CHEMISTRY LAB

1 **DESCRIPTION**: Teams will answer a series of questions or complete a task involving the science processes of chemistry focused in the areas of **kinetics and aqueous solutions.**

TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 minutes

2 **EVENT PARAMETERS:**

a. **Students** must bring
   i. a non-programmable, non-graphing calculator.
   ii. A pencil
   iii. No reference materials are allowed

b. **Event Supervisors** must provide
   Whatever other reagents/glassware are appropriate for the tasks students are asked to do
   i. Periodic Table
   ii. Any constants needed

c. **Safety Requirements**: Students must wear the following or they will not be allowed to participate: closed-toed shoes, **ANSI Z87** indirect vent chemical splash goggles **(see http://soinc.org)**, pants or skirts that cover the legs to the ankles, a **sleeved shirt**, and a lab coat or **chemical** apron that reaches below the knees. Gloves are optional. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in a hazardous/unsafe manner (e.g., tasting or touching chemicals or flushing solids down a drain and not rinsing them into a designated waste container provided by the supervisor) will be disqualified from the event.

3 **THE COMPETITION**: The competition will consist of a series of stations that include activities similar to those in first year high school courses. These stations could include hands-on activities, questions about each topic, interpretation of experimental data (graphs, diagrams, etc.), and/or observation of an experiment set up and running. Supervisors are encouraged to use computer or calculators with sensors/probes wherever possible. Students may be asked to collect data using probeware that has been set-up and demonstrated by the Supervisor. Or the supervisor may provide students with data sets collected by such sensors/probes following demonstration of the data collection. Data will be presented in a tabular and/or graphic format and students will be expected to interpret the data. Students should be aware that nomenclature, formula writing, and stoichiometry are essential tools of chemistry and may be included in the event at any time. Stoichiometry includes, for example, such abilities as mole conversions and percentage yield. For purposes of nomenclature and formula writing, students are expected to know the symbols and charges for the following ions by memory: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate, and hydroxide. Students should know how to use the "ite" form of an ion, which is one less oxygen than the "ate" form. Students should be able to use the periodic table to obtain the charge for monatomic ions (e.g., Na^+, S^{2-}, etc.).

4 **SAMPLE QUESTIONS**

a. Kinetics

Students will demonstrate an understanding of the principals of kinetics. They must be able to measure reaction rates and identify how and why reaction conditions (temperature, concentration, particle size, and catalysts) affect reaction rates. At the regional level, teams will NOT be asked to determine rate laws experimentally or from data provided. At the state and national levels, teams will be asked to determine rate laws from actual experimentation or data provided, and teams should also be able to determine rate constants with correct units.

b. Aqueous Solutions

Students will demonstrate an understanding of the principals and properties of aqueous solutions. They must be able to calculate solution concentrations given quantities of solute and solvent, and to calculate quantities of material required to produce a solution of specified concentration. Molarity, molality, mass percentage, and parts per million may be required. At the state and national levels, conversions between concentration units may be required. Tasks will be chosen from the following:

1. Use the concept of density to experimentally determine the concentration of a solution.
2. Determine solution concentration using a series of standard absorbencies and Beer's Law.

3. Use freezing point depression to determine the molar mass of a solute.
4. Use titration to determine an unknown concentration.
5. Identify and explain factors that effect solution formation.
6. Construct a solubility curve.
7. Determine whether a solution is saturated, unsaturated or supersaturated..

5 **SCORING: Kinetics: 50% and Aqueous Solutions: 50%.** Time may be limited at each station. , but time will not be used as a tiebreaker or for scoring. All ties will be broken by selected questions chosen by the supervisor. These questions may or may not be identified to the students.

RECOMMENDED RESOURCES:

See www.soinc.org

NATIONAL SCIENCE EDUCATION STANDARDS:

a. Scientists rely on technology to enhance the gathering and manipulation of data. New techniques and tools provide new evidence to guide inquiry and new methodology to gather data, thereby contributing to the advance of science. The accuracy and precision of the data, and therefore the quality of the exploration, depends on the technology used.
b. A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other reactions, chemical bonds are broken by heat or light to form very reactive radicals with electrons ready to from new bonds. Radical reactions control many processes such as the presence of ozone and greenhouse gasses in the atmosphere, burning and processes of fossil fuels, the formation of polymers and explosions.
c. Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles.