Thread NSTA Charles Law

-----Original Message-----
From: John and Robyn
Sent: Jan 28, 2008 5:32 PM
To: physicalscience@list.nsta.org
Subject:

Good afternoon,

I'm looking for ideas on demos/labs dealing with Charles's law, that would work well with 8th grade students.

Thanks

John

For another example of how to crush a can with air pressure, look at this demonstration that I first saw done by the "Weird Science" group at a conference:

http://meigsmagnet.org/%7Efranklint/geewhiz.html#Crushing%20a%20Can%20with%20Air%20Pressure
Tommy Franklin [frankltd@k12tn.net]

The crushed can email reminded me of a diferent way to crush cans for those teaching air pressure. My objection to the traditional heating-the-water-in-the-can demo is that the boiling water and move to cold water is a distraction for many kids. Too many things going on. Try this one.
Obtain an empty 1 gal. metal can (SK sells them for $5. You can get them for free from your art teacher or local painters. Ask for empty rubber cement cans or empty kerosene or paint thinner cans). Fill it with water. Stopper it and attach a 15-20 ft. hose to a short length of glass tubing inserted into the stopper. Put the can out the window and invert the can (or stand on a lab bench, hold the can over your head, and place the other end of the hose in the lowest drain in your room). As the water drains out of the can, no air enters. Without that outward pressure, the can slowly and dramatically crushes. The kids see that nothing but air pressure is the force at work. And they love thinking what people seeing the water drain out of the hose must be thinking!

Bill

just wanted to clear something up that I inferred from the email below. It was stated that the steam coming out is just there to show the air is hot enough. That's not quite true. The steam coming out shows the water is boiling. The water isn't just there to show the air is hot enough. The steam forces almost all the air out of the can. The sudden decrease in pressure inside the can isn't due to the air being cooled down suddenly (PV=nRT), but because the steam condenses to water. The steam has already forced most of the air out, so only water in the gas phase is present. When the can is cooled quickly and the steam condenses suddenly to liquid, there is almost no gas in the can, hence almost no pressure. Then the air outisde can push in on the sides and crush the can.

It's the huge decrease in volume of the gas (steam, not air) as it condenses to liquid that evacuates the can of any gas, leaving it susceptible to the huge (relative) outside air pressure.

Bill

Bill Bleam
Chemistry teacher, Radnor High School (retired)
Chemistry Education Consultant
521 St. Davids Rd., Wayne, PA 19087
(H) (610) 687-5352
(C) (484) 919-3233

One could argue that “pressure change demo” (or condensation demo) would be a better title for this activity than a “ Charles' Law “demo. One could even emphasize the condensation effect by :

- Using two soda cans,
  - (A) dry
  - (B) containing the small amount of water.
- Heat both cans until can (B) is full of steam.
- Cool both cans rapidly by submerging them.
- Delta T of each can was at least 70 Kelvin, can (A) probably cooled more since we don’t know how hot it was initially.
- Can B collapses to a smaller volume than can A.
- The greater volume change must be due to the smaller interior pressure in can B caused by the steam condensation.

Eric W. Dalton, K-12 Instructional Coordinator
Science,Health,PE, & Driver Education
Fauquier County Public Schools
320 Hospital Drive, Suite 40
Warrenton, VA 20186
540-351-1003
540-349-1729 fax
edalton@fcps1.org

From: physicalscience-request@list.nsta.org [mailto:physicalscience-request@list.nsta.org] **On Behalf Of** William Bleam Jr
Sent: Thursday, January 31, 2008 4:02 PM
To: suzanne reay; McMinn, Louise
Cc: physicalscience@list.nsta.org
Subject: Re: Charles' Law

I do a demo that the kids want me to repeat over and over again, so you might need lots of empty soda cans :-) You can do it with charles law or even when you're talking about the amount of pressure the atmosphere puts on us. You will need: 1 empty soda can, about 1 teaspoon of water, a hotplate, and a beaker of water standing by.

Put about 1 tsp of water in the can and heat it until you see steady steam coming out of the can (that's all the water's there for- to make sure you do the next step when the air inside the can is hot enough)

Using an oven mitt or tongs quickly take the can and turn it upside down in the beaker so the open mouth is underwater. If you did it right and the air in the can is hot enough it will instantly crush.....if not the can will suck up the water, so try it once without the audience. The kids LOVE it.
suzanne reay [suzannereay@gmail.com]

I start my class each year with this demo. I put only about 1/4 inch of water in the flask, heat it in a microwave for about 2 minutes - then quickly spill the water out and stretch the balloon over the top. (I don't use the soap).
I line them up on my demo table - then ask the students how I was able to do this.
We then try all of their suggestions - rarely do they come up with the procedure. It is a great introduction to problem solving, pressure, effects of heat, etc. I leave them out - if they are not touched the balloon will stay in place most of the year. We often return to the demo to emphasize the effects of pressure

Louise McMinn
8th Grade Science
Scofield Magnet Middle School
641 Scofieldtown Road
Stamford, CT 06903

lmcminn@ci.stamford.ct.usInside-Out Balloon

Put a drop of soap in a balloon but don't get it on the mouth. Heat a flask with about an inch of water in it until the water is almost boiling. Quickly put the balloon over the mouth of the flask. Let the balloon inflate a bit then pick up the flask and put it into a plastic container with ice water. The balloon will go inside the flask - inside out! You can repeat this as many times as you wish - the soap is so the balloon doesn't stick to the inside of the flask.

What do you think?

Pam Mozdy-Allen, NBCT

Seminole Middle, FL

You can do this one with empty 2-L pop bottles if you have access to hot and cold water.

Carefully pour very hot water into a bottle, about 1/4 full, slosh around a bit, then dump it out and quickly put the lid on tight. Just that alone will cause the bottle to collapse a bit as the warmed air inside cools.

Pour really cold water over the outside of the bottle will help it to collapse even more, and faster.

Then pouring really hot water over the outside of the bottle will cause it to expand once again, perhaps even to the point where the bottle regains its original shape.

This can even be done to some degree at the sink just using the tap water.

Good luck. cros.
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Dale Croswell