



1. **DESCRIPTION:** Prior to the tournament, teams will design, build, and bring **up to three** bottle rockets to the tournament to launch a ping pong ball attached to a parachute to stay aloft for the greatest amount of time.

A TEAM OF UP TO: 2 IMPOUND: No EYE PROTECTION: B EVENT TIME: 8 minutes

2. **EVENT PARAMETERS:**

- a. Teams must provide **up to three rockets, three unaltered ping pong balls and three student made parachutes. Commercially produced parachutes are not allowed.**
- b. Parachutes must be attached to ping pong balls with tape only. The ping pong ball attached to the parachute assembly makes up the parachute payload system.
- c. All participants must properly wear eye protection at all times. Participants without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows. Participants without eye protection will not compete.
- d. Event Supervisors must provide a launcher (that uses a Schrader valve), an air pump, a pressure gauge, and timing devices. Teams may bring their own manual bicycle pump with a pressure gauge to use, but it must attach to the launcher provided by the Event Supervisor.
- e. This event should be held inside with a high ceiling (greater than 20 feet recommended). Tournament directors must provide the ceiling height (in feet) to teams at least 1 month in advance. Extreme care must be taken to protect the floor and ceiling of any inside facilities used for practice and competition.

3. **CONSTRUCTION PARAMETERS:**

- a. Rocket pressure vessels must be made from a single **20 oz, in measured volume**, or less plastic carbonated beverage bottle with a nozzle opening internal diameter of approximately 2.2 cm (a 1/2-inch Schedule 40 PVC pipe must fit tightly inside the nozzle opening) and a standard neck height from flange to bottle's opening of under 1.6 cm. The bottle label must be presented at check in.
- b. The structural integrity of the pressure vessel must not be altered. This includes, but is not limited to: physical, thermal or chemical damage (e.g., cutting, sanding, using hot or super glues, spray painting).
- c. The nose of the rocket must be rounded or blunt at the tip and designed such that when a standard bottle cap (~3.1 cm diameter x 1.25 cm tall) is placed on top of the nose, no portion of the nose touches the inside top of the bottle cap (see Figure 1).
- d. Only tape must be used to attach fins and other components to the outside of the pressure vessel. Nothing may be added to or placed on the inside of the pressure vessel. No glues of any type may be used on the pressure vessel. Metal of any type is prohibited anywhere on the rocket or parachute payload system.
- e. Fins and other parts added to the bottle must be 5 cm or higher above the level of the bottle's opening, to ensure rockets fit on the launcher (see Figure 2).
- f. All energy imparted to the rocket/parachute payload system must originate from air pressure provided by the tire pump; no water. Gases other than air, explosives, liquids including water, chemical reactions, pyrotechnics, electrical devices, elastic powered flight assists, throwing devices, remote controls, and tethers are prohibited at any time.
- g. At the National Event the launcher nipple will extend into the rocket 1.173 in +/- 0.2 in (3.0 cm +/- 0.5 cm) above the top side of the shoulder of the bottle (see Figure 3).

Figure 1

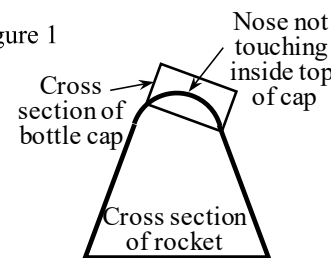


Figure 2

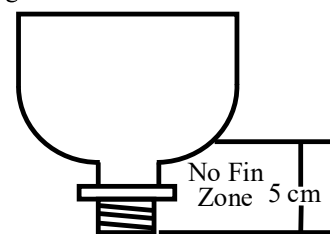
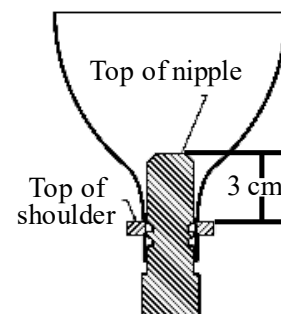


Figure 3



4. **PRACTICE LOG:**

- a. During inspection, each team must present a flight log **and graph** of recorded data for each rocket **design**. Data must include 5 or more parameters (3 required and at least 2 additional) for 15 or more test flights prior to the competition for each rocket. The required parameters are: 1) pressure (psi), 2) estimated/recorded peak flight height (feet), 3) time aloft (seconds). The additional parameters are chosen by the team (examples include: # fins, parachute diameter, etc.).



- b. For each rocket design, the team needs to prepare a graph showing estimated/recorded peak flight height (feet) vs Pressure (psi). The graph(s) must be printed out from an electronic source. Hand drawn graphs are not allowed.
 - c. If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the log.
 - i. Information about the tool hardware, software, materials, and supplies used
 - ii. Details of the source of any digital files (e.g.; CAD, STL, OBJ) utilized by the tool including but not limited to when and where the file was obtained, including the web address if downloaded from the internet
 - iii. Descriptions of how the team constructed the final device from the tool created components
 - d. Data on the graph must match the 15 or more recorded test flights for each rocket design.
 - e. Rocket designs without flight logs and graphs will be penalized a -10 second penalty for each scorable flight.
 - f. All submitted logs will be returned to teams.
5. **THE COMPETITION:**
- a. Teams must arrive at the competition site ready to launch with proper eye protection to have their rocket(s) inspected for safety. **If the Event Supervisor has safety concerns that cannot be addressed to their satisfaction rockets will not be launched.**
 - b. Teams will have **8 minutes to make a total of three launches using any combination of rocket, ping pong ball and parachute that the team presented for inspection at check in.**
 - c. **When teams are called to launch, the 8 minute timer starts when the team enters the launch area. Teams that brought their own manual tire pump will connect it to the pressure vessel connection of the launcher.** Teams will load their rocket onto the launcher. Once the rocket is loaded, but NOT pressurized, teams will place the parachute payload system on or in the rocket. After the payload parachute system is loaded it cannot be manipulated. Teams will then pressurize the rocket to the pressure (psi) of choice based on their practice log data. At no time should the pressure vessel (bottle) be pressurized beyond the lesser value of **50 psi** or the maximum pressure determined by the Event Supervisor for safe operations given ceiling height at the tournament location. The Event Supervisor will check the gauge on the pump to ensure the rocket is pressurized to the psi chosen and justified by the team's data.
 - d. The Event Supervisor will make sure 3 timers are ready and then signal a team member to make a loud announcement of, "3, 2, 1, LAUNCH!" Then a team member will proceed to launch the rocket. After launching, the team will prepare for the next launch.
 - e. Timing begins when the rocket separates from the launcher and stops when the parachute payload system lands.
 - f. If the parachute payload system does not separate from a rocket, timing is from when the rocket separates from the launcher to when any part of rocket touches the ground.
 - g. If any part of a rocket or parachute payload system hits the ceiling or any part connected to the ceiling (e.g., a rafter, light, basketball hoop), then timing is stopped at the instant of contact.
 - h. If a rocket fails to separate from the launcher because of a problem with the supplied launcher then the launch never occurred and the launch can be restarted.
 - i. All times for each launch **MUST** be recorded for breaking ties. Time aloft is recorded in hundredths of a second. The middle value is the officially recorded **flight** time.
 - j. Teams filing an appeal must leave their rocket(s), parachute payload system(s), and Practice Log(s) in the event area.
6. **SCORING:**
- a. **Ranking is determined by the sum of the two greatest times of flight of the 3 launches.**
 - b. **Rockets and/or parachute payload systems violating 2.c, 3.a-f will not be launched. Rockets violating rules 4.a-b. will be penalized with a -10 second penalty for each scorable flight.** Teams unable to make any launches will receive participation points only.
 - c. **Ties will be broken by the greatest time aloft of the parachute payload system from each team's un-scored 3rd launch.**

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org