**Observations in a Baggie Lab**

**Experiment overview**

The purpose of this experiment is to make observations about the changes that occur when several substances are mixed and to design controlled experiments to identify the substances responsible for the observed changes.

**Background**

**Chemistry** is defined as the study of matter, what a substance is made of, its structure and properties, and the changes that it undergoes. Observations of the properties of matter are often complex. Experiments should be designed so that the effects of different variables on the behavior of a substance can be studied individually. This is done by making observations under controlled conditions as 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.

When three substances – solid calcium chloride, solid sodium bicarbonate, and a solution of phenol red in water- are mixed in a closed container, a complex series of changes is observed. 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. The three substances that are used in this experiment are all common chemicals. Sodium bicarbonate (baking soda) is used as a food additive in baking. Calcium chloride (road salt) is used as a de-icer for sidewalks. Phenol red is a solution of a naturally occurring dye that is used as an indicator, it changes color in different conditions. The phenol red is a solution of the dye dissolved in water. Thus water must be considered as a fourth substance in the overall reaction, and its effects should be examined.

**Safety Precautions**

Calcium chloride is slightly toxic by ingestion. Phenol red is a dye solution and will stain skin and clothing. Avoid contact of all chemicals with skin and eyes. Wear chemical splash goggles and a chemical-resistant apron. Wash your hands with soap and water before leaving the lab. All of the contents can be rinsed down the drain under running water.

**Materials**

Calcium chloride (s), CaCl2  Sodium bicarbonate (s) NaHCO3 4 Plastic cups

Phenol red (aq) Water, distilled Zip-lock bags

2 Pipettes 2 Spoons

**Procedure**

**Part A. The Overall Reaction**

1. Observe and describe the appearance of calcium chloride, sodium bicarbonate, and phenol red solution. You must give THREE OBSERVATIONS PER CHEMICAL. Record the observations in Data Table A.
2. Lay a zip-lock bag flat and place the following three substances in *separate* locations in the bag. SEE DIAGRAM TO RIGHT.
   1. half spoonful of calcium chloride

|  |
| --- |
|  |
| C  A B |

* 1. half spoonful sodium bicarbonate
  2. pipette full of phenol red indicator solution

1. Squeeze out as much air as possible from the bag and seal it. Allow the contents to mix thoroughly.
2. Carefully observe (by means of sight and touch) the changes that take place in the bag. Record all observations in Data Table B. YOU MUST MAKE AT LEAST 5 OBSERVATIONS OF THE CHANGES IN THE BAG. 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 others.
3. The contents of the bag may be rinsed down the drain under running water. Rinse out the bag with water and dispose of the bag in the trash.

*What questions arise concerning the changes that were observed during the reaction in the bag?*

1. Think of at least four questions that could be investigated to determine the interactions that responsible for the observed changes. For example, is water or liquid necessary for the reaction to occur? Write your questions in the space provided in Data Table C.

**Part B: 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 the chemicals as in Part A. and carry out the reactions in separate zip-lock bags. If water is tested in a controlled experiment, use the same amount as of phenol red solution in Part A.
2. Fill out the chart in Data Table D to indicate the substances used in each controlled experiment and the resulting observations. Do as many experiments as you need to identify the substances responsible for the observed changes.

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hr\_\_\_\_\_\_\_\_\_\_

**Data Table A. The Overall Reaction**

|  |  |
| --- | --- |
| *What are the properties of the individual substances?* | |
| **Chemical** | **Observation** |
| Calcium Chloride |  |
| Sodium Bicarbonate |  |
| Phenol Red |  |

**Data Table B. The Overall Reaction Continued**

|  |  |
| --- | --- |
| *What happens when the substances are mixed together?* | |
| Observations |  |

**Data Table C. THE QUESTIONS**

|  |  |
| --- | --- |
| *Write four questions you want answered concerning the changes that were observed.* | |
| Questions | 1.  2.  3.  4. |

**Data Table D. 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* |  |  |  |  |  |

**Post –Lab Questions**

1. Based on the results of the controlled experiments, what combinations of substances seem to be responsible for the decrease in temperature? List the name and chemical formulas for each substance.
2. Based on the results of the controlled experiments, what combinations of substances seem to be responsible for the increase in temperature? List the name and chemical formulas for each substance.
3. Based on the results of the controlled experiments, what combinations of substances seem to be responsible for the formation of a gas? List the name and chemical formulas for each substance.
4. Based on the results of the controlled experiments, what combinations of substances seem to be responsible for any color changes you observed? List the names of any substances involved and the color change that resulted. You should have several combinations for this answer.

1. Phenol red is an indicator composed of water and an organic dye. What part of the phenol red solution was responsible for the observations found in questions 1-3? Provide evidence from Data Table D to support your claim.
2. How did you design your experiment to confidently conclude that your answers to questions 1-4 are correct? Clearly state what parts of experimental design were used.
3. Color changes were observed in this lab. Phenol Red is an indicator.
   1. What is an indicator and what are they used for?
   2. What color is Phenol Red in an acid and in a base? Report answers below in the data table
   3. Find one example of an acidic reaction and one basic. Report below with evidence.

|  |  |
| --- | --- |
| Phenol Red Colors | |
| Acid |  |
| Base |  |

Acidic Combo: Basic Combo:

Evidence from Table D: Evidence from Table D: