

Balloon Staging

Objective

To simulate a multistage rocket launch by using two inflated balloons that slide along a fishing line by the thrust produced from escaping air.

- Target concept: Velocity
- Preparation time: 10–30 min
- Duration of activity: 55–65 min
- Student group size: Teams of two or three

Materials and Tools

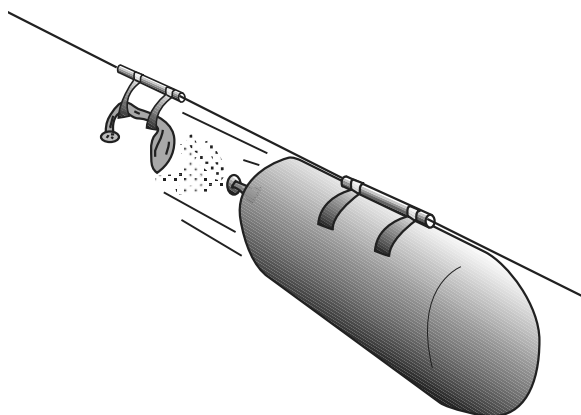
- Two long party balloons
- Nylon monofilament fishing line (any weight)
- Two plastic straws (milkshake size)
- Styrofoam coffee cup
- Masking tape
- Scissors
- Two spring clothespins

Management

The activity described below can be done by students or used as a demonstration. Younger students may have difficulty in coordinating the assembly steps to achieve a successful launch. For safety, consider attaching the fishing line along one wall where there is not much traffic, so students will not walk into the line.

Background Information

Traveling into outer space takes enormous amounts of energy. This activity is a simple demonstration of rocket staging that Johann Schmidlap first proposed in the 16th century.



When a lower stage has exhausted its load of propellants, the entire stage drops away, making the upper stages more efficient in reaching higher altitudes. In the typical rocket, the stages are mounted one on top of the other. The lowest stage is the largest and heaviest.

In the Space Shuttle, the stages attach side by side. The Solid Rocket Booster's attach to the side of the external tank. Also attached to the external tank is the Shuttle orbiter. When exhausted, the SRBs jettison. Later, the orbiter discards the external tank as well. Thanks to staging, not only can we reach outer space in the Space Shuttle, but we can also reach the Moon and other planets using various spacecraft.

Procedure

1. Thread the fishing line through the two straws. Stretch the fishing line snugly across a room, and secure its ends. Make sure the line is just high enough for people to pass safely underneath.

2. Cut the coffee cup in half so that the lip of the cup forms a continuous ring.
3. Stretch the balloons by preinflating them.
 - a. Inflate the first balloon about three-fourths full of air and squeeze its nozzle tight.
 - b. Pull the nozzle through the ring.
 - c. Twist the nozzle and hold it shut with a spring clothespin.
 - d. Inflate the second balloon.
 - e. While doing so, make sure the front end of the second balloon extends through the ring a short distance. As the second balloon inflates, it will press against the nozzle of the first balloon and take over the clip's job of holding it shut. It may take a bit of practice to achieve this.
 - f. Clip the nozzle of the second balloon shut also.
4. Take the balloons to one end of the fishing line and tape each balloon to a straw with masking tape. The balloons should point parallel to the fishing line.
5. Remove the clip from the first balloon and untwist the nozzle. Remove the nozzle from the second balloon as well, but continue holding it shut with your fingers.
6. If you wish, do a rocket countdown as you release the balloon you are holding. The escaping gas will propel both balloons along the fishing line. When the first balloon released runs out of air, it will release the other balloon to continue the trip.
7. Distribute design sheets and ask students to design and describe their own multistage rocket.

Assessment

1. Collect and display student designs for multistage rockets.
2. Ask each student to explain his/her rocket to the class.

Extensions

1. Encourage the students to try other launch arrangements, such as side-by-side balloons and three stages.
2. Can students fly a two-stage balloon without the fishing line as a guide? How might the balloons be modified to make this possible?

