MATERIALS SCIENCE DRAFT RULES 17

1. DESCRIPTION: Teams will complete lab activities and answer a series of questions related to the materials science portion of polymers and plastics with an emphasis on chemical structure, reactivity and behavior.

   A TEAM OF UP TO: 2 EYE PROTECTION: C APPROXIMATE TIME: 50 minutes

2. EVENT PARAMETERS:
   a. Each student must bring safety equipment (e.g., goggles, lab coat, apron) and a writing implement. Each team may bring two dedicated calculators of any type and two 8.5" x 11" sheets of paper that contain information on both sides in any form and from any source. The sheets may not be contained in a sheet protector but they may be laminated.
   b. 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. Shoulder length hair, or longer, must be tied back. Students who unsafely remove their safety clothing/goggles or are observed handling any type of the material or equipment in an unsafe manner will be penalized or disqualified from the event.
   c. Supervisors must provide reagents/glassware/equipment needed for the lab activities.
3. THE COMPETITION:
   a. The competition will focus on the chemical structure, synthesis, characterization, performance, processing, and applications of polymeric materials.
   b. The event will consist of a written exam accompanied by at least one lab activity, or station, where students are asked to collect or interpret data.
   c. Structure and synthesis topics: Organic chemistry nomenclature of alkanes, alkenes, alkynes, alcohols, esters, ethers, aromatics, ketones, amides, amines, carboxylic acids. Common polymer terminology and vocabulary such as block polymer, monomer, branched, linear, network, entanglement, thermoplastic, thermoset, elastomer, adhesive, catalyst, initiator, additives, abbreviations and trade names of common polymers, natural polymers, recycling codes. *Concepts that may be addressed at the state or National level include: Identification of the mechanism of synthetic reactions such as addition, condensation, geometric and stereoisomerism, isotactic, syndiotactic and atactic.*
   d. Characterization, performance, processing and application topics: density, optical properties, gas permeability, molecular weight size and distribution, heat capacity, solubility, crystallinity, melting and glass transition points, fracture, crazing, viscoelastic materials, molding, extrusion, casting, foams, fibers, films, coatings, latex, resin, stress-strain behavior, materials selection, stiffness of material (Young's modulus), breaking strength of a material (yield strength), resistance to flow (viscosity), transverse strain (Poisson's ratio) and microscopy. *Concepts that may only be addressed at the State or National level include: Infrared spectroscopy, mechanism of deformation and strengthening of polymers, permanent deformation of material under constant load (creep rate).*
4. SAMPLE QUESTIONS/ACTIVITIES:
   a. Which type of polymer is typically a thermoplastic and flexible?
   b. Draw three repeating units for the polymer made by condensation of the following molecules.
   c. Show the initiation, propagation and termination steps for the following addition polymerization.
   d. Why are plasticizers commonly used?
   e. Determine the density, solubility and melting properties of polymers.
   f. Synthesize a cross-linked polymer and determine the modulus properties.
   g. Interpret infrared data to identify an unknown plastic.
   h. Measure the creep rate and viscosity of the provided samples.
   i. Measure strain at different temperatures.
5. SCORING: Highest score from the combined written and lab sections will determine the winner. Selected questions may be used as tiebreakers.