**How many colors can you make?**  Le Chatelier’s Principle

*Adapted from AP Chemistry: Guided-Inquiry Experiments)*

Chemical equilibrium means that there are forward and reverse reactions occurring simultaneously at equal rates. This means that the amounts of both the reactants and products remain constant. That is, the reactants are consumed to generate products at the same rate the products react to regenerate the reactants. No net change in amount occurs. To the outside observer it looks as if nothing is happening because on the macroscopic scale, no properties of the reaction system change. This is known as dynamic equilibrium.

Le Chatelier’s Principle:

“If a change in concentration, temperature, pressure or volume is imposed on a chemical system at equilibrium, then the equilibrium shifts by changing concentration or pressure to counteract the imposed changed and establish a new equilibrium.”

**Instructions:** Create a data table including each equilibrium and the addition of the materials listed as stresses to the equilibrium. Predict the effect of each stress on the system. Record the result of each stress individually and an explanation of why it had that result. This is a station lab. Carry a test tube rack with 8 clean test tubes. Pour some of each equilibrium solution into a test tube and add stresses one at a time to create different colors. Try to make a rainbow in your test tube rack!

An Acid-Base Indicator Equilibrium

 The reaction of bromothymol blue, a weak acid, is well known. Investigate its behavior in water with dilute acid and base.

 Simplified equation HB <--> H+ + B-

 Yellow Blue

Materials: 0.10M NaOH, 0.10M HCl, 0.10M NaCl

Hydrated Cobalt Complex Ions in Alcohol Solution Equilbrium

 Investigate the equilibrium hydrated cobalt in solution with chloride ions in an ethanol solution. There is a small amount of water dissolved in the ethanol.

 [Co(H2O)6]2+ + 4Cl- + Heat <--> [CoCl4]2- + 6 H2O

 Pink Blue

 Materials: solid NaCl, warm and cool water bath, water, acetone, and AgNO3 (aq)

Some Complex Ion Equilibrium

 An equilibrium system can be formed in solution with iron(III) nitrate and potassium thiocyanate.

 Fe3+ + SCN- <--> FeSCN2+

 Pale Orange or Red

 Yellow

Materials: 0.10M KNO3, solid FeCl3, solid KSCN, and sodium phosphate

An equilibrium system can be formed in a solution with copper(II) chloride in water. The copper ion bonds to six water molecules, while Cl- ion remains in the solution.

 [Cu(H2O)6]2+ + 4Cl- <--> [CuCl4]2- + 6H2O

 Blue Green

Materials: Water, concentrated HCl (CAREFUL)