**Lesson Plan** : Precipitate Reactions

*This lesson plan is intended to be a guide to see how a demonstration might fit in to the lesson, information wise. This lesson plan does not contain the modes of how to teach, rather a suggested outline of information.*

**Students will:**

* know how to write a balanced molecular equation including states of matter
* know how to write balanced total and net ionic equations
* know the definitions of precipitates, spectator ions
* Identify spectator ions
* Identify precipitates
* Use solubility rules to determine solubility of a product

**Background Knowledge Assumed**

* students can predict products
* students can balance chemical equations
* students understand the concept of ions and solutions

**Hook**

The instructor does the demonstration “[Making Chalk](http://sites.jmu.edu/chemdemo/2011/06/14/making-chalk/)” on the overhead.

**Lesson**

1. The instructor begins to discuss what the students saw. Two aqueous solutions were mixed and a solid was formed. Whenever this happens it’s called a precipitate. A precipitate is an insoluble product formed from two soluble reactants. The instructor refers to the example sheet (see below) that goes with the demo. In the reaction we just saw a solution of calcium chloride was mixed with a solution of sodium carbonate. The instructor asks the students what the molecular formulas are for these compounds.   
   *The students should be able to translate the names of the compounds to their formulas, CaCl2 and Na2CO3.*   
   Then the instructor asks what the products of these reactions are.

*The students should be able to predict the products of the reaction, they just won’t know the states of matter yet.*

1. The instructor goes over common solubility rules so that the students can determine what the states of matter for the products will be. All compounds that contain Group 1 ions or ammonium ions are soluble. Nitrates and acetates are soluble. Chlorides, bromides, and iodides are soluble, except when bonded so silver, lead, copper (I), or mercury (II). Most sulfates are soluble. Most metal hydroxides, carbonates, and phosphates, and sulfides are insoluble.
2. So how do you tell if a reaction is going to form a precipitate? You predict products, then you check to see if a compound breaks into its ions in water by using the solubility rules. Writing all of these ions out is called a total ionic equation. The instructor walks the class through writing the total ionic equation, explaining the convention of writing charges, and emphasizing the importance of keeping the equation balanced.
3. The instructor points out that there are ions on both sides of the reaction that aren’t really participating in what is going on. These are called spectator ions because they just sit around and watch the precipitate form. So what can we do to better see what’s going on in this reaction? We can rewrite this and write what’s called a net ionic equation. The net ionic equation doesn’t contain spectator ions. Does anyone see spectator ions in this equation?  
   *The students should respond Cl- or Na+.*The instructor then leads the students through writing the net ionic equation without the spectator ions.
4. The instructor then leads the class in identifying the spectator ions as well as the precipitate in the reaction. The instructor tells the class that they can now identify the state of matter in the reaction that they witnessed. The instructor asks the students the state of each compound listed in the reaction.  
   *The students should be able to answer that all of the compounds are aqueous except for CaCO3.*

There is a set of practice problems that goes along with this lesson, (under [Making Chalk](http://sites.jmu.edu/chemdemo/2011/06/14/making-chalk/)). It practices predicting products, balancing reactions, determining solubility, and identifying precipitates.

Making Chalk – Precipitate Example

25g of calcium chloride is dissolved in 150mL of water. This solution is then mixed with 150mL of 0.75M sodium carbonate.

1. Write a balanced chemical equation for the reaction of the 2 aqueous solutions described above.
2. Write a total ionic equation for this reaction.
3. Write a net ionic equation for this reaction.
4. What are the spectator ions for this reaction?
5. Is there a precipitate in this reaction? If so, what is it?
6. Go back and write in the states of matter in the reaction above.

Review from previous topics:

1. What is the concentration of the calcium chloride solution?
2. How many molecules of sodium carbonate went into making the solution described?