

Two-Liter Bottle Rocket

Introduction:

Using human muscle power, animal power, and the wind, people have been building transportation systems since ancient times. More recently, man has used combustible fuels to run motors, jets and rockets. Transportation systems can be classified as land, air, water, space vehicles. Also, "non-vehicle" transportation systems include things like elevators, escalators, pipelines, and conveyor belts. Transportation has enabled people to explore the world. We have gone everywhere, from deep under the sea to the cold, polar, regions to the upper reaches of the atmosphere. In exploring outer space, far from the pull of gravity from earth, objects seem to have no weight. This is known as weightlessness or zero gravity.

To first feel this weightlessness, rockets must be used to put satellites and astronauts into space. Without them, we would know little about Earth's surroundings, and we would not have all the benefits that satellites provide for us. Such rockets burn fuel to provide a thrust that pushes it upward. In fact, most of a rocket is made up of fuel -- its cargo or "payload" takes up a fairly small amount of room by comparison. A Russian schoolmaster, Konstantin Tsiolkovskii, put forward the first scientific ideas on rocket propulsion in 1903. However, it wasn't until 1926, when an American engineer, Robert Goddard, launched the first liquid fuel rocket, that space travel was really born.

Sputnik I was launched by the Soviets in October 1957 and was the first spacecraft to go into orbit around the earth. In April 1961, Soviet astronaut Yuri Gagarin became the first person to travel in space. The National Aeronautics and Space Administration (NASA) is constantly trying to develop a system which will deliver a payload into orbit. The world's mightiest rockets work on exactly the same principle as a balloon that zooms upward and when you release it. The balloon and rocket are pushed forward by a rush of gas escaping backward. This thrust is what pushes the rocket forward. The safe return of the delivery system is also an important part of their mission.

This activity will allow you to take on the role of an engineer for NASA. You will design, build, and launch a compressed air rocket that will fly straight and return safely back to Earth.

Some Rocket Vocabulary

Escape Velocity---	Weightlessness---	Recovery System---
Nose Cone---	Fin---	Parachute---
Propellant---	Altitude---	Apogee---
Rocket---	Angle---	Payload---
Thrust---	Telemetry---	Tumbling---
T-time---	Ignition---	N.A.S.A.--
Recovery System---	Gravitational pull---	

TASK:

Design, build, and launch a compressed air rocket made from a plastic two-liter bottle. The rocket should fly as high as possible and return to earth safely within a designated target area.

Materials: Tools/Equipment:

- plastic two-liter bottle
- glue (hot, epoxy, Goop, rubber cement...)
- scissors
- tape (Duct, masking, ...)
- non-metallic construction materials (cardboard, Styrofoam, posterboard, etc. ...)
- decoration (paint, markers, sparkles, paper, etc ...)

Concepts:

1. Transportation is moving people and/or goods from one place to another.
2. Transportation systems can be classified as land, air, water, space, and non-vehicle transportation.
3. NASA stands for National Aeronautics and Space Administration.
4. The four basic parts of any transportation system are: guidance; propulsion; payload; and control.
5. Newton's Third Law of Motion says, "For every action there is an equal, but opposite reaction." We will be launching rockets using PRESSURIZED WATER/AIR as the propellant. The propellant is forced downward; the equal and opposite action is the rocket being pushed up!
6. The six recovery systems of a rocket include: parachute; streamer; tumble; featherweight; glide; and helicopter recovery.
7. Aerodynamics is the study of how things are affected by the flow of air around them.

Specifications:

1. The result must be a space transportation vehicle capable of launching a "standard" 2-liter bottle launcher provided by the pack. Be creative; there are very few (but important!) specifications here. But remember; *typically* a simple design works best; "shuttle" or "airplane"-like designs don't make very good "rockets".
2. The bottle that serves as the engine and main body of the rocket can not be cut, punctured, scratched or damaged in any way or the rocket will not hold the air pressure.
3. The rocket may not have metallic or otherwise sharp or unreasonably dangerous materials in construction as determined by the judges or a consensus of leaders.
4. The fins must not extend any lower than where the bottle narrows at the neck. [Staying 1-1/2" above the 'lip' of the nozzle is a good rule-of-thumb. Otherwise the fins will interfere with the launch pad.
5. The rocket must launch as one complete unit, but may come down as several pieces.
6. On launch day, the rocket will be registered with judges. The rocket will be launched twice; it will be judged on how high it flies, and on how close it comes to the center of a target.

2-Liter Rocket Judging

• **Rocket design:**

-Safety - pass or fail; non-metal, no sharp edges, structurally sound (no scratches or warps to the bottle surface, fins attached securely, etc all for safe launching)

-Fastest-looking - Most Colorful - Best Craftsmanship

• **Rocket performance:**

- 2 launches per scout at 80 psi
- 1 point per feet height (25 ft increments)
- 200 points for all pieces in 30 ft circle
- 100 points for all pieces within 60 ft circle
- scores for both launches will be added together

BOTTLE ROCKET

* DESIGN CONSIDERATIONS *

- Nose Cone reduces drag!
- More fins = more stable; but more drag!
- More weight = "coasts" better; but flies slower!

- More water = more propellant; but heavier rocket!

Cardboard "nose cone"

Ball of clay, or other added weight

Tape OR Glue Wrap

May wrap with cardboard/poster-board to glue fins to. Or, tape or glue directly to bottle "fuselage."

3 or 4

fins! (balsa, cardboard, Styrofoam...)

AT LEAST 1 inch

