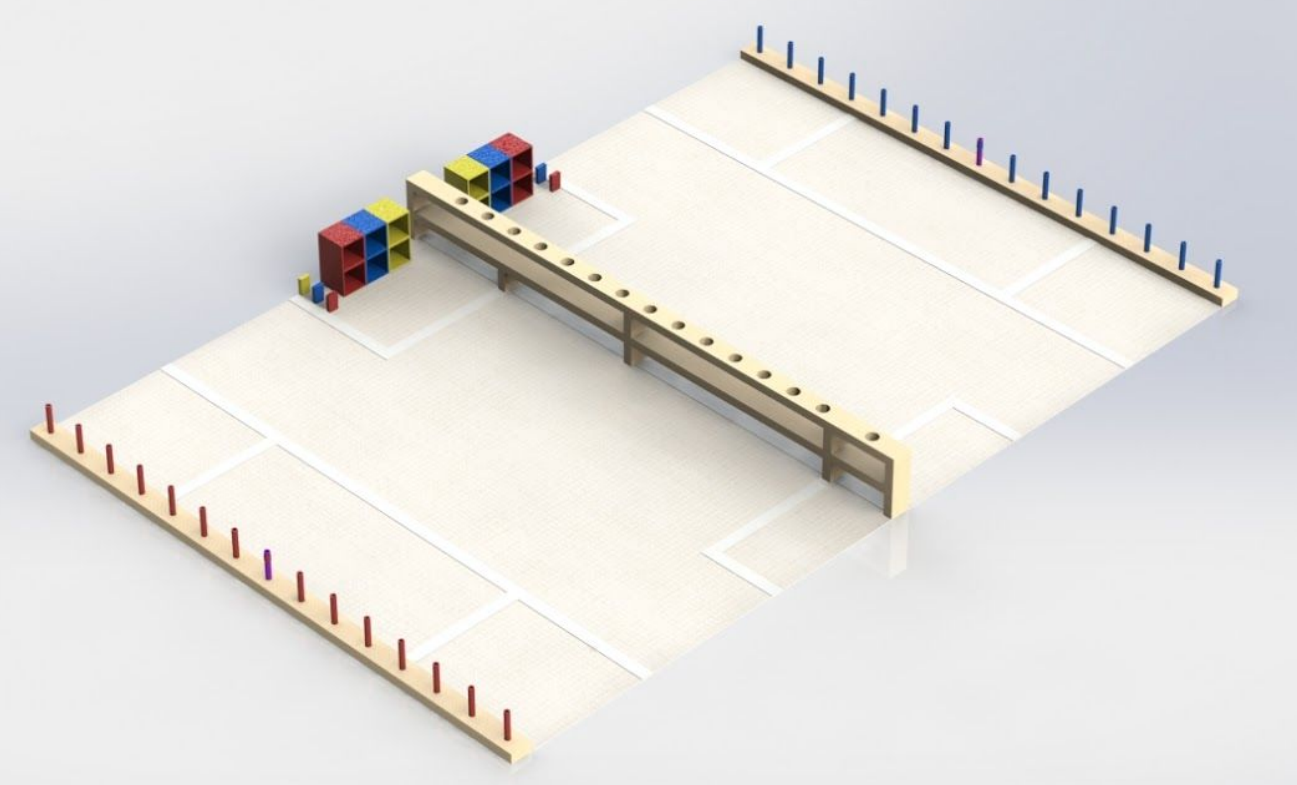


# Savage Soccer 2020: FDA Frenzy

Rules Version 1.0  
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# 1. Definitions

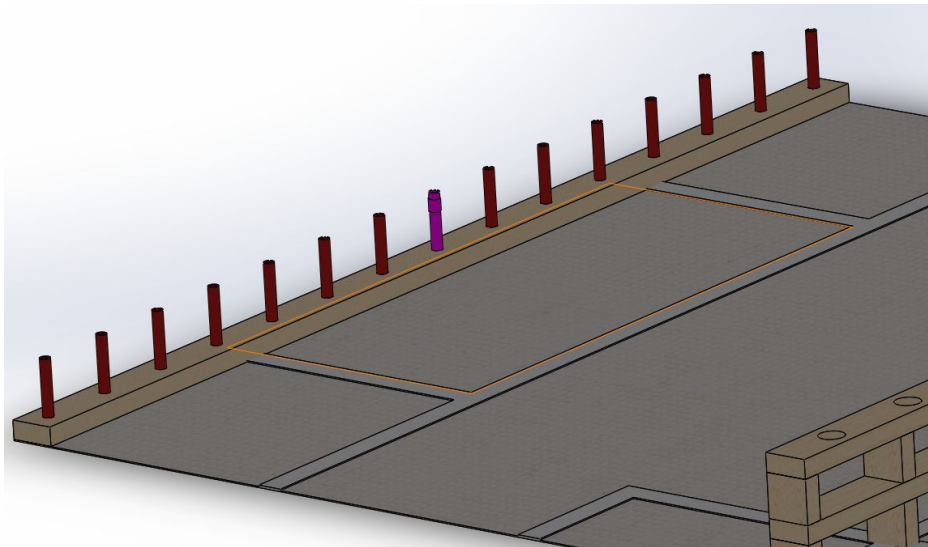
- 1.1. **AUTO LINE:** A line 25" from the end of the LABORATORY, one for each COALITION. AUTO LINES are denoted with 2" gaffer's tape.
- 1.2. **AUTONOMOUS:** The first 15 seconds of each match during which robots run on preloaded code.
- 1.3. **CENTRIFUGE (Colorful Experiments Needed to Test Research Information, For Ulterior Game Experience):** A structure made of six (6) SLOTS used for scoring SAMPLES. Two (2) red SLOTS are stacked on top of each other, two (2) blue SLOTS are stacked on top of each other, and two (2) yellow SLOTS are stacked on top of each other. The red SLOTS are closest to the ends of the LABORATORY, the yellow SLOTS are closest to the RACK, and the blue SLOTS are in between. The CENTRIFUGE is 53.125" from the end of the LABORATORY.
- 1.4. **COALITION:** Two teams which work together to defeat another COALITION in competition. COALITIONS are chosen randomly (in qualification rounds) or drafted (in elimination rounds). A COALITION's teams always share a color.
- 1.5. **COALITION CAPTAIN:** The top-ranked teams at the end of all the qualifying matches.
- 1.6. **COALITION STATION:** An area outside the LABORATORY with borders at the short ends of the LABORATORY where RESEARCH GROUPS operate their robots. Each COALITION has their own COALITION STATION.
- 1.7. **COLLABORTENTION TEST TUBE:** A purple TEST TUBE with a band of 1" wide gaffer's tape placed 0.5" down from the top to denote the COALITION color. COLLABORTENTION TEST TUBES are used for endgame scoring.
- 1.8. **DECONTAMINATION (Designated Edge Cell On Normal Team Alliances, Measured IN Auto To Indicate Outside Navigation):** A 25" square in each corner of the LABORATORY, denoted by 2" gaffer's tape.
- 1.9. **ENDGAME:** The last 30 seconds of the match during the TELEOPERATED period.
- 1.10. **LABORATORY:** The 12' x 8' playing area. A wooden frame that is approximately 3.5" high and 1.5" thick forms the LABORATORY wall.
- 1.11. **POST-DOC:** A RESEARCH GROUP member that is currently not holding a joystick.
- 1.12. **RACK (Research And Collabortention Kiosk):** A structure in the center of the LABORATORY that consists of two 1.5" x 3.5" x 96" wooden beams spanning the width of the LABORATORY and supports for the beams. The lower beam on the RACK is 3.5" above the ground, and the higher beam is 8.5" above the ground. The top beam contains fourteen (14) holes, each 2" in diameter, for scoring TEST TUBES and one (1) hole, also 2" in diameter, for scoring COLLABORTENTION TEST TUBES. The fourteen (14) holes for scoring TEST TUBES begin 10" away from the end of the RACK, on the side of the LABORATORY containing the CENTRIFUGES, and they are spaced 5.5" apart from each other. The hole for COLLABORTENTION TEST TUBE scoring is 5.5" from the end of the RACK, on the side of the LABORATORY furthest from the CENTRIFUGES.

- 1.13. RESEARCH GROUP:** A group of students belonging to a particular team. A RESEARCH GROUP must consist of at least 2 students, but cannot have more than 3 students. If pandemic-related safety concerns arise, RESEARCH GROUPs may consist of just one (1) person.
- 1.14. SAMPLE (Shaded Assets Maintained & Packed by Laboring Equipment):** A 1.75" x 2.875" x 0.625" box used for scoring. SAMPLEs are either red, yellow, or blue in color.
- 1.15. SLOT:** A 4.375" x 4.375" x 5.125" box used for scoring SAMPLEs. The front face of each SLOT is open. SLOTS may be red, blue, or yellow. SLOTS may be made using standard-size tissue boxes for an at-home LABORATORY, but any in-person competitions will make SLOTS out of wood.
- 1.16. STORAGE (Starting Tube Operation Racks At Game Edges):** The structure, one of which is placed at each end of the LABORATORY, where TEST TUBEs may begin the match. The STORAGE is a 1.5" x 3.5" x 96" wooden beam that spans the width of the LABORATORY. Each STORAGE has fifteen (15) holes, each 0.875" in diameter, for TEST TUBEs. The outermost holes are 2.5" from the end of the STORAGE, and the remaining holes are spaced evenly, 6.5" apart from each other.
- 1.17. TELEOPERATED:** The 2-minute period of the match following AUTONOMOUS during which robots are controlled by human drivers.
- 1.18. TEST TUBE (Tubular Enclosure Sanitized and Taken by Teams Under Big Elevation):** A ½"-diameter, 6"-long Schedule 40 PVC Pipe used for scoring. TEST TUBEs are painted the color of their COALITION.

## 2. Game Rules

### 2.1. LABORATORY (Field) Layout

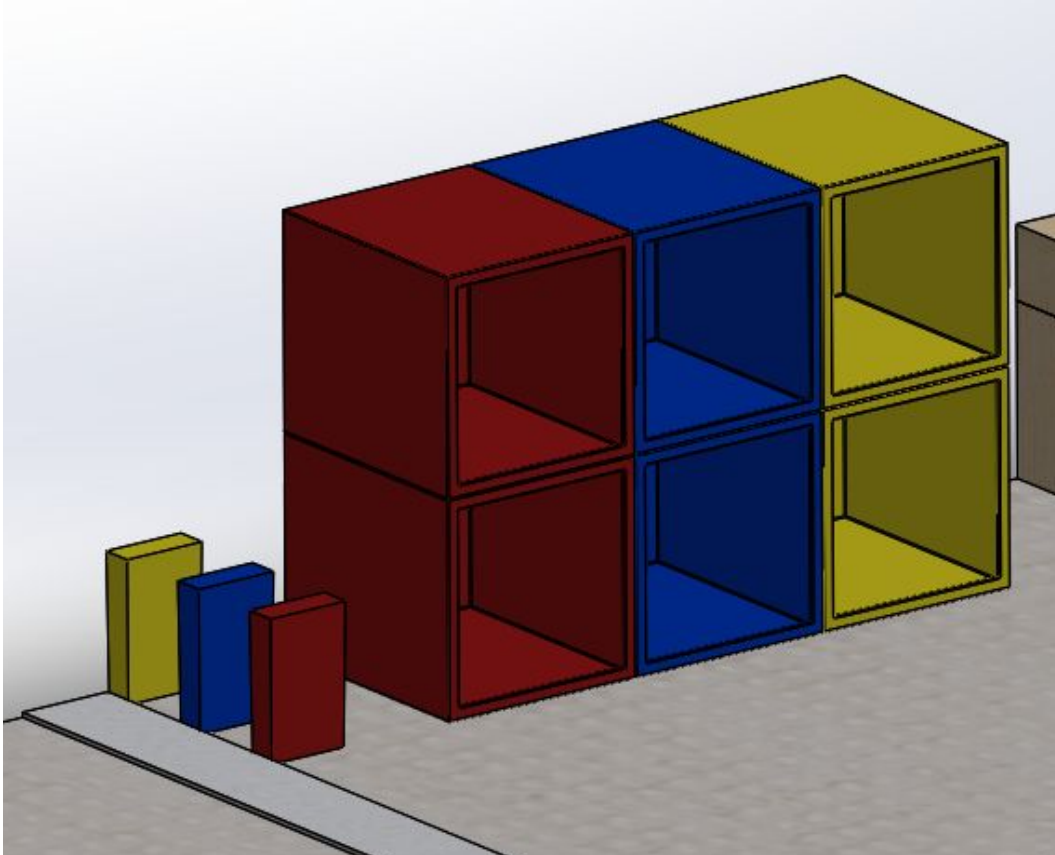
- 2.1.1. The outer boundaries of the playing area are defined by the LABORATORY wall.
- 2.1.2. The main surface of the playing area is "high-traffic" carpet that may have minor bumps and surface irregularities.
- 2.1.3. Robots will begin the match behind the AUTO LINE on their COALITION's side of the LABORATORY. Robots may be in contact with the STORAGE, but they may not be supported by the STORAGE.
- 2.1.4. Each COALITION begins the match with fourteen (14) TEST TUBEs and one (1) COLLABORTENTION TEST TUBE, distributed as follows (See Figure 1):
  - 2.1.4.1. The COLLABORTENTION TEST TUBE begins the match in the central hole of the STORAGE.
  - 2.1.4.2. Each robot may preload up to one (1) TEST TUBE. A TEST TUBE is considered preloaded if it is in contact with the robot at the start of the match.
  - 2.1.4.3. The remaining twelve (12) TEST TUBEs, plus any TEST TUBEs teams choose not to preload, may be placed either on the ground behind a COALITION's AUTO LINE or in the remaining holes in a COALITION's STORAGE.



**Figure 1: Depicts a possible starting configuration for the red COALITION. COALITIONS may choose to preload up to one (1) TEST TUBE per robot. COALITIONS may also choose to start the match with TEST TUBEs on the ground behind the AUTO LINE.**

- 2.1.5. One (1) SAMPLE of each color starts the match 49" from the end of the LABORATORY, on the same side of the LABORATORY as the

- CENTRIFUGE. All three samples start the match standing up, with their largest faces parallel to the opening of the CENTRIFUGE. See Figure 2.
- 2.1.6. The yellow SAMPLE starts the match against the LABORATORY wall. See Figure 2.
  - 2.1.7. The blue SAMPLE starts the match directly in front of and 1.625" away from the yellow SAMPLE. See Figure 2.
  - 2.1.8. The red SAMPLE starts the match directly in front of and 1.625" away from the blue SAMPLE. See Figure 2.



**Figure 2: Depicts the starting configuration of the SAMPLEs and the CENTRIFUGE for the red COALITION. The starting configuration for the blue COALITION is a mirror image of Figure 2.**

- 2.1.9. All LABORATORY dimensions should be considered to be  $\pm 0.5$  inch.
  - 2.1.10. FDA Frenzy matches can be played remotely with only one half of the LABORATORY constructed (if only one COALITION or robot is playing at a time).
- 2.2. Match Timing**
- 2.2.1. Each match will consist of an AUTONOMOUS period, TELEOPERATED period, and an ENDGAME period.

## 2.3. Match Scoring

### 2.3.1. Scoring Chart: - Points

| Action                                 | Awarded for   | Match Points (Auto) | Match Points (Teleop) | FDA Certifications/Elimination Bonus |
|--|---|---------------------|-----------------------|--------------------------------------|
| <b>Cross the AUTO LINE</b>             | Each robot fully crossing over the AUTO LINE  | <b>1</b>            | <b>0</b>              | -                                    |
| <b>TEST TUBE scored in the RACK</b>    | Scoring TEST TUBEs in/on the RACK   | <b>5</b>            | <b>5</b>              | -                                    |
| <b>TEST TUBE scored under the RACK</b> | TEST TUBEs scored on the opposition side of the LABORATORY                              | <b>2</b>            | <b>2</b>              | -                                    |
| <b>Opponent's STORAGE TEST TUBEs</b>   | Scoring opponent's TEST TUBE in a COALITION's own STORAGE                               | <b>20</b>           | <b>10</b>             | -                                    |
| <b>High SLOT SAMPLEs</b>               | SAMPLEs scored in the higher CENTRIFUGE SLOT of matching color                          | <b>10</b>           | <b>5</b>              | -                                    |
| <b>Low SLOT SAMPLEs</b>                | SAMPLEs scored in the lower CENTRIFUGE SLOT of matching color                           | <b>4</b>            | <b>2</b>              | -                                    |
| <b>DECONTAMINATION</b>                 | Any robot that ends the match in DECONTAMINATION  | -                   | <b>3</b>              | -                                    |
| <b>COLLABORTENTION</b>                 | Scoring the COLLABORTENTION TEST TUBE in the designated spot in the RACK during ENDGAME | -                   | <b>10</b>             | -                                    |

**2.3.2. Scoring Chart - FDA Certifications**

| Action                          | Awarded for  | Match Points (Auto) | Match Points (Teleop) | FDA Certifications/Elimination Bonus                                      |
|---------------------------------|--|---------------------|-----------------------|---|
| <b>COLLABORTENTION Achieved</b> | Both COALITIONS score their COLLABORTENTION TEST TUBE during ENDGAME                   | -                   | -                     | 1   |
| <b>CENTRIFUGE Completed</b>     | A COALITION that scores all three (3) SAMPLEs in the CENTRIFUGE SLOTS of correct color | -                   | -                     | 1 FDA Certification in Qualifications OR 2x SAMPLE Points in Eliminations |
| <b>Match Win</b>                | A COALITION with the highest score at the end of the match                             | -                   | -                     | 2   |
| <b>Match Tie</b>                | When both COALITIONS obtain the same score at the end of the match                     | -                   | -                     | 1   |

**2.3.3.** Game pieces scored in AUTONOMOUS will be counted for points at the end of AUTONOMOUS **AND** at the end of TELEOPERATED, provided they are still in a scoring position.

**2.3.4.** Final scores will be calculated at the end of the match. The referee's scoring decisions are final.

**2.3.5.** TEST TUBE Scoring

**2.3.5.1.** A TEST TUBE is considered to be scored in the RACK or STORAGE if it is entirely supported by the RACK or STORAGE and any other TEST TUBEs scored in that RACK or STORAGE. TEST TUBEs in contact with a robot are not considered scored for that robot's COALITION.

**2.3.5.2.** A TEST TUBE is considered scored on the opposition's side of the field if it has come to rest on the carpet of the LABORATORY and is entirely on the opposition's side of the RACK.

### **2.3.6. SAMPLE Scoring**

- 2.3.6.1.** A SAMPLE is considered to be scored if it is fully supported by the interior walls or floor of the SLOT of matching color or another SAMPLE inside the SLOT of matching color. A SAMPLE placed in a SLOT of a different color is not considered to be scored. SAMPLEs in contact with a robot are not considered scored for that robot's COALITION.

### **2.3.7. Points will be calculated as follows:**

- 2.3.7.1.** At the end of AUTONOMOUS, points will be scored as follows:

- 2.3.7.1.1.** Each robot that crosses the AUTO LINE at any point in AUTONOMOUS earns one (1) point. To earn the point, the entire robot must be across the AUTO LINE.
- 2.3.7.1.2.** TEST TUBEs scored in the RACK are worth five (5) points.
- 2.3.7.1.3.** TEST TUBEs scored on the opposition's side of the LABORATORY are worth two (2) points.
- 2.3.7.1.4.** Opposition TEST TUBEs picked up off the ground and scored in a COALITION's own STORAGE are worth twenty (20) points.
- 2.3.7.1.5.** SAMPLEs scored in the lower CENTRIFUGE slot of the correct color are worth four (4) points.
- 2.3.7.1.6.** SAMPLEs scored in the higher CENTRIFUGE slot of the correct color are worth ten (10) points.
- 2.3.7.1.7.** Points will only be tallied at the end of the AUTONOMOUS period.

- 2.3.7.2.** At the end of TELEOPERATED, points will be scored as follows:

- 2.3.7.2.1.** TEST TUBEs scored in the RACK are worth five (5) points.
- 2.3.7.2.2.** TEST TUBEs scored on the opposition's side of the LABORATORY are worth two (2) points.
- 2.3.7.2.3.** Opposition TEST TUBEs picked up off the ground and scored in a COALITION's own STORAGE are worth twenty (20) points.
- 2.3.7.2.4.** SAMPLEs scored in the lower CENTRIFUGE slot of the correct color are worth two (2) points.
- 2.3.7.2.5.** SAMPLEs scored in the higher CENTRIFUGE slot of the correct color are worth five (5) points.
- 2.3.7.2.6.** Points will only be tallied at the end of the TELEOPERATED period.

### **2.3.7.3. ENDGAME:**

- 2.3.7.3.1.** A robot that ends the match fully inside their COALITION's DECONTAMINATION earns three (3) points.
- 2.3.7.3.2.** A robot that scores the COLLABORTENTION TEST TUBE in the appropriate location in the RACK during ENDGAME earns ten (10) points for their COALITION.

### **2.3.7.4. Elimination Bonus**



- 2.3.7.4.1. During elimination matches only, a COALITION that scores all three (3) of their SAMPLEs during a match will receive a two (2) times multiplier on all points they earn from scoring SAMPLEs.
- 2.3.7.5. The winner of the match is the COALITION that has the most points at the end of the match.
- 2.3.8. FDA (Final Demonstration of Ability) Certifications will be calculated as follows during qualification matches:
  - 2.3.8.1. Each team on a COALITION that wins a match receives two (2) FDA Certifications.
  - 2.3.8.2. Each team on a COALITION that draws a match receives one (1) FDA Certification.
  - 2.3.8.3. Each team on a COALITION that loses a match receives zero (0) FDA Certifications.
  - 2.3.8.4. If both COALITIONS score their COLLABORTENTION TEST TUBE during the ENDGAME period, every team in the match earns one (1) FDA Certification.
  - 2.3.8.5. If a COALITION scores every SAMPLE during a match, each team on that COALITION earns one (1) FDA Certification.

## **2.4. Competition Structure**

- 2.4.1. The competition will consist of Qualifying Matches followed by Elimination Matches.
- 2.4.2. Qualifying Matches
  - 2.4.2.1. All teams will play in the same number of Qualifying Matches. The number of qualifying matches at each event will be determined by the length of the event and the number of teams competing.
    - 2.4.2.1.1. For all teams to have an equal number of official matches, some teams may be required to play an extra match, known as a surrogate match. This match does not count in the official ranking of any surrogate teams participating. Surrogate matches will be indicated on the match list.
  - 2.4.2.2. Teams will be given their schedule of qualification matches no later than the start of the first match of that day's event.
  - 2.4.2.3. Teams will be randomly assigned to COALITIONS during qualifying matches. The qualification match schedule will show the match number, the four teams competing in each match, and the color they are assigned for that match.
- 2.4.3. Ranking: At the end of the qualifying matches, teams will be ranked based on the following:
  - 2.4.3.1. Greatest number of FDA Certifications
  - 2.4.3.2. If tied, total number of wins
  - 2.4.3.3. If still tied, the total sum of AUTONOMOUS points.
  - 2.4.3.4. If still tied, points earned from scoring COLLABORTENTION TEST TUBES

- 2.4.3.5. If still tied, points earned from scoring SAMPLEs
- 2.4.3.6. If still tied, opposing COALITION's average point score (before penalties).
- 2.4.3.7. If still tied, team's average point score (before penalties).
- 2.4.3.8. If still tied, a coin flip.
- 2.4.4. Elimination Matches
  - 2.4.4.1. The number of COALITIONS participating in elimination matches will be no less than four, but may be increased prior to the start of the event based on the number of teams participating.
  - 2.4.4.2. COALITION Drafting
    - 2.4.4.2.1. At the conclusion of the qualifying matches, the top-ranked teams will be designated as COALITION CAPTAINS. In order of their ranking, each COALITION CAPTAIN will draft one team. An additional drafting round may take place at the discretion of the tournament director, increasing the number of teams per elimination COALITION to three.
    - 2.4.4.2.2. COALITION CAPTAINS may not draft other teams designated as COALITION CAPTAINS or those already drafted into service for other COALITIONS.
    - 2.4.4.2.3. If a team declines the draft of any COALITION CAPTAIN, they WILL NOT be allowed to play in the elimination matches.
  - 2.4.4.3. During elimination matches, the #1 ranked COALITION will play the lowest ranked COALITION entering the elimination matches (i.e. if there are eight COALITIONS, #1 will play #8). The #2 COALITION will play the second-to-lowest ranked COALITION, and so on.
  - 2.4.4.4. Elimination matches will be a best 2-of-3 format.
  - 2.4.4.5. Each COALITION partner must play at least once during the first 2 matches of a best two-of-three round. If a robot becomes seriously damaged, the COALITION CAPTAIN must inform the head referee immediately after the match in which the damage occurred. The head referee will then decide if the robot is exempt from this rule. The damaged robot must be re-inspected by the head referee before each best two-of-three round and must be re-declared inoperable in order to continue receiving the exemption.

## **2.5. Driver Rotation**

- 2.5.1. If safety concerns conflict with the rules in Section 2.5, these rules will not be enforced. The tournament director will announce any changes to these rules in advance of the competition.
- 2.5.2. During each match, teams will be required to switch their drivers halfway through the driver control period. There will be a ten-second (10) period

during which the drivers must complete the switch or power will be shut off for the duration of the match.

- 2.5.3.** Teams may choose to have another student operating other non-driving functions of the robot during the match. This optional position is not required to switch during a match.
- 2.5.4.** Teams must have at least four different students to rotate through the driver position. In the event that fewer than four students attend the competition, teams must still place four students in the ordered list and forfeit the driving time of the missing student(s).
- 2.5.5.** Four student participants of a team must drive their robot within the first two official matches in which the team places a robot on the LABORATORY. Once the required number of team members have driven the robot, teams must continue switching drivers during their matches but any team member may come to the LABORATORY to drive.
- 2.5.6.** If it is known in advance that a student will be late to the event, please contact the tournament director at [savage@wpi.edu](mailto:savage@wpi.edu) as soon as possible to discuss possible alternatives.

## **2.6. Match Sequence**

- 2.6.1.** Each match is one hundred thirty-five (135) seconds long.
- 2.6.2.** 0-15 seconds - Robots enabled under Autonomous Control.
- 2.6.3.** 15 seconds - COALITIONS are awarded points scored in autonomous.
- 2.6.4.** 15-70 seconds - Robot under first Driver Control.
- 2.6.5.** 70-80 seconds - Driver switch period.
- 2.6.6.** 80-135 seconds - Robot under second Driver Control.
- 2.6.7.** 105 seconds - Endgame Period Begins
- 2.6.8.** 135 seconds - Match ends, robots disabled.

## **2.7. General Rules**

- 2.7.1.** All referee decisions regarding rules of play and judgments are final. Those that argue with the referee may be subject to disqualification.
- 2.7.2.** Repeated, egregious, or intentional rule-breaking may result in a disqualification.
- 2.7.3.** Definitions
  - 2.7.3.1.** Pinning: A robot is considered pinned when it is being held against a LABORATORY obstacle or another robot by a robot from an opposing COALITION and cannot move in any direction. The closest referee will begin counting the pin from the moment the pin begins.
  - 2.7.3.2.** Penalty: Five (5) points are added to the opposing COALITION's score.
  - 2.7.3.3.** Disqualification: robots may be disqualified based on their actions that violate the rules of the game. If a referee calls for a disqualification, the offending robot will receive a loss and 0 FDA Certifications for that match. The remaining teams of both COALITIONS will receive their win/loss in qualification matches. If

a team is disqualified during an elimination match, their COALITION will receive a loss and the opposing COALITION will receive a win.

#### **2.7.4. Robot and Field Interaction Rules**

**2.7.4.1.** Robots may NOT descore TEST TUBEs or SAMPLES scored by the opposing COALITION in the RACK or CENTRIFUGE .

**2.7.4.1.1.** If a team violates this rule, they will receive one penalty for each of the removed objects.

**2.7.4.1.2.** The removed objects will be returned to the respective scoring area, regardless of the intent of removing them.

**2.7.4.2.** A robot may not remove a TEST TUBE or SAMPLE from the LABORATORY. A robot that does this will receive a penalty.

**2.7.4.3.** Robots may only control one (1) TEST TUBE OR one (1) SAMPLE at a time. Violation of this rule is one penalty per additional game piece. A robot is in control of a game piece if the game piece were to travel with the robot during any rotational or translational motion.

**2.7.4.4.** RESEARCH GROUP members may not extend into the LABORATORY. A violation of this is one penalty.

**2.7.4.5.** Robots may not intentionally use TEST TUBEs or SAMPLEs for anything other than their intended use (e.g. robots may not use TEST TUBEs as javelins). A violation of this rule will result in a penalty. Accidental misplacement or mishandling of TEST TUBEs and SAMPLEs is expected and will not be punished.

**2.7.4.6.** Robots may not control the COLLABORTENTION TEST TUBE until the ENDGAME period. Violation of this rule results in a penalty for the offending COALITION and will bar that COALITION from receiving any COLLABORTENTION points or the COLLABORTENTION FDA Certification for that match. In addition, the opposing COALITION will automatically receive the COLLABORTENTION FDA Certification.

**2.7.4.7.** Any robot that initiates contact with an opposing COALITION's robot in AUTONOMOUS by reaching past the RACK receives one (1) foul. Mutual contact, in which an instigator cannot be reasonably identified, will not be punished.

**2.7.4.8.** Robots may not intentionally tip an opposing team's robot. The tipping robot will be disqualified from the match if, in the referee's opinion, they initiated a lifting action that results in tipping. In incidents where the tipped robot initiates the action or both robots are in motion, the involved robots may be disabled.

**2.7.4.9.** Robots will be disabled for physically interacting with anything outside of the LABORATORY.

**2.7.4.10.** If a robot is pinned for five seconds, the pinning team receives a penalty. An additional penalty will be applied every 5 seconds until

the offending robot has moved at least 12" away from the pinned robot. Per rule 2.7.2., robots that accumulate multiple pinning penalties in a match are subject to immediate disqualification from the match.

**2.7.4.11.** All parts of the robot must remain attached to the robot for the duration of the match and must not cause any hazard of entanglement to the other robots. Any infraction of this rule may result in an immediate disqualification. Minor pieces which unintentionally become detached from the robot, do not affect the outcome of the match, or are the result of improper design/construction will not cause a disqualification.

**2.7.4.12.** Teams are allowed to modify their robots between matches as long as the robot remains compliant with all specifications and rules after the modification. Any significant modification should be brought to the attention of the referees or head inspector prior to the start of the team's next match. Teams may be subject to re-inspection at the discretion of the referees/head inspector. While teams are allowed to modify their robots between matches, multiple robots per team are not allowed.

## **2.8. Safety Rules**

**2.8.1.** Team members may interact with their robot during a match only through the transmissions of the radio-controller. Only designated RESEARCH GROUP members may be in contact with the controls during the match.

**2.8.1.1.** Only members of a team's RESEARCH GROUP will be allowed at the LABORATORY during a match.

**2.8.1.2.** All RESEARCH GROUP members must stay within their COALITION STATION for the entirety of the match. Repeat violations of this rule may result in disqualification at the discretion of the referees.

**2.8.2.** RESEARCH GROUP members may not extend any part of their body onto the LABORATORY. Violations of this rule will lead to disqualification at the discretion of the referee.

**2.8.3.** Referees will disable and may disqualify any robot they deem to be a safety hazard.

**2.8.4.** Referees may request that teams alter any portion of their robots that are considered safety hazards or damaging to the LABORATORY or game pieces at any point during the competition. It is the right of the referees to prevent teams from playing in matches until hazards are removed from the robot.

**2.8.5.** Damage to the LABORATORY, the objects, or the control system may result in the disabling or disqualification of the robot at the discretion of the referees. If the referee determines that further movement of the robot would result in LABORATORY damage, it will be disabled.

**2.8.6.** Strategies aimed solely at the destruction of or damage to an opponent's robot or the LABORATORY are not in the spirit of Collaboration and will not be allowed. This includes intentionally removing game objects from the LABORATORY. Repeat violations of this rule may result in disqualification at the discretion of the referees.

**2.9. Question and Answer System**

**2.9.1.** Please submit all questions or requests for rules clarifications via email to [savage@wpi.edu](mailto:savage@wpi.edu). Questions and answers will be publicly posted on the event website.

### **3. The Robot**

#### **3.1. Size Restriction**

- 3.1.1. At the start of each match, every part of the robot except for the flag holder (drinking straw, as specified in rule 3.4.4) must fit, unconstrained, in a stable position, within a box 15.25" by 15.25" by 18" in any orientation. The robot must be fully self-supported, in contact only with the horizontal, carpeted (or taped) surface of the playing LABORATORY.

#### **3.2. Weight Restriction**

- 3.2.1. Each robot's weight must not exceed 12.0 lbs.
- 3.2.2. The 12 lb. limit does not include the robot battery, the radio transmitter (i.e. the 75 MHz transmitter, VEXNet Joystick, or the VEX V5 Controller) or the color-designating flag.

#### **3.3. Controls**

- 3.3.1. Teams will each bring and provide their own controls to the competition. Crystals will be provided at the competition at the start of each match. Teams that use VEXNet must provide their own, known working VEXNet Keys.
- 3.3.2. Radio operation of the robots is not permitted in the pits. Teams should bring their phone cords/tethers for testing and operating in the pits. It is advisable that teams not bring their radio crystals to the competition.

#### **3.4. Construction Rules**

- 3.4.1. A robot must be designed to operate by reacting only against features within the confines of the LABORATORY boundaries.
- 3.4.2. Gaining traction by use of adhesives or by abrading or breaking the surface of the LABORATORY is not allowed and will be considered LABORATORY damage and subject to disqualification.
- 3.4.3. Teams must have their assigned team number clearly marked on their robot such that it is visible from 15' away. The numbers should be at least 3" high, 0.75" thick, and be on opposing sides of the robot. Team numbers will be assigned via the Savage Soccer website team list.
- 3.4.4. Teams must place a standard drinking straw, cut to 6" long, such that the straw is perpendicular to the ground on their robot. The top of the straw must extend above the top of the robot while in its starting configuration. This straw will have a colored flag inserted into the top to designate the COALITION color. Prior to each match, teams must place the correct color flag on their robot, as indicated on the match list. Flags will be provided at the start of the match and must be removed from the robot before leaving the playing LABORATORY. Multiple infractions of this rule may result in disqualification at the discretion of the referees.
- 3.4.5. A robot may not intentionally contaminate the LABORATORY or an opponent's robot with lubricants or other debris.
- 3.4.6. Robots may only be designed and built after the initial kickoff event.

#### **3.5. Building Constraints**

- 3.5.1. Each team will be expected to use parts only from the VEX Robotics System unless specified below.
- 3.5.2. Teams may NOT modify any of the VEX electronics or motors. Modification of items on the additional materials list is permitted.
  - 3.5.2.1. Teams may replace or reconfigure internal motor gear-trains with other gears designed to work with that motor, such as replacing broken gears, reconfiguring the 393 motor for high speed, or changing V5 Smart Motor cartridges.
- 3.5.3. Robots using PIC or Cortex controller may use any 7.2V battery, up to approximately 3500 mAh. Only one battery may be used on the robot at a time. Robots using the V5 Controller may only use the VEX Li-Ion battery, part number 276-4811.
- 3.5.4. Robots may only use publicly available VEX parts, found at <http://www.vexrobotics.com/vex>, and parts listed on the additional materials list. Robots may not use VEX IQ components, or VEX Pro parts that do not qualify under the additional materials list.
- 3.5.5. Robots may only use up to \$50 of materials listed on the Additional Materials List. Robots that utilize materials from the Additional Materials list (see 3.6.2) must provide a Bill of Materials with the appropriate retail cost of each item.
- 3.5.6. Robots that use a PIC or Cortex may use up to eight VEX motors, and an unlimited number of VEX servos. Robots that use a V5 controller may use up to 5 VEX Smart Motors.
- 3.5.7. Teams may purchase pneumatics kits, provided it is equivalent to any kits or portions thereof shown at <https://www.vexrobotics.com/v5>

### 3.6. Materials

- 3.6.1. Any amount of materials in the Additional Materials List will be allowed provided the total costs of all items on the robot is within the budget specified in 3.5.4 and it does not violate any other rules
- 3.6.2. Additional Materials List
  - 3.6.2.1. Plastic sheet, up to 0.25" thick.
  - 3.6.2.2. Aluminum or steel sheet, up to 0.125" thick.
  - 3.6.2.3. Any aluminum, steel, or plastic round shaft or tubing up to 0.5" diameter.
  - 3.6.2.4. Any bearings.
  - 3.6.2.5. Plywood, MDF, or wood up to 0.5" thick.
  - 3.6.2.6. "Foam rubber" or styrofoam like materials up to 0.75" thick.
  - 3.6.2.7. Pizza boxes, cardboard or foam-board.
  - 3.6.2.8. String or twine.
  - 3.6.2.9. Any springs or elastic bands (must be designed to release energy no faster than it was input).
  - 3.6.2.10. Fasteners, washers, adhesives, and tape.
  - 3.6.2.11. Lubricants used to reduce friction within parts of your robot.
  - 3.6.2.12. Non-functional decorations.



- 3.6.2.13. Paper, plastic-wrap, aluminum foil, fabric or any paper or cloth-like material.
- 3.6.2.14. Plastic 3D printed parts no bigger than a 3" in length, width, or height. All 3D printed parts must weigh less than 0.25 lbs.
- 3.6.2.15. Any sensors.
- 3.6.3. Materials that are not official VEX EDR materials, or are not listed as approved additional materials must be approved via email to [savage@wpi.edu](mailto:savage@wpi.edu). Responses will be posted publicly. Robots that attend the competition with unapproved materials on their robot will not be given approval at the event and will not pass inspection until the offending materials have been removed.

### **3.7. Energy Sources**

- 3.7.1. The energy used by the devices in the competition must come solely from:
  - 3.7.1.1. A change in altitude of the center of gravity of the device
  - 3.7.1.2. Energy stored by deformation of any approved materials.
  - 3.7.1.3. Electrical energy delivered by the battery to the electronics and motors provided with the kit.
  - 3.7.1.4. Pressure stored in the pneumatics system, not to exceed 100 psi.

### **3.8. Electronics**

- 3.8.1. Teams must keep clear and easy access to their robot controller, specifically the power switch. The indicator lights on the front or top of the controller must also be clearly visible.
- 3.8.2. Teams must keep clear and easy access to the crystals in their robot receiver. Crystals will need to be exchanged quickly prior to each match. Inspectors or referees may request a team move the receiver to provide easier access before they are allowed to play.
- 3.8.3. Prior to each match, teams using the PIC (old) controller will receive a crystal set from the Field Captain. The crystals must be returned before the team leaves the LABORATORY at the end of the match. Multiple infractions may lead to disqualification at the discretion of the head referee.
- 3.8.4. All teams are required to program their robot such that the robot will start and stop while under the control of a standard VEX LABORATORY control system. Specifically, VEX Net or Cortex robots must use a WIFI template, while PIC robots must use a timed competition template with a 15 second autonomous mode and a 254 second operator control mode. Teams will not pass inspection unless they are able to demonstrate their robots can be enabled and disabled by the LABORATORY.

## 4. Mini-Game

### 4.1. Definitions

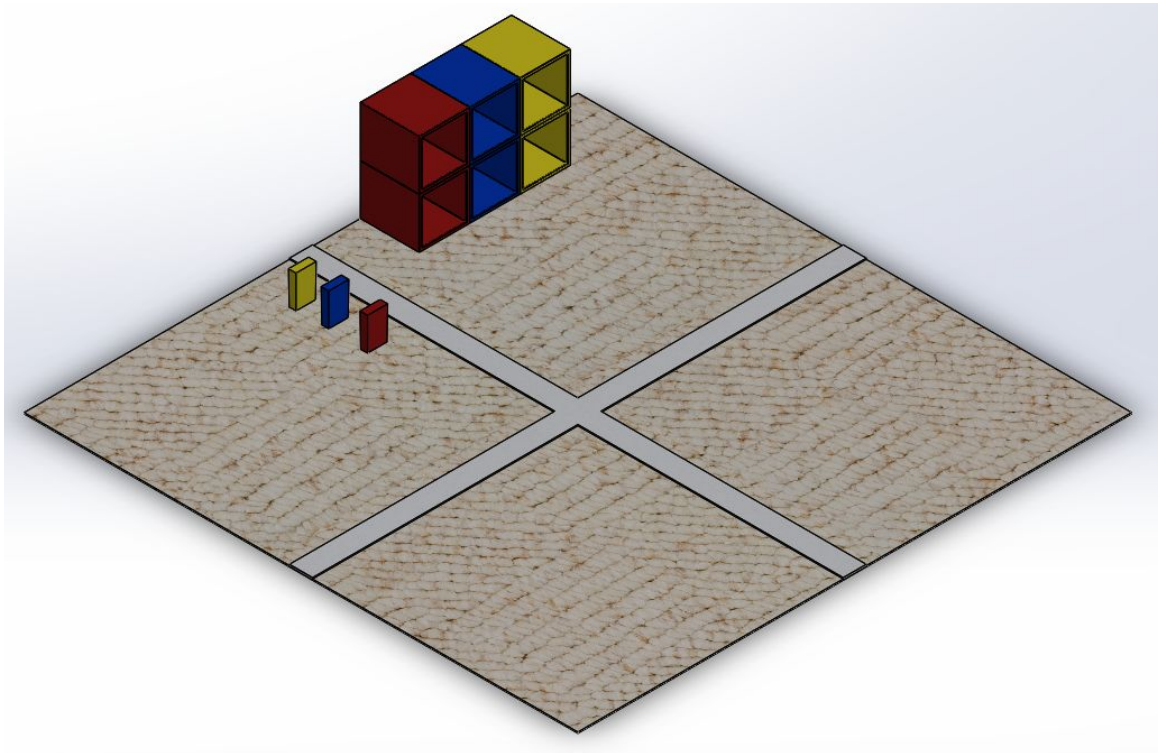
- 4.1.1. **CENTRIFUGE (Colored Experiments Needed for Test Research Information, For Ulterior Game Experience):** A structure made of six (6) SLOTS used for scoring SAMPLEs. Two (2) red SLOTS are stacked on top of each other, two (2) blue SLOTS are stacked on top of each other, and two (2) yellow SLOTS are stacked on top of each other. The red SLOTS are closest to the SAMPLE ZONE, the yellow SLOTS are farthest from the SAMPLE ZONE, and the blue SLOTS are in the middle. The back of the CENTRIFUGE is against the edge of the LABORATORY, and the yellow SLOTS are 5.5" from the edge of the LABORATORY.
- 4.1.2. **CENTRIFUGE ZONE:** The quadrant of the LABORATORY containing the CENTRIFUGE.
- 4.1.3. **FREE ZONE:** Either of the two quadrants of the LABORATORY that do not contain the SAMPLEs or the CENTRIFUGE.
- 4.1.4. **LABORATORY:** The 48" x 48" playing area. The LABORATORY is divided into four equal quadrants, denoted by lines of opaque tape. No LABORATORY walls or boundaries are necessary.
- 4.1.5. **SAMPLE (Shaded Assets Maintained & Packed by Laboring Equipment):** A 1.75" x 2.875" x 0.625" box used for scoring. SAMPLEs are either red, yellow, or blue in color. SAMPLEs can be standard-size Tic Tac<sup>®</sup> boxes. Color differentiations can be made by purchasing different flavors of Tic Tacs<sup>®</sup> or otherwise altering the visual appearance of the boxes such as coloring the boxes with paint or markers. Color differentiations made by teams must be clear and obvious in the submission video.
- 4.1.6. **SAMPLE ZONE:** The quadrant of the LABORATORY containing the SAMPLEs. The SAMPLE ZONE must be adjacent to the CENTRIFUGE ZONE and is the quadrant closest to the CENTRIFUGE.
- 4.1.7. **SLOT:** A 4.375" x 4.375" x 5.125" box used for scoring SAMPLEs. The front face of each SLOT is open. SLOTS may be red, blue, or yellow. SLOTS can be made using standard-size tissue boxes by emptying the box and cutting out the side that already has a hole in it, leaving a 0.25" border around the edges.

### 4.2. LABORATORY (Field) Layout

- 4.2.1. The mini-game can be played on any flat surface, though carpet is recommended.
- 4.2.2. Robots may begin the match anywhere teams please in the FREE ZONES.
- 4.2.3. Each robot may start the match with one (1) preloaded SAMPLE. The preloaded SAMPLE must be in contact with the robot at the start of the match.
- 4.2.4. SAMPLEs begin the match in the SAMPLE ZONE. All SAMPLEs start the match standing up, with their largest faces parallel to the front of the

CENTRIFUGE. Teams may populate the SAMPLE ZONE with as many SAMPLEs as they would like, but there should be approximately the same number of each color of SAMPLE.

**4.2.5.** All LABORATORY dimensions should be considered to be +/- 0.5 inch.



**Figure 3: Mini-game Field Setup**

### **4.3. Timing**

**4.3.1.** The mini-game will consist of one (1) three-minute period.

### **4.4. Scoring**

**4.4.1.** Final scores will be calculated at the end of the match. The referee's scoring decisions are final.

**4.4.2.** A SAMPLE is considered to be scored if it is fully supported by the interior walls or floor of the SLOT of matching color or another SAMPLE inside the SLOT of matching color. A SAMPLE placed in a SLOT of a different color is not considered to be scored.

**4.4.3.** SAMPLEs scored in the lower CENTRIFUGE slot of the correct color with the robot in TELEOPERATED mode: two (2) points.

**4.4.4.** SAMPLEs scored in the higher CENTRIFUGE slot of the correct color with the robot in TELEOPERATED mode: five (5) points.

- 4.4.5. SAMPLEs scored in the lower CENTRIFUGE slot of the correct color with the robot in AUTONOMOUS mode: six (6) points.
- 4.4.6. SAMPLEs scored in the higher CENTRIFUGE slot of the correct color with the robot in AUTONOMOUS mode: fifteen (15) points.

#### **4.5. Competition Structure**

- 4.5.1. The mini-game will be contested by teams working on their own to achieve the highest possible score.
- 4.5.2. Teams will film their robots completing the challenge and submit their videos to the Game Design Committee to have their scores recorded.
- 4.5.3. Teams submit scores by filling out [this form](#).
  - 4.5.3.1. Both in the video and in the form, teams shall clearly specify during which parts of their submission their robot is under autonomous control and during which parts the robot is under teleoperated control.
  - 4.5.3.2. Teams may choose to be fully autonomous or fully teleoperated, if they wish.
  - 4.5.3.3. If teams choose to use both autonomous control and teleoperated control in the same round, they must complete all autonomous actions first and then switch to teleoperated. Teams may not switch back and forth between autonomous and teleoperated.
  - 4.5.3.4. If it is unclear, the Game Design Committee shall assume that the robot is under teleoperated control.
- 4.5.4. The Game Design Committee will review each submission and verify each team's score. Please allow sufficient time for the Game Design Committee to review each submission.
- 4.5.5. Teams may upload as many submissions as they wish. Only the highest score for each team will be counted.
- 4.5.6. The Game Design Committee will maintain a running leaderboard, which will be posted on the competition website.
- 4.5.7. Teams will be ranked as follows:
  - 4.5.7.1. Greatest number of total points earned
  - 4.5.7.2. If tied, greatest number of points earned under AUTONOMOUS operation
  - 4.5.7.3. If still tied, earliest scoring of last SAMPLE. For example, if Team A and Team B both earn 25 points, but Team A scores their final SAMPLE with 30 seconds remaining, and Team B scores their final SAMPLE with 20 seconds remaining, Team A is ranked above Team B.

#### **4.6. Driver Rotation**

- 4.6.1. Safety must remain the top priority. As such, the normal driver rotation rule does not apply to the mini-game as it would require students to gather. Teams may compete with one driver.

#### **4.7. General Rules**

- 4.7.1. All referee decisions regarding rules of play and judgments are final.

- 4.7.2. Repeated, egregious, or intentional rule-breaking may result in a disqualification.
- 4.7.3. It is understood that teams may be unable to perfectly replicate the setup described in these rules, but the Game Design Committee reserves the right to reject submissions in which the team's LABORATORY setup severely violates the criteria established in these rules. If a submission is rejected, reasoning behind such rejection will be provided to the submitting team. Teams may resubmit after correcting any problems with their setup.
- 4.7.4. The Game Design Committee reserves the right to reject submissions that do not embrace the spirit of the game. If a submission is rejected, reasoning behind such rejection will be provided to the submitting team, and that team may resubmit after correcting any problems.
- 4.7.5. A team that commits a foul will have their score decreased by five (5) points.
- 4.7.6. **Robot and Field Interaction Rules**
  - 4.7.6.1. Robots may NOT descore SAMPLEs from the CENTRIFUGE. Violation of this rule will result in one (1) penalty for each descored SAMPLE.
  - 4.7.6.2. Human team members MAY remove SAMPLEs from the CENTRIFUGE and return them to the SAMPLE ZONE at no penalty if there are not enough SAMPLEs for the robot to score. If team members must reset SAMPLEs, they must make a concerted effort to ensure an approximately equal number of SAMPLEs of each color are reset.
  - 4.7.6.3. Robots may only control one (1) SAMPLE at a time. Violation of this rule is one penalty per additional game piece.
  - 4.7.6.4. Robots may not intentionally use SAMPLEs for anything other than their intended use. A violation of this rule will result in a penalty. Accidental misplacement and mishandling of SAMPLEs is expected and will not be punished.
  - 4.7.6.5. Robots may not physically interact with anything outside of the LABORATORY.

#### **4.8. Safety Rules**

- 4.8.1. Team members may interact with their robot during a match only through the transmissions of the radio-controller.
- 4.8.2. RESEARCH GROUP members may not extend into the LABORATORY except for the aforementioned purpose of resetting SAMPLEs as needed. When resetting SAMPLEs, please ensure a safe distance between RESEARCH GROUP members and the robot.

#### **4.9. The Robot**

- 4.9.1. At the start of each match, every part of the robot must fit, unconstrained, in a stable position, within a box 15.25" by 15.25" by 18" in any

orientation. The robot must be fully self-supported, in contact only with the horizontal surface of the LABORATORY.

- 4.9.2.** Each robot's weight must not exceed 12.0 lbs.
- 4.9.3.** The 12 lb. limit does not include the robot battery or the radio transmitter.
- 4.9.4.** Teams must provide their own controls.
- 4.9.5.** A robot must be designed to operate by reacting only against features within the confines of the playing LABORATORY boundaries.
- 4.9.6.** Gaining traction by use of adhesives or by abrading or breaking the surface of the playing LABORATORY is not allowed and is subject to disqualification.
- 4.9.7.** A robot may not intentionally contaminate the playing LABORATORY or an opponent's robot with lubricants or other debris.
- 4.9.8.** Robots may only be designed and built after the initial kickoff event.
- 4.9.9. Building Constraints**
  - 4.9.9.1.** Teams may NOT modify any electronics or motors. Modification of other items is permitted.
    - 4.9.9.1.1.** Teams may replace or reconfigure internal motor gear-trains with other gears designed to work with that motor, such as replacing broken gears, reconfiguring the 393 motor for high speed, or changing V5 Smart Motor cartridges.
  - 4.9.9.2.** Robots may use any 7.2V battery, up to approximately 3500 mAh. Only one battery may be used on the robot at a time.
  - 4.9.9.3.** Robots may use any commercially available robot kits or additional materials.
  - 4.9.9.4.** Robots may use up to four (4) actuators.
- 4.9.10. Materials**
  - 4.9.10.1.** Teams may use any materials they please, provided those materials and their use are safe.
- 4.9.11.** The energy used by the devices in the competition must come solely from:
  - 4.9.11.1.** A change in altitude of the center of gravity of the device
  - 4.9.11.2.** Energy stored by deformation of any approved materials.
  - 4.9.11.3.** Electrical energy delivered by the battery to the electronics and motors provided with the kit.
  - 4.9.11.4.** Pressure stored in the pneumatics system, not to exceed 100 psi.
- 4.9.12.** Teams must keep clear and easy access to their robot controller, specifically the power switch, for safety measures.

#### **4.10. Question and Answer System**

- 4.10.1.** Please submit all questions or requests for rules clarifications via email to [savage@wpi.edu](mailto:savage@wpi.edu). Questions and answers will be publicly posted on the event website.