NATIONAL ROBOTICS COMPETITION

NRC PRESCHOOL CATEGORY (ARTec Challenge)

H_2O Heroes: Sustainable Water Champions

Version: 28 March 2024

Organised by:

Science Centre Singapore

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ABB

NRC 2024 PRESCHOOL CATEGORY

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	28 March 2024	Official Challenge Booklet release

Table of Contents

1. General Information

1.1 National Robotics Competition (NRC) 2024

National Robotics Competition (NRC) has been an ongoing competition organised annually by Science Centre Singapore for the past 25 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. It is the only robotics competition in Singapore supported by the Ministry of Education.

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 2024 tournaments comprise of:

- NRC Regular Category
- NRC Open Category
- NRC AI Maker Series
- NRC Preschool
  - Kubo Challenge
  - **ARTec Challenge**
- NRC Smorphi
- NRC RoboCup Singapore CoSpace Coding Challenges
  - Autonomous Driving Category
  - Rescue Category

Registration for these category challenges will be via https://www.gevme.com/NRC24.
Competition registration opens from **till 1st July 2024.**

Note: Registration will be on a first come, first serve basis. If the category is full, your registration will be rejected and refunded

1.2 Theme for NRC 2024

Every year, NRC revolves around a specific theme and this year, the theme for NRC is "Water **(H_2O) Heroes**". Safe drinking water refers to water that is free from harmful contaminants and is suitable for human consumption without any risk to health. It is essential for maintaining public health and preventing waterborne diseases. Access to safe drinking water is a fundamental human right and is crucial for sustaining life and promoting overall well-being. As a H_2O Hero, what can we do to ensure availability and sustainable management of water and sanitation for all?

2. Team and Age Group Definition

2.1 Team Definition

Each team will have a minimum of 2 members and up to 5 members, accompanied by 1 to 2 coaches.

The age group in NRC Preschool (ARTec) Category is:

- 5 - 6 years old (as of 31 Dec 2024)

2.2 Expectations on Teams

Teams should behave fairly and be respectful towards other teams, coaches, judges, referees, chief referees and competition organisers. Teams are to adhere to the competition rules to ensure fair competition.

The construction and coding of the robot may be done only by the team. The task of the coach is to accompany them, help them with organisational and logistical matters and support the team in the case of questions or problems. The coach cannot be involved in the construction and programming of the robot.

On the competition day, during mission runs, coaches may offer students advice and guidance. However, all work related to the preparation and submission, and the actual competition must be performed by the student members of the team.

If any of the rules mentioned in this document are broken or violated, the judges, referees or chief referees can decide on one or more of the following consequences. Before a decision is reached, a team or individual team members may be interviewed to find out more about the possible violation of the rules. The interview can include questions about the robot or the program.

- A team may get up to a 50% reduced score for one or more judging rounds.
- A team may be disqualified completely from the competition immediately.

2.3 Rules Hierarchy

On the competition day, the following rule hierarchy applies:

- General Rules for NRC Preschool Category provides the basis for rules in this category.
- Questions & Answers (Q&As) can override rules in the general rules document.
- **The Chief Referees have the final say in any decision.**

3. Tournament Format and Procedure

In this category, there are 2 rounds:

- An onsite presentation round (including a Q&A session with each team) on **21st or 22nd August 2024**.
- An onsite competition round on **27th or 28th August 2024**.

3.1 Competition Format

Presentations and Q&A sessions will be conducted on the same day for the participants. These will be held onsite at Party Room, KidsSTOP™ on **21st or 22nd August 2024**.

The Competition Round will be conducted on **27th or 28th August 2024** for all participants. This will be held at Annexe Hall 1, 2 & 3, Science Centre Singapore.

Scores from the Presentation (30%) and Competition Round (70%) will be combined for the Overall Championship.

3.2 Competition Schedule

Dates	**Components**	**Mode**
21st or 22nd August (Wednesday - Thursday)	NRC Preschool Presentation	Onsite KidsSTOP™ (Party Room & Train Station)
27th or 28th August (Tuesday - Wednesday)	NRC Preschool Competition	Onsite Science Centre Singapore (Annexe Hall 1, 2 & 3)

*Teams will be notified of their scheduled presentation date and time
**The Organiser reserves the right to amend the competition schedule and mode of the competition. Participants will be notified of any changes via email.

3.3 Presentation Format

Presentations and Q&A sessions will be conducted on the same day for the participants. These will be held onsite at Party Room, KidsSTOP™ on **21st or 22nd August 2024**.

- Each presentation shall not exceed a duration of 5 minutes (excluding Q&A).
- Each Q&A session will take approximately 3 minutes.
- Presentation format shall not exceed 10 PowerPoint Slides.
- Pre-recorded video presentations are not allowed.
- Slides may include photos and/or short videos to showcase the students' learning process.
- Students are to present their prototype based on the introductory story during the presentation.
- Students are encouraged to take an active role during the presentation.

Evaluation Criteria	**Maximum Score**
Coding and Design of ARTec Robot	10
Reflection	10
Presentation	10

More details on the scoring can be found at Section 7.

3.4 Robot Run

The competition will be held onsite on **27th or 28th August 2024**.

- Teams will get 1 practice run (30 minutes) before the actual attempt.
- Teams shall complete all the ARTec missions within 60 minutes on the day of the Competition Round.
- There will be 4 missions to complete. Refer to Section 5 for the duration of each mission.
- All teams will begin the same mission simultaneously.

Missions	**Maximum Score**
Mission 1: Keeping Our Waterways Clean	14
Mission 2: Our Water Loop	22
Mission 3: Sowing Seeds To Sustain Our Reservoir Ecosystem	18
Mission 4: Our H_2O Hero Robot Tree	16

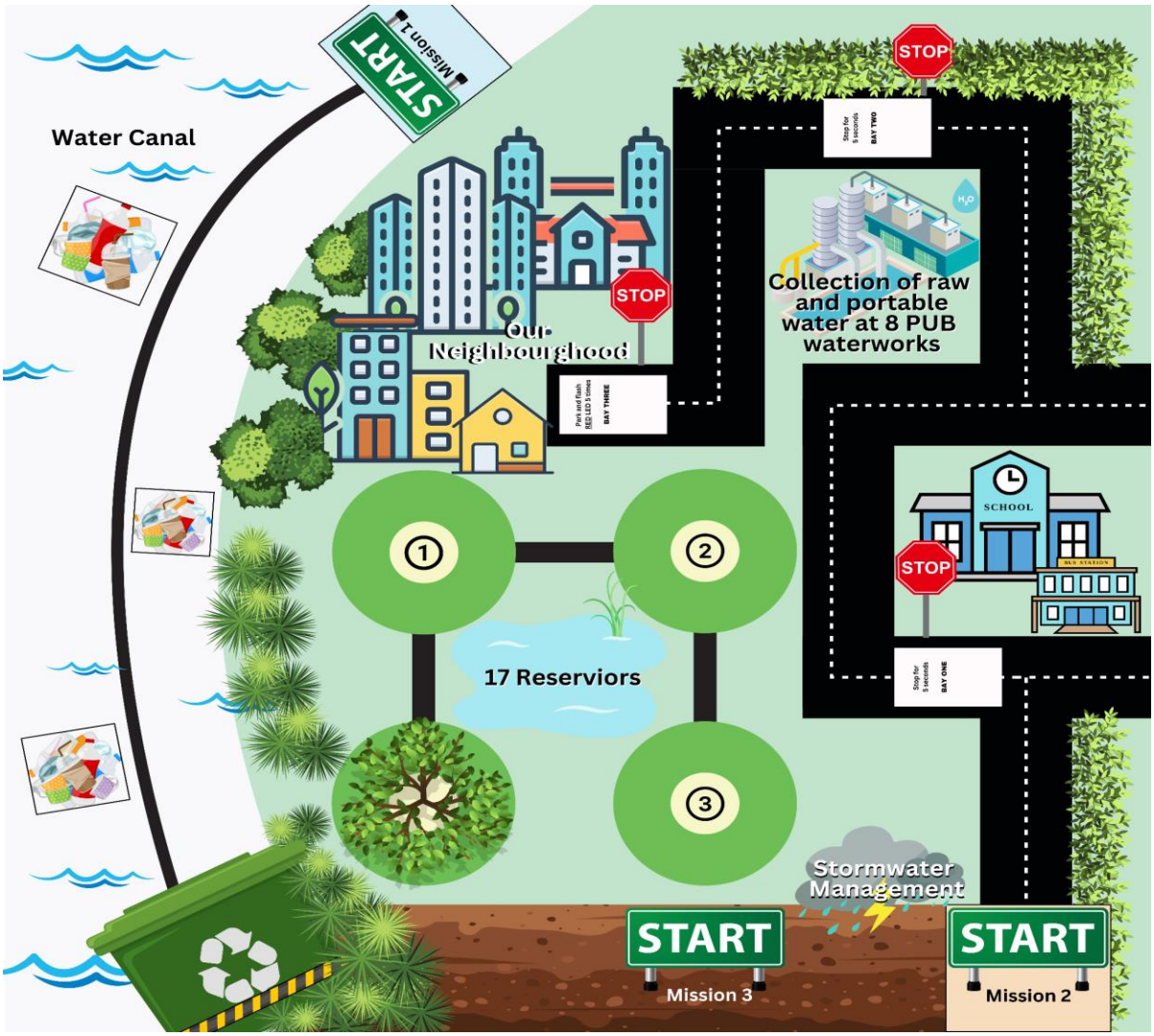
Points to note about the Competition:

- The game field mat will be provided to each participating team, together with a set of ARTec Coding+ set prior to the competition.
- Instructions will also be given to download the Icon Programming software to the participating team's laptop (not provided)
- Participating teams must bring along the game field mat, game objects, ARTec Coding set and the team laptop on the day of the Competition Round on 27th or 28th August 2024 (tentatively).
- Participating teams that fail to return the game field mat, game objects and ARTec Coding set will be liable to make full payment of the items listed above to Wow! Education.
- In the event that overall scores are tied, the team with the shortest overall time (during the competition) wins the Competition Round.
- Scoring rubrics for the Competition Round can be found in Section 7.

4. Game Table and Equipment

4.1 Game Field

The game field mat will be provided to each participating team, together with the blocks to construct the game objects.



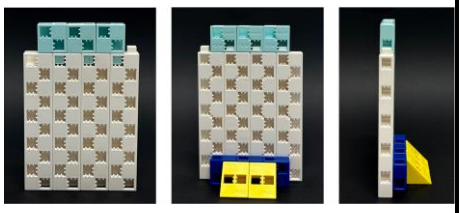
Participating teams are required to bring along the game field mat, game objects, ARTec Coding set and the team laptop on the day of the Competition Round on 27th or 28th August 2024.

The dimensions of game field 1 are as follows:

- 1 m (Length) x 1 m (Breadth)

4.2 Game Objects

The ARTec Robot must start from the playable area labelled as “START”.

Mission	Game Object
1. Keeping Our Waterways Clean Robot shall do a line trace to clear the waterway. There are 3 pieces of debris placed upright along the waterway to be collected to the recycling bin. Robot will end the mission by stopping at the recycling bin (denoted by the game object).	 Black blocks as debris  Front, back, side view of the recycling bin
2. Our Water Loop Robot shall self drive through the “Water Loop” to visit the different locations of the water loop, stopping at the designated bays and ending at its destination (Our Neighbourhood).	N.A.
3. Sowing Seeds To Sustain Our Reservoir Ecosystem Robots shall transport the seeds from the “START” to the designated planting circles around the reservoir. Upon planting each seed, the Robot has to return to the “START”, to collect the next seed to be planted in the next planting circle.	 Yellow blocks as seeds
4. Our H_2O Hero Robot Tree	To release on the day of the competition

5. ARTec Missions

The missions will be explained in multiple sections.

The order of the missions is fixed, and every team will start simultaneously.

Each mission will be given a maximum duration for completion as follows:

Mission	**Preparation (Minutes)**	**Robot Attempt (Minutes)**	**Total Duration (Minutes)**
Mission 1: Keeping Our Waterways Clean	3	4	7
Mission 2: Our Water Loop	5	15	20
Mission 3: Sowing Seeds To Sustain Our Reservoir Ecosystem	3	15	18
Mission 4: Our H_2O Hero Robot Tree	5	10	15

For scoring rubrics please refer to Section 7.

5.1 Keeping Our Waterways Clean

Teams are to build a H_2O Hero Line Trace Robot to clear the waterway (denoted by the Black Line) of three debris (ARTec Blocks) and transport them to the recycling bin located at the end of the waterway to be disposed of. Robot will end the mission by stopping at the recycling bin (denoted by the ARTec Game Object)

- Robot shall commence from the “START Mission 1” position.
- Three debris (ARTec Block) are placed within the designated box along the waterway.
- These debris will be collected by the Robot as it moves along the waterway.
- The debris is moved to the bin at the end of the waterway.
- The H_2O Hero Robot shall end the mission by stopping at the recycling bin (designated by the game object).
- If the H_2O Robot moves out of the waterway (denoted by the Black line), teams can decide to re-attempt the mission again from the “Start” point.
- If the three debris are not successfully collected, teams can decide to re-attempt the mission again from the “Start” point.
- If the H_2O Robot does not stop at the recycling bin successfully, teams can decide to re-attempt the mission again from the “Start” point.
- If the H_2O Robot topples over the game object designated as the recycling bin, teams can decide to re-attempt the mission again from the “Start” point.
- H_2O Hero Robot shall clean the waterway independently and the team shall have no physical contact with the manipulatives throughout the run (hands free).
- The mission will end when the Robot has collected between one to three debris and successfully stopped and placed them at the recycling bin.

5.2 Our Water Loop

Teams shall construct a H_2O Hero Self Drive Robotic Car to drive through the different locations of the water loop. The Robot shall stop at two designated bays for five and three seconds consecutively and stop at “Our Neighbourhood” at the end of the loop and signalling its end of mission by flashing the Red LED lights five times.

- Robot shall commence from the “START Mission 2” position. The Robot shall follow the road and stop for five seconds at bay 1.
- The Robot shall proceed along the water loop and make a 3 second stop at bay 2.
- Teams can re-attempt the mission. The re-attempts shall start from the “Start Mission 2” position.
- The mission will complete when the Robot moves and stops at bay 3 (located at “Our Neighbourhood”) and signals its end of mission by flashing its Red LED lights five times.

5.3 Sowing Seeds To Sustain Our Reservoir Ecosystem

Teams construct their H_2O Hero Robot to transport the seeds (ARTec Block) from the “Start Mission 3” position to the designated planting circles designated by numbers 1 to 3, to plant the seeds. After planting each seed, the Robot will need to return to the “Start” position to collect the next seed to be planted. The seeds will be planted sequentially in the planting circles 1 to 3. Each planting run shall start from the “Start Mission 3” position.

- Robot shall commence from the “START Mission 3” position and move the first seed to planting circle 1.
- The Robot will return to the “Start” position using the same route.
- Teams shall then reposition the Robot to commence the second run. They shall start from the “Start Mission 3” position.
- They shall then move the second seed to planting circle 2.
- The Robot will then return to the “Start” position using the same route.
- Teams shall then reposition the Robot to commence the third and final run. They shall start from the “Start Mission 3” position.
- They shall move the third seed to planting circle 3.
- The Robot will return to the “Start” position using the same route.
- Teams can decide to re-attempt the planting of seed by starting from the “START Mission 3” position.

5.4 Our H_2O Hero Robot Tree (Mystery Mission)

Teams shall construct, decorate and program their H_2O Hero Robot to move to the designated planting circle. They shall commence from the “Start Mission 3” position and their Hero Robot shall transport itself to the designated circle to plant itself and signal its end of mission by flashing the Blue LED lights three times.

- Teams will be given additional blocks to decorate the robot.
- Robot shall commence from the “START Mission 3” position and move to the mystery circle to plant itself in this mystery mission.

- Teams can decide to re-attempt by starting from the “START Mission 3” position.

***The hidden task will only be made known to participating teams on the day of the Competition, after the first 3 missions have been completed.**

6. Specific Game Rules

For this competition, there are some specific rules as mentioned below:

6.1 Specific Rules about Materials

- The ARTec robot must be assembled using the ‘Complete set of ARTec Coding+’ Kit provided to each participating team by Science Centre Singapore.
- The ARTec Icon Programming softwares to be used for all coding.
- Teams are encouraged to use the ARTec blocks to decorate and enhance their ARTec robot for the various missions.
- The mystery mission will have additional points for decoration of the robot to be the H_2O hero. Additional assorted blocks will be provided during the start of the mission to enable teams to do so.

6.2 Specific Rules about the Missions

Team can bring the ARTec robot assembled to the competition. They do not need to re-build the robot on the competition day.

Prior to each mission attempt, the team may touch the ARTec robot to equip it and update the coding for the selected mission.

The team is only allowed to move the ARTec robot, not the game objects. Game objects not attached to or not in contact with the ARTec robot cannot be moved to another Mission Area.

During a mission attempt, while the ARTec robot is running its program, members of the team are:

- *Not allowed to touch any game object*. If a participant touches a game object, the referee will give a verbal warning to the team and reset the game object to its original position and orientation. A total of 2 verbal warnings will be given. After which, the Organisers reserve the right to not score for that mission.
- *Not allowed to touch the game field mat while the ARTec robot is completing its mission*. If a participant touches the game field mat while the ARTec robot is running its programme, the referee will give a verbal warning to the team. A total of 2 verbal warnings will be given. After which, the Organisers reserve the right to not score for that mission.
- The team can decide to stop the current robot run and re-attempt the mission. In this event, they shall raise their hand to inform the referee. Team can handle the robot only upon receiving the verbal acknowledgment from the referee. The referee shall reset the game object to its original position and orientation. Final score will be based on the last attempt.

6.3 Specific Rules about the Competition

Each mission is completed when either:

The robot achieves the mission goals and the team communicates to the referee that the mission is complete.

OR

The time limit has expired for the mission.

Missions will be considered successful when the mission goals have been achieved.

7. Scoring

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

Presentation Score: Up to 30 points scored as described in the table below.

Competition Score: Up to 70 points scored as described in the table below.

7.1 Presentation Score

Evaluation Criteria	**Maximum Score**
Coding and Design of ARTec Robot • The design and coding of ARTec robots to carry out the missions	10
Reflection ● What the team have learnt during the process ● What was their favourite part of the process	10
Presentation ● Clarity of presentation ● Creativity of presentation ● Q&A	10

7.2 Competition Score

Missions	Score	Total
1. Keeping Our Waterways Clean		
Transport the THREE (3) black debris to the recycling bin ***(hands-free)**** • Every black debris in the recycling bin has three (3) points. • Every black debris that touches the recycling bin has two (2) points. • Every black debris outside the recycling bin has one (1) point. Re-attempts: All black wastes will be returned to the designated locations and the Robot shall be placed to the Start Mission One position[+] Robot that does not stop at the recycling bin is considered an incomplete mission and no points will be awarded.	9	**14**
Achieve mission goal within duration: • Less than or at THIRTY (30) seconds: 3 points • Less than or at TWO (2) minutes: 2 points • Less than or at FOUR (4) minutes: 1 points	3	
During competition, no interference from coaches[#]	2	
2. Our Water Loop		
Visiting the THREE (3) locations in sequence of the reservoir, the PUB Waterwork location and our neighbourhood ***(hands-free)**** • First stop at the reservoir (Bay ONE): The robot stops on top of the white box for FIVE (5) seconds. (4 points) • Second stop at the PUB Waterworks (Bay TWO): The robot stops on top of the white box for THREE (3) seconds. (4 points) • Third stop at Our Neighbourhood (Bay THREE): The robot **parks** on top of the white box and flashes its RED LED lights Five (5) times with ONE (1) second each time. (4 points) • In the event that the robot deviates out of the black line route while in motion, it will incur a deduction of TWO (2) points.	12	**22**
For any re-attempts, Robot will be placed to the Start Mission Two position[+]		
Achieve mission goal within duration: • Less than or at TEN (10) minutes: 8 points • More than TEN (10) minutes, less than or at ELEVEN (11) minutes: 6 points	8	

• More than ELEVEN (11) minutes, less than or at THIRTEEN (13) minutes: 4 points • More than THIRTEEN (13) minutes, less than or at FIFTEEN (15) minutes: 2 points		
During competition, no interference from coaches[#]	2	
3. Sowing Seeds To Sustain Our Reservoir Ecosystem		
Transport the THREE (3) YELLOW seeds from START zone to the designated planting circle 1, 2, and 3 in the field. Starting from Planting Circle 1: • Each seed placed within the inner circle (beige) of the Planting Circle (green): 3 points. • Each seed placed within the outer circle (green), or between the inner circle (beige) and outer circle (green) of the Planting Circle: 2 points. • Each seed placed between the outer circle (green) and the field, or anywhere on the field: 1 point • In the event that the Robot deviates from the black line route while in motion, it will incur a deduction of FOUR (4) points. For any re-attempts, Robot will be placed to the Start Mission Three position[+]	9	**18**
Achieve mission goal within duration: • Less than or at TEN (10) minutes: 7 points • More than TEN (10) minutes, less than or at ELEVEN (11) minutes: 6 points • More than ELEVEN (11) minutes, less than or at THIRTEEN (13) minutes: 4 points • More than THIRTEEN (13) minutes, less than or at FIFTEEN (15) minutes: 2 points	7	
During competition, no interference from coaches[#]	2	
4. Our H_2O HERO^		
Create and decorate the 'H20 HERO ROBOT TREE'	4	**16**
Travel along the field from START zone to planting circle 1, 2, 3 and park in the fourth planting circle (see image): • All wheels of the robot are within the planting circle (3 points) • All wheels of the robot are outside the planting circle (1 points)	3	

Parked and flash Blue LED lights 3 times (2 points)	2	
Achieve mission goal within duration: • Less than or at SEVEN (7) minutes: 5 points • More than SEVEN (7) minutes, less than or at EIGHT (8) minutes: 4 points • More than EIGHT (8) minutes, less than or at NINE (9) minutes: 3 points • More than NINE (9) minutes, less than or at TEN (10) minutes: 2 points For any re-attempts, Robot will be placed to the Start Mission 3 position	5	
During competition, no interference from coaches[#]	2	

* No physical contact with the Game Objects or Robot throughout the Robot run

A TIME-OUT may be requested by coaches in order to provide students with advice and guidance throughout the competition. Nonetheless, throughout the competition, every task must be executed by the student members comprising the team. The time-out duration is at the discretion of the coach. The duration of the competition encompasses the time utilised during the time-out.

^ Mission 4 activity, rules and designated location will be announced on the day of the Onsite Competition

+ Final score will be based on the last attempt

7.3 Best ARTec Robot Design (Additional Prize)

Scoring for the Best ARTec Robot Design will be based on the following:

Evaluation Criteria	**Score**
Creativity ● Imagination used to develop and create the 'H_2O Hero Robot"	10
Innovation ● Original solution and application to add significant value to the robot	10

* Note that the Best ARTec Robot Design score is an additional prize category, and the scores will not be counted towards the overall championship score.

7.4 Best Teamwork Score (Additional Prize)

Scoring for the Best Teamwork will be based on the following:

Evaluation Criteria	**Score**
Team Play ● Organise teammates toward a positive common goal with teamwork	10
Attitude ● Demonstrate participation and show enthusiasm throughout the competition	10

* Note that the Best Teamwork score is an additional prize category, and the scores will not be counted towards the overall championship score.

8. Awards

Overall Championship

Teams are considered for the Overall Championship Award based on the total scores of their Presentation and Competition Rounds.

Score tables can be found in Section 7.

The top team will receive the following:

$500, trophy, banner, and one medal for each participant.

Best Presentation

Awards will be based on scores given during the Presentation Round.

The top 3 teams will receive one medal for each participant.

Best Robot Performance

Awards will be based on scores given during the Competition Round.

1st Place: Trophy, medals (per participant)
2nd Place: Medals (per participant)
3rd Place: Medals (per participant)

Best ARTec Robot Design

Award will be based on scores given during the Competition Round.

The best team will receive one medal for each participant.

Best Teamwork

Award will be based on scores given during the Competition Round.

The best team will receive one medal for each participant.

Certificate of Participation

All participants will also be presented with a Certificate of Participation for taking part in the competition.

The Organiser reserves the right to amend the prizes without prior notice.