

# MATERIALS SCIENCE



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

- DESCRIPTION:** Teams will answer a series of questions or complete tasks involving the science processes of chemistry focused in the areas of Materials Science.  
**A TEAM OF UP TO:** 2      **EYE PROTECTION:** C      **APPROXIMATE TIME:** 50 minutes
- EVENT PARAMETERS:**
  - Teams may bring: two non-camera calculators, writing utensils and 5 pages (both sides) containing information from any source (sheet protectors are allowed).
  - Event Supervisors will provide: any materials needed for lab stations.
  - 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.
- THE COMPETITION:**
  - The competition will focus on: evaluating the mechanical performance of materials and the intermolecular forces of materials.
  - The event will consist of an activity or activities with supporting questions.
  - Students will interpret data by preparing data tables and constructing graphs of the data.
  - All measurements must be recorded with correct significant figures and units. All calculations must also include correct significant figures and units.
- LABS:** Material Performance & Atomic/Molecular Structure Topics are limited to:
  - General properties of material classes (metals, ceramics, polymers, composites):** i. **Physical characteristics** (density, strength, thermal properties, etc.), ii. **Manufacturing techniques and natural occurrences**, iii. **Chemical composition** (elements, bonds, etc.)
  - Material characterization techniques:** i. **Visual** (optical and electron microscopy), ii. **Physical tests:** Stiffness of material (Young's Modulus), Breaking strength of a material (Yield Strength), Surface Area/Volume ratio, Permanent deformation of material under constant load (Creep Rate), Resistance to flow (Viscosity). For State and National tournaments: Resistance to fracture (Fracture toughness), Resistance to repetitive strain (Fatigue Limit), Stiffness under shear load (Shear Modulus), Transverse, inherent strain (Poisson's Ratio), Bulk Modulus. iii. **Material selection for specific applications** (choosing the best material for an application based off of a list of materials and their properties)
  - Intermolecular Forces and Surface Chemistry:** i. **Chemical tests:** Surface Chemistry, surface tension, contact angle. ii. **Crystal Structures;** Ionic, Covalent, Crystalline, Semi-Crystalline, Amorphous, Common atomic packing (FCC, BCC, HCP, Simple Cubic), Atomic packing factor (Geometry only)
- SAMPLE QUESTIONS:** See Science Olympiad ([www.soinc.org](http://www.soinc.org)) website for Sample Questions
  - Material Performance Relationships:**
    - Using an apparatus provided by the event supervisor: generate a stress vs. strain curve, and calculate Young's modulus, identify the yield strength and offset yield strength.
    - For a ceramic material, what types of bonds are generally formed, and how does this contribute to properties such as density, hardness, and brittleness
  - Intermolecular Forces and Surface Chemistry:**
    - Based on droplet characteristics, characterize the hydrophobicity or hydrophilicity of the provided surfaces. For example, students may be asked to identify unknown surfaces or rank the hydrophobicity of the provided surfaces.
    - Using the Wilhelmy plate apparatus and the provided equation, determine the surface tension of a liquid. Evaluate changes in surface tension with the application of surfactants or other liquids.
    - Students may be provided images to measure contact angles, evaluate boiling points of liquids, perform polymer melt tests for crosslinking, and will answer questions related to these measurements.
- SCORING:** Material Performance (lab and written exam) 50% and Intermolecular Forces (lab and written exam) 50%. All ties will be broken by pre-selected questions chosen by the supervisor.  
**Recommended Resources:** All reference and training resources including the Chem/Phy Science CD (CPCD) are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>