OPTICS

DESCRIPTION: Students will compete in lab activities in the areas of **geometric and physical optics**.

EVENT PARAMETERS: Students may bring and use any type of calculator. No **other** resource materials may be used unless provided by the event supervisor.

A TEAM OF UP TO: 2 **APPROXIMATE TIME**: 50 Minutes

THE COMPETITION: The competition will consist of experimental tasks and questions related to **geometric optics and physical optics**. All answers will need to be provided in SI units (such as meters and seconds) with proper significant figures.

1. Geometric optics may include the following topics:

a) Reflection (Law of reflection)
b) Refraction (measurement of index of refraction, Snell's Law)
c) Critical Angle (measurement of critical angle)
d) Dispersion Due to a Prism
e) Simple Lens and mirrors (ray tracing, measurement of focal length, mirror equation, thin lens equation, magnification, lens maker's equation)
f) Division C only: Wave fronts and Rays (Huygens's Principle)

2. Physical Optics may include the following topics:

a) Visible Spectrum (colors: primary/secondary & additive/subtractive, human vision, etc)
b) Electromagnetic Spectrum
   1) Wavelength, frequency, velocity, nomenclature of EM spectrum,
   2) Inverse square law applied to the intensity of light
   3) Doppler shift

   Division C only:
   4) Energy and momentum of photons,
   5) Bright Line Spectra,
   6) Absorption Spectra

Division C only:

c) Interference and superposition of waves
d) Double Slit Interference (Young's experiment--location of peaks only, not intensity)
e) Lasers (theory of operation, difference between coherent and non-coherent light)

Sample Experimental Stations:

Example Station 1 Measure the focal length of convex and/or concave lenses and/or mirrors

Example Station 2: Using ray-tracing techniques, find the image/object locations of one and/or two lens and/or mirror systems. Specify the image/object characteristics (real/virtual, magnification, erect/inverted, object/image distances, lens/mirror focal lengths).

Example Station 3: Set up mirrors and/or lenses to direct a beam of light on to a target around an obstacle. The object is to have the student set up the problem, but the supervisor turns on a light such as a Maglite (or laser). For the first year prisms are not to be used!

Example Station 4 The object is to align a beam from a light source provided by the officials to bounce off all given mirrors (Division C only may also include lenses and refraction) to strike a given target. Students will begin with a set number of points and then points will be deducted for the time it takes to set up the devices and the distance that the light ends up from the center point of the target.

SCORING: Points will be awarded for correct answers, measurements, calculations, and analysis of data. Supervisors are encouraged to provide a standardized form on which students can show all measurements and calculations. Ties will be broken using a designated task(s) or question(s). The event supervisor will identify the tiebreaker question(s) or task(s) on the answer form provided to the students at the beginning of the competition period.

Where feasible, supervisors are encouraged to provide students with brief demonstration(s) of data collection by computer and/or calculator sensors/probes followed by distribution of previously prepared data sets. If used, data will be presented to students in a tabular and/or graphic format(s) and students will be expected to analyze and/or interpret the data.

National Science Education Standards: Physical Science CONTENT STANDARD B: As a result of their activities in Grades 9-12, all students should develop an understanding of interactions of energy and matter.