NATIONAL ROBOTICS COMPETITION

# NRC Junior Robotics 2022

# GENERAL RULES

Version 25 May 2022

Main Organiser:

SCIENCE CENTRE singapore

Sponsored by:

Ministry of Education SINGAPORE

Co-Organiser:

DUCK LEARNING opportunities in education

Supported by:

WRO®

# NRC 2022 JUNIOR ROBOTICS
# CHALLENGE BOOKLET CHANGE LOG

| Version | Release Date | Description |
|---|---|---|
| 1.0 | 25 May 2022 | Official Challenge Booklet release |
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# Contents

# 1. General Information

## 1.1. National Robotics Competition (NRC) 2022

National Robotics Competition (NRC) has been an ongoing competition organised annually by Science Centre Singapore for the past 23 years with support from the Ministry of Education, various partners and sponsors. NRC has attracted more than 60,000 team members and 240,000 supporters to date.

NRC spurs students' interest and innovation in Science, Technology, Engineering and Mathematics (STEM). Students will be able to put their knowledge to practice and engage in hands-on STEM learning. With NRC as a stage for students to develop kinaesthetic learning and collaboration, it encourages students to develop problem solving skills, entrepreneurial skills, creative thinking skills and team spirit among the team members. This is in line with Science Centre Singapore's mission "To promote interest, learning and creativity in science and technology, through imaginative and enjoyable experience and contribute to the nation's development of its human resource."

NRC 2022 tournaments comprise of:

- WRO® RoboMission (previously known as WRO® Regular Category)
- WRO® Future Innovators (Previously known as WRO® Open Category)
- WRO® Future Engineers
- NRC Junior Robotics
- NRC Preschool (New)
- CoderZ Coding Challenge

In 2022, NRC will include a new NRC Preschool category, for age group 5-6.

Registration for these category challenges will be via https://www.gevme.com/NRC2022.
Competition registration opens from **1st May to 31st July 2022.**

## 1.2. Introduction to NRC Junior Robotics 2022

Robots are used in different ways to help reach areas that are too dangerous or difficult for people to traverse. For this mission, you are to collect deep-sea specimens for further studies as part of your research and to leave a sensor for data collection. Due to the sensitivity of the environment, you are not to destroy the surroundings during the collection process and must collect a specific number of specimens to aid in your studies. However, do watch out for other dangers that may lurk in the deep.

### 1.3. Focus Areas

Every NRC category and game has a special focus on learning with robots. In the NRC Junior Robotics category, students will focus on developing in the following areas:

- General coding skills & basic robotics concepts (perception of environment, control,
- navigation).
- General engineering skills (building a robot that can push/lift objects of certain sizes).
- Developing optimal strategies to solve concrete missions.
- Computational Thinking (e.g., tinkering, debugging, collaboration etc.).
- Teamwork, communication, problem solving, creativity.

All these aspects lead to different requirements for the mechanical design of the robot and the complexity of the code. When participating in NRC for multiple seasons, the teams can grow and develop with the program, solving increasingly complex missions as they get older.

### 1.4. Learning is Most Important

NRC wants to inspire students around the world for STEM related subjects and we want the students to develop their skills through playful learning in our competitions. This is why the following aspects are key for all our competition programs:

- Teachers, parents, or other adults can help, guide and inspire the team, but are not allowed to build the codes/finish the challenges.
- On a competition day, Teams and Coaches respect the final decision judges take and work with other teams and judges on a fair competition.

## 2. Team and Age Group Definitions

### 2.1. Team Definition

A team consists of one (1) coach with a minimum of two (2) or maximum of three (3) team members. One (1) coach and one (1) team member is not considered a team. Registration will be denied.

### 2.2. Coach Definition

The minimum age of a coach in the NRC tournament is age 20 at the time of registration.

Coaches may work with more than one team. Coaches may offer students advice and guidance prior to the competition; however, all work, preparation and submissions and the actual competition must be performed by the student members of the team.

# 3. Responsibilities and team's own work

A team should play fair and be respectful towards teams, coaches, judges and competition organizers. By competing in NRC, teams and coaches accept the WRO® Guiding Principles that can be found at: https://wro-association.org/wp-content/uploads/2021/08/WRO-Guiding-Principles-and-Ethics-Code-2022.pdf.

The construction and coding of the robot may be done only by the team. The task of the coach is to accompany the team organizationally and to support them in advance in case of questions or problems, but not to do the construction and programming of the robot themselves. This applies to both the day of the competition and the preparation.

A team is not allowed to communicate in any way with people outside of the competition area while the competition is running. If communication is necessary, a judge may allow team members to communicate with others under supervision of a judge.

Team members are not allowed to bring and use mobile phones or any other communication device into the competition area.

It is not allowed to use a solution (hardware and / or software) that is (a.) the same or too similar to solutions sold or posted online or (b.) the same or too similar to another solution at the competition and clearly not the own work of the team. This includes solutions from teams of the same institution and/or country.

If there is a suspicion in relation to above rules, the team will be subjection for investigation and any consequences can apply. The organizing team reserves the right to not allow this team to progress to the next competition, even if the team would win the competition with the solution that is likely not their own.

If any of the rules mentioned in this document are broken or violated, the judges can decide on one or more of the following consequences. A team or individual team members may be interviewed to find out more about the possible violation of the rules.
This can include questions about the robot or the program.

- A team may get up to a 50% reduced score in one or more runs.
- A team may be disqualified completely from the tournament immediately.

# 4. Game documents and rule hierarchy

Every year, WRO® publishes a new version of the general rules for this category including the season challenge and the scoring sheets for the different age groups.

The general rule documents, the scoring sheets and Q&As may be different in a national competition in a country due to local adaptations by the National Organizer. Teams need to inform themselves about the rules that apply in their country. For any international WRO® event, only the information WRO® has published is relevant. Teams that qualify for any international WRO® event should inform themselves about possible differences to their local rules.

At the competition day in both NRC and WRO®, the following rule hierarchy applies:

- General rule document provides the basis for rules in this category.
- Questions & Answers (Q&As) can override rules in the general rule document.
- The judges on the competition day have the final word in any decision.

# 5. General Rules – NRC Junior Robotics Regular Category

The following are the rules of competition at NRC Junior Robotics 2022.

- There is a presentation and Q&A session for this category.

## 5.1. Competition Participation Process

Presentations, Q&A and Challenge will be done on the same day for the participants.
These will be held in Science Centre Singapore on **30 August 2022**.
Scores from the Presentation (30%) and Challenge (70%) will be combined for the Championship Award.

## 5.2. Presentations

Presentations and Q&A will be done before their challenge. Judges will be roaming around the tables to talk to the participants about their robots and challenges faced. Scoring will be based on the following rubrics.

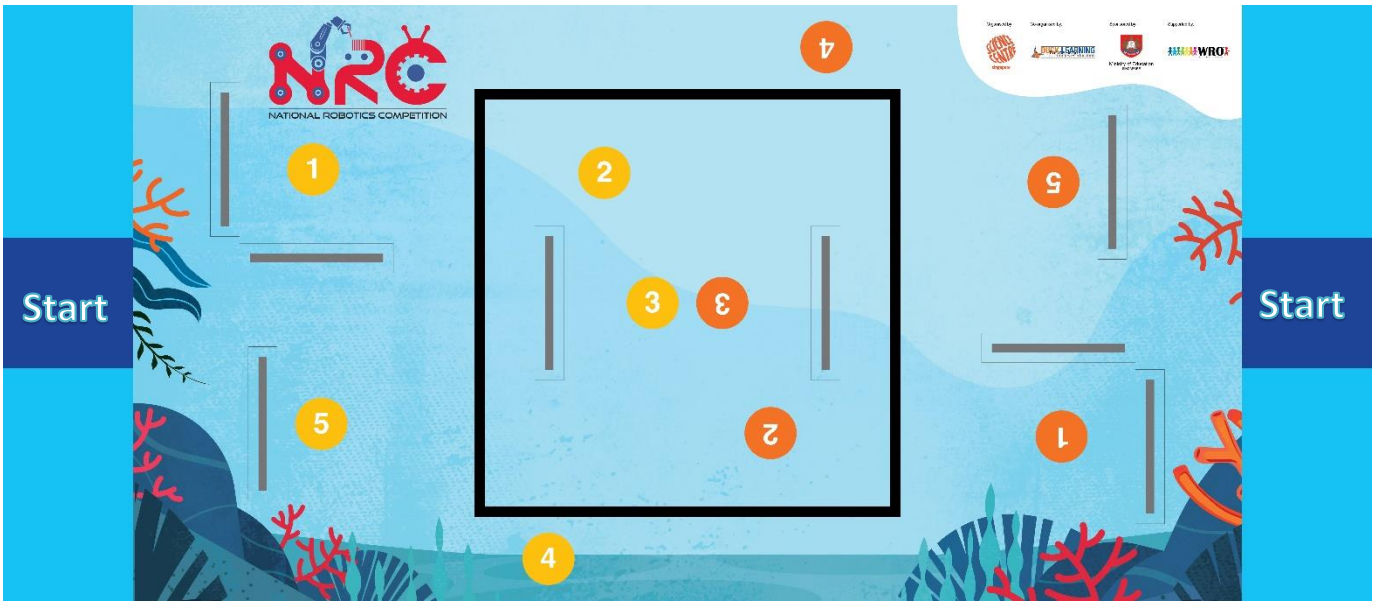
| **Criteria** | **Score** |
|---|---|
| Programming and Building<br>How did they program their robot<br>How did they design the robot<br>What did they learn during the process | 20 |
| Presentation<br>Communication of ideas<br>Quick Thinking | 10 |

## 5.3. Challenge

Teams will get 1 practice run and 2 attempts to complete their Challenge Run on the day. The best score of the 2 attempts will form the score for the Championship Award.

## 5.4. Game Field

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




If the table is larger than the game mat, the mat will be centered in all dimensions. Possible space between the mat and the wall will be counted towards the area on the mat.

## 5.5. Table and game mat specifications

1. The dimensions of the mat are 2362 mm x 1143 mm.

2. The internal dimensions or a game table should be 2362 mm x 1143 mm (like the game mat) or max. + / - 5mm in each dimension.

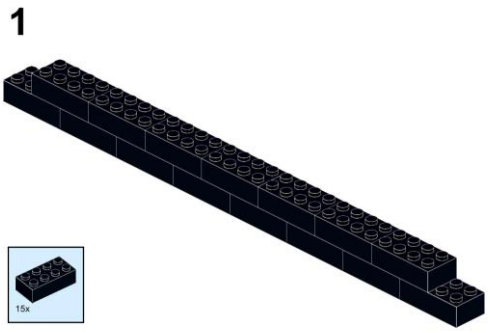
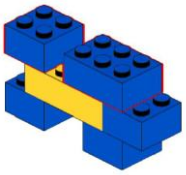
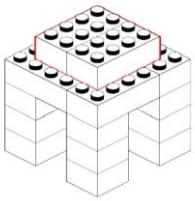
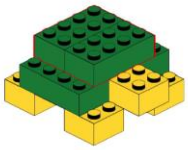
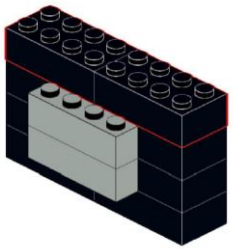
3. All black lines are at least 20mm.

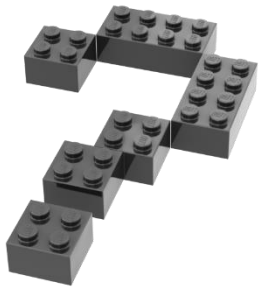
4. The game mat must be printed with a matt finish /overlay (without reflecting colors!). Teams are recommended to reach out to organisers to purchase an official game mat.

# 6. Information on the Start Area

The robot must start from within the dark blue area at the short edge of the map.

## 6.1. Game Objects, Positioning, Randomization

| | |
|---|---|
| **4 Obstacles**<br><br>On the game field, there will be four obstacles placed. You are not to move the obstacles from their original position. |  |
| **5 Animals**<br><br>There are 5 different animals placed in the 5 circles on the playfield.<br><br>Fish will be in circles 1 and 2.<br>Jellyfish in circle 3.<br>Turtle in circles 4 and 5.<br><br>Animals may be placed upright in any orientation within the circles. |  x2<br>  x1<br>  x2 |
| **1 Sensor**<br><br>The Sensor will begin with your robot in the starting area. Your task is to drop the sensor in the pre-determined location (inside one of the five circles) that will be shared to you at the start of your run. |  |

| | |
|---|---|
| **1 or 2 Mystery Creature**<br><br>(Surprise Rule – to be shared on the challenge day)<br>You never know what lurks in the deep. |  |

# 7. Robot Missions

For a better understanding, the missions will be explained in multiple sections. **The team can decide in which order they will do the missions.**

### 7.1. Drop the Sensor at a pre-determined location

The Sensor will begin with your robot in the starting area. Your task is to drop the sensor in the pre-determined location (inside one of the five circles) that will be shared to you at the start of your run. Mission will be considered successful if the sensor is within the circle at the end of the challenge run. Partial points may be awarded if the sensor is touching a circle.

| **Final State** | **Points** |
|---|---|
| Sensor fully within the correct circle and without an animal inside the circle | 25 |
| Sensor touching the correct circle or with an animal inside the correct circle | 15 |
| Sensor within or touching another circle | 5 |

### 7.2. Collect the five animal specimens

Transport the five animal specimens from their circles to the drop off point above the water. Additional points will be awarded if specimens are within the dark blue zone at the end of the challenge run.

| **Final State** | **Points (each)** |
|---|---|
| Animals out of their circle and within the dark blue zone | 25 |
| Animals out of their circle and above the water zone | 15 |
| Animals out of their circle but not above the water zone | 5 |

### 7.3. Avoid the Obstacles

Avoid hitting the obstacles within the playfield. More points will be awarded if the obstacles are left untouched. If obstacles are out of either of the boxes. No points will be awarded.

| **Final State** | **Points (each)** |
|---|---|
| Obstacles within the grey box | 10 |
| Obstacles within the white box (even if touching the line) | 5 |

### 7.4. Mystery Challenge

There's a mysterious creature lurking in the depths. Find out more on the Challenge Day. (Worth 25 points)

### 7.5. Park the Robot

Park the robot before the timer runs out. Park it within the dark blue starting zone to get full points. Otherwise, if the robot ends above the water, you'd score partial points. Teams can only score these if the robot has scored points in the other section.

| **Final State** | **Points** |
|---|---|
| Robot within Dark Blue Zone | 10 |
| Robot within Light Blue Zone | 5 |

## 8. Specific NRC Junior Robotics Game Rules

For the Junior Robotics competition, the normal Regular Category General Rules apply. There are some specific rules just for the Junior Robotics age group. These specific rules are mentioned here:

### 8.1. Specific rules about material

a. The controllers, motors and sensors used to assemble the robot must be from the LEGO Education WeDo 2.0 Core Set or Spike Prime set. Any number and combination of controllers (Smarthubs), motors and sensors are allowed. Any LEGO branded non-electrical/non- digital elements can be used in the construction of the robot.

### 8.2. Specific rules about the game

a. During the attempt, the robot may be moved/operated under programmed control autonomously or under remote control or using a combination of the two methods. The robot can be controlled by any compatible device.

b. During an attempt, the team is allowed to touch/grab the robot when any part of the robot, e.g., a wheel, touches a Base Area (any of the blue areas).

c. During an attempt, the team is also allowed to move a robot from one Base Area to another Base Area. It is only allowed to move the robot, not the game objects. **Game objects not attached to the robot cannot be moved to another base by lifting the robot.**

d. During an attempt, members of the team are:

- ***Not allowed to touch any game object outside of Base Areas.*** If a team touches a game

object outside a Base Area, the judge will place the touched item at the location on the field where it was located when the team touched the item and, in the state, it was when touched. Organisers reserve the right to not score for that object or disqualify the team.

- ***Not allowed to touch the robot unless the robot is touching a Base Area***. If a team touches a robot which is not touching a Base Area, the judge will place the robot the nearest Base Area. Organisers reserve the right to disqualify the team.

e. The mission is completed when either:
   - The robot moves to the Starting Area, stops, the chassis of the robot is completely within the Area (cables are allowed to be outside of the area) and the team communicates to the judge that the robot has finished.
   - A team member shouts “STOP” and the robot does not move anymore.
   - The 2-minute time limit has expired.

### 8.3. Specific rules about the competition

a. Teams can bring the robots assembled to the competition. They do not need to re- build the robots on the competition day or in the video.

# 9. Scoring

The overall scoring of the teams is based on the sum of two scores:

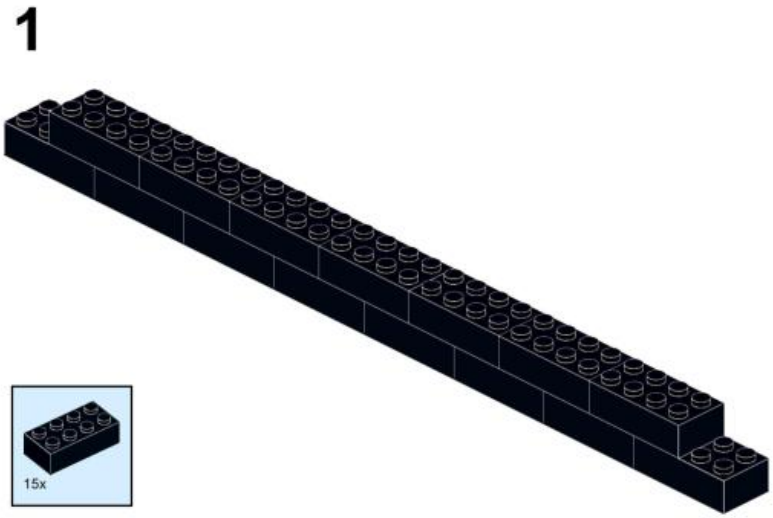
- **Game field Score:** up to 200 points scored as described in the table below.
- **Surprise Tasks Score**: up to 25 points scored when a team performs additional tasks on the game field.

### Game Field Score

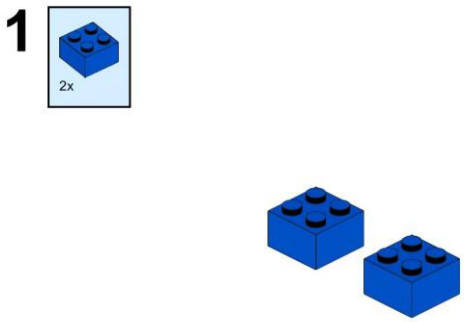
| **Tasks** | **Each** | **Total / Max** |
|---|---|---|
| **Drop the Sensor at a pre-determined location** | | |
| Sensor fully within the correct circle and without an animal inside the circle | **25** | **25** |
| Sensor touching the correct circle or with an animal inside the correct circle | 15 | |
| Sensor within or touching another circle | 5 | |
| **Collect the five animal specimens** | | |
| Animals out of their circle and within the dark blue zone | **25** | **125** |
| Animals out of their circle and above the water zone | 15 | |
| Animals out of their circle but not above the water zone | 5 | |
| **Avoid the Obstacles** | | |
| Obstacles within the grey box | **10** | **40** |
| Obstacles within the white box | 5 | |
| **Park the robot** | | |
| Robot within Dark Blue Zone<br>Teams can only score these if the robot has scored points in the other section. | 10 | **10** |
| Robot within Light Blue Zone<br>Teams can only score these if the robot has scored points in the other section. | 5 | |
| **Maximum Score** | | **200** |
| **Mystery Challenge** | | |
| To be announced on day of challenge. | 25 | 25 |

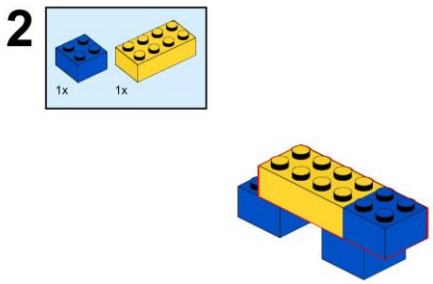
# 10. Assembly of Game Elements

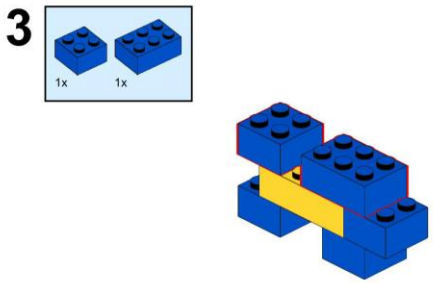
**Obstacle**



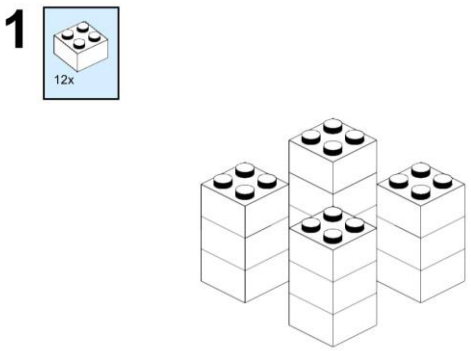

**Animals - Fish**

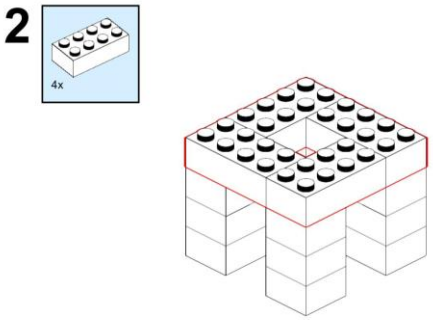


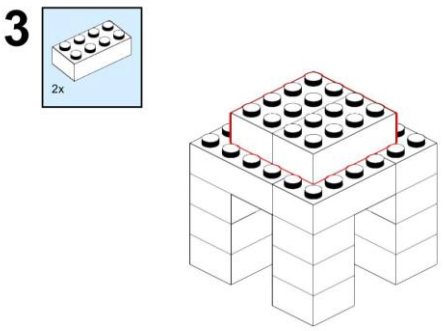


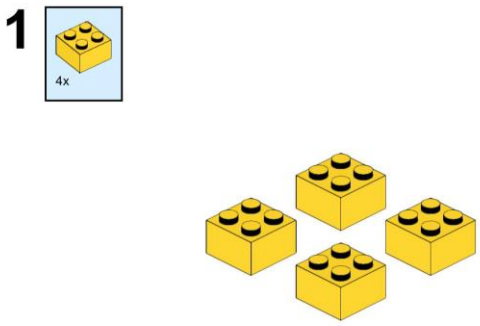

**Animals - Jellyfish**

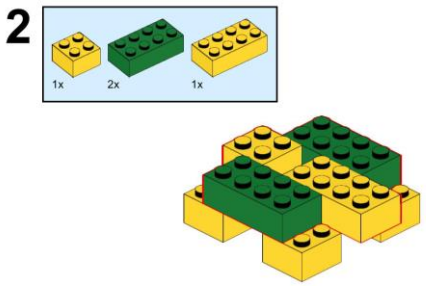


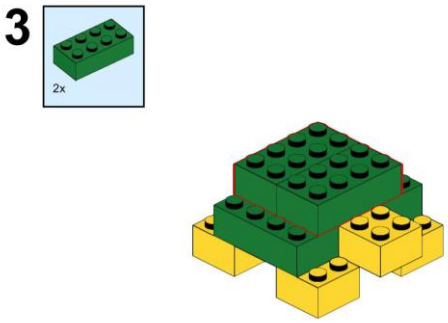


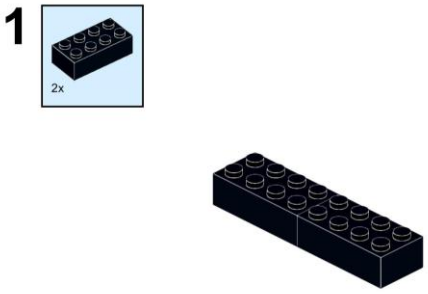

**Animals - Turtle**

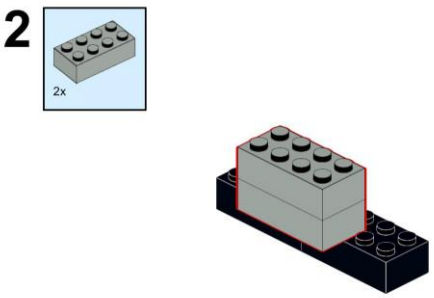





**Sensor**

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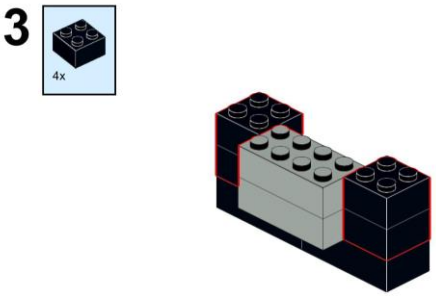
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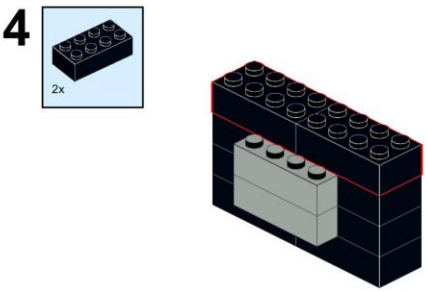
4
2x

# 11. Awards

| Tournaments | Awards | Rank | Remarks |
|---|---|---|---|
| NRC Junior Robotics | Championship Awards* | 1st | Teams are considered for the Championship award based on the scores of their Robot Mission and for their presentation. Scores table can be found in the Scoring section. |
| | Best Robot Performance Award | 1st | Award will be based on scores given during the Challenge. |
| | | 2nd | |
| | | 3rd | |
| | Judges' Award | | Up to 5 Judges Awards will be given in this category to the Judges' discretion |