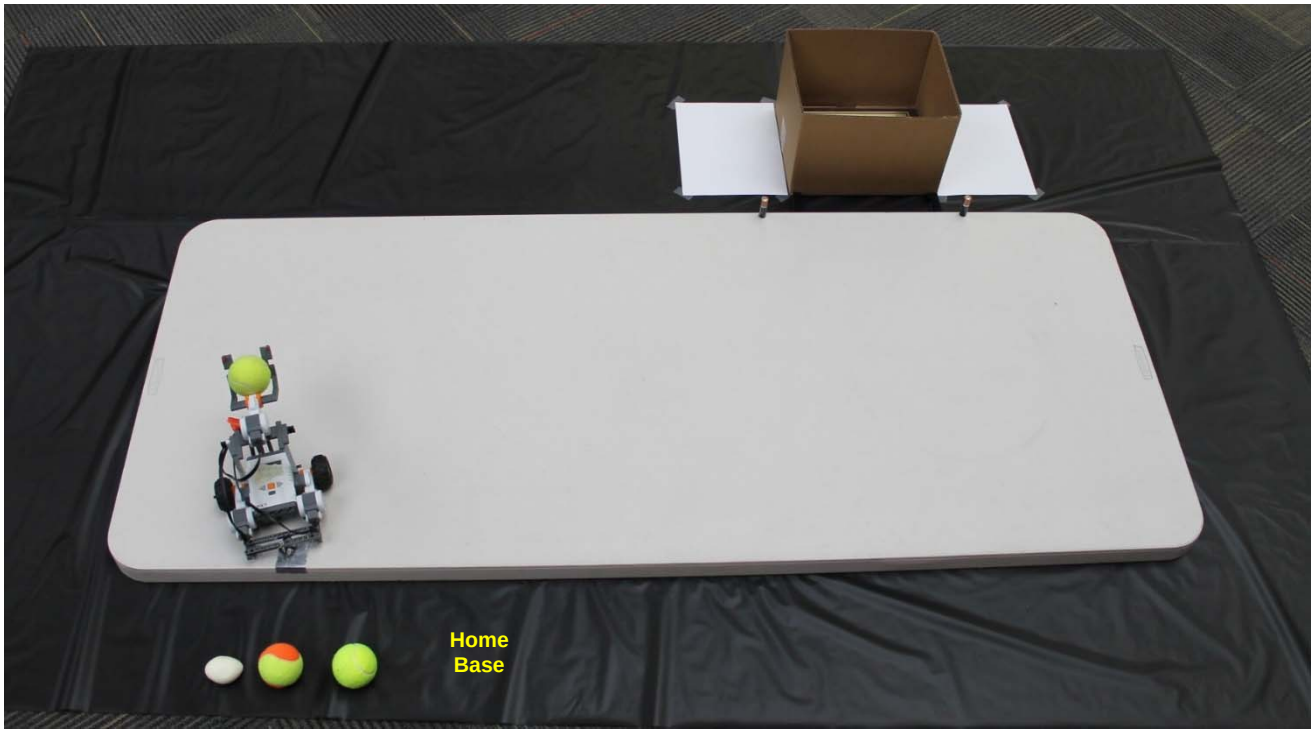
Avoid Meltdown - Robofest® 2014 Game

V1.1 1-10-14 (Official Version)



[Figure 1] *AvoidMeltdown* playing field example (Jr. Division)

1. Mission Synopsis

A nuclear power plant is in trouble. An autonomous nuclear responder robot detected the problem and instantly delivers up to 3 water balls (tennis balls) and a special ball (hardboiled egg) into the plant (box) without human help in 2 minutes. The robot can carry only one ball at a time. Two concrete blocks (AA size batteries) near the plant need to be removed off the table. Also, the volume of the box (outer dimension) should be reported in cubic centimeters at the end of the Game.

For Jr. Division, the height and depth of the box will be given. The box is aligned in parallel with the table. For Sr. Division, only the depth of box will be given. The box is *not* aligned in parallel with the table.

Additional unknown tasks may be given for the World Championship, but not for qualifiers.

Learning Objectives of this challenge are motion, navigation, manipulation, object detection, localization, logic, ratio, proportion, math operations, measuring, and geometry.

2. How to Play and Score the Game

Each team is given 2 rounds, 2 minutes per round. For each Jr. & Sr. age division round, the playing field configuration including box size may be different for each round. Each team can have up to 7 team members.

Teams will be given 30 minutes after the unknown factors (see Tables 1 & 2) are unveiled. All teams must submit their robot with a visible team ID tag to the restricted impound area when the 30 minutes have expired. The ***expanded*** size of the robot will be checked when the robot is impounded (see later section for details). Manual configuration changes made to the robot during the round must meet the specific initial size requirement. No team is allowed to download new programs for the round after impounding.

After impounding the robots, the judges will re-setup the tables. Note that the rest of the playing field's information / dimension is completely unknown and will not be announced at all.

To start, a Judge (or Emcee) will specify which way (starting orientation) the robot will face, within the range of 10 to 2 o'clock direction from the perspective of the player. The robot must be placed in the Home Base area as long as part of it is on *or* over the foil tape base and meets the initial size requirements; it may hang over the edges of the table. Players may pick up and modify (add and/or remove parts) their robot without penalty only when any part of the robot is on *or* over the Home Base (foil tape). Human players are to put the balls and egg into/onto their robots.

If any part of the robot is touched outside of Home Base by a player after the game has started, it must be restarted from Home Base in starting orientation and a penalty will be given. When a penalty occurs, the Judge will show a Red Card. No more than two penalties in total may be assigned per round. When restarting by human players, the orientation of the robot must be the same direction as when the game started (starting orientation), and the team may (1) start without reset *OR* (2) request reset of the box. Whenever the box is reset, a penalty is given. If a human player touches or moves the ball or egg when not at Home Base, it is also regarded as a violation.

See the scoring sheet at the end of this document for detailed point and penalty values. Each team must return the robot to the impound area at the end of the round and it must remain there until the next unveiling and prep time. During this time, teams are encouraged to talk with other teams to see what they have learned and accomplished.

3. How to set up playing fields

The playing field is a 30" x 72" (actual width is 75.5cm) plastic folding table that can be purchased at discount stores like Lowes, Kmart, or Sam's Club. The surface is light in color such as almond; however, the exact color and brightness is unknown until the competition day. The four corners of the table are rounded. The thickness of the table is about 4.5 cm.

Figure 1 shows a possible playing field configuration for Jr. Division. The table should be placed on a dark colored floor with the legs folded under. For each competition site, all the tables including practice tables should be identical. Especially the thickness of the tables should be the same.

The box is located opposite side of the Home Base. Any box can be used and the color of the box is unknown. The thickness of the box material is unknown. Inside the box, a hard material like a plaque will be placed as shown in Figure 1 so that the egg can be broken if dropped without care. Box size requirements are specified in section 3.1.

One 4.8cm x 4.8cm aluminum foil tape square will be placed at an unknown location along the *longer* edge of the table as the Home Base (Home). The location of Home is not too close to the corner of the table.

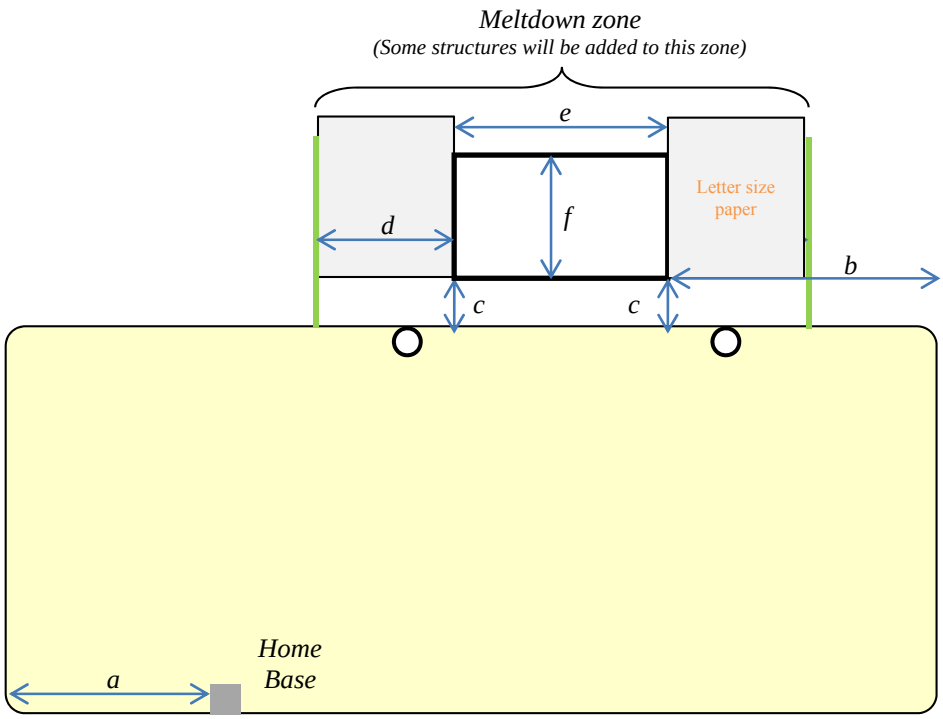
Two concrete blocks (AA size batteries) will always be located within the meltdown zone. Unlike previous Robofest Games, tennis balls are not wrapped with foil tape.

3.1 Jr. Division Playing Field

Table 1 lists parameters for the Jr. playing field shown in Figure 2. Table thickness is not critical for Jr. Game.

	min	**max**	**Unveiled?**
a	25cm	40cm	No
b	30cm	50cm	No
c (fixed)	8cm (10 Lego size)	8cm	Already known
d (fixed)	21.6cm (shorter side of letter size paper)	21.6cm	Already known
e	20cm	50cm	No
f	20cm	50cm	Yes
Height of the box	15cm	50cm	Yes

[Table 1] Jr. playing field parameters



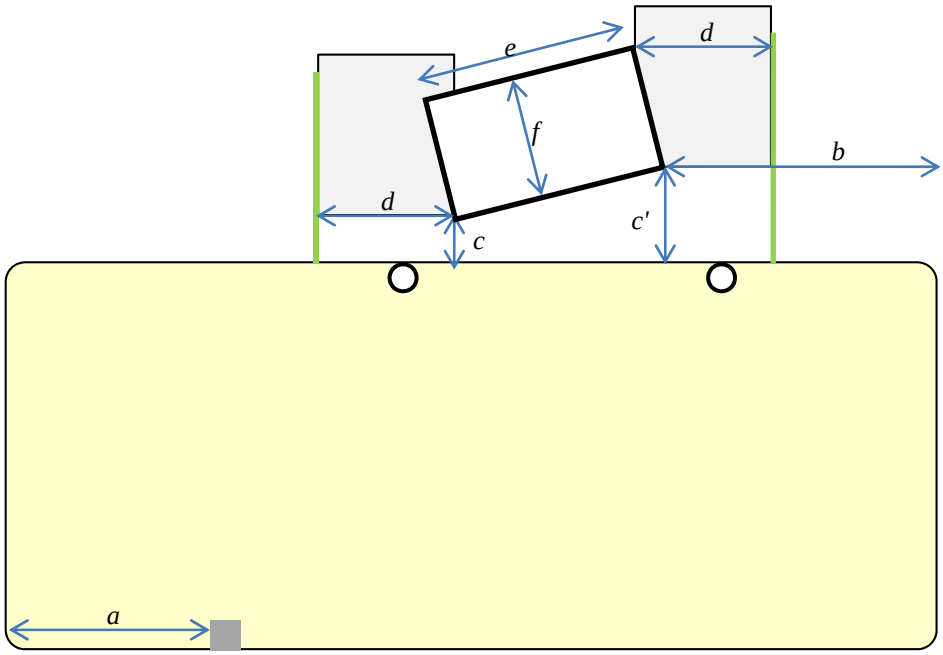
[Figure 2] Jr. playing field diagram

3.2 Sr. Division Playing Field

Table 2 lists parameters for the Sr. playing field shown in Figure 3.

	min	**max**	**Unveiled?**
a	25cm	40cm	No
b	30cm	50cm	No
c (fixed)	8cm (10 Lego size)	8cm	Already known
d (fixed)	21.6cm (shorter side of letter size paper)	21.6cm	Already known
e	20cm	50cm	No
f	20cm	50cm	Yes
Height of the box	15cm	50cm	**No**
c'	(c+3) cm	(c+10) cm	No
Table thickness	4cm	5cm	Yes

[Table 2] Sr. playing field parameters



[Figure 3] Sr. playing field diagram

3.3 How to set-up the box

Between the table and the box, two simple Lego structures will be placed as shown in Figure 4. The structure is a part of the playing field. Note the height of the structure is about 2cm. Color is unknown.

[**Figure 4**] Lego structures (Jr & Sr) between the box and the table.
Right most picture shows pieces for sample Jr. structures. Actual structure might be different.

4. Robot Specifications (For both Jr. and Sr. Division)

- Initial maximum width and length is 35cm x 35cm (the robot may expand automatically after starting. The size is always checked when starting at the Home Base)
- Expansion is allowed. But the max size cannot be bigger than 70 cm. Note that 75.5 cm is the width of the table.
- Height and weight limitation: none
- Any number of sensors/sensor types (unless it is harmful to humans)
- Any number/type of motors/servo motors (multiplexor is OK to use)
- Any material/robot kit may be used to construct your robot including tape, glue, bolts and nuts, rubber bands, etc.
- Team ID tag on top of the robot is required.
- Number of controllers (brains): see Table 3 below.

5. Sr. Division Details

The difference between Jr. and Sr. Division challenges are summarized in Table 3.

	Jr. Division	Sr. Division
Grades	5~8th	9~12th
Box orientation	Parallel to the table	Not parallel to the table
Math skills	trigonometry not required	trigonometry may be required
Number of controllers (programmable main brain)	One	No limit
Recommended Programming Language	GUI based (Visual programming) language	C or Java

[Table 3] Jr. and Sr. Division differences

6. Rules to Play Rounds and Determine Winners

The Emcee shall announce the following before each round: *No adult is allowed in the pit area from now through the end of the round.* ***None can come in and out during the 30 min.*** *The use of any communications devices to remotely control robots or communicate with players is prohibited in this competition arena. If anyone sees any suspicious activities, please notify the nearest volunteer immediately. Only two team members can stay in the competition area.*

Teams will compete in a pre-determined order decided by the site host. The Emcee will briefly introduce teams to the audience.

Winners in each division will be decided by the **average** Final Score of the 2 rounds. Tie breakers will be: (1) best Final Score of two rounds, (2) rerun, if needed.

7. Special Notes

- *Though every effort is made to be consistent and precise, in all of the dimensions of the playing field and parts, Robofest assumes some error of up to plus / minus 0.2cm. Robofest encourages feedback loop control using landmarks, not dead reckoning. Final decisions are at the discretion of the Chief Game Judge.*
- If there are multiple playing fields at the competition sites, the Chief Game Judge will check consistency between the playing fields.
- When the robot is searching for the box using distance sensor(s), Judges should maintain at least 4 feet distance from the table.

8. FAQs (Please check for possible additional FAQs at www.robofest.net → 2013-2014 Programs → Game)

- *Can the egg be in a package and the package can be dropped into the box?* Yes. (Package design should be ready and easy to put on if required. Any package application is part of 2 minute time. Egg removal and checking time by Judges is not part of 2 minute time.)
- *Does the robot need to come back Home by itself at the end?* No.
- *Can teams adjust the height of the robot after the box information is unveiled?* Yes. Teams may need to bring additional parts.
- *Is there a required sequence of missions?* No.
- *Can we ask for a reset of the box when the robot is in action?* No, only when the robot is at the Home Base.
- *Can we ask for a box reset without penalty when the robot is over Home Base?* No. A Red Card is given, whenever the box is reset, if the maximum red cards have not already been given.
- *I grabbed my robot. Can I restart my robot without the box reset?* Yes.

- *Must the robot stop at Home Base?* No. But it is desirable to make it stop. A player may pick it up at the Home Base without penalty.
- *Do the Judges stop the clock to reset the box?* No.
- *Can a robot still display the volume after the 2 minute time runs out?* Yes, without any penalties.
- *Can a player reset the box?* No. It must be done only by Judges. Remember: you will be asked to restart if you touch the box. A penalty will be assessed.
- *Robot came back Home on its own and the human player did not touch the robot when loading the ball and restarting. Must the robot use the same starting orientation?* No.
- *Are teams permitted to have multiple programs?* Yes.
- *Are the size and weight of the egg known?* No.
- *Can teams package the egg before the start of the game?* No. Only during the 2 minutes.
- *Can teams use a tool to precisely measure the starting angle?* No.

9. Bill of Materials (BOM) to Construct a Playing Field

	Est. Unit Cost	Quantity	Cost
30" x 72" Folding Table; Suggested tables can be found at: www.buylifetime.com/Products/BLT/PID-22901.aspx; Almond color; Folding tables will be re-used in future Robofest games. Note that the thickness of the table is about 4.5cm.	$50 (at Lowe's)	1	$50
Tennis ball	$1	3	$3
Hardboiled egg	$.5	1	$.5
White letter-size paper for the effective zone (Reuse scratch paper)			N/A
Aluminum foil tape at Home Depot or Lowes	$7	1	$7
LEGO Blocks			
(Used) AA battery		2	N/A
Total			**$60.50**

10. Change logs

(From v0.42 10-23-13 to this version)

- Section 1, cubic millimeters at the Hone Base -> cubic centimeters at the end of the Game (Score sheet also revised accordingly)
- Section 3.2, Table 2 updated
- Section 3.3, Figure 4. Lego structures shown are samples. Actual structure might be different
- Score sheet: final score calculation formula has changed

(From v1.0 12-3-13 to this official version)

- Figure 1, 2, 3, and 4 with letter size papers. Only white papers will be used.
- Figure 4, rightmost picture. The color of the outer block will be black

Robofest 2014 Game AMD Scoring Sheet *(v1.0)*

Division: Junior / Senior Team Name: _____

Team School / Organization Name: _____ Team Number: _____

Round: *First* *Second* Track No.: _____

Judging Items (*checked at the **end** of a game round*)		**Count**	**Point Value (per count)**	**Score Earned / Lost**
Water Ball	Not in the box, but it was touching the meltdown zone when dropped	0 1 2 3	5	
	Inside the box	0 1 2 3	15	Max. 45
Egg	Inside the box (not broken)	0 (no) 1 (yes)	20	
	Inside the box (broken)	0 (no) 1 (yes)	10	
	Not in the box, but it was touching the meltdown zone when dropped (not broken)	0 (no) 1 (yes)	10	
	Not in the box, but it was touching the meltdown zone when dropped (broken)	0 (no) 1 (yes)	5	Max. 20
Blocks	Off the table	0 1 2	5	Max. 10
The robot measured the volume of the power plant, and reported the volume _____ (Measured Value) in cm^3 **at the end of the Game**.		0 (no) 1 (yes)	20	Max. 20
The robot remained intact throughout Game.		0 (no) 1 (yes)	5	Max. 5
Number of Red Cards that were given when a human player touched the robot, playing field, *or* the plant was reset		0 1 2	-2	Max. 0
** If Measured Value was "blank", Final Score is Total Score. If Measured Value is a number, calculate $e = \frac{\lvert CorrectValue - MeasuredValue \rvert}{CorrectValue}$ Final Score = $\begin{cases} Total\ Score - 17 & if\ e \geq 1.0 \\ Total\ Score - 15 * trunc(e,2) & otherwise \end{cases}$		**Total Score** Max. possible is 100		
		Final Score ** Calculated by Scorekeeper using Excel. Not to be rounded.		

*Truncation function **trunc(e,2)** means 2 decimal places will be left after truncation, i.e. errors under 1% will be ignored.*

Judge initials: _____ *Team player initials:* _____