2016 Botball Game Review

Version 1.30 01/08/16

Contents

Revision History

Version 0.95 – This write up was cloned from the preliminary 2015 game document. The pictures on page 3 should be considered "close enough". A 3-D rendering from the SolidWorks workup is included in the table construction document and may be helpful to use in conjunction with the pictures in this document for interpretation of the game rules.

Version 1.00 – For this write up the game picture was replaced with one showing the finalized version of the game board as prepared for the January, 2016 Instructors Summit. The overhead view of the game board layout has been corrected to match the finalized version of the game board. Note that it is not to scale. The game board construction document more precisely provides location information for the game board. The role of the telemetry panel was modified to allow teams to use it for supplemental robot communication during the progress of the game. The tape lines for the slope and crater rim were reconfigured for black duct tape. Miscellaneous errata have been corrected and references to the KIPR Link changed to the KIPR robot controller.

Version 1.10 – Capitalized all named game objects, and italicized them for their first use. Cleaned up the overhead board layout.

Version 1.20 – Made changes to the game layout and scoring to better balance this year’s game. Will replace scoring matrix with a judge’s score sheet.

Version 1.30 – This. Changes. Everything.

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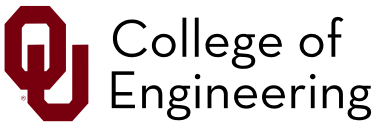
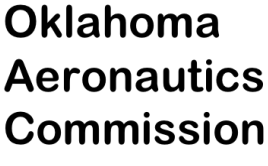




This Year's Game

Robots Save Mars Mission Crew Member

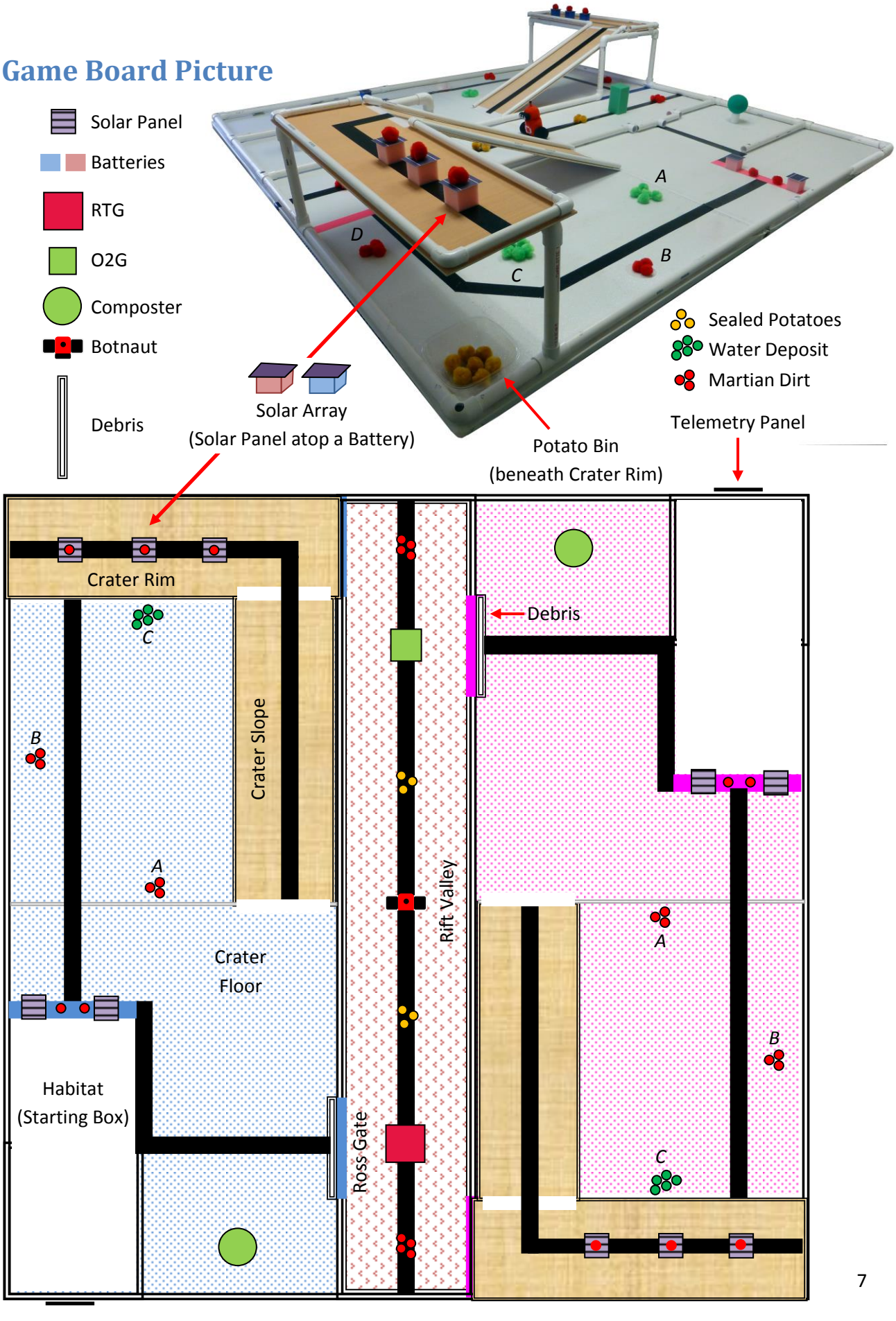
Unanticipated events have forced an immediate evacuation of the first Mars mission to have a live crew. *Botnaut* was unable to reach the escape pod in time for its emergency lift off and is now stranded on the Martian surface. To survive for months while waiting for the next mission to arrive, Botnaut needs help from your robots, which NASA has sent as an advance mission to prepare a new *Habitat* on the *Crater Floor* to sustain the next crew. Fortunately, the crater floor is not too far from the *Rift Valley*, where Botnaut is searching for *Water Deposits*, *Sealed Potatoes*, and scavenging survival gear from an earlier lander. The survival gear – an *Oxygen Generator (O2G)* and a *Radioisotope Thermoelectric Generator (RTG)* – are in need of maintenance for long-term occupation of the Habitat your robots are constructing.

The storm has knocked out most radio communications, but your robots can still get directions from NASA via a *Telemetry Panel* located near the Habitat. Using communication can assist your robots in helping Botnaut get to the new habitat with as many resources as possible.

Saving Botnaut will also require your robots to do a number of things to ready the crew quarters for habitation. On e of these will be to clean the *Martian Dirt* off of each *Solar Array* (defined as a *Solar Panel* atop a *Battery*) already set up on the *Crater Rim* and, if possible, add to their number. Care must be taken getting up to the Crater Rim since it might require traversing a treacherous *Crater Slope* up the crater wall. On the Crater Floor, your robots will need to retrieve a supply of Sealed Potatoes from their storage location within an insulated container – the *Potato Bin* – underneath the Crater Rim. By adding Water Deposits and Martian Dirt in the right proportions, as well as special *Composter* located near the Habitat, it is possible to get the potatoes to begin growing as a food source for keeping Botnaut alive once pre-packaged food supplies on hand have been exhausted.

As for the Rift Valley, the shortest route requires clearing a pathway – the *Ross Gate* – of *Debris* to get to Botnaut, but there is also a longer route free of obstacles. One word of caution: a second team of robots is also at work at the other end of the crater performing similar tasks to yours to provide mission redundancy, but the communications damage might have them making efforts that conflict with your attempts to help Botnaut.

Game Board Picture



Game Board Areas

Official game board specifications are on the Team Home Base. All tournament boards will match these specifications within +/-0.5 inches or 1%, whichever is greater.

The game board is composed of four 4'x4' (reusable) modules whose surfaces are pebble grain white fiberglass reinforced plastic panel (FRP). A fully assembled game board will be ~8'x8'. A panel channel or black duct tape is used to close exposed seams where modules abut.

Side – Each side is delineated by the inside edges of the surrounding PVC and the tape marking the entrance to the Rift Valley. The Rift Valley, including the colored tape in the PVC openings is not on either side.

Starting Box – The boundary of each side's *Starting Box* (30" x 15" x 12" high) is defined by the **inside edges** of the tape lines and PVC that surround the Starting Box. The color of a side is identified by the color of the tape fronting its Starting Box.

Habitat – Each side's Habitat is the floor of its Starting Box.

Crater Floor – The boundary of each side's Crater Floor is defined by the inside edges of the PVC and does not include any colored tape, the Habitat, Crater Slope, Crater Rim, or Rift Valley.

Crater Rim and *Crater Slope* – The Crater Rim and Crater Slope are 39" x 12" x 3/16" plywood (cut from a 2' x 4' piece - you can substitute foam core for plywood on your practice table). The boundary of a side's Crater Rim and Crater Slope are defined by the **inside edges** of the PVC that surrounds each. The surface connecting the Crater Rim to the Crater Floor is the Crater Slope. The horizontal surface connecting to the Crater Slope is the Crater Rim.

Potato Bin – The Potato Bin for each side is a container placed on the Crater Floor underneath the Crater Rim in the corner across from the Habitat. The corner tab of the bin will be placed overlapping the corner of the PVC. At game start, each Potato Bin contains 7 gold poms.

Ross Gate – An entrance to the Rift Valley denoted by colored tape.

Rift Valley – The floor of the Rift Valley is the 18" wide corridor between the two-team sides and is bisected by a black (duct) tape center line joining the panels. It can be accessed by clearing the Debris or from an 18" wide entrance (another Ross Gate) under each Crater Rim. Each Rift Valley entrance (Ross Gate) is marked by a tape threshold that is the same color as its side. The threshold (tape) is not part of the side.

Telemetry Panel – The Telemetry Panel for each side is a transparent clipboard mounted at the center of the back-end of the Habitat. During setup and any time throughout the game, a team can place black-and-white patterns (such as QR codes) on their Telemetry Panel, which faces their Crater Rim. The pattern must be printed on a US letter-sized piece of paper. A pattern must be completely removed before another pattern is placed. A pattern not mounted on the Telemetry Panel must be placed on the floor. During pattern placement, teams must **not** interfere with the game, including making contact with game elements or robot structures.

Game Pieces

- 1 - Botnaut
- 1 - 3" x 3”x 6” green foam block (*Oxygen Generator* or *O2G*)
- 1 - 4" red foam cube (*RTG*)
- 2 - 4" green foam balls (*Composters*)
- 5 - 2" pink foam cubes (*Batteries*)
- 5 - 2" blue foam cubes (*Batteries*)
- 12 - solar panels (form a *Solar Array* when placed on top of 2" cube)
- 30 - red poms (*Martian Dirt*)
- 20 - yellow poms (*Sealed Potatoes*)
- 20 - green poms (*Water Deposits*)

Game Piece Starting Positions

- Botnaut will be placed on the middle of the Rift Valley facing the audience.
- 2 clusters of 3 gold poms will be placed at marked locations along the line in the Rift Valley – 1 cluster of 3 gold poms in front of Botnaut, and 1 cluster of 3 gold poms behind Botnaut.
- The Oxygen Generator (O2G) and RTG will be placed along the line in the Rift Valley at marked locations near the gold poms. The side will be determined randomly by the table program.
- 7 gold poms (Sealed Potatoes) will be placed in each Potato Bin.
- 4 red poms (Martian Dirt) will be placed at each end of the Rift Valley at marked locations.
- A cluster of poms will be placed in each of 4 marked positions outside each Habitat (Starting Box), positions labeled A, B, C, and D. Each cluster will consist of either 3 red poms or 5 green poms. For each team’s side, 2 of the clusters will be all red poms and 2 will be all green poms. The labeled location for each cluster will be determined randomly by the table program and set up by the judges during hands-off.
- 3 Solar Arrays (of a Battery color matching the colored tape of the corresponding side) will be placed at marked positions along the black centerline of each Crater Rim. Each Solar Array will have a red pom (Martian Dirt) on top of its Solar Panel rendering it inactive. For a Solar Array to be active, no red pom may be touching its Solar Panel.
- Each team will have 2 Solar Arrays (each consisting of a Solar Panel and a Battery of color matching the colored tape on their side) and 2 red poms (Martian Dirt) that can be placed anywhere on the colored tape at the opening of their Habitat (Starting Box).
- The Debris on each side of the Rift Valley is an unmounted PVC structure that blocks an entrance (Ross Gate) to the Rift Valley. Before hands-off, teams may choose to position the Debris so that the coupler opens toward either their Habitat or the Rift Valley.

Scoring

1. Robots On YOUR Crater Slope On YOUR Crater Rim On OTHER side Crater Slope On OTHER side Crater Rim	 ___ X 10 = _____ ___ X 20 = _____ ___ X 30 = _____ ___ X 60 = _____	_____ **TOTAL**
2. Botnaut (Circle one) On YOUR Crater Floor or Habitat On YOUR Crater Slope On YOUR Crater Rim	 10 20 → 40	_____ **TOTAL**
3. Red Block (RTG) / Green Block (O2G) On YOUR Crater Floor, Slope, or Rim On YOUR Habitat colored tape	 ___ X 10 = _____ ___ X 30 = _____	_____ **TOTAL**
4. Green Ball (Composter) On YOUR Crater Floor, Slope, or Rim In volume of Potato Bin on YOUR side	 ___ X 5 = _____ ___ X 20 = _____	_____ **TOTAL**
5. Solar Arrays (Panel on top of Small Cube) On YOUR Crater Floor or Slope On YOUR Crater Rim	 ___ X 5 = _____ ___ X 20 = _____	_____ **TOTAL**
6. Poms (Red, Green, Yellow) On YOUR Habitat (R, G, Y) In Potato Bin: (R, G) anywhere on YOUR side (Y) on YOUR Habitat IF G = Y IF R = Y Circle Multiplier(s) → X2 X2 →	 ___ X 1 = _____ ___ X 4 = _____ ___ X 2 = _____ Subtotal = _____ ↓ ___ X _____ = _____	_____ **TOTAL**

Scoring Rules

The official scoring rules for the 2016 Botball Game are made up of this 2016 Botball Game Review document **and** any updated scoring rules on the 2016 Team Home Base. Posts on the 2016 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. To be in a Habitat, a game piece must touch the surface of that Habitat (PVC does not count as the surface). If the Potato Bin is touching the surface, it is in that Habitat.
2. To be in a Potato Bin, some part of a game piece must be within the volume of that Potato Bin.
3. Green poms (Water Deposits) and red poms (Martian Dirt) score inside a Habitat, within a Potato Bin, or within a Potato Bin inside of a Habitat.
4. Gold poms (Sealed Potatoes) score inside of a Habitat or within a Potato Bin inside of a Habitat. In addition, if the number of gold poms is equal to the number of red and/or green poms also contained within a Potato Bin inside of a Habitat, the value of all poms within that Potato Bin increases.
5. The green ball (Composter) scores on the surface of a Crater Floor, Crater Slope, Crater Rim, or within a Potato Bin. When in a Potato Bin, the value of the Composter increases.
6. The RTG and the Oxygen Generator (O2G) score on the surface of a Crater Floor, Crater Slope, Crater Rim, or on the colored line at the opening of a Habitat. When on the colored line at the opening of a Habitat, the value of the game item increases.
7. For a cube (Battery) and Solar Panel to form a Solar Array, the cube must be touching the surface of a Crater Floor, Crater Slope, or Crater Rim, and the Solar Panel must be touching the top surface of the cube (not leaning against the edges of the top surface). If two Solar Panels are on the same cube, the combination only counts as a single Solar Array. If a red pom (Martian Dirt) is touching a solar panel, the Solar Array is inactive and does not count for scoring purposes.
8. For the purposes of scoring, a robot is defined minimally as a KIPR Robot Controller with at least two motors or a Create connected to it. A robot with 2 controllers counts as a single robot.
9. A game object or robot scores on a Crater Rim if it is touching the top of the surface of the Crater Rim and is not touching a Crater Slope, a Crater Floor, a Ross Gate, or the Rift Valley. For a robot to score in the Crater Rim, its power button must also be above the plane of the Crater Rim surface.
10. A game object or robot scores on a Crater Slope if it is touching the top of the surface of the Crater Slope and is not touching a Crater Floor, a Ross Gate, or the Rift Valley.
11. The score is determined by final object location, and not by how they got there. Judges will wait until any scoring objects still moving have come to rest before scoring a game.
12. A game piece cannot score in more than one area. If it is in more than one area it is counted as being in the area which produces the higher overall score.
13. During the Double Elimination rounds, a team's Create may not ever be entirely on the other team's side. **Doing so will result in a disqualification for the offending team.**

If your team doesn't agree with the score as calculated they must immediately notify the table judge(s) **before** leaving the table and **before** any items have been moved on the table. If they do not agree with the table judges they may ask to speak with the head judge. Teams will be required to initial the score sheet before leaving 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 (including the 12” ceiling), 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 (first condition to apply):

1. Team with the most robots on the Crater Rim.
2. Team scoring Botnaut in their Habitat.
3. Team with the most scoring solar arrays on the Crater Rim.
4. Team scoring the RTG on their Habitat's colored tape.
5. Team scoring the Oxygen Generator (O2G) on their Habitat’s colored tape.
6. Team with the most points in their Potato Bin.
7. Team with the most green poms in their Potato Bin.
8. Team with the most red poms in their Potato Bin.
9. Team with Botnaut on their side.
10. Team with a scoring RTG.
11. Team with a scoring Oxygen Generator (O2G).
12. Team with the most scoring Solar Arrays.
13. Team with the green ball (Composter) in their Potato Bin.
14. Team with the most poms in their Potato Bin.
15. Team with the most poms in their Habitat.
16. Team with the most scoring green balls (Composters).
17. Team with the most gold poms in their Habitat.
18. Team with the most green poms in their Habitat.
19. Team with the most red poms in their Habitat.
20. Team with the robot (defined by the KIPR robot controller power switch) closest to Botnaut.

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, we request that the robots not leave the pits for any purpose until the conclusion of the tournament or suspension of play for the day. Adults are not allowed into the pits (except to help teams carry in equipment as they are arriving in the morning); 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, but **does** allow for appropriate mentor guidance of the team.

Spirit of Botball: This is a 100% student-driven experience.
Students know this and adults know better!

Mentors, parents, and other adults who wish to actively participate in the construction, programming, testing, and/or documentation of a robot are invited to participate in the KIPR Open.

Setup (before "Hands-Off")

Up to two students from a team may bring the team's robot(s) to the tournament table and perform the setup. Teams will place their robot(s) within their Starting Box as desired. Teams arrange the 2 Solar Arrays and the 2 red poms (Martian Dirt) on the colored tape at the opening of their Starting Box as desired. Teams may choose to position the Debris so that the coupler opens toward either their Habitat or the Rift Valley. Teams may also place black-and-white patterns (such as QR codes) on the Telemetry Panel facing the Crater Rim. 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 edge of the game board so as to not interfere with the Telemetry Panel. Starting lights must either be aimed at the team's light sensors or at the floor and cannot be aimed so as to disrupt an opponent (judges' ruling).
- Starting lights may **not** break the vertical projection of the board inside its PVC boundary.
- There are two starting lights for each team, so each robot can have its own starting light; both lights will turn on and off at the same time and cannot be controlled individually.
- **Teams cannot touch starting lights after Hands-Off.**

Teams will greet each other and visually inspect each other's robots **before calibration**. Inspection is limited to a maximum of 1 minute unless a specific challenge is made. Teams are encouraged to utilize the **Bill of Materials** spreadsheet provided on the Team Home Base for each of their robots to ensure they won't have a robot's construction challenged (the Bill of Materials is also useful as documentation). Teams must notify table judges **before the end of "Hands-Off"** if they believe the table is not set up properly. When both teams are ready, each team positions/activates its robots and then – **Hands-Off**!

If judges determine a team is taking too long to calibrate, they will issue a 30-second warning. At the end of the 30 seconds, a team that is not ready for "Hands-Off" 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")

Once "Hands-Off" has been declared, the team members will either remain by their Starting Box 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 and a camera may be used to read from the Telemetry Panel. If a moving violation 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" to start their robots. Teams may not place or replace a pattern in the Telemetry Panel until after the game starts.

During "Hands-Off", the judges place the RTG and Oxygen Generator (O2G) on either side of Botnaut, and place the clusters of red poms (Martian Dirt) and green poms (Water Deposits) on the Crater Floor. The locations of these game objects will be determined randomly by the Controller that handles the starting lights for each round.

Timeout Card

Each team will be given a single red Timeout Card, labeled with their team name and number when they register on-site. Only the team whose name appears on the card may use it. The card can only be used while that team is at the table before "Hands-Off". While a team is at the table, 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 pits 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 entire tournament. Teams are advised to save their timeout card for the Double Elimination rounds, as Seeding rounds are best 2 out of 3.

After the Game Begins (after the lights turn 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 then allowed to leave the Starting Box.

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

- 0 seconds: lights turn on; robots can leave start boxes
- 15 seconds: lights turn off
- 115 seconds: Lights blink turn back on and blink for five seconds.
- 120 seconds: lights turn off; game over; robots must turn off motors and freeze/power down servos.

Throughout the game, teams may place or replace black-and-white patterns on their Telemetry Panel. A pattern must be completely removed before another pattern is placed. A pattern not mounted on the Telemetry Panel must be placed on the floor. During pattern placement, teams must **not** interfere with the game, including making contact with game elements or robot structures.

During the Double Elimination, a team's Create may not ever be entirely on the other team's side.

Judges may at any time after a game has started decide that a robot is in violation of game 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 (the students representing the team at the game board) 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. If teams do not agree with the table judges after discussing the issue, they can ask to speak with the head judge. Once both teams agree with the judges' score and a team member from each team initials the score sheet, or the head judge has arbitrated and made a decision, 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. Teams are encouraged to have a **Bill of Materials** for each robot they bring to the table as a means for minimizing the likelihood of a robot's construction being challenged. There is a Bill of Materials spreadsheet on the Team Home Base, which can be used to specify which kit parts are being used for the robots at the table.

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 make a correction, remove offending pieces, or take the robot off the table; otherwise, they 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 unsafe for humans 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 that a table judge fetch the head judge for arbitration and a final ruling.**

Spirit of Botball: Mentors and spectators should respect teams' and judges' decisions.

Seeding Rounds

Seeding rounds take place before Double Elimination. There will be three Seeding rounds. The order in which teams appear in each round is set by tournament software and is the same for each round. In Seeding, a team plays the game unopposed, and the score for both sides counts, where your Seeding Round score is (*the score for your side*) + (*the score for the other side*). Note that Seeding scores are the **sum** of the entire board and **teams are encouraged to cross sides and use the whole board for scoring during Seeding**.

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 (the side from which the robots will start) is determined when teams are called to be on deck for their turn in a Seeding round.

Double Elimination (DE) Rounds

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. As the tournament progresses, the order of matches and table sides for the competing teams are determined 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 tiebreakers and special scoring conditions. The size of Double Elimination scores does 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 same side or split between the two sides).

Alliance Scoring

Alliance rounds will follow all of the same scoring rules as a regular Botball round. The total Alliance score is (*Your side's score*) + (*Ally side's 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 2016 Botball Game consist of this 2016 Botball Game Review document **and** any updated game rules on the Team Home Base. Posts on the 2016 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, wrenches, screwdriver and color stickers. Materials supplied at the workshop for creating your game board (e.g., Botnaut, 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. **Consult the official parts lists for allowable kit parts!**
2. Small removable mounting dots/strips such as those produced by Glue Dots, UGlu and/or Scotch Brand Restickable Dots/Strips (acquired at team's expense) may be used for construction purposes. They may not be exposed for sticking things otherwise in any manner. In particular, this means you may **not** use your mounting dots/strips to contact the game board, game elements, or the other team's entry. **Note that neither hot melt glue nor any other adhesives, other than removable mounting dots/strips, are allowed in robot construction.**

   – Mounting dots/strips are available at stores such as Home Depot, and online from vendors such as Amazon.

3. Judges may require excessive adhesive to be removed. You should always try to come up with a mechanical means for construction and only resort to using adhesive methods 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 team's expense.
7. Servo horns may be trimmed as desired. Damaged pieces will be replaced at team's 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 single standard US letter-sized (8.5" X 11") or A4-sized (210mm x 297mm) sheet.
   c. Standard 3/16" thick foam board as long as the amount can be taken from a standard US letter-sized or A4 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").

9. If your entry uses paper and/or foam core board, you MUST bring a template showing how the material you are using was cut out of **each** 8.5" X 11" (or A4) sheet. The paper/foam core board may only be held in place through the use of other kit parts (including UGlu). **Paper and foam core board may only be black or white; only grayscale may be used for printing including official logos for sponsors of your team, or QR codes.**
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 externally to 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. Teams using cameras may request that anyone whose attire includes significant color blobs closely matching game object colors stand well back from the table.**
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 top plate, dust bin, and brush bar box. If any optional pieces are removed, they may NOT be reused anywhere else on the entry. The Create may not be assembled/disassembled otherwise.
17. Teams are limited to the number and size screws as follows: 20 -#8-32 quarter inch, 45 -#8-32 half inch, and 35 -#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. There is also #8-32 threaded rod: 10 - 1", 2 - 2", 2 - 3", and 1 - 6" long.

Robot Logistics

18. Each robot if named can only have a name (G-rated) approved by an adult team leader before the tournament.
19. Multiple processors (such as two KIPR robot controllers) may exist on a single robot.
20. It is not necessary to use all the parts in a kit.
21. The starting box is 15" x 30" x 12" tall.
    - The starting box boundaries are given by the **interior edge** of the PVC and **interior edge** of the colored and black tape that delineates it.
    - The starting box extends vertically **12 inches (30.48 cm).**

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 neither sensor nor shielding may extend outside the starting box.
    - The Battery cubes must be placed flat and touching the surface of the colored tape line for the Starting Box whether or not a robot is intended to manipulate them. Similarly, the Martian Dirt poms must be touching the surface of the colored tape line for the Starting Box whether or not a robot is intended to manipulate them.

23. All Independent structures not under computer control 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. Teams may only run robots with their team number on them.

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** at game start (the Starting Box floor and border PVC is not an external restraint) including any supplied game pieces.
    - 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 as structures (judges judge intention); there are special rules regarding projectiles, discussed later.
    - The igus© chain **must** be permanently affixed to a robot (defined as a KIPR Robot Controller with a minimum of two attached motors) by at least one end of the chain. Using the igus© chain in a gear-driven system for motion of a robot component counts as being affixed to the robot. The igus© chain may **not** be used as a projectile (even tethered) or as an independent structure. If the Head Judge deems the use of the igus© chain to be in violation of this rule, the offending team will be disqualified for the round.

25. No electrical modifications may be made to any KIPR robot controller, the Create, any sensors or any motors, except for substitution of batteries with one approved by KIPR.

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 game pieces, are allowed.
    - 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 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, Bluetooth, wireless, or semaphores) may be used during tournament play other than what is allowed by use of the Telemetry Panel:
    - The USB 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
    - Your robot controllers must have their Wi-Fi turned off to ensure there is no question about external communication coming into play
        - See the workshop slides for instructions on how to ensure this is done before coming up to the table.

31. Teams are allowed up to ten (10) US standard letter-sized 8½" x 11" sheets of paper (20# maximum) for the purpose of use with the Telemetry Panel. Each sheet must have a separate pattern imprinted on it in black-and-white. Telemetry Panel pattern sheets may not be used for any other purpose than to communicate with the team's robot via the Telemetry Panel. Pattern sheets do not count against the sheet that may be used for robot construction as defined above. Only one pattern sheet may be placed on a team's Telemetry Panel at a time and any pattern sheet not on a Telemetry Panel, or being actively added or removed from a Telemetry Panel, must be placed on the ground. Team members found holding pattern sheets may be found by the judges to be in violation of the game interference rule, which may result in the team being disqualified for that round.

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

$$\text{DocScore} = \frac{3}{10}(\text{Period1Doc\%}) + \frac{3}{10}(\text{Period2Doc\%}) + \frac{1}{10}(\text{Period3Doc\%}) + \frac{3}{10}(\text{OnsiteDoc\%})$$

Seeding Scoring Formula

$$\text{SeedScore} = \frac{3}{4}\left(\frac{\text{n} - \text{SeedRank} + 1}{\text{n}}\right) + \frac{1}{4}\left(\frac{\text{TeamAverageSeedScore}}{\text{MaxTournamentSeedScore}}\right)$$

Double Elimination Scoring Formula

$$\text{DoubleEliminationScore} = \left(\frac{\text{n} - \text{DERank} + 1}{\text{n}}\right)$$

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