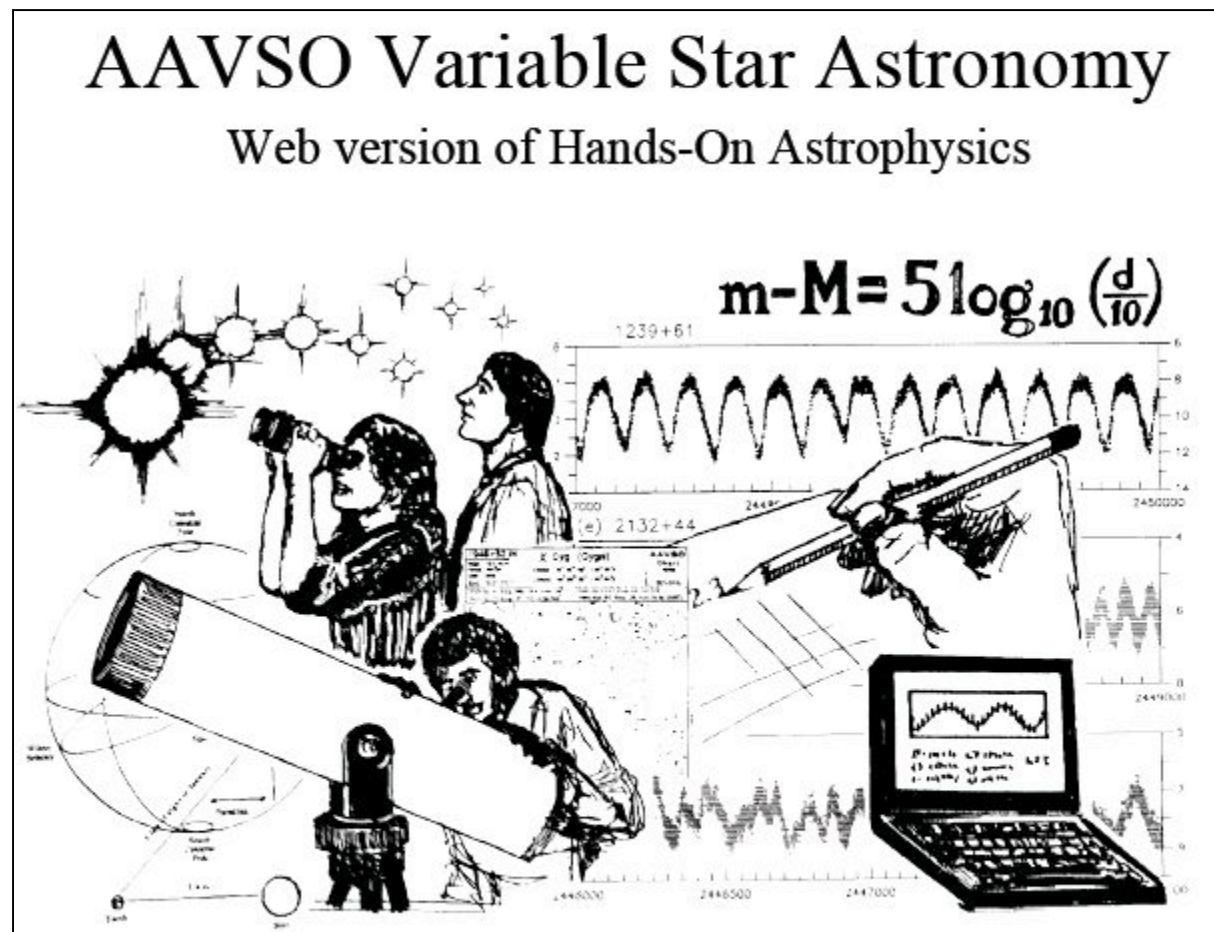


# Variable Star Astronomy

(formerly known as Hands-On Astrophysics)

## Education and Public Outreach Initiative



Chapter 6: Measuring Variable Stars



The rate of change of magnitude is the most important factor in determining the type of variability. The rate of change is measured in magnitudes per day. The rate of change is usually between 0.01 and 0.1 magnitudes per day. The rate of change is usually between 0.01 and 0.1 magnitudes per day.

Chapter 7: Observing Variable Stars in the Real Sky



There are over 10,000 stars known to be variable. The rate of change of magnitude is the most important factor in determining the type of variability. The rate of change is measured in magnitudes per day. The rate of change is usually between 0.01 and 0.1 magnitudes per day.

Chapter 8: The Nature of Light

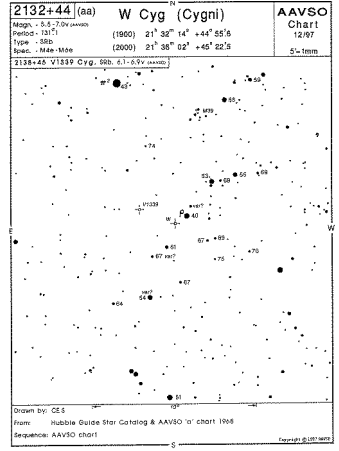
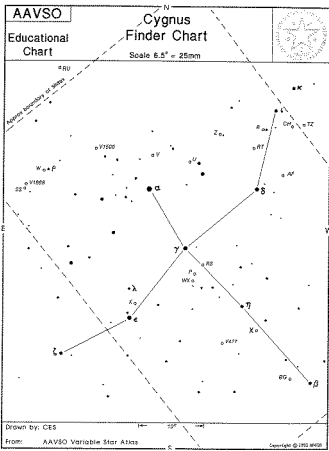
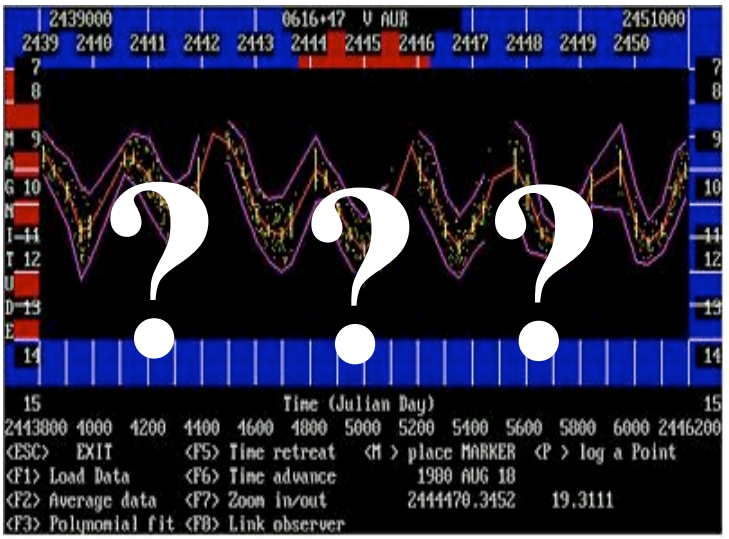
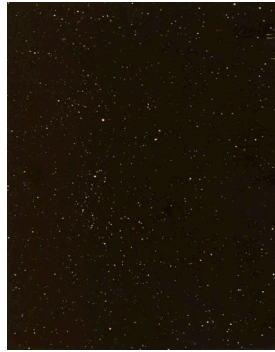
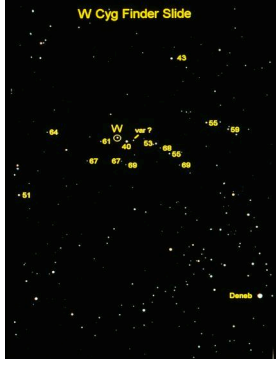
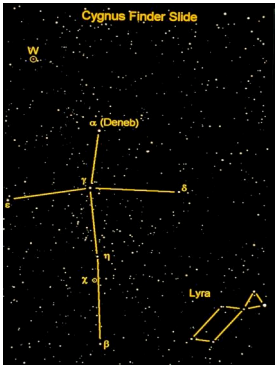


The speed of light is constant in a vacuum. The speed of light is approximately 300,000,000 meters per second. The speed of light is constant in a vacuum. The speed of light is approximately 300,000,000 meters per second.

**Hands-on Astrophysics**

**Backyard Astronomy Variable Stars**  
How to Observe Variable Stars

An educational program created by The American Association of Variable Star Observers and funded by the National Science Foundation

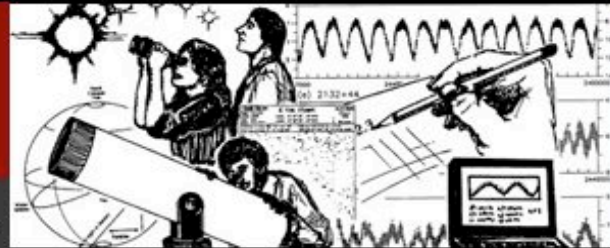




# Variable Star Astronomy

Discover the excitement of doing real science with real data!

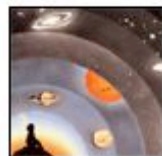
You are invited on a journey into the hearts of the stars—to see the rhythms of their pulsations, and to gain an understanding of how they evolve.



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**Variable Star Astronomy**, formerly published as *Hands-On Astrophysics*, was developed for anyone who is interested in astronomy and in learning more about the behaviors and properties of stars. The conversion of the curriculum to electronic format has been completed for the Student Manual and the Teacher Pages. The supporting materials - slides, video and star charts have also been converted, and the VSTAR software is in progress. The AAVSO, with support from the Chandra X-Ray Center, is delighted to make this rich educational content available to you, free-of-charge, below. If you have any questions or comments please [contact us](#). Enjoy!

**Introduction and Table of Contents**, [.pdf](#)



## UNIT 1: Planets and Stars

*Chapter 1: The Solar System and Beyond*, [.pdf](#)

*Chapter 2: The Nature of Stars*, [.pdf](#)



## UNIT 2: Introducing the Sky

*Chapter 3: Familiarizing Yourself With the Night sky*, [.pdf](#)


*Chapter 4: Our Bearings in the Sky*, [.pdf](#)


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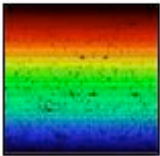
 [Chapter 4: Our Bearings in the Sky, .pdf](#)

 **UNIT 3: Observing Variable Stars**

[Chapter 5: Introducing the Hands-On Astrophysics Constellations, .pdf](#)

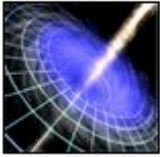
[Chapter 6: Measuring Variable Stars Visually, .pdf](#)

[Chapter 7: Observing Variable Stars in the Real Sky, .pdf](#)

 **UNIT 4: The Message of Light**

[Chapter 8: The Nature of Light, .pdf](#)

[Chapter 9: The Life of a Star, .pdf](#)

 **UNIT 5: Analysis of Variable Stars**

[Chapter 10: Statistical Concepts, .pdf](#)

[Chapter 11: Variable Stars, Light Curves, and Variability, .pdf](#)

[Chapter 12: Variable Stars and Phase Diagrams, .pdf](#)

[Chapter 13: Variable Stars and O-C Diagrams, .pdf](#)

**GLOSSARY, .pdf**

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(617)-354-0484

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## Chapter 7: Observing Variable Stars in the Real Sky

### Introduction



Every night hundreds of amateur astronomers around the world look at the night sky from their backyards, just as you are now preparing to do. Stargazers contemplate the splendor and poetry of the dancing jewels above them, and feel serene within the solitude of night and the constancy of the universe. Amateur astronomers, too, appreciate the wonders of the stars; however, they also know that the stars are not constant, but vary in their brightness. So they observe them systematically, filling their logbooks with data which they plot and analyze. They not only want to enjoy the stars, but want to investigate and analyze their behavior and share their findings with other astronomers around the world. Amateur astronomers do not feel alone in the darkness. They know they have nighttime companions with a similar mission: to become intimately acquainted with stellar behavior, to decode the messages from variable stars. So when you go out to your backyard and begin your quest, remember that there are many eyes observing the heavens along with you.

There are over 30,000 stars known to be changing in brightness and another 14,000 stars suspected to be changing in brightness. These known and suspected variable stars require continual, systematic observation over decades to determine their short-term and long-term behavior, and to catch and record any unusual activity. During the last two decades, variable stars have been closely monitored using specialized instruments on large ground-based telescopes, and x-ray, ultraviolet, and infrared detectors aboard satellites. It is essential to have ongoing visual data from amateur astronomers to correlate with the multi-wavelength observations these specialized instruments obtain.

## Stellar Evolution

### CLASS ACTIVITIES

#### BACKGROUND

[GALACTIC NAVIGATION](#)[CHANDRA 101](#)[TRACKING CHANDRA](#)[ASK AN EXPERT](#)

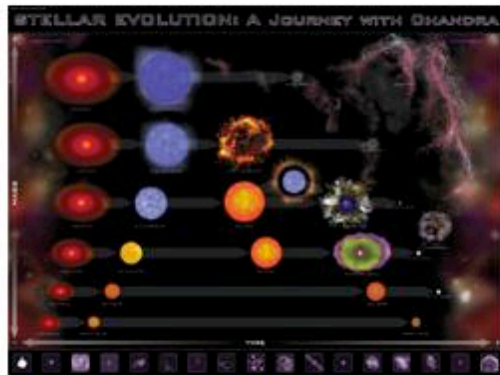
### INTERACTIVE GAMES

#### PRINT MATERIALS

#### EDUCATION LINKS

### WEB SITE TOOLS

[CHRONICLES](#)[EMAIL NEWSLETTER](#)[SITE MAP](#)[NEW & NOTEWORTHY](#)[IMAGE USE POLICY](#)[QUESTIONS & ANSWERS](#)[GLOSSARY OF TERMS](#)[DOWNLOAD GUIDE](#)

[Request a copy of the Stellar Evolution poster](#)

When the Universe came into existence ~14 billion years ago, the only elements were hydrogen, helium, and traces of lithium, beryllium, and boron. The heavier elements did not yet exist. Heavy elements are produced by nucleosynthesis - the fusion of nuclei deep within the cores of stars. At some point in time, the first stars were formed, and within their cores the fusion process created heavier and heavier elements; the most massive

stars produced nuclei as heavy as iron. When the stars used up their nuclear fuel, they started to evolve. The evolutionary processes of stars depend upon their initial mass. Mid-sized stars eject planetary nebulae, leaving a white dwarf core remnant. More massive stars explode as supernovae, leaving neutron stars or black holes at the centers of the supernovae remnants. The elements that were created within the cores of the first stars were ejected into space where they intermingled with the surrounding interstellar medium. This medium -- the gas and dust between the stars -- provides the raw material for the formation of new generations of stars. Eventually, these elements became incorporated into large clouds of gas and dust that condensed and formed protostars. And so the cycle of stellar formation and destruction continues - each new generation further enriching the interstellar medium with heavy elements that become incorporated into the next generation. We are just beginning to understand stellar formation and destruction - and how the Sun, Solar System and life on Earth are connected to this never-ending cycle.

- ▶ [The Story of Stellar Evolution: Introduction and Background](#) [html](#) | [pdf](#)
- ▶ [Interactive Guide to Stellar Evolution](#) (flash)  
[printable version available in pdf](#)
- ▶ [Our Cosmic Connections Activity & Webquest](#)
- ▶ [Stellar Cycles Post Assessment Activity](#)

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## VARIABLE STARS

Stars appear to shine with a constant light; however, thousands of stars vary in brightness. The brightness that a star appears to have (apparent magnitude) from our perspective here on Earth depends upon its distance from Earth and its actual intrinsic brightness (absolute magnitude.) The behavior of stars that vary in magnitude (brightness) - known as variable stars - can be studied by measuring their changes in brightness over time and plotting the changes on a graph called a light curve. Amateur astronomers around the world observe variable stars and assist professional astronomers by sending their data to variable star organizations, such as the American Association of Variable Star Observers (AAVSO) in Cambridge, Massachusetts. The behavior of some variable stars can be observed with the unaided eye or binoculars. Measuring and recording the changes in apparent magnitude and drawing the resulting light curves will allow you to begin to unravel the stories of the often turbulent and always exciting lives of variable stars. The collection and study of variable star data requires the ability to estimate the apparent magnitudes of stars. The two activities that follow will assist you in acquiring the skill of estimating the magnitudes of variable stars.

The two activities, Stellar Heartbeats and A Variable Star in Cygnus, have been adapted from the "[Hands-On-Astrophysics](#), Variable Stars in Math, Science, and Computer Education" curriculum project developed and published by the American Association of Variable Star Observers (AAVSO.)

**Activity #1:** Stellar Heartbeats [html](#) | [flash](#) | [pdf](#) | [ppt](#)

**Activity #2:** A Variable Star in Cygnus [html](#) | [flash](#) | [pdf](#) | [ppt](#)

**Alignment of Performance Task with National Standards:** [html](#) | [pdf](#)

**Useful Resources:**

- ▶ [Types of Variable Stars](#) (at AAVSO)
- ▶ [Estimating Magnitudes Using Interpolation](#) (at AAVSO)
- ▶ [Brief Explanation of Magnitudes](#) (from Hands-On-Astrophysics)
- ▶ [Brief Explanation of Julian Day System](#) (from Hands-On-Astrophysics)
- ▶ [Backyard Astronomers Trigger Multi-satellite Observing Campaign on SS Cygni](#) and [Astronomers Team Up for Chandra Observations of SS Cygni](#) (Chandra Chronicles Articles describing how the AAVSO amateur observers assisted the Chandra X-Ray Observatory)
- ▶ [Hands-On-Astrophysics](#), Variable Stars in Math, Science, and Computer Education (at AAVSO)
- ▶ [HOAFUN](#) (at AAVSO - an interactive and easy-to-use tutorial for estimating the magnitudes of variable stars and understanding the light curves of different types of variable stars.)

Done

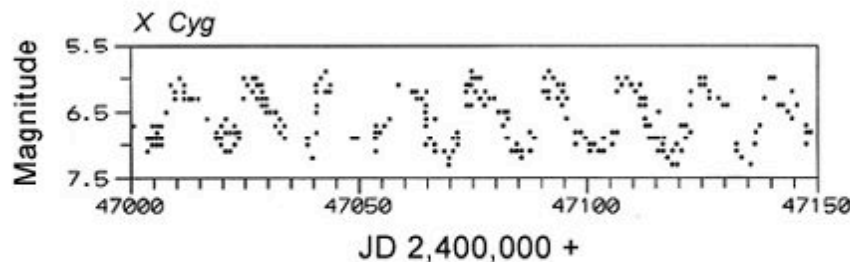


EDUCATIONAL MATERIALS

### Stellar Heartbeats

Variable stars are stars that vary in brightness, or magnitude. There are many [different types of variable stars](#). One group of variable stars is the pulsating variables. These stars expand and contract in a repeating cycle of size changes. The change in size can be observed as a change in apparent brightness ([apparent magnitude](#).) Cepheid variables are one type of pulsating variable stars. Cepheids have a repeating cycle of change that is periodic - as regular as the beating of a heart. Observations of the changes in apparent magnitude of variable stars - including Cepheids - are plotted as the apparent magnitude versus time, usually in [Julian Date \(JD\)](#). The resulting graph is called a light curve.

The light curve for the Cepheid variable star X Cyg (located in the constellation Cygnus) is shown below. Each data point represents one observation. Once many observations have been plotted, important information can be obtained from the resulting pattern of changing magnitudes. The period for X Cyg is the amount of time it takes for the star to go through one complete cycle from maximum magnitude (brightness), through minimum magnitude (dimmiest), and back to maximum magnitude (brightness.)



Light curve for the Cepheid variable star X Cyg.

CLASS ACTIVITIES

- BACKGROUND
- GALACTIC NAVIGATION
- CHANDRA 101
- TRACKING CHANDRA
- ASK AN EXPERT
- INTERACTIVE GAMES
- PRINT MATERIALS
- EDUCATION LINKS

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WEB SITE TOOLS

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ACTIVITY #1 - STELLAR HEARTBEATS

Recording Stellar Heartbeats

Julian Date	Magnitude
JD 2449050	
JD 2449110	
JD 2449150	
JD 2449180	
JD 2449240	
JD 2449300	
JD 2449350	
JD 2449375	
JD 2449435	
JD 2449500	
JD 2449540	
JD 2449635	
JD 2449700	
JD 2449740	
JD 2449760	
JD 2449800	
JD 2449870	
JD 2449950	

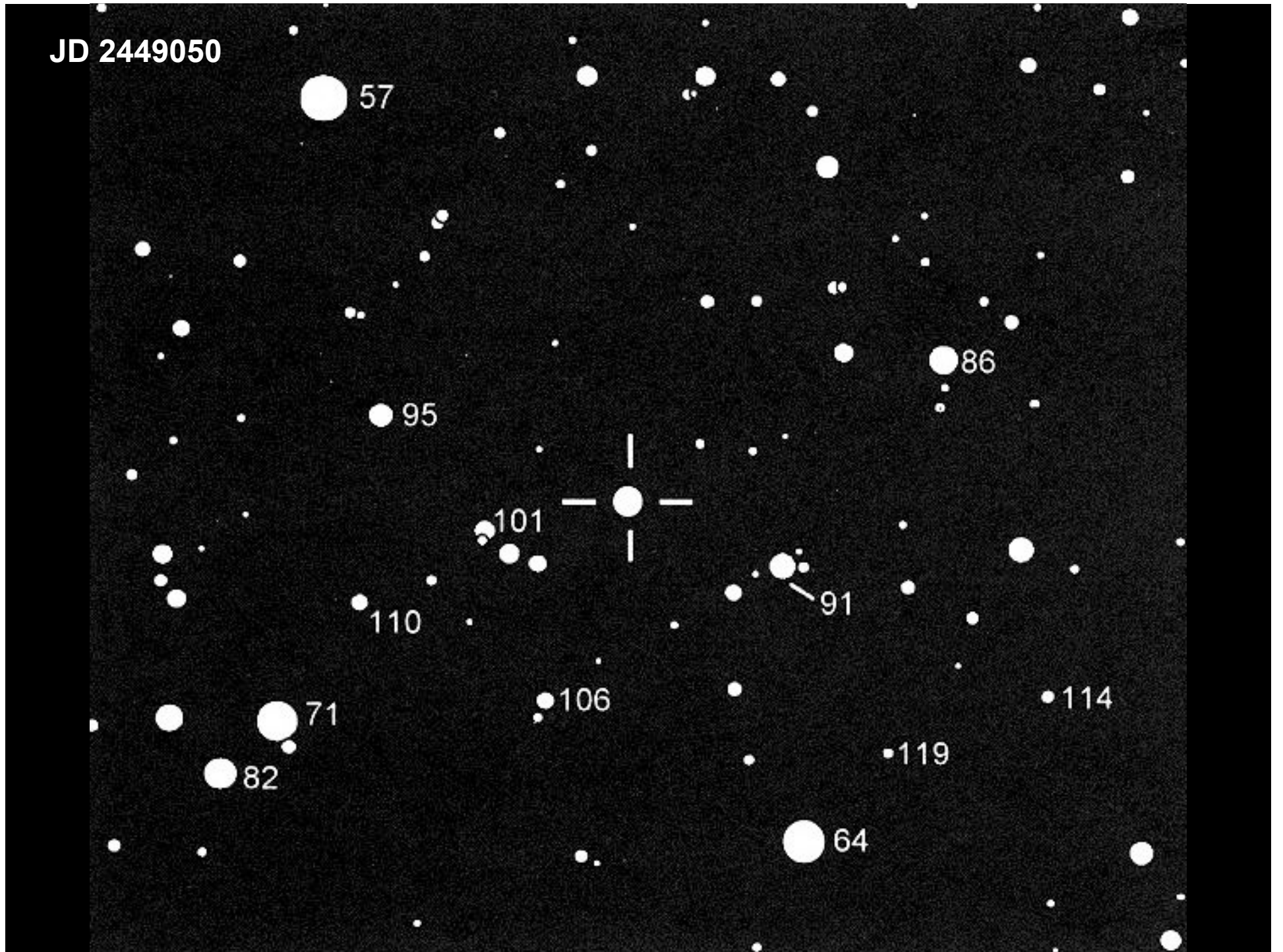
Estimate the magnitude of your variable star on the first picture of the star field using the magnitudes of the stars around it. Proceed through each of the pictures and place your estimated magnitude next to the corresponding JD in the table provided.

next image >

CLOSE BACK NEXT



JD 2449050



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**Activity #2: A Variable Star in Cygnus**

The constellation Cygnus was named by Erasthenes, a Greek who is famous for calculating the circumference of the Earth by measuring the length of a shadow cast by the Sun on a day when he knew its rays shone directly into the bottom of a well several kilometers away. Cygnus, represented as a flying swan, is also sometimes called the [Northern Cross](#). The brightest apparent magnitude star in the constellation of Cygnus the swan is Deneb. Deneb is one of the three bright stars that make up the asterism of the summer triangle - a prominent feature of the summer and autumn night sky.

The area of the sky represented by the constellation Cygnus contains many variable stars. One of the variable stars in Cygnus is named W Cygni, or W Cyg.



W Cygni Finder Slide

51 54 61 67 69 73 75 79

Get Image

W Cyg with lines

[Next: Estimating Magnitudes](#)

[Return to Variable Stars Index](#)

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NASA Smithsonian CXC

Harvard-Smithsonian Center for Astrophysics  
60 Garden Street, Cambridge, MA 02138 USA

Operated for NASA by SAO  
This site was developed with funding from

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**ACTIVITY #2 - A VARIABLE STAR IN CYGNUS**

**Plotting Magnitude**

Estimate the magnitude of W Cyg in each image using the magnitude of the comparison stars. Place our estimated magnitude next to the corresponding JD in the table provided.

JD 2449835

next image >

Julian Day	Magnitude
2449835	
2449859	
2449917	
2449951	
2449979	
2449991	
2450013	

more information on apparent magnitude  
more information on Julian Date

CLOSE BACK NEXT

Done

North is up

W Cyg Field Slide #1 28 April 1995 Julian Date 2449835



JD 2449835



# *Chandra Website*

## **Chandra and AAVSO Educational Activities:**

### **1) Completed in HTML, PDF, Flash, Powerpoint:**

**Stellar Heartbeats**

**A Variable Star in Cygnus**

### **2) NOW IN PROGRESS**

**\*Introduction and Background**

**\*Variable Stars and the H-R Diagram**

**VSA 9.3 will remain unchanged**

**Different H-R Diagram**

**Set of Light Curves to be requested**

**\*ds9 – Analysis of Two Pulsating X-Ray Sources**

**Cen X-3 and GK Per**

**\*The Science Teacher and the NESTA Journal**

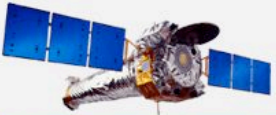
**\* Galileo Conference, ASP**

Chandra Education Data Analysis Software & Activities - Microsoft Internet Exp...

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## CHANDRA EDUCATION DATA ANALYSIS SOFTWARE AND ACTIVITIES

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 [Installation](#) | 
 [Learning ds9](#) | 
 [Activities & Images](#) | 
 [Evaluation](#)

[\[Contact Help\]](#) | 
 [\[Chandra Public Page\]](#)

### New Users

Before you access this system, you may want to read about the Chandra X-Ray Observatory Mission and science on the Chandra public outreach page. Helpful links are:

- [Chandra 101](#): a short summary of the mission
- [Chandra Mission](#): a detailed description of the mission.

If you are a new user of this system, follow the steps linked below, in the order listed, to install and familiarize yourself with the system software before going to the images and analysis activities.

**Step 1:** [Install the system](#)  
**Step 2:** [Learning ds9](#)  
**Step 3:** [Images & Analysis Activities](#)

### Chandra Education Data Analysis Software And Activities

Welcome to the home page for the Chandra Education Data Analysis Software and Activities. The system linked from this page allows educators, students, amateur astronomers and the general public to perform X-ray astronomy data analysis using data sets from the Chandra X-ray Observatory, the "ds9" image display program, and astrophysical software analysis tools.

Our goal is to provide a system that allows you to experience much of the same analysis process that an X-ray astronomer would follow in analysing the data he or she has received from a Chandra Observation.

**Experienced or returning users** who have already installed the "ds9" imaging system on their computers should first check the [system update link](#) to see if any upgrades affect their installation. Then they may visit the section of their choice using the navigation bar above.

**Note:** Please upgrade to ds9 2.2.1 at your earliest convenience. Details on how to do so can be found on the [Install the system](#) page.

**Evaluation**

After you have used this system, we would be very interested in your comments. We hope you will help us with suggestions for improvements and further developments, particularly ways to make the material more appealing and accessible to students. [Access the comment and evaluation form.](#)

*Beta Release*  
**Last updated:** 11/25/02

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 [Installation](#) | 
 [Learning ds9](#) | 
 [Activities & Images](#) | 
 [Evaluation](#)

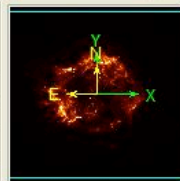
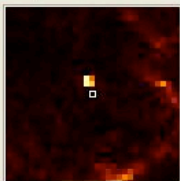
**Resources:** [ds9](#) | [Chanda Public Information & Education](#)

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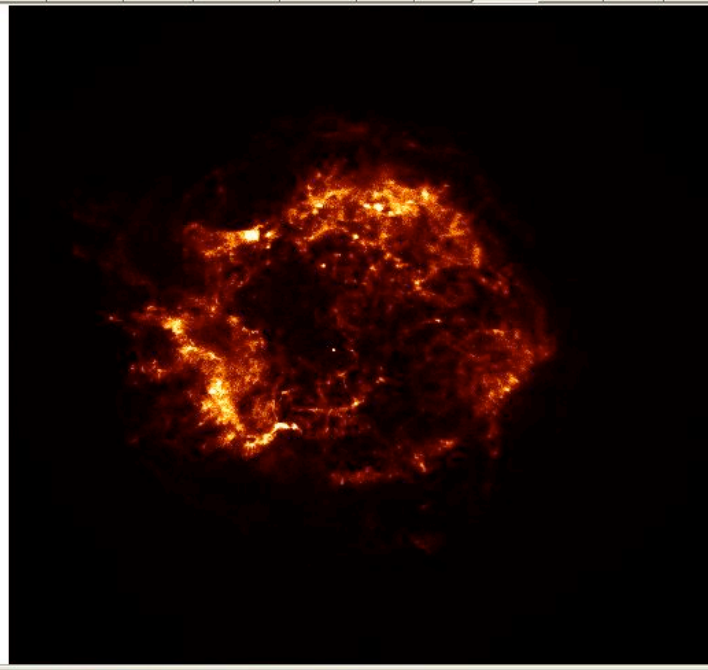
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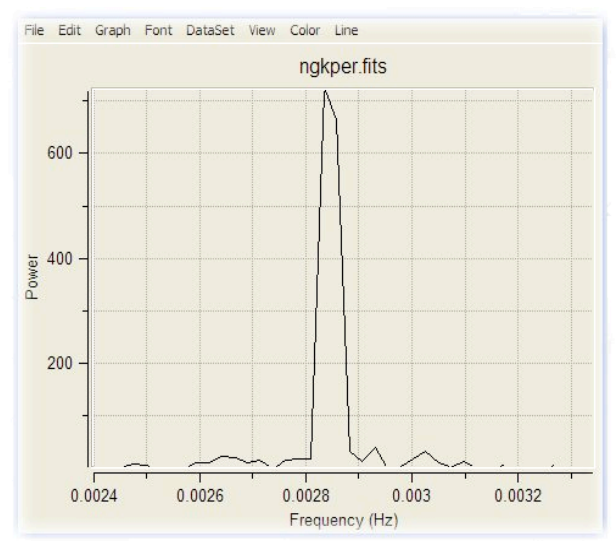
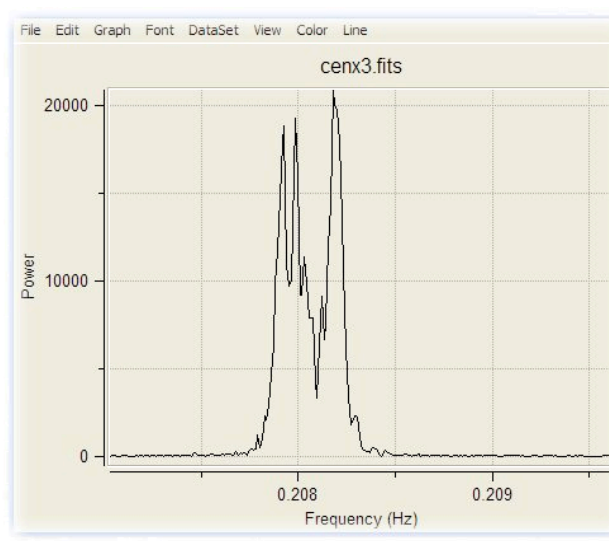
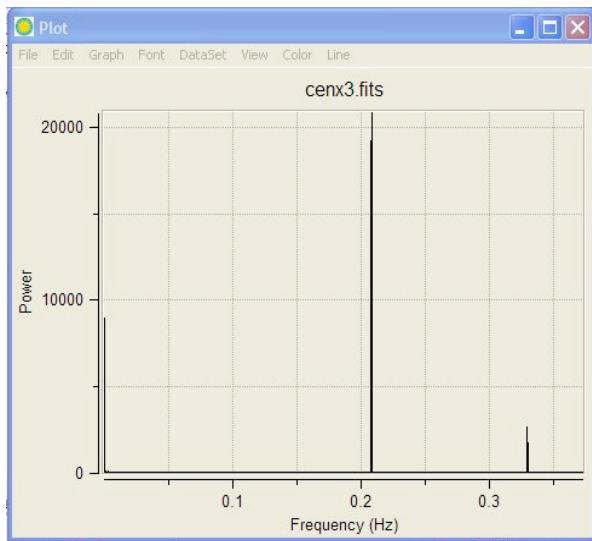
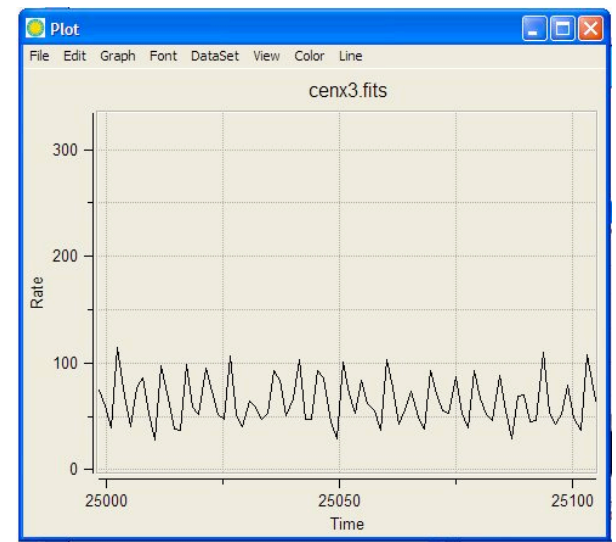
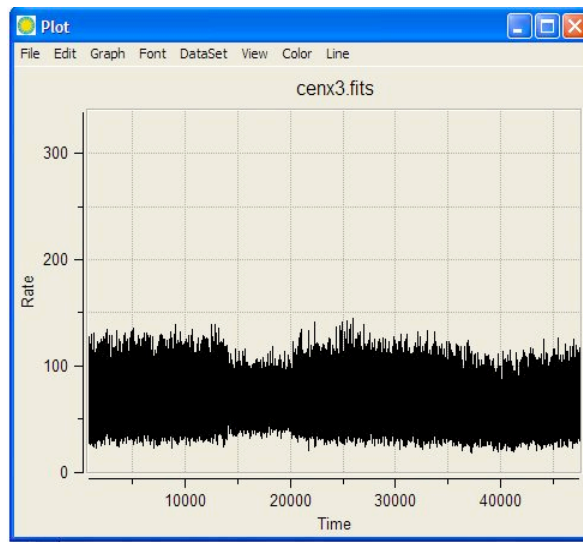
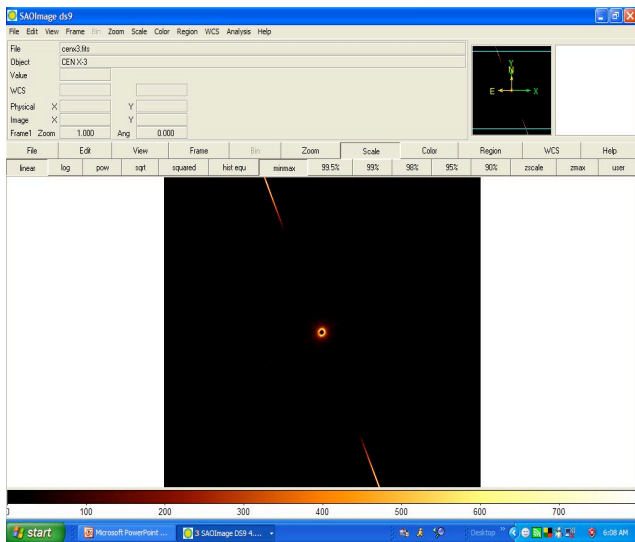
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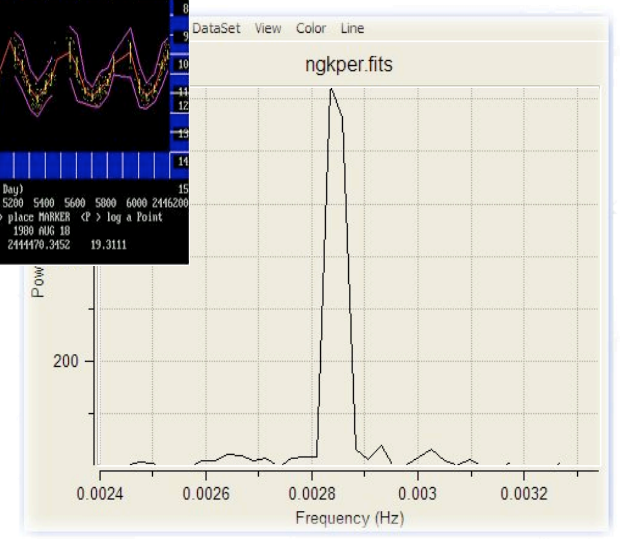
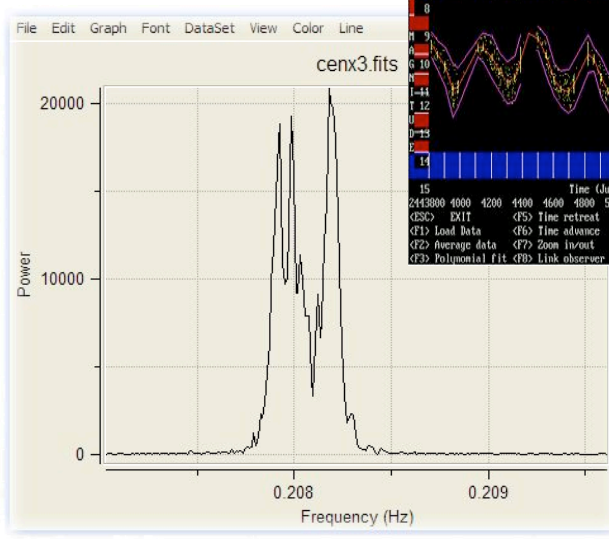
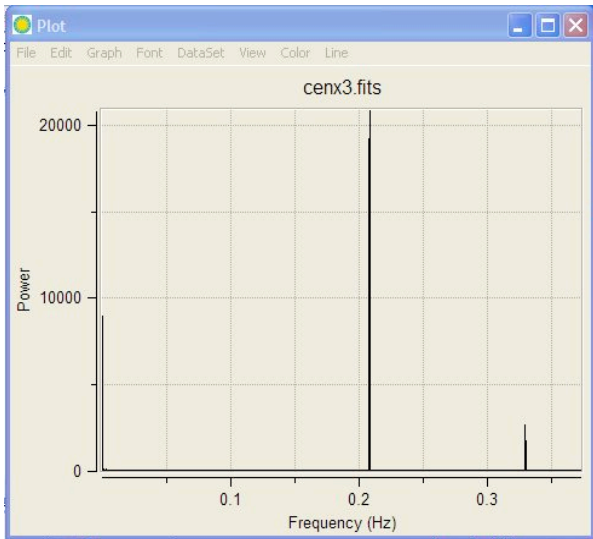
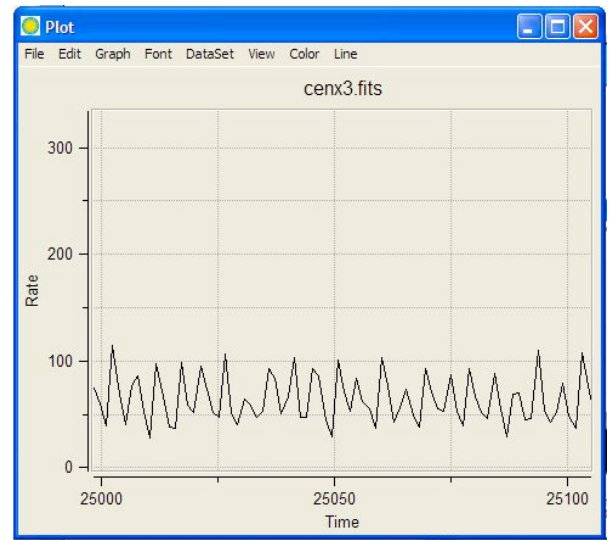
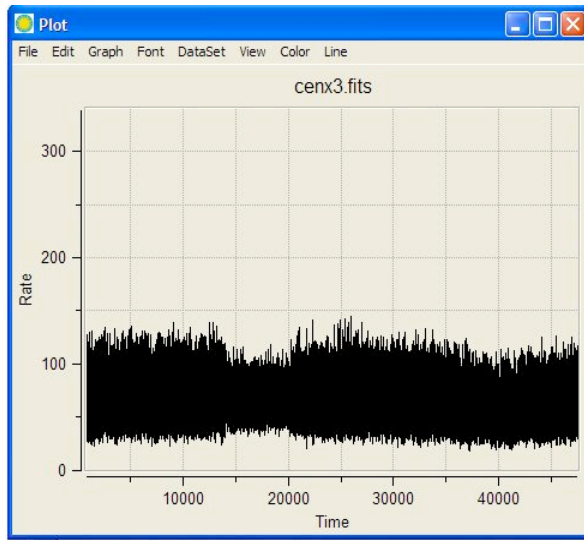
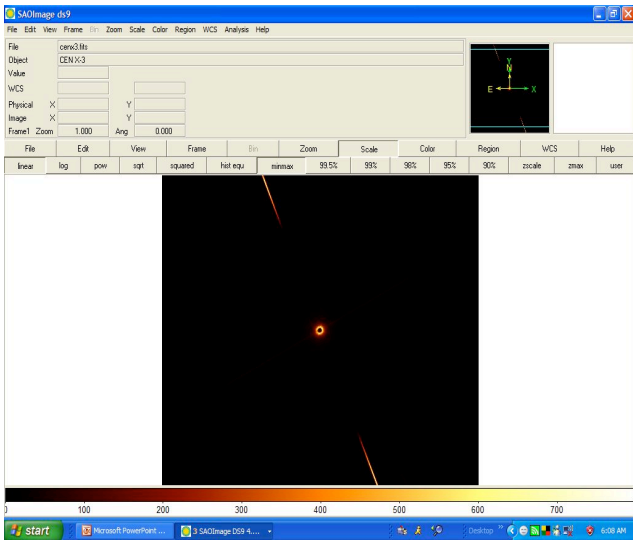
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## Variable Star Of The Month

### Variable Stars

VSOTS

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[Powerpoint Intro](#)

[Stars Easy-To-Observe](#)

[Historical Light Curves](#)

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[Observing Manual](#)

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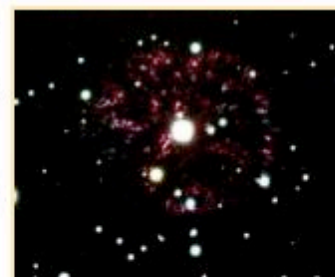
### Pick a star

- Create a light curve  
 Recent Observations  
 Find charts **GO**  
 VSX

### November, 2000: GK Persei (Nova Persei 1901)

#### The New Star of the 20<sup>th</sup> Century

Late on the evening of February 21, 1901, the Scottish clergyman Thomas David Anderson was walking toward his home in Edinburgh when he cast a final "casual" glance up to the sky and noticed a brilliant third magnitude star in the constellation Perseus. His first feeling was one of disappointment because he felt sure that this star had been there for some time, escaping his notice, and he grudged the time lost when he might have been regarding it. The next day he reported his find to the Greenwich Observatory and was surprised to realize that he was the first discoverer of Nova Persei 1901, the first new star of the 20th century.



**Nova Remnant GK Per**  
 Image Credit: [WYN Consortium, Inc.](#)

Back at the Harvard Observatory, where the now famous collection of celestial photographs had been started under the direction of E. C. Pickering (co-founder of the AAVSO), it was found that the new star was actually not completely new. A number of early photographs show that in the position of the new nova there was previously a faint star of magnitude 13 that showed small fluctuations in light. It so happened that this Perseus region had been photographed just two days before Dr. Anderson's discovery and showed the star at its minimum brightness. Thus, in less than two days, it had brightened from the thirteenth to the third magnitude, an increase of 10,000 times in luminosity - an absolute explosion!



For the next two days, the star continued to increase in brightness, at a somewhat slower rate, until it reached a maximum of magnitude 0.2, about the brilliance of Capella and Vega. The total change in brightness was fourteen magnitudes and had been accomplished in less than four days. Immediately after the nova reached 0.2 magnitudes, it quickly (although not as quickly as it rose) began to fade. Six days after maximum, the nova had faded to second magnitude and two weeks later it reached the fourth. At this point, a series of oscillations set in, with a

# *Science Olympiad*



## **Variable Stars and the National Science Olympiad:**

- 1) Have been part of Division C (high school) Event since 1999**
- 2) Focus topic for 2007 through 2009 competition**
- 3) 48 states send 60 teams to national competition**
- 4) ~2500 teams (5000 students) prepare for regional and state competition each year**
- 5) AAVSO website promoted as primary source of information**
- 6) All Deep Sky Objects selected for specific study either on the Chandra website and/or on the AAVSO website**
- 7) Epsilon Aur, ALWAYS variables and Coaches Manual**

# NSO Astronomy C - Variable Stars - 2009

## A. Pulsating Variables:

### 1) Long Period Variables

a) Mira type **Mira, RU Virginis**

b) Semiregular **Betelgeuse**

2) Cepheids **RS Puppis**

3) RR Lyrae

## B. Cataclysmic (Eruptive) Variables:

1) **Recurrent Novae** **RS Ophiuchi**

2) **T Tauri** **T Tauri**

3) **Symbiotic** **Z Andromedae**

4) **U Geminorum** **RX Andromedae**

5) X-Ray Binaries **Circinus X-1**

6) Supernovae

a) Type II **G292.0+1.8,**

b) Type Ia **SN 1006**

C. **Eclipsing Binaries** **Epsilon Aurigae\*\*\*\*\***



# THE EARTH SCIENTIST

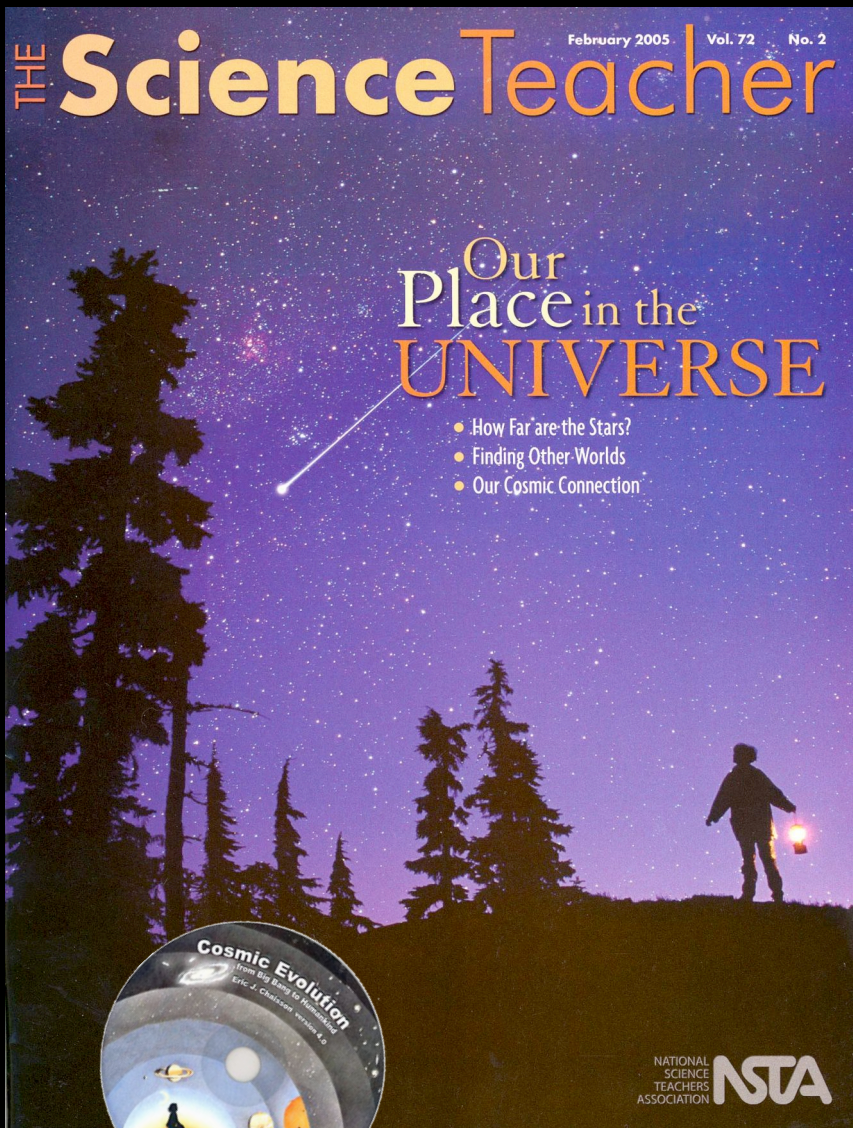


Sunlight plays off the Canada Glacier in the Wright Valley, one of the McMurdo Dry Valleys. Photo credit: Peter Doran, National Science Foundation

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# Stellar Evolution – A Journey with Chandra



Chandra :: Educational Materials :: Stellar Evolution :: Our Cosmic Connections Activity - Netscape

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http://chandra.harvard.edu/edu/formal/stellar\_ev/cosmic/

Chandra :: Educational Materials :: Stellar ...

ABOUT CHANDRA | EDUCATION | FIELD GUIDE | PHOTO ALBUM | PRESS ROOM | RESOURCES

### EDUCATIONAL MATERIALS

#### Our Cosmic Connections Activity

**CLASS ACTIVITIES**  
 BACKGROUND  
 GALACTIC NAVIGATION  
 CHANDRA 101  
 TRACKING CHANDRA  
 ASK AN EXPERT  
**INTERACTIVE GAMES**  
**PRINT MATERIALS**  
**EDUCATION LINKS**

Search  Go

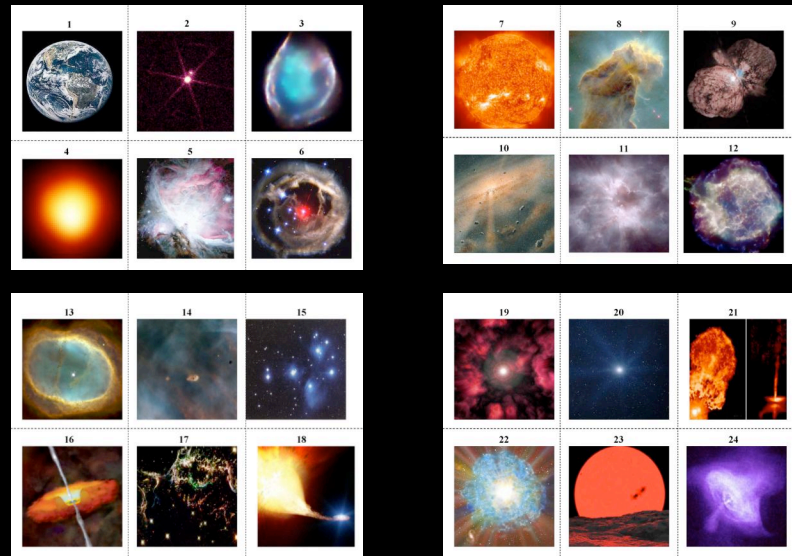
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**CHANDRA**  
 X-RAY OBSERVATORY

Ever since the first stirrings of consciousness, humankind has lifted its eyes towards the mystery of the heavens and found solace in the contemplation of the seemingly peaceful and eternal panorama of the night sky. People of ancient cultures viewed the sky as the inaccessible home of the gods. They observed the daily motion of the stars, and grouped them into patterns and images. They assigned stories to the stars, relating to themselves and their gods. They believed that human events and cycles were part of larger cosmic events and cycles. The night sky was part of that cycle. The steady progression of star patterns across the sky was related to the ebb and flow of the seasons, the cyclical migration of herds and the hibernation of bears, the correct times to plant or harvest crops. Everywhere on Earth people watched and recorded this orderly procession with symbols carved into bones and antlers, paintings on elk hide and rocks, and stone monuments and alignments. The motions of the Sun, Moon, stars and planets served as their calendar, clock, and compass.

We still have not lost our fascination for the night sky. The colored and twinkling display overhead causes us to pause and reflect, invoking the same deep stirrings that our ancestors felt when they looked towards the stars. When we look up we feel connected to the grandeur of the sparking array above us; however we no longer view the sky as inaccessible. Technological advances are taking us on


Lola Chaisson, Artist



# Stellar Evolution – A Journey with Chandra

Chandra X-ray Observatory :: Interactive Webquest - Netscape

## Interactive Cosmic Webquest



A	B	C	D	E
F	G	H	I	J
K	L	M	N	O

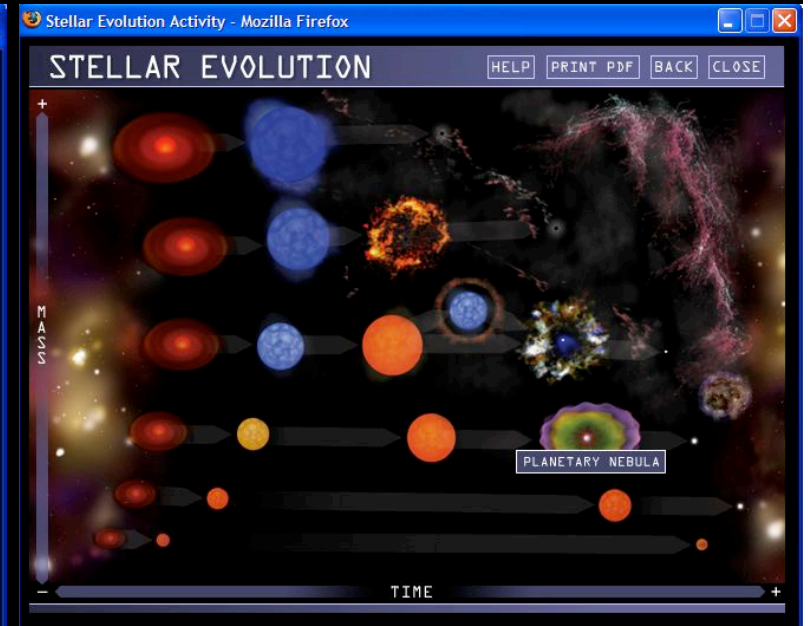
A Type Ia supernova  
 A mid-sized star  
 A massive star

[Introduction](#)  
[Directions](#)  
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#1

A		I	
B		J	
C		K	
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F		N	
G		O	
H			

CHANDRA X-RAY OBSERVATORY



Stellar Evolution Activity - Mozilla Firefox

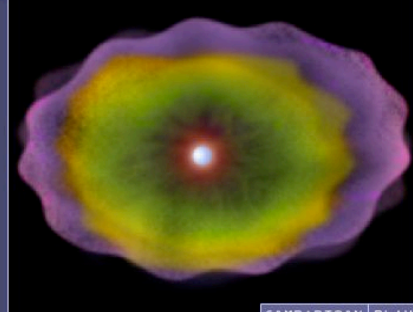
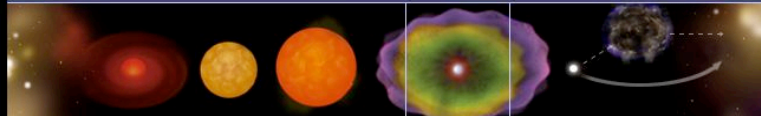
## STELLAR EVOLUTION

HELP HOME BACK NEXT CLOSE

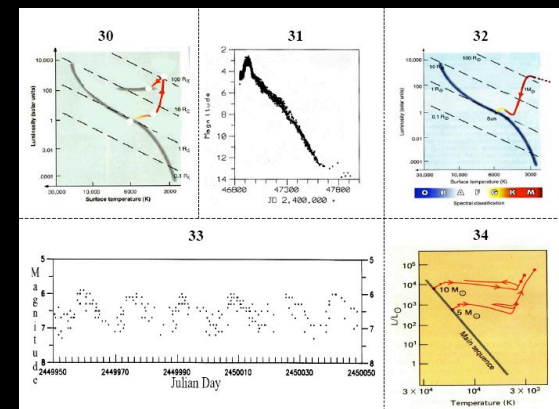
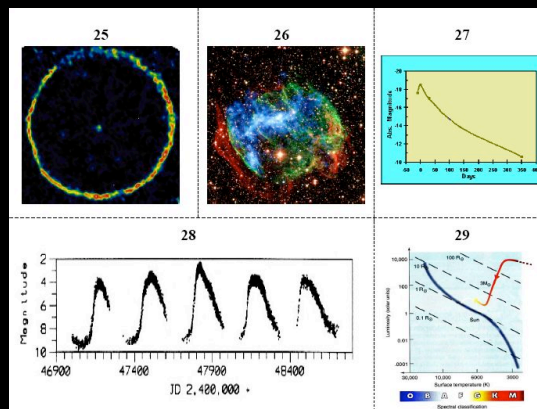
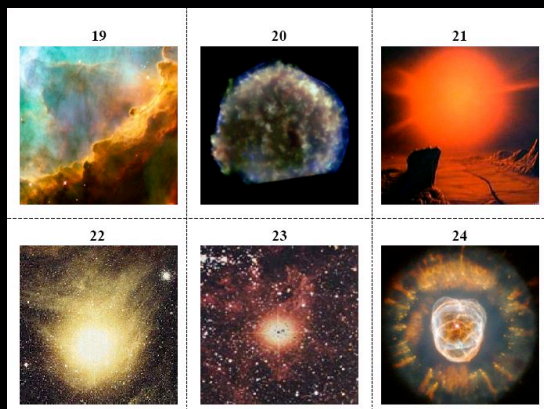
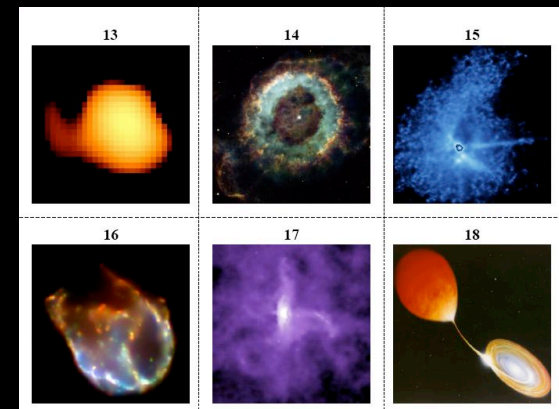
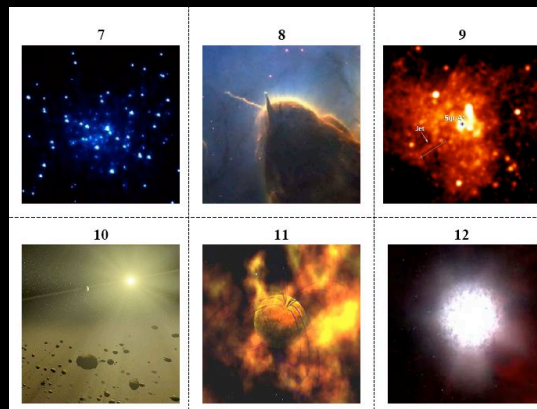
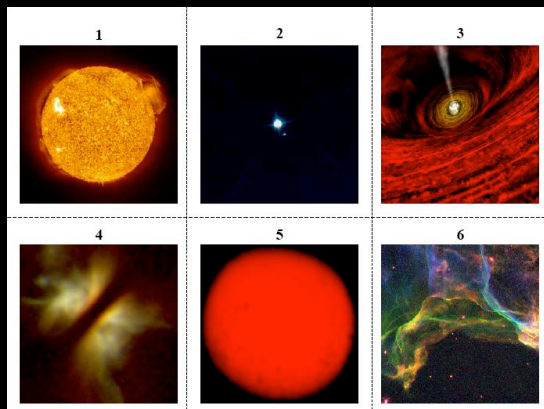
### Planetary Nebula

After the core-helium-burning giant phase, all of a Sun-like star's available energy resources will be used up. The exhausted giant star will puff off its outer layer leaving behind a smaller, hot star with a surface temperature of about 50,000 degrees Celsius. When the high speed "stellar wind" from the hot star rams into the slowly moving material ejected earlier, the collision creates a complex and graceful filamentary shell called a planetary nebula. A composite image of the **Cat's Eye Nebula** (see comparison) from Chandra (purple) and Hubble (red & green) shows where the hot, X-ray emitting gas appears in relation to the cooler material seen in optical wavelengths.

COMPARISON PLAY

# Stellar Cycles Sets and Cosmic Connections Request URL: [http://chandra.harvard.edu/edu/epo/request\\_special.html](http://chandra.harvard.edu/edu/epo/request_special.html) [donna.young@tufts.edu](mailto:donna.young@tufts.edu) **Stellar Cycles Card Set:**



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## Education and Outreach

Welcome to the AAVSO Education and Public Outreach (EPO) webpage!

**Here you can find out about our projects, programs, and activities. We also provide access to resources to help you in your own EPO activities.**

Education and Public Outreach is important for the AAVSO ...

- To attract, train, and retain new variable star observers and members of all ages
- To increase awareness, understanding, and appreciation of variable star astronomy, and variable star observing among amateur and professional astronomers, educators, students, and the general public.
- To improve science education and literacy through the unique power of variable stars, and variable star observing to motivate students, young and old.



Done



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## Current Projects, Programs, and Activities

- ★ [AAVSO Speakers Bureau](#)  
The Speakers Bureau is a service established for people and groups looking for enthusiastic, knowledgeable speakers to provide informative presentations for astronomy clubs, star parties, banquets, Scout Troops, Astronomy Day activities and other public and private astronomy functions.
- ★ [Presentation Library](#)  
Our Presentation Library contains PowerPoint presentations on variable stars, observing techniques and other astronomical topics. These are available free to the public to use in making your own presentations.
- ★ [Online Activities and Resources](#)  
This page contains links to various online activities and resources, such as Hands-On Astrophysics learning activities, time series analysis software, and remote control of ground based and space based telescopes.
- ★ [AAVSO EPO Discussion Forum](#)  
The aavso-epo discussion group is an online forum for sharing thoughts and experiences in EPO with amateur and professional astronomers, educators and outreach activists. Registration is open to anyone with an interest in education and public outreach in variable star astronomy, and it's free!
- ★ [AAVSO Mentor Program](#)  
AAVSO connects experienced observers with new observers to assist them in observing, recording and reporting observations of variable stars to the AAVSO International Database.



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## Programs Under Development

★ **Variable Star Astronomy**

Variable Star Astronomy (VSA) is an AAVSO educational project, originally developed as ~~Hands On Astrophysics (HOA)~~ with funds from the National Science Foundation. It is a flexible set of hands-on educational materials, activities, and investigations, based on the AAVSO's unique electronic database of variable star measurements. Students will be able to experience the excitement of doing real science with real data! By carrying out all aspects of the research process, they can develop and integrate skills in science, math, computing, and other areas. VSA is being converted to a web-based format and is expected to be available again in the new format sometime in 2008.

★ **AAVSO Writers Bureau**

The AAVSO Writers Bureau is offering variable star and topical astronomy content on a monthly basis to editors of astronomy club and society newsletters. This gives us the chance to inform the public about the fascinating objects we study, as well as the science and research being done, while providing reliable, accurate information to newsletter editors who may lack the time or expertise to write or vet submissions.

## The Education and Public Outreach Committee

The committee consists of amateur and professional astronomers with a wide range of interests in informal and formal education at all levels.

- Dr. Pamela Gay (Chair), Southern Illinois University, Physics Department, Edwardsville, Illinois
- Barry Beaman, Rockford, Illinois
- Jaime García, Instituto Copernico, Mensoza, Argentina
- Mary Kadooka, University of Hawaii, Institute for Astronomy
- Dr. Roger S. Kolman, Harper College, Palatine, Illinois
- Douglas Lombardi, Las Vegas, Nevada
- Paul Mortfield, Thornhill, Ontario, Canada
- Mario Motta, M.D., Gloucester, Massachusetts
- Dr. Pebble Richwine, University of Arizona, Institute for Astronomy
- Dr. Christine Anne Royce, Shippensburg University, Department of Teacher Education,

Done