

# RAFT IDEAS

**Topics:** Chemical Reactions, Acids & Bases, Exothermic, Endothermic

## Materials List

(Per student or team)

- ✓ Paper towel
- ✓ Small re-closeable clear plastic bag
- ✓ Re-closeable clear plastic bag, large, gallon size or equal
- ✓ Water
- ✓ Calcium chloride, 1¼ ml (¼ teaspoon)
- ✓ Baking Soda 1¼ ml (¼ teaspoon)
- ✓ Measuring spoons, 1¼ ml (¼ teaspoon) - 1 for each chemical & H<sub>2</sub>O
- ✓ Optional: pH indicator – strip or liquid (see **Acid or Base?** or **Cabbage Patch Indicator**)

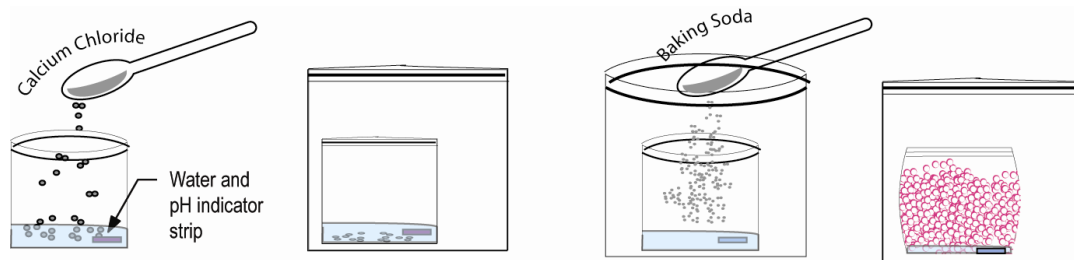
This activity can be used to teach: Next Generation Science Standards:

- Structure of matter; Property of materials; Mixtures (Grade 5, Physical Science, 1-1, 1-3, 1-4)
- Chemical reactions (Physical Science, Middle School, 1-2 & 1-6; High School, 1-2, 1-5, & 1-6)
- Science/Engineering Practices(grades 4-12)



# Flat Bag! Cold Bag! Puffy Bag!

Experience temperature changes and more from chemical reactions!



Experience these “cool” heat producing, cold producing, and gas producing reactions that are safely contained within nested plastic bags.

## To Do and Notice

**Safety Notes:** Avoid eye, oral, and skin contact with the chemicals listed in the experiments. Wearing eye protecting goggles is recommended. For any accidental eye contact immediately flush the eye gently with water and consult a physician. These chemical reactions will produce heat and gas so be sure to use **only** the amount of chemical specified in the instructions!

1. Place a paper towel on the work surface to contain any spills and to ease cleanup.
2. Put 1¼ ml (¼ teaspoon) of water, into a small re-closable, clear plastic bag.  
Optional: Add pH indicator and note the color.
3. If the chemicals are clumped together, shake or crush in the bag before opening.
4. Add 1¼ ml (¼ teaspoon) of calcium chloride to the small bag. (Note: if any calcium chloride is spilled then use a spoon (not fingers!) for cleanup and/or carefully wrap up the spill in the paper towel.)
5. Carefully seal the small bag.
6. Place the small sealed bag inside a larger re-closable bag. Carefully seal the larger bag, running fingers along the seal several times to ensure a tight seal.
7. Gently shake, or massage, the solution to help the calcium chloride dissolve. Note any temperature change (feel the bag) in the solution. Note color change if pH indicator is used.
8. Carefully open both bags and add 1¼ ml (¼ teaspoon) of baking soda (sodium bicarbonate) to the smaller bag. Quickly seal each bag.
9. What changes, if any, are noted in the temperature, color, or volume of the contents of the smaller bag? Hold the bags up to an ear. What is heard? What might cause the bag to inflate? What type of gas might be in the bag?
10. A well sealed larger bag will contain any liquid if the smaller bag leaks or pops.

**Disposal** -Bags and the chemicals can be thrown in the garbage. Solutions from these experiments can be poured down the drain provided the faucet is turned on to allow the solution to be diluted with a large amount of water.

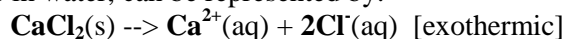
## The Science Behind the Activity

A chemical reaction that produces excess energy, usually in the form of heat, is said to be **exothermic**. When a chemical reaction requires additional energy, usually in the form of heat, the reaction is said to be **endothermic**. The required heat energy can be supplied by the surrounding matter (reactants, air, and container), resulting in a

cooling of the reactants, air, and container. For physical reactions the terms used are **exergonic** and **endergonic**.

An **acidic** solution is a solution that has more **hydrogen ions (H<sup>+</sup>)** than **hydroxide ions (OH<sup>-</sup>)**. A **basic** solution is a solution that has more hydroxide ions (OH<sup>-</sup>) than hydrogen ions (H<sup>+</sup>). **Indicators**, certain chemical containing solutions or paper strips, are used to visually indicate the relative concentrations of hydrogen ions (**pH**). By definition a solution that is neither acidic nor basic is said to have a pH of 7. Pure water has a pH of close to 7. Cabbage juice contains **anthocyanins**, chemicals that are highly sensitive to pH levels. Anthocyanins reflect red light in the presence of acids, indicating the pH is less than 7, but reflect blue light when mixed with a basic solution, indicating the pH is more than 7.

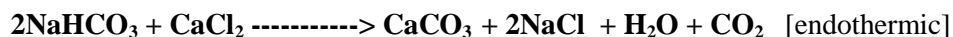
Anhydrous calcium chloride (**CaCl<sub>2</sub>**) is a molecular form of calcium chloride that is free of water, hence the term **anhydrous**. Anhydrous calcium chloride is commonly used for deicing roads. When calcium chloride dissolves in water both chemical and physical changes occur and the process is exothermic since heat is released. The dissolving of the calcium chloride in water, can be represented by:



Note: The exothermic reaction may be less noticeable if the anhydrous calcium chloride has absorbed moisture in storage.

The (s) indicates that the substance is in the solid phase and the (aq) indicates that the substance is dissolved in water (**aqueous**). When the calcium chloride dissolves in water, a basic solution is formed (hence, the blue-green color of the pH indicator when calcium chloride is added).

Baking soda is a chemical called sodium bicarbonate (**NaHCO<sub>3</sub>**). When calcium chloride and sodium bicarbonate are mixed in the presence of water, a chemical reaction occurs. The ionic bonds in the sodium bicarbonate and the calcium chloride break apart and the atoms and molecules rejoin to form calcium carbonate, sodium chloride, water, and carbon dioxide. The reaction requires additional energy and so is endothermic and in this experiment the temperature of the bag and its contents drops. Carbon dioxide is the gas that inflates the bag. The chemical reaction can be represented by the following:



When sodium bicarbonate reacts with calcium chloride, the resulting chemical reaction creates an acidic solution, which causes the pH indicator to turn a reddish-pink color. CaCO<sub>3</sub> is the main component of chalk.

**Web Resources** (Visit [www.raft.net/raft-idea?isid=570](http://www.raft.net/raft-idea?isid=570) for more resources!)

- General & Introductory Chemistry - [http://chemistry.about.com/od/generalchemistry/General\\_Introductory\\_Chemistry.htm](http://chemistry.about.com/od/generalchemistry/General_Introductory_Chemistry.htm)
- Chemistry websites for students - <http://www.chem1.com/chemed/genchem.shtml>