# Activity 4

## Simple Rocket Science

### Objective

Students perform a simple science experiment to show how a rocket works and to demonstrate Newton's Third Law of Motion.

### Standards

Science, Technology, Language Arts

### Materials

- Pictures, drawings or videotapes of rocket launches
- 1 plastic straw (milkshake size)
- 10 long party balloons
- Clear cellophane tape
- 6 – 8 meters of nylon monofilament fishing line (any size)
- Scissors
- 1 spring clothespin
- 1 straw rocket drawing (Figure 8, page 80), colored and cut out
- Chart paper, 3 pieces
- Journal or a sheet of paper, 1 per student
- Markers, crayons, and pencils
- 2 classroom chairs
- Pieces of paper
- Camera and film

### Educator Information

- Carefully review the setup of the experiment and gather all required materials.
- Decide where the experiment needs to be set up in the classroom.
- This activity may need additional adult assistance.
- Because of safety concerns, an adult should blow up the balloon.
- Read the information about the International Space Station (ISS). The ISS is a science laboratory in space where the crew performs science experiments.
- Read information on the history of rockets and on the scientists who studied rockets. Be prepared to share this information with students.
- Read the following information and be prepared to share it with the class.

  *Sir Isaac Newton described the principles of rocket science in three laws of motion. A simplified explanation of his third law of motion helps young students understand how rockets work. This law states that every action has an equal and opposite reaction. When a rocket expels fuel or propellant out of its engine, the rocket moves in the opposite direction. The rocket pushes the propellant*

*out, and the propellant then pushes the rocket. The propellant comes out of the engine. This is the action. The rocket lifts off the launch pad in the opposite direction. This is the reaction.*

- Explain to the class that this experiment shows how rockets work. The balloon experiment and a rocket both demonstrate Newton's Third Law of Motion, which states that for every action there is an equal but opposite reaction.
- For additional simple rocket demonstrations, view the *Rockets* guide at *http://spacelink.nasa.gov/products/Rockets.* In this guide, the activity, *3, 2, 1 Pop*, is an excellent demonstration of how a rocket works.

## Procedure

1. Remind students that rocket launches are necessary to build the ISS. Share pictures, drawings, or videotapes of rocket launches with students. Discuss what they see in the pictures, in the drawings, or on the videotape. Note the direction that the rockets move. Note where the engines are and where the flames or fire comes out.
2. Ask students if they know how a rocket works. Explain to them that they will be conducting a simple demonstration or science experiment to show how a rocket lifts off the launch pad. Students, just like the astronauts in space and scientists on Earth, will conduct an experiment to gather information.
3. Thread the fishing line through the straw. Attach each end of the line with the straw on it to the back of a classroom chair. Stretch the line tightly.
4. Have an adult blow up a balloon and keep it tightly closed with fingers or with a clothespin.
5. Tape one part of the rocket pattern (Figure 8, page 80) to the balloon. Tape the balloon carefully to the straw while keeping it tightly closed. See *Figure 9.*
6. Show students the position of the balloon on the fishing line. Place the balloon near one end of the fishing line with the open end closest to the chair. Explain to the class that in this experiment, an adult will release air from the balloon.
7. The word, *hypothesis*, is introduced if appropriate. Show the class the word written on a piece of chart paper. For scientists, a

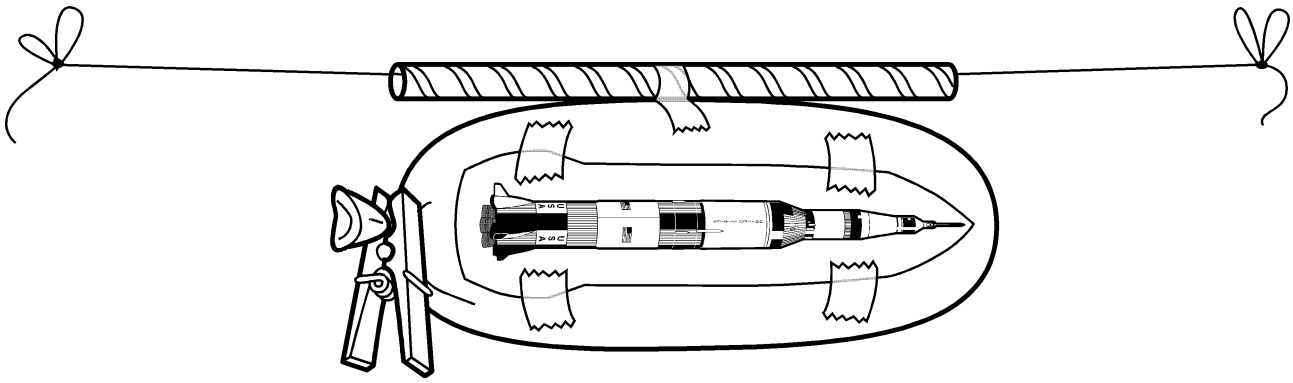

*Figure 9. Balloon Experiment Diagram*

hypothesis is a reasonable or good guess about what they think will happen in an experiment.

8. Tell the class that the air will be released from the balloon. Discuss in which direction the air will move. The balloon will also begin to move. Based on their prior experiences, ask the students to make a good guess about the direction the balloon will travel when air is released. Ask the class to verbalize a hypothesis, or guess, about the movement of the balloon. Students point with their fingers to indicate the direction in which they think the rocket will travel.
9. Write the hypothesis developed by the class on the chart paper.
10. When discussing directions, encourage the class to use the word, *opposite*. Introduce or review the concept of opposites.
11. To help students remember the correct sequence of events in the experiment, write directions or draw pictures to represent the steps on chart paper. Display the directions in the classroom.

## Experiment

1. Prepare to launch, or release, the air from the balloon. Just like a rocket launch, practice a countdown, *10,9,8,7,6,5...*, before the air is released.
2. Carefully remove fingers or the clothespin from the balloon and release the air. The balloon will travel in the opposite direction from which the air escaped.
3. Ask students if their guess or hypothesis was correct.
4. Explain to the students that scientists must repeat an experiment many times. Repetition of an experiment ensures that the results are accurate. Like scientists, the class must repeat the experiment with the balloon to determine that the results are always the same.
5. Let students choose a reasonable number of times to repeat the experiment. Scientists need to have many repetitions to increase the reliability of their results.
6. Before repeating the experiment, tell the class that scientists need a method to record the results from experiments.
7. Ask the class to devise a simple way to record information or data from the experiment. For example, if the experiment repeats five times, ask students to write the numerals from 1 to 5 on an individual sheet of paper or in a journal.
8. Students sit in front of the experiment and observe. Have students draw an arrow next to the numeral to indicate the direction the balloon traveled each time. Data collection could also be a class activity.
9. Be ready to repeat the experiment the number of times suggested by the class. If necessary, use a new balloon blown up by an adult. When attaching the balloon to the straw, be certain that the open end of the balloon is always facing the same direction. Remember to practice a countdown. Collect data from the experiment.
10. As the experiment repeats, let students participate by holding the balloon closed and releasing the air. Remind the class to observe the balloon's movement and to record the data.
11. Allow students to compare their data. Ask students if they can learn something or draw a conclusion from this information.
12. If appropriate, introduce the word, *conclusion*. Write the word, *conclusion*, on chart paper. A *conclusion* is a statement of the results from the experiment. Ask the class what they learned from the experiment. Write their conclusion on the paper. For example, the conclusion could be, "*When the air was*

*released from the balloon, the balloon moved in the opposite direction*."

13. Discuss whether the original hypothesis or guess was correct. Have students verbalize why they think the balloon traveled in the opposite direction.
14. Explain to students why the movement of the balloon is like a real rocket's movement. If appropriate, introduce the information about Newton's Third Law of Motion. In a rocket, propellant escapes from the bottom of the rocket. In the balloon experiment, air escapes from the end of the balloon. The rocket lifts off due to the escaping propellant. The balloon moves due to the escaping air. Like a rocket, the balloon travels in the opposite direction.
15. Display the chart paper with the hypothesis, the chart paper with the conclusion, and the data collection sheets in the room. If a camera is available, add pictures of the students conducting the experiment to the display.

## Assessment

- Observe students as they answer questions about the experiment. Have students draw a picture of the experiment in their journals or on a piece of paper. Ask them to explain their drawing and explain the relationship between the balloon's movement and the released air. Ask students to describe how a rocket works.

## Enrichment

- Challenge students to apply what they learned in this experiment. Repeat the experiment with one change. When attaching a balloon to the straw, reverse the placement of the open end of the balloon. If the open end was to the left, place it to the right. Ask students to form a hypothesis about the movement of the balloon when the air releases. Conduct the experiment. Repeat if necessary. Discuss whether the hypothesis was correct. Talk about the similarities and differences in this experiment and the original experiment. Ask the students if the balloon, in both experiments, moved in the opposite direction from the release of the air. Discuss how students applied what they learned or their conclusion from the first experiment to a new situation.
- Repeat the experiment with another variation. Change the position of the fishing line. Attach one end to the ceiling. Place the straw on the line and stretch the line tightly. Attach the balloon. Attach the other end of the line to a chair or object in the room. Repeat the experiment. Ask students to apply what they learned to a new situation.
- In a journal or on a sheet of paper, or as a group exercise with the educator writing on chart paper, ask students to list the steps needed to conduct the experiment. Discuss the importance of completing the steps in the right order. Encourage the use of ordinal numbers, such as *first*, *second*, and *third* in their descriptions.
- Have students use directional words to describe the movement in the balloon experiment or a rocket launch. Discuss words such as *up* and *down*, *left* and *right*, and *forward* and *backward*. Introduce or review the concept of words that are opposites. Have students generate a list of words that are opposites.
- From the *Suggested Reading* list or other sources, select books that feature pictures and drawings of rocket launches. Encourage students to look at the depictions of rocket launches and think about what they now know about how a rocket works. Ask students to look at the pictures and note the direction in which the rockets move.

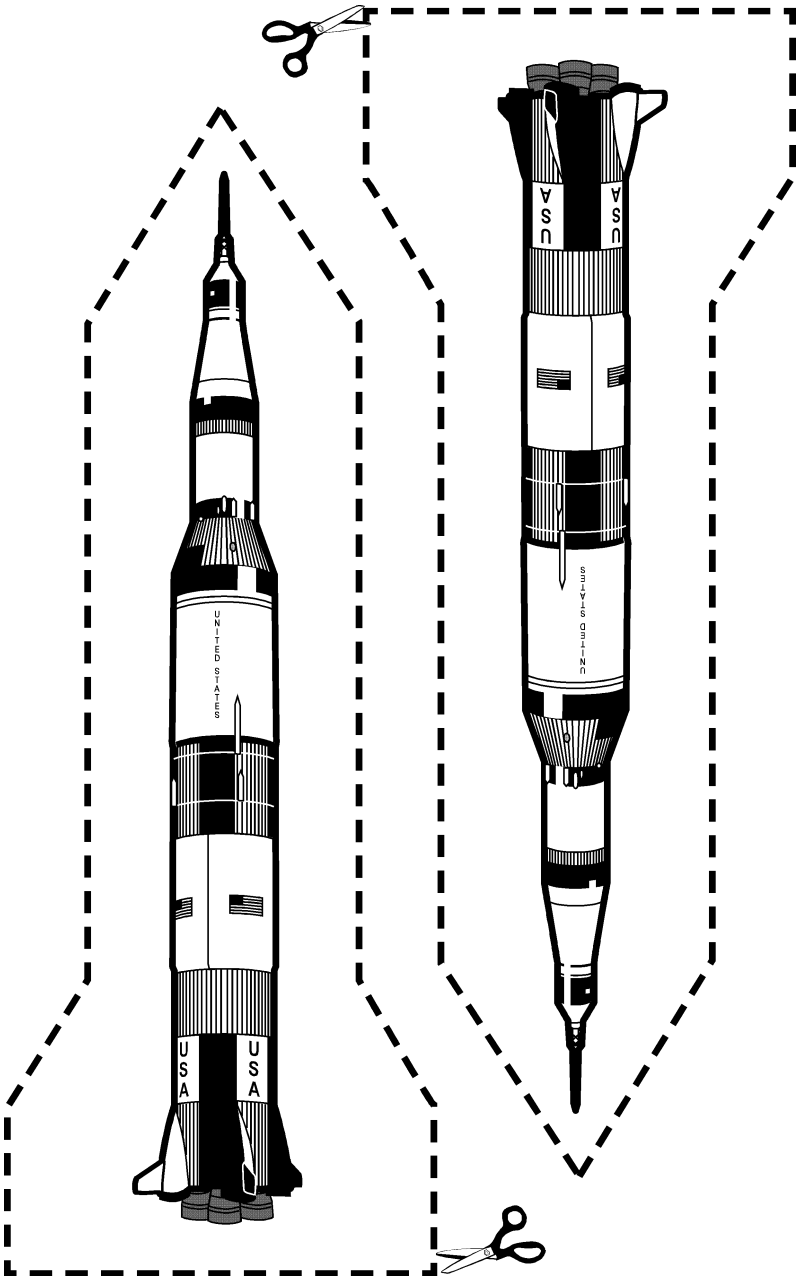


*Figure 8. Straw Rocket Pattern*