ASTRONOMY

1. **DESCRIPTION:** Students will demonstrate an understanding of the basic concepts of mathematics and physics relating to galaxies.

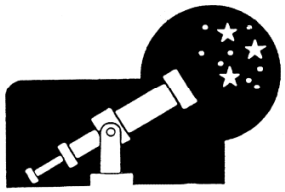
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:** Each team member is permitted to bring either a laptop computer or one 3-ring binder (any size) containing information in any form from any source. The materials must be 3-hole punched and inserted into the rings (notebook sleeves are allowable). Each team member is permitted to bring a programmable calculator. No Internet access is allowed.

3. **THE COMPETITION:** Using information which may include H-R diagrams, spectra, light curves, motions, distance equations and relationships, stellar magnitudes and classification, multi-wavelength images, charts, graphs, and animations, participants will be asked to complete activities which include the following:

   a. Use all available information to determine answers relating to **quasars, AGNs, galaxy clusters and groups of galaxies**, including star formation, massive and **supermassive** black holes, galactic structure, globular clusters, Type Ia & Type II supernovae, eclipsing binaries and X-ray binaries.
   b. Use all available information, including Kepler's laws, to determine answers relating to the orbital motions of binaries; cosmological distance equations and the period-luminosity relationship **(**Cepheids and RR Lyrae) to answer questions related to characteristics and distances of galaxies, Hubble's Law **or spectra** to answer questions about Hubble's constant and the recessional velocities and distances of galaxies.
   c. Students will be asked to identify, be knowledgeable about, and answer questions relating to the content areas outlined above for the following Deep Sky Objects (DSOs): *Epsilon Aurigae**, NGC 6240, 3C321, Cen A, Stephan's Quintet, MACSJ0717.5+3745, Bullet Cluster (1E 0657-56), Perseus A (NGC 1275), SN 2006gy, SN 1996cr, NGC 4603, NGC 7771, NGC 2623, JKCS041, NGC 1068. H2356-309** *Epsilon Aurigae is part of a nationwide observing campaign for 2010 and 2011, and will be included in the Astronomy Event for 2011.
   d. Competition may include one or more stations. Examples include sequencing images of galaxies by **distance or activity**; placing images of different types of objects in the correct locations within galaxies; matching images of light curves with the appropriate objects; using charts, data tables and/or graphs to determine distances and calculate Hubble's constant; using graphing calculators to plot observational data and calculate periodicity or distance.

4. **SCORING:** All questions will have been assigned a predetermined number of points. The highest score wins. Selected questions having differentiated weights will be used to break ties.



Recommended Resources: All reference and training resources including the **Astronomy CD Rev. 2011** are available on the Official Science Olympiad Store or Website at http://www.soinc.org

National Science Education Standards: Science as Inquiry, Content Standard A: Use Technology and Mathematics to Improve Investigations and Communications; Formulate and Revise Scientific Explanation and Models using Logic and Evidence; Earth and Space Science, Content Standard D: The Origin and Evolution of the Universe (Grades 9-12).

THIS EVENT IS SPONSORED BY: Chandra Education and Public Outreach Office for the Chandra X-Ray Observatory