**Identification of Cations in Solution – Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), Mg\(^{2+}\)**

The process of determining the composition of a sample by conducting chemical tests is called qualitative analysis. By using the appropriate tests and applying logic, the identities of the ions present in an unknown solution can be determined. A qualitative analysis scheme is typically made up of a systematic set of chemical reactions where a certain subset of the ions present in the solution are selectively precipitated and removed. The color of the precipitates and solutions provide the means to identify the ions present. Flame tests are also used to identify certain ions that are difficult to identify chemically. In this assignment, you will need to develop your own qualitative analysis scheme to separate and identify the Group II cations Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), and Mg\(^{2+}\). As you complete this analysis, remember that careful observation and logical reasoning are the keys to a successful qualitative analysis.

1. Start *Virtual ChemLab* and select *Identification of Cations in Solution* from the list of assignments. The lab will open in the Inorganic laboratory.

2. Enter the stockroom by clicking inside the *Stockroom* window. Once inside the stockroom, drag a test tube from the box and place it on the metal test tube stand. Now click on the Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), and Mg\(^{2+}\) bottles to add these cations to the test tube and click *Done* to send the test tube out to the laboratory. Return to the laboratory and click on the TV monitor handle to pull it down. As you proceed with the chemical analysis watch the TV screen to see the chemistry involved in the chemical reactions. You may also want to make some copies of your original test tube by clicking on the *Divide* button in case you make a mistake and need to start over.

3. What do the solubility rules tell you about the way to separate the second group of cations? How can you tell each of the ions in this group apart? Think about changing the temperature and the pH. Design your own qualitative scheme for identification of these four Group II ions and write it below. Experiment with each of the four ions alone and then in combinations. Test an unknown to see if you can really determine the presence or absence of each of the four ions in this group.

4. Return to the *Stockroom*. The bottom right shelf is called the Unknowns shelf. Click on the *Unknowns* label to reconfigure the stockroom to create a practice unknown. Click on the Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), and Mg\(^{2+}\) bottles and on the left side make the minimum = 0 and maximum = 4. Click on the *Save* arrow to return to the regular stockroom. An unknown test tube labeled *Practice* will be placed in the blue unknown rack. Drag the practice unknown from the blue rack to the metal stand and then return to the laboratory.

5. Test the *Practice* unknown and determine if it contains each of the ions Ba\(^{2+}\), Sr\(^{2+}\), Ca\(^{2+}\), and Mg\(^{2+}\). To check your results, click on the *Lab Book* and on the left page, click the *Report* button, select the ions you think are present in the unknown, click *Submit*, then *Ok*. If the ion button is green, you correctly determined whether the ion was present or not. If the ion button is red you did not make the correct analysis. Return to the laboratory and click the red disposal bucket to clear the lab. If you want to repeat with a new practice unknown, return to the stockroom and retrieve it from the blue rack. Continue until you obtain only green buttons when submitted.