NATIONAL ROBOTICS COMPETITION

WRO® Future Innovators Category 2022

Elementary (Primary), Junior (Secondary), Senior (Tertiary)

GENERAL RULES

Version: 25 May 2022

Main Organiser:

Science Centre Singapore

Co-Organiser:

DUCK LEARNING opportunities in education

Sponsored by:

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WRO®

NRC 2022 WRO® FUTURE INNOVATORS CATEGORY

CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	25 May 2022	Official Challenge Booklet release
1.1	15 July 2022	Updated Section 9: • Reiterate Championship team representation for Singapore in WRO
1.2	4 August 2022	Updated Section 11: • Scoring sheet for Secondary and Tertiary updated to highlight difference in judging for project
		Updated Section 9: • Secondary and Tertiary to be awarded in same category

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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 participants 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 participants. 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 WeDo
- NRC Preschool (New)
- CoderZ Coding Challenge

In 2022, NRC emerged a new initiative to include 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 WRO® Future Innovators

In the WRO® Future Innovators category teams develop a robot that helps solve real-world problems. There is a new theme every year, often connected to the UN Sustainable Development Goals. After research into the theme each team develops an innovative and functioning robotic solution. They present their project on the competition day.

1.3. Focus Areas

Every WRO® category has a special focus on learning with robots. In the WRO® Future Innovators category, students will focus on developing in the following areas:

- Research and development: identify a specific problem within the season theme, research and come up with a creative solution.
- Prototyping: turning your idea into a functional robot solution.
- Technical engineering skills: implementing a robotic solution while using different source of materials (controllers, motors, sensors, 3rd party equipment etc.).
- Software engineering skills: developing a code that supports the robotic solution (e.g., using sensors, interaction between multiple devices).
- Innovation: Think about potential users, the impact and how you could turn your prototype into reality.
- Presentation skills: Prepare a project booth and present the idea to judges & audience.
- Teamwork, communication, problem solving, creativity.

1.4. Age-appropriate judging

All teams in this category are judged on several criteria that fit in tree scoring rubrics. The scoring rubrics have a slightly different weight / importance for the different age groups (e.g., or younger students there is more focus on the presentation, for older students there is more focus on innovation and technical aspects).

1.5. Learning is most important

WRO® 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 or code/program the robot.
- On a competition day, Teams and Coaches respect the judges' final decision and work with other teams and judges on ensuring a fair competition.

2. Team and Age Groups definitions

2.1. Team Definition

A team consists of two (2) to three (3) team members. One (1) team member is not considered a team. A team may only participate in one of the WRO® categories in a season. A student may only participate in one team.

The age groups in WRO® Future Innovators Competition are:

- Primary: students 8-12 years old (in season 2022: born years 2010-2014)
- Secondary: students 13-16 years old (in season 2022: born years 2006-2009)
- Tertiary: students 16-19 years old (in season 2022: born years 2003-2006)

The maximum age reflects the age that the team member turns in the calendar year of the competition, not his/her age at the competition day. It is strictly enforced that student cannot be older than specified age group for the respective competition category. If all members of a team are younger than required, then the team must participate in the corresponding age group category. Team members are not confined to school-going students. Anyone can participate in the corresponding age groups.

**** Members of the Championship winning team, at the age of 16 (in the competition year), will not be eligible to compete in the WRO® Future Innovators, Junior Category (11 – 15 years old). The next best ranking team with the appropriate age requirements will qualify.***

2.2. Coach Definition

The minimum age of a coach in the NRC tournament is age of 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 related to preparation and submission, and the actual competition must be performed by the student members of the team.

3. Responsibilities and team's own work

A team should behave fairly and be respectful towards other 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 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. This applies to both the day of the competition and the preparation.

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. 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 national / international final.
- A team may be disqualified completely from the competition 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. These rules are the basis for all international WRO® events including NRC.

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.

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. Robotic solution & project booth

Teams in this category build a robotic solution inspired by the theme of the season.

A robotic solution has the following characteristics:

- The solution is a robotic device that has several mechanisms, sensors and actuators and is operated with one or more controller(s). A robotic device should do more than a machine that is only repeating a certain workflow and should make autonomous decisions.
- The solution can use one or multiple robot devices. Every robot should work autonomously and not be operated by a remote control. Any remote controlled or additional devices are only allowed if this is connected to the solution for the real world (e.g. interacting with humans). If multiple robots are used, they should ideally communicate with each other (digitally or mechanically).
- The solution should be innovative and should help humans in their daily life. They can replace certain parts of human tasks or make it possible to do things we could not do before. Teams should always think about the effect it will have on people and society if robots help or replace humans.
- The robot solution presented can be a model of what the solution would look like in real life. However, this model should demonstrate as closely as possible the performance and functions and scale to the actual robot if it would be produced, especially in the older age groups.
- There is no restriction on the use of controllers, motors, sensors, or any other building equipment the team needs to create their robotic solution and project booth; however, it should not be the intention to use as much materials as possible. The judges will base their scoring on the project idea connected with a meaningful use of materials for every robotic solution.
- Teams can use any software / programming language to code the robotic solution. All software / code that is used for the solution must be coded by the team itself or must be readily available to everyone (e.g. free open source tools).
- Teams present their project and their robotic solution in a project booth (or other defined area) that is the same size for all teams at the tournament. The international booth size is 2m x 2m x 2m (even if the provided walls are larger. Each team will be provided with 3 vertical display surfaces within the booth, as close to the booth size as possible. The robotic solution and all booth decorations etc. should fit inside the booth, otherwise the team cannot be judged.
- To explain their thinking to visitors, the team should use their booth to present information about their project in addition to showcasing their robotic solution. (Information about the team, the research, the development of the solution, etc.) There is no pre-described format for presenting the information, the team can use posters, displays or other materials.
- A team must be able to demonstrate all aspects of the robotic solution within the booth. The team may be outside (in front) of the booth to present their solution.
- Teams will be provided with a table. The size of a table will be 120cm x 60cm (or as close as possible). The table size will be consistent across teams. If a team uses the table, the table must be placed inside the project booth. Teams are allowed up to 3 chairs in the booth area.

- The use of fire or mist is prohibited for safety reasons (e.g. to prevent legionnaires' disease). If you need to use liquids for your project, please check with the venue and competition organizer before the event. The use of liquids may be restricted to water only and may be restricted to a specific amount or may be forbidden completely pending on the regulations associated with the event. If fire, mist or liquids are important for your solution, think about other ways to showcase it in your video and in your project booth.
- It is permitted to develop a project from a previous year; however, the team should describe how this project is clearly different or more evolved from the previous project in their report.

6. Additional materials

The overall judging in this category is based on the robotic solution itself, the presentation on the competition day (information given by the team and presented in the booth) and the following additional materials:

- Project report
- Project video

The project report and video are mandatory for all teams in all competitions.

Additional materials must be submitted before the competition day, giving the judges enough time to prepare. The competition organizer will announce the submission deadline. All materials must be submitted electronically. On the competition day the team should bring a minimum of 2 printed project reports, one to hand over to the judges and viewing copy for interested visitors.

6.1. The project report has the following requirements:

Goal	Help the judges understand the project and prepare questions for the judging session.
Maximum number of pages	20 pages single sided (10 pages double sided), including attachments, not including front-page, table of contents and list of sources. Longer reports will not be judged and will result in a score of zero points.
File type	PDF
Maximum file size	15 MB
Content structure	• Team introduction and roles (max. 1 page) • Summary project idea (max. 1 page) • Presentation of the robotic solution (max. 12 pages including photos of your robotic solution and/or screenshots from the coding): o Evolution of project idea during the preparation o Research into similar ideas that are available (if any) o Construction of the solution o Coding of the solution o Challenges during the development process • Social impact & innovation (max. 6 pages): o Impact of your solution on (local/global) society (Include possible negative effects) o One tried, practical use case of your idea o Secondary & Tertiary age group only: Answer the other questions for this area that are asked in the scoring sheet for these age groups. *IMPORTANT NOTE: For the Primary age group the chapter about the robotic solution should be max. 15 pages, the chapter on social impact & innovation max. 3 pages.*
Language	The report must be done in English.
Expectation	The project report should be made by the team only, not by the coach or others. A coach or others may only help or guide in any technical issues that teams have while preparing the report (especially for younger kids). We expect a more professional style of document, language and wording from older students than from younger students. Judges will consider whether the report is delivered at a level appropriate to the age of the team when scoring.
Template	A project report template is added to this document (refer to 12. Project Report Template)

Written report to be named in the following format:

- Team Number, Team Name, School/Organization, Tournament
  Eg. 'A001, Team ABC, ABC School, WRO® Open report

6.2. The project video has the following requirements:

Goal	Present the team and the robotic solution to the public. Demonstrate how the robotic solution works. The video is also a guide for the judges, it gives you some extra time to present your robot solution.
Maximum length of the video	90 seconds (1.5 minutes).
File type	.avi, .mpeg, .wmv, .mp4
Maximum file size	100 MB
Goal	**In the video the team shows their robotic solution while it is running. The team can do this in the real-world environment.** The team should not repeat everything they have written in the report. Teams should briefly introduce themselves and the project idea, but the main part of the video should show how the robotic solution works.
Language	The video must be done in English. (English subtitles can be used to help with understanding, but these are optional.)
Expectation	The video should be done by the team, not by the coach or others. A coach or others may only help or guide with regard to any technical issues that teams have while preparing the video (especially for younger students). Judges will consider whether the video is delivered at a level appropriate to the age of the team when scoring. Please note: Judges do not expect a professional video production. It is completely acceptable if teams just use a mobile device (e.g. smartphone, tablet) to capture the video in one go.

Video to be named in the following format:

- Team Number, Team Name, School/Organization, Tournament
  Eg. 'A001, Team ABC, ABC School, WRO® Open video

All report & video submissions are to be received by the Organizers by **2nd September 2022, 1700hrs.** The submissions will contribute to your final scores under judging criteria respectively, refer to 11. Judging.

7. Missions

7.1. Introduction

Robotics and artificial intelligence are becoming an increasingly important part of current research and science. Continuous progress in the field of robotics enables new robots to act in a better way in the environment of humans. The combination of robotics and artificial intelligence can change the world and especially the environment of humans.

Some people see dangers rather than opportunities in direct human contact with robots in the daily environment. The challenges of the future will be to seize the opportunities and to make robot-human interaction helpful and safe.

Service robots are already performing partially or fully automated services. They help people in difficult environments or with monotonous or dangerous tasks. As supporters and friends, robots take on a wide range of tasks to relieve people of time-consuming tasks and mental strain and to increase human comfort.

However, development is far from complete. What other tasks can robots take on in the future? How can it be ensured that robots act as helpers in your daily life?

We need your idea for your robot friend!

7.2. Your Robot Mission

For the WRO® Future Innovators category in 2022, teams have the task to develop a robot model which represents the robot as a friend and helper in the daily life of people. Teams may choose one of the three areas (1, 2, 3) to work on, but they can also choose to work on a project that focuses on a combination of these three areas.

1. Robots at Home

In your home there are a lot of tasks that have to be done regularly. Robots can take over work processes autonomously or support people with tasks in or around the home. Maybe you already do household tasks yourself where a robot could simplify the work processes. Since the robot works in the household in the direct environment of the human being, mutual consideration is particularly important. The robot should act in a way that does not endanger humans and vice versa.

We are looking for robotic solutions that perform tasks in the household in order to relieve the people that live there.

2. Robots in Rescue

Every rescue poses new challenges for the people involved. Apart from extinguishing fires, think of rescuing humans or animals from threatening situations or recovering cars. The protection of the rescue workers is always the top priority. During rescue operations in dangerous or inaccessible surroundings, the rescue may be delayed if the situation is not safe for the rescue crew.

We are looking for robotic solutions that can support and relieve the rescue services or that can carry out rescue tasks independently.

3. Robots in Healthcare

Healthcare is an important part of our world. As soon as we feel unwell, suffer from injuries, or are in need of other help, we go to the doctor.

Working in the healthcare sector is often strenuous and requires a high level of concentration from employees. This applies to a doctor's office, hospital, nursing home, and all other sectors of health care.

When dealing directly with people, however, care and consideration is required. A robot can help to improve the situation in the health care system or to make the work for health care professionals easier. A robot can help improve social interaction, can fetch and bring materials, or can even perform medical tasks.

We are therefore looking for robotic solutions that improve or support aspects of healthcare.

For all sub-themes mentioned above (Robots at Home, Robot in Rescue, and Robots in Healthcare) you can find a connection and inspiration using the Sustainable Development Goals. There are multiple goals that support the theme, depending on your project idea: https://www.un.org/sustainabledevelopment/sustainable-development-goals/

8. Presentation & Judging

Teams in this category need to go through the following process on the competition day:

- Setting up their project booth and testing of the robotic solution
- Inspection of the booth (e.g. check for booth size)
- Presentation of the robotic solution in one or multiple judging sessions

Each judging session takes 10 minutes. Judges will form groups of 2-3 judges and visit teams at their booth. First, the team has 5 minutes to present the project idea and demonstrate the robotic solution live at the project booth. Judges will keep time and stop the team after 5min. Then, judges will ask questions about the project and the robot solution.

In general, teams must maintain a presence within the team's booth during competition hours in order to present to members of the general public but, of course, the team should take a look at other projects and ideas as well.

A team should inform themselves of the schedule of the competition day and should be present at their booth in time for a judging session. The team must make sure that the booth is ready, and the robotic solution is on stand-by for a live presentation in English before the judges arrive.

If a robotic solution does not function during a judging session the judges will see if they can come back at a later time and/or the team can demonstrate the solution in the next judging session.

The judging at NRC will be executed in the different age groups with the appropriate scoring sheet for each age group. This will result in there being winning teams for each age group.

Judges will prepare themselves for the competition by reviewing the report and video. In addition, at least one judging meeting will take place in the morning of, or the days before the competition. Here, the judges will discuss the judging process and will align on a joint understanding of the scoring sheets.

Judges should not judge teams from their own school / institution or country. If not enough judges are available, other judges from the judging group will ask the questions to the team during the judging session.

Judges will always view the performance of the team during the judging session and on the full competition day. Judges can deduct points on situations outside of a judging session as well, e.g., if the judges see that the coach is doing the work of a team.

8.1. Special Requests per Age Group

Primary

If you are in this age group, you will need to explain how your robotic solution will help your community.

Secondary

If you are in this age group, you will need to explain the impact of your solution on current issues facing society. Think of questions like: What impact will your robot model have on society? Who will benefit from your solution?

Tertiary

If you are in this age group, you will have to investigate how your idea can become reality. Describe the possible challenges and demonstrate which problems must be solved to get your robot model ready for action. Present your thoughts in an appealing way.

9. Awards

At NRC Future Innovators, 1st, 2nd and 3rd place are awarded to the teams that overall score best in their age group.

Tournaments	Awards	Rank	Criteria
WRO® Future Innovators	WRO® Future Innovators Category (Primary)	Championship*	Participated in Presentation
		2nd	
		3rd	
	WRO® Future Innovators Category (Secondary and Tertiary)	Championship*	Participated in Presentation
		2nd	
		3rd	

In addition, there will be a number of specific awards that will be presented to teams. These are awarded based on the assessment of the judges of an age group (or all judges of the competition), independent of the overall scoring of the teams. These awards will be presented to the winning teams during the award ceremony.

9.1 *The Championship Awards

Championship Award recipients are eligible to represent Singapore to compete in the WRO® 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 WRO International. This year the competition will be held in Dortmund, Germany from 17 – 19 November 2022. NRC's participation to WRO® International Final will depend on the prevailing guidelines from MOE.

10. Glossary

Coach	A person assisting a team in the process to learn different robotics aspects, teamwork, problem solving, time management, etc. The role of the coach is not to win the competition for the team, but to teach them and guide them through the problem identification and in discovering ways to solve the competition challenge.
Competition organizer	The competition organizer is the entity that hosts the competition a team is visiting. This can be a local school, the National Organizer of a country that runs the National Final or a WRO® Host Country together with WRO Association running the International WRO® Final.
Judging Group	In general, 2 or 3 people form a judging group. These group will visit the teams in a judging session and ask questions. The same people will have seen the project report and video before the judging session as well.
Judging Session	Teams are judged in judging sessions. Every session has 10 minutes, 5 minutes for a presentation from the team, 5 to answer questions from the judges.
Project Booth	The project booth is the place where teams present their solution. The project booth's dimensions are 2m x 2m x 2m.
Robotic Solution	The robotic solution is the core result of the team's work. A team presents their solution to judges. A robotic solution cannot be larger than the project booth.
WRO®	In this document, WRO® stands for World Robot Olympiad Association Ltd., the non-profit organization running WRO® worldwide. WRO® is responsible for the (international) game and rule documents.
NRC	In this document, NRC stands for National Robotics Competition.

11. Scoring sheets

Presented below are the scoring sheets as used in the international final.

The Judges are asked to grade all criteria on a scale, similar to grading in some educational systems. Based on that grade the number of points the team gets for that specific aspect of the competition is calculated. The maximum points are presented on the scoring sheet.

At NRC, judges work in pairs or little groups. Teams are visited by at least 2 judge groups. The judges score each criterion and discuss their scoring after each round. The winners are selected on the base of the scoring of the judges and a discussion in a judge meeting after all judging rounds are completed.

11.1 Judging Criteria – Primary

Category	Criteria	Points
1. Project (Total Points: 50)	**1. Creativity** - The project is original, worthwhile and shows creative thinking / innovative and imaginative design / interesting and divergent interpretation and implementation.	**10**
	2. Quality of Solution - The project is well-thought out and is a good solution to the problem. The solution supports the theme of the WRO® season.	**15**
	3. Research & Report - Research was done. The report is a good summary of the project from the problems - solutions - process - findings - team - task.	**15**
	4. Entertainment Value - The project has a certain "WOW" factor - looks fun, captures the attention of passer by - makes you want to see it again or learn more about it.	**10**
2.Programming (Total Points: 45)	**1. Automation** - The project uses appropriate inputs from sensors to run specific routines and clearly demonstrates automation in the completing of the tasks.	**15**
	2. Good Logic - The programming options used make sense, work reliably, are relevant in terms of their use, complexity and design.	**15**
	3. Complexity - The project uses multiple languages, sensors or controllers and incorporates more advanced / complex algorithms, structure, and design.	**15**
3. Engineering Design (Total Points: 45)	**1. Technical Understanding** - Team members can produce clear, precise, and convincing explanations about each step of the mechanical and programming process.	**15**
	2. Engineering Concepts - The project shows evidence and good use of engineering concepts and team members can explain the concepts and need for use.	**10**
	3. Mechanical Efficiency - Parts and energy have been used efficiently - evidence of proper use of mechanical concepts / principles (gears/pulleys/levers/wheels & axles)	**10**
	4. Structural Stability - The projects (robots and structures) are strong, sturdy and the demonstration can be run repeatedly - parts don't detach - little need for repairs.	**5**
	5. Aesthetics - The mechanical elements have aesthetic appeal, there is evidence that the team went out of their way to make the project look as professional as possible.	**5**
4. Presentation (Total Points 40)	**1. Successful Demonstration** - A demo of the capabilities was completed, there is a sense that it could reliably be repeated, and that preparation and practice have taken place.	**15**
	2. Communication & Reasoning Skills - The team was able to present their project idea in an interesting way - how it works - why they chose it - why it has relevance.	**10**
	3. Quick Thinking - The team is able to easily answer questions about their project. They were also able to deal with any problems that arose during the presentation.	**10**
	4. Project Video - Only marks for videos provided on time. The video is a good pitch for the project - presenting the problem, the solution and the team.	**5**
5. Teamwork (Total Points: 20)	**1. Unified Learning Outcome** - There is evidence that team members have internalized knowledge and understanding of the subject matter pertaining to their project.	**10**
	2. Inclusiveness - The team is able to demonstrate that all members played an important role in the development, construction and presentation of their project.	**5**
	3. Team Spirit - The team displays positive energy, good cohesiveness, value one another and are enthusiastic and excited about sharing their project with others.	**5**
	Maximum Points	**200**

*Projects that are clearly not within the theme will receive a score of 0.

11.2 Judging Criteria – Secondary

Category	Criteria	Points
1. Project (Total Points: 50)	**1. Creativity** - The project is original, worthwhile and shows creative thinking / innovative and imaginative design / interesting and divergent interpretation and implementation.	10
	2. Quality of Solution - The project is well-thought out and is a good solution to the problem. The solution supports the theme of the WRO® season.	15
	3. Research & Report - The report is a good summary of the project: the problems - solutions - process - findings - team - task. Research shows extra elements of entrepreneurship such as, cost structure, revenue stream, key resources, and partners.	15
	4. Entertainment Value - The project has a certain "WOW" factor - looks fun, captures the attention of passer by - makes you want to see it again or learn more about it.	10
2.Programming (Total Points: 45)	**1. Automation** - The project uses appropriate inputs from sensors to run specific routines and clearly demonstrates automation in the completing of the tasks.	15
	2. Good Logic - The programming options used make sense, work reliably, are relevant in terms of their use, complexity and design.	15
	3. Complexity - The project uses multiple languages, sensors or controllers and incorporates more advanced / complex algorithms, structure and design.	15
3. Engineering Design (Total Points: 45)	**1. Technical Understanding** - Team members are able to produce clear, precise, and convincing explanations about each step of the mechanical and programming process.	15
	2. 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.	10
	3. Mechanical Efficiency - Parts and energy have been used efficiently - evidence of proper use of mechanical concepts / principles (gears/pulleys/levers/wheels & axles)	10
	4. Structural Stability - The project (robots and structures) is strong, sturdy and the demonstration can be run repeatedly - parts don't detach - little need for repairs.	5
	5. Aesthetics - The mechanical elements have aesthetic appeal, there is evidence that the team went out of their way to make the project look as professional as possible.	5
4. Presentation (Total Points 40)	**1. Successful Demonstration** - A demo of the capabilities was completed, there is a sense that it could reliably be repeated, and that preparation and practice have taken place.	15
	2. Communication & Reasoning Skills - The team were able to present their project idea in an interesting way - how it works - why they chose it - why it has relevance.	10
	3. Quick Thinking - The team are able to easily answer questions about their project. They were also able to deal with any problems that arose during the presentation.	10
	4. Project Video - Only marks for videos provided on time. The video is a good pitch for the project - presenting the problem, the solution and the team.	5
5. Teamwork (Total Points: 20)	**1. Unified Learning Outcome** - There is evidence that team members have internalized knowledge and understanding of the subject matter pertaining to their project.	10
	2. Inclusiveness - The team are able to demonstrate that all members played an important role in the development, construction and presentation of their project.	5
	3. Team Spirit - The team display positive energy, good cohesiveness, value one another and are enthusiastic and excited about sharing their project with others.	5
	Maximum Points	200

*Projects that are clearly not within the theme will receive a score of 0.

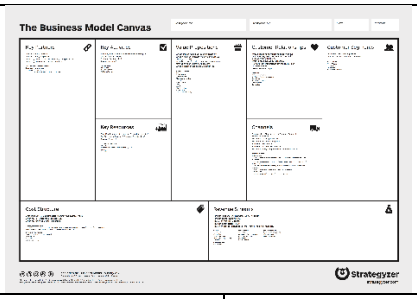
11.3 Judging Criteria – Tertiary

Category	Criteria	Points
1. Project (Total Points: 50)	**1. Creativity** - The project is original, worthwhile and shows creative thinking / innovative and imaginative design / interesting and divergent interpretation and implementation.	**10**
	2. Quality of Solution - The project is well-thought out and is a good solution to the problem. The solution supports the theme of the WRO® season. Prototype development and next step of the project is elaborated clearly.	**15**
	3. Research & Report - The report is a good summary of the project: the problems - solutions - process - findings - team - task. Research shows extra elements of entrepreneurship such as, cost structure, revenue stream, key resources, and partners.	**15**
	4. Entertainment Value - The project has a certain "WOW" factor - looks fun, captures the attention of passer by - makes you want to see it again or learn more about it.	**10**
2.Programming (Total Points: 45)	**1. Automation** - The project uses appropriate inputs from sensors to run specific routines and clearly demonstrates automation in the completing of the tasks.	**15**
	2. Good Logic - The programming options used make sense, work reliably, are relevant in terms of their use, complexity and design.	**15**
	3. Complexity - The project uses multiple languages, sensors or controllers and incorporates more advanced / complex algorithms, structure and design.	**15**
3. Engineering Design (Total Points: 45)	**1. Technical Understanding** - Team members are able to produce clear, precise, and convincing explanations about each step of the mechanical and programming process.	**15**
	2. 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.	**10**
	3. Mechanical Efficiency - Parts and energy have been used efficiently - evidence of proper use of mechanical concepts / principles (gears/pulleys/levers/wheels & axles)	**10**
	4. Structural Stability - The project (robots and structures) are strong, sturdy and the demonstration can be run repeatedly - parts don't detach - little need for repairs.	**5**
	5. Aesthetics - The mechanical elements have aesthetic appeal, there is evidence that the team went out of their way to make the project look as professional as possible.	**5**
4. Presentation (Total Points 40)	**1. Successful Demonstration** - A demo of the capabilities was completed, there is a sense that it could reliably be repeated, and that preparation and practice have taken place.	**15**
	2. Communication & Reasoning Skills - The team were able to present their project idea in an interesting way - how it works - why they chose it - why it has relevance.	**10**
	3. Quick Thinking - The team are able to easily answer questions about their project. They were also able to deal with any problems that arose during the presentation.	**10**
	4. Project Video - Only marks for videos provided on time. The video is a good pitch for the project - presenting the problem, the solution and the team.	**5**
5. Teamwork (Total Points: 20)	**1. Unified Learning Outcome** - There is evidence that team members have internalized knowledge and understanding of the subject matter pertaining to their project.	**10**
	2. Inclusiveness - The team are able to demonstrate that all members played an important role in the development, construction and presentation of their project.	**5**
	3. Team Spirit - The team display positive energy, good cohesiveness, value one another and are enthusiastic and excited about sharing their project with others.	**5**
	Maximum Points	200

*Projects that are clearly not within the theme will receive a score of 0.

12. Project Report Template

- PDF, max 15 MB
- Max. 20 pages single sided (10 pages double sided), including attachments, not including front-page, table of contents and list of sources.
- *Please note: longer reports cannot be taken into consideration for the judges scoring!*

	Primary	Secondary/Tertiary
Front Page		
Table of Contents		
Team Presentation	Max. 1 page	Max. 1 page
Let us know a bit more about your team. Who are in the team? Where are you from? How have you divided the tasks in the team? Add a picture of your team.		
Summary Project idea	Max. 1 page	Max. 1 page
Describe your project and solution in an "executive summary". If someone would only Share all the information your readers and important stakeholders need to know. What is the problem your project is solving and why did you choose this problem? How is the robotic solution going to solve the problem you established? What is the value of your robotic solution? What would happen if it would be used in real life? Why is your project important?		
Presenting robotic solution	Max. 15 pages	Max. 12 pages
Describe your robotic solution and how you have developed it. General aspects: How did you come up with this idea? What other ideas did you investigate? Did you find similar ideas being available? What is different about your solution? Technical aspects: Describe the mechanical construction of the solution Describe the coding of the solution Did you face any challenges during the development process?		
Social impact & Innovation	Max 3. pages	Max 6. pages
Describe the impact of your solution for society. Who will it help? How important is it? Give a concrete example of how/where your idea could be used. (Think about who would use and how many people would benefit from it.)		
Secondary & Tertiary age group only: Describe more about the innovation and entrepreneurship aspects of your project (see scoring criteria). You could use the concept of a business model canvas to explain aspects of your project as a start-up idea. It is not important that you fill all parts of this canvas, you could only fill the parts where you feel they are most relevant for your project. https://en.wikipedia.org/wiki/Business_Model_Canvas		
List of sources		
Make a list of the documents and – reliable - websites you have used for your research and the people you have spoken with.		