



The Messy Meter



Hot Or Cold? Chemical Reactions

In this experiment, kids will use common kitchen ingredients to create and observe two different chemical reactions!

A chemical reaction is a process in which one set of chemical substances is transformed into another. In other words, two or more chemicals combine to make two completely different chemicals.

Sometimes this process involves reactions that also change temperature. In this activity kids will predict if there will be a temperature change and what that change will be for each chemical reaction they create.

Recommended Grades:
4 - 8

Estimated Time:
45 Minutes

Subject:
Chemistry/Math

WHAT YOU'LL NEED

Pantry Staples:

- White Vinegar
- Baking Soda
- Steel Wool
- Small Bowl
- Sealable Freezer Bags
- One Tablespoon Measuring Spoon
- 1 Cup Measuring Cup
- 1/4 Cup Measuring Cup
- Paper Towels

Specialty Supplies:

- Pocket Food Thermometer
- 1 Quart Glass Canning Jar with Lid
- Kitchen Timer or Stopwatch

Bonus Fun:

Repeat the experiments by varying the amounts of chemicals used. Do you think adding more or less vinegar or baking soda will change your results? What will happen if you don't squeeze the excess vinegar out of the steel wool?



STEPS

Part One

1. Place the thermometer in an empty freezer bag and seal it. Allow the thermometer to set for 5 minutes and record the temperature.
2. Remove the thermometer and pour 1/4 cup (2 ounces) of vinegar into the bag. Place the thermometer back in the bag, seal it, and after 5 minutes, record the temperature.
3. After recording the temperature, unseal the bag (leaving the thermometer in) and pour in one tablespoon of baking soda (premeasured) and quickly reseal the bag.
4. After 2 minutes, record the temperature and compare it with the first temperature reading of just the vinegar itself.

Part Two

1. Place the thermometer in an empty glass canning jar and put on the lid. Allow the thermometer to set for 5 minutes and record the temperature.
2. Pour 1 cup of vinegar into the small bowl and soak the steel wool in the vinegar for 1 minute. Squeeze the excess vinegar from the steel wool.
3. Remove the thermometer from the jar. Wrap the soaked steel wool around the measuring end of the thermometer. Place the steel wool wrapped thermometer back in the jar and quickly put the lid back on.
4. Observe the jar for 5 minutes. Do you see any reaction happening in the jar? After 5 minutes, record the temperature (without opening the jar) and compare it with the temperature reading of the empty jar.



Questions to Engage Youth:

What was your hypothesis about the two reactions?

What was the temperature change in the first reaction?

What happened to the sealed freezer bag? Why do you think this happened?

What was the temperature change in the second reaction?

What did you observe about the sealed canning jar? What was formed inside?

What did you notice when you opened the canning jar? Did any of your senses notice anything different?

Were you surprised by the results?

Explanation:

Through the process of a chemical reaction, energy (in the form of heat) can sometimes either be given off or taken in. The technical terms for these types of reactions are exothermic (giving off heat) and endothermic (taking in heat). Most of the time when we think of heat given off, we think of fire or an explosion which can be a very spectacular reaction. On the other hand, when we think of heat taken in, we think of something getting cold, very slowly.

In this experiment, we tested the hypothesis that exothermic reactions are big and spectacular and endothermic reactions are relatively boring. The very quick and spectacular reaction between vinegar (Acetic Acid - CH_3COOH) and baking soda (Sodium Bicarbonate - NaHCO_3) produced Sodium Acetate ($\text{C}_2\text{H}_3\text{NaO}_2$) and Carbon Dioxide (CO_2). In doing this, the reaction took in heat from the surrounding atmosphere, making it endothermic. By producing CO_2 , it also inflated the sealed freezer bag.

In the second half of the experiment, soaking the steel wool in vinegar (Acetic Acid) actually helped dissolve the protective coating on the steel wool allowing the Iron (Fe) in the steel wool to be exposed to Oxygen (O_2) and Water (H_2O) in the atmosphere. When these three chemicals combine, Iron (III) Oxide (Fe_2O_3) or "rust" will be formed. In the chemical reaction of iron rusting, heat will be given off, making this an exothermic reaction. But the reaction is not nearly as spectacular as the vinegar and baking soda endothermic reaction.

Career Connections:

If you had fun with this experiment, guess what? You can have that kind of fun every day when you grow up and get a job. Chemistry is used in all kinds of careers like scientific research, yes, but also medicine, environmental science, the legal field and the military. It's even used by chefs, since cooking is all about using heat to produce chemical reactions to bring out great flavors in food!

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