SOARING ROCKETS

Background Information for Activity Leaders

Overview

Children will explore the properties of air by building and launching a simple rocket.

Key Concepts

- Like all matter, air is made up of molecules.
- As an object moves through the air, air molecules collide against it. The collisions between the surface of the object and the air molecules result in a force called **air resistance**.
- Air resistance is a type of friction between an object and the air. The force of air resistance is called **drag**.
- Air resistance works against gravity to decrease the speed of a falling object.
- Even though air molecules are so small that they can not be seen, each collision causes a force on a moving object. The force from each individual collision is very tiny. There are, however, millions of these collisions each second, and millions of tiny forces add up to create a large overall force.
- The faster an object moves through the air, the more air resistance it encounters. This is because the object has to push the air molecules out of the way faster.
- The position of an object can be described by locating it relative to another object, such as a tree or a building.
- Tracing and measuring an object's position over time describes its motion or **flight path**.
- Pushing or pulling can change the position and motion of objects. The size of the change is related to the strength of the push or pull.
- **Aerodynamic** objects are designed to reduce air resistance and to improve flight distance and speed.

Background Information for Activity Leaders

What to Expect

- Most children will try to make their own rocket design from the start. Encourage them to begin by trying out the basic design in the EXPLORE section of their Learning Card.

- When children build a basic rocket and try it out, the performance of the basic design will give them ideas about what design factors they might be able to alter. Encourage them to try out their designs and record their observations. The process the children go through to design their rocket is more important than accomplishing a successful design. They are using the design process

Common Misconceptions

- *Children may think: "If an object is moving, something has to be pushing it."*

  When an object begins to move a force has affected it. The object will continue to move until another force such as friction, or an obstacle stops it. Consequently, the force that caused it to start moving does not need to continually push it.

- *Children may think: "Heavy objects always fall faster than light objects."*

  Wherever there is air resistance, more massive objects fall faster than less massive objects Without air resistance, all objects fall to the ground at the same time when dropped from the same height simultaneously. For example, without air resistance, if you dropped an piano and a feather, they would both hit the floor at the same time.

SOARING ROCKETS

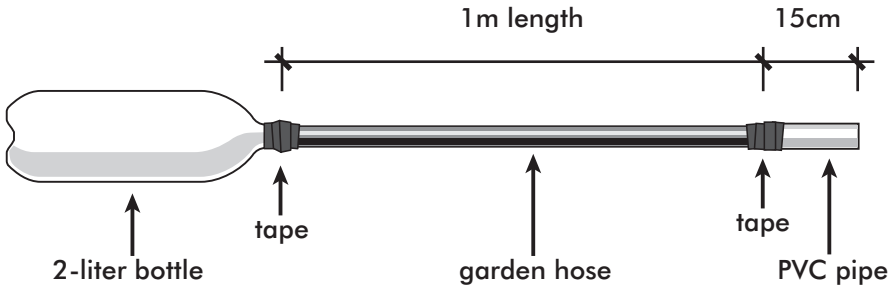
Rocket Testing Station Instructions

Materials:

(1-5) empty 2-liter plastic bottles
(1) 1 m length of garden hose
(1) roll electrical tape
(1) 15 cm piece of PVC pipe

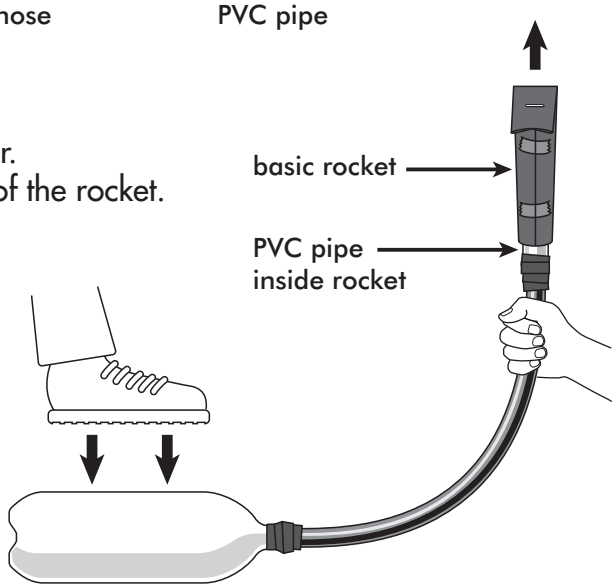
Build the launcher:

1. Cut a 1 m length of garden hose.
2. Place one end of the hose flush with the mouth of an empty, plastic 2-liter soft drink bottle.
3. Connect the mouth of the bottle to the opening of the hose by wrapping tape around the pieces. Make sure to make the connection airtight.
4. Place the other opening of the hose flush with a piece of PVC pipe and tape them together, making sure that the connection is airtight as well.
5. Check that the connection allows air to flow freely from the bottle to the pipe.



To operate the launcher:

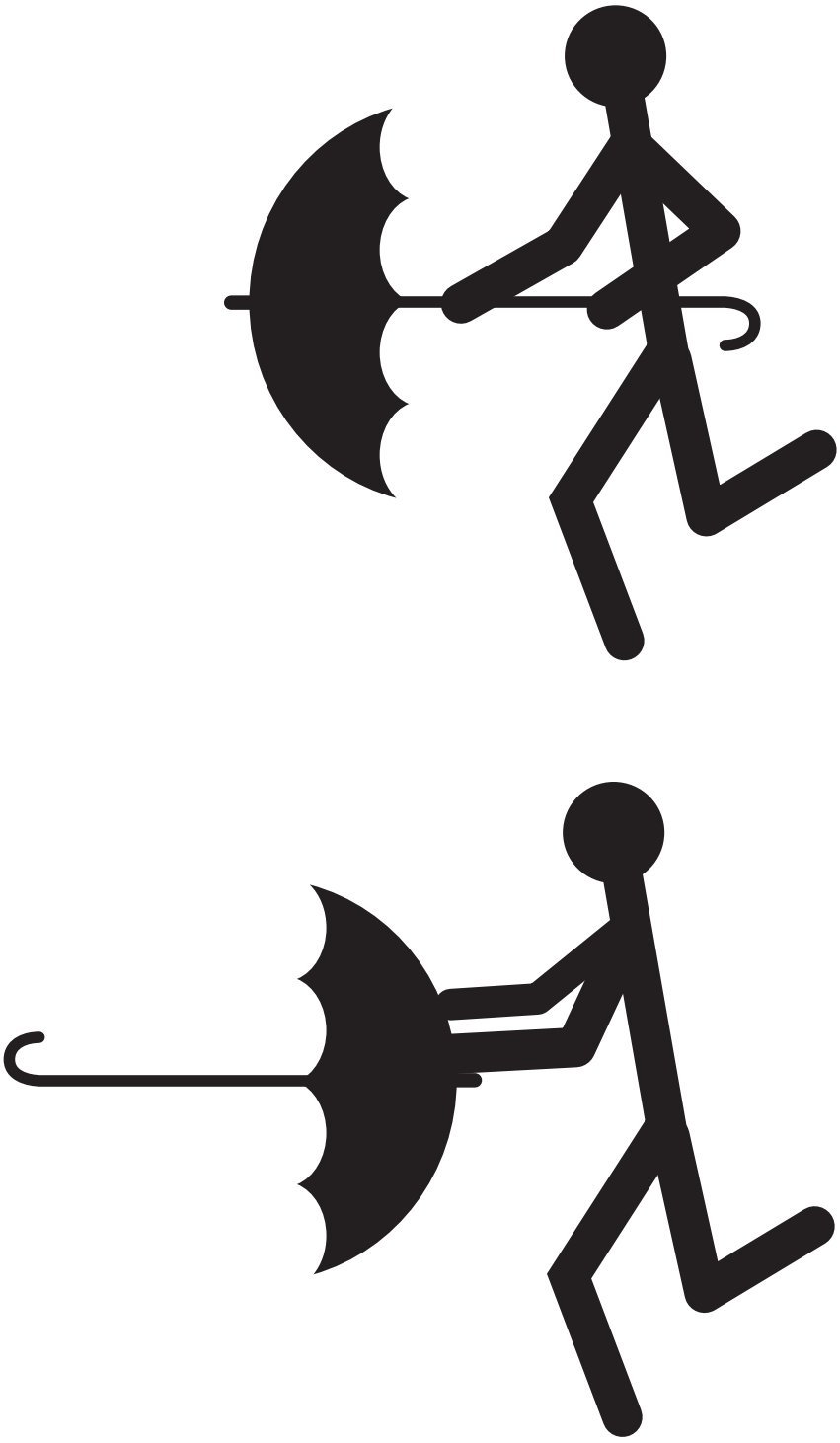
1. Place the empty plastic 2-liter bottle on the floor.
2. Insert the PVC pipe into the rolled up cylinder of the rocket.
3. Point the rocket upward at a 90-degree angle.
4. Swiftly and forcefully step on the bottle.



The air in the bottle will be pushed into the hose and then the pipe. The force of the rushing air will cause the rocket to launch.

Only operate the launcher outdoors.

Air Resistance Illustration



SOARING ROCKETS

Data Collection Sheet

Name:_____ **Date:**_____

WONDER What shapes help a rocket fly better?

RECORD Draw the flight path you observe as your rocket is launched. A flight path can be represented by a dotted line showing where the rocket started up to where it stopped. Draw something next to the flightpath (a flag pole, tree, house) that shows how high it flew.

Flight Path - Your Basic Rocket

trial 1

trial 2

Flight Path - Your Improved Rocket

trial 1

trial 2

CONCLUDE What did you discover about rockets? How did air resistance affect your rocket's flight path? What improvements made your rocket more aerodynamic?

_____

_____

SOARING ROCKETS

Activity Leader's Guide

Group Size: 4 children
Time: 45 minutes

Set Up the Expedition

Materials

For the activity leader:
- (1) air resistance illustration
- (1) umbrella
- (1-5) empty 2-liter bottles
- (1) 1m length of garden hose

For each group:
- ***Soaring Rockets*** Learning Cards
- (1) ruler
- various types of paper
- various kinds of craft supplies
- (1) 15 cm piece of 1" diameter PVC pipe

For each child:
- (1) ***Soaring Rockets*** Data Collection Sheet
- (1) sheet of white paper
- (1-2) paper clips
- (1) safety googles

Prepare the demonstration:
1. Place the Air Resistance illustration in a place where all the children can gather around and see.
2. Prepare an umbrella for the children to use.

Prepare the exploration:
1. Follow the instructions on page 4-3 to construct and operate the rocket testing station.
2. Cut a 1" diameter PVC pipe into 15cm lengths. Make one for each child. The segments can be reused for other activities.
3. Place a variety of types of paper and craft supplies at each group station.

Engage

1 Gather the children together.

Ask:
"Each of these scenes shows a child running with an umbrella. Which of these is less work for the child? Can you explain why?" One picture shows a child running with an open umbrella that is held horizontally, open toward the child. The other umbrella is open, held horizontally, away from the child. Ask a volunteer to demonstrate each picture, using an umbrella, and report back to the group what occurred.

Say:
"It is harder to run with the umbrella facing away from you because the inside bowl of the umbrella traps the air molecules and tries to pull them along. Air is made up of many molecules of air which are too small for us to see. The air molecules push back against anything moving through it. This is called air resistance."

2

Say:
"Air resistance is limited to objects traveling through the air, but drag is not. Objects traveling through the air, such as planes, or through the water, such as boats, can experience drag. Drag causes objects to slow down. Engineers shape objects that need to move at high speeds so that they experience less drag. This process makes the object aerodynamic."

Ask:
"Can you think of some objects that need to be aerodynamic?"
Examples should include airplanes and cars.

APEX SCIENCE

Ask:
"Why do planes, cars, and rockets have to be designed to be aerodynamic?" Encourage children to exchange ideas. Aerodynamically designed cars, planes, or rockets move more efficiently. They move faster and farther, and use less power and fuel, because there is less drag to overcome.

Ask:
"Can you think of any sports that use aerodynamics?" Encourage children to exchange ideas. Car racing, skiing, speed skating, playing baseball (the way the pitcher throws the ball), sky diving, swimming etc.

Explore/Expand

3 If working with groups greater than 4-6 children, divide the children into groups. Distribute the Data Collection Sheet and the Learning Cards.

Say:
"Now you will use what you know about air resistance and what is required for an object to be aerodynamic to build your own rocket."

4 Allow children enough time to complete the WONDER, EXPLORE, RECORD, EXPAND, and CONCLUDE sections of their Learning Card.

Conclude

5 Gather the children together and ask the following questions:

"What did you notice about the performance of your basic rocket?" Encourage children to discuss what they noticed about the height the rocket reached and its flight path. Air resistance causes rockets to slow down. Aerodynamic designs travel farther, and have a predictable flight path.

"What factors might influence the flight of the rocket?" Encourage children to discuss their findings.

"What changes did you make to the rocket?" Encourage children to describe what they changed about their original basic rocket design.

"How did your design changes affect the rocket's flight?" Encourage children to discuss what they noticed about the height the rocket reached and its flight path.

6 **Say:**
"Congratulations! You have earned your 'Ask Me About Air' stamp. Now you are ready to tell people about air."

APEX SCIENCE

SOARING ROCKETS

Expedition Learning Card

What affects rockets as they move through the air?

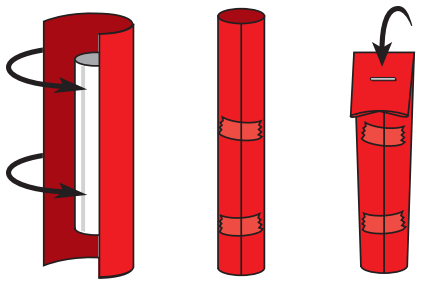
air resistance
flight path
aerodynamic

Explore how air exerts air resistance on objects.

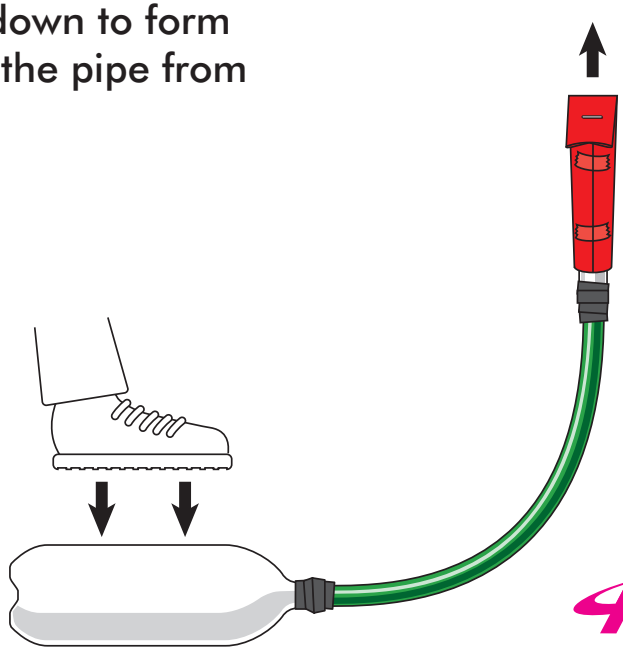
1 WONDER What designs makes a rocket aerodynamic?

Record your ideas on your Data Collection Sheet.

2 EXPLORE



1. Wrap a piece of construction paper around a 15 cm piece of PVC pipe.
2. Tape the paper so that it does not unroll.
3. Fold and staple the long end down to form the top of the rocket. Remove the pipe from the paper roll.
4. Put on your safety goggles!
5. To launch your rocket, place your rocket onto the pipe of the launcher and swiftly step on the empty soda bottle.
6. Launch your rocket again.



APEX SCIENCE

SOARING ROCKETS

Expedition Learning Card

3 RECORD Notice everything you can about your rocket's flight path. The flight path describes the distance and the direction your rocket travels.

Draw or write on your Data Collection Sheet your observations during two trials.

4 EXPAND Experiment with the basic rocket design. Try to improve it so that the rocket travels farther and on a predictable flight path.

Use your Data Collection Sheet to record your observations about the flight path of your improved rocket design during two trials.

5 CONCLUDE What did you discover about rockets? How did air resistance affect your rocket's flight path? What improvements made your rocket more aerodynamic?

Discovery

Why did we do that?

- The air is full of small particles or molecules.
- Air resistance is friction between an object and the air.
- The position of an object can be described by locating it relative to another object or to the background.

Congratulations!

You have earned your "Ask Me About Air" stamp! Now you are ready to tell people about air!

APEX SCIENCE