ROCKET BALLOONS

CHART #1

I. Topic Area

Rocket Balloons

II. Introductory Statement

Students will learn how a rocket works.

III. Math Skills

a. Measurement
b. Averaging

Science Processes

a. Recording data
b. Observing
c. Controlling variables

IV. Materials

Sausage-type balloons
Soda straws
Masking tape
String (Monofilament fishing line works best)
Measuring tape or meter stick
Student page 17

V. Key Question

"How does a rocket work? What gets it off the ground?"

VI. Background Information

1. In this initial investigation, we are going to consider the relationship between the length of the balloon and the distance which it travels.
2. Logically, the more air in the balloon, the longer it will be and, therefore, the farther it will travel.
3. This is an example of Newton's Third Law of Motion: for every action there is an equal but opposite reaction. The backward thrust of the air produces the forward motion of the balloon.

VII. Management

1. This activity will take one to two class periods, or 45-90 minutes.
2. Try to have as many different lines strung as possible to use as tracks for the balloons to run on. Hang the strings at student eye level.
3. This activity works best in small groups.
4. Assign jobs which can be rotated: one person to (a) launch the balloon, (b) record the distance, (c) observe and check.
5. If room is limited, you will have to lessen the size of the balloons.

VIII. Procedure

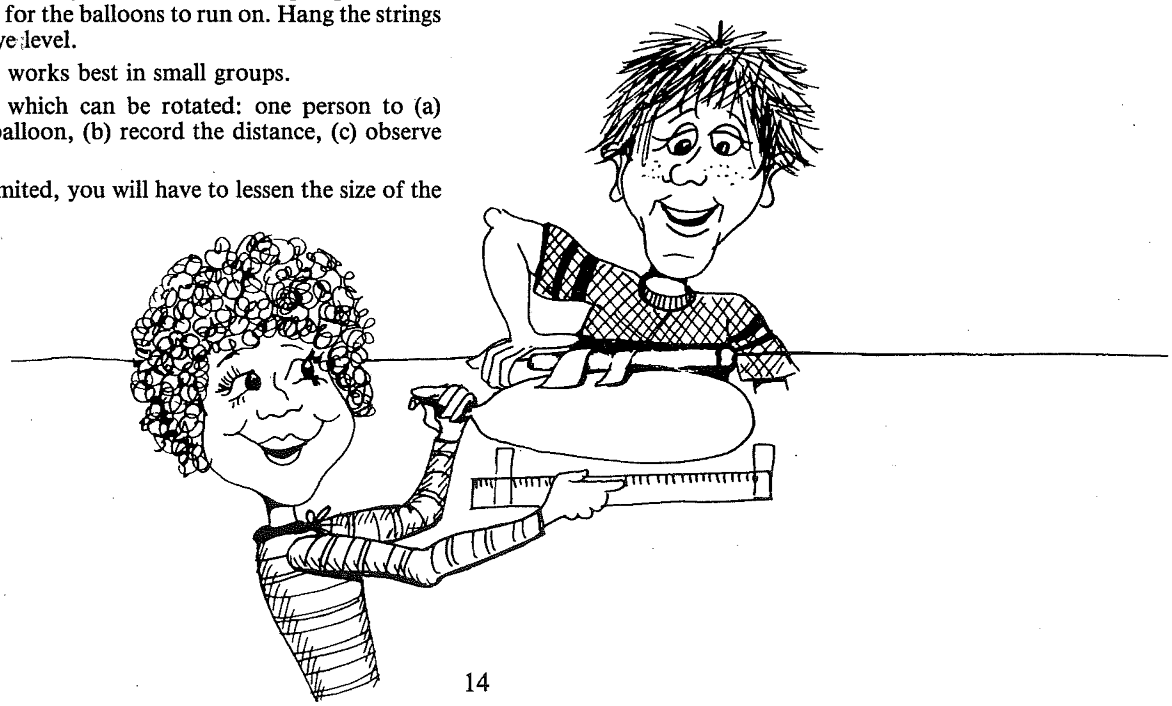
1. As air escapes from the balloon, the rocket will travel along the track (string).
2. Thread string through a straw and attach the ends of the string to a wall or other object. Stretch the string as tightly as possible.
3. Blow up a balloon to the desired size, measure it, and record the data.
4. Tape the balloon to the straw. It is best to tape the soda straw and balloon together near the opening of the balloon, with tape pieces fairly close together.
5. BE CAREFUL--don't let the air out yet!
6. Release balloon. Observe and record the distance it travels.

IX. What the Students Will Do

1. Students will make balloon rockets and measure, record the length of the balloon.
2. Students will attach the balloon rocket to the track.
3. Students will measure the distance the balloon travels when it is released.
4. Students will record data.

X. Discussion

1. Why does the balloon travel along the string? (thrust: the backward thrust of the released air creates the forward motion of the balloon).
2. What happened as the length of the balloon was increased? (from student observation. Why?) (more air was released).
3. What factors could cause a balloon not to go as far as it should?



ROCKET BALLOONS

CHART # 2

I. **Topic Area**

Rocket Balloons

II. **Introductory Statement**

Students will explore the ways in which the angle of ascent might affect a rocket.

III. **Math Skills**

a. Measurement - linear
b. Measurement - angles
c. Averaging

Science Processes

a. Recording data
b. Observing
c. Controlling variables

IV. **Materials**

Sausage-type balloons
Soda straws
Masking tape
String (Monofilament line, again)
Measuring tape or meter stick
Protractor to measure the angle of the string--blackboard type?
Student page 18

V. **Key Question**

"Does the distance a balloon rocket travels change as the angle of ascent increases?"

VI. **Background Information**

1. Since the balloon will have to travel up the line at an angle, some of the thrust will be expended in this effort.
2. We will be comparing the distance traveled when the rocket is traveling at different angles.

VII. **Management**

1. This activity works best in small groups and will take 45-60 minutes.
2. Try to have as many different lines strung as possible.
3. Again, assign jobs which can be rotated--a launcher, a recorder and a checker.
4. Hopefully, if students are careful when checking the measurements of the angles when they move the lines, they will also be careful in the physical process of moving the lines.
5. Again, if space is limited, lessen the size of the balloon.

VIII. **Procedure**

1. Follow Steps 1-6 of the Procedure in part A of this investigation.
2. After each distance is recorded, change the angle of the track the rocket balloon must travel. To measure the angles easily, cut off the bottom margin of a clinometer (Student page 2) and use it.
3. Repeat the above procedure for the different angles of the string.

IX. **What the Students Will Do**

1. After making rocket balloons and measuring their lengths as before, students will measure the distance the balloons travel along the track or line.
2. Students will retest their balloons (blown up to the same length each time) each time that the angle of the track is changed.
3. Students will record the data and compare the distances traveled at each angle.

X. **Discussion**

1. What happens when the line is changed from level flight to a different angle or flight?
2. Does it take more or less power to lift the balloon rocket "off the ground" when the line is at an angle than it does when the line is level? Why?
3. Does it take more or less power to move the balloon rocket the same distance along an upward path as it does to move it along a level path? Why?

XI. **Extension**

Students can calculate the speed at which their rocket balloons travel by dividing the distance traveled by the time it took.

ROCKET BALLOONS

CHART #3

I. **Topic Area**

Rocket Balloons

II. **Introductory Statement**

The students will investigate the effects on the rocket balloon's flight when its opening is changed.

III. **Math Skills**

a. Measurement-linear
b. Measurement-angles
c. Geometry-diameter, circumference

Science Processes

a. Recording data
b. Observing
c. Controlling variables

IV. **Materials**

Sausage-type balloons
Soda straws
Masking tape
Various devices to regulate size of opening in balloons--see Background Information
String (Monofilament)
Measuring tape or meter stick
Protractor or clinometer--see part B
Student page 19

V. **Key Question**

"How does the size of the opening affect the balloon rocket's flight?"

VI. **Background Information**

1. We are introducing a new variable here--the size of the opening in the balloon.
2. The greater the opening, the faster the air will escape. One question is whether the increased force of the thrust is great enough to compensate for the shorter length of time that the air is escaping.
3. Different sized openings can be made by taping short pieces of straws inside the end of the balloons; soda straws, MacDonald's straws, and "cocktail sipping straws" would give three variations. You might also try bent paper clips if you watch the sharp ends and roll the mouth of the balloon around the shape created. Wine corks which have been sliced thin and had different sized holes made in them also make good end pieces. Scour the dime store or hardware store for small, lightweight plastic rings of various sizes.
4. Make sure that students are consistent when they measure the openings; establish that they will measure only the inside diameter of the opening. (If you have a pair of calipers rusting in the closet, this might be a fun time to bring them out.) Mention "diameter" and "circumference" if you wish.
5. After students have tested their rockets with the five different openings using the horizontal track, reintroduce the second variable of the angled track. As the angle of the string approaches 90°, perpendicular to the floor, the size of the opening needs to increase to overcome gravitation.

VII. **Management**

1. As before, this activity works best in small groups, with students rotating the jobs. It will require one to two class periods.
2. Have students experiment with fitting end pieces into the mouth of a balloon before testing as this takes some dexterity. Also, set the standards for measuring the openings and have students practice.
3. Once the students have established the different "mouthpieces" they are going to use, run the activity using only the horizontal line and recording the variations in distance traveled caused by the difference in openings.
4. Discuss the results from the horizontal test with the students. Have them predict the results when the line is set at 45° and at 90°.
5. Run the last two sections of the test changing both the angles of the line and the circumference of the opening.

VIII. **Procedure**

1. The students will construct rocket balloons as they did before, in parts A and B of this investigation, but they will experiment with creating different-sized, measurable openings at the mouth of the balloon.
2. When they have established the method of making the openings, have them measure the diameter of five "mouthpieces" of various circumferences and record the information of the student page (19).
3. Have students test each of the five "mouthpieces" using a horizontal track and record the results. Make sure that the balloon used is always the same length.
4. After discussing the results obtained on a horizontal flight, ask students what they think will happen on the angled flights.
5. Finally, have students test their rocket balloons using the same "mouthpieces," but on the 45° and 90° tracks.
6. Record all data and discuss the results.

IX. **What the Students Will Do**

1. Students will make rocket balloons as before, but will also create end pieces which will produce five different openings for their rockets.
2. Students will test their balloon rockets on the horizontal track using each of the five "mouthpieces" successively, and record the results.
3. After discussing the results of that test and predicting what will happen when the rocket balloons are tested at an angle, students will complete the tests for the 45° and 90° tracks.
4. Students will complete the student page by filling in the results of those tests.
5. Comparisons may be made among all the charts. What balloon actually went farthest?

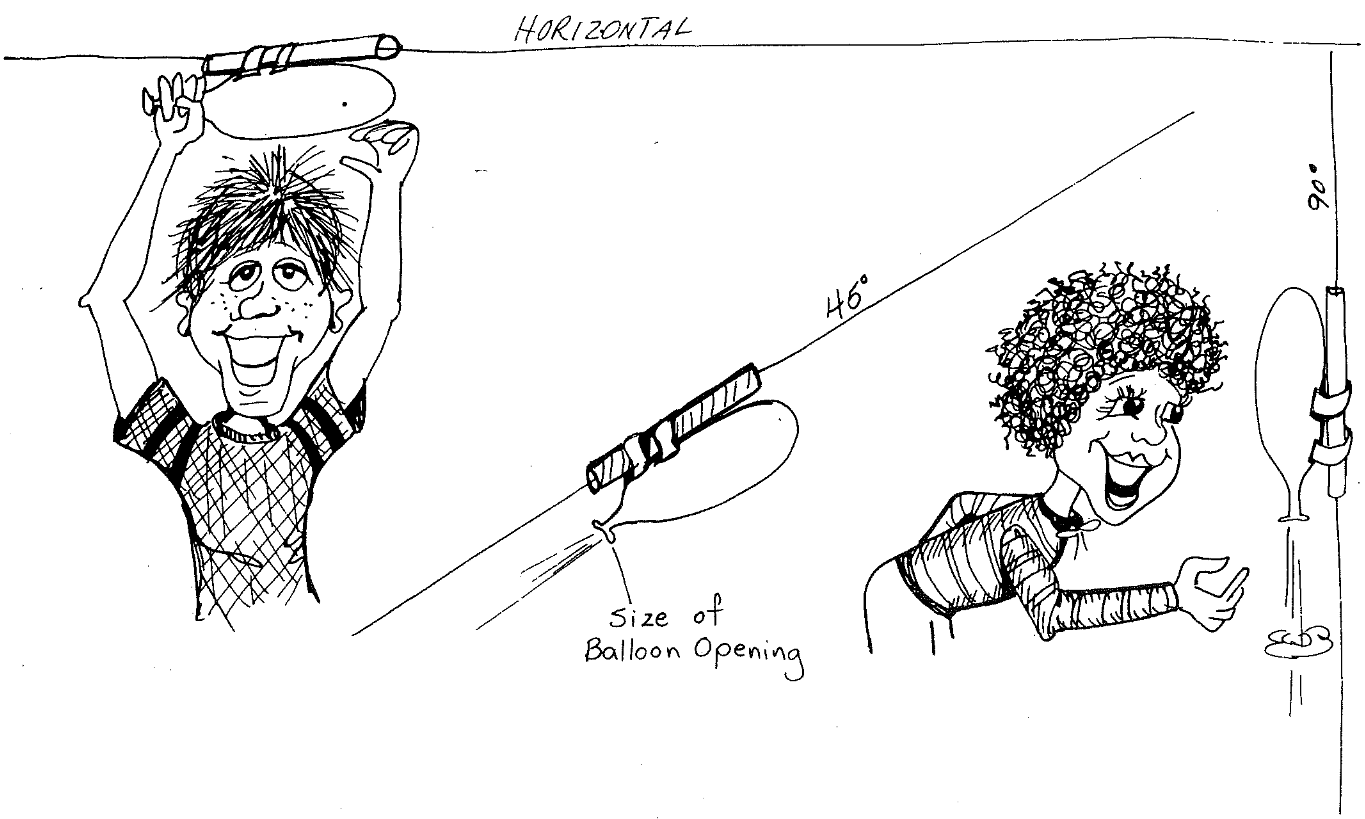
X. **Discussion**

1. What happens if you decrease the size of the opening of the balloon rocket on a horizontal flight? Why?
2. What happens if you decrease the size of the opening of a balloon rocket on an angled flight? Why?
3. How great was the difference in the distances the rockets traveled? What was the average distance each rocket with the same diameter opening traveled on the same path?

XI. **Extension**

If students are interested, have them add the variable of different balloon lengths once again. You can challenge them to design the best rocket balloon for each of the three tracks by varying length and the size of the opening.

String two parallel lines and run a relay race. Divide the groups into teams. Have them each mount the first balloon. At the word "Go!", each team releases its first rocket, which will go until it stops. It must then be reblown up and proceed from that point. When it reaches the opposite wall, it must be turned around and started again. When the rocket returns to home base, the second balloon replaces it and "flies" the course, and so on. Students will have to decide for themselves which is the most effective design--opening and length--before the race begins in order to obtain optimum speed and distance in each "heat."



_______________________ NAME

ROCKET BALLOONS

CHART #1

Balloon length vs. Distance Traveled

	Balloon Length	Distance Traveled			Average Distance
		Trial 1	Trial 2	Trial 3	
1.					
2.					
3.					
4.					
5.					

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ROCKET BALLOONS

CHART # 2

Angle of Flight vs. Distance Traveled

	Balloon Size	Distance Traveled		
		Horizontal	45°	90°
1.				
2.				
3.				
4.				
5.				

NAME ______________________

ROCKET BALLOONS

CHART #3

	Balloon Size	Size of Balloon Opening	Distance Traveled		
			Horizontal	45°	90°
1.					
2.					
3.					
4.					
5.