

Atmospheric Pressure Soda Can Lab

As you have studied the composition and the layers of the atmosphere, the words air pressure and atmospheric pressure have been used, but what is atmospheric pressure? **Atmospheric pressure** is the weight of the air. At sea level this is equal to 14.7 pounds per square inch. As you increase in altitude, the amount of pressure decreases. At 5000 feet the pressure decreases to about 12 lb/in². In this lab, you are going to discover a cool effect that demonstrates how much weight the air has on a soda can. [You can use this chart to find the atmospheric pressure at your town's elevation.](#) Because we are talking about pounds per square inch all measurements should be in inches.

1. What is the height of the can?
2. What is the diameter of the can?
3. Find the surface area of your soda can. $S_{\text{area}} = 2\pi rh + 2\pi r^2$ is the formula for finding the surface area of a cylinder.
4. The average psia (pounds per square inch actual) is about 12. That means for every square inch of the can there are 12 pounds of air pressure. Multiply the psia (12) by the surface area of the can. This answer is how many psia there is surrounding the can.

Place a small amount of water inside the can; just enough to get the bottom of the can wet. Place the can onto the hot plate. The hot plate should be on high. Wait a few minutes for the water in the can to get really, really hot. You are looking for escaping steam. While you are waiting fill the bowl up with cold water. When you see steam, let it heat up for another 30 seconds or more. Using a glove or tongs, quickly grab the can and turn it upside down and place it into the bowl of water.

5. Describe your observations.
6. If all the air pressure is being exerted on the outside of the can all the time, why didn't it react the way it did before you put it in the cold water?
7. In your own scientific explanation, describe the science behind why the soda can did, what it did?

Teachers Notes, Suggestions, and Procedures

1. Purpose and objective
 - a. The purpose of this lab is to demonstrate how much air pressure surrounds us and in this case sod cans. It is amazing to me to see that many students have never seen or participated in the common “Crush the can” experiment.
 - b. I have added a twist to the experiment by attempting to have students calculate the total air pressure pushing against outside of the can.
2. There is a link in the assignment that shows the different air pressures at various altitudes.
3. Materials needed:
 - a. Enough empty soda cans for as many groups of students you will have. (I start collecting cans from students about 3 weeks in advance.)
 - b. Hot plates. You can easily place two soda cans on each hot plate if needed.
 - c. Tongs or gloves, something safe that will allow students to grab the soda can off of the hot plate.
 - d. Bowls with cold water in them.
 - e. Paper towels to wipe up any water that spills.
4. Procedures
 - a. Students need to place a full dropper of water into the bottom of their empty soda can.
 - b. Students need to heat up the soda can until they see the can steaming, and I mean really steaming. I have my students wait one minute after they see the first hint of steam.
 - c. Using protective gloves or tongs, the student will grab the can off of the hot plate, turn it upside down, and place it into the water bowl.
 - d. This is when filming the can crushing is kind of cool, because many students haven’t ever seen the effect and there are some cool reactions that can be seen.
 - e. Have the students in groups answer the questions on the paper.
5. The Discussion
 - a. After the experiment, clean up, and paperwork is completed, we discuss the science behind what happened.
 - i. Why did this happen?
 - ii. How many pounds of air pressure is there total on the outside of the can?
 - iii. Imagine your body’s surface area. Imagine how many pounds of pressure are all over you?
 - iv. Why don’t we implode right now with that many pounds of pressure on us?
 - v. Why doesn’t the can implode the moment you drink it?
 - vi. I also discuss videos and movies they might have seen where airplanes or spacecraft have been punctured and why the movies portrait people and things being “sucked” out of the plane.
6. You can watch a sample of the reactions of students and some slo-mo video. <https://youtu.be/R-Gx9usiHZk>

