Having a Gas with Cola

Measure the amount of Carbon Dioxide in a carbonated drink.

A somewhat quantitative method of finding how much gas is dissolved in a can or bottle of cola. Gas is extracted, collected and measured from a can or bottle of cola.

This lab activity requires at least two people per group.

Materials:
- Large Ziploc® bag or other type of sealable bag (1 gallon size or larger).
- Can or small plastic bottle of cola (355 to 1 liter) - room temperature to slightly warm
- 1 one-liter Graduated cylinder (or cut open a 1 or 2 liter plastic bottle)
- Large bowl or other catch basin
- Nucleation source - Salt, Mentos, Lifesavers, Sugar or any other nucleation/catalyst for getting carbon dioxide out of solution.

Assembly:
1. Set up your gas catching apparatus:
   a. Fill the basin with water.
   b. Fill and invert the graduated cylinder or cut open plastic bottle. The inverted cylinder should be full of water (this water will be displaces by bubbled carbon dioxide gas).
2. Set up your gas extracting apparatus:
   a. Open your Ziploc® bag and place inside of it, your "nucleation source" and a can or bottle of cola. (If using a can of cola, loosen or bend upwards the metal tab to help open it later).
   b. Suck out[1] any extra air surrounding the can of cola. You can do this by sealing the bag except for one end. Place your mouth around the opening and inhale.
   c. Completely seal the bag.
   [1] This is a whole other topic.
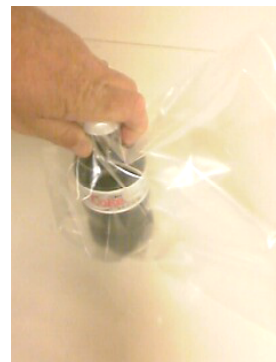
To do and notice:
Getting the gas out of solution:
1. Carefully open the cola **inside** the bag. This can be done by popping the tab of the metal can or twisting the cap on the bottle from the outside of the bag.
2. To aid in the removal of the carbon dioxide from solution, pour the entire contents from the can or bottle into the surrounding bag. Make sure the soda comes in contact with the "nucleation source."
3. Shaking the bag and contents helps to expel the gas from solution.
4. Let the contents set for a while to allow more gas to escape from solution.

Measuring the amount of gas:

5. One partner should hold the inverted graduated cylinder so there is room to slide the bag under the graduated cylinder's opening while still below the water's surface.
6. The other partner should slide the Ziploc® bag under opening of the graduated cylinder.
7. Carefully pull open a small portion of the bags seal (alternatively, you can cut or pierce a corner on the opposite end of the bag).
8. Squeeze the air from the bag so that it bubbles up inside of the inverted graduated cylinder. You should notice that the rising gas is displacing the water inside of the cylinder.
9. Remove as much gas from the bag as possible without crushing the can (the can should be totally empty of fluid too).
10. If the graduated cylinder fills to the 1 liter mark (or whatever the highest volume reading is), seal the bag and start bubbling again under a new or refilled graduated cylinder.
11. Seal and remove the bag and can.
12. Read the measurement of gas on the graduated cylinder (add together if using more than one graduated cylinder).
13. The empty can is also full of carbon dioxide, so this amount of gas needs to be added to the amount of gas collected in the graduated cylinder to get the total amount of gas that came out of solution (Most cans of cola are about 355 ml in volume. This paper is not taking into account the air-gap above the liquid cola.).
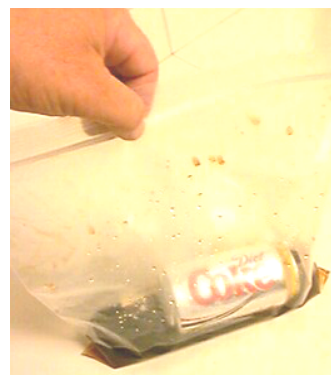
What's going on?
Most colas (or sodas) are solutions of carbon dioxide and water plus flavorings.
In this lab, we separated the solvent (the liquid, which is mostly water) from the solute (the gas- carbon dioxide).
The solute while in solution is part of the liquid. When released, it goes into the gas phase and takes up significantly more volume. You should have gotten a couple times the volume of gas as the original solution.

Many sources state that common colas have 3 to 4 times the volume of gas as total liquid dissolved in them.

My experimental data:
Gas bubbled in to the Graduated cylinder	= 780
Gas inside of the empty soda can	= 355 ml (see above)
Total gas expelled	= 1135 ml of gas

From my experiment at about 20˚C, I got about 3.2 times the amount of gas as liquid cola (355 ml).
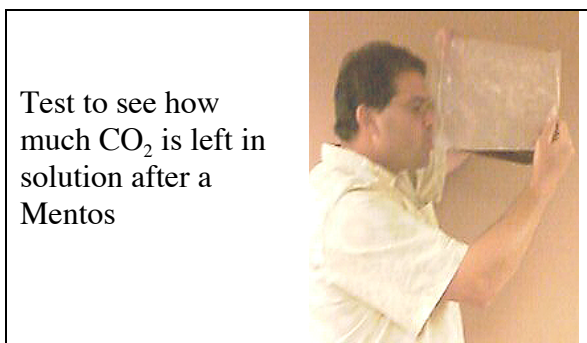
Other Options for doing data collection and calculations:

Mass vs. Volume:
You could mass the contents of a full can of soda and a can in which all the gas has been expelled. You can compare the volume of gas to the mass loss using 44g/mole for CO_2 and PV=nRT.

Molarity:
1. Determine molarity of the Carbon Dioxide in the cola solution:
    a. The volume of a can of cola or bottle is listed on the side of the container.
    b. Collect and calculate the volume of CO_2. Calculate the number of moles of CO_2 by using PV=nRT,
    c. Molarity = moles of solute / kilograms of solvent

Test to see how much CO_2 is left in solution after a Mentos

Other resources:
http://www.science-house.org/CO2/activities/co2/soda.html
http://hypertextbook.com/facts/2000/SeemaMeraj.shtml
http://scifun.chem.wisc.edu/CHEMWEEK/CO2/CO2.html

also,thanks to Julie Yu for the help