Reaction, Yes or No?

Visitors create a chemical reaction by mixing baking soda, calcium chloride and phenol red in a sealed plastic bag. The results of the reaction include a temperature change, a color change, and the production of a gas.

OBJECTIVES:

Visitors learn about three signs that indicate that a chemical reaction has taken place: an energy transfer, a color change, and new products. They also learn that the making or breaking of chemical bonds is involved in chemical reactions.

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Reactions, Yes or No?

Procedure:

1. Always wear safety goggles.

2. Put 3 heaping spoonfuls of baking soda \((\text{NaHCO}_3)\) into the plastic bag.

3. Put 4 heaping spoonfuls of calcium chloride \((\text{CaCl}_2)\) into the same plastic bag.
   Do you notice any chemical changes occurring?

4. Using the graduated cylinder, measure 10 ml of phenol red.
   Pour it into the paper cup.
   What color is the liquid?
   Is it cloudy or is it clear?

5. Without spilling the liquid, slide the paper cup into the plastic bag. Carefully seal the bag.

6. Get ready to make several observations.
   Hold the top of the bag in one hand and squeeze the bottom of the bag to mix all the chemicals.
   What evidence tells you that a chemical reaction has occurred?
   What do you see, hear, and feel? Is there a change in temperature?

7. Throw away the bag and rinse out the graduated cylinder.
Evidence that a chemical change has occurred:

- Energy (heat) transfer
- Color change
- “New stuff”

A Closer Look:

Why did the bag get hot?

Chemical bonds hold molecules together and store energy. When chemical reactions occur, bonds break and some energy can be lost as heat.

Why did the color change?

Indicators are chemicals that change color when chemicals react. In this experiment, when the calcium chloride and baking soda dissolve in liquid, they react to form an acid. Phenol red is an indicator that turns yellow when it mixes with an acid.

Why did the bag inflate?

A gas, carbon dioxide ($CO_2$), is also produced by the reaction. The gas creates the bubbles you see and inflates the plastic bag.
Experiment: Reaction, Yes or No?

MATERIALS

(with amounts to have on hand)

- One 25-ml plastic graduated cylinder
- One box of 100 quart-size, resealable plastic storage bags (keep at least four unopened boxes on hand)
- Phenol red (keep 25 g on hand)
- One 250-ml squirt bottle
- Two 1-ml (1/4-tsp) measuring spoons
- Two 8-oz jars with lids
- CaCl₂ (calcium chloride) pellets, 4-6 mesh (NOTE: keep CaCl₂ in airtight container; otherwise it will pick up moisture from the air and become less effective) (keep at least 4 lb on hand).
- Baking soda (keep at least 4 lb on hand)
- 1-oz portion cups (keep at least 500 on hand)
- One quart-size storage jar
- One 1000-ml plastic bottle

Setup/Takedown Procedures

ORIGINAL SETUP

☐ Label the 1-ml spoons “Calcium Chloride” and “Baking Soda.”
☐ Label the 8-oz jars “Calcium Chloride” and “Baking Soda.”
☐ Label the quart-size storage jar “Calcium Chloride Pellets.”
☐ Label the 1000-ml plastic bottle and the 250-ml squirt bottle “0.001M Phenol Red.”

WEEKLY SETUP

SET UP THIS EXPERIMENT AT THE END OF A BENCH NEAR A TRASH CAN.

☐ Fill the labeled quart-size jar with CaCl₂ (calcium chloride) pellets.
☐ Place extra portion cups and quart-size plastic bags in the tub as needed for week.
☐ Place a 4-lb box of baking soda in the tub.
☐ Prepare phenol red solution if necessary (keep 1 l on hand) (see Materials Prep).
DAILY SETUP

- On an end of a bench next to a trash can, set out the visitor instructions in a Plexiglas holder.
- Set out the following equipment on a tray lined with a white mat:
  - Labeled jar of calcium chloride pellets (keep lid on jar)
  - Labeled jar of baking soda
  - Two labeled spoons
  - Box of resealable plastic bags
  - One plastic graduated cylinder
  - One labeled 250-ml squirt bottle of phenol red
  - A stack of portion cups

DAILY TAKEDOWN

- Tightly close the CaCl₂ (calcium chloride) jars.
- Rinse the graduated cylinder and scoops.
- Store the tightly capped phenol red squirt bottle in an upright position.
- Sponge off the tray, mat, and outsides of jars.
- Return all supplies to tub under counter.

WEEKLY TAKEDOWN

- Empty the squirt bottle; store the remaining phenol red in the plastic bottle, tightly capped.
- Wash the graduated cylinder, tray, mat, and two scoops.
- Clean the tray and leave it at the station.
- Return the mat to general lab storage.

RUNNING SUGGESTIONS

◊ Make sure the locking plastic bag is well closed, otherwise the CO₂ (carbon dioxide) will escape and the bag won't inflate.
EXTENSIONS

Other indicators, such as methyl red, can be used.

To prepare methyl red:

- Mix 0.145 g methyl red with 800 ml 1% ethyl alcohol.
- Stir until mostly dissolved.
- Use one part of this stock to two parts dH₂O (deionized water) for a final solution.

SAFETY & DISPOSAL

No special precautions needed; follow standard lab safety procedures.

MATERIALS PREP

To prepare phenol red solution:

- Weigh 0.4 g of phenol red.
- Add 1000 ml dH₂O (deionized water).
- Mix well.
- Store in labeled/dated bottle.