Chemistry, Part 2 – Live Labs

In Chemistry, students will develop an understanding of the key principles of matter, and the elements and the periodic table, with a focus on the trends and reactivity of the elements. Students will learn about chemical compounds and bonding, as well as the types of chemical reactions, and how they all adhere to the conservation of matter. Students will go on to be able to solve for chemical proportions in compounds, as well as quantities in chemical reactions, including finding the limiting reagent and percent yield. Students will then learn about solutions and solubility, and will move on to the nature and behavior of acids and bases. Students will study gases and will learn the gas laws, as well as be able to comprehend the concept of chemical equilibrium.

1. **Freezing Point Depression**
   Students will experimentally determine the effect of solutes on the freezing temperature of water by altering solute concentrations of different solutions and measuring their freezing points by placing the solutions in test tubes and submerging them in an ice bath. The solute that will be used by the student is sugar. When ice crystals are observed to be forming, the temperature will be noted by the student for that particular solute concentration, and the results will be organized in a table.

2. **Enthalpy of Ice**
   Students will determine the heat of fusion of ice through experiment, and then compare that value to the published value for the heat of fusion of ice, and will then calculate the enthalpy change for the fusion of ice. Students will use a calorimeter and a thermometer to measure the temperature of a mixture of ice and water, as it eventually becomes just water, and the heat of the process. Students will also measure the mass of the ice being melted. Students will then use the formula Q – mCdeltaT to calculate the total gain or loss of heat in the water, and will then find the energy required to melt the ice.

3. **Reaction Rates, Concentration**
   Students will experiment with the effect that concentration has on reaction rates, as well as determine the mathematical relationship between concentration and reaction rate, thus determining the order of the reaction. Students will then add a catalyst, and observe how the catalyst changes the rate of reaction. Students will add varying amounts of Na2S2O3 into wells and will then add water and HCl, and as precipitate is formed, the times it takes to happen will be recorded. The same process will be repeated, with the addition of a catalyst. The results will be put in table form and analyzed.

4. **Reaction Rates, Temperature**
   Students will observe the relationship between reaction rates and temperature, experimentally, and will find the mathematical relationship between the two using their data. Students will add Na2S2O3 into wells, and will react this with HCl. The reaction will be performed at varying temperatures, and the time that it takes to react (form precipitate) for each will be recorded and put in a table. The results will be interpreted, to find the mathematical relationship between the rates of reaction and the temperature in which the reaction happens.

5. **Solubility Product Constant**
   Students will experimentally find/estimate the solubility constant for a reaction, involving Ca(NO3)2 and Na2C2O4. Solutions of progressively diluted concentrations of Ca(NO3)2 will be put in wells, and reacted with a drop of Na2C2O4. Each well will be analyzed, specifically looking for the well in which no precipitate has formed, which will help to determine the solubility constant. The values will be recorded in a table and analyzed.

6. **pH and pH Indicators**
   Students will gain a better understanding of pH and how it relates to the concentrations of strong acids or strong bases. They will mix a series of solutions with varying pH levels and will observe those, alongside other commercial and natural indicators. Using a dropping bottle, the students will fill wells with solutions ranging from strong acids to strong bases, with calculated concentrations and pH values, and indicator paper strips will be used to determine if the pH of the solutions that were made matched their expected pH levels. The values will be organized in a table.

7. **Titration**
   Students will better understand molarity. They will perform a simple titration and use the experimental data to determine the molarity of vinegar, and will go on to calculate the percent of acetic acid in the vinegar. Vinegar will be placed in a small beaker, and diluted with water. Then, NaOH will be added to titrate the vinegar solution. Phenolphthalein indicator paper will be used to find the amount of NaOH required to bring the vinegar solution to a neutral pH of 7. The experiment will be repeated, and the outcomes averaged to reduce experimental error, and the results will be interpreted and used to find the molarity of vinegar as well as the percent of acetic acid in the vinegar.

8. **Molar Mass by Titration**
   Students will verify the molar mass of a compound by conducting a titration using KHP and KOH. The KHP will first be dissolved in water and the pH of the solution will be assessed using the phenolphthalein indicator paper. KOH will then be added incrementally, until the solution is measured as having a neutral pH. The process will be repeated five times, so that students can average their results, reducing error. Then, by knowing the amount of KOH added, they will be able to determine the molarity of the KHP, and its molar mass.

9. **Buffers**
   Students will make a buffer solution and will observe, through experimentation, how buffers work and their properties. Students will mix acetic acid, sodium acetate, and the indicator, bromophenol blue into wells. The students will then add varying amounts of HCl and NaOH into the wells, noting the color changes and the approximate pH values. The results will be recorded in a table and interpreted.

10. **Oxidation - Reduction**
    Students become familiar with single replacement reactions. They gain a better understanding of oxidation, reduction and oxidation-reduction reactions; as well as the reactivity of some metals. They will perform a series of reactions to understand single replacement reactions and the ideas of oxidation, reduction, and oxidation-reduction reactions. Students will react Cu(NO3)2, Fe(NO3)2 and Zn(No3)2 with raw copper, iron, and zinc. Students will then look for and record which metals appeared to have been oxidized, and who the corresponding oxidizing agents were. The results will then be organized in a table and interpreted.