



# Junior Robotics Competition 2018 RoboJunior Search & Rescue-Primary Level Rules



## **Preface:**

The field for the Search & Rescue-Primary Level event will consist of two level platforms connected with a ramp as described in section 1 below. The team must build and programme their robot to carry out the rescue mission autonomously and without any human assistance. Just the right size of robot and the best programming will allow the team to reach and rescue the victim in the shortest possible time.

## **Rules and Regulations:**

**The Robots are required to have full autonomy. The students competing in the event must do the construction and programming of their robots without any help or interference from their teachers or mentors.**

The Judge will apply all the rules fairly and without prejudice. All decisions made by the Judge during the games are final. Any argument by a team member with the judges will result in a warning. Continued or repeated arguments will result in immediate disqualification of the team. At the conclusion of each game, the Judge will ask the captains to sign the score sheet. By signing the score sheet the captains accept the final score on behalf of the entire team.

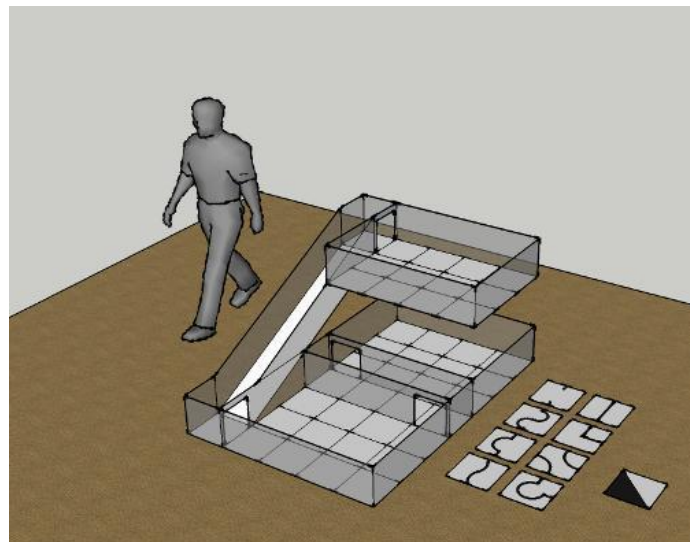
## **1. THE ARENA**

### **1.1 Description**

**1.1.1** The arena is modular. Each module can be considered to be a room in a building. Rooms may be placed adjacent to each other (on the same level horizontally) or may be stacked vertically.

**1.1.2** Rooms on the same level may be connected by hallways. Rooms on different levels are connected with a ramp. A ramp does not exceed an incline of 25 degrees from the horizontal surface, and must have walls at least 10 cm high.

**1.1.3** The Ramp area (hereafter known as the Ramp) consists of the ramp itself and the top and bottom platforms that connect it to other rooms. The shape of the arena is similar to the drawing shown here on the right.



### **1.2 Dimensions**

**1.2.1** Each room is approximately 120 cm by 90 cm, with walls that are at least 10 cm high. The first room in the arena may or may not have an entrance doorway. The evacuation zone does not have an exit door.

**1.2.2** Hallways and the Ramp also have walls at least 10 cm high, and 30 cm wide, ( $\pm 2$  cm).

**1.2.3** Each room has one or two doorways. Robots may enter and exit through the same doorway if intersections are used. Doorways are 25 cm x 25 cm in size ( $\pm 2$  cm).

### **1.3 Floor**

**1.3.1** The floor of each room has a white or close to white tone. The floor is not made up of tiles (as shown above).

**1.3.2** The floor may be either smooth or textured (like linoleum or carpet), and may have steps of up to 3 mm height at joins between rooms. The floors are levelled.

### **1.4 Line**

**1.4.1** The floor of each room is marked with a black line for a robot to follow. The black line is 1 to 2 cm wide and may be made with standard electrical (insulating) tape or printed onto paper or other materials. The black line forms a path on the floor. There are no grid lines as indicated in the above drawings.



**1.4.2** The line is always at least 10 cm from the nearest wall. A robot is allowed to follow the wall if the line is straight along the wall.

**1.4.3** Where the black line is used, it will enter and exit each room through the standard doorways. Straight sections of the black line may have gaps with at least 5 cm of straight line before each gap. The gap is 20 cm at most. If a gap is running along a wall, it is 30 cm at most. See sections 1.4.4 and 1.4.5 below.

**1.4.4** Note that **during the first day of the competition**, there are no gaps in the black line from start to the entrance of the "Evacuation Zone". The only exception will be a 2 cm silver band placed across the black line at the entrance to the "Evacuation Zone" room. The robot must continue on the black line past this break without stopping.

**1.4.5** Note that **during the second day of the competition**, the set up remains the same except one or two white gaps of no more than 30 cm long will be added along the black course line in the manner described in section 1.4.3 above as well as in the "Evacuation Room" in the manner described in section 1.7.1 below.

## 1.5 Debris and Speed Bumps

**1.5.1** Speed bumps are maximum height of 1cm. They are white and fixed on the floor. They may be angled.

**1.5.2** Debris has a maximum height of 3mm, and will not be fixed on the floor. They are small materials such as toothpicks or small wooden dowel, etc. Debris may be spread towards or adjacent to walls.

**1.5.3** Speed bumps and debris will be on the arena **only on the second day of the competition** and will not be on the ramp or in the "Evacuation Zone".

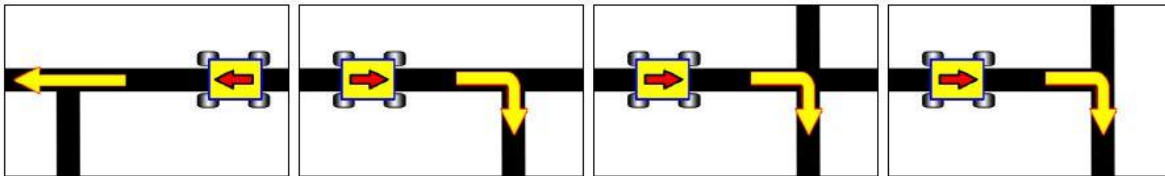
## 1.6 Intersections

**1.6.1** Intersections can be placed anywhere except in the evacuation room. For example, there may be intersections leading up to or down from the ramp.

**1.6.2** There will be a green dot placed at each intersection. **On the first day of the competition**, the robot should take the rightmost path when it reaches an intersection. **On the second day of the competition**, the robot should take the leftmost path when it reaches an intersection.

**1.6.3** The intersections are always perpendicular, but may have 3 or 4 branches.

\* **NOTE:** These diagrams below illustrate the case of taking the rightmost path. If a round is designated to be all left preference, it will take the opposite turns at the intersection.



## 1.7 Evacuation Zone

**1.7.1** The black line will continue beyond the entrance to the last room (Evacuation Room). On the second day of the competition, few straight line gaps along the line will be added in the Evacuation Room. Teams may use other search strategies to navigate this last room.

**1.7.2** At the entrance to the evacuation room, there is a 25 mm x 250 mm strip of reflective silver tape on the floor.

**1.7.3** The Evacuation Point tile is placed at one corner of the evacuation room. The Evacuation Point tile is a right angled triangle with sides of 30 cm x 30 cm, and it is painted in black.

## 1.8 Victims

**1.8.1** A Victim may be located anywhere on the floor of the evacuation room, but will be at least 10 cm from the nearest speed bump or debris.

**1.8.2** The victim takes the form of a regular soft drink can (355 ml), internally weighted to approximately 150 grams. Teams need to be prepared for minor variations.

**1.8.3** The victim will be electrically conductive. Its surface is silver and reflects light.

## 1.9 Environmental Conditions

**1.9.1** Teams must come prepared to adjust their robots to the lighting conditions at the venue.



**1.9.2** Lighting and magnetic conditions may vary along the course in the rescue arena. The arena may be affected by magnetic fields (e.g. generated by under floor wiring and metallic objects).

**1.9.3** Teams should prepare their robots to handle expected lightning interference. While the organizers and judges will try their best to minimize external lighting interference, it is not possible for them to foresee all unexpected ones such as camera flash from spectators.

## **2. THE ROBOT AND THE TEAM**

### **2.1 Control**

**2.1.1** Robots must be controlled autonomously. The use of lasers, a remote control or manual control, or passing information (by sensors, cables, other interference, etc.) to the robot is not allowed.

**2.1.2** Robots must be started manually by the team captain.

**2.1.3** Pre-mapped type of dead reckoning is prohibited. (Movements predefined based on known locations).

**2.1.4** Robots must not damage any part of the arena in any way.

### **2.2 Construction and Programming**

**2.2.1** Any robot kit or building blocks, either available on the market or built from raw hardware, may be used, as long as the design and construction of the robot are primarily and substantially the original work of the students.

**2.2.2** Any commercially produced robot kits or sensor components that are specifically marketed to complete any single major task of the event will be disqualified. For example, pre-programmed sensors with special features for line-following or obstacle tracing are not allowed. If there is any doubt, the teacher-in-charge should verify with the Competition Coordinator and the Chief Judge at least a week before the start of the competition. Any team found to be in violation of this rule during the competition will be immediately disqualified.

**2.2.3** Bluetooth Class 2, 3 and ZigBee communications are the only wireless communication types allowed in this competition. Robots that have other types of wireless communications on board will need to be either removed or disabled for possible interference with other robots. A team that does not comply will be immediately disqualified.

### **2.3 Team**

**2.3.1** A team is composed of 2 to 4 members. A team can compete with one qualified robots. The substitution of robots during the competition within the team or with other teams is forbidden.

**2.3.2** The team members will designate a Team Captain who manually starts the robot. The Team Captain is the only member allowed to handle the robot when instructed by the Judge. No member is allowed to step or lean on any part of the arena. Only team members participating in the round are allowed to be near the arena.

**2.3.3** The team members should remind their teacher-in-charge and their mentors, chaperons, or visitors not to be present around the arena during the games.

### **2.4 Inspection**

**2.4.1** The robots will be examined by the Judge before the start of the round and at any time during the competition, when deemed necessary by the Judge, so as to ensure that the robots meet the constraints described above.

**2.4.2** It is the responsibility of teams to have their robots re-inspected, if their robots are modified at any time during the competition.

**2.4.3** Students will be asked to explain the operation of their robot, in order to verify that the construction and programming of the robot is their own work. Students will be asked about their preparation efforts.

### **2.5 Violations**

**2.5.1** Any violations of the inspection rules will prevent that robot from competing until modifications are applied. However, modifications must be made within the time schedule of the round and teams must not cause delays in the overall schedule of the Search & Rescue event.

**2.5.2** If a robot fails to meet all specifications (even with modification), it will be disqualified from that round (but not from the competition).

**2.5.3** Absolutely no outside assistance (from a teacher, mentor, parent or visitor), no matter how small or seemingly insignificant, is allowed to be given to any member of a competing team. This violation will cause a team to lose points or risk disqualification.



## **3. THE PLAY**

### **3.1 Pre-round Practice**

Where possible, competitors will have access to practice arenas for calibration, testing and tuning throughout the competition. Whenever there are dedicated arenas for competition and practice, it is at the organizers' discretion if testing is allowed on the competition arena.

### **3.2 Team readiness:**

All team members should be ready with their qualified robot to compete per the schedule posted at the start of day one of the competition. The schedule may be modified by the Judge if necessary. The teams should be present and ready to compete for the two days of the competition.

### **3.3 Start of Play**

**3.3.1** A run begins at the scheduled starting time whether or not the team is present/ready. Start times will be posted prominently around the venue.

**3.3.2** Once the run has begun, the robot playing is not permitted to leave the competition area for any reason.

**3.3.3** A team will be given a maximum time to both calibrate their robot and complete the course. The time for each run will be determined by the Judge on the day of the competition, based on the number of teams participating and the time constraint of the overall competition schedule. The Judge will advise all the teams of this maximum time.

**3.3.4** Calibration is defined as taking sensor readings and modifying the robot's programming to accommodate such sensor readings. Any and all pre-mapping activities will result in immediate disqualification of the robot for the round.

**3.3.5** Teams may calibrate their robot in as many locations as desired on the arena, but the clock will continue to count down. Robots are not permitted to move under power while calibrating.

**3.3.6** Once a team is ready to perform a scoring run, they must notify the Judge. To begin a scoring run, the robot is placed on the starting tile in the first room as indicated by the referee. Once a scoring run has begun, no more calibration is permitted.

### **3.4 Game Play**

**3.4.1** Modifying the robot during a run is prohibited; which includes remounting parts that have fallen off.

**3.4.2** All parts that the robot may lose intentionally or unintentionally should be left in the arena until the run is over. Neither the team nor a judge is allowed to remove parts from the arena during a run.

**3.4.3** Teams are not allowed to give their robot any advance information about the field. A robot is supposed to recognize the field by itself.

### **3.5 Scoring**

**3.5.1** A robot is awarded points for successfully negotiating rooms, hallways, ramps and each hazard (gaps in the line, speed bumps, intersections and obstacles).

**3.5.2** Successfully negotiating is defined as entering through one doorway, completely following the line, negotiating all line gaps, intersections, speed bumps, obstacles, and exiting through a doorway without human interaction.

**3.5.3** Failed attempts at negotiating elements of the arena are defined as "Lack of Progress" (see section 3.6).

**3.5.4** Points available for successfully negotiating rooms:

1st Attempt = 60 points, 2nd Attempt = 40 points, 3rd Attempt= 20 points

**3.5.5** Points available for successfully negotiating hallways and ramps:

1st Attempt= 30 points, 2nd Attempt = 20 points, 3rd Attempt = 10 points

**3.5.6** If intersections are used, the path may go to the opposite direction through a room/hallway/ramp (going back to the path that a robot already took). The points will be awarded as if it was a new room/hallway/ramp.

**3.5.7** There are no points available for negotiating rooms/hallways/ramps beyond the third attempt in each.

**3.5.8** Points available for successfully negotiating each gap in the black line: 10 points per gap.

**3.5.9** Points available for successfully avoiding each obstacle blocking the black line: 10 points per obstacle.



**3.5.10** A robot is considered to have successfully negotiated an obstacle when it moved through the tile where an obstacle was placed.

**3.5.11** Points available for successfully completing a tile that has speed bumps: 5 points per speed bump tile.

**3.5.12** Points available for successfully completing a tile that has an intersection: 10 points per direction through intersection tile.

**3.5.13** Each gap, obstacle, speed bump and intersection tile can only be scored once per direction through the room, not each attempt through the room.

**3.5.14** Reaching a victim: a robot is awarded 20 pts for a successful reach. "Successful reach" means that the robot has touched the victim with any part of the robot.

**3.5.15** Successful rescue of a victim: Robots are also awarded points for successfully rescuing victims. A successful victim rescue occurs when the victim is moved to the evacuation point (it needs to be completely inside of the evacuation point), in its original upright orientation, and no part of the robot is in contact with the victim.

The team captains may declare either a "Lack of Progress" or "End of Round" when a failed attempt at a victim rescue occurs (see 3.6).

Points available for a successful rescue: 1st Attempt = 60 points, 2nd Attempt = 40 points, 3rd Attempt = 20 points

\*No points scored for rescue attempts beyond the third attempt.

**3.5.16** Additional Points for lifting the victim with no part of the victim touching the floor = 20 points

**3.5.17** Ties in scoring will be resolved on the basis of the time taken by each robot (or team of robots) to complete the course (this includes calibration time).

### **3.6 Lack of progress:**

**3.6.1** A robot must follow the black line where it is present. Failure to follow the line is considered a Lack of Progress.

**3.6.2** A Lack of Progress occurs if the robot is stuck in the same place or loses the black line without regaining it by the next tile in the sequence (see figures below).

**3.6.3** A Lack of Progress occurs if the robot does not follow the correct path after an intersection tile.

**3.6.4** The team captain can also call for a Lack of Progress at any time (s)he wants (for example if the robot is in danger).

**3.6.5** If a Lack of Progress happens in the first room, a robot will be placed on the starting tile. For other rooms, the robot will be placed on the last tile of the former room and re-enter the room/hallway/ramp once again. Only the team captain is allowed to restart the robot without changing programs and/or modifying the robot.

**3.6.6** A team is not allowed to restart a robot in other room/hallway/ramp than the one where a Lack of Progress occurred. However a team is allowed to restart a robot in a room/hallway/ramp where the Lack of Progress occurred as many times as they want.

**3.6.7** A robot is allowed to proceed to the next module ONLY after completing the current module without a Lack of Progress. Module includes room, hallway, and ramp. If the robot fails to negotiate the current module after the third failed attempt, the team captain may choose to move the robot to the end of the current module to continue on.

**3.6.8** The team captain may also choose to make further attempts at the failed room to earn the additional points available for overcoming obstacles, gaps in the line, and speed bump points that have not already been earned in the previous attempts at the room.

### **3.7 Victim Placement**

**3.7.1** Six different victim Placement Areas are in the evacuation room, each one approximately 30 cm x 30 cm in size, will be designated on the day of the competition.

**3.7.2** The location of each area will be made known on the day of the competition but will not be marked on the field. No Placement Area will come within 10 cm of a wall or the evacuation point.

**3.7.3** Only 1 victim will be used in a round.

**3.7.4** Once a robot begins its scoring round and has entered the Arena, the referee will roll a standard 6 sided dice to determine which Placement Area the victim will be located. The referee will place the victim randomly within the chosen 30 cm x 30 cm Placement Area.



**3.7.5** If the victim is moved from its spot by a robot attempting a rescue, and the robot subsequently requires a restart, the victim will remain where it moved to. If it has been knocked over, it will remain knocked over.

**3.7.6** If the robot is in contact with the victim and the team captain calls for a Lack of Progress, the referee may roll the dice once more and place the victim at a new location.

### **3.8 Evacuation Point Placement**

**3.8.1** The Evacuation Point is placed in any of the non-entry corners in the evacuation room.

**3.8.2** Once a robot begins its scoring round and has entered the Arena, the referee will roll a standard 6 sided dice to determine in which corner the Evacuation Point will be located.

**3.8.3** After a Lack of Progress happened in any room, the referee may roll the dice once more and place the Evacuation Point at a new corner.

**3.8.4** The Judge will try to secure the Evacuation Point down, but you should expect slight shift at times.

### **3.9 End of Play**

**3.9.1** A team may elect to stop the round early at any time. In this case, the team captain must indicate to the referee the team's desire to terminate. The team will be awarded all points achieved up to the call for end of round.

**3.9.2** The round ends when the time expires, when the team captain calls the end of the round or when the victim is successfully rescued.

## **4. Team Members Interview**

**4.1** The S&R-Primary Level Judges may arrange for a technical interview for all team members during the event. The judges will go around interacting with the students. The interview will be set up as a casual conversation in a "questions and answers" atmosphere. The main objective of the interview is to discuss the technical challenges which the students faced during the construction and programming of the robots. The judges will be looking for innovative solutions to the different challenges.

**4.2** A team will not fail an interview except if the judges determine that the students did not construct and / or programme their robot themselves. Failing the interview may disqualify the team from maintaining (if applicable) their first, second or third place.

**4.3** It is acceptable that different team members have varied skills in programming and/or construction. But all members must have adequate construction and programming knowledge.

## **5. Clarification of Rules.**

If any rule clarification is needed, please contact the Search and Rescue Chief Judge Mr. Fernand Deschamps at [fernandeschamps@gmail.com](mailto:fernandeschamps@gmail.com) or the Competition Coordinator at [nijad@sciencetech.ca](mailto:nijad@sciencetech.ca)

## **6. CODE OF CONDUCT**

### **6.1 Fair Play and Behaviour**

**6.1.1** All team members are expected to play a fair and clean game. It is important that the participants learn from each other as well as enjoy the competition. Team members and robots are not allowed to cause damage to any part of the arena.

**6.1.2** All participants (team members, teachers-in-charge and chaperons) are expected to treat each other with respect and to adhere to the rules and regulations of the competition. Participants must follow the directions of the Search & Rescue-Line Judges and of the RoboJunior Officials.

**6.1.3** Teams will be responsible for checking update information (schedules, meetings, announcements, etc.) during the event. Update information will be provided by the Judges. All teams are required to compete in the two days of the competition.

### **6.2 Teacher-In-Charge and Mentors**

**6.2.1** The teacher-in-charge and mentors (chaperons, parents, or visitors) are not allowed to assist in the construction or programming of the robots. For safety reasons, only teacher-in-charge and the officially registered chaperon(s) are allowed to stay at the team's work areas, but not around the arena. These teachers and chaperons must refrain from touching the robots or giving any verbal directions to repair or re-program any robot. Violators may risk the disqualification of their team.



### **6.3 Decisions of the Judges.**

**6.3.1** All decisions during the game are made by the Judge who is in charge of the arena and of the participants around it. All the decisions made by the Judge are final.

**6.3.2** A team captain (or any team member through their team captain) has the right to voice a concern to the Judge. The communication should be conducted calmly and with respect. No rude arguments with the Judges by the team members, teachers or chaperons are allowed. Such rude arguments will result in a warning. If the argument continues or another rude argument occurs, this may result in immediate disqualification of the team from the competition..

**6.3.3** At the conclusion of the scoring round, the team captains must review and sign the score sheet. By signing the score sheet the captains accept the final score on behalf of the entire team.

## **7. ADDITIONAL REQUIREMENTS**

### **7.1 Robot Construction:**

**7.1.1** Robots must be constructed exclusively by the student members of a team. Mentors, teachers, parents or companies may not be involved in the design, construction, and assembly of robots.

**7.1.2** For the construction of a robot, any robot kit or building block may be used as long as the design and construction are primarily and substantially the original work of a team. This means that commercial kits may be used but must be substantially modified by the team. It is not allowed to mainly follow a construction manual, or to just change unimportant parts.

**7.1.3** Indications for violations are the use of commercial kits that can basically only be assembled in one way, or that robots from different teams, build from the same commercial kit, all basically function or look similar.

Robots must be constructed in a way that they can be started by the captain without the help of another person.

### **7.2 Robot Programming:**

**7.2.1** Robots must be programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the programming and debugging of robots.

**7.2.2** For the programming of the robots, any programming language, interface or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or presets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified.

### **7.3 Robot Inspection:**

Team members should make sure that the Judge inspects and certifies their robot during the practice period and before any scoring run. The Judge may request other inspections if necessary. The inspections may include verification of the robot's construction and/or programming.

