# Box Bot

**Elementary, Middle School, High School**

**Contest Description**

The Box Bot contest challenges student teams to design, construct, program and operate a battery-powered robot for use in a package delivery simulation.

**Rules**

1. Only two team members at a time are allowed at the playing field while the Robot is on a task attempt. To share in participation, members may switch out with each other between attempts.

2. There will be a random selection prior to the competition to determine which House the team is to deliver packages to.

3. Once the House is determined, the team steps up to the playing field and has 30 seconds to perform any needed setup routines and download the applicable program to their robot.

4. The Judge starts the match, and the team performs task attempts for 90 seconds. The first 70 seconds are autonomous (no remote control) and the final 20 seconds can be operator controlled via a wireless remote. More matches run until every team has competed once, this process is known as a “round”. There are 3 rounds in the contest. After each match, teams may go to the pit and fix or adjust the robot.

5. The judges will signal when operator control is available. Teams may choose to continue with their robot in autonomous mode if desired.

6. The robot is defined as the micro-controller, (NXT, EV3, VEX-IQ, Parallax, Arduino, etc.) and anything connected to it in any way, including any loose objects being held, manipulated, or moved.

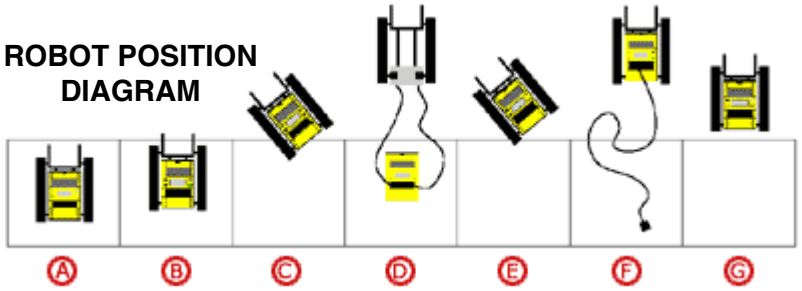
7. The robot must be programmed using programming software. (i.e. LEGO MINDSTORMS, RoboLab, Pbasic, C, etc.)

8. A scoring attempt is started when the team starts a program. Delaying or causing the release of stored energy in any form by hand is not allowed. This starting technique applies during the whole match, not just at the beginning.

9. Before the match, between scoring attempts, and only while the Robot is completely inside the “Endzone” area, the team may aim the Robot, repair it, add or remove parts, switch programs, and reset mechanisms.

10. All scoring attempts must start with the robot completely inside the “Base” area as shown in the robot position diagram in position A, with the robot turned on but all programs turned off. The robot must start from within the base lines. This starting technique applies during the whole match, not just at the beginning.

**ROBOT POSITION DIAGRAM**



11. Jigs or other alignment devices may be used to help aim the robot in starting position and they must stay completely in the end zone.

12. While on a scoring attempt, the robot is to be controlled only by its program, its motors, and its interaction with the field, and not by interaction of any kind with the team. Remote control or signaling of sensors in any way is not allowed during the autonomous period.

13. A scoring attempt is an effort by the robot to move one or more of the game objects into a scoring position. Scoring attempts can be tried in any order, re-attempted whenever possible, or not attempted at all.

14. During the autonomous period the robot is understood to be on a scoring attempt starting from the instant a program is initiated. The next time the team controls or interacts with the robot in any way (touching/carrying is most common), it is a signal that the robot is failing or can no longer continue on its own, and the current scoring attempt is immediately terminated. The team must then bring the robot by hand to the starting position (Base) for the next scoring attempt. Any changes to the playing field after the instant the team interacts with the robot are invalid, and are reversed by the referee.

15. Points for scoring objects are awarded only if the object is ***completely*** in scoring position as specified in the game description, no matter where the robot is, and no matter whether the object is packaged, palletized, or bound/connected to other objects.

16. Objects in the way of future scoring attempts can be removed from the field by the referee upon request unless doing so would have a direct effect on scoring.

17. Refer to the robot position diagram after rule 10. If a scoring attempt is terminated while all functional parts of the Robot are completely out of the **"*End Zone*"** as shown in positions D, F and G, the team must bring the Robot by hand to Starting Position (Base) for the next scoring attempt. Because of this action, one "*Robot Return Penalty"* is deducted from the score, but accomplishments made during the scoring attempt are retained. Scoring attempts terminated in positions A, B, C and E do not result in a "*Robot Return Penalty"*, and there is no loss if the robot happens to be out of the Base when the match ends.

18. If an object being moved **IS NOT** held by or linked to the robot when a scoring attempt is terminated, the object stays where it is on the field. If an object **IS** held by or linked to the robot when a task attempt is terminated there are two possibilities: 1) Objects that began the Match in the End Zone are kept by the team for another task attempt. 2) Objects that did not begin the Match in the End Zone are taken off the playing field by the referee (and do not score).

19. Points can be scored in any order.

20. At any time during the match, the team may recover robot parts that come off as an obvious result of damage or disintegration. The team may do this by hand or request help from the referee.

21. The team may not touch "Task Models" or "Scoring Objects" at any time. If they are damaged or otherwise disturbed between task attempts or by anything but valid robot action, the referee restores them as soon as possible. If it is obvious to the referee that task model damage is part of team strategy the team will be disqualified from the event.

22. To minimize controversy about what happened during a match, THE SCORE IS DETERMINED AT THE END OF THE MATCH, BY THE CONDITION OF THE FIELD AT THAT TIME ONLY. If the thickness of a line on the field comes into question, and for other situations that are “too close to call” the team is given the benefit of the doubt. Scores from each Round are independent, and only a team’s best score counts.

23. The “Terms & Rules” are superseded by the “Game Description” when the two conflict.

24. Teams must bring documentation of their design process and the iterations that have taken place during the current school year. (ie. Engineers Notebook or Portfolio)

25. Decisions of the judges are final and binding.

# Game Description

Points are awarded for moving packages (foam blocks) into a scoring area (staging, truck or house).

Points:

- 5 points for each box in the “staging” position. Staging position is shown in yellow on the playing field. The warehouse is the green area on the playing field diagram.
- 10 points for each box in the “truck” position. The truck position is shown in blue on the playing field. There will be walls on each side of the truck and boxes must be inside the truck walls and not touching a black line to count.
- 15 points for each box stacked on another box in the “truck” position.The truck position is shown in blue on the playing field. There will be walls on each side of the truck and boxes must be completely inside black line and not sitting on a field or truck wall to count.
- 10 points for each box in the appropriate “house”. The light blue areas are the 2 house positions one of which will be randomly selected as a delivery location prior to the start of the match. Boxes must be inside the truck walls and not touching a black line to count
- 20 points for each box stacked on another box in the “house” position. Boxes must be completely inside black lines and not touching field surface or truck wall to count.
- -10 points for any damage or movement of the “truck” by the robot or package making contact with the truck. This would include knocking down the truck walls or unintentional movement of the truck walls.
- -5 points anytime a robots task is interacted with outside of the “base” (Robot Return Penalty)

1. “Starting Position” is with the entire robot completely within the “Base”. The base is shown in red on the playing field diagram and is defined as the square center section on one end of the board. (No part of the robot may extend over the black lines surrounding the base)

2. On the judges signal, the robot is to leave the base, attempt to earn challenge points through a scoring attempt and return to base with only its program to control it. If the team touches the robot before it returns to the end zone a “Robot Return Penalty” will be given and the robot must be returned to “Starting Position.”

# Tips:

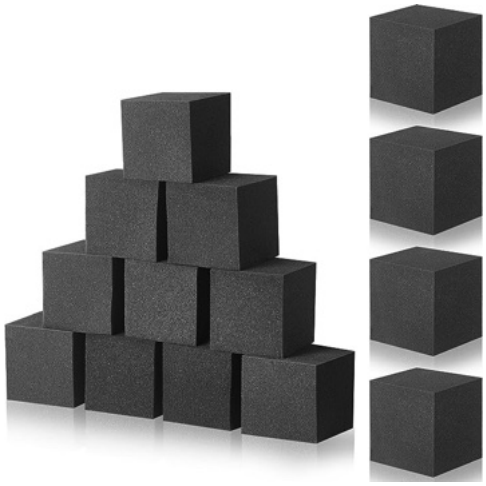
- Concentrate on developing a solution step by step. Don’t try to get it all at once or things will get out of hand very quickly.
- Teamwork is crucial. The challenge is too much for one person to get done alone in time. Try dividing up tasks for different team members.
- Test and refine your design as many times as possible. The robot must be ready for whatever comes its way.

# Playing Field

The following is the description for the Box Bot competition for the National Robotics Challenge. Please keep in mind that the challenge points do not necessarily need to be earned in a specific order.

**Boxes**

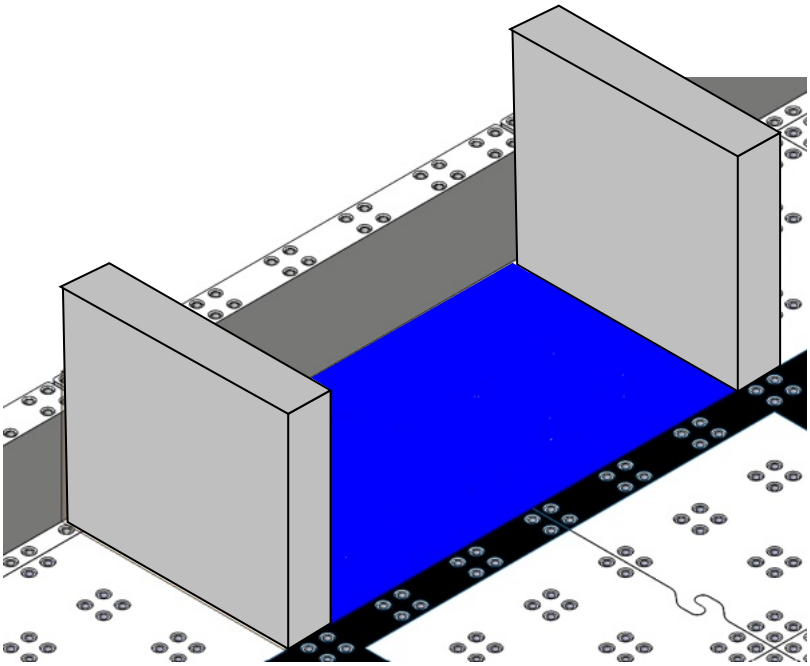
The 4” x 4” x 4” foam blocks shown are what will be used for the scoring objects (boxes) in the competition. These are trampoline/ parkour foam blocks. The blocks can be purchased on Amazon: https://www.amazon.com/dp/B0C4SLC597



**4” X 4” FOAM BLOCKS (BOXES)**

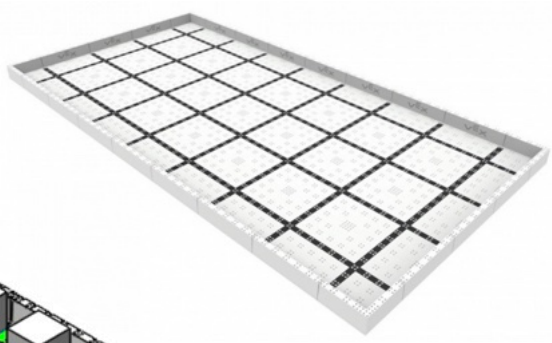
**Truck**

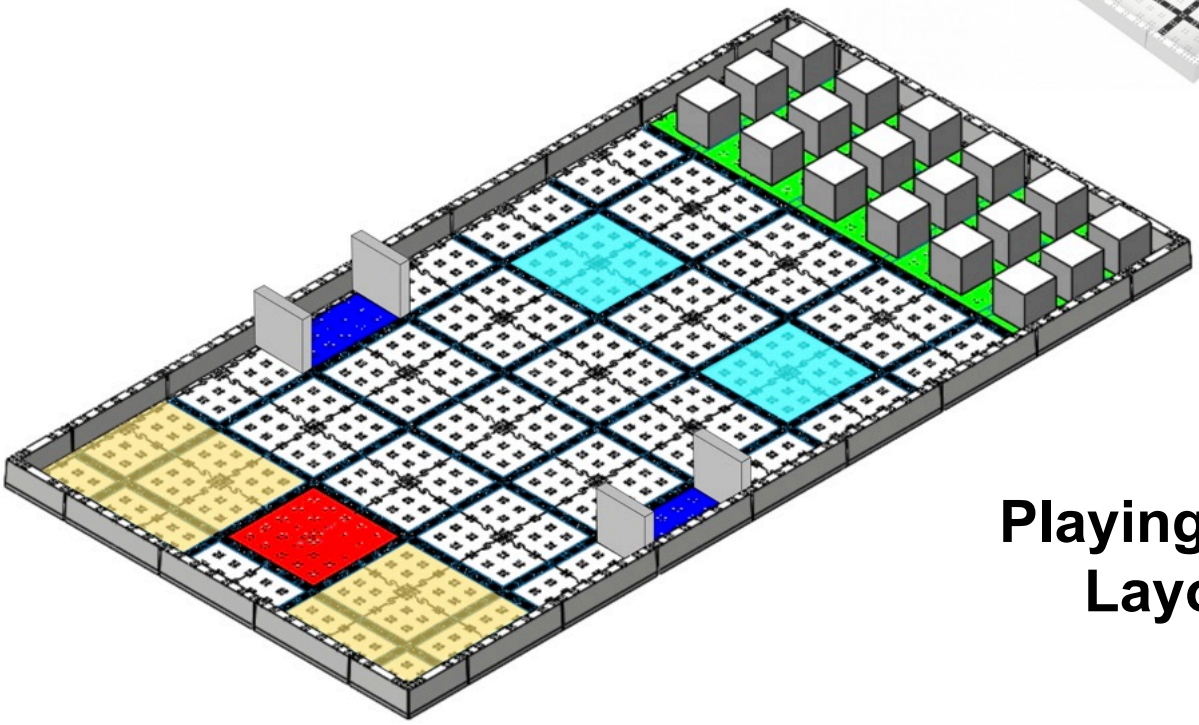
Truck walls will be 1” x 6” x 6” blocks. These blocks can be made from wood or plastic (3D printed). Walls will be held in place with VEX 1 x 2 Connector pins. 4.8mm diameter x 14mm deep with a 6.6mm diameter x 2mm deep counterbore holes will be drilled into each truck wall allowing the 1x2 connector pin to hold the wall in place. NOTE: The wall can be knocked over if the robot makes contact with the wall. Teams should make sure their robots will not hit the wall as it passes or while loading the truck. Points are deducted if a wall falls over from robot action.



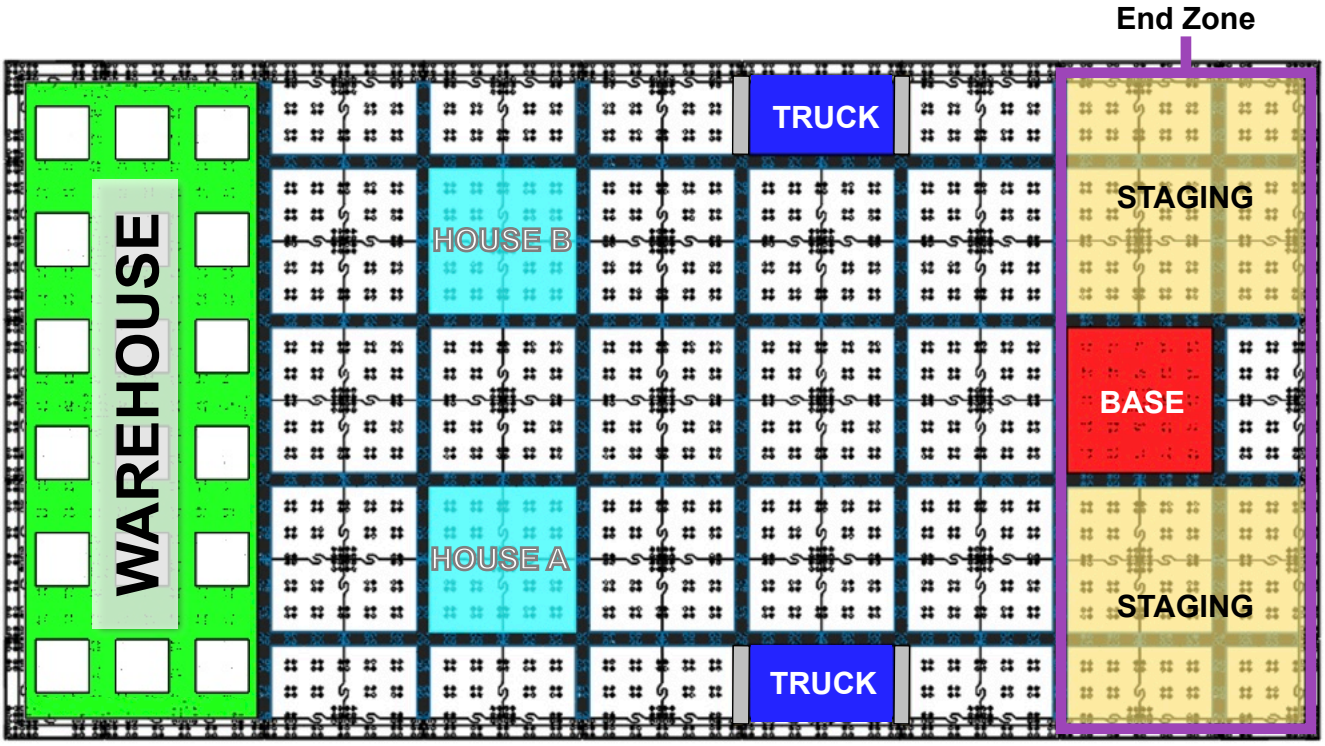
## Playing Field

For the main playing field the NRC is created from 2 - Vex IQ Field Kits (Half 4'x8' Field) to create a full 4’ x 8’ field. You can purchase this product at:  www.vexrobotics.com





# Playing Field Layout



# *FINAL EVENT* – Box Bot

**LEVEL:** _____ **Elementary** _____ **Middle School** _____ **High School**

**SCHOOL:** _____

**CAPTAIN:** _____

| Team Check-In _____ | | Table/House _____ | | Table/House _____ | | Table/House _____ | |
|---|---|---|---|---|---|---|---|
| **Tasks** | Points Each | Scored Objects Round 1 | Points Awarded Round 1 | Scored Objects Round 2 | Points Awarded Round 2 | Scored Objects Round 3 | Points Awarded Round 3 |
| ***In Staging (Position 1)*** | | | | | | | |
| • Box | **+5** | | | | | | |
| ***Truck (Position 2)*** | | | | | | | |
| • Box on Ground Level | **+10** | | | | | | |
| • Stacked Box | **+15** | | | | | | |
| ***House (Position 3)*** | | | | | | | |
| • Box on Ground Level | **+10** | | | | | | |
| • Stacked Box | **+20** | | | | | | |
| ***Damage*** | | | | | | | |
| • Damage to Truck (Position 2) | **-10** | | | | | | |
| ***Robot Return Penalty*** | | | | | | | |
| Number of times the robot is handled by a team member outside the End Zone. | **-5** | | | | | | |
| **Total Points** | | | | | | | |

**Highest Total: _____**

Judge's Comments: _____

_____

Judge's Signature: _____