



Water Bottle Rocket Competition

Level: Middle and High School (6th – 12th grades)

Type of Contest: Team

Teams: 2-3 students per team; max 6 teams per school

Overview: Students will work as an engineering design team with the goal of building a water-bottle rocket that travels the greatest altitude. The team is responsible for submitting a lab report that documents the engineering design process.

Materials: Water, plastic 2 liter soda bottles, tape (any kind), and glue (only glue that will not compromise integrity of plastic bottle; see Construction Rule #5)

Rules:

1. Only plastic 2-liter soda bottles are to be used. New bottles should be used whenever possible.
2. Bottles, which have been exposed to sunlight for long periods of time, should not be used. Bottles should be retired from use after 10 -15 launches.
3. The pressurized portion of the rocket must consist of one plastic 2-liter soda bottle. The manufactured structural integrity of the bottle cannot be altered. No metal parts will be allowed on the pressurized rocket body. The mass of the empty rocket assembly cannot exceed 300 grams.
4. No commercially finished or model products may be used.
5. Caution: No materials will be allowed that can compromise the integrity of the plastic bottles (e.g., hot glues or super glues). Cold glue is acceptable, but duct tape works wonders. Sanding or other abrasion of the plastic used for the pressurized body is not allowable.
6. Students should place their name on the rocket.
7. All energy imparted to the rocket must originate from the water/air pressure combination. No other potential or kinetic source of energy will be permitted.
8. While each team can receive guidance and support from their teacher and others, the rocket and lab report must be an original representation of the team's work.

Rocket Launching Rules

1. Each rocket launched must pass a safety inspection and have a mass measurement taken. The rocket may only be launched once for each pressure test. If the rocket is to be launched again it must have another pressure test.
2. Safety goggles must be worn when within 30 feet (10 meters) of a pressurized rocket.
3. Rockets will be pressurized to 60 pounds per square inch (psi) for competition; never exceed 90 psi under any circumstances. Once the rocket is pressurized, no contestant can touch or approach the rocket.
4. Never lean over the top of a pressurized bottle.
5. Timing of the rocket stops when the first part of the rocket hits the ground, when the rocket disappears from the judges' sight or when the rocket impacts or gets entangled in an object (e.g., the rocket collides with a tree or fence).
6. Though various rocket components may separate during the flight, all must remain linked together with a maximum distance not to exceed three (3) meters. If a nose cone is used, it can separate, but should remain attached to the rocket body. If any part of the rocket becomes unattached during flight, the rocket will be disqualified.
7. No parachutes, streamers or draglines may be used. The rocket must approximate a parabolic flight path.

Safety Precautions

1. All rockets will be launched using the launching pad provided by the judges.
2. One person, the designated safety officer, is to check for safe practices and can stop a launch whenever unsafe practices are observed.
3. One person is designated as the loading officer and is responsible for securing the rocket to the pad and charging the rocket with the appropriate air pressure.
4. One person, the designated launch officer, counts down to launch the rocket.
5. Be sure the launch pad is secured to the ground before launch.
6. All persons should be at least 10 ft. (3 meters) from the rocket when it is being pressurized.
7. Use only bicycle pumps or air compressors to pressurize rockets. Always have a means for accurately measuring the air pressure. Never charge a rocket without air pressure measurements.
8. Keep electrical cords away from all water sources. If a compressor is employed, use long air hoses rather than long electrical cords.
9. If a leak is observed during pressurization, stop adding air and release the rocket using standard launch techniques. Then repair the leak.
10. Bottles modified with fins, nose cones, and extra mass should be carefully tracked by all personnel and avoided as the rocket returns to earth. Never attempt to catch a spent rocket or any payload that the rocket has launched.
11. If the rocket fails to release after the pin is pulled, immediately clear the area and inform the adult supervisor. The supervisor will jiggle the rocket with a long stick and cause it to release.
12. Never launch near any buildings, power lines, cars, or anything else that can be damaged.

Contest Scoring and Judging

1. The height of the rocket will be determined by the judges. The triangulation method will be used by the judges to determine height. Time of flight will also be measured to help with potential ties and scoring.
2. Scores for the performance will equal the **ratio** of each device's performance relative to the winning device's performance on that task. Those scores are weighted according to the maximum points for performance which is 50 points.
3. Each team must submit an engineering lab book that documents the engineering design process. The lab book is worth 25 points. **See Year End Engineering Lab Book Instructions and Rubric.**
4. Ingenuity of design will also be judged via a rubric at the discretion of the judges. The design score is worth 25 points **See Design and Ingenuity Rubric on following page.**
5. The performance, design and lab book scores will be added to determine winners; the highest possible score is 100.

Awards: Awards will be given for 1st, 2nd, and 3rd place teams at two levels: Middle School (6th – 8th grade) and High School (9th – 12th grade)

MESA WATER BOTTLE ROCKETS: DESIGN AND INGENUITY RUBRIC

Student Names:

School:

Level (Middle/High School):

Criteria	Exceptional (5 pts)	Excellent/Good (4 pts)	Satisfactory/Meets Criteria (3 pts)	Fair (2 pts)	Poor (1 pt)	Totals
Creativity: How creatively did team use materials/items						
Design: Device was well conceived; functional and effective						
Ingenuity: Design was ingenious, different from what would be considered "normal" or expected						
Quality/Craftsmanship: Device was built well, showing capable craftsmanship and attention to detail						
Aesthetics: In judge's opinion, it is a great looking project, aesthetically pleasing to the eye						

GRAND TOTAL

(25 points possible)