

## OFFICIAL RULES FOR 2022 JPL INVENTION CHALLENGE

The JPL Annual Invention Challenge is celebrating its twenty-third year of operation. The title for this year's contest is the “**Sticky Wicket Contest**”. The objective and rules are listed below. Questions related to this contest should be directed to: Paul MacNeal at cell phone (626)788-7433 or e-mail to [paul.d.macneal@jpl.nasa.gov](mailto:paul.d.macneal@jpl.nasa.gov).

**OBJECTIVE:** Create a device that can strike a maximum of five small rubber balls and cause them to move towards the targets as defined in the rules. Points are awarded for successfully completing each target. The winner will be the team whose device receives the highest point total.

### Rules:

#### 1) ELIGIBILITY

The contest is open to all JPL employees, contractors, and their immediate family members. The contest is also open to teams of middle school and high school students from southern California.

#### 2) REGISTRATION – PROFESSIONAL

Application forms for the professional category are found on the website (entitled ENTRY FORM FOR PROFESSIONAL TEAMS) and must be filled out and emailed to [paul.d.macneal@jpl.nasa.gov](mailto:paul.d.macneal@jpl.nasa.gov). The professional category includes JPL employees, JPL contractors, and special guest teams. The deadline for emailing the application is midnight on November 5, 2022. Questions related to the application form can be addressed to Mr. Paul MacNeal at [paul.d.macneal@jpl.nasa.gov](mailto:paul.d.macneal@jpl.nasa.gov).

Only the first 10 applications will be allowed to compete in the finals. Five additional applications will be taken in case any Professional teams drop out prior to the contest.

#### 3) REGISTRATION – MIDDLE SCHOOLS AND HIGH SCHOOLS

To make it easier to process badging at JPL, each team must email their completed, [entry form](#) (found on website) to [Kimberly.C.Johansen@jpl.nasa.gov](mailto:Kimberly.C.Johansen@jpl.nasa.gov). The Excel spreadsheet should be filled out for every team member, teacher, or chaperone on a separate row. The Team Name should be listed on each row to help avoid confusion. The Single Point of Contact (POC) only needs to be filled out once for each team. Please skip two or three rows when providing multiple teams on the entry form. Additionally, to make the badging process flow smoothly each team must **mail** a printout of the Excel entry form and all of 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 August 29, 2022 and be postmarked no later than midnight October 1, 2022. 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 5, 2022. Questions regarding the entry forms can be directed to

[Kimberly.C.Johansen@jpl.nasa.gov](mailto:Kimberly.C.Johansen@jpl.nasa.gov) in Public Services at (818)354-2413. Each school is allowed no more than three teams. Internal school competitions are encouraged to select the top three teams if necessary.

**IMPORTANT:** 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 (students, teachers, chaperones) plans to attend the contest at JPL, and they are a foreign national, it is **important that they contact Paul MacNeal prior to November 4, 2022.**

**For those teams invited to the final contest held at JPL, 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 30, 2022. Failure to send in the signed video release form by the requisite time will prevent participation and access to the JPL contest for those that fail to comply with this request.**

#### 4) ELIMINATION ROUND FOR MIDDLE AND HIGH SCHOOLS

Only the first 90 student team entries will be permitted to compete at the regional competitions. Student teams will compete at a regional competition held on Saturday, November 19, 2022 at either Augustus Hawkins High School in Los Angeles or Segerstrom High School in Santa Ana.

Details for the regional competitions will be sent to all registered teams. The top five teams with the highest point total from each regional competition will be invited to compete at the JPL contest held on Friday, December 9, 2022 (see Rule 6 below). In addition, the next 10 teams with the highest point total between both regional competitions will also be invited to compete at the JPL contest.

#### 5) FINALS

The date and time for the final contest is Friday, December 9, 2022 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 rain (more than mist) or wind greater than 15 MPH, the contest will be held indoors. Check-in for the event will begin at 10:15 AM.

#### 6) DEVICE RULES

The device must have the following characteristics:

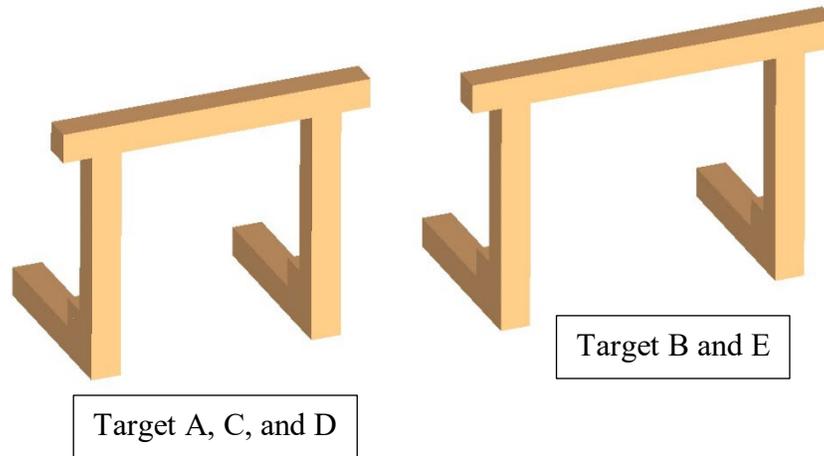
- a) Can strike officially supplied rubber balls (see Rule 8) towards five different targets (see Rule 7) located as shown in the Contest Area (see Rule 9). The ball must be positioned on the ground or above the ground at the location shown in Figure 1. Only one rubber ball can be started in motion at a time. Each ball can be struck only once. Once a target has been successfully completed, that target is unavailable for further point awards. The device can be realigned between each shooting event.
- b) Can complete the entire task of moving all 5 rubber balls within sixty seconds. Any shooting event started after sixty seconds will not count.

- c) Cannot alter the balls in any way. No adhesives or tapes are permitted to touch the balls.
- d) Can initiate each event by a single operation (cut a string, flick a switch, pull a pin, drop a weight, etc.) provided by the contestant. No human power may be used during the initiation of the device to add dynamic or potential energy to produce motion of the ball or device. All stored energy systems must be energized prior to the start of each event. No remote-control devices of any kind are allowed.
- e) Can load the ball inside the device.
- f) Can strike the ball towards the target. Pushing the ball is not allowed. Determination of a pushing or striking action is up to the sole discretion of the Field Judge. It is advisable to ensure that the action is clearly a striking motion.
- g) Can remain within the device set-up area dimensional limits before, during, or after the task as defined in Rule 9. Violation of this rule will disqualify each shooting event from receiving any score. Note: There is no height limit.
- h) Must utilize safe energy sources. Examples of disallowed energy sources are chemical explosions, caustic gases, and rocket motors. High pressure gas or vacuum 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. An electrical cord with a maximum of 15 Amps be available for use.
- i) Can be made from any materials if they are non-toxic and safe.
- j) Must 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) Must 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) Can adapt to non-level ground (see Rule 9).
- m) **SPECIAL RULE FOR MIDDLE/HIGH SCHOOL TEAMS ONLY:** To avoid plagiarism, the devices participating in the finals may not be significantly changed after the elimination round. The basic concept of the device (energy source type, maneuver method, and size) must be maintained. Minor modifications to the device are allowed within these constraints.

## 7) TARGET DESCRIPTION

The targets are shaped like croquet wickets (see image below). Each target has a different point value based on its apparent difficulty. All wickets have a clear height of 30 cm [11.8 inches] above the ground. All targets are firmly affixed to the ground using strong tape. If a target is moved, it will be reattached prior to the start of the next contestant's events. The wickets are made from wooden 2 x 2 furring strips (1.5" x 1.5" square).

- a) Target A is the furthest left target. The wicket has a 25 cm [9.8 inch] wide opening.
- b) Target B is second from the left. The wicket has a 32 cm [12.6 inch] wide opening.
- c) Target C is in the center. To achieve points for Target C, the ball must pass through the wicket and then touch a vertical stake. The stake does not need to be knocked down. The wicket has a 25 cm [9.8 inch] wide opening. The vertical stake is a 1.0 inch diameter rod that is 12 inches tall.
- d) Target D is second from the right. The wicket has a 25 cm [9.8 inch] wide opening.
- e) Target E is the furthest right target. The wicket has a 32 cm [12.6 inch] wide opening.



### 8) RUBBER BALL DESCRIPTION

The officially supplied rubber balls are extremely bouncy. They are manufactured by Champion Sports and are known as Rhino Skin Poly Playground Ball Sets. The listed size is 4” diameter. The SKU is PX4SET. If you wish to purchase the balls for practicing, the estimated cost is \$32.68 at [www.championsports.com](http://www.championsports.com) but they can be found for less cost at other Internet sites.

Details of the officially supplied rubber balls are as follows:

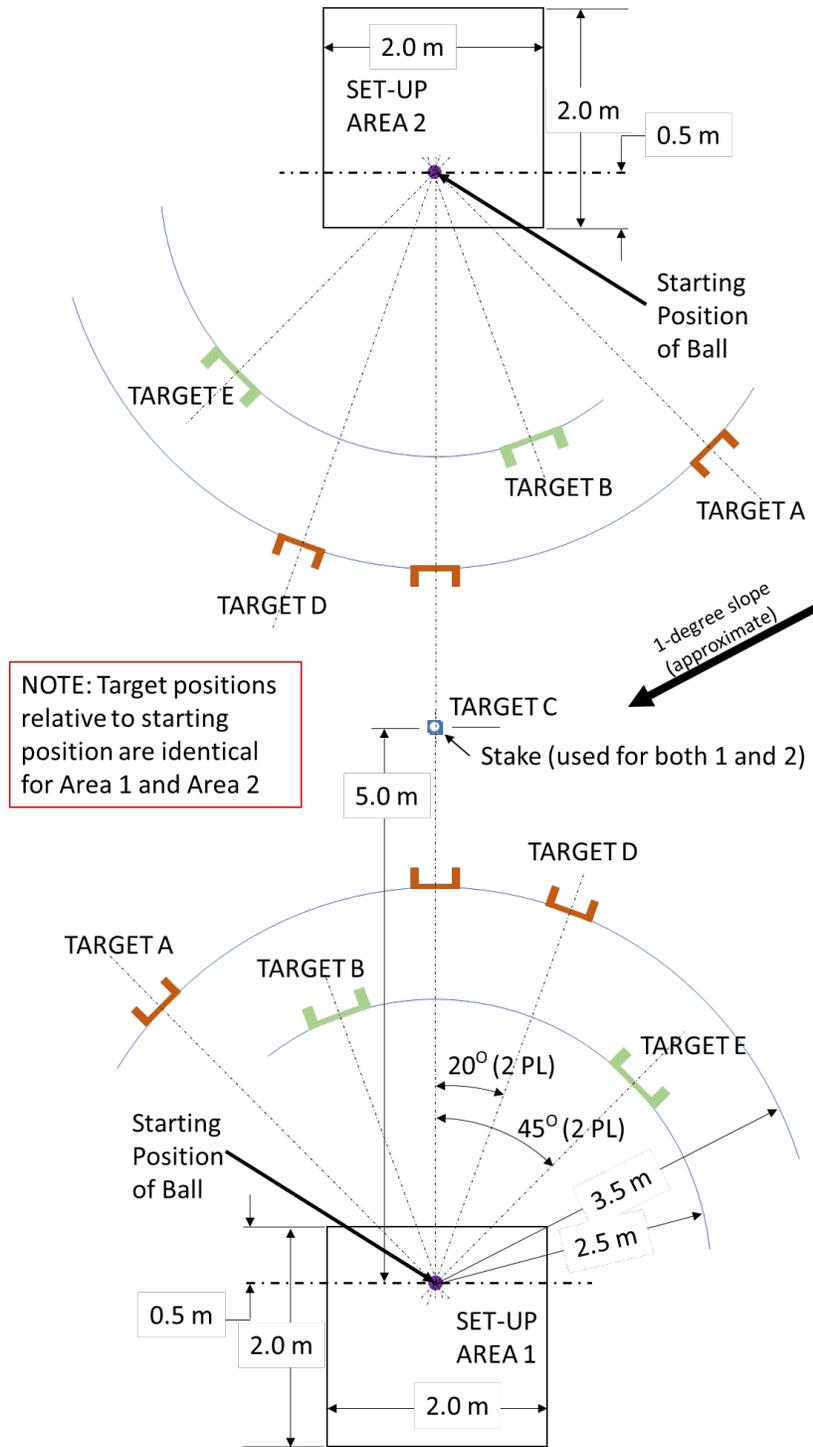
- a. Weight is approximately 119 grams [4.2 ounces].
- b. Outside diameter of the inflated rubber ball is approximately 13.33 cm [5.25 inches].
- c. The ball is inflated to approximately 10 psi.
- d. When dropped from a height of 36 inches, the ball rebounds to a height of 27.5 inches +/- 1.5 inches.



### 9) CONTEST AREA DESCRIPTION

The contest site is at least 6 meters wide and 14 meters long. There are two identical areas (Area 1 and Area 2). The ground is concrete with a rough finish and has a slight slope (approximately 1 degree across the width as shown in Figure 1). The stake, which is Target C, is common for both areas.

The size of the set-up area for the device is 2.0 meters wide by 2.0 meters deep. Each team will be randomly assigned to either set-up area. See Figure 1 for a description of the contest area, the device set-up area, and the specific locations of each target.



**Figure 1: Set-Up Areas and Target Locations**

## 10) SCORING

To successfully complete a target, the rubber ball must pass completely through the leading edge of the wicket. Remember that Target C also requires that the rubber ball touch the stake. Points are awarded based on two parameters. The first parameter is the Target. The second parameter is the color of the ball.

- a) Each target has a point value based on apparent difficulty.
  - i. Target A has a point value of 20 points.
  - ii. Target B has a point value of 10 points.
  - iii. Target C has a point value of 30 points.
  - iv. Target D has a point value of 20 points.
  - v. Target E has a point value of 10 points.
  
- b) The balls must be run in a specific order. The blue ball goes first, the red ball goes second, the yellow ball goes third, the green ball goes fourth, and the orange ball goes fifth.
  - i. The blue ball has a multiplier value of 3.
  - ii. The red and yellow ball have a multiplier of 2.
  - iii. The green and orange ball have a multiplier of 1.
  
- c) Scores for each successfully completed target are a product of the target value and the multiplier. For example, if the yellow ball successfully completed Target B, the point total for that event is 2 times 10 points for a total of 20 points. The maximum possible score is 190 points.

## 11) CONTEST PROCEDURE

The order in which teams will participate is selected by a random process. The team will be given a three-minute period to setup their device. Safety advisors will be observing the team during their setup time and will warn and potentially stop the team if any setup operations can lead to potential accidents. Strict time limits will be imposed to ensure that all contestants are able to operate their device. At the beginning of the setup period each team will be handed the five rubber balls. Each team is responsible for placing the rubber ball into their device making sure that the ball is placed on or above its starting position.

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 procedure for running the task and determining the official time for the task is as follows:

- a) The referee will give a countdown (3...2...1...GO!) for the start of operation for the device.
- b) The timers will start the time at the referee's direction. At 45 seconds, the lead timer will yell "15 Seconds Remain". At 60 seconds, the lead timer will yell "STOP". Any ball that has not left the device by that time will not be counted for scoring. When the last ball is initiated the Field Judge will say "STOP" in an audible voice.
- c) Timers will stop their watch when they hear the Field Judge announce "STOP". They

will compare their times and the lead timer will determine the official time. The official time will be recorded on the scoresheet by the Scorekeeper.

- d) The field judge will observe the tasks and make sure that the team does not provide any energy to assist the motion of the ball during any of the rubber ball motion events. The field judge will ensure that the rubber ball is struck and not pushed. Any rubber ball that is pushed will not count for award points. The field judge will observe that the device remains within the set-up area before, during, or after each motion event. If any violation occurs for a specific ball initiation, the Field Judge will audibly shout out “BAD”.
- e) The referee will determine if each ball successfully completes its target. The referee will audibly shout out “GOOD” for each target successfully accomplished.
- f) The Scorekeeper will notice the color of the ball and the intended target. If the referee announces that the task was completed successfully (i.e. “GOOD”), then the Scorekeeper will write down the color, the target, and the outcome. If “BAD” is announced by the Field Judge, the score for that ball cannot be counted.
- g) The Scorekeeper will calculate the score for each ball and write it down on the scoresheet. The Scorekeeper will total the points for the entire task and write it onto the entry form.
- h) The Scorekeeper will hand the scoresheet to the Announcer who will announce the official score and running time for the team.

All teams will be asked to remove their device and place it back in their original waiting area.

The winning team will be the team whose device has the highest official score. If two or more teams are tied, then the team that completed the task in the fastest time will be declared the winner. Times within 0.05 seconds will be declared an official tie.

## 12) AWARDS

Trophies will be divided into two categories: JPL employees/family/contractor entries and school team entries. Trophies 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 lightest, heaviest, most unusual, most artistic, and most creative designs.