

## OFFICIAL RULES FOR 2014 JPL INVENTION CHALLENGE

The JPL Annual Invention Challenge is ready for its seventeenth year. The title for this year's contest is the **"Keep It Moving Contest"**. The objective and rules are listed below. Questions related to this contest should be directed to: Paul MacNeal at work phone (818) 354-7824, M/S T1723, located in Building T1723-128, or e-mail to [paul.d.macneal@jpl.nasa.gov](mailto:paul.d.macneal@jpl.nasa.gov).

**OBJECTIVE:** Create a device that can move a billiard ball at least 5 meters from the starting point using three or more different modes of transportation and then have the ball initiate a portion of the device that makes an audible sound exactly 20 seconds after starting. The winner will be the team whose device complies with all of the rules and completes the task closest to 20 seconds.

### Rules:

#### ELIGIBILITY

- 1) The contest is open to all JPL employees, contractors, and immediate family members. The contest is also open to teams of students from Southern California middle schools and high schools providing that they have completed all required forms as outlined in rules 3 and 4 below.

#### REGISTRATION – JPL PERSONNEL

- 2) Applications for JPL employees, contractors, and immediate family members entering the contest (found on website) must be filled out and submitted to Public Services prior to midnight November 15, 2013. Completed entry forms should be directed to Public Services at FAX (818) 393-4641, or sent via email to [Rhonda.M.Dash@jpl.nasa.gov](mailto:Rhonda.M.Dash@jpl.nasa.gov). All entries will be time stamped based upon the time received. Only the first 20 JPL/contractor entries will be permitted to compete. Five alternates will be accepted in case some entries withdraw prior to the competition.

JPL employee family members and friends are welcome to watch the contest, but must be cleared through the security office prior to arrival. JPL employees must fill out the visitor request form as found in the link: <http://protective-services.jpl.nasa.gov/visitrequest.html>

#### REGISTRATION – SCHOOLS

- 3) In order to make it easier to process badging at JPL, each team must email their completed, typed entry form (found on website) to [Rhonda.M.Dash@jpl.nasa.gov](mailto:Rhonda.M.Dash@jpl.nasa.gov). Additionally, to make the badging process flow smoothly each team must **mail** a printout of their completed student team entry form and the "Authorization and Release for Photos, Audio and/or Video Recordings of and/or Artwork" agreement form (found on website) for each person (student, guest, teacher, and chaperone) planning to attend the JPL contest. Each video release form must be completely filled out and signed. If the student is under 18 years of age, then use the appropriate form filled out and signed by their parent or guardian. **The emailed entry form and entire set of video release forms must be filled out and submitted to Public Services no earlier than September 1, 2014 and be postmarked no later than midnight October 4, 2014.** Completed forms must be mailed to Public Services at Jet Propulsion Laboratory, M/S 186-113, 4800 Oak Grove Drive, Pasadena, CA 91109. All entries will be time stamped based upon the time received. Student teams will be notified to verify their

acceptance into the contest by October 8, 2014. Questions regarding the entry forms can be directed to [Rhonda.M.Dash@jpl.nasa.gov](mailto:Rhonda.M.Dash@jpl.nasa.gov) in Public Services at (818)354-0112. Each school is allowed no more than three teams. Internal school competitions are encouraged to select the top three teams if necessary.

Any foreign person, 18 or over, student or adult, will need to fill out a special form which is processed by the Public Services Office. The process takes nearly three weeks; therefore, if anyone plans on attending the contest at JPL, and they are a foreign national, it is important that they contact Public Services prior to November 7, 2014.

**Additions or corrections to the registration forms and/or video release forms need to be mailed to the Public Services Office with a postmark no later than Wednesday, November 26, 2014. Faxed forms will not be accepted. Failure to send in the signed video release form by the requisite time will prevent participation and access to the JPL contest for those students that fail to comply with this request.**

#### SPECIAL RULES FOR SCHOOL TEAMS

- 4) Only the first 80 student team entries will be permitted to compete at the regional competitions. Student teams will compete at a regional competition held on Saturday, November 22, 2014 at either Augusta Hawkins High School in Los Angeles or Chapman University in Orange. Details for the regional competitions will be sent to all registered teams. The top five teams with the highest score from each regional competition will be invited to compete at the JPL contest held on Friday, December 5, 2014 (see Rule 5 below). In addition, the next 10 teams with the highest scores between both regional competitions will also be invited to compete at the JPL contest.

#### LOGISTICS

- 5) The date and time for the final contest is Friday, December 5, 2014 between 11:30 AM and 1:00 PM. The contest is held at the Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109. The contest area is located north of the fountain area, in front of the Administration Building (Bldg. 180) steps. In the event of heavy rain (more than mist), the contest will be held indoors. Check-in for the event will begin at 10:15 AM.

#### DEVICE RULES

- 6) The device must have the following characteristics:
  - a. Be able to continuously move (not just spin) an officially supplied billiard ball utilizing three or more different modes of transportation for a total of exactly 20 seconds. The billiard ball must be visible at all times. At least one mode of transportation must be chosen from each category as specified in Rule 6b. Movement is defined as translation in any direction. An observed stoppage of movement of more than one second will invoke a two second penalty. A second observed stoppage of movement of more than one second will invoke an additional two second penalty. A third observed stoppage of movement of more than one second will result in

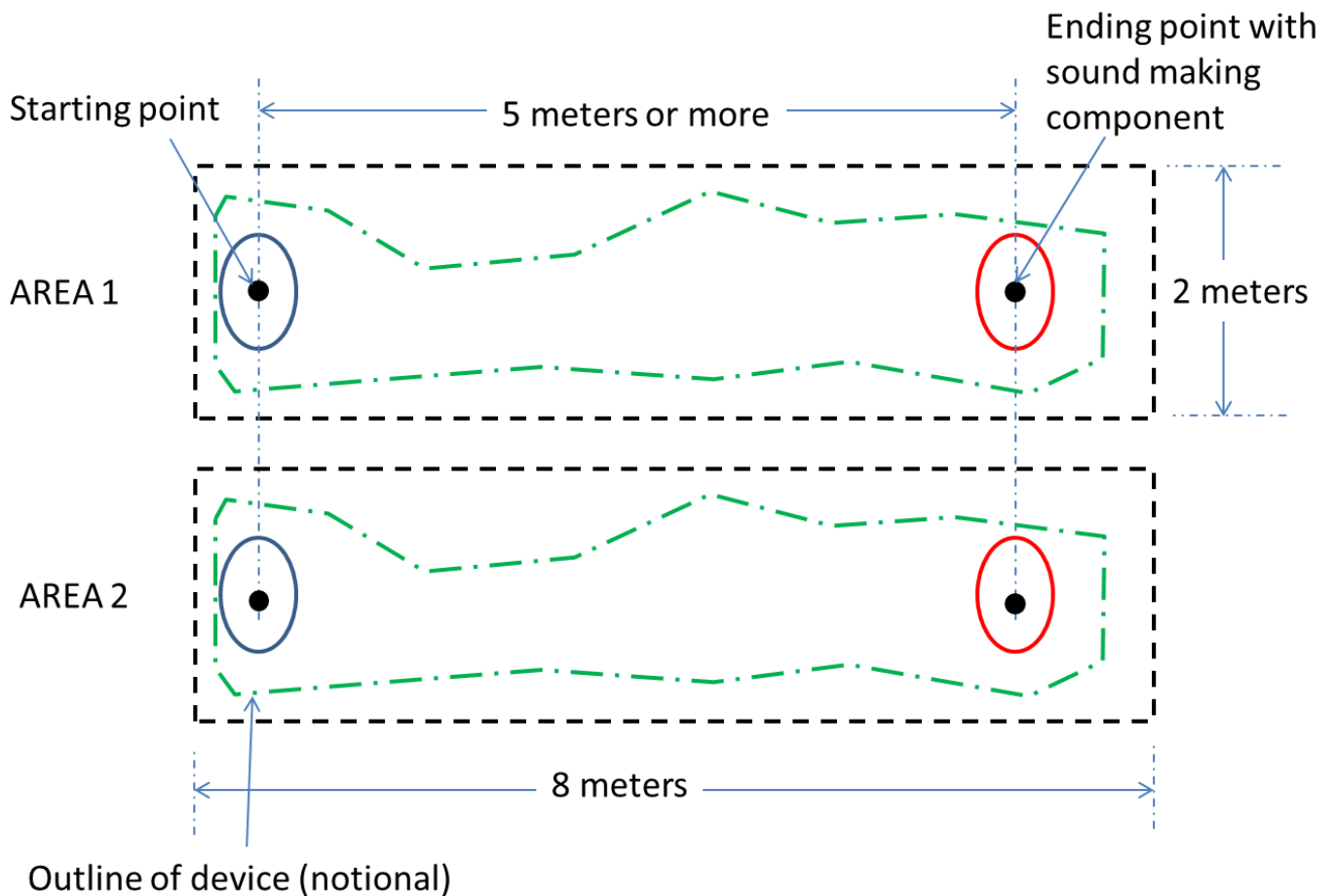
disqualification. Please note that a billiard ball that spins without translational movement is considered to be stopped. Note that the billiard ball can stop more than once as long as it starts moving within one second of stopping.

- b. Have transportation modes selected from three different categories.  
Category A consists of motion caused by springs (compression springs, extension springs, torsion springs, etc.), rubber bands, bungee cords, or surgical tubing.  
Category B consists of motion caused by gravity (either the billiard ball falling or some other mass falling)  
Category C consists of all other possible types of energy source. Examples include but are not limited to fans, compressed air, and motors. Dangerous sources of energy are not allowed (see Rule 6g). An electrical cord rated for 15 Amps will be made available for use.
- c. Width is limited to 2 meters (6 feet 6 inches).
- d. Length must be at least 5 meters such that the portion of the device that contains the component that initiates the audible sound must require the billiard ball to be 5 meters (16 feet 5 inches) or more away (measured as a straight-line projection on the ground) from where the billiard ball started its journey. The device can be composed of one or more components that are not required to be connected together. The maximum length of the device is 8 meters (26 feet 3 inches).
- e. Be able to accept the officially supplied billiard ball which weighs 156–170 grams (5.5 to 6 ounces) with a diameter of 57.15 mm (2.25 inches). No alterations in any manner can be made to the billiard ball including, but not limited to, adhesives or tapes. Damaging the billiard ball (chip, crack, etc.) will disqualify the device.
- f. Be able to initiate an audible sound by having the billiard ball trigger/initiate a portion of the device to make a moderately loud sound. The sound must be louder than 80 dB at a distance of 3 meters (10 feet). Please review the Sound Level Chart on the website located at <http://www.jpl.nasa.gov/events/inventionchallenge/2014/index.cfm> for indications of how loud this is. Note: The official time for the task will stop when the sound is heard by the timers.
- g. Utilize safe energy sources. Examples of disallowed energy sources are chemical explosions, caustic gases, and rocket motors. High pressure gas systems and other questionable sources must be cleared through Paul MacNeal and the Safety Coordinator prior to performing at both the regional contest and the final contest.
- h. Be initiated by a single operation (cut a string, flick a switch, pull a pin, etc.) provided by the contestant. No human power may be used to add dynamic or potential energy to produce motion of the ball. All stored energy systems must be energized prior to starting the task.
- i. Be made from any materials as long as they are non-toxic and safe.
- j. Place the official entry number provided by the contest organizer (3” high numbers or larger) on at least two sides of the device for easy identification.
- k. Not use any clamps, tape, or any other means to attach to the ground. The device must only rest on the ground, however heavy weights may be used.
- l. Not use any remote control devices of any kind.
- m. Be able to adapt to non-level ground (see Rule 7).

- n. **SPECIAL RULE FOR SCHOOL TEAMS ONLY:** To avoid plagiarism, each team that competes at the regional contest will have photographs taken of their device. The basic concept of the device (energy sources, ball movement methods, size) must be maintained. Minor modifications to the device are allowed within these constraints.

#### CONTEST AREA DESCRIPTION

- 7) The contest site is located in front of the steps leading to Building 180. The site will contain two side-by-side areas for setting up and operating the device. The size of each area is 2 meters by 8 meters. Each team will be randomly assigned to either operating area. The ground is concrete with a rough finish and has a slight slope (approximately 2 degrees across the width). See Figure 1 for a description of the contest area.



**Figure 1. Contest Area – top view**

## SCORING

- 8) The official time for the billiard ball's journey is measured as follows:
- The time starts when the referee counts down the start as an audible "3...2...1...GO!"
  - The person must initiate the device within one second of hearing the "GO" or their device will be given a time penalty (see Rule 6a).
  - The time ends when the audible sound is heard by the timers.
  - The field judge will indicate the time on the score sheet to the nearest 0.01 second and calculate the difference between the measured time and 20 seconds.
  - Per Rule 6a, if the ball stops moving for more than one second, penalty time will be added to the calculated difference (either a two second penalty or a four second penalty).
  - Penalty time will be added to the calculated time difference to determine the official time.
  - All other rules must be in compliance for the official time to be counted.

## CONTEST PROCEDURE

- 9) The order in which teams will participate is selected by a random process. The team will be given a three minute period of time to setup their device. Strict time limits will be imposed to ensure that all contestants are able to operate their device. At the beginning of the setup time period each team will be handed the official billiard ball. The team is responsible for placing the billiard ball inside their device.

Each team shall designate a speaker that is not involved with the device setup to talk about their team and their device during the setup period. The team will be asked if they are ready to proceed. The referee will give a countdown (3...2...1...GO!) for the start of operation for the device. The timers will start the time at the referee's direction. A penalty of two seconds shall be added for any team that prematurely initiates their device. The timers will stop their stopwatch when they hear the audible sound created by the device. If the sound is not audible, the device will be disqualified. The referee will observe the billiard ball's journey and will assess time penalties (if necessary) per Rule 6a. The referee will determine if the task has been completed per the rules of the contest. All decisions are final.

Three or more timers will determine the official time for completion of the task and will let the field judge know of their official time. All decisions are final. The field judge will indicate the time on the score sheet to the nearest 0.01 second and calculate the difference between the measured time and 20 seconds. The field judge will ask the referee if any penalty time should be added to the measured time and then calculate the official time.

Once the time has been entered into the scoring sheet the team will be asked to remove their device and place it in a designated viewing area as directed by volunteers.

The winning team will be the team whose device completes the task closest to 20 seconds (either slower or quicker). In the event of a tie (times within 0.05 seconds), each team will be asked to setup their device and run their device another time until the tie is eventually broken.

## AWARDS

- 10) Trophies will be divided into two categories: JPL employees/family/contractor entries and school team entries. Trophies for fastest completion of the task will be given for first, second, and third place for each category at all contests (regional contests and the JPL contest). Certificates will be issued for the most unusual, most artistic, and most creative designs.