Air Play Teacher Guide

OBJECTIVE

- Explore properties of air.
- Learn the effects of high and low air pressure on an object according to Bernoulli's Principle.
- Create a toy that displays a ring-shaped segment of moving air called a vortex.

CONCEPTS COVERED

- Air takes up space and has weight.
- Air pressure is the force exerted on the surface by the weight of the air.
- Effects of low and high air pressure on an object according to Bernoulli's principle.

SCIENCE PRACTICES

- Making predictions.
- Creating a hypothesis and testing for answers.
- Engaging in argument from evidence.
- Obtaining, evaluating and communicating information.

STANDARDS ADDRESSED

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

New York Hall of Science

47-01 111th Street
Queens, NY 11368-2950
718 699 0005
Fax: 718 699 1341
www.nysci.org

How to Use This Guide

This video is an introduction to air pressure, defining concepts like pressure and gravity. Your students will watch the *Air Play* video and will have access to a student guide that accompanies the video. The student guide includes a materials list and a procedure list to help them to recreate the experiment and to follow along with the experiment. The materials are all simple items they can find in their homes. If your students are not able to gather the materials to follow along with the experiment, they can observe the instructor conducting the experiment and its results. They will still be able to answer the reflection questions which are located at the end of the student guide. We have included those questions in the teacher guide with the answers. There are vocabulary words in the guide that students can refer to when any new concepts have been introduced. At the end of the teacher guide there are some links to other related resources to extend the learning. We hope this video and guide can add some enrichment to your air play exploration.

Resource Synopsis

In this video, students can follow along with the demonstrations and activities to explore the properties of air and the concept of air pressure. During each demonstration and activity, students will have a deeper understanding of the properties of air, air pressure and changes in air pressure.

Demonstration: What Is Air?

In this demonstration the following properties of air are reviewed:
Air takes up space.
Air has weight.

Air taking up space is demonstrated by sealing an empty bottle and squeezing it. The bottle is difficult to crush because the bottle is filled with air. Air has weight is demonstrated by inflating two balloons and placing them on either side of a dowel like a balance beam. One is deflated and the dowel moves downward toward the inflated balloon because it has more weight.

Activity 1 illustrates that there is air pressure all around us that constantly pushes on objects in all directions. The students will do an experiment that exhibits that air pressure is pushing on a glass of water and the cardboard placed on the top of the glass even after it is turned upside down.

Demonstration: Moving Air

In this demonstration, students will observe what happens when there is an unbalanced force acting on an object and how that object moves. Students will also see what happens to an object when the forces acting on it are balanced.

TROUBLESHOOTING TIPS

Activity 1: Air Pressure

- If a paper cup or plastic cup is used for the activity, hold the cup gently and try not to squeeze the cup. The air inside the cup will push the water out.

Demo: Moving Air

- Adult supervision is required when handling the hair dryer if students want to try this activity at home.

Activity 2: Bernoulli's Principle

- Make sure the length of the paper strip is not too long otherwise the paper will be too heavy to see the effect.

Activity 3: Homemade Air Zooka

- The plastic loosens when it has been used for a long time. Replace the plastic when needed.

Activity 2 exemplifies Bernoulli's principle through a hands-on activity. Students will see the effect of moving air on a strip of paper causing the top of the paper to move because of low air pressure.

Activity 3 builds an understanding of how a vortex moves through the air. Students will design their own air zooka and try different materials and other variables to see how they move through the air.

Questions and Answers (Student Guide)

Why did the water stay inside the cup when it was turned upside down?
Answer: The air pressure is pushing in all directions outside the cup and the air pressure is greater than the air pressure inside of the cup.

How does blowing air on top of the strip of paper change the air pressure?
Answer: The moving air on the top surface of the strip of paper caused the air pressure to exert less force on the top surface of the paper. The stationary air below the paper is exerting more force or it has greater air pressure pushing the paper up.

What would happen if you change the size of the hole or change the size of the cup?
Answer: The result will vary depending on the design of the air zooka. For example, larger air zookas will exert more force when tapped and will create a larger vortex ring that can travel a farther distance. The size of the hole can also change the size of the vortex ring and may change the speed as it travels. Using different materials can also have an effect on the formation of the vortex ring and its distance traveled.

Try These Next

Explainer TV
Watch how we can manipulate air pressure with fire and alcohol to crush this 5-gallon water jug.
https://www.youtube.com/watch?v=EaOSXk9ztyk

New York Hall of Science

47-01 111th Street
Queens, NY 11368-2950
718 699 0005
Fax: 718 699 1341
www.nysci.org

Background information

Air Pressure

When we hear the word air pressure, it refers to the weight of air molecules pressing down on the Earth. Air pressure is measured by a device called a barometer with the units psi or pounds per square inch. At sea level, the air pressure is measured as 14.7 psi and varies as altitudes change. This means that at sea level there are 14.7 pounds of air pressure pressing down on every square inch of our bodies. Our bodies can still move freely and we don't feel like we're getting crushed because the air is exerting pressure on us in all directions and the pressure inside our body is the same.

Air Zooka

The correct name for the air cannon, smoke-ring device is "vortex generator." The "ring" of air that shoots out of the cannon is actually a flat, vertical section of air. The outer edge of this moving air is rolling backwards on itself. This vortex of air is generated because the air leaving at the center of the hole is traveling faster than the air leaving around the edge of the hole. The air around the edges takes longer to get out of the can. That swirling or vortex motion can be observed if a little smoke is in the container before giving the plastic a tap. This activity demonstrates that air occupies space and the rolling smoke rings are an added bonus.

Bernoulli's Principle

Bernoulli's principle states that the faster air is moving, the lower its pressure. Since the air inside the vortex is moving faster than the air outside the vortex, the higher inward pressure from the outside air is the force that holds the smoke ring together. Eventually, friction steals away all the energy stored in the vortex and the smoke ring drifts to a stop and vanishes. Very cool!

Check out more activities at www.nysci.org.

New York Hall of Science

47-01 111th Street
Queens, NY 11368-2950
718 699 0005
Fax: 718 699 1341
www.nysci.org