



Air Pressure Power

<p>THE BASICS</p>	<p>THE TOOLBOX</p>	<p>EDUCATION STANDARDS</p>	<p>Physical Science Content Standard: Understanding that air has mass and weight and can be compressed to do large amounts of work.</p>
<p> Grade Level: K-12</p>	<ul style="list-style-type: none"> • Flat surface to work on • Heavy wooden or flexible plastic 12-inch ruler 	<p>SAFETY CONCERNS</p>	<p>Be careful of breaking the rulers, rulers being flipped up in the air, and hitting someone. Remember, plastic bags are a potential suffocation hazard!</p>
<p> Estimated Time: 30 min.</p>	<ul style="list-style-type: none"> • Full-sized sheet of newspaper • Plastic food storage bag (not Ziploc) • Stack of 5-6 books 	<p>FOR KIDS WITH DISABILITIES</p>	<p>Visually-impaired students can place their hands over the newspaper and books to feel what happens. Mobility-impaired participants may work with a partner.</p>



Educational Objective:

To develop an understanding that air has mass and weight, and that it exerts pressure or pushes on its surroundings. To demonstrate that compressed air can do surprising work.

What to Do:

- Separate newspaper into individual sheets for *Heavy News*.
- Make sure plastic bags do not have holes in them for *Book Lift*. Have extra bags handy.

Questions to Ask Students As They Do This Activity:

- What happened that you expected to happen?
- What happened that you didn't expect to happen?
- If every square inch of surface has 14.7 pounds of air pressing down on it, can you estimate the total weight of air pressing down on the newspaper?
- How can you reduce the weight of air on the paper?
- What experiences have you had with compressed air holding things up, for example, air in the tire of your bicycle or automobile?

Why It Happens:

Heavy News: Air is composed of many different gases. The air above the newspaper pushes down on the whole surface of the newspaper in the same way that your body weight pushes down on it if you were sitting on top of it. The average atmospheric pressure of the earth is 14.7 pounds per square inch. That means that every square inch of the surface of the newspaper has 14.7 pounds of air pushing down on it. If you figure out the total number of square inches of area on the surface of the newspaper by multiplying the length of the sheet by its width, and then multiply by 14.7 pounds for each of them, you'll find out that the weight of the air above the newspaper is quite large. For example a typical 28-inch by 22-inch sheet of newspaper has over 9,000 pounds of air exerting pressure on it when it lies flat on a tabletop. That's a lot to move with a ruler.

As you fold the paper, you reduce the area it covers, and therefore the amount of air pushing down on it. Eventually, when the paper gets small enough, the ruler can push the paper up into the air. As you walk, you have to push air out of the way, just as you have to push water when you walk across a swimming pool. There is very little resistance to your walking through air. Air resistance only becomes noticeable when you are moving quite rapidly as in a vehicle.

Book Lift: As you blow into the plastic bag, more and more air is forced into the same small space inside the bag. In order for more air to fit into the bag, the air molecules have to be closer together. There are more of them in a given volume and they hit the inside of the bag more often, so the pressure of the bag increases. When the amount of air pressure pushing up on the bag from the inside is as great as the pressure pushing down on the bag from the atmosphere, plus the weight of the books, the books can be supported by the compressed air. Many machines use the compressed air and compressed liquid to do work in just this way. In fact, this is how hydraulic brakes work.



WEB SITES

- **What's Happening Inside Highs & Lows**
[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/crclm/act/home.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/crclm/act/home.rxml) (Grades 9-12)
- **Make Your Own Barometer**
<http://sln.fi.edu/weather/todo/barometer.html> (Grades 3-12)

SOFTWARE

- **Whelmers**
The Learning Team, 1997.
(Grades K-12)
- **Chemistry Gateways: Exploring the Gas Laws**
LOGAL Software, Inc.
(Grades 9-12)

READING ROOM

- Allen, David. **Air: All About Cyclones, Rainbows, Clouds, Ozone and More.** Firefly Books, 1993. (Grades 5-6)
- Dunn, Andrew. **The Power of Pressure.** Thomson Learning, 1993. (Grades 3-8)
- Seller, Mick. **Air, Wind, and Flight.** Gloucester Press, 1992. (Grades 3-8)

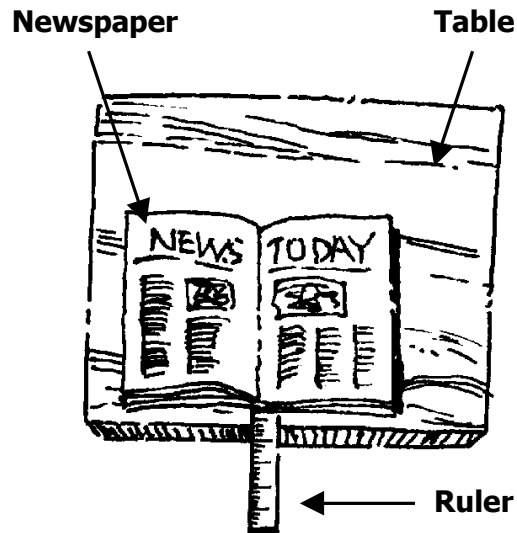
Career Connections

Air is composed of many gases. Chemists study the properties and behavior of these and other gases.

AIR PRESSURE POWER ACTIVITY SHEET

Heavy News

1. Lay a 12 inch ruler on the edge of table so that about 4 inches stick out over the edge of the table.
2. Open a full sheet of newspaper and lay it flat over the ruler and close to the edge of the table, as in the diagram.
3. Predict what will happen if you push down hard on the edge of the ruler. Do you think that the paper will fly up into the air? Try it! (Note: Do not hit the ruler too hard or you might break it)



4. Did the paper fly into the air easily? Why or why not?
5. What do you think would happen if you fold the paper in half and try again? Try it!
6. Keep folding the paper into smaller pieces. Is it getting easier or more difficult to move the paper? Why?

Book Lift

1. Lay a plastic food storage bag flat on the surface of a table near the edge.
2. Set a book on top, leaving the open end of the bag sticking out over the edge of the table.
3. Gather together the opening of the bag and blow into the bag like a balloon, keeping the opening as small as possible. What happens after a few blows? Add more books and repeat. Did you topple the books?