**Demonstration Document: Baking soda and Vinegar as reaction that absorbs energy.**

When bonds are formed, energy is released. This can be as heat, light, sounds, and more. When bonds are broken apart, they absorb energy. This can be seen by the temperature lowering in the surrounding areas and in the mixture itself. For this experiment, we will be making baking soda and vinegar together and monitoring the temperature. If the temperature rises, we know that bonds have been formed. If the temperature decreases, we know that bonds were being broken.

For the SEEd standard: CHEM 4.1; construct an argument with evidence for whether a reaction absorbs or releases energy. Emphasize that the overall change in energy is related to the energy absorbed when bonds are broken, and the energy released when bonds are formed.

Estimated Grade level: 5-6

**Items for one person:**  \*All supplies can be purchased

A glass at any grocery store. Goggles can be found

A bowl to put the glass in (flat bottom) at any hardware stores. \*

1/3 cup vinegar

1 Tbsp. baking soda

A thermometer

Goggles

**Items for 5 separate groups:**

5 glasses

5 bowls to put the glasses in

1 2/3 cup vinegar

5 Tbsp. baking soda

5 thermometers

Goggles for each person

**SODIUM BICARBONATE (Baking soda): **

There are no health or environmental effects associated with this material.

**Eyes:** avoid direct contact. Can cause irritation. Irrigate with flowing water immediately after exposure for 15 minutes.

**Skin:** not a skin irritant. Wash off with soap and water as necessary.
Inhalation: No known effects. Remove to fresh air.

**ACETIC ACID (Vinegar):**

**Eyes:** Wear goggles. Can causes serious eye irritation. Irrigate with flowing water immediately after exposure for 15 minutes.

**Skin:** Can cause skin irritation. Wash hands with soap and water as necessary.

**Inhalation:** Can cause irritation Move to fresh air. Seek medical advice if discomfort or irritation

persists.

1. Wear goggles. (Gloves not required, but recommended)
2. On a flat surface, place the bowl in the center. Add the glass to the inside of the bowl.
3. Add the 1/3 vinegar to the glass.
4. Add the thermometer and wait until the temperature stabilizes. Note the starting temperature.
5. Before adding the baking soda, inform class to watch the thermometer and to remember the lowest (or highest) temperature that is seen.
6. Add the 1 Tbsp. of baking soda to vinegar.
7. Record the lowest temperature seen. Since the bonds were broken in the baking soda and vinegar, the reaction absorbed energy from the surroundings, making the temperature colder.
8. Dispose of reactants.

These can be poured down the drain with running water. No special disposal needed. The glass, thermometer, and bowl can be washed with no special precautions. Store baking soda and vinegar in separate places.

The chemical reaction that is happening is:

Vinegar + Baking soda🡪 Sodium acetate + water + carbon dioxide

CH3COOH + NaHCO­3 🡪 CH3COONa + H2O + CO2

The hydrogen breaks from acetic acid. The HCO­3 breaks away from the Na. The OH- is then further broken down from the HCO3. This combines with the hydrogen to give H2­O, and CO2.