NATIONAL ROBOTICS COMPETITION

NRC 2023 REGULAR CATEGORY

Lower Primary, Upper Primary, Secondary, Tertiary

GENERAL RULES

Version: 30 March 2023

Organiser:

Science Centre Singapore

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NRC 2023 ROBOMISSION CATEGORY

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	10 March 2023	Official Challenge Booklet release
1.1	23 March 2023	Updated Playfield Specification
1.2	30 March 2023	Updated Robot Controller

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1. General Information

1.1. National Robotics Competition (NRC) 2023

National Robotics Competition (NRC) has been an ongoing competition organised annually by Science Centre Singapore for the past 24 years with support from the Ministry of Education, various partners and sponsors. This competition has attracted more than 62,500 participants and 250,000 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 participants.

This year, NRC marks its 25th Anniversary and it promises to be filled with exciting challenges that will ensure a fun and meaningful learning experience for the participants. NRC is also an excellent opportunity for students to interact with their peers, teachers and judges from the various industries during the course of the competition.

NRC 2023 tournaments comprise:

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

Registration for these category challenges will be via https://www.gevme.com/NRC2023. Competition registration opens from **24 February to 1 July 2023.**

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 2023

Every year, NRC revolves around a specific theme and this year, the theme for NRC is "**Sustainable Solutions**". Climate change is a global challenge, and Singapore is taking firm actions to do our part to build a sustainable future. This year, the challenges will revolve around Singapore's national agenda on sustainable development.

2. Teams and Rules Hierarchy

2.1. Team Definition

Each team will have a minimum of 2 members and up to 3 members.

This category is open to the following age groups:

- Lower Primary: students 7-9 years old (in season 2023: born years 2014-2016)
- Upper Primary: students 10–12 years old (in season 2023: born years 2011 – 2013)
- Secondary: students 13-16 years old (in season 2023: born years 2007-2010)
- Tertiary: students 16-19 years old (in season 2023: born years 2004-2007)

Students need not be from the same school. However, all the members of a team must be in the same category age group to qualify.

2.2. Expectations on Teams

Teams should behave fairly and be respectful towards other teams, coaches, judges and competition organizers. 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 organizational 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/mentors are not allowed to communicate with their teams.

If any of the rules mentioned in this document are broken or violated, the judges 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 not qualify for the next round of the tournament (e.g. finals)
- A team may not qualify for the national/international final
- 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 document builds the base for rules in this category.
- Game Rules document of the age group will clarify the missions on the field and may add special game definitions.
- Questions & Answers (Q&As) can override rules in the general rule document.
- **The Chief Referees have the final say in any decision.**

During a season, NRC may publish additional Question & Answers (Q&As) that can clarify, extend, or re-define rules in game and general rule documents. Teams should read these Q&As before the competition.

3. Robot Material and Regulations

1. Every team builds one robot to solve the challenges on the field. The maximum robot dimensions before the robots starts a run are 250 mm x 250 mm x 250 mm. Cables must be included in these dimensions. After the Robot has started, the dimensions of the robot are not restricted.

2. Teams are allowed to use only the following materials to build the robot:

a) For Lower Primary

Controller	LEGO® Education SPIKE™ ESSENTIAL; LEGO® Education WeDo 2.0
Motors	Only motors from the platforms/sets mentioned at "Controller"
Sensors	From the platforms/sets mentioned at "Controller".
Batteries	Only official LEGO rechargeable batteries (no. 45612 for SPIKE™ Essential).
Building Materials	For the construction of the robot only LEGO® branded elements are allowed.

b) For Upper Primary and Secondary

Controller	LEGO® Education MINDSTORMS® NXT or EV3; LEGO® Education SPIKE™ PRIME; LEGO® MINDSTORMS® NXT, EV3 or Robot Inventor.
Motors	Only motors from the platforms/sets mentioned at "Controller".
Sensors	From the platforms/sets mentioned at "Controller". In addition, it is allowed to use the following materials: • HiTechnic Color Sensor
Batteries	Only official LEGO rechargeable batteries (no. 9798 or 9693 for NXT, no. 45501 for EV3, no. 45610 for SPIKE™ Prime/Robot Inventor).
Building Materials	For the construction of the robot only LEGO® branded elements are allowed.

c) For Tertiary

Controller	Any LEGO® Education / MATRIX Robotics/ Makeblock/ TETRIX Robotics
Motors	Any motors compatible with the chosen Controller
Sensors	Any sensors compatible with the chosen Controller
Batteries	For Lego Controllers - Only official LEGO rechargeable batteries (no. 9798 or 9693 for NXT, no. 45501 for EV3, no. 45610 for SPIKE™ Prime) For others – Any compatible batteries
Building Materials	Any materials

3. It is allowed to cut the size of original LEGO® ropes or tubes. Any other modification on any other original LEGO® or electronical part is not allowed, and it is not allowed to use screws, glues or tape or any other Non-LEGO® material to fasten any components on robots.

4. The number of motors and sensors to be used is not restricted.

5. If a team wants to use any equipment to align in the start area, this equipment must be built out of LEGO® materials, it must fit into maximum robot dimensions (i.e. included in the 250 mm x 250 mm x 250 mm dimensions).

6. A team is allowed to bring and use only one controller when called to the playfield. The team can bring spare controllers and parts on standby into the quarantine area. If the team needs a spare controller or any other parts from outside the quarantine area (eg. from the coach or mentor), the team should contact the judge before getting the spare part.

7. A team should place the controller in the robot in a way that makes it easy to check the program and stop the robot by a judge.

8. *(For Upper Primary, Secondary and Tertiary)* A robot must be autonomous and finish the missions by itself. Any radio communication, remote control and wired control systems are not allowed while the robot is running.

9. (For Lower Primary) 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.

10. A team is not allowed to perform any actions or movements to interfere or assist the robot after the robot started with the run.

11. Any software to code the robot is allowed and teams can prepare the code before the competition day. If a team uses a software that requires an online connection (e.g. a browser-based tool), the team should check if there is an offline version for the competition day. The competition organizer is not responsible to provide an online infrastructure (e.g. WiFi for everyone).

12. Bluetooth, Wi-Fi or any remote connection must be switched off during check time and robot runs. Only teams can use remote connections if there is no other way to transfer the code from a device (e.g. a tablet) to the controller. However, it is strongly recommended to transfer code via cable to avoid problems (e.g. multiple devices with the same name) at the competition day. Of course, it is not allowed to interfere or obstruct any other team or robot with the remote connections a team uses.

13. Use of SD cards to store programs is allowed. SD cards must be inserted before check time and may not be removed until the next practice time starts.

14. A team should prepare and bring all the equipment, enough spare parts, software and portable computers it needs during the tournament. Teams are not allowed to share a laptop and / or the program for a robot on the competition day. The competition organizer is not responsible for the maintenance or replacement of any material, not even in case of any accidents or malfunctions.

15. The robot can be marked (label, ribbons, etc.) to prevent participants from losing it or confusing it with the robots of the other teams, as long as this does not change its performance or give clues about the assembly process.

16. Teams can bring the robots assembled to the competition. They do not need to re-build the robots on the competition day.

4. Playfield Specifications and Material

Every team will have to use their robot to solve mission on a play field.

Details of the playfield are as below:

- The playfield design has to be printed on a mat that is pasted onto the game table.
- The game mat used for the competition will be UV PP Synthetic Paper 170 gsm.
- The dimension of the mat is 2362 mm x 1143 mm.
- Game tables should have the same size or max +/- 5mm in each dimension.
- The official height of the borders of a game table is 70mm and will be in black.

Refer to the individual age-group game rules challenge booklet for the playfield design.

If the position of game objects on the field is not clearly defined and the specified area for the game object is larger than the object itself, the object should be place centred in an area.

5. Competition Format and Procedure

5.1 Competition Format

	Dates	Remarks
Presentation Week	21 August – 30 August	
Presentation Finals	2 September	For shortlisted teams
Robot Run Week	4 September – 8 September	
Robot Run Finals	9 September	For shortlisted teams

Teams will first present their robot project during Presentation Week.
Shortlisted teams will then compete in the Presentation Finals.

Teams will then participate in Robot Runs during Robot Run Week.
The top teams from each category will be shortlisted for the Robot Run Finals held on **9 September 2023.**

Please note that the dates (2 & 9 September) may be subjected to changes due to possible election call on a Saturday. In the event that the election is held on one of the mentioned Saturdays, the respective event (Presentation Finals and Robot Run Finals) will be shifted to the Sunday (3 & 10 September).

5.2 Presentation Format & Judging Criteria

Presentations are scheduled from **21 August to 30 August 2023.** Participants will be notified on their scheduled date. Shortlisted teams will then compete in the Presentation Finals held on **2 September 2023**.

The details of the Presentation are as follows:

1. Teams will present to a panel of Judges on their scheduled day and session at Science Centre Singapore.

2. Teams will have to prepare a **10-minute presentation** followed by a **5-minute Q&A by the Judges**.

3. The goal of the presentation is to help the judges understand the team's project and hence prepare questions for the team. This will enable judges to have a better understanding of the team's learning processes.

4. The presentation will be on the team's robot and building process, as well as research into the respective themes of your challenge category:
   - **Lower Primary – Green School**
   - **Upper Primary and Secondary – Green City**

- **Tertiary – Green World**

1. Suggestions for content structure include:
    - Team introduction and roles of individuals
    - Research into respective themes of challenge category:
        i. **Lower Primary – Green School.** Team to envisage how to incorporate sustainability into their school and to share what is a green school. Team can share their concept and ideas that can be used for a green school. For example, how we can incorporate robot in school environment and increase the school's sustainability effort.
        ii. **Upper Primary / Secondary – Green City.** Team to envisage what a green city should be and look like. Team can share their ideas, design, plan, and technology that can be used in a green city. For example, how robots can help the development of infrastructure and building to make our city into a greener city. Team can also share about the use of renewable energy sources and adding greenery when building sustainable buildings.
        iii. **Tertiary – Green World.** *(More details will be updated)*
    - Presentation of their challenge solution including:
        i. Development journey and progress
        ii. Construction of the solution
        iii. Coding of the solution
        iv. Challenges during the development process
        v. Sample video of their robot tackling the missions

6. Teams will also be required to showcase their physical robot that they have built for the mission. Presentation scoring breakdown is shown in the Judging Criteria.

7. Visual materials are allowed in the presentation (e.g. PowerPoint slides, boards, charts etc.).
    - Teams are to provide for their own equipment needed for their presentations. For example, laptops (charged and ready to present) or boards and charts.
    - There is no limit on number of slides used as long as presentations remain within the 10-minute timeframe.

8. All the members in the team are required to attend the presentation, unless under exceptional circumstances.

9. The official language for all presentation is English. Interpreters are not allowed.

10. Teams that fail to report at their allocated presentation time slot will be disqualified.

Judging Criteria for NRC Regular Category Presentation:

Category	Criteria	Points
Programming (Total Points: 50)	**Automation Level** The project uses appropriate inputs from sensors to run specific routines and clearly demonstrates automation in the completing of the tasks.	15
	Good Logic The programming options used make sense, work reliably, are relevant in terms of their use, complexity and design.	15
	Strategy Use of sub-routines and sub-functions, how the team complete mission objectives, coming up with different strategies to see what works.	20
Engineering Design (Total Points: 50)	**Engineering Concepts** The project shows evidence and good use of engineering concepts and team members are able to explain the concepts and need for use. Designer / Builder applications.	15
	Mechanical Efficiency and Structural Stability Parts and energy have been used efficiently – evidence of proper use of mechanical concepts / principles (gears/pulleys/levers/wheels & axles). The project (robots and structures) is strong, sturdy and the demonstration can be run repeatedly – parts don't detach – little need for repairs.	20
	Overall design & aesthetic The Robot design is functional yet unique and aesthetically appealing.	15
Presentation (Total Points: 50)	**Successful Demonstration** Using unique, interesting and aesthetic method to convey the project and Theme.	20
	Communication & Reasoning Skills The team is able to present their project idea in clear, concise and engaging way.	20
	Quick Thinking The team is able to easily answer questions about their project. They are also able to deal with any problems that arose during the presentation.	10
Research (Total Points: 50)	**Research contents quality and relevancy** There is evidence that team members explain their research and content relevant to the theme.	15
	Research methodology The team is to share how they conduct their research & the method on how they obtained their information. E.g. Internet, survey.	15
	Learning outcome & teamwork The team is able to explain the research journey and give an insight to what they have learnt.	20
Total Points		**200**

5.3 Robot Run Challenge Format

Robot Run Challenge are scheduled from **4 September to 8 September 2023.** Participants will be notified on their scheduled date. Shortlisted teams will then compete in the Robot Run Finals held on **9 September 2023**.

1. Teams will be quarantined in in designated team areas and are only allowed to modify the construction or code of the robot during Practice Times. If teams want to make test runs, they need to queue with their robots (controller included). No laptops should be brought to the competition table and no own mats should be brought to the team area. Teams need to calibrate their robots during practice time, not directly before an attempt. Calibration and practice will be done at their assigned Competition Table.

2. If there are any Surprise Rules during the competition round, this will be conveyed to the teams by a briefing that will be conducted by the Referee in charge before the start of the Practice Time. If the surprise rule brings additional game elements, teams are not allowed to remove these elements from the playing field if they do not want to solve the surprise rule.

3. If there are randomization of any gameplay elements, this will be done before the start of each Challenge Attempt, with all teams having the same layout in the same Challenge Attempt round.

4. During inspection for the Challenge Attempt, the judges will inspect the robot and check all regulations. If a violation is found at the inspection, the judge will give the team three minutes to convert the violation. It is not allowed to transfer new programs during these three minutes. If the violation cannot be solved during the time, the team is disqualified for this attempt.

5. No transfer of materials (physical, digital, or otherwise) between the designated team areas and outside the quarantined area. Any team found in violation will be subjected to the penalties listed in 2.2.

6. Awards & Prizes

For each category - Lower Primary, Upper Primary, Secondary and Tertiary respectively:

<table>
<tr><th>Award</th><th>Rank</th><th>Remarks</th><th>Prize</th></tr>
<tr><td rowspan="3">Best Presentation Award</td><td>1st</td><td rowspan="12">Participated in Presentation</td><td rowspan="12">Medal and Certificate for each team member</td></tr>
<tr><td>2nd</td></tr>
<tr><td>3rd</td></tr>
<tr><td rowspan="3">Best Research Award</td><td>1st</td></tr>
<tr><td>2nd</td></tr>
<tr><td>3rd</td></tr>
<tr><td rowspan="3">Best Programming Award</td><td>1st</td></tr>
<tr><td>2nd</td></tr>
<tr><td>3rd</td></tr>
<tr><td rowspan="3">Best Engineering Design Award</td><td>1st</td></tr>
<tr><td>2nd</td></tr>
<tr><td>3rd</td></tr>
<tr><td rowspan="3">Best Robot Performance Award</td><td>1st</td><td rowspan="3">Competed in Robot Run</td><td>Trophy [1 per team], Medal & Certificate for each team member</td></tr>
<tr><td>2nd</td><td rowspan="2">Medal & Certificate for each team member</td></tr>
<tr><td>3rd</td></tr>
<tr><td colspan="2">Championship Award [Refer to 6.1]</td><td>Competed in Presentation Week and Robot Run Finals</td><td>Cash Prize, Trophy [1 per team], Medal & Certificate for each team member</td></tr>
</table>

Across all categories:

Award	Remarks	Prize
Best Costume Award	For the most creative or impressive attire that the team wears during the Presentation Week & Robot Run Week	Medal and Certificate for each team member
Judges Award	Apart from all the awards listed, judges may present up to 5 other awards to teams and/or individuals that have displayed outstanding attributes (during the competition) that set them apart in a unique way.	

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

6.1 The Championship Award

This is the most prestigious award that a team can win. It is bestowed on the team that embodies the NRC spirit. Teams are considered for the Championship Award based on their overall excellence and total learning experience during the competition.

The Championship Award assessment is based on the scores of the top finalists according to the following weightage:

- **60% Robot Performance (Based on Robot Run Finals)**
- **40% Presentation Score (Based on Presentation - 10% Programming, 10% Engineering Design, 10% Presentation and 10% Content)**

Championship Award recipients are entitled to the following cash prize:

Category	**Cash Prize Quantum**
Lower Primary	$1000
Upper Primary	$1500
Secondary	$1500
Tertiary	$2000

Championship Award recipients are eligible to represent Singapore to compete in the Global Robotics Games (GRG) International Final.

In the event that an International School win any of the top two awards, they will be acknowledged and given medals and trophies, but the next best local team will represent Singapore for the GRG International.