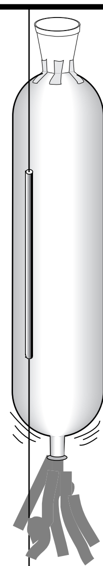

Teacher Information

Rocket Transportation

Objective:
To problem solve ways to lift a load using a balloon rocket.

Description:
Students construct a rocket out of a balloon and use it to carry a paper clip payload.

Science Standards:
- Science as Inquiry
- Physical Science - Position and motion of objects
- Science and Technology - Abilities of technological design

Science Process Skills:
- Observing
- Communicating
- Measuring
- Collecting Data
- Inferring
- Predicting
- Making Models
- Defining Operationally

Mathematics Standards:
- Problem Solving
- Communication
- Reasoning
- Connections
- Estimation
- Measurement

Management:
This activity works best with students working in teams of three or four. It will take approximately one hour to complete. The activity focuses on the scientific processes of experimentation.

Background Information:
The mass of a rocket can make the difference between a successful flight and a rocket that just sits on the 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 than smaller rockets, but when they become too large their structures weigh them down too much.

A solution to the problem of giant rockets weighing too much can be credited to the 16th-century fireworks maker John Schmidlap. Schmidlap attached small

Materials and Tools:
- Large long balloons (Several per group)
- Fishing line
- Straws
- Small paper cups
- Paper clips
- Tape
- Clothes pins
- Scales

rockets to the top of big ones. When the large rockets exhausted their fuel supply the rocket casing dropped behind and the remaining rocket fired. Much higher altitudes can be achieved this way.

This technique of building a rocket is called staging. Thanks to staging, we can not only reach outer space in the Space Shuttle, but also the Moon and other planets using various spacecraft.

Procedure:

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 floor 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 rockets lifting ability between each try (e.g. adding additional balloons, changing locations of the payload bay, replacing the initial balloon as it loses some of its elasticity enabling it to maintain the same thrust, etc.)

Discussion:

1. Compare what you have learned about balloons and rockets.

2. Why is the balloon forced along the string?

Assessment:

Compare results from student launches. Have students discuss design elements that made their launch successful and ideas they think could be used to create an even more successful heavy-lift launcher.

Extensions:

• 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? Can you think of a way to cut this cost?

• 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 units. Discuss the differences.

Rocket Transportation

Rocket Team ______________________

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- **Predict how much weight your rocket can lift to the ceiling** ______________________
  (2 small paperclips = approximately 1 gram)

Test	Weight Lifted	Results of Test
1		
2		
3		
4		

Based on your most successful launch:

•What was the maximum amount of weight you could lift to the ceiling?____________

Sketch Your Rocket

Explain how you designed your rocket to lift the maximum amount of weight.

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- **What other ways could increase the lifting capacity of your rocket?**

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