2013 Botball Game Review

Version 1.0

01/12/2013

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National Sponsors

NORTHROP GRUMMAN

Foundation

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Will be added later.

This Year's Game

The Mars Sample Return Mission!

The Mars Science Laboratory, *Curiosity,* is a marvel of mobile science. But there are questions that require laboratory analysis that can only be done on Earth. For this reason, planetary scientists desperately want a *Mars Sample Return (MSR)* mission. Given tight budgets, the world space community turns to Botball students to develop the automation technology needed to:

- retrieve samples cached by *Curiosity*;
- gather, sort, and separate unusual and interesting samples detected from orbit;
- load the samples into the return containers;
- assemble the return vehicle (rocket) and prep it for launch.

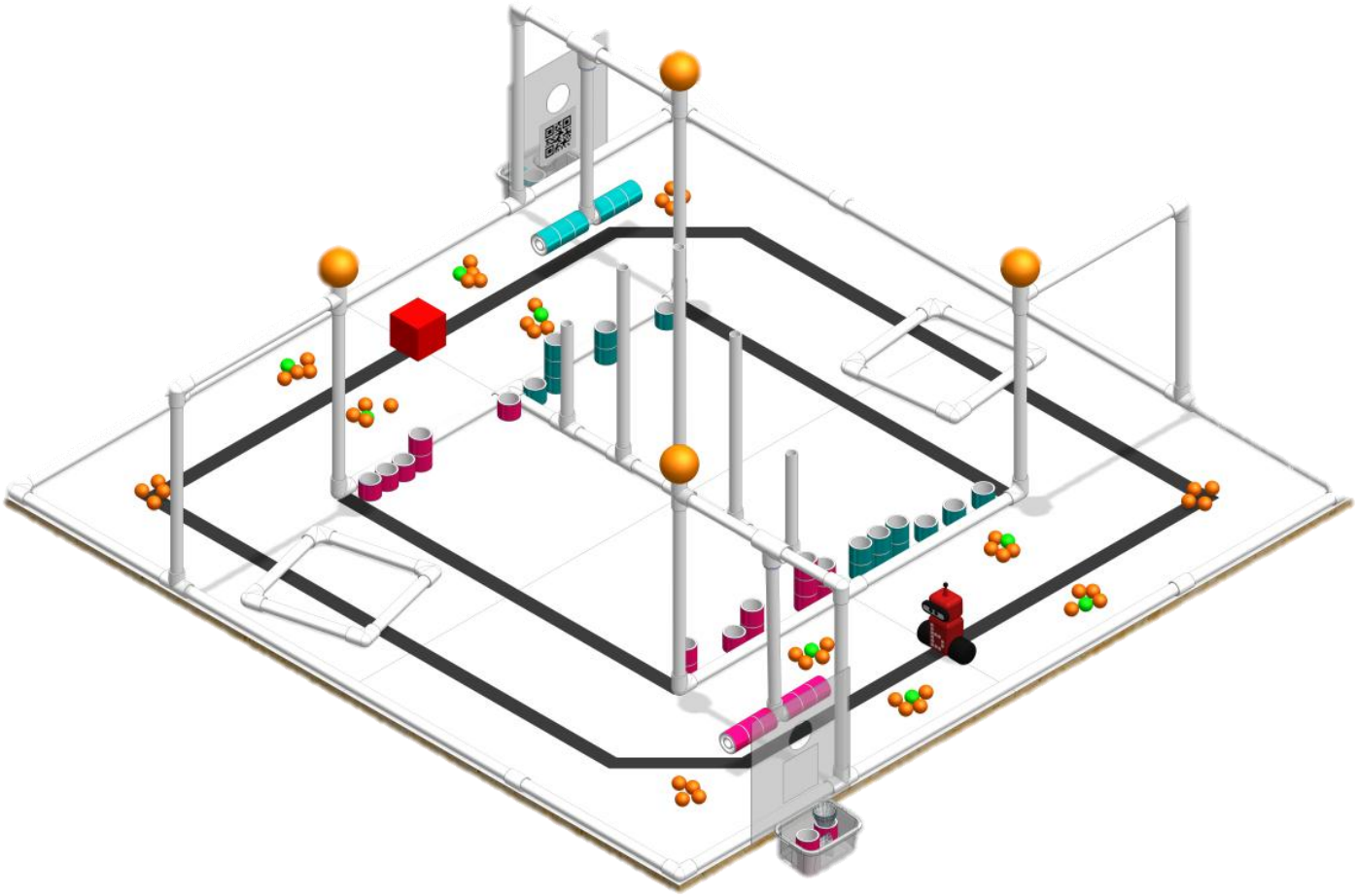
In a sign of international cooperation, multiple MSR teams and robots will be operating concurrently, and potentially working together to assemble and prep the return vehicles. Cooperation doesn't mean the teams aren't also competing for the bragging rights to return the most and the purest samples, from Mars, to the scientists on Earth.

Rockets will be awarded points for the number of **Booster Sections** assembled. Bonuses will be awarded if the rockets are assembled on the more centrally located launch pads, and if they have **Nose Capsules** placed on the top of the **Booster Sections**.

Samples need to be moved to the launch area for loading. Green **Organic Samples** are the most desirable and score the most points when they are isolated from the orange **Inorganic Samples,** which score fewer points. Some points are awarded for getting samples into the *Launch Area*, more if they are in the *Transport Container* and the most if they are in the *Transport Container* in the *Launch Area*.

Botguy, the **Sample Cube**, and the **Geodes** also need to be moved to the *Launch Area*. Points are awarded for getting these items into the *Launch Area*, more if they are in the *Transport Container* and the most if they are in the *Transport Container* in the *Launch Area*.

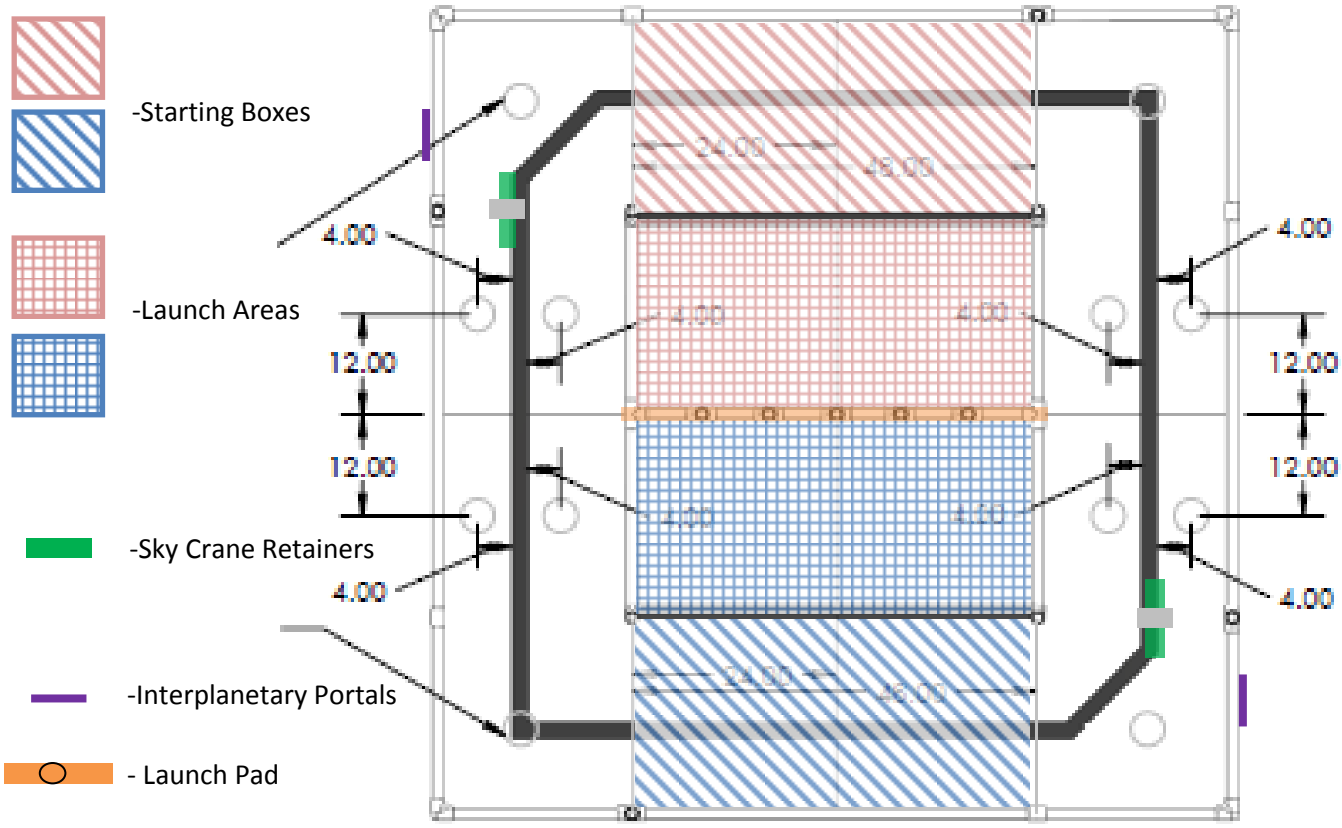
Game Board Picture



The Game Board Areas

Official game board specifications are on the Team Home Base – all parts are available at Home Depot or Lowes (a sample of the surface material is in your game piece set). All tournament boards will match these specifications within +/-0.5 inches or 1%, whichever is greater.

The game board is composed of four, 4' x 4' (reusable) modules whose surfaces are pebble grain white fiberglass panels. A fully assembled game board will be ~8' X 8'. A panel channel (rounded side up) is used to close exposed seams where modules abut. Each side has a starting box, a launch area and an interplanetary portal used by team members to introduce game pieces. Each interplanetary portal is labeled with a QR code containing a 'P' or a 'T' for the pink or teal side respectively.



Starting Box – The boundary of the *Starting Box (48 x 22 x 15 inches high)* is defined by the **inside edges** of the black tape, pencil lines, and PVC that surrounds the *Starting Box*.

Launch Area– the boundary of the *Launch Area* is defined by the **inside edges** of the PVC and tape that surround the *Launch Area.*

Game Pieces (all are scoring items)

1 Botguy
1 Red Sample Cube (4” poof cube)
4 Orange Geodes (4” diameter poof balls)
48 Orange Inorganic Samples (1.5” poms)
8 Green Organic Samples (1.5” poms)
6 Nose Capsules (Badminton Shuttlecocks)
16 Small Rocket Booster Sections (2” tall 2” PVC with one tape band - 8 teal, 8 pink)
8 Medium Rocket Booster Sections (4” tall 2” PVC with two tape bands - 4 teal, 4 pink)
6 Large Rocket Booster Sections (6” tall 2” PVC with three tape bands - 3 teal, 3 pink)

Game Piece Starting Positions

- Botguy and the Red Sample Cube will be placed in the middle of the pathway, one on each side. The side and orientation of each will be randomly determined after “hands off”.
- Four (4) of the Orange Inorganic Samples will be placed at each corner of the path center line inside a 4” diameter circle.
- Four (4) of the Orange Inorganic Samples, and one (1) Green Organic Sample in a 4” diameter will be placed in the other eight (8) circles.
- The Orange Geodes will start on top of the T connectors on each air lock.
- Three (3) of the small (one band) Rocket Boosters will start in the Interplanetary Portal holders along with three (3) Nose Capsules.
- Two (2) of the large (three band) Rocket Boosters will start on the *Sky Cranes*.
- Prior to game start, teams may reposition the remaining rocket booster sections in their *Launch Area* with the stipulation that they must touch the game surface, must touch the PVC along the Non-Launch Pad sides of their *Launch Area*, and not extend outside their *Launch Area*.
- Prior to game start, teams may position their *Transport Container* anywhere inside their *start box* (including on their robots, so long as everything is within the boundaries of their *Start Box*).

The *Transport Container* **must** be inside the starting box and can be positioned on the robot if desired.

Scoring

1. LAUNCH AREA

Poms	#____ x1 = _____	
Orange Foam Ball	#____ x5 = _____	
Red Cube	#____ x10 = _____	= _____ TOTAL
Botguy	#____ x30 = _____	

2a. TRANSPORT AREA NOT IN LAUNCH AREA *(ON YOUR SIDE)*

If the team scores in this area, do not use section 2b.

Orange **or** Mixed Poms	#____ x2 = _____	
Green **only** Poms	#____ x25 = _____	
Orange Foam Ball	#____ x10 = _____	= _____ TOTAL
Red Cube	#____ x20 = _____	
Botguy	#____ x60 = _____	

2b. TRANSPORT IN LAUNCH AREA *(ON YOUR SIDE)*

If the team scores in this area, do not use section 2a.

Orange **or** Mixed Poms	#____ x3 = _____	
Green **only** Poms	#____ x50 = _____	
Orange Foam Ball	#____ x15 = _____	= _____ TOTAL
Red Cube	#____ x30 = _____	
Botguy	#____ x90 = _____	

3. BOOSTERS OFF SKY CRANE

Booster Packs	#____ x5 = _____	= _____ TOTAL

4. BOOSTERS ON LAUNCH PAD

#_____	#_____	#_____	#_____	#_____	
x10	x20	x30	x20	x10	= _____ TOTAL
x2	x2	x2	x2	x2	

Notes:

- only one capsule per pole will score
- items scoring in more than one area only score in the one yielding the highest score

Scoring Rules

The official scoring rules for the 2013 Game are made up of this 2013 Botball Game Review document **and** any updated scoring rules on the team home base. Posts on the 2013 Team Home Base in the Game Rules Question area will be used to update this document and provide notice of any rule changes or adjustments.

1. The boundary of the *Starting Box* is defined by the **inside edges** of the black tape, pencil lines, and PVC that surrounds the *Starting Box*.
2. The boundary of the *Launch Area* is defined by the **inside edges** of the black tape and PVC that surrounds the *Launch Area*.
3. Game pieces must touch the surface in the *Launch Area* to score, or follow the "electricity" rule.
4. The “electricity” rule allows a group of touching pieces within the same vertical projection to score if at least one of the pieces in the group is touching the surface.
5. The *Transport Container* is defined by the inside edges of its PVC boundary.
6. The *Transport Container* PVC must touch the game surface ("electricity" rule does not apply to the *Transport Container*) in order for the pieces within it to score within the *Transport Container*.
7. Game pieces score in the *Transport Container* if the center portion of the piece is within the vertical projection of the inside edges of the PVC defining the *Transport Container* **and** touching the surface or touching a scoring piece touching the surface (“electricity” rule).
8. If some part of the *Transport Container* PVC is touching the surface of the *Launch Area* everything scoring in the *Transport Container* scores as being in the *Transport Container* in the *Launch Area*.
9. Rocket *Booster Sections* only score if the launch pad support pole is within the volume of the *Rocket Booster Section.*
10. The *Nose Capsule* must break the vertical projection of the launch pad support pole **and** some part of the *Nose Capsule* must be touching either the top of the launch pad support pole or the top of the top Rocket *Booster Section* to double the points of **all** scoring Rocket *Booster Sections*.
11. A *Rocket Booster* retainer on the *Sky Crane* is cleared if the crane does not enter the volume of a *Rocket Booster Section.*
12. The score is determined only where objects finish up, and not by how they got there. Judges will wait until any scoring objects still moving have come to rest before scoring a game.

If your team does not agree with the calculation of the score they must immediately notify the table judge(s) **before** leaving the table and **before** any items have been moved on the table. Teams will be required to initial a score sheet before they leave the table – this signifies that they accept the score.

Tie Breakers & Special Scoring Conditions

If one team never breaks any border of the starting box, they lose the round. If both teams break the boundary of their starting box and one team's robot does not shut down their motors or does not stop commanding their servos to move at the end, they lose the round. In the case of a tie score, a team wins if none of the above conditions apply **AND** they are the team with (first condition to apply):

1) Team scoring the most rocket booster points (includes any doubling)
2) Team scoring the most rocket booster bands
3) Team with the most poms in their transport container in launch area
4) Team with the most poms in their transport container
5) Team scoring the most green poms
6) Team scoring Botguy
7) Team scoring Red Payload Cube
8) Team scoring the most orange poms
9) Team scoring the most orange balls
10) Team with fewest booster sections on the sky crane
11) Team with the transport container in the launch area
12) The robot with the KIPR Link power switch closest to Botguy

Game Play

Fair Play and Spirit of Botball

Botball is about the development of **student** skills. Once a team enters the pits with their robots, they should not leave the pits for any robotics purpose until the conclusion of the tournament or suspension of play for the day. Adults are not allowed into the pits and all adults accompanying a team should understand that responsible Botball mentorship does not include working on the robot entries or programming the robot entries for the students.

Setup (before "Hands Off")

Up to two students from a team bring the team's robot(s) to the tournament table and perform the set up. Teams will place their robot(s) within their starting box as desired. Teams **must use** the tournament provided *Transport Container* during their setup. Note that the *Transport Container* must be in the starting box (it can be on the robot) even if the team strategy does not use it. During the seeding rounds, teams my arrange the opposing sides *Transport* or remove it from the table during setup, but the opposing booster sections will be placed randomly such that there are eight booster bands on each side of the opposing *Launch Area*. Prior to the start of the game, teams may position either or both of the starting lights on their side as they wish, provided:

- Starting lights must be attached to the outside edges of the game board on your side.
- Starting lights may not be in physical contact with any part of your entry or game pieces.
- Starting lights may only break the vertical projection of the game board over the starting box.
- Starting lights may not be aimed to disrupt an opponent or blind anyone (judge's interpretation).
- **Teams cannot touch starting lights after *Hands Off*.**
- There are two starting lights for each team so each Link controlled robot can have its own starting light; both lights will turn on and off at the same time and cannot be controlled individually.

Teams shake hands and visually inspect each other's robots **before calibration**. Inspection is limited to a maximum of one (1) minute unless a specific challenge is made. Teams must notify table judges **before the game starts** if they believe the table is not set up properly. When both teams are ready or judges decide adequate time has been allowed for calibration, each team positions/activates its robots and then -- **Hands off!**

If the judges feel a team is taking too long to calibrate, they will issue a 30 second warning. At the end of the 30 seconds, if either team is not ready for 'hands off', that team will be assigned a fault, and the setup clock will be reset. The target setup time (which may be extended at judges' discretion) is 90 seconds.

Before the Game Begins (after "Hands Off")

After *hands off* the judges randomly select the position and orientation of *Botguy* and the *Red Sample Cube*. The starting lights are initiated **by a judge** to signal to the robots that the round has begun. Students will stand by their *interplanetary portal* or kneel/sit around their side of the table. No part of a team's robot(s) may leave the starting box until the round has begun (movement is OK so long as the starting box boundary isn't violated). If this happens, the judges will call a fault on the team. Team members may not move the starting lights any time after hands off, however robots may. If a team receives a 2nd fault in a round, they forfeit the round. Team members may not signal to their robots after "hands off" in any way to start their robots or otherwise. Each team will be given a single, red Timeout Card labelled with their team number when they register at the tournament site. At any time **before** 'hands-off' a team may turn in their timeout card and get a 3 minute timeout. The team may spend that time in the pit or at the table, but not to practice at the table (but may practice the starting sequence). Only a single timeout per team is allowed for the tournament. Teams are advised to save their time out card for double elimination rounds, since seeding rounds are best 2 of 3.

After the Game Begins (after Lights on)

Once the starting lights have turned on, the round counts unless a judge rules otherwise. At the start of the game the starting lights turn on and robots are allowed to leave the starting box as soon as the lights turn on. When the lights come on the team members may begin injecting their *Rocket Boosters* and *Nose Capsules* through their interplanetary portal, as they see fit, until they either run out, or the lights start to flash signalling the final 5 seconds of the game.

1. A team may not inject anything other than the game pieces from the *Interplanetary Storage Area*.
2. Other than nominal intrusion (arguably accidental and not affecting game play), a team member may not break the plane of the shield around the *interplanetary portal*. Team members are not allowed to directly touch their entry.
3. Robots may insert a probe into the portal so long as neither it nor the robot grasps the shield around the portal.
4. The probe may have sensors that a team member can touch with a game piece. Additionally, the robot may project a structure through the portal and the team member may place injection items on it.

The round lasts two minutes (120 seconds). The lighting Sequence is:

- 0 seconds: lights turn on; robots can leave start boxes; capsules and boosters can be injected
- 15 seconds: lights turn off
- 115 seconds: Lights blink for five seconds; no further space equipment can be injected
- 120 seconds: lights turn off; game over; robots must turn off motors and freeze or power down servos.

Judges may at any time after a game has started, decide that a robot is in violation of construction rules, or that team members are guilty of interference, and then disqualify the team's entry for that round.

End of Game

Robots must **cut power to their motors (including those on the Create) and stop servo motion** by the end of the round or that team will lose the round in all situations except against a team that does not break the boundary of the starting box (in seeding this condition will give a score of 0). Scoring is based on the location of pieces at the end, not how the pieces got there. Scoring takes place when the round has ended and items have come to rest.

If all motion has stopped before 120 seconds, the judges may ask the teams if their robots are done and if so may end the round at that time (both teams must agree). Incidental motion from a servo holding a position under load is OK.

If teams do not agree with a score calculation they must notify the judges **immediately**. Do not be afraid to talk to the judges about your score. Any scoring issues must be addressed while both teams are at the game table. Once both teams agree with the judges' score and a team member from each team initials the score sheet, the score is **final**.

Challenges

Challenges may only come from judges and team members at the table. If either team wants to challenge the validity of the robots they are facing, they have to bring it to the table judges' attention during the inspection period. Teams can bring the list of parts to the table to aid in the inspection. Challenges have to be specific.

Judges are the final arbiters. Judges can dismiss what they believe to be spurious or irrelevant challenges. Teams determined by the judges to be in safety or performance changing violation will be given an appropriate time period by the judges (typically a minute) to remove the offending parts or forfeit that round. A robot that is determined before the beginning of a round to be in a safety or performance changing violation of the construction rules will not be allowed to play while in that state. A robot ruled to be not human-safe will not be allowed to run until modified.

There are no instant replays; we do not want to see videos to question decisions; if a team is unhappy with a judge's decision, they should politely challenge it then and there; **challenges to scoring or robot construction after the teams have left the table will not be considered. Prior to leaving the table teams may request a table judge to fetch the head judge for a final ruling.**

Seeding Rounds

Seeding rounds take place before double elimination. There will be three seeding rounds for each team. In seeding, teams play the game unopposed, but both sides are scored since a team may score points for the other side. The Seeding round score is (your side score) - (opponent side score). During Seeding rounds your opponent's score will always be zero unless your team scores points on your opponent's side.

Seed scores of less than 0 will be counted as 0, except when a team passes on a round, in which case their score will be -1 for the round. A team's Seed Score is the average of their best two seeding rounds.

The table side used by a team for a seeding round is determined when teams are called to be on deck for their next round.

Double Elimination

A team is out of the double elimination tournament when it has lost two games. Initial matches are decided by KIPR tournament software using seeding round scores. Matches and table sides during a tournament are determined as the tournament progresses using KIPR tournament software. The two teams for a match play each other and the highest score at the end of the game wins subject to tie-breakers and special scoring conditions. Double elimination scores do not affect ranking, only wins and losses.

Alliance Matches

Alliance Logistics

At selected tournaments, if a team is eliminated from the Double Elimination tournament before the Finals of Double Elimination play, that team may sign up to play in Alliance Matches. Alliance Matches will pair up two teams to play the game collaboratively with the goal of scoring the most points. Each team will bring one robot to the table to run simultaneously. The teams will place their robots in any of the starting boxes (i.e. both on the A side, both on the B side, or split between the A and B side).

Alliance Scoring

Alliance rounds will follow all of the same scoring rules as a regular Botball round. The total Alliance score is (Your side score) + (Ally's side score). The Alliance team with the highest combined score from a single run will win the Alliance Tournament. Alliance matches will be conducted until tournament officials suspend play (usually when the final double elimination rounds are reached).

Construction Rules

The official construction rules for the 2013 Game consist of this 2013 Botball Game Review document **and** any updated game rules on the Team Home Base. Posts on the 2013 Team Home Base in the Game Rules Question area will be used to update the document.

Kit Rules

1. Robots may be constructed out of any or all of this year's kit parts except: the boxes, bags, wrapping or packing material, the chargers, download cables (including the white iRobot Create cable), wrenches, screwdriver and color stickers. Materials supplied at the workshop for creating your game board (e.g., Botguy, poms, etc) are not part of the kit and cannot be used on your entry. The included cameras are the only USB devices that may be plugged into a robot during the game.

2. Twelve square inches of UGlu have been supplied in the kit and additional UGlu may be used as desired (at team's expense). It may only be used for construction purposes; it may not be exposed for sticking things otherwise in any manner. *In particular, this means you may **not** use UGlu to contact the game board, game elements, or the other team's entry.* **Note that hot melt glue or any other adhesives are not allowed.**

   - Spare UGlu may be purchased through the Botball Store or the retailers listed at:

     http://www.ugluit.com/index.php?id=73

3. Judges may require excessive UGlu to be removed. You should always try to come up with a mechanical means for construction and only resort to UGlu as a last resort!

4. Supplied servo accessories such as grommets, screws, etc may only be used to mount pieces to the servo horn.

5. Servos and motors may be mounted to structural pieces using the supplied machine screws.

6. You may trim the connector potting material as needed to ease insertion or mounting of sensors. Damaged pieces will be replaced at teams expense.

7. Servo horns may be trimmed as desired. Damaged pieces will be replaced at teams expense.

8. Extra pieces you may add to your entry are:

   a. Up to 100cm of thread or line or cable (maximum diameter 1mm) may be used as desired except for offensive measures such as entanglement and entrapment.

   b. Paper (maximum 20#) so long as the amount can be taken from a standard 8.5" X 11" sheet.

c. Standard ¼" thick foam board as long as the amount can be taken from a standard 8.5" X 11" footprint.

d. Up to 10 standard office rubber bands of maximum size #19 may be used (#19 is 3.5" x 1/16" x 1/32").

8. If your entry uses paper and/or foam board, you MUST bring a template showing how the material you are using was cut out of **each** 8.5 X 11 sheet. The paper/ foam board may only be held in place through the use of other kit parts (including UGlu). **Paper and foam board may only be black or white; only gray scale may be used for printing including official logos for sponsors of your team. Teams may print QR codes on their paper; however the codes for the letters P and T are prohibited.**

10. Rubber bands may not be glued or melted. Rubber bands may be cut, but only a total of ten rubber bands or five pieces of rubber band (or any combination therein) may be used on a single entry.

11. Soda straws, paper, electrical tape and/or foil may be used as light guides for sensors (light guides may be shielded by using tape, but not in a fashion that is for structural purposes or for manipulation). Light guide materials are in addition to the allowable parts.

12. **Teams are not allowed to shield robot sensors from outside of their official entry (i.e., teams are not allowed to stand between their robots and the audience to keep the robots from sensing the audience). Teams should orient and calibrate the sensors on their robot appropriately so that this is not an issue.**

13. You are limited to ten (10) 4" white zip ties (included in the kit), and they may be used for any purpose. You may replace damaged ties with ones of equivalent size (black or white).

14. Lego parts cannot be physically modified.

15. Metal parts may NOT be cut, or broken to a smaller size. Straps and plates may be bent if desired.

    - Warning: KIPR will not provide replacements for metal parts that have been altered or damaged. Replacements may be purchased from the Botball Store.

16. Optional Create parts are the rear wheel, the drive wheel clips, and the rear cargo bay wall. These parts may be used as desired as kit parts. The rear cargo bay wall may be removed, disassembled and loaded with standard pennies for added weight, in which case it must be re-installed on the Create. The Create may not be assembled/disassembled otherwise. The green battery box may only be used as a substitute battery.

17. Teams are limited to the number and size screws as follows: eight - #6 silver screws (packed with the Create), 25 - #8-32 quarter inch, 50 - #8-32 half inch, and 40 - #8-32 three-quarter inch screws. All #8-32 screws are black. There are 10 silver M3 x 14mm screws and six silver M3 nuts.
    - Only the #6 machine screws should be used in the mounting holes on the Create.

Robot Logistics

18. Each robot must have a name (G rated) approved by an adult team leader before the tournament.

19. Multiple processors (such as two Links) may exist on a single robot.

20. It is not necessary to use all the parts in a kit.

21. The starting box is 48" X 22" X 15"

    - The starting box boundaries are given by the **interior edge** of the PVC and **interior edge** of the tape and pencil lines that delineates it.
    - The starting box extends vertically **15 inches (38cm)**

22. **All elements (game elements, multiple robots and other structures) being used by a team for a round must be within the volume of the starting box at game start**

    - After game start, robots are allowed to expand in size.
    - Starting light sensors should be shielded as demonstrated in the workshop slides and may not extend outside the starting box
    - Game elements specified for the starting box must be placed in the starting box whether or not a robot is intended to manipulate them

23. All Independent structures should be clearly marked with the team's number. Maximum label size is 1" diameter (Avery #5410), or you may use permanent marker directly on the structure.

24. Robot teams can have a maximum of 4 independent structures on the field at a time

    - All components together must fit in the starting box **without any external restraint** (the starting box floor and border PVC is not an external restraint) at game start.
    - Each structure must be large enough so that it does not, in the judge's opinion, constitute a jamming or entanglement hazard.
    - Examples of structures include: robots, barricades, detachable baskets, etc.
    - A team's entry can contain as many robots up to the structures limit that can be constructed from the parts in a single kit.
    - Items intentionally ejected from a robot count (judges judge intention); there are special rules regarding projectiles, discussed later.

25. No electrical modifications may be made to any Link, the Create, any sensors or any motors, except you may substitute a different battery in the Create (i.e., the green battery pack filled with alkaline batteries – an expensive alternative!)

26. No wire extensions may be used except those provided in the kit (foil may **not** be used as wire!)

Safety

27. Human & Robot Safety:

    - No untethered robot launched projectiles, other than LEGO balls and game pieces are allowed (items sent onto the game board through the *interplanetary portal* are not considered to be projectiles)
    - No tethered projectiles containing metal pieces are allowed
    - No metal pieces are to be used in effectors that move or rotate at high speed
    - No metal protrusions are to be used that are likely to cause electrical short risks for other robots
    - Judges will judge safety. Teams may alert judges to a potential safety or entanglement hazard, but judges will interpret whether or not a robot is safe, needs to be modified, or is not allowed to run.

28. Electrical tape (either black or white) may be used (or required to be used by judges) to cover metal pieces that are deemed to otherwise be a safety risk to robots or humans. NOTE: tape still may not be used structurally.

29. If a robot is not considered safe, as decided by the Head Judge, then the robot will not be allowed to run until it has been modified.

External Communication

30. No external communications (e.g., IR, blue-tooth, wireless, or semaphores) may be used during tournament play:

    - The serial cables & chargers may not be used during tournament play
    - Non-radio communications among the robots forming your team's entry is allowed
    - Teams found in violation of this rule may be removed from the tournament

Overall Winner Calculations

A team's overall score is calculated as the sum of their Seeding, Double Elimination, and Documentation scores. The overall score is between 0 and 3.

Documentation Scoring Formula

$$\text{Doc Score} = \frac{3}{10}(\text{Period 1 Doc\%}) + \frac{3}{10}(\text{Period 2 Doc\%}) + \frac{1}{10}(\text{Period 3 Doc\%}) + \frac{3}{10}(\text{On site Doc\%})$$

Seeding Scoring Formula

$$\text{Seed Score} = \frac{3}{4}\left(\frac{n - \text{Seed Rank} + 1}{n}\right) + \frac{1}{4}\left(\frac{\text{Team Average Seed Score}}{\text{Max Tournament Seed Score}}\right)$$

Double Elimination Scoring Formula

$$\text{Double Elimination Score} = \left(\frac{n - \text{DE Rank} + 1}{n}\right)$$

Note: For all formulas *n* = Number of Teams at Tournament