

Dynamic Design: Launch and Propulsion

Safety Rules

APPENDIX A

Safety begins now! As in any project requiring a group of students to work together to use tools to construct, test, and redesign products, there are certain safety precautions. It is necessary for both you and your students to understand these rules and follow them exactly.

General Lab Safety

1. During the use of tools for any construction or launches, students and adults should wear safety goggles.
2. Before any tool is used, discuss the safety issues surrounding the proper use of the equipment.

Building the Rocket

1. Use only plastic drink bottles. New bottles should be used whenever possible. Bottles that have been exposed to sunlight for long periods of time should not be used. Bottles should be retired from use after 10-15 launches.
2. Use only the materials approved by the classroom teacher to construct the rocket.
3. No metal pieces or sharp objects may be used in the construction.
4. Take precautions when cutting bottles. The first incision can be made with a sharp carpet knife and the other cuts can be completed with scissors.
5. Do not use hot glue when attaching fins to the rocket body. The heat from the glue can weaken the plastic to the extent that the rocket may not be able to withstand the launch pressures. The use of cold-melt hot glues is acceptable. No cyanoacrylates (super-glues) should be used.
6. The supervisor must approve each design before the launch.

The Launch Area

1. Check your launch area for any potential concerns. Choose a large clearing such as an athletic practice field or vacant lot. When launching in smaller areas, use reduced pressures and adjust the launch angle to compensate for the wind.
2. The launch area and range should be large enough for the rocket pressure and should be clear before launching any rocket.
3. Do not attempt to catch a spent rocket or payload. Vertically, a rocket typically will reach 150 meters. A very aerodynamic rocket will impact the ground with speeds approaching 50 m/s (120 mph). When adding weight to the rocket with nose cones and payload, additional safety margins must be established.

The Launch

1. Launch your water rocket only under the guidance of a trained, professional adult.
2. Assign a supervisor to be responsible for completing a safety check list before launching (see attached list).



3. Always anchor the launch pad. When working on a solid concrete area, you may be able to weigh the pad down, tie it down to something solid, or attach the cord to a tree or a building in the opposite direction to counter the pull.
4. Safety goggles must be worn when within 10 meters (30 feet) of a pressurized rocket.
5. All persons not directly involved in the launch should be at least 5 meters (approximately 16 feet) from the rocket when it is being pressurized and during the launch process.
6. If you are filling rockets with a garden hose, make sure the hose has a shutoff valve and that water is kept some distance from the launch area. Keep the water off when not in use.
7. To pressurize the rocket, use only bicycle pumps, air compressors, or scuba tanks with air pressure gauges. Never charge a rocket without air pressure measurements.
8. Rockets can be pressurized with various air pressures, but never above 75 psi under any circumstances. Bottle designs vary and bottles can burst at lower pressures due to bottle type, fatigue from overuse, poor construction techniques, or exposure to sunlight. Never attempt to perform a bottle burst test.
9. Keep electrical cords away from all water sources. If using a compressor, use long air hoses rather than long electrical cords.

Assign the following personnel to be responsible for the launch:

- Safety Officer: Checks for safe practices and can stop a launch whenever unsafe practices are observed.
 - Loading Officer: Responsible for securing the rocket to the pad and charging the rocket with the appropriate air pressure.
 - Launch Officer: Commences the countdown and launches the vehicle.
 - Downrange Officer: Spots the rocket and assures the safe landing of the rocket and payload.
 - Maintenance Manager: Observes the launch and records data.
- As the bottle is being pressurized, all except the loading officer should stay away from the area. Never lean over a pressurized bottle.
 - All persons should face the rocket during launch. Kneel down and participate in the countdown. Keep the sun at your back or over your shoulder. Do not face the sun.
 - If a leak is observed during pressurization, stop adding air and release the rocket using the standard launch techniques. Then repair the leak or replace the bottle.
 - Bottles that are 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.
 - 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.

Signatures

I have read the Safety Rules and will observe them during the construction and launch of water bottle rockets.

Signature of student/supervisor _____

Safety Rules and the Safety Checklist are adapted from Jake Winemiller and Ron Bonnstetter
<http://tc.unl.edu/rbonnstetter/rockets/safety.html>