Law of Conservation of Matter

This experiment will explore whether matter is created or destroyed during a chemical reaction.

Materials

- Balance
- 4 graduated cylinders
- 3-150 mL beakers
- 0.1M solutions of: NaOH, CuSO₄, NH₃ (aq), Na₂CO₃

Substitutions

- 4 (2 oz.) plastic cups
- 3 (5 oz.) plastic cups
- Drano and ammonia solutions
- Bluestone algaecide and washing soda

Procedure

1. Label the four graduated cylinders (or 2 oz. cups) to contain the solutions (one each for NaOH, CuSO₄, NH₃ (aq), and Na₂CO₃).

2. Use a graduated cylinder to measure about 60 mL (2 oz.) of the NaOH solution. Use a second graduated cylinder to measure about 60 mL (2 oz.) of the CuSO₄ solution and pour it into a 150 mL beaker (or 5 oz. cup).

3. Carefully place the two containers on the balance. Weigh the solutions and their containers together and record their combined weight in the Data section.

4. Pour the NaOH solution into the container with the CuSO₄ solution. Allow the solutions to mix. Describe what happens in the Data section.

5. Weigh both containers and the mixture again. Record the new weight. Did the weight change?

6. Repeat the process in steps 2 and 3 above, first substituting NH₃ (aq.) for the NaOH solution, then substituting Na₂CO₃ for the NaOH solution. In each case measure and record the masses as described in steps 3 and 5 above.
Data and Observations

<table>
<thead>
<tr>
<th>Total Weight</th>
<th>Before (g)</th>
<th>After (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NaOH and CuSO₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH₃ (aq) and CuSO₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na₂CO₃ and CuSO₄</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observation of mixture:

Complete the following equations:
1. NaOH + CuSO₄ ----> ________________________________
2. NH₃ (aq) + CuSO₄ ----> ________________________________
3. Na₂CO₃ + CuSO₄ ----> ________________________________

Questions
1. What is the insoluble solid that is produced? Use a solubility chart to predict the identity of the insoluble product.
2. Use the periodic table to prove that total formula mass is conserved. Why is it important to balance a chemical reaction?
Extensions
The substances chosen for this lab are common and easy to find. You may want to repeat this lab with solutions of:

Note that NEITHER iron(II) or zinc carbonates or hydroxides are as insoluble as the copper(II) analog. While Barium and lead salts have frequently been used in this type experiment, the problems associated with disposing of these materials suggest NOT USING either of these salts in experiments.

Teacher's Notes
This experiment verifies the Law of Conservation of Matter: Matter is neither created or destroyed as a result of chemical changes, but may be changed in form.

The balanced equations are as follows:
- \(2\text{NaOH (aq)} + \text{CuSO}_4 \text{(aq)} \rightarrow \text{Na}_2\text{SO}_4 \text{(aq)} + \text{Cu(OH)}_2 \text{(s)}\)
- \(4\text{NH}_3 \text{(aq)} + \text{CuSO}_4 \text{(aq)} \rightarrow \text{Cu(NH}_3\text{)}_4\text{SO}_4 \text{(s)}\)
- \(\text{Na}_2\text{CO}_3 \text{(aq)} + \text{CuSO}_4 \text{(aq)} \rightarrow \text{Na}_2\text{SO}_4 \text{(aq)} + \text{CuCO}_3 \text{(s)}\)

The insoluble product that is formed is called a precipitate. Solubility Tables can help students predict which product will be insoluble (form a precipitate).

For additional ideas on this concept, see Experiment #2 and the Teacher's Notes.

Solution Preparation
The sodium hydroxide can be obtained from Drano™ or Red Devil™ Lye. If you use Drano, the solution does not need to be very concentrated but you should filter the aluminum filings that are mixed in with the pellets of NaOH. Lye is CAUSTIC so wear gloves and wash all surfaces anyone might touch.

Copper (II) sulfate can be purchased at a good hardware or swimming pool supply store as an algaecide (Bluestone) or root eater. Aqueous ammonia (formerly called ammonium hydroxide) is nothing more than household ammonia, and can be used straight out of the bottle from the grocery store.
Finally, the sodium carbonate can be purchased at the grocery store as washing soda (Arm and Hammer brand) and can be mixed with water to form a solution.

0.1 M solutions can be prepared by dissolving the following masses of solid into enough water to make 1-L of solution:

<table>
<thead>
<tr>
<th>Solid</th>
<th>Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper sulfate</td>
<td>25</td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td>4</td>
</tr>
<tr>
<td>Sodium carbonate</td>
<td>10.6</td>
</tr>
</tbody>
</table>

**Safety Precautions**

As mentioned in the solutions preparations section, sodium hydroxide is CAUSTIC and should be handled carefully. Students may need to wear gloves. The base will feel slippery on the skin and should be washed immediately. Copper solutions can cause eye infections, so students should wash their hands after handling these substances, too.

**Disposal**

All solids should be placed in trash cans. Most solutions can be poured down the sink. Check your local municipal water regulations concerning copper sulfate, as some water regulators restrict the concentration of copper (II) ions that can be poured down drains.