

**2003 Science Olympiad Coaches Clinic
Hammond, Indiana
Astronomy C**

- 1.) **ALL resources for this event are listed at the bottom of the event description in the Coaches Manual.**
- 2.) **This presentation – complete with audio – is on The Wright Center website: http://www.tufts.edu/as/wright_center/fellows/sci_olympiad/sci_olympiad.html**
- 3.) **Use a 3-ring binder with index tabs for different sections. Do NOT bring books (or any other materials) – looking up information in books takes way too much time. The same also applies to using a laptop. It takes longer to access information on a laptop than it does to look it up in a well-organized and understood 3-ring binder. Students should NOT SIMPLY PRINT OUT COPIES THAT THEY ADD TO THE BINDER – THEY SHOULD MAKE UP THEIR OWN. IT WILL GIVE THEM A BETTER UNDERSTANDING OF THE MATERIAL....I.E. INSTEAD OF PRINTING OUT THE SLIDES FROM MY PRESENTATION OF GALACTIC STRUCTURE THEY SHOULD DRAW THEIR OWN AND LABEL THE PARTS THEMSELVES AND GLUE ON REAL IMAGES OF STELLAR OBJECTS IN THE APPROPRIATE LOCATIONS.**
- 4.) **KNOW the Deep Sky Objects listed in part 5. Go to Astronomy Picture of the Day, the Chandra and Hubble websites, and get copies of the most common MULTIWAVELENGTH images of these objects. Have a section in the binder for the 20 Deep Sky Objects listed. Have a separate page for each object with all images of that particular object. Also – the images do not have to be in the “usual” orientation – students should be able to recognize the images if they are “upside down”. They also need to know the constellation that the objects are located in and recognize the constellations. Common constellations will not have any lines connecting the stars – and sometimes the mythological images are used. IMAGE RECOGNITION ANSWERS ARE WEIGHTED MORE HEAVILY THAN ANY OTHER ANSWERS.**
- 5.) **UNDERSTAND the H-R Diagram. Understand the relationships plotted on the diagram and know where the different types of stars, such as normal, giant, supergiant, white dwarf, etc. are located. Be able to place objects on the H-R diagram such as the Cas A supernova remnant or the M57 planetary nebula. The focus of this event is stellar evolution so understand the sequence that different mass stars go through as they evolve from the main sequence to their final end products. Have a section in the binder just for H-R Diagrams. Place copies of different diagrams in this section. Include H-R diagrams of open clusters, (Pleiades and Hyades are good examples) globular clusters**

(M15 and Tuc 47 are good examples) and one showing the location of Cepheid and RR Lyrae variables. Use a blank H-R Diagram to place images of any of the Deep Sky Objects (DSO's) listed in part 5 that can be plotted on the diagram in their appropriate locations. **QUESTIONS DIRECTLY RELATED TO BASIC UNDERSTANDING OF THE RELATIONSHIPS PLOTTED ON THE H-R DIAGRAM ARE WEIGHTED NEXT.**

- 6.) SPECTROSCOPY. Light from stars and other DSO's is represented as spectra. The MOST IMPORTANT and ONLY knowledge necessary to identify and match spectra to objects is this: **For normal main sequence stars the hotter the star the fewer spectral lines – the cooler the star the more spectral lines.** Only the coolest stars such as spectral class M contain **compounds**. If a spectrum contains **iron** it must be a supernova remnant. A really complex spectrum is associated with such objects as remnants and planetary nebulae – however planetary nebulae do not contain iron. Look for **IRON, COMPOUNDS, and NUMBER OF LINES**. Have a section in the binder with examples of spectral lines AND images – for planetary nebulae, supernovae remnants, and a range of stars from hot to cool.
- 7.) LIGHT CURVES. There are only three different types that will be on this event, and it is easy to tell the difference. **MIRA** variables are fairly periodic and have a long period ~ **300 days**. There are two types of pulsating variable stars – **Cepheids** are periodic and have a period of **~3-70 days**. **RR Lyraes** are periodic and have a period of **less than one day**. **Supernovae** have a huge peak during the explosion and then fade away over time. **Type II** are dimmer and fade more slowly than **Type Ia** which are brighter and fade more rapidly. Have a section of the binder with samples of light curves and the type of objects that produce them.
- 8.) GALACTIC STRUCTURE. Know the structure of spiral galaxies and especially **KNOW WHERE** all types of stellar objects, population I and II stars, blue stragglers, and globular clusters are located. Since this is very important and basic information answers specifically related to galactic location of objects **WILL BE WEIGHTED**. There will be some identification of galaxy types – do NOT bother with the Hubble Tuning Fork – there is no confirmed evolution of galaxies from one type to another.
- 9.) COSMOLOGICAL DISTANCES. Students should know which methods are used for different distances ...that is – have the basic understanding that parallax can only be used for nearby stars and that only entire galaxies and a Type Ia supernova event are bright enough to measure the distances to galaxy clusters.
- 10.) MATHEMATICAL EQUATIONS. The equations and relationships listed

are the **ONLY** ones needed for the event. Any constants or other numbers will be provided. Students should rearrange each equation for each variable in order to take less time. The most efficient way to handle the calculations is to enter the equations into programmable calculators. Understanding these equations and knowing when to use them is important. **THE MATHEMATICAL ANSWERS ARE WEIGHTED ACCORDING TO DIFFICULTY – THERE ARE THREE DIFFERENT WEIGHTS FROM EASY TO DIFFICULT.** A section in the binder should list the equations in every available form and the reasons they are used. The event will be ~30% mathematical calculations.

- 11.) **STELLAR EVOLUTION.** A separate section should be included with a page for each stage of stellar evolution – stars, giants and supergiants, supernovae events, white dwarfs, planetary nebulae, pulsars and neutron stars, etc. This page should either include or be cross-referenced to any of these objects that are in the list of Deep Sky Objects that the students are responsible for learning. As much cross-referencing as possible should be done so connections can be made among objects, evolution, spectra, light curves, and location on the H-R diagram.

- 12.) **RESOURCES.** No other resources are necessary besides the ones listed at the end of the event description in the Coaches Manuel. Students should access the skyserver URL and go through the activities with black holes and Hubble’s Law. Accessing the Chandra website and going through the two variable star activities will give students a basic understanding of Cepheid variable stars.

- 13.) The Pennsylvania State Science Olympiad competition is on April 23rd. I am running the event. It will be shorter and more basic than the national competition. By that date students should have their binders well organized. **THE DAY AFTER THE PENNSYLVANIA STATE COMPETITION THE EVENT WITH ANSWER KEY WILL BE POSTED ON THE WRIGHT CENTER WEBSITE.** The Pennsylvania state event can then be used as a practice test for the national competition approximately 3 weeks later.