

**DESCRIPTION:**

Teams will answer a series of questions or complete a task involving the science processes of chemistry focused in the areas of **thermodynamics and physical properties**. No reference materials are allowed. Do not bring a calculator! If needed, calculators will be supplied.

SAFETY REQUIREMENTS:

Students must wear the following or they will not be allowed to participate: close-toed shoes, OSHA approved chemical splash goggles with indirect vents, pants or skirts that cover the legs to the ankles and a lab coat or 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.

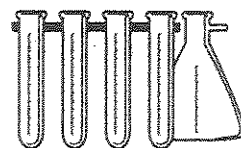
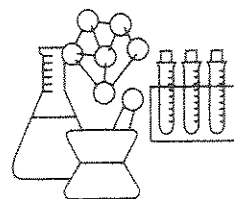
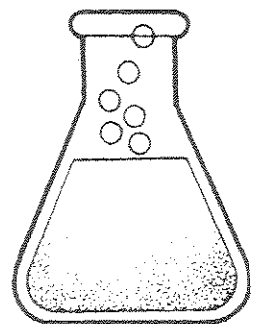
TEAM OF UP TO: 2**APPROXIMATE TIME:** 50 minutes**THE COMPETITION:**

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 calculator sensors/probes wherever possible or 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.).

1. The event will cover theory and application of the areas below. The following items will be provided by the supervisor if needed: (a) periodic table (b) calculator (c) any constants needed (d) any polyatomic ions not included in the group to be memorized (e) Standard Reduction Potentials.

2. The lab portion may be run in microscale.

3. Cleanup should occur after all materials have been returned or a penalty may be given.



4. All measurements must be recorded with correct significant figures and units. All calculations must also include correct significant figures and units. Stations might include the following topics or activities:

Thermodynamics: Students should understand the following concepts: direction of heat flow; endothermic and exothermic processes; units of heat measurement; 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 (at the State or National level Gibbs free energy and entropy may be included).

- Determine specific heat of metal (coffee cup calorimeter)
- ΔH of a reaction (e.g., acid/base or any endothermic or exothermic reaction)
- Determine specific heat of liquid
- Experiment based on heat exchange between water samples
- Heat of fusion of ice
- At the State or National level: Hess Law Applications (calculations and experiments)

Physical Properties: Students should understand the following concepts: density; color; conductivity; boiling & melting points; electrical resistance; elasticity / brittle, not brittle; solubility; magnetism; extensive (amount of matter) & intensive (type of matter) properties.

- Determine the density of a substance (solid or liquid)
- Use density to identify an unknown metal
- Determine the elasticity of a solid using Hook's Law
- Separate a mixture by physical properties (magnetism, solubility, etc.)
- Explore the effect of temperature on solubility

SCORING:

Points will be awarded for correct answers and/or proper technique. 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.

