Balloon Blast

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Objective

Students will devise a plan to measure the distance of a balloon's flight, predict the direction a balloon will travel as it deflates, experience Newton's Third Law (For every action, there is an opposite, yet equal, reaction), collect relevant data, graph results, and draw conclusions.

Time

This activity requires at least two class periods, one for exploration and another to graph and analyze the data collected.

Materials

Provide each student with a balloon and a permanent marker. Straws, several types of string, quart-size plastic zip-lock bags, tape, a tape measure, and meter stick also should be available. A copy of "Newton's Laws of Motion," and the "Quiz," student pages

Classroom Setup and Management

For each student, make photocopies of both student sheets. Distribute the quiz after students have read "Newton's Laws of Motion."

Have students work in groups of four.

Engage

Inflate a balloon, but do not tie the end. Now turn it loose and ask your students, *How far did the balloon travel?* Students should conclude that it is difficult, if not impossible to measure the distance traveled, given the balloon's erratic flight. Ask, *How can we measure the distance a balloon can travel as it deflates?*

Explore

1. Give each student a balloon. Have students write their names on their balloons with a marker. For at least five minutes, have students repeatedly inflate and release their balloons. During this time, have students observe their balloons' flight path and distance traveled.
2. Afterward, have groups gather to discuss the best way(s) to measure the distance traveled by a deflating balloon. Ask, *What are the problems involved in this task? What are the possible solutions?* Students may share their ideas (this approach works better for younger students), or groups can continue without further discussion.

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3. Ask students, *What materials could we use to measure how far a balloon travels?* Show students the materials and tools available to them. Ask, *Could we use a straw and string, or a plastic bag?* Explain that students can choose from among the materials supplied to find a way to measure the distance a balloon can travel.

   Note. One possible strategy for measuring the distance a balloon travels follows is to tape a straw to the top-side of the balloon, and then threading a 10-meter string through the straw so that the straw slides freely up and down the string, propelled by the deflating balloon. The string can be marked at meter intervals for ease in measurement, and can be fastened between two chairs or held tightly by two students.

   Teachers may share this strategy method with students, or have students develop their own methods. Students' creativity often will produce other strategies that work just as well.
4. Have each team select materials to test its experimental design and develop a data chart (T-chart) on which to record its predictions and the actual distances traveled.
5. Once a test plan is developed, have each student predict the distance the balloon will travel. Then, have groups conduct their tests by inflating their balloons and letting them go. Students will discover that balloons move in the opposite direction from which air is exiting. On their data sheets, students should record their predictions for the distance traveled, actual distance traveled, and the difference between the two.
6. During this exploration, students will likely discover that the amount of air forced into the balloon is an important factor in determining how far it travels. Teams should adjust their data collection to reflect this variable. In fact, this is an excellent activity through which to introduce variables. You may consider studying the distance traveled when all balloons are filled with the same number of puffs of air [What might the problem be with this approach?] or are filled to the same diameter. Discuss other potential variables.
7. Each team should have at least four trials with a balloon, using a different balloon for each trial and recording the results each time.
8. Next, have students construct a bar graph. Plot the estimated distances traveled in one color and the actual distance traveled in a contrasting color.

Explain

1. Have students interpret the graph.
2. Ask students, *Did your prediction get closer to your actual measurement as you repeated the experiment? Why or why not?*
3. Ask students, *What did you discover about the direction the balloon traveled?* This is an excellent time to introduce Newton's Laws.

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4. Ask, *How did the amount of air in the balloon affect the distance it traveled?*
5. Ask students, *How does the behavior of your balloon compare to that of a rocket?*

Elaborate

1. Ask students, *What might happen if other variables were included in this experiment?* For instance, you (the teacher) might suggest using different types of string, different sized balloons or different shaped balloons.
2. Share and discuss "Newton's Laws of Motion," sheets with the class (see p. 6).
3. Apply the Laws of Motion to the activity. (For instance: For every action, there is an opposite, and equal reaction: How did the balloon on the string demonstrate that Law?).

Evaluate

Have students use the data gathered from their graphs to write a paragraph about what they have learned. Ask, *What conclusions can you draw?* The balloon traveled farther when the string was tight. The balloon distance traveled depended on many factors.

Extend

- Research rockets.
- Read *How Do You Go to the Bathroom in Space?* by William R. Pogue.
- Explore *The Way Things Work* by David Macaulay.

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Newton's Laws of Motion

First Law of Motion

An object at rest will remain at rest unless acted on by an unbalanced force.

An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

This law is often called the "Law of Inertia." It means that there is a natural tendency of objects to keep on doing what they're doing. All objects resist changes in their state of motion. In the absence of an unbalanced force, an object in motion will maintain this state of motion. This is why you wear a seat belt.

Second Law of Motion

Acceleration is produced when a force acts on a mass.

The greater the mass (of the object being accelerated), the greater the amount of force needed (to accelerate the object).

This means that heavier objects require more force than do lighter objects to move the same distance. **(F=ma)** Force equal mass times acceleration. Acceleration refers to **the rate at which the velocity of an object changes. Keep in mind that velocity refers both to speed (distance traveled over time) and direction of travel.**

Third Law of Motion

For every action, there is an equal, and opposite, reaction.

This means that for every force there is a reaction force that is equal in size, but opposite in direction. In other words, whenever an object pushes another object, it gets pushed back in the opposite direction equally hard. For instance, when a rocket takes off, it pushes down on the ground with a powerful force (action); meanwhile, the ground pushes the rocket upward with an equal force (reaction).

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Name

Quiz

1. What scientist first explained the Laws of Motion?

2. How many Laws of Motion are there?

3. What is another name for the First Law of Motion?

4. Based on Newton’s Laws, explain why we need to wear seatbelts.

5. Which law says that force is equal to mass times acceleration (F=MA)? Apply this law to moving furniture.

6. Newton’s Third Law of Motion explains how rockets are launched into space. Explain how this law applies to the balloon experiment in this activity.

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