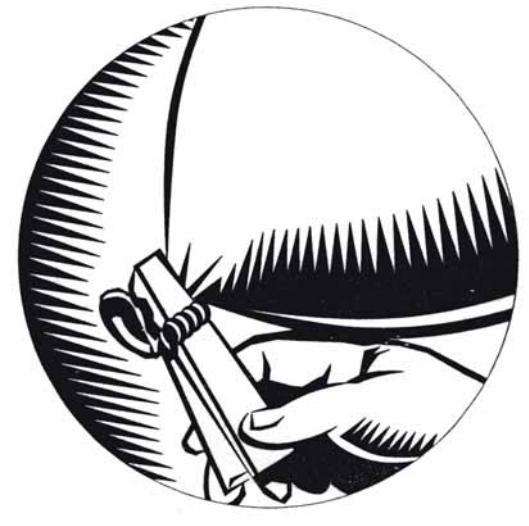
Rocket Transportation

Students construct a balloon rocket and use it to carry a paper clip payload.



Grade level

Middle school and up

Materials

- Large long balloons (several per student group)
- Fishing line
- Straws
- Small paper clips
- Tape
- Clothes pins
- Scales

Discussion

Engineers and scientists have met many challenges to reach outer space with various spacecraft. The mass of a rocket can make the difference between a successful flight and a rocket that just sits on a launch pad. As a basic principle of rocket flight, a rocket will leave the ground when the engine produces a thrust that is greater than the total mass of the vehicle. Large rockets, able to carry a spacecraft into space, have serious weight problems. To reach space and proper orbital velocities, a great deal of propellant is needed: therefore, the tanks, engines and associated hardware become larger. Up to a point, bigger rockets fly farther when smaller rockets, but when they become too large their structures weigh them down too much.

One solution is to attach small rockets atop the big ones. When the large rockets exhaust their fuel supply, the rocket case drops behind and the remaining rocket fires. Much higher altitudes can be achieved this way. This technique of building a rocket is called staging.

Activity

(This activity works best with student teams of three or four)

1. Attach a fishing line to the ceiling or as high on the wall as possible. Try attaching a paper clip to a fishing line and hooking it on to the light or ceiling tile braces. Make one drop with the fishing line to the door or table top per group. Note: The line may be marked off in metric units with a marker to aid students in determining the height traveled.
2. Blow up the balloon and hold it shut with a clothes pin. You will remove the clip before launch.
3. Use the paper cup as a payload bay to carry the weights. Attach the cup to the balloon using tape. Encourage students to think of creative locations to attach the cup to the balloon.
4. Attach the straw to the side of your rocket using the tape. Be sure the straw runs lengthwise along the balloon. This will be your guide and attachment to your fishing line.
5. Thread the fishing line through the straws. Launch is now possible simply by removing the clothes pin. Note: The fishing line should be taut for the rocket to travel successfully up the line, and the clipped balloon nozzle must be untwisted before release.
6. After trying their rocket, have students predict how much weight they can lift to the ceiling. Allow students to change their design in any way that might increase the rocket's lifting ability between each try (e.g., adding additional balloons, changing locations of the payload bay etc.)

Discussion

Have students compare what they have learned about balloons and rockets and compare results of their experiments. Why is the balloon forced along the string?

Additional challenges

Can you eliminate the paper cup from the rocket and have it still carry paper clips? If each balloon costs one million dollars and you need to lift 100 paper clips, how much money would you need to spend? How could you cut costs? Without attaching the paper cup as a payload carrier, have the students measure the distance the balloon travels along the string in a horizontal, vertical and 45 degree angle using metric unit. Discuss the differences.

This activity provided by the NASA.