Classroom Demonstrations Showing the Properties of Air

Showing Air Pressure

The first of these is quite simple, requiring a ruler and double paged sheet of newspaper like the *Chicago Tribune*. Using the *New York Times*will of course provide more journalistic cachet.

Place the ruler on a table with some portion of it overhanging the edge. At this stage, I have found it useful to ask the class what they would expect to happen if I applied a downward force to the edge of the ruler hanging off the table. Of course, they know that the torque applied to the ruler would cause the ruler to rotate upward. Now, use the newspaper to cover the portion of the ruler on the table. It is important that all of the ruler be covered, and that no part of it (that is on the table) sticks out from underneath the paper.

Next squeeze out as much of the air from under the paper as you can. Now, apply the same downward force to the ruler? What happens? If you have a fairly thin ruler, and have done a good job of squeezing air out from the paper, you can snap the ruler.

Why does this occur? This occurs because you are now trying to move the ruler against the force exerted by the atmosphere against the newspaper. A good math extension here would be for your students to measure the width and length of the sheet covering the ruler, calculate the area of the paper covering the table, and remembering that the air exerts of pressure of 14.7 pounds per square inch at the surface of the Earth, calculate the total amount of force the air is exerting on the paper.

A good question to raise (and this underscores the importance of Pascal's Law) is why you squeezed the air out from underneath the newspaper? Why would your results be different (and less dramatic) if you did not do this part of the experiment so well?

Showing Air has Volume

For this experiment, you will need some plastic cups (clear ones are best), a container to hold water, some push pins, and some paper towels.

Take a paper towel and wad it up so that it will stick inside a cup even if you hold the cup upside down. Fill a bowl with water, and slowly lower the cup into the water. In this step, it is critical that you lower the cup straight down and not on an angle. Make sure the cup is fully submerged, and then slowly raise the cup out of the water, again being sure that you raise it straight up. Now, pull the wad of paper out and pretend to fling it at someone in the class. They are likely to hide in horror at the thought of being struck with a drenched paper towel; imagine their surprise then when they realize the towel is completely dry. Why does this result occur?

Now, repeat the first part of the experiment. When the cup is submerged, use a push pin to puncture a small hole in the bottom of the plastic cup. Your students will then be able to see air bubbles forming at the puncture and rising up. This will reinforce that there was a layer of air trapped between the water level and the paper towel, keeping the towel dry in the first part of the experiment.

Showing that Air has Mass

There are several different ways you can show air has mass, here is a simple way to do this. For this you will need two balloons, some tape, and a ruler (preferably a meter stick). Tape the two balloons (without blowing them up) at nearly opposite ends of the ruler. Now balance the ruler on a fulcrum or metal rod stretched between two desks or extending from a ring stand. The idea is to show that the system is in balance. Note carefully the exact position of the balancing point, and of one of the balloons that you are about to remove from the ruler. Take this balloon and blow it up, returning it exactly to its original position. Is the system in balance now? Which end is heavier? Where did the additional mass come from? This should show your students that air has mass.

Another variant of this is to blow up the balloons at the beginning, and balance the meter stick with the inflated balloons. Then, carefully removing one and allowing the air to release, put it back on the ruler in its original position and show the system is not in balance.