MIND TREKKERS
Carbonating Juice Lesson Plan

Amount of time Demo takes: 3-5 min

Materials:
1. Two-liter pop bottles (2 per demo, 6 total)
2. Baking soda, enough to fill cylinder
3. Vinegar (2 cups, aka 16 oz. per demo)
4. Powdered drink mix (amount for 34 oz. of drink)
5. Clean drinking water (1 liter/demo)
6. Small drinking cups to hand out (1 oz of drink, 30 cups per 1 liter)
7. 4 funnels: 1 each for water, powdered juice, baking soda, and vinegar
8. Cooler with ice to cool water or mixed drink to used for demo
9. Waste bucket for reacted vinegar and baking soda (There should be a large stack of buckets brought over in truck, find one before event starts.)
10. Large cooler with ice, to chill drink mix in 2 liter bottles (1) cooler, (2 bags of ice)
11. Carbonating Juice kit “U-Fizz”, tubing, cylinders and caps for bottles (2)

Set up instructions and instructional procedure:
1. Measure and pre-make a few liters of powdered drink mix to set aside in cooler with ice. Follow instructions on label to make drink, but make sure to leave about 2.5 inches of air space at the top of each bottle.
   Aside: Cold liquids hold carbonation better than warm, so use cold water and keep the juice chilled in a cooler.
2. Measure at least 2 cups of vinegar into one bottle. Put the baking soda cylinder into the plastic sleeve and fill the cylinder with baking soda.
3. Get ready! Remove the baking soda cylinder from its sleeve and gently drop it into the vinegar. The reaction will begin, but don’t worry! Simply attach one end of the hose to the vinegar-baking soda bottle quickly - that way you don’t lose too much CO2.
4. Squeeze the juice bottle to remove the air gap at the top, then attach the other end of the hose.
5. There are two things you should do alternately:
   a. Swirl the vinegar and baking soda bottle to make sure all the baking soda is reacted. Don’t get any in the hose, though - it doesn’t taste very good.
   b. Shake the juice bottle vigorously. This greatly helps to mix all of the carbon dioxide into the juice.
6. When the reaction stops and your juice is ready, open the vinegar bottle side first, then remove the hose from the juice bottle. Serve in small amounts.

If you’re not sure about how to do this demo, there is a very handy video linked at the bottom of the lesson plan!

SAFETY!
Keep your hands and the materials clean - wash everything out between demos.

Lesson’s big idea

The starting materials are vinegar (acetic acid; \( \text{CH}_3\text{CO}_2\text{H} \)) and baking soda (sodium bicarbonate; \( \text{NaHCO}_3 \)).

**Baking soda:**
Sodium bicarbonate undergoes dissociation in water to form \( \text{Na}^+ \) and \( \text{HCO}_3^- \):
\[
\text{NaHCO}_3 \rightarrow \text{HCO}_3^- + \text{Na}^+ \\
\text{(full dissociation; 100%)}
\]

**Vinegar:**
As a weak acid, \( \text{CH}_3\text{CO}_2\text{H} \) (acetic acid) partially dissociates in water to form \( \text{H}^+ \) and \( \text{CH}_3\text{CO}_2^- \) (acetate):
\[
\text{CH}_3\text{CO}_2\text{H} \rightarrow \text{CH}_3\text{CO}_2^- + \text{H}^+ \\
\text{(partial dissociation; <100%)}
\]

The bicarbonate ion reacts with a proton from the acetic acid to form carbon dioxide and water:
\[
\text{H}^+ + \text{HCO}_3^- \rightarrow \text{H}_2\text{O} + \text{CO}_2
\]

The chemical reaction between the vinegar (an acid) and the baking soda (sodium bicarbonate, a base) forms carbon dioxide. As the gas forms inside the first bottle, the pressure increases. The tubing that connects the two bottles allows the carbon dioxide molecules to travel to the second bottle containing the juice, where they are pushed into the beverage, carbonating it.

**Assessment**

**Sample questions you can ask:**
1. What gas is released from the vinegar and baking soda?
2. How does the carbonation get into the juice?

**Clean Up**

Clean up between demonstrations if needed. When completely finished gather all materials listed for this demonstration and make sure everything is accounted for. If something was used up, broken or damaged, let someone know so it can get replaced or fixed.

Be sure to wash out all of the funnels, bottles, hoses, measuring cups, and any other equipment. Clean up any spilled juice/vinegar/etc.

**References:**
To watch video of how to do this demo go here:

http://www.thinkgeek.com/geektoys/science/c908/

http://en.wikipedia.org/wiki/Carbonation
National Standards:
K-4 Physical Science Standard B, Properties of objects and materials
5-8 Physical Science Standard B, Properties and changes of properties in matter
9-12 Physical Science Standard B, Chemical reactions