

Materials and Nano Science

- 1 **DESCRIPTION:** Teams will answer a series of questions or complete a task involving the science processes of chemistry focused in the areas of **Materials Science**.

TEAM OF UP TO: 2

EYE PROTECTION: #4

APPROXIMATE TIME: 50 minutes

- 2 **EVENT PARAMETERS:**

- Students** are allowed to bring a non-programmable calculator, writing instruments, and one 8.5" x 11" two-sided page of notes containing information in any form from any source.
- Event Supervisors** will provide any other needed event items.
- Safety Requirements:** Students must wear the following or they will not be allowed to participate: closed-toed shoes, ANSI Z87 indirect vent chemical splash goggles (see <http://soinc.org>), pants or skirts that cover the legs to the ankles. **Additionally** and a long sleeved lab coat that reaches the wrists and the knees or a long sleeved shirt that reaches the wrists and a chemical apron that reaches the knees **are required**. Chemical 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.

- 3 **THE COMPETITION:**

A. Structure and Performance Relationships

Students will perform laboratory based experiments designed to evaluate the relationship between the atomic/molecular structure and the performance characteristics of common materials. Students will be expected to understand the fundamental characteristics, chemical structures and performance characteristics of metals, ceramics, polymers, semi-conductors and composites. An emphasis will be placed on creating and/or utilizing stress-strain curves to evaluate the Young's modulus and related performance characteristics of a material or materials.

B. Nanomaterials

Nanomaterials topics will focus on nanoparticles and carbon nanotubes. Students will be expected to understand general introductory topics regarding the physical and chemical properties that arise within the nano size regime. Questions will concentrate in the topic areas of large surface area to volume ratios, quantum effects, and nanomaterials visualization. Students may be provided imagery of nanomaterials to aid in understanding the effect of size on materials. Using materials supplied by the event supervisor, students may perform and answer questions related to cubic crystal structures. Topic areas for crystal structures include: formula, density, dimensions. Miller Indices, and use of x-ray data to determine unit cell dimensions. Event supervisors may choose to incorporate internet based modeling and/or simulations into event tasks and questions.

4. **SCORING:** Structure/performance 50% and Nanomaterials 50% of final score. All ties will be broken by selected questions chosen by the supervisor. These questions may or may not be identified to the students.

RECOMMENDED RESOURCES:

<http://www.uwstout.edu/chemistry/scienceolympiad.cfm>

NATIONAL SCIENCE EDUCATION STANDARDS: Science as Inquiry, Content Standard A: Use Technology and Mathematics to Improve Investigations and Communication. Physical Science Content Standard B: Structure of Atoms, Structure and Properties of Matter, Motions and Forces, Interactions of Energy and Matter.