

# MACHANA FOREVER



**Version 2**  
**This set of rules is FINAL**

### Gameplay & Scoring, General:

Each full round of play is two minutes long, and comprises an initial 30s autonomous period that automatically rolls into the 90s “regular” RC period.

No part of the robot can be moving prior to game play.

There are several scoring opportunities in this game:

1. **Simmons Bracelet: Be the first player to remove the Simmons bracelet to their side.**
2. **Vibranium return: Get as much vibranium from the Harvard Bridge back into the Charles River**
3. **Vibranium hiding: Collect vibranium in the hiding area**
4. **DNA Synthesis: Construct DNA by placing the bases in the DNA molecule (remember adenine, cytosine, guanine, and thymine from your bio GIR? Well, we’re using balls.)**
5. **Beaver Mask Multiplier: Pull the rings to move the beaver mask to your side for a point multiplier.**
6. **Lab Centrifuges: Spin the lower spinners for speed points and to release more bonus balls.**
7. **Benzene Ring Torque: crank the hexagonal key to lift the crucible of the magic juice to give Tim power of the Beaver**

Players must remain on their respective sides of the game table, except on the Harvard Bridge which is a common area accessible to both players.

Course staff are empowered to make all scoring judgments and interpretation of rules. Remember, display unqualified kindness and respect in the face of fierce competition.

## Simmons Bracelet

**Description:** Be the first player to remove the bracelet from its platform to your side

First player to collect the bracelet	11 point bonus
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**Notes:**

1. The first player to fully remove the bracelet from its platform and move it to their side will earn the bonus points.
2. Bracelet points are scored only once.

## Vibranium

**Description:** Points are awarded by having vibranium in your side of the Charles River or in a hiding area (between your ramp and side of the lab) at the end of game play.

Vibranium in Charles	3 points per vibranium
Vibranium in hiding	0.5 points per vibranium

**Notes:**

1. Vibranium may be collected by either player anywhere along the Harvard Bridge. Points are awarded based on the number of pieces of vibranium in a player's side of the river or their designated vibranium hiding spot, independent of which player may have placed them.
2. Points are determined at the end of game play.
3. Five pieces of Vibranium per player will be distributed evenly (more or less) on the bridge. Vibranium is in many shapes, sizes and weights. Their initial location and selection will vary round to round, and day to day. Design for these variations.



## DNA Synthesis

**Description:** Points are awarded by having balls in designated areas in the DNA strand at the end of game play:

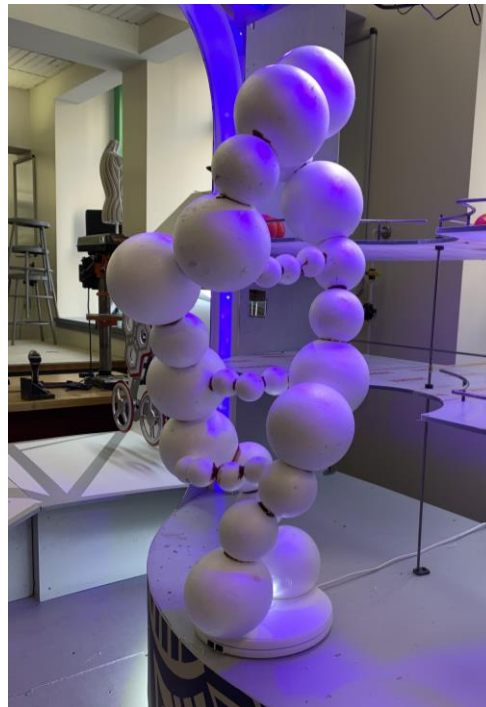
1. The lower DNA level
2. The middle DNA level
3. The upper DNA level

Points are distributed as follows:

Lower DNA level	Middle DNA level	Upper DNA level
21 points per ball	27 points per ball	48 points per ball

**Notes:**

1. Three balls may start anywhere in the starting box of a robot, including on or in the robot.
2. No part of the robot may be touching the DNA at the end of game play to be awarded DNA synthesis points.



## Beaver Mask Multiplier

**Description:** Pull the ring the move the beaver mask to your side of the lab to apply a multiplier to your points.

**Scoring:**

The multiplier is determined by the position of the beaver mask. The highest multiplier value is applied to all points, and the multiplier may be obtained at any time during game play. The maximum multiplier obtained by each player will be applied once, and only once. Official referees, course instructors, and staff will determine which multiplier value is obtained.

The actuators (pullers) for the beaver mask are located on the front of the lab on each player's side.

Multipliers:

- 1.2x
- 1.5x
- 1.8x
- 2.0x



**Notes:**

1. The multiplier may be obtained at any time, and is applied to all points acquired during game play.
2. The multiplier may be obtained at any time.

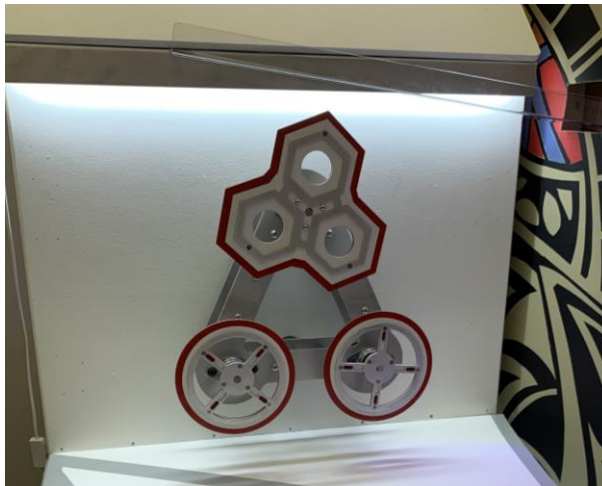
## Lab Centrifuge

### Scoring:

Each lab has two centrifuges (lower disks). Points are awarded based on the maximum steady state speed obtained, according to the table below.

Outer Centrifuge	
Speed (RPM)	Points
25-50	5
51-100	10
101-150	20
151-200	40
201-250	47
251+	0

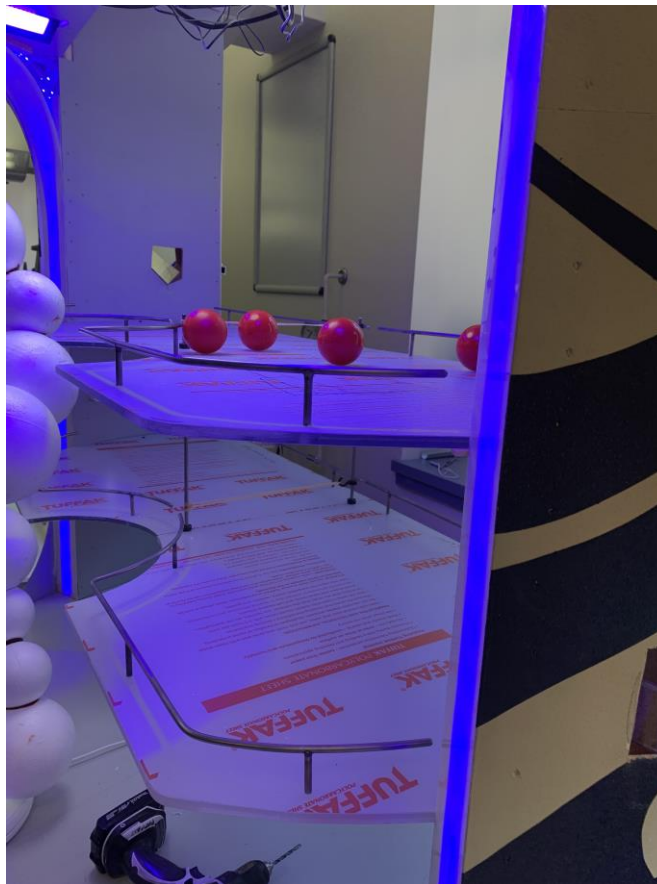
Inner Centrifuge	
Speed (RPM)	Points
25-50	3
51-100	7
101-150	15
151-200	21
201-250	26
251+	0



**Notes:**

1. Centrifuges may not be spun is beyond 250 rpm. A score of zero will be awarded to centrifuges that spin beyond 250rpm
2. Additionally, balls are released onto the lab shelves based on the duration spent in any particular speed zone. Balls are released onto the upper lab shelf by spinning the outer centrifuge. Balls are released onto the lower lab shelf by spinning the inner centrifuge. These bonus ball points are determined at the end of game play, and are not doubled if they happen to be released during the autonomous period. A ball is released every 5 seconds within a particular speed zone.
3. Points for balls are awarded based on the number of balls and their shelf location at the end of game play. Each chute will start with 5 balls.

Base of Lab	Lower Lab Shelf	Upper Lab Shelf
0	2	5





## Benzene Ring Torque Challenge

**Description:** Points are awarded by cranking the benzene ring to lift the crucible to Tim to give special beaver powers. Points are awarded for each zone the crucible passed through, i.e. they are cumulative as you move through zones.

Zone
First zone: 15 points
Second zone: 11 points
Third zone: 8 points
Fourth zone: 5 points



### Notes:

1. Points are awarded once and only once. Raising the crucible up and down repeatedly will not score multiple times.
2. If the crucible is first lifted during autonomous play, it is scored based on the zones achieved during autonomous play. If the crucible is lifted during regular play, it is scored based on the zones achieved during regular play. A crucible zone will not be scored for both play periods. For example, a crucible that reaches the first zone during autonomous play will be scored 30 points. Leaving the beaver at this elevation during RC period does not count for additional RC points. However, should a player continue to lift the crucible during the RC period to the second mark, an additional 11 points will be awarded.

## Ramp Start Bonus

**Description:** If you choose to start entirely on the ramp, you will be awarded a starting bonus of 5 points. Ramp bonus points are not doubled for an autonomous start.

### Autonomous Period:

To encourage exploration and learning of electronics in 2.007, the Autonomous Period is 30 seconds. Vibranium, spinning, bracelet, benzene ring points are doubled during the autonomous period. Ball points that result from the bonus balls releasing onto the shelves are not doubled and are only counted at the end of play. If neither competitor wishes to use the autonomous period, they can indicate to the referee and the contest will begin with the 90 second remote control phase.

### Scoring Examples:

#### Game 1:

Blue autonomously grabs the Simmons Bracelet, and dumps three vibranium pieces in the river. The clock ticks over to RC gameplay, and Blue pulls the beaver mask to the 1.8x mark

Blue's score:  $(22 \text{ [autonomous bracelet]} + 18 \text{ [three autonomous vibranium]}) * 1.8 = 72 \text{ points}$

Red placed one Ball in the middle DNA shelf and drove to the outer centrifuge, spinning to 30rpm, which also released 5 balls to the upper shelf after 25 seconds of holding that speed.

Red's score:  $27\text{[DNA]} + 5 \text{ [Outer spinner]} + 25 \text{ [balls onto upper shelf]} = 57 \text{ points}$

Blue prevails. That was close!!!

#### Game 2:

Blue raced to grab the bracelet, places a ball in the DNA on the bottom-most area, and pulls the Beaver Mask to 1.8x

Blue's score:  $(11 \text{ [bracelet]} + 21 \text{ [ball in DNA]}) * 1.8 = 57.6 \text{ points}$

Red autonomously cranked on the benzene rings to lift the crucible to the 3<sup>rd</sup> zone, and then drove to the multiplier during the RC time and pulled the beaver mask to the 1.8 mark.

Red points:  $(68\text{[autonomous benzene ring]}) * 1.8 = 122 \text{ points}$

What an exciting round!! Red has the higher score and therefore wins.

### Rules & Regulations

#### 1. General Principles

- a. These rules are intended to create opportunities to learn engineering.
- b. Those things not specifically forbidden are allowed.

#### 2. Timing

- a. Each round of the contest is 120 seconds long.
- b. For the first 30 seconds, no control signals may be sent to the robot. So that your robot can sense the start of the round, lights will be positioned in the starting box and triggered at the start of the round.
- c. If both players agree to not use the first 30 seconds, then the match will last 90 seconds.
- d. Robots may not be touched by players during game play.

#### 3. Winning & Advancing

- a. There will be a single elimination tournament with 32 slots in the bracket. The winner of the tournament is the winner of the contest.
- b. In the tournament, the highest scoring robot in each match advances to the next round. In general, only one machine may advance. If there is a tie, it will be broken by weighing the two systems. The lighter machine prevails.
- c. There are two ways to earn a spot in the tournament bracket – 16 spots are given to the 16 highest players in a ladder, 16 more spots are awarded through a qualification tournament.
- d. The qualification tournament has only one round. Of those who win their match, the top 16 scorers advance into the single elimination tournament. The qualification tournament is run the night before the final tournament. Placement within this tournament bracket is determined by seeding scores. Seeding rounds will be held during the last week of lab time. In the seeding rounds, machines will run on the table unopposed.
- e. Ladder rounds can be held at any point on or after February 21, at any time the lab is open. A student establishes their position on the ladder by: 1) demonstrating to a section instructor, TA, or UA that they can score at least one point, and 2) placing their name on the list according to the points they receive. If a student ties with a score already on the ladder, the student is in the position below that score. The ladder is simply a list of students, ordered according to the points they can obtain during the semester. The ladder may include all students, but only the top 16 scorers secure their position for the final round of play, i.e. the second night of our festivities.

### 4. Control

- a. When possible, contestants must participate in controlling their own machines. Rarely, schedule conflicts may preclude a player from operating their machine, in which case, with their instructor's permission, another player can be designated.
- b. All control must be accomplished without contacting the robot.
- c. Control may be achieved via radios and, in addition, any another wireless device approved by their section instructor (e.g. TV remote control, laser pointer, recorder, accordion, bagpipes, cell phone, Xbee, Bluetooth, etc).
- d. A contestant may use their single lab issued six channel radio controller. However, contestants may add more degrees of control by using additional controllers such as a TV remote control, laser pointer, or playstation controller.
- e. Outside Controllers are permitted, but only to supplant the existing 6-channel controllers.
- f. A contestant may not deliberately interfere with the radio or other remote control of the opposing player.
- g. "Assistant drivers" may be used, though only one standard lab RC may be used for the player.
- h. Contestants must wear safety glasses when in the vicinity of the table. Some prescription glasses are acceptable.

### 5. Robot Configuration

- a. Your entire robot must fit in a *Starting Volume* at the time of impounding and at the beginning of each match when set up on the table. The starting volume is 12" square and 16" tall. The box is "virtual" and has no ceiling or door. These dimensions are smaller than those of the lockers, so you should be able to fit the robot and also your tools and spare materials in your locker. This virtual starting box may be placed anywhere within the colored starting zone at the front of the tables (between the ramp and Harvard Bridge), or entirely on the ramp (for the bonus start points) at the beginning of play.
- b. Your entire robot must be made from lab supplied materials and components, fasteners and items in the stock shelves, approved batteries, and electronic components authorized by your section instructor. The tools in the tool kit are considered to be part of your robot kit and can therefore be part of your machine as long as safety and protection of the table are adequately considered in your design. Items that primarily serve to make robots look cool generally will be allowed including LEDs, seven-segment displays, and such items. There are no chemicals in the kit or supply cabinet aside from epoxy, cyanoacrylate adhesive, grease, and such things. For example, baking soda and vinegar would make a great balloon inflation means, but they are not in the kit and cannot be in your robot. Electric motors (or other actuators) taken from appliances (or other household or industrial equipment) are not allowed.
- c. Your "kit" includes up to 6 cubic inches of 3D printed parts. You are also limited to consuming up to 4 cubic inches of support material.
- d. You may use any combination of four lab supplied gearhead motors AND any combination of four continuous rotation and position servos.

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- e. Machine weight is limited to 12lbs. You should generally still attend to the weight of your machine as excess weight may lead to poor performance. Also, weight of your system will be used as a tie breaker.
- f. Energy may be stored in batteries, compressed air, elastic strain, and gravitational potential energy. Total stored energy may not exceed 50kJ. This limit will be enforced by the section instructors based on calculations in the lab notebooks. Compressed air may not exceed 50 psi gauge pressure and all air containers can add up to 2 liters maximum. Mechanisms using large amounts of rubber or springs must have adequate safety locks to reduce the chance of accidents. These locks may be removed once all contestants and onlookers are safely away from the device. Safety of all forms of energy storage will be at the discretion of the section instructors and judges.
- g. No boost converters are allowed. Voltage is limited to the 7.4V LiPO batteries. If 7.4 V is to be supplied to any electronics, it must be approved and checked by an instructor AND must be fused. The LiPo batteries are considered 800 mA-hr devices, regardless of their markings.
- h. The rechargeable AA -four packs that are typically used with the lab radio receivers are considered 500 mA-hr devices, regardless of the actual labeling on the batteries.
- i. Contestants will be responsible for charging their own batteries, compressed air containers, springs, rubber bands, etc.
- j. Your machine may be reconfigured between rounds. One reason to reconfigure is to accommodate the differences between the right and left sides of the field. You will know at least 5 minutes before you compete which side your machine will be assigned.
- k. You will have access to set up your machine(s) within the starting box prior to each round. You should be able to complete your set-up fully in fewer than three minutes.

### 6. Sporting Conduct & Safety - Gracious Professionalism

- a. Harvard Bridge is considered common space and useable by both players.
- b. Crossing to the other player's side of the table is not permitted.
- c. Damaging the contest table and or control equipment is strictly forbidden.
- d. In the case of destruction deemed by the judges to be accidental, the judges may permit repairs and a rematch.
- e. Contestants and spectators (i.e. any human beings) may not directly affect the motion of the machines or anything else on the table.
- f. It is permissible for a robot to reach outside the boundaries of the table during a round.
- g. Nets or entanglement devices are not permitted, but other defensive devices generally are permitted.
- h. NO DANGEROUS MACHINES. THE JUDGES' DECISIONS ON SAFETY MUST BE RESPECTED AND OBEYED PROMPTLY.

**General questions may be asked of UA's, TA's, and Instructors; however, all officially sanctioned rule interpretations will be made by instructors and staff.**