Observation and Experiment

Scientific Method Lab

“The world is full of obvious things, which nobody by any chance ever observes.”

Background

The scientific method is not a process performed in defined steps. It is a dramatic process to understand the world around us. Typically beginning with an observation and then trying to understand that observation by asking questions and coming up with possible answers to those questions.

Chemistry is the study of matter. Observing matter can be very challenging due to all the variables that can exist due to its properties and interactions. When designing experiments it is important to observe only one variable at a time to understand what is taking place.

In this experiment we will begin by combining solid calcium chloride (CaCl₂), solid sodium bicarbonate (NaHCO₃), and phenol red. Many changes will take place (e.g., color change, change in temperature). Our goal is to conduct an experiment to determine which individual variables contribute to the overall reaction.

Materials

- Calcium chloride (solid), CaCl₂
- Phenol Red solution
- Sodium bicarbonate (solid), NaHCO₃
- 2 plastic spoons
- 2–50 mL beakers
- 10 mL graduated cylinder
- Zip lock bags

Safety Precautions

Calcium chloride is slightly toxic if ingested. Phenol red is a dye solution and will stain skin and clothing. Avoid contact with eyes and skin. Wash your hands with soap and water before leaving the laboratory.

Pre-Lab Questions

1. A student protested: “Both calcium chloride and sodium bicarbonate are common household substances. Why should I wear my goggles?” Explain why!

2. Which of the following is NOT a characteristic of the scientific method: (a) logic, (b) imagination, (c) bias, or (d) evidence? Explain your answer.
Procedure
Part A: The Overall Reaction

1. Observe and describe the appearance of calcium chloride, sodium bicarbonate, and phenol red solution. Record your observations in Data Table A.

2. Lay a zip-lock plastic bag flat and place the following three substances in separate locations in the bag.
   - a. 1 teaspoon of calcium chloride
   - b. ½ teaspoon of sodium bicarbonate
   - c. 5 mL phenol red indicator solution

3. Squeeze out as much air as possible from the bag and seal it. Mix the contents.

4. Carefully observe (by means of sight and touch) the changes that take place in the bag. Record all observations in Data Table A.

   NOTE: If the bag gets too full or tight, open the bag and then reseal it. Do NOT open the bag near your face or the face of any of your lab partners.

5. To dispose: Rinse out contents in the drain and dispose of the bag in the trash.

6. Think of at least 4 questions that could be investigated to determine the interactions that are responsible for the observed changes.

Part B: Controlled Experiments

7. With the other group at your lab table carry out a series of controlled experiments using different combinations of the materials in this lab. Use the same quantities of materials as in part A.

8. Fill out the change in Data Table B to indicate which materials were used for each experiment. Do as many experiments as needed to identify the substances responsible for the observed changes – it should not be necessary to conduct all nine different tests.