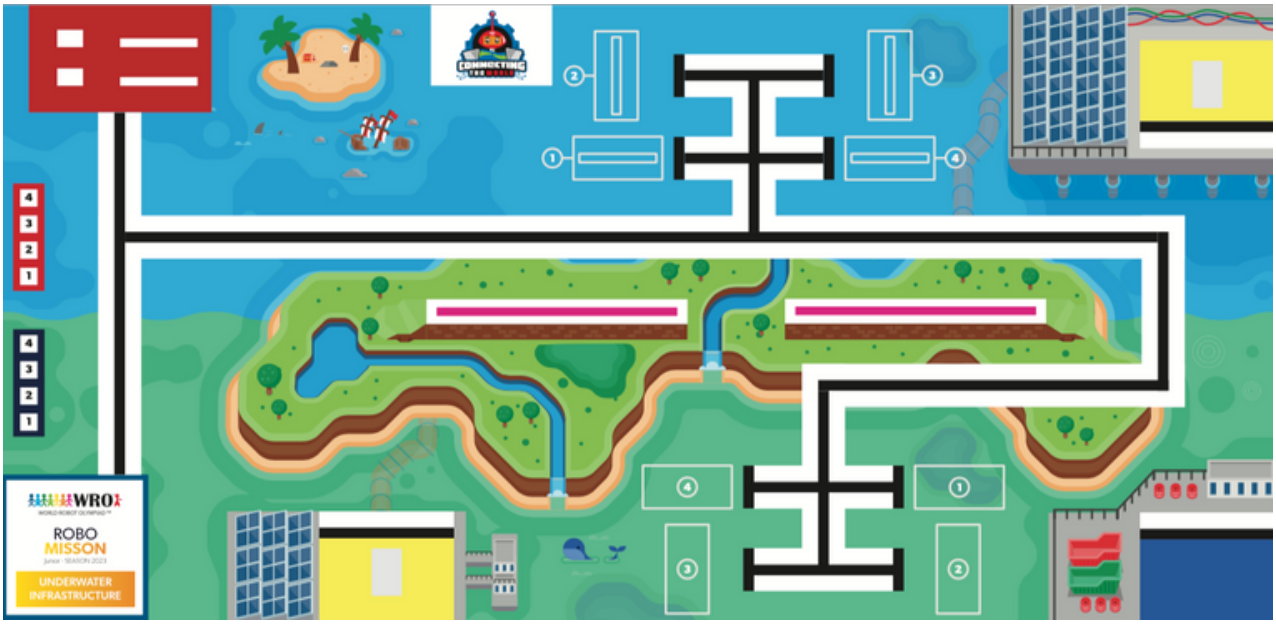
Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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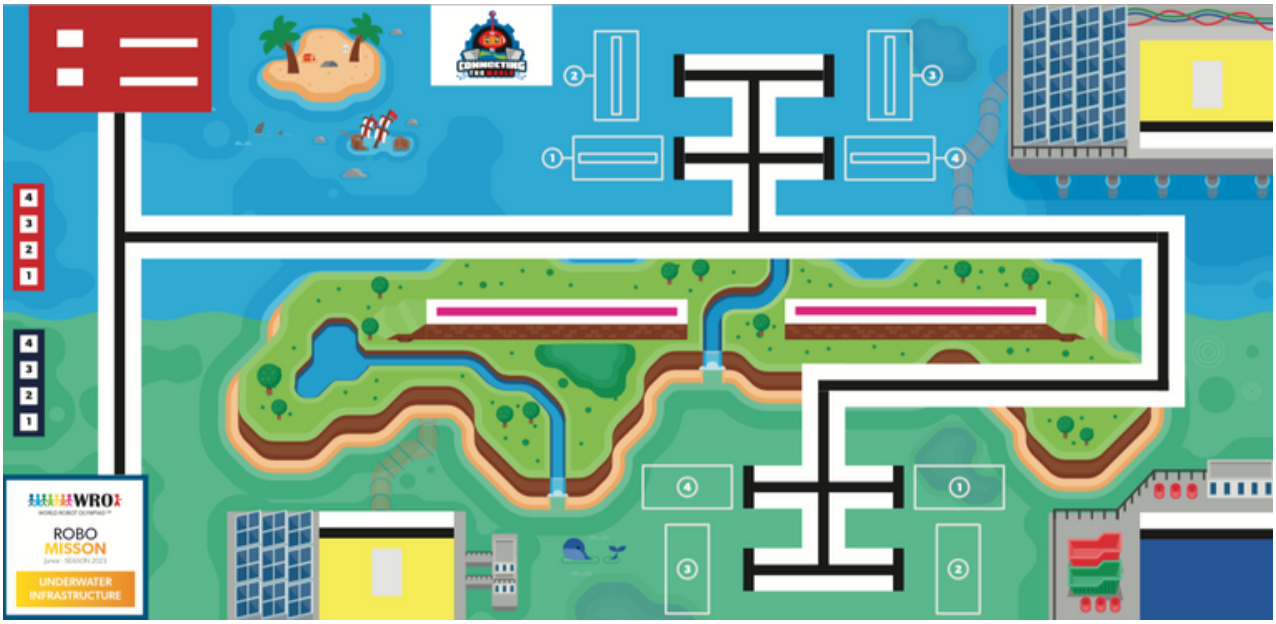
Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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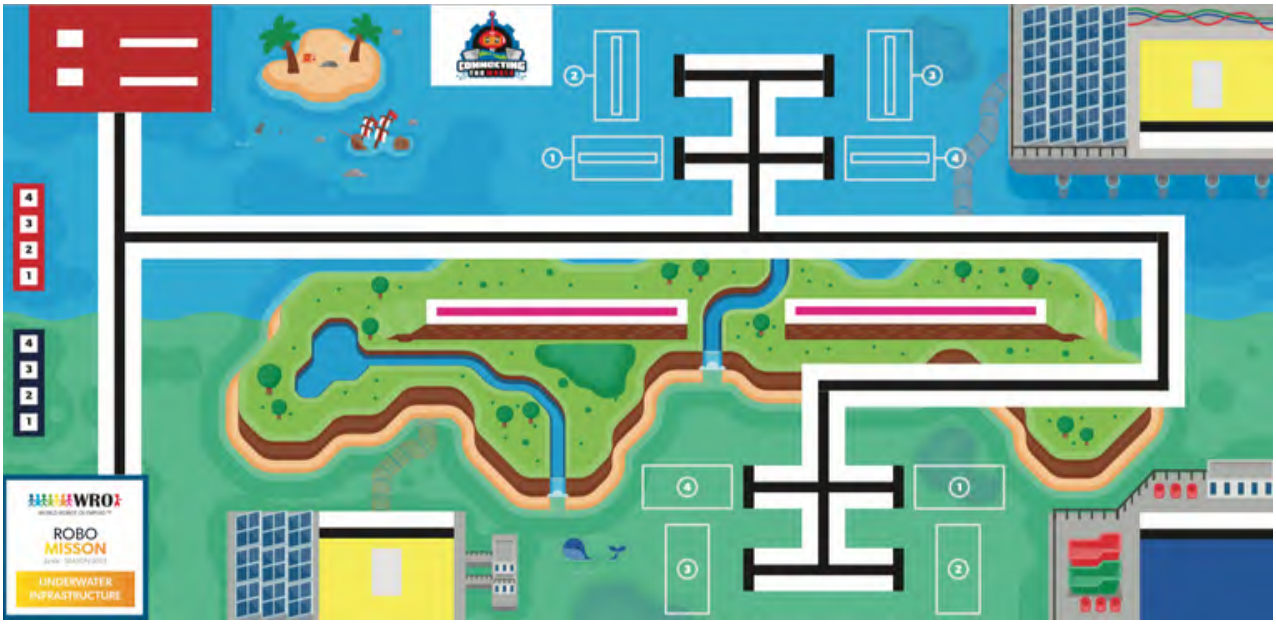
Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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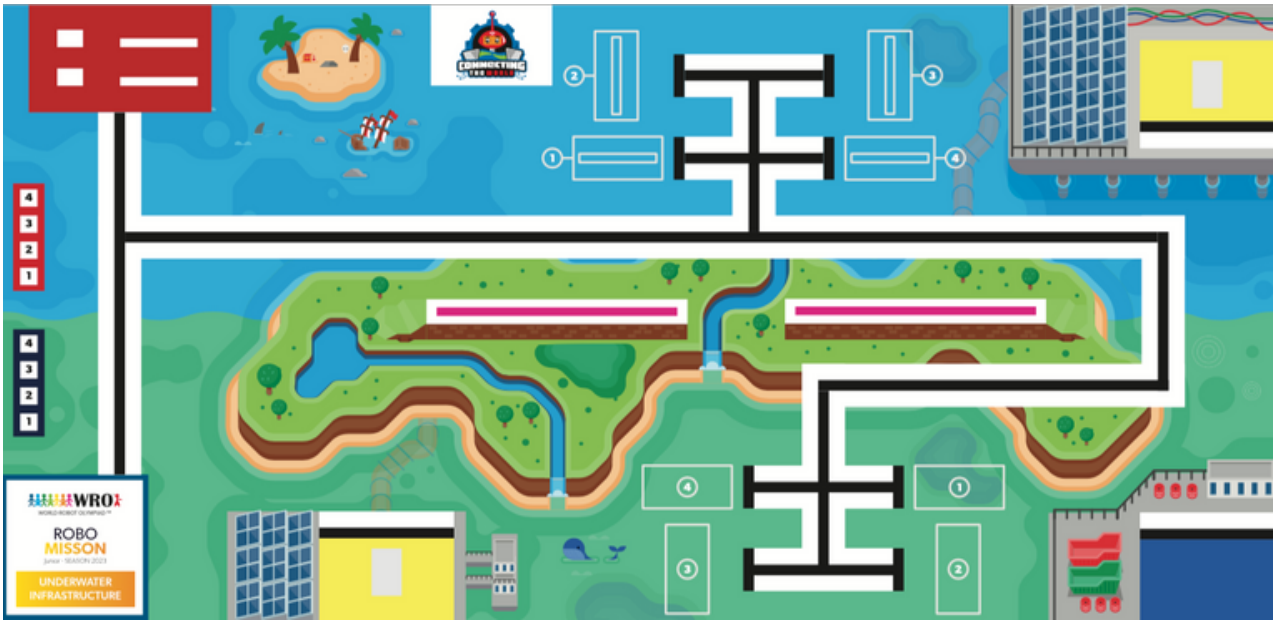
Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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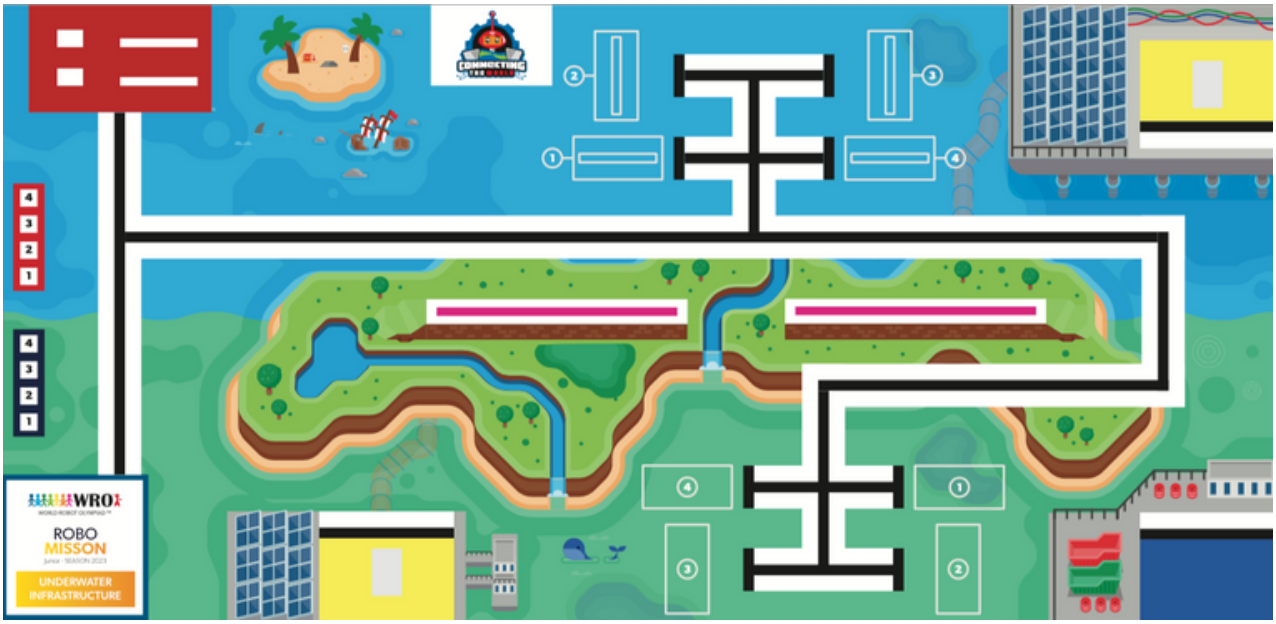
Sub Task:_____ Date:_____



Purpose: _____

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Outcome:_____

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Scoring Sheet

Team name: _____ **Round:** _____

Tasks	Each	Max.	#	Total
Underwater deployment				
Submarine cable is completely inside the correct connection slot	**12**	**24**		
Submarine cable is touching the correct connection slot	7			
Server object is completely inside the correct connection slot	**12**	**24**		
Server object is touching the correct connection slot	7			
Server object or Submarine cable is touching or inside the wrong connection slot (max. one object per connection slot)	4			
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot	6	**12**		
Find broken cable				
Broken cable completely inside the repair facility		**13**		
Broken cable touching the repair facility		9		
Activate offshore solar farm				
Solar panel of solar farm is activated	11	**22**		
Get bonus points				
Island barrier is not moved or damaged	6	**12**		
Park the robot				
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**13**		
Maximum Score		**120**		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

_____ _____

Signature Team Signature Judge

Team name: _____ **Round: _____**

Tasks	Each	Max.	#	Total
Underwater deployment				
Submarine cable is completely inside the correct connection slot	**12**	**24**		
Submarine cable is touching the correct connection slot	7			
Server object is completely inside the correct connection slot	**12**	**24**		
Server object is touching the correct connection slot	7			
Server object or Submarine cable is touching or inside the wrong connection slot (max. one object per connection slot)	4			
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot	6	**12**		
Find broken cable				
Broken cable completely inside the repair facility		**13**		
Broken cable touching the repair facility		9		
Activate offshore solar farm				
Solar panel of solar farm is activated	11	**22**		
Get bonus points				
Island barrier is not moved or damaged	6	**12**		
Park the robot				
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**13**		
Maximum Score		**120**		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

_____ _____

Signature Team Signature Judge

Team name: _____ **Round: _____**

Tasks	Each	Max.	#	Total
Underwater deployment				
Submarine cable is completely inside the correct connection slot	**12**	**24**		
Submarine cable is touching the correct connection slot	7			
Server object is completely inside the correct connection slot	**12**	**24**		
Server object is touching the correct connection slot	7			
Server object or Submarine cable is touching or inside the wrong connection slot (max. one object per connection slot)	4			
Additional: Both the submarine cable and the server object of the Caribbean and/or Pacific side are completely inside the correct slot	6	**12**		
Find broken cable				
Broken cable completely inside the repair facility		**13**		
Broken cable touching the repair facility		9		
Activate offshore solar farm				
Solar panel of solar farm is activated	11	**22**		
Get bonus points				
Island barrier is not moved or damaged	6	**12**		
Park the robot				
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**13**		
Maximum Score		**120**		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

_____ _____

Signature Team Signature Judge

Team name: _____ **Round: _____**

Tasks	Each	Max.	#	Total
Underwater deployment				
Submarine cable is completely inside the correct connection slot	**12**	**24**		
Submarine cable is touching the correct connection slot	7			
Server object is completely inside the correct connection slot	**12**	**24**		
Server object is touching the correct connection slot	7			
Server object or Submarine cable is touching or inside the wrong connection slot (max. one object per connection slot)	4			
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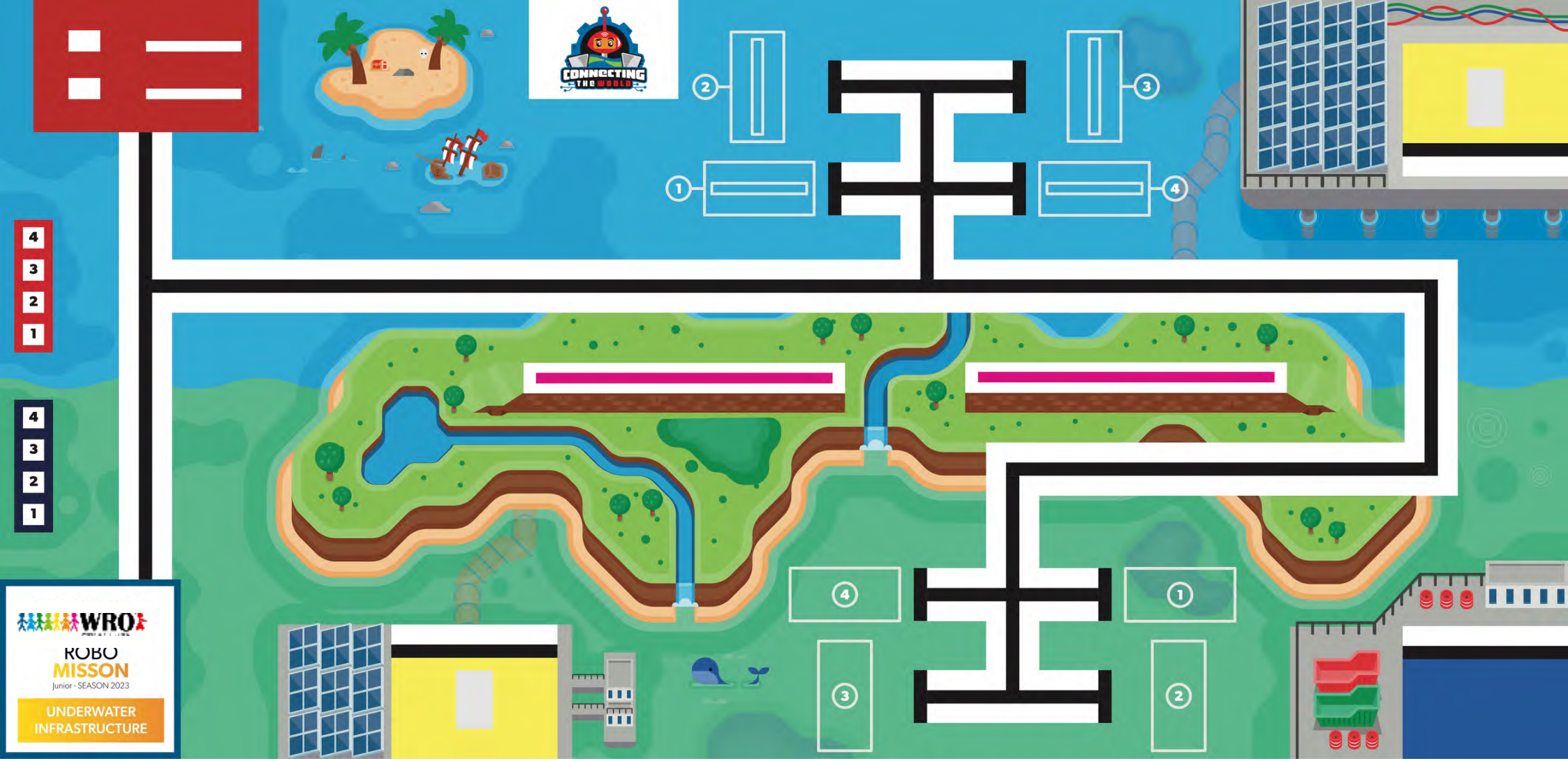
Projection of the robot is partly in the Start & Finish Area *(only if other points, not bonus, are assigned)*		**13**		
Maximum Score		**120**		
			Surprise Rule	
			Total Score in this run	
			Time in full seconds	

_____ _____

Signature Team Signature Judge

AWARDS
ACTIVITIES
WRO
WORLD ROBOT OLYMPIAD
WORLD ROBOT OLYMPIAD
INDIA 2019
27TH - 28TH JULY
BENGALURU
NATIONAL ORGANISER
INDIA STEM FOUNDATION
ACCOMMODATION PARTNER
OYO
DIGITAL STORE PARTNER
Gugglu
PRESENTING PARTNER
SMART Cities



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