

A dramatic photograph of two firefighters in silhouette, working against a massive, intense fire. The fire is bright yellow and orange, filling the background. The firefighters are positioned in the foreground, their forms dark against the bright light of the flames. One firefighter is on the left, and the other is on the right, both appearing to be focused on their task.

RARC Competition II Firefighting Simulation November 5, 2011

Rules and Procedures

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RARC II Competition Overview

- 3 Divisions
 - Club (Elementary), Middle, and High School
- Open Platform
 - NXT, Boe-Bot, or any other autonomous platform that meets size specifications. **Bots are not limited to a source or number of parts**
- Table Top, Room-to-Room Search
 - Standard 4'x8' competition tables with a white floor and black walls. (Page 26 lists sources for instructions on how to build competition tables)
 - Bots must locate “fires” and extinguish them

Elementary Division

- The goal of the challenge is to find as many fires (red balls) as possible and to extinguish them (knock them off the pedestals) in the shortest amount of time. Returning to the station (base) will give you extra points.
- Balls that are knocked down will remain on the table and will not be moved by the judge. Team members are not allowed to move or reset the balls.
- Unlike previous competitions, your robot IS NOT limited to a particular source (kit numbers) or number of parts that it may contain.
- Your robot's wheelbase must fit in the home base which is 12 inches wide and 8 inches in length. Sensors and attachments may go over this requirement within reason e.g., the light sensor is placed on the black line that is perpendicular to the base.
- Each round is a maximum of 3 minutes long. Your score is cumulative (both results are added together). Time will be the tie breaker if needed.
- If bot is touched, the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base. The -5 point penalty will apply each time that the robot is touched if you choose to restart from base.
- Team captains must carry the score sheet to the judge's table once the round is complete. Failure to do so will result in a score of ZERO for that round.

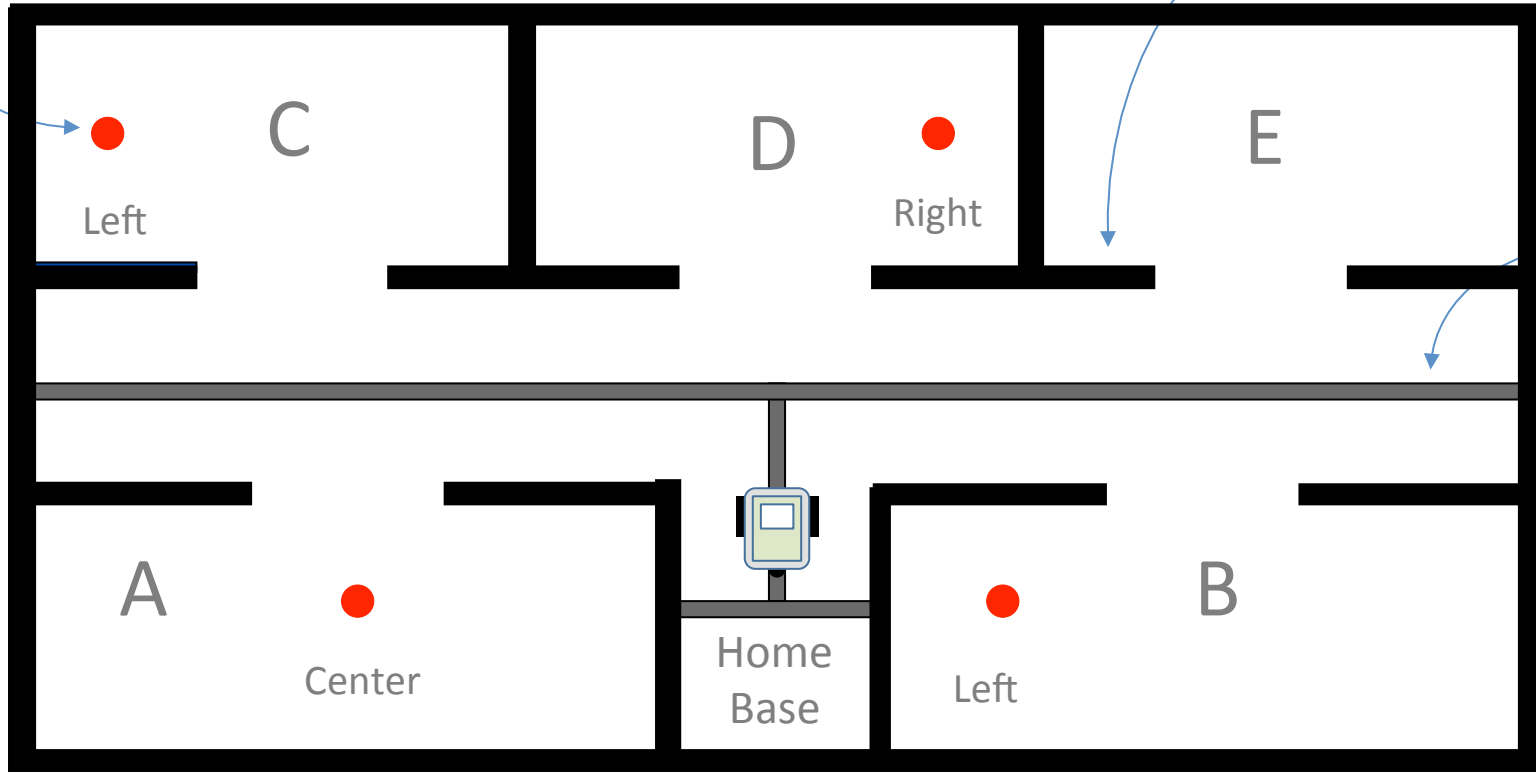
RARC Firefighting Simulation – Elementary Div.

2x4 Boards

NXT Balls on (PVC) Pedestals

4' x 8' Competition Table

Black Tape



- Location of balls is constant (Room E does not have a ball) (Actual location dimensions can be found on the table dimension page.)
- Bot must knock red LEGO balls from pedestals (pedestals may also fall without a penalty in the elementary division)
 - Each red ball (fire) has a 15 point value.
- Bot can return to Home Base for additional 10 points
- 2 rounds of 3 minute (max) timed runs
- Bots scored on cumulative points (time – tie breaker)

RARC Elementary Division Competition Rules

Robots

- Wheelbase must fit in Home Base (attachments or sensors may go over within reason)
- Must navigate autonomously through hallways and rooms
 - Cannot launch objects or reach into rooms from base or hallways.
- Cannot use remote controls
- Sensors
 - Use of light and ultrasonic sensors is strongly encouraged.

RARC II Elementary Division Rules

Conduct of Rounds

- Teams will go through 2 rounds of 3 minutes each.
- Location of balls is always known.
 - Location of the balls is always constant.
 - One ball per room, located in the left, right or center position.
 - A red ball will always be located in rooms A, B, C and D.
 - Room E will never have a ball
 - Goal is to locate and extinguish “fires” in the fastest time possible.
- Bot starts from home base (**all wheels must be behind the line**).
- Time starts when bot wheel crosses black line leaving base.
- **Once the balls get knocked down from the pedestals, the balls will remain in place on the table wherever they may fall. The team members or judges will not be allowed to remove or reset the balls until the round ends.**
- Time ends when any part of the robot enters base, team declares “stop time,” or at 3:00 minutes.

RARC II Elementary Competition Rules

Scoring

- Balls must be dislodged by the robot from pedestals for points.
- Balls will remain on the table after they are dislodged. **Balls may not be moved by team members until the round ends.**
- If bot is touched the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base.
- Return to Base points awarded only if bot autonomously returns to base (any part of the robot enters the base).
- **The team captain must carry the scoring sheet to the scoring table. (Failure to turn in a scoring sheet will result in a score of ZERO)**
- **Time will be the deciding factor in case of a tie**

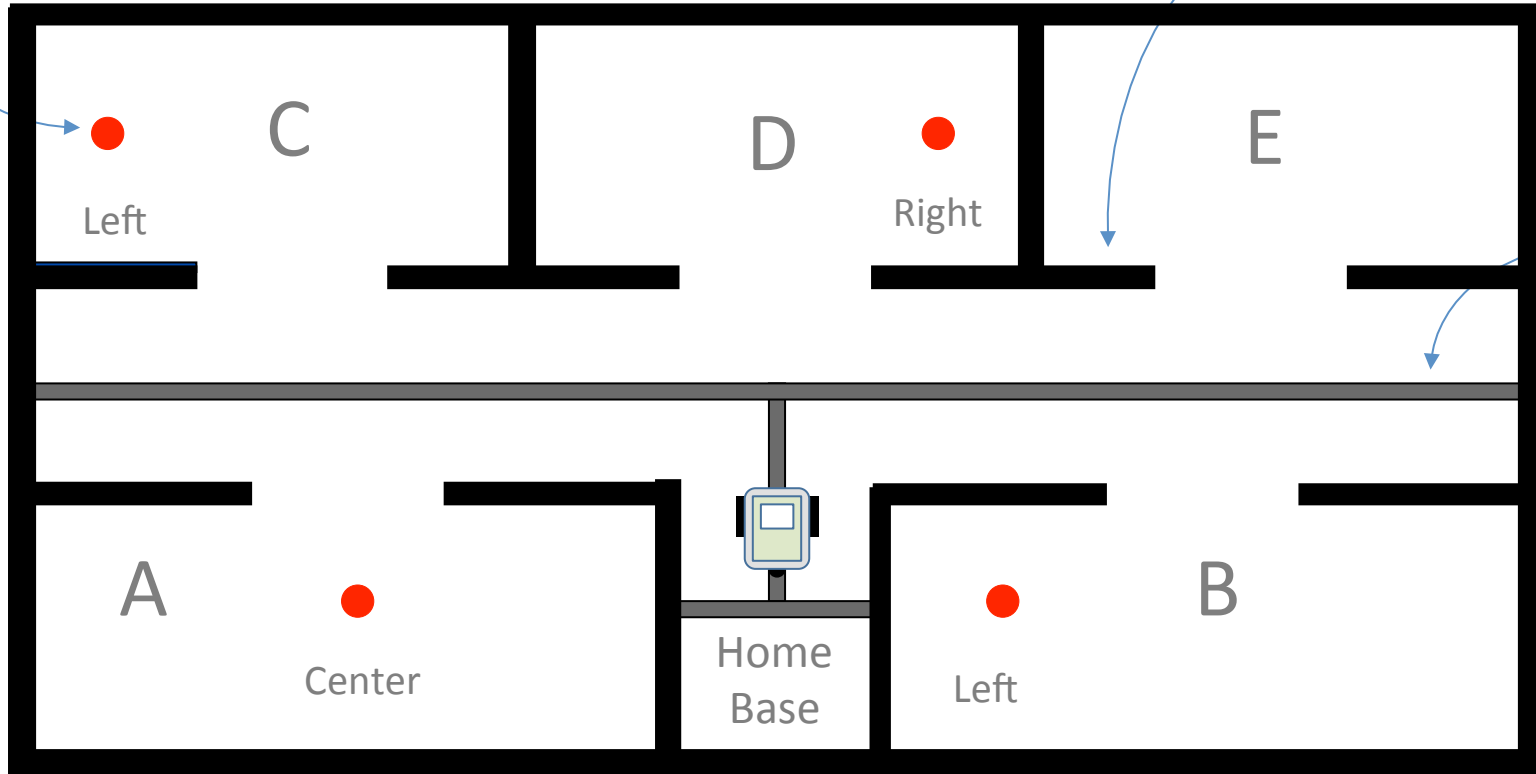
Action	Point Value
Red Ball - Dislodged	15
Return to Base	10
Bot Restart	-5

RARC Firefighting Simulation – Elementary Div.

2x4 Boards

NXT Balls on (PVC) Pedestals

4' x 8' Competition Table

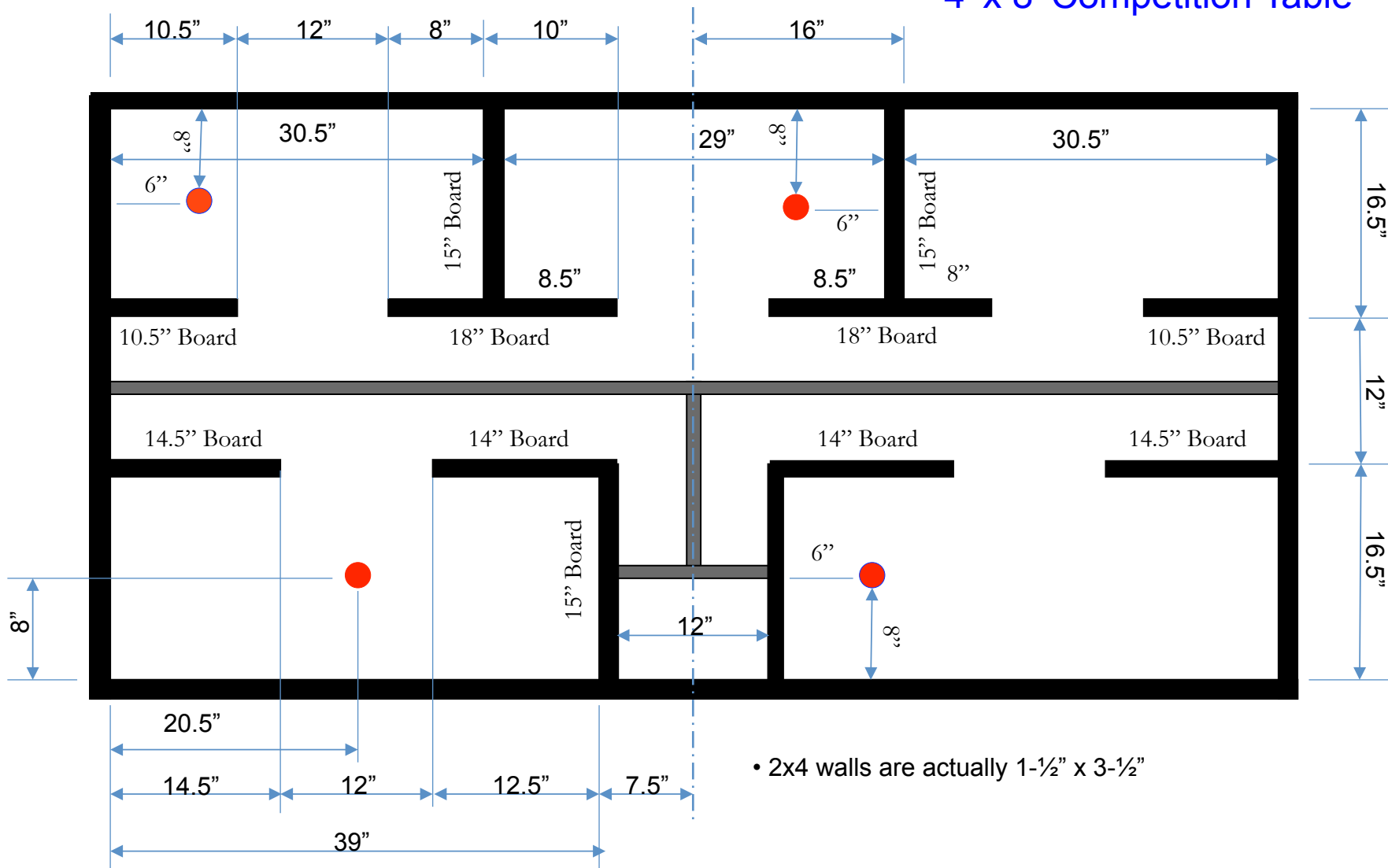


Black Tape

- Location of balls is constant (Room E does not have a ball)
- Bot must knock red LEGO balls from pedestals (pedestals may also fall without a penalty in the elementary division)
 - Each red ball (fire) has a 15 point value.
- Bot can return to Home Base for additional 10 points
- 2 rounds of 3 minute (max) timed runs
- Bots scored on cumulative points (**time – tie breaker**)

RARC Comp II Competition Table Dimensions – Elementary Division

4' x 8' Competition Table



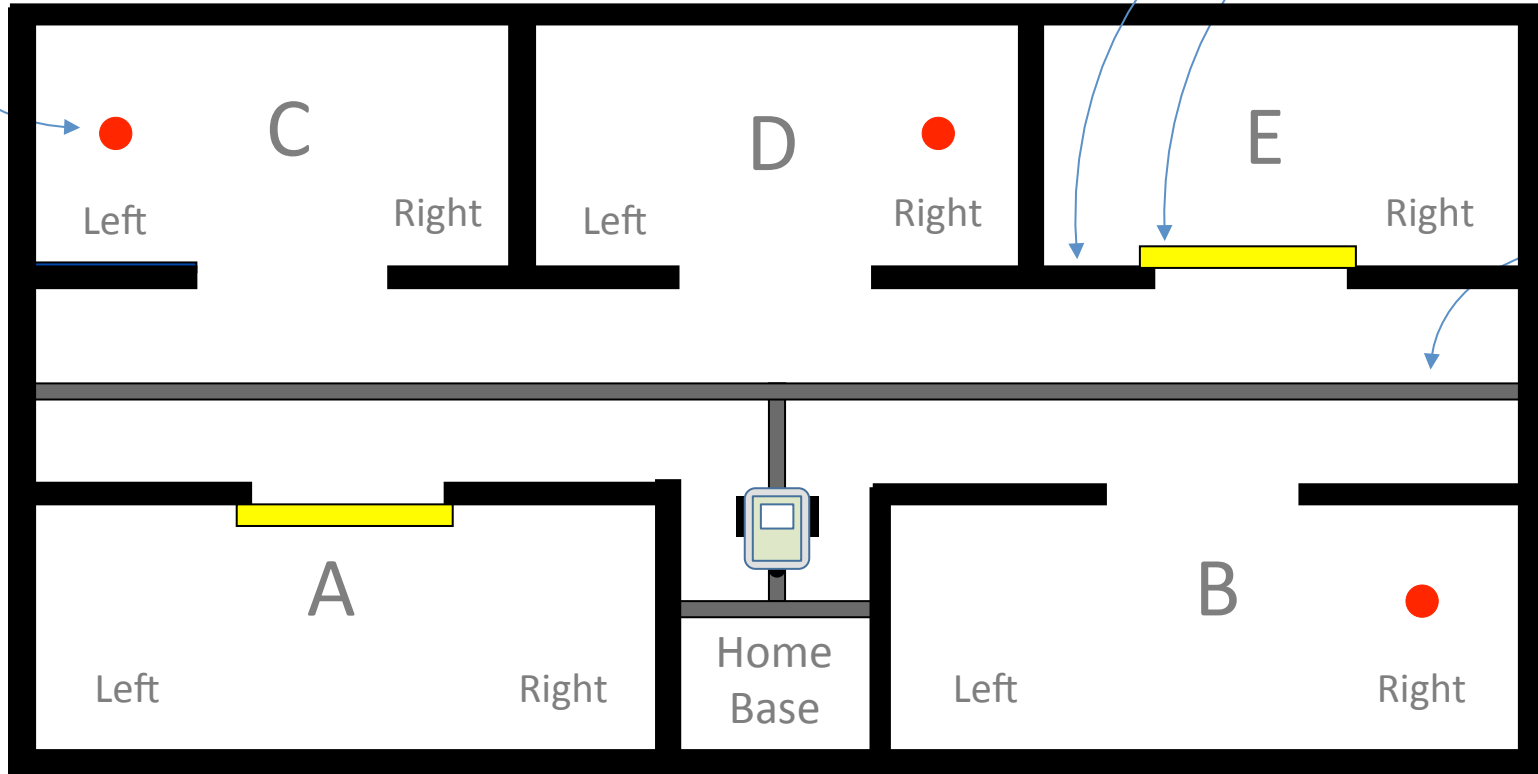
Middle School Division

- The goal of the challenge is to find as many fires (red balls) as possible and to extinguish them (knock them off the pedestals) in the shortest amount of time. Use of an actuator versus bumping the pedestals/balls will give you extra points. Returning to the station (base) will also earn extra points.
- The location of the balls will change before each round according to the roll of a numbered cube (see page 17). Rooms with no “fire” will be blocked **but door (blocking piece of 2x4) will not be secured to the table.**
- **Balls that are knocked down will remain on the table and will not be moved by the judge. Team members are not allowed to move or reset the balls.**
- **Unlike previous competitions, your robot IS NOT limited to a particular source (kit numbers) or number of parts that it may contain.**
- **Your robot’s wheelbase must fit in the home base which is 12 inches wide and 8 inches in length. Sensors and attachments may go over this requirement within reason e.g., the light sensor is placed on the black line that is perpendicular to the base.**
- Each round is a maximum of 3 minutes long. Your score is cumulative (both results are added together). Time will be the tie breaker if needed.
- If bot is touched, the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base. The -5 point penalty will apply each time that the robot is touched if you choose to restart from base
- **Team captains must carry score sheet to the judge’s table once the round is complete. Failure to do so will result in a score of ZERO for that round.**

RARC Firefighting Simulation – Middle Division

NXT Balls on (PVC) Pedestals

4' x 8' Competition Table



Black Tape

- Location of balls and which rooms are blocked (represented by yellow lines, actual color will be black) is determined by the roll of a number cube.
- Rooms will be blocked using an 18 inch 2x4 segment which will not be secured to the table in any way.
- Bot must knock (red) balls from pedestals
 - Red balls (fire) have point value.
- Bot can return to Home Base for additional points
- 2 rounds of 3 minute (max) timed runs
- Bots scored on cumulative points (time – tie breaker)

RARC II Middle Division Rules

Robots

- Wheelbase must fit in Home Base (attachments or sensors may go over within reason)
- Must navigate autonomously through hallways and rooms
 - Cannot launch objects or reach into rooms from base or hallways.
- Cannot use remote controls
- Sensors
 - Use of line following and ultrasonic sensor is strongly encouraged.
 - RARC III Competition will require these functions

RARC II Middle Division Rules

Conduct of Rounds

- Teams will go through 2 rounds of 3 minutes each.
- Location of balls and blocked rooms is determined by roll of a number cube.
 - Locations changed before each bot starts.
 - One ball per room, located in left or right position.
 - A red ball will always be located in room D.
 - Rooms A and B will have opposite functions i.e., one will have a red ball and one will be blocked
 - Rooms C and E will have opposite functions i.e., one will have a red ball and one will be blocked
 - Teams may not change programs based on roll result. Teams may only press the start button on the robot and may not cycle through the programs once the table setup has been modified.
 - Goal is to search for and locate “fires”.
- Bot starts from home base (all wheels behind the line).
- Once the balls get knocked down from the pedestals, the balls will remain in place on the table wherever they may fall. The team members or judges will not be allowed to remove or reset the balls until the round ends.
- Time starts when bot wheel crosses black line leaving base.
- Time ends when bot returns to base (2 wheels in base), team declares “stop time,” or at 3:00 minutes.

RARC II Middle Division Competition Rules

Scoring

- Balls must be dislodged from pedestals for points. Balls may not be moved by team members or judge until the round ends.
- Use of an actuator implies that the bot is stationary and uses a third motor or actuator to knock the ball from its pedestal. The judge must be able to clearly see that the ball was not bumped off the pedestal i.e. if the robot's wheels are moving while activating the third motor or actuator, the judge will record a value of 5 if the ball falls of the pedestal.
- If bot is touched the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base.
- The team captain must carry the scoring sheet to the scoring table once the round is complete. (Failure to turn in a scoring sheet will result in a score of ZERO).

Action	Point Value
Red Ball - Actuator	15
Red Ball - Bumped	5
Return to Base	10
Bot Restart	-5

- Return to Base points awarded only if Bot autonomously returns to base (2 wheels inside base).

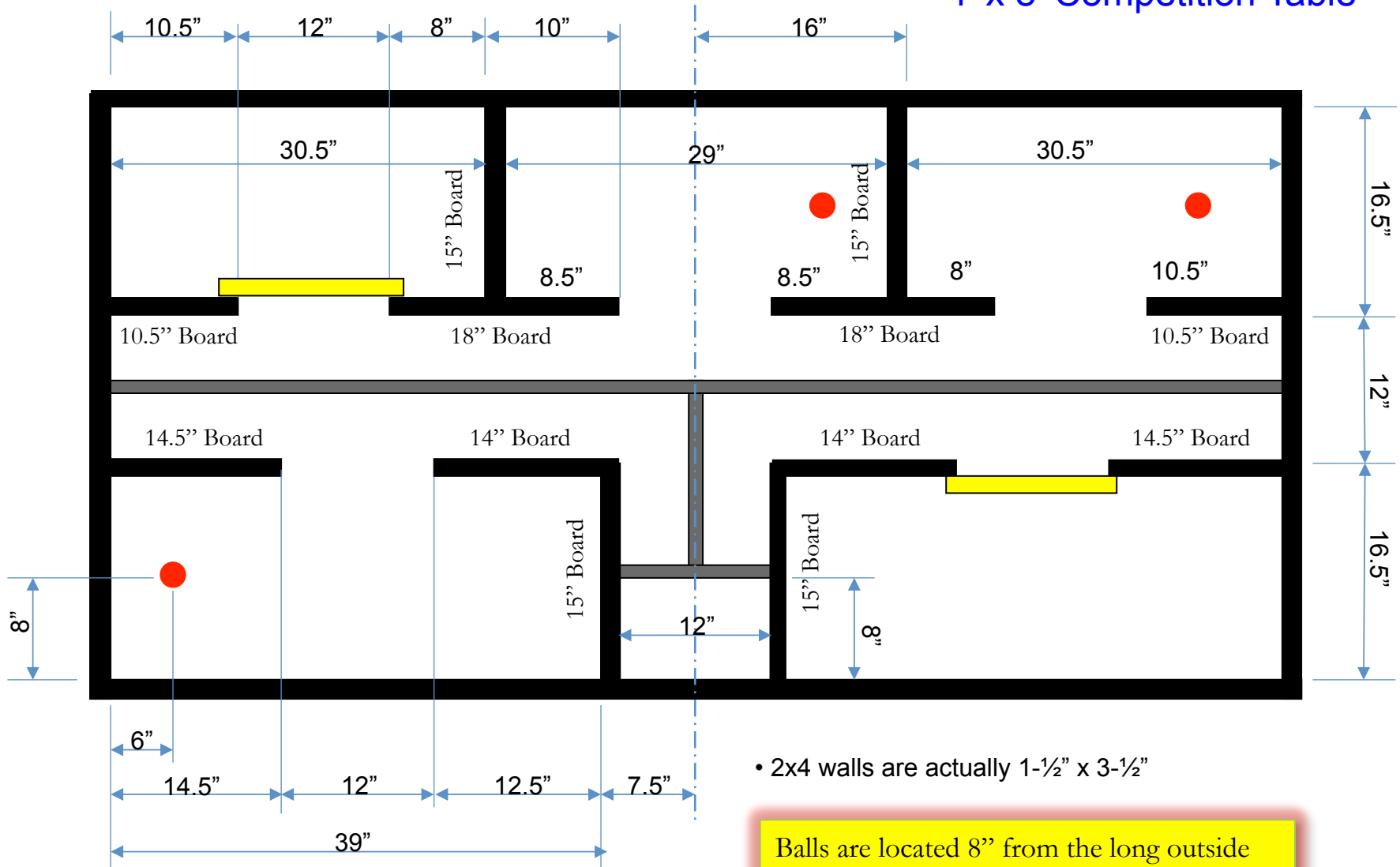
Ball & Blocked Room Location Chart – Middle School

Roll	A	B	C	D	E
1	RL	Blocked	Blocked	RR	RL
2	RR	Blocked	Blocked	RL	RR
3	Blocked	RR	RL	RR	Blocked
4	Blocked	RL	RR	RL	Blocked
5	RL	Blocked	Blocked	RR	RR
6	Blocked	RR	RL	RL	Blocked

Red - Left 

RARC Comp II Competition Table Dimensions – Middle School Division

4' x 8' Competition Table



Balls are located 8" from the long outside perimeter walls and 6" from the short perimeter walls

High School Division

- The goal of the challenge is to find as many fires (red balls) as possible and to extinguish them (knock them off the pedestals) in the shortest amount of time. Use of an actuator versus bumping the pedestals/balls will give you extra points. Returning to the station (base) will also earn extra points.
- Knocking off Blue LEGO balls will earn a -10 or -5 point penalty depending on whether an actuator is used or not.
- The location and color of the balls will change before each round according to the roll of a numbered cube (see page 23).
- Balls that are knocked down will remain on the table and will not be moved by the judge. Team members are not allowed to move or reset the balls.
- Unlike previous competitions, your robot IS NOT limited to a particular source (kit numbers) or number of parts that it may contain.
- Your robot's wheelbase must fit in the home base which is 12 inches wide and 8 inches in length. Sensors and attachments may go over this requirement within reason e.g., the light sensor is placed on the black line that is perpendicular to the base.
- Each round is a maximum of 3 minutes long. Your score is cumulative (both results are added together). Time will be the tie breaker if needed.
- If bot is touched, the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base. The -5 point penalty will apply each time that the robot is touched if you choose to restart from base
- Team captains must carry score sheet to the judge's table once the round is complete. Failure to do so will result in a score of ZERO for that round.

RARC Firefighting Simulation High School Div.

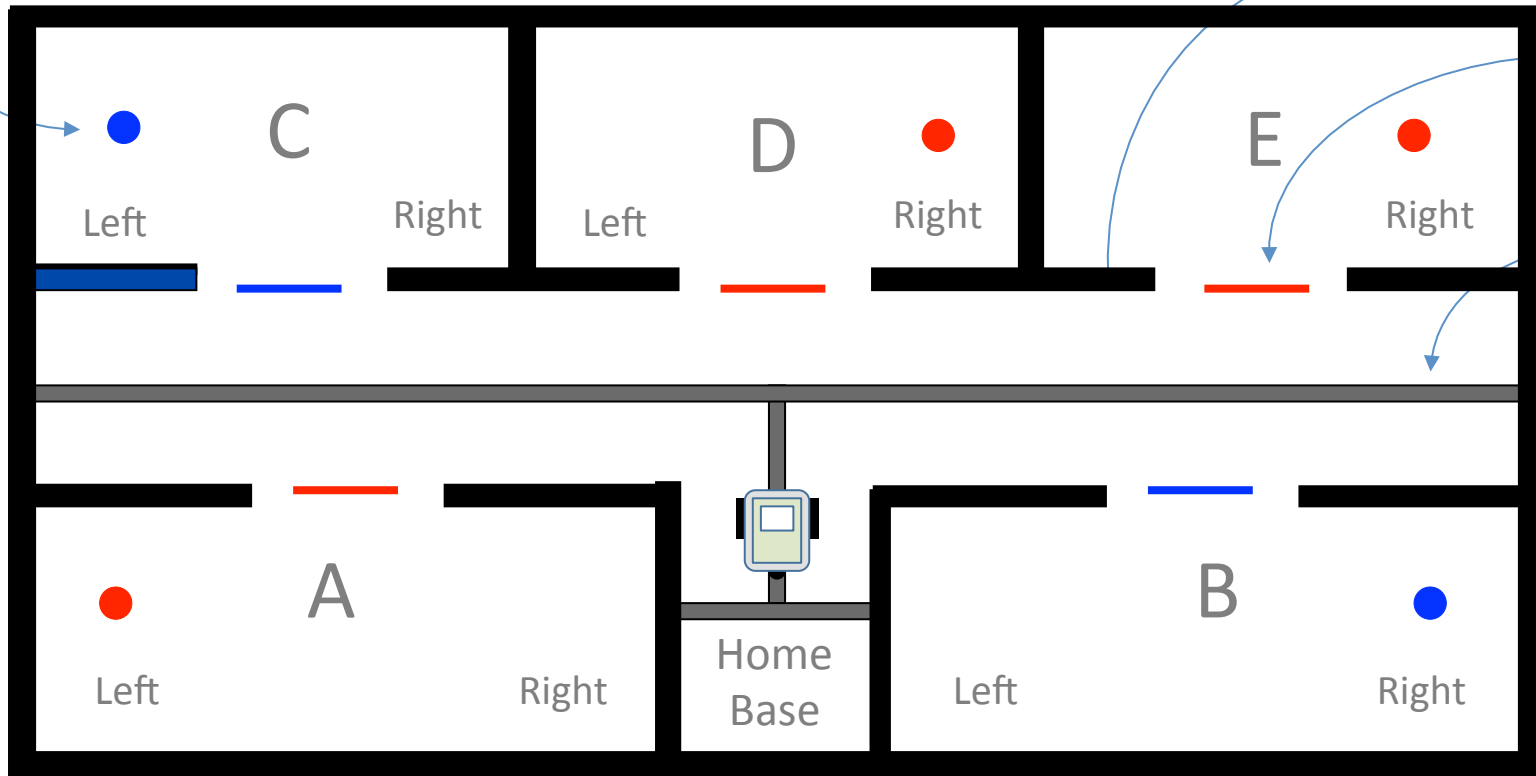
NXT Balls on (PVC) Pedestals

2x4 Boards

4' x 8' Competition Table

Colored Tape

Black Tape



- Location of balls determined by roll of number cube
- Bot must knock (red) balls from pedestals
 - Red balls (fire) have point value. Blue balls (no fire) have negative point values.
 - Tape lines will be changed each round to match color of ball in room.
- Bot can return to Home Base for additional points
- 2 rounds of 3 minute (max) timed runs
- Bots scored on cumulative points (time – tie breaker)

RARC II High School Division Rules

Robots

- Wheelbase must fit in Home Base (attachments or sensors may go over within reason)
- Must navigate autonomously through hallways and rooms
 - Cannot launch objects or reach into rooms from base or hallways.
- Cannot use remote controls
- Sensors
 - Use of line following and color sensors (particularly for high school division) is strongly encouraged.
 - RARC III Competition (Mini Urban Challenge) will require these functions

RARC II High School Division Rules

Conduct of Rounds

- Teams will go through 2 rounds of 3 minutes each.
- Location of balls is determined by roll of a number cube.
 - Locations changed before each Bot starts.
 - One ball per room, located in left or right position.
 - A red ball will always be located in room D.
 - Rooms A and B will have opposite colors
 - Rooms C and E will have opposite colors
 - Tape lines placed to match color of balls in each room.
 - Teams may not change programs based on roll. Teams may only press the start button on the robot and may not change or modify the programs once the table setup has been modified.
 - Goal is to search for and locate “fires”.
- Bot starts from home base (all wheels behind the line).
- Once the balls get knocked down from the pedestals, the balls will remain in place on the table wherever they may fall. The team members or judges will not be allowed to remove or reset the balls until the round ends.
- Time starts when Bot wheel crosses black line leaving base.
- Time ends when bot returns to base (2 wheels in base), team declares “stop time,” or at 3:00 minutes.

RARC II Competition High School Rules

Scoring

- Balls must be dislodged from pedestals for points. Balls may not be moved by team members or judge until the round ends.
- Use of an actuator implies that the bot is stationary and uses a third motor or actuator to knock the ball from its pedestal. The judge must be able to clearly see that the ball was not bumped off the pedestal i.e. if the robot's wheels are moving while activating the third motor or actuator, the judge will record a value of 5 if the ball falls of the pedestal.
- If bot is touched the round is over (stop time) or a -5 point penalty is assessed for a restart from Home Base.
- The team captain must carry the scoring sheet to the scoring table once the round is complete. (Failure to turn in a scoring sheet will result in a score of ZERO).

Action	Point Value
Red Ball - Actuator	15
Red Ball - Bumped	5
Blue Ball - Actuator	-10
Blue Ball - Bumped	-5
Return to Base	10
Bot Restart	-5

- Return to Base points awarded only if Bot autonomously returns to base (2 wheels inside base).

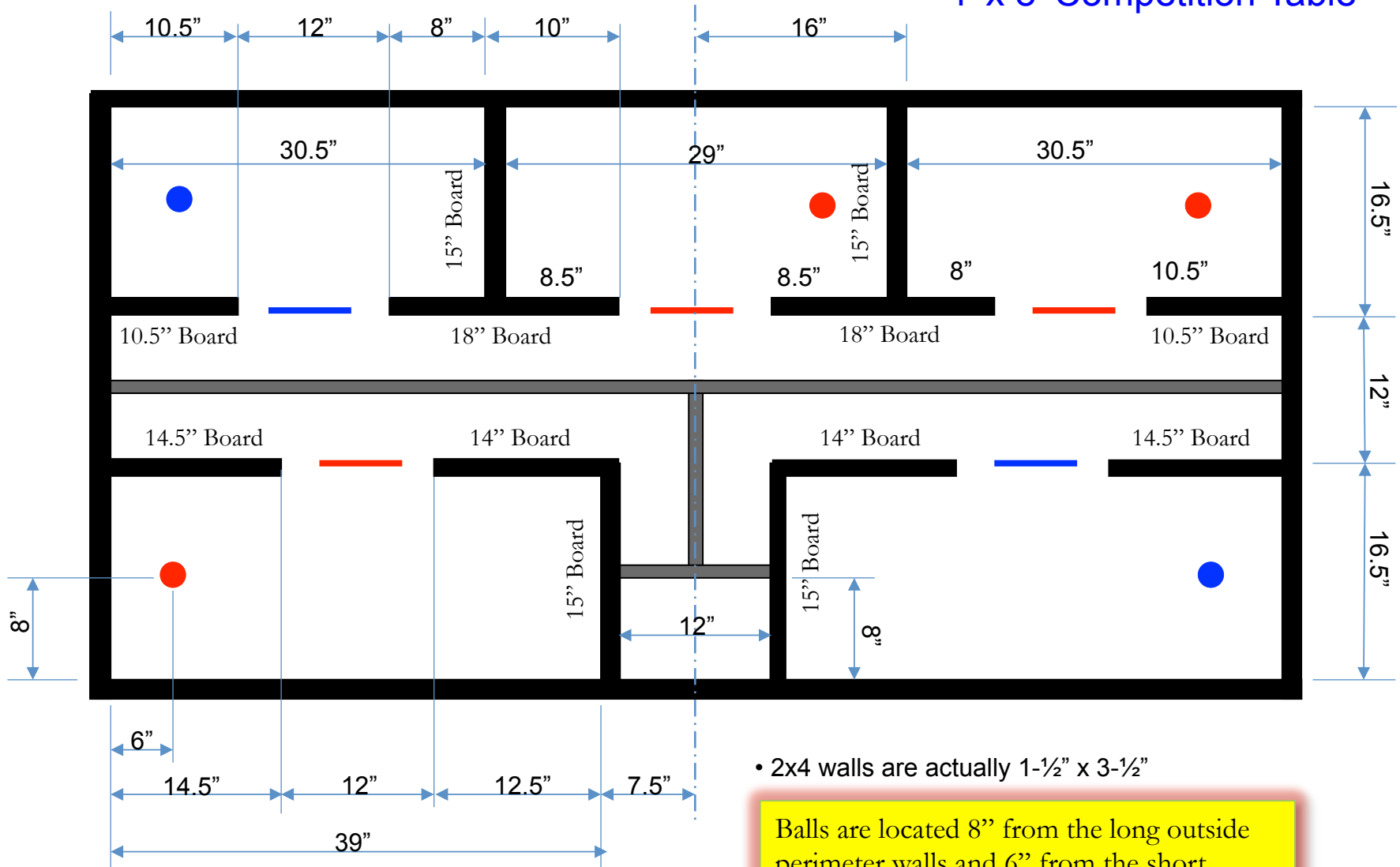
Ball Location Chart – High School

Roll	A	B	C	D	E
1	RL	BR	BL	RR	RL
2	RR	BL	BR	RL	RR
3	BL	RR	RL	RR	BL
4	BR	RL	RR	RL	BR
5	RL	BL	BL	RR	RR
6	BR	RR	RL	RL	BR

Red - Left 

RARC Comp II Competition Table Dimensions – High School Division

4' x 8' Competition Table

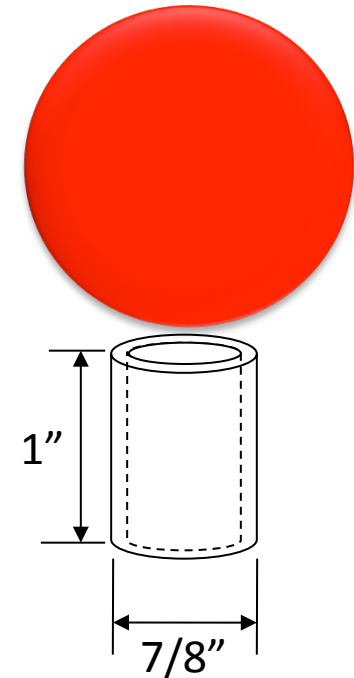


• 2x4 walls are actually 1-1/2" x 3-1/2"

Balls are located 8" from the long outside perimeter walls and 6" from the short perimeter walls

Item	Quantity
2x4 x 93" (table walls)	2
2x4 x 48" (table walls)	2
4x8 Sheet Plywood (floor)	1
2x4 x 14.5" (interior walls)	2
2x4 x 14" (interior walls)	2
2x4 x 10.5" (interior walls)	2
2x4 x 15" (interior walls)	4
2x4 x 18" (interior walls)	2
PVC Pipe (pedestals as shown)	2
NXT Plastic Balls	4 Elem, 3 Middle, 5 High School
¾" Black Electrical Tape	1 roll
½" Red and Blue Electrical Tape – High Div.	1 roll each

Materials



½" PVC &
NXT Plastic Ball

Competition Table Resources

Here are some websites that you can visit for information on how to build a competition table:

http://edoutreach.wpafb.af.mil/Robotics/media/table_construction.pdf

<http://www.techbrick.com/Lego/TechBrick/TeamTips/NewTeams/Documents/TechBrickTableBuild.pdf>

<http://ausfll.org/res/fllTable.pdf>

<https://landroids.netfirms.com/landroids.org/Landroids%20FLL%20Table%20100608.pdf>

<http://sketchup.google.com/3dwarehouse/details?mid=d1047fba877024b1e41db8d254f9844e>