



# CHEMISTRY LAB

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://www.soinc.org) as they apply to every event.

1. **DESCRIPTION:** Teams will complete one or more tasks and answer a series of questions involving the science processes of chemistry focused in the areas of gases and **thermodynamics**.

**A TEAM OF UP TO:** 2

**EYE PROTECTION:** C

**APPROX. TIME:** 50 min.

2. **EVENT PARAMETERS:**

- Students:** Each student must bring safety equipment and a writing implement and each team may bring two non-camera capability calculators and five 8.5" x 11" sheets of paper that may contain information on both sides in any form from any source (sheet protectors are permitted).
- Supervisors:** Must provide reagents/glassware/references that are needed for the tasks (e.g., Periodic Table, table of standard reduction potentials, any constants needed).
- Safety Requirements:** Students must wear goggles, an apron or a lab coat and have skin covered from the neck down to the wrist and toes (gloves are optional, but if a host requires a specific type they must notify teams). Long hair, shoulder length or longer, must be tied back. Students who unsafely remove their safety clothing/goggles or are observed handling any of the material or equipment in an unsafe manner will be penalized or disqualified from the event.

3. **THE COMPETITION:**

- The competition will consist of a series of tasks similar to those in first year high school courses. These tasks could include hands-on activities, questions about each topic, interpretation of experimental data (graphs, diagrams, etc.), or observation of an experiment set up & running.
- Supervisors are encouraged to use computers or calculators with sensors/probes. Teams may be asked to collect data using probe ware that has been set up & demonstrated by the Supervisor or they 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 & students will be expected to interpret the data.
- Students should be aware that nomenclature, formula writing & stoichiometry are essential tools of chemistry & may be included in the event. Stoichiometry includes mole conversions & percentage yield. For purposes of nomenclature & formula writing, students are expected to know the symbols & charges for the following ions: nitrate, carbonate, phosphate, acetate, sulfate, ammonium, bicarbonate & hydroxide. Students should know how to use the "ite" form of anion (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.,  $\text{Na}^+$ ,  $\text{S}^{2-}$ ).

4. **SAMPLE QUESTIONS:**

- Gases:** Students will complete experimental tasks and answer questions related to the physical properties of gases, effect of greenhouse gases and ozone depletion on our climate, behavior of gases described by the following: Avogadro's Law, Boyle's Law, Charles' Law, Dalton's Law, Gay-Lussac's law, Graham's Law, and the ideal gas law. Activities may include: determine the: density of a gas, partial pressure of a gas, molar mass of a gas, relative rates of diffusion. Examine the relationship between: pressure and volume, pressure and temperature, temperature and volume.
- Thermodynamics:** Students should understand the following concepts: direction of heat flow; endothermic and exothermic processes; units of heat measurement (joules, calories, etc.); heat capacity; calorimetry; enthalpy change; thermochemical equations; heat of fusion & solidification; heats of vaporization & condensation; phase diagrams; heat of solution; heat of combustion; heats of reaction; standard heat of formation & heat of reaction; and associated calculations. Activities may include: determine specific heat of metal (coffee cup calorimeter),  $\Delta H$  of a reaction (acid/base) (endo/exo), determine specific heat of liquid, experiment based on heat exchange between water samples, heat of fusion of ice, heat of combustion of a candle. **State or National level only** may include: Gibbs free energy and entropy and Hess's Law (calorimetry adding hydrate and nonhydrate).

5. **SCORING:** **Approximately Gases 50% and Thermodynamics 50%.** Time may be limited at each task, but will not be used as a tiebreaker or for scoring. Ties will be broken by pre-selected questions.

**Recommended Resources:** All reference and training resources including the Chem/Phy Sci CD (CPCD) are available on the Official Science Olympiad Store or Website at [www.soinc.org](http://www.soinc.org)