**Lab #1: Baggie Lab**

*Materials*

* Calcium Chloride (CaCl2)
* Phenol Red (C19H14O5S)
* Sodium bicarbonate (NaHCO3)
* Water (H2O)
* 2, 50mL Beakers
* Graduated Cylinder
* 2 small plastic cups or jars
* Spoons
* Pen for labeling
* Zipper-lock plastic bags

Careful observations are the foundation of chemistry. The goal of chemistry is to answer how, what, and why physical phenomena occur. The answers to these questions are found in experiments, which may be described as observations made under controlled conditions. Observations and experiments are the foundation of the scientific process.

Chemistry is defined as the study of matter – what a substance is made of, its structure and properties, and the changes that it undergoes. Experiments should be designed so that the effects of different variables on the behavior of a substance can be studied independently. This is done by making observations under controlled conditions; where only one variable at a time is changed. Controlled experiments make it possible to separate or isolate the factors that are responsible for a given observation in a complex series of events.

**Pre-Lab Questions:**

1. *What is a “variable”?*
2. *Why do you think scientists change only one variable or thing at a time when conducting an experiment?*

*3. What does it mean to be a controlled experiment?*

**Part 1: What will you be doing in this lab?**

When three substances – solid calcium chloride (CaCl2), solid sodium bicarbonate (NaHCO3), and a solution of phenol red (C19H14O5S ) mixed with water (H2O) – are mixed in a closed container, a complex series of changes is observed. Observations include temperature changes, color changes, and changes in state.

Imagine that each substance in the mixture represents a variable. By changing only one variable at a time, it should be possible to determine the contribution of each substance to the changes observed for the overall reaction.

Note: Phenol red is a naturally occurring dye that is used as an indicator (a solution that changes color under different conditions). Because phenol red is a solution of dye dissolved in water, it is actually composed of two substances. Thus, water must be considered as a fourth substance (variable) in the overall reaction, and its effect should also be examined.

**Reading check:**

1. Why should you only change one variable at a time? (I.e. adding only two solutions together at a time instead of all four)
2. What is the purpose of Phenol Red in this experiment?

**Part 2: The Overall Reaction**

1. Obtain two small jars. One with calcium chloride and one with sodium bicarbonate. Keep the jars closed when not in use.
2. Obtain phenol red and water in labeled containers (given by your teacher).
3. Observe and describe the appearance of CaCl2, NaHCO3, and phenol red solution. Record the observations in Data Table A.
4. Lay a zipper-lock plastic bag flat and place the following substances in separate locations in the bag.
   1. ½ teaspoon of calcium chloride.
   2. ½ teaspoon of sodium bicarbonate
   3. ~3 pipettes of phenol red indicator solution and ~6 pipettes of water.
5. Squeeze out as much air as possible from the zipper-lock bag and seal it. Allow the contents to mix thoroughly.
6. 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 labmates.
7. The contents of the bag may be rinsed down the drain under running water. Rinse out the bag with water and carefully dry with paper towels. The bag will be reused by your group.
8. Think of at least four questions that could be investigated to determine the interactions that are responsible for the observed changes. For example, is water or a liquid necessary for the reaction to occur? Write your questions in the space provided in Data Table A.

|  |  |
| --- | --- |
| **Data Table A: The Overall Reaction** | |
|  | **What are properties of the individual substances?** |
| **Chemical** | **Observations** |
| Calcium Chloride |  |
| Sodium Bicarbonate |  |
| Phenol Red |  |
| Observations | **What happens when the substances are mixed together?** |
|  |
| Questions | **Write four questions concerning the changes that were observed.** |
| 1. |
| 2. |
| 3 |
| 4. |

**Part 3: Controlled Experiments**

1. Design and carry out a series of *controlled* experiments to determine which combinations of substances are responsible for the observed changes. Always use the same quantities of chemicals as in Part A. Carry out the reactions in zipper-lock plastic bags, making sure to rinse and dry between each trial. If water is tested in a controlled experiment, use the same amount of water as of phenol red solution in Part A.
2. Fill out the chart in Data Table B to indicate the substances used in each controlled experiment and the resulting observations. Space has been provided for nine experiments. Do as many experiments as needed to identify the substances responsible for the observed changes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Table B: Controlled Experiments**  *Place a check in the appropriate box to show which chemicals were mixed in each experiment.* | | | | | |
| **Number** | **Calcium Chloride** | **Sodium Bicarbonate** | **Phenol Red** | **Water** | **Observations** |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |

**Part 4: Putting it all together**

1. Based on the results of the controlled experiments, what combinations of substances seem to be responsible for the observed temperature changes in the overall reaction?
2. What temperature changes were observed in the individual controlled experiments? If there was a different observed temperature than in the controlled experiment, (Part A) explain how your experiment produced the different temperature.
3. What color change was observed in the overall reaction? What evidence, if any, did the controlled experiments provide concerning the combination of chemicals responsible for the color change?
4. How were the following three things related: the temperatures, the color changes and the formation of gas bubbles?
5. What controlled experiments were done to evaluate if a liquid is necessary for the observed effects in Part A? i.e. Did any reaction occur in the absence of water?
6. What evidence suggests that a new chemical substance is produced in the overall reaction of the substances mixed in Part A? What combination of chemicals may be responsible for the new substance?