

WHAT A GAS!

GRADES 3–6

CLYDETTE RISPONE

OVERVIEW:

This lesson will demonstrate that air is matter, that it takes up space and exerts pressure. Two hands-on activities will illustrate these concepts.

ITV SERIES:

Dr. Dad's Ph³: Gas Laws

LEARNING OBJECTIVES:

The students will be able to

- ❖ develop an understanding of some of the properties of air
- ❖ demonstrate that air takes up space
- ❖ explain that air has pressure
- ❖ describe how air pressure can do work and overcome gravity

VOCABULARY

properties
volume

MATERIALS:

FOR EACH GROUP OF FOUR STUDENTS:

Activity One

- paper
- aluminum pie pan
- pint sized mason jar
- votive candle
- water

Activity Two

- clear plastic cup
- index card (large enough to cover the mouth of the cup)
- water

PER CLASS:

- matches
- food coloring

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BACKGROUND

Air is a mixture of several gases. The most important gases that make up the air that we breathe are oxygen and nitrogen. It is because of this makeup of the air that surrounds us that life can exist on this planet. Air contains approximately 21% oxygen and 78% nitrogen. The remaining 1% is a mixture of several gases, with argon being the most common of them.

Air has mass and takes up space. Like all gases, it has no definite shape but takes the shape of its container as the molecules of air spread out in all directions.

Air has no taste or smell and cannot be seen, but the effects of moving air (wind) can be seen in rustling leaves, sailboats moving, and kites flying. Because sound results from the movement of the air, there would be no sound if there was no air. (There would be no sound in a total vacuum.)

PRE-VIEWING ACTIVITIES:

Brainstorm with the students what they know about air. Ask the students how they know if something is real. Fan a piece of paper. What do you feel? What is the paper pushing against? What do you feel pushing against you when you are swinging on a swing?

FOCUS FOR VIEWING:

Explain to the students that air is everywhere even though we can't taste it, see it, or smell it. Explain that in the video Dr. Dad will do activities with air. Instruct students to pay close attention and be ready to make predictions as to what will happen.

VIEWING ACTIVITIES:

Start the video where Dr. Dad says, "I've got some really cool air tricks I've been working on."

Stop the video after he tells Olivia to put the cup with the paper towel in it into the water. Discuss students' predictions as to what will happen.

Resume viewing for explanation.

Tell the students that they will try their own "cool" air tricks. Pass out the materials to each group of four students. (Materials: votive candle, mason jar, aluminum pie pan). Have the students place the candle in the center of the pie pan and pour about 1-1/2" of water around the candle. (Adding food coloring to the water is optional but it does help them to see the water rising.) Ask: "What's inside your glass?" (Air) Direct the students to place the jar over the unlit candle until the mouth of the jar rests on the bottom of the pan. Ask: "What did you observe?" Next, light or have students light their candles. Now direct the students to lower the jar over the lit candle until the mouth of the jar rests on the bottom of the pan. Ask: "What happens?" (Flame goes out, water rises up in the jar) Ask for a volunteer to explain what he or she thinks has happened.

Explanation: Air is in the jar. About 1/5 the volume of air is oxygen. When the jar is lowered over the burning candle the oxygen is quickly consumed in the chemical reaction of burning, resulting in less gas; therefore less pressure. The water rises about 1/5 of the way up the jar because it now takes the place of the consumed oxygen.

Have students turn their attention back to the video and **view** what Dr. Dad calls his lung experiment. After Ting tries to pull the plastic bag out of the bottle **pause** the video and ask the students why she is unable to do so. Then **return** to the video for explanation.

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POST-VIEWING ACTIVITIES:

Pass out the materials for the second activity. Ask students to place their index card over the mouth of their empty cup. Say: "Keep your hand on your index card and turn your cup over. Remove your hand that is touching the index card. What happened?" (The index card falls off.) Allow students to discuss their observations. Next, direct one student from each group to fill the cup with water. Say: "Cover the mouth of the cup with the index card. Keeping your hand on top of the card carefully turn the cup over. (Be sure they keep the cup over the pie pan from the first activity to catch any water.) Now, gently remove your hand from the index card. What happens to the index card now?" (The card stays in place keeping the water from falling out.) Encourage students to have their explanations match their observations.

Explanation: The empty cup's index card falls off because of the pull of gravity. The full cup's index card remains in place due to the outside air pressure being greater than the air pressure inside the cup. When the cup of water is first inverted the air pressure inside and outside the cup is equal. Therefore, due to the pull of gravity water begins to leave the cup. This small amount of water loss causes the water level to drop, while the volume of air, or space above the water, is increased. Though the quantity of air above the water remains the same, the volume occupied by the air is now greater so the air pressure decreases. This results in greater air pressure outside the cup than inside the cup. As you continue to lose water, the difference in pressure continues to increase until the air pressure outside slightly exceeds the total air pressure inside the cup, causing the paper to push in and the loss of water to abate.

ACTION PLAN:

Invite a welder in to talk about his job of working with compressed gases.

EXTENSIONS:

ART

Have the students place a small amount of India ink on their paper. Using a straw have the students blow the ink to form a tree. After the ink has dried use a small sponge to put leaves or blossoms on the tree