ASTRONOMY

1. **DESCRIPTION:** Teams will demonstrate an understanding of **Variability of Low & Mid-Mass Stars.**.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS:**
   a. Each team may bring one of the following options containing information in any form and from any source:
      i. two three-ring binders;
      ii. a computer/tablet and a three-ring binder; or,
      iii. two computers/tablets, of any kind.
   b. If three ring binders are used they may be of any size and the information contained should be attached using the available rings. The information or pages may be removed during the event. Sheet protectors and laminated sheets are allowed.
   c. Each team may bring two stand-alone calculators of any type to use during the event. If the participants are using a computer/tablet they may use the calculator app or other program on their device in place of a stand-alone calculator.
   d. Participants using computers/tablets as a resource should have all information stored so that it is available to them offline. **However, teams may be asked to access a dedicated NASA image analysis website to answer some JS9 questions. If so, supervisors will provide an alternative (e.g., proctor-supplied computer or screen shots) for teams that did not bring a laptop/tablet.**
3. **THE COMPETITION:**

   Using information which may include Hertzsprung-Russell diagrams, spectra, light curves, motions, cosmological distance equations and relationships, stellar magnitudes and classification, multi-wavelength images (gamma-ray, X-ray, UV, optical, IR, radio), charts, graphs and JS9 imaging analysis software, teams will complete activities and answer questions related to:
   a. Stellar evolution including stellar classification, spectral features and chemical composition, luminosity, blackbody radiation, color index and H-R diagram transitions, **proto-stars, T Tauri variables, Herbig-Haro (HH) objects, red giants, Mira variables, RR Lyrae variables, carbon stars, white dwarfs, planetary nebulas, neutron stars, dwarf & recurrent novas, Type Ia supernovas, magnetic cataclysmic variables (MCVs).**
   b. **Use orbital mechanics, Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of binary and multiple star systems; use parallax, spectroscopic parallax, period-luminosity relations, and the distance modulus to calculate distances to RR Lyraes, and Type Ia supernovas; use hydrostatic equilibrium and the Stefan-Boltzmann law to answer questions relating to stellar structure and interiors.**
   c. Identify and answer questions relating to the content areas outlined above for the following objects:
      i. **HOPS 383**
      ii. **HH 24-26**
      iii. **V1331 Cyg**
      iv. **HBC 672**
      v. **Orion Nebula**
      vi. **Alpha Tauri**
      vii. **RR Lyrae**
      viii. **Omicron Ceti**
      ix. **ESO 577-24**
      x. **IC 4593**
      xi. **U Antliae**
      xii. **LP 40-365**
      xiii. **ASASSN-16oh**
      xiv. **V Sagittae**
      xv. **AR Scorpii**
      xvi. **SDSS 1035+0551**
      xvii. **Tycho's SNR**
4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Selected questions will be used to break ties.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org

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