

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 a programmable calculator and 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). **No Internet access 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 for the following topics:
 - a. Use all available information to determine answers relating to **normal galaxies and starburst galaxies**, including **star formation, mid-sized and massive black holes, galactic structure, globular clusters, population I & II stars**, 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 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, **Milky Way Galaxy (MWG), Sagittarius A*, Andromeda Galaxy (M31), The Cartwheel Galaxy, M84, M33, NGC 604, M33 X-7, M101, C153, M82, SN1994D, Sn1993J, M15 and G1.**
 *Epsilon Aurigae is part of a nationwide observing campaign for the International Year of Astronomy (2009) and will be included in the Astronomy Event for 2010 and 2011.
 - d. The competition may include one or more tasks at stations such as: **sequencing images of galaxies by the degree of star formation; 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:

- a. **Science Olympiad Astronomy CD:** Available at www.soinc.org store
- b. <http://www.aavso.org/>
- c. http://chandra.harvard.edu/edu/formal/stellar_ev/
- d. http://www.tufts.edu/as/wright_center/products/sci_olympiad/sci_olympiad_astro.html
- e. <http://chandra.harvard.edu/photo/index.html>
- f. <http://antwrp.gsfc.nasa.gov/apod/astropix.html>

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).

