



Can You Push Against Air and Win?

THE BASICS	THE TOOLBOX	EDUCATION STANDARDS	Physical Science Content Standard:
 Grade Level: K-12  Estimated Time: 20 min.	<ul style="list-style-type: none"> • Widemouth plastic gallon jar or small plastic bucket • Sturdy plastic bag large enough to cover mouth of container • String or rubber band 	SAFETY CONCERNS	Understanding that air takes up space and is constantly exerting pressure on everything around it. Use plastic dishes and jars rather than glass when possible. Remember that plastic bags are a potential suffocation hazard!
		FOR KIDS WITH DISABILITIES	Visually-impaired students can feel what's happening to the bag. Mobility-impaired participants may need to work with a partner.



Educational Objective:

To develop an understanding that air takes up space and exerts pressure, or pushes on everything around it.

What to Do:

- Test the plastic bags for holes.
- Have extra bags handy since the first bag may develop holes as you do the activity.

Questions to Ask Students As They Do This Activity:

- Is the air pressing in the same way from every direction? How can you tell?
- When have you felt the force or pressure of air?
- What experiences have you had with strong wind?
- What experiences have you had filling a tire with air? Filling a balloon?

Why It Happens:

Inside the bucket and bag are trillions of air particles called molecules bouncing around like ping-pong balls in a big box. As they strike the

sides of the bucket and bag, they create pressure on the inside. The air on the outside of the bucket and bag are pushing on them as well. When you push down on the bag, the air pressure inside increases because you are forcing the same number of air molecules into a smaller space, and therefore, they hit the sides of the bag and bucket more often. What you feel, is the greater air pressure pushing up on the bag.

What about when you put the bag inside the bucket and pulled up? By pulling up on the bag, you increased the amount of space inside the bucket and bag. This gives the air molecules inside more space to bounce around, so they hit the sides less often and produce less pressure.

So why is it hard to pull the bag up? Because the air pressure outside the bag and bucket is now greater than the air pressure inside. What you feel is the outside air pushing in!

Extensions:

Stuff a paper towel tightly into the bottom of a glass. Turn the glass upside down to make sure the towel stays in place. Next, fill a bowl with water. Turn the glass upside down, and holding the glass very straight, plunge it into the water. Count to 10. Lift the glass out of the water without tipping it. Pull the paper towel out of the glass. Is the paper still dry? Why or why not? The glass was full of air. Therefore, the paper in the glass stayed dry because water couldn't get into the glass. Even though we can't always smell or taste air, we know they are present because they take up space, just as it did in your glass.

Fill a glass halfway with water. Place a piece of cardboard over the top of the glass. Holding the cardboard tightly in place, turn the glass upside down over a bowl while holding the cardboard in place. Keep the glass straight. Take your hand away from the cardboard. What happened? You can see that not only does air take up space, but it exerts pressure. Air pushes up, down, and sideways on everything it touches. There is more air outside of the glass pushing up on the cardboard, than on the inside of the glass pushing down on the water and the cardboard. Since the air pressure was greater on the outside of the glass than on the inside, the cardboard stayed in place, and kept the water from falling into the bowl.

Take an empty 2 liter bottle and push a deflated balloon inside. Be careful not to drop the balloon all the way inside the bottle. Next stretch the neck of the balloon over the bottle's mouth and blow up the balloon. The balloon should not inflate because of the air inside the bottle and the pressure it is exerting against the balloon. The balloon cannot expand because the air is taking up the space in the bottle and the air inside the bottle is exerting a greater pressure on the outside of the balloon than exists on the inside of the balloon.

WEB SITES

- **Is Air Really There?**
<http://www.nasm.edu/galleries/gal109/LESSONS/TEXT/AIRREAL.HTM> (Grades 4-8)
- **Air Activities**
<http://www.nasm.si.edu/galleries/gal109/> (Grades K-12)

SOFTWARE

- **Whelmers**
The Learning Team, 1997.
(Grades K-12)
- **Seasons, Clouds and Winds**
Riverside Scientific, Inc.
(Grades 6-10)

READING ROOM

- Mebane, Robert, and Thomas Rybolt. **Air & Other Gases.** Twenty-First Century Books, 1995. (Grades 3-8)
- Somerville, Richard. **The Forgiving Air: Understanding Environmental Change.** University of California Press, 1996. (Grades 9 and up.)

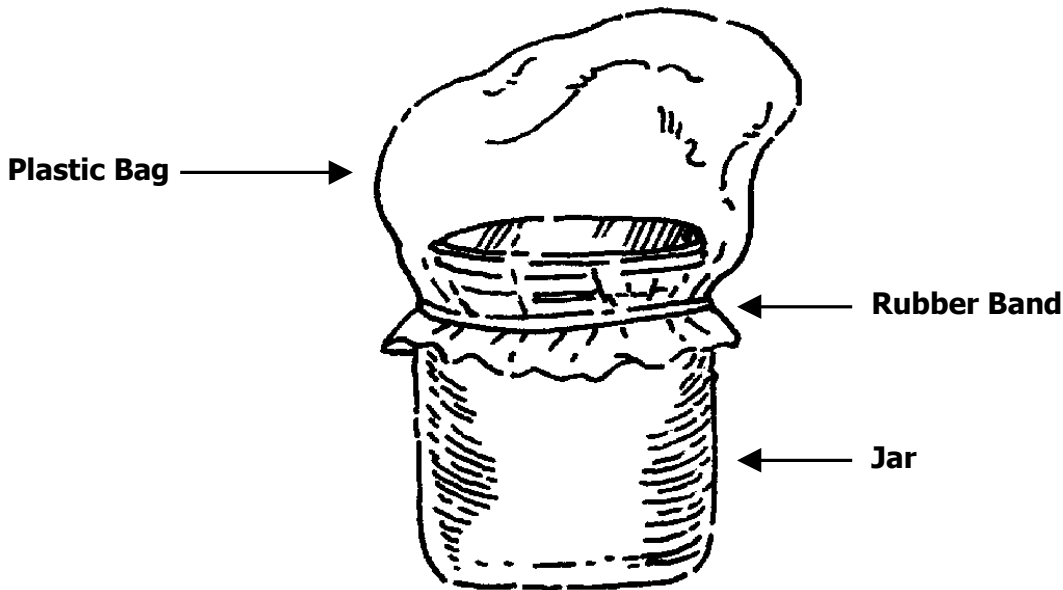
Career Connections

Meteorologists are people who study and forecast weather. You can arrange a visit to a local television station to find out more about meteorology.

CAN YOU PUSH AGAINST AIR AND WIN ACTIVITY SHEET

An Empty Container?

1. Put air into a plastic bag by blowing into it or waving it through the air.
2. Clamp the opening of the bag around the mouth of a container, such as a jar or bucket, and fasten it tightly by wrapping string around it two or three times and tying it. You may also use a rubber band to hold the bag in place.



3. Now try to push the bag into the container. What do you feel as you push on the bag? Why do you think this happens?
4. Let everyone try to push it in.
5. Remove the bag and place it inside the container, like a liner.
6. Fold the top of the bag over the lip of the container, just like the lining in a trash can, and again secure with string or a rubber band.
7. Try to pull the bag up out of the container. What happens? How can you explain what happened?