EDUCATIONAL OUTREACH
FLORIDA POLYTECHNIC UNIVERSITY

ENDO AND EXOTHERMIC REACTIONS

Description

Overview:

A chemical reaction is a process that leads to the chemical transformation of one set of chemical substances to another. Chemical reactions are an integral part of technology, of culture, and indeed of life itself. Burning fuels, smelting iron, making glass and pottery, brewing beer, and making wine and cheese are among many examples of activities incorporating chemical reactions that have been known and used for thousands of years. Chemical reactions abound in the geology of Earth, in the atmosphere and oceans, and in a vast array of complicated processes that occur in all living systems.

Chemical reactions must be distinguished from physical changes. Physical changes include changes of state, such as ice melting to water and water evaporating to vapor. If a physical change occurs, the physical properties of a substance will change, but its chemical identity will remain the same. No matter what its physical state, water (H2O) is the same compound, with each molecule composed of two atoms of hydrogen and one atom of oxygen. However, if water, as ice, liquid, or vapor, encounters sodium metal (Na), the atoms will be redistributed to give the new substances molecular hydrogen (H2) and sodium hydroxide (NaOH). By this, we know that a chemical change or reaction has occurred.

Exothermic Reactions. Exothermic reactions are reactions or processes that release energy, usually in the form of heat or light. In an exothermic reaction, energy is released because the total energy of the products is less than the total energy of the reactants.

An endothermic reaction is any chemical reaction that absorbs heat from its environment. The absorbed energy provides the activation energy for the reaction to occur. A hallmark of this type of reaction is that it feels cold.

The Activity

Lab Safety at all times- do not taste, touch or smell anything without permission
GLOVES AND GOGGLES ON AT ALL TIMES

Part 1: Endothermic Reaction

The term endothermic process describes a process or reaction in which the system absorbs energy from its surroundings; usually, but not always, in the form of heat.

Materials:
•25 ml citric acid solution (can be purchased at a pharmacy over the counter or online from Amazon, granules can also be purchased and reconstituted with water)
•15 g baking soda
•8 oz Styrofoam cup (can use larger)
•thermometer (for part 1 and 2)
•Popsicle stirring stick

Procedure:
How to Create an Endothermic Reaction
1. Pour the citric acid solution into a coffee cup. Use a thermometer or other temperature probe to record the *initial* temperature. Record in the data table below.
2. Stir in the baking soda (sodium bicarbonate). Track the change in temperature as a function of time. Record the first meeting as 1 min, then continue recording the temperature in minute increments over 5 minutes.
3. With gloved hands, touch the outside of the Styrofoam cup
4. The reaction is: $H_3C_6H_5O_7(aq) + 3\ NaHCO_3(s) \rightarrow 3\ CO_2(g) + 3\ H_2O(l) + Na_3C_6H_5O_7(aq)$

Time	Initial	1 min	2 min	3 min	4 min	5 min
Temperature						

5. When you have completed your demonstration or experiment, simply wash the cup out in a sink. No toxic chemicals to mess with!

Analysis:
1. Observations:
What did the reaction feel like?

What did the reaction look like?

2. In your own words, explain an endothermic reaction?

3. In an endothermic reaction, what is happening to the heat?

4. During an endothermic reaction in a beaker, if we are part of the surrounding and touched the beaker, it would feel?

Extension: If time permits, after the 5 minutes, add an additional 15g of baking soda to your cup of citric acid and baking soda solution. Record the temperature and discuss your finding.

Part 2: Exothermic Reaction

An exothermic reaction is a chemical reaction that releases energy by light or heat. It is the opposite of an endothermic reaction. Expressed in a chemical equation: reactants → products + energy.

Materials:
• A clean 16-ounce plastic soda bottle or large cup
• 1/4 cup 20-volume hydrogen peroxide liquid (20-volume is a 6% solution, ask an adult to get this from a beauty supply store or hair salon, can also be purchased on Amazon)
• 1/2 Tablespoon (one packet) of dry yeast

- 1 1/2 Tablespoons of warm water
- 1 tbsp Liquid dish washing soap
- Food coloring (optional)
- Small bathroom cup (approx. 2 oz) cup
- Safety goggles and gloves

NOTE: The foam will overflow from the bottle, so be sure to do this experiment on a washable surface or place the bottle on a tray.

Procedures:

Caution: Hydrogen peroxide can irritate skin and eyes. Wear goggles and gloves.

1. Carefully pour the hydrogen peroxide into the bottle or large cup. Take the temperature of the hydrogen peroxide and record the *initial* temperature in the data table below.
2. Add 8 drops of your favorite food coloring into the bottle.
3. Add about 1 tablespoon of liquid dish soap into the bottle and gently swish the bottle around a bit to mix it. You do not want bubbles to form.
4. In a separate small cup, combine the warm water and the yeast together and mix for about 30 seconds.
5. Now the adventure starts! Pour the yeast water mixture into the bottle (a funnel helps here) and watch the foaminess begin!
6. Track the change in temperature as a function of time. Record the first meeting as 1 min, then continue recording the temperature in minute increments over 5 minutes.

Time	Initial	1 min	2 min	3 min	4 min	5 min
Temperature						

7. Make observations.

How does it work?

The foam you made is special because each tiny foam bubble is filled with oxygen. The yeast acted as a catalyst (a helper) to remove the oxygen from the hydrogen peroxide. Since it did this very fast, it created lots and lots of bubbles

8. Clean up. The foam produced is just water, soap, and oxygen so you can clean it up with a sponge and pour any extra liquid left in the bottle down the drain.

Analysis:

1. Observations:

What did the reaction feel like?

What did the reaction look like?

2. In your own words, explain an endothermic reaction?

3. In an endothermic reaction, what is happening to the heat?

4. During an endothermic reaction in a beaker, if we are part of the surrounding and touched the beaker, it would feel?

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