

1. **DESCRIPTION:** Participants will complete lab activities and answer a series of questions related to the materials science 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:**

- Each team may bring two **calculators of any type dedicated to computation** and two 8.5" x 11" sheets of paper that may contain information on both sides in any form and from any source.
- Each participant must bring safety equipment (e.g., goggles, lab coat, apron) and a writing utensil.
- Participants 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 or longer hair must be tied back. Participants 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.
- Supervisors must provide reagents/glassware/equipment needed for the lab activities.

3. **THE COMPETITION:**

- The competition will focus on the chemical structure, synthesis, characterization, performance, processing and applications of polymeric materials.
- The event will consist of a written exam accompanied by **at least one lab activity or station** where participants are asked to collect or interpret data.
- Structure and synthesis topics: Organic chemistry nomenclature of alkanes, alkenes, alkynes, alcohols, esters, ethers, aromatics, ketones, amides, amines, and 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 only be addressed at the State or National level include: *Identification of the mechanisms of synthetic reactions such as addition, condensation, stereoisomerisms (including geometric), isotactic, syndiotactic and atactic.***
- 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:**

- Which type of polymer is typically a thermoplastic and flexible?
- Draw three repeating units for the polymer made by condensation of the following molecules.
- Show the initiation, propagation and termination steps for the following addition polymerization.
- Why are plasticizers commonly used?
- Determine the density, solubility and melting properties of polymers.
- Synthesize a cross-linked polymer and determine the modulus properties.
- Interpret infrared data to identify an unknown plastic.
- Measure the creep rate and viscosity of the provided samples.
- 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.

**Recommended Resources:** The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries the Chem/Phy Science CD; other resources are on the event page at [soinc.org](http://soinc.org).