



XMM-Newton Education and Public Outreach Program

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Sonoma State University
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E/PO Work Breakdown Structure

1) Management

2) Formal Education

- Educator Ambassador Program
- Supernova Educator Unit
- *CLEA X-ray Spectroscopy Lab*
- Portable Planetarium Show

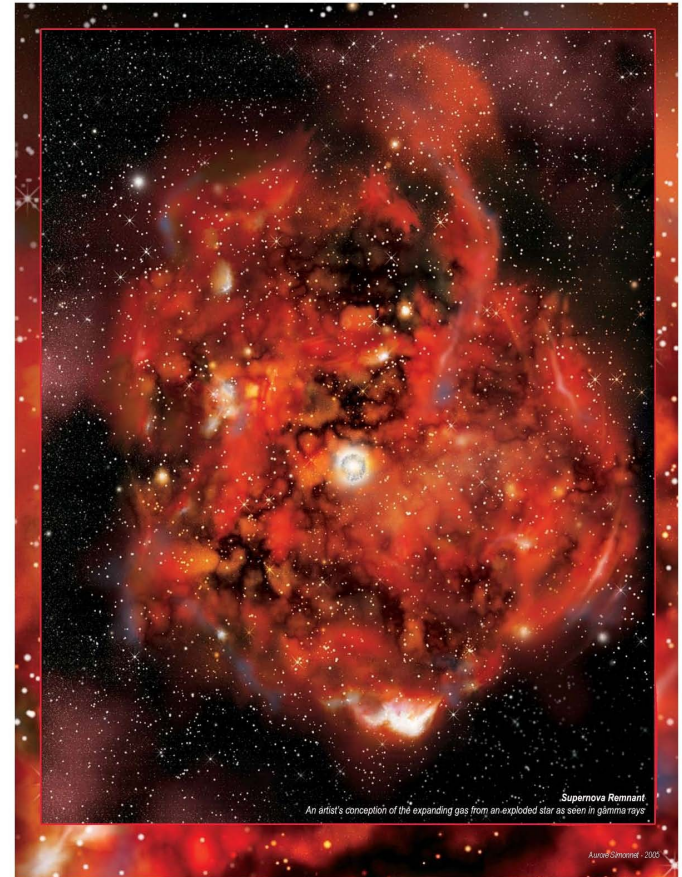
3) Informal Education

- Space Place Partnership
- After School Programs
- Global Telescope Network

4) Public Outreach

- Additional publications - ruler
- E/PO Web Site
- *Amateur Astronomers & Night Sky Network*

5) Assessment and Evaluation (WestEd)





SSU E/PO group

**Prof. Lynn Cominsky
Director**



**Dr. Phil Plait
NERD**

**Prof. Gordon Spear
GTN Director**



**Aurore Simonnet
Scientific Illustrator**



**Sarah Silva
Program Manager**

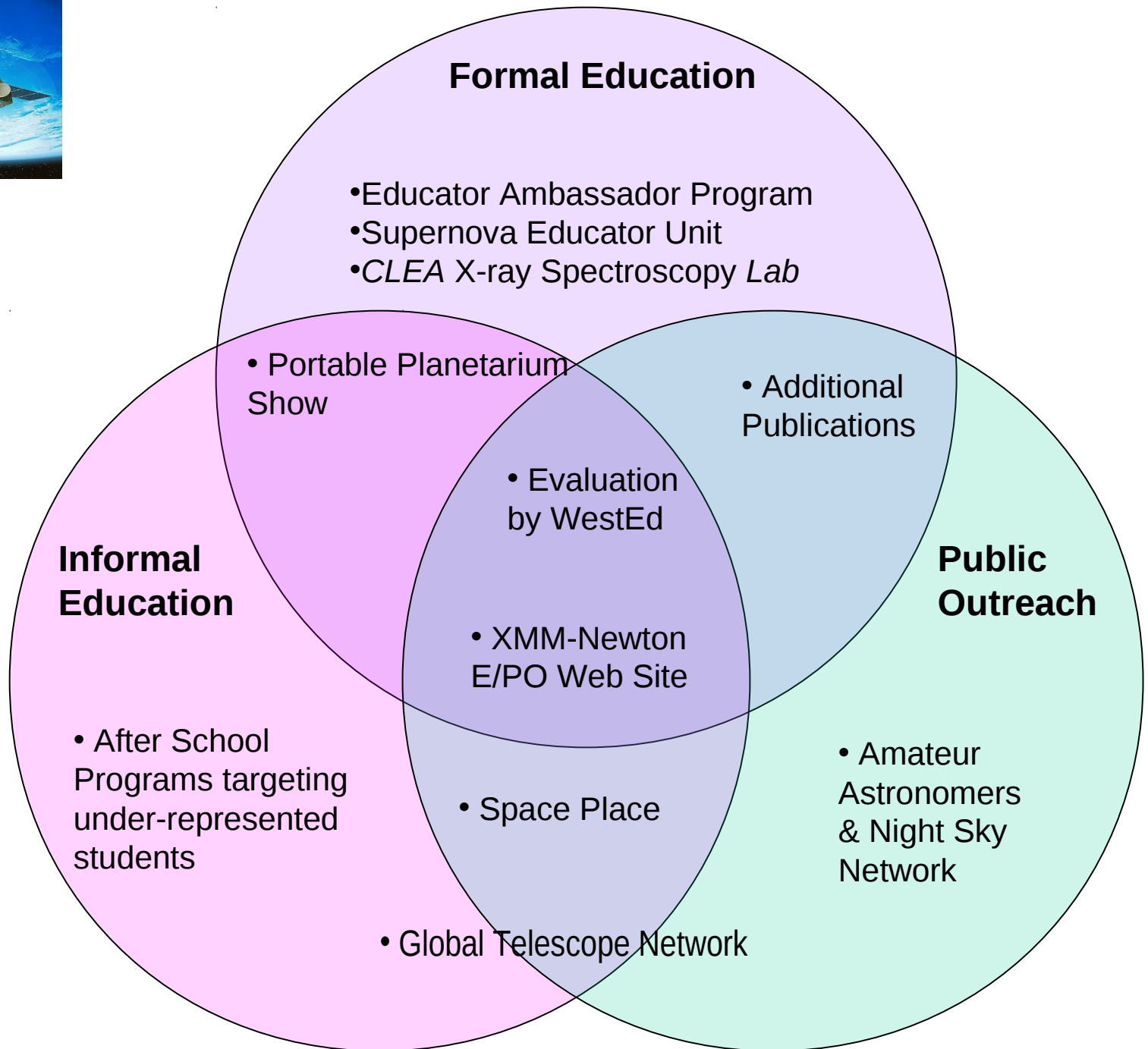


**Tim Graves
Instructional
Technology
Consultant**



XMM-Newton Science and E/PO Goals

<p>When and where are the chemical elements created?</p>	<p>Use x-ray observations of supernova remnants as an engagement to teach students about the relationship between the death of stars and the birth of the chemical elements.</p>
<p>How does nature heat gas to X-ray emitting temperatures?</p>	<p>Use the map of the x-ray sky to illustrate the diversity of objects in the high-energy Universe, compare them to the visible sky and teach about the properties of different energies of light</p>
<p>What are the X-ray signatures of accreting black holes?</p>	<p>Use the engagement of black holes to develop science literacy for grades 4 - 12 and the general public.</p>





Educator Ambassadors

- XMM-Newton supports 2 Educator Ambassadors
 - Master teachers selected in national competition
 - Next bi-yearly training July 10-14, 2006 at SSU
 - Volunteers?
- XMM-Newton workshops and talks have directly reached over 3300 students, teachers, and members of the general public through 34 talks and workshops in 2003-2005



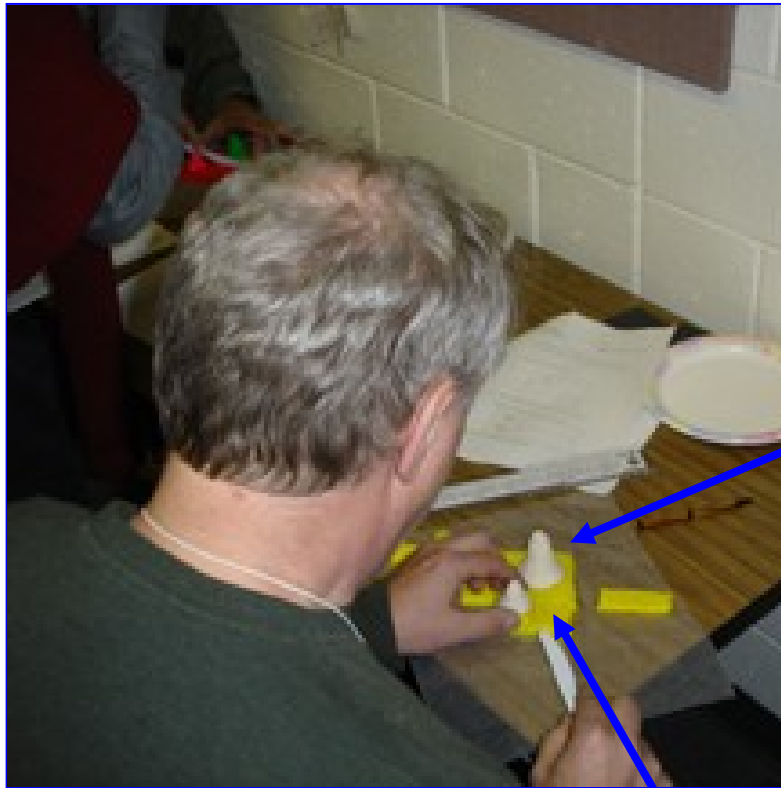
Tom Estill, Chabot
Space and Science
Center, Oakland, CA



Prof. Christine Royce,
Ed.D., Shippensburg
University, PA



Teacher Training Example



star

background

- “*Cookie Cutter Astrophysics*”
- Remove background from stellar image
- Compare the brightnesses of the two stars in the “image”
- Tools: scale, ruler and plastic knife



Supernova Educator Unit – with GLAST

- **3 activities**

- Biography of a Supernova
- The Crawl of the Crab
- At the Heart of a Supernova

*Reviewers needed –
draft now available!*



- **Poster of Supernovae**

- Images of real Supernovae
- Shows what a Supernova looks like during different stages of the explosion – timeline used for biography



CLEA Laboratory

- Dying Stars and the Birth of the Elements
- Released in early 2006, debuted at AAS in Washington DC
- Uses simulated x-ray spectra to teach about the abundances of chemical elements in supernovae
- (DEMO)

The screenshot displays two windows from the CLEA Laboratory software. The top window, titled "CLEA Exercise - X-Ray Astronomy of Supernova Remnants", shows the spacecraft's current position and time. It includes a digital clock for Universal Time (21:52:55) and Greenwich Sidereal Time (10:27:24), a compass, and a slew rate control. The spacecraft has reached coordinates of Right Ascension 23h 23m 24.0s and Declination 58° 48' 54.0". The bottom window, titled "VIREO Reticon Spectrometer Reading", shows a plot of X-ray intensity versus energy (KeV) with a peak at approximately 1.1 KeV. Below the plot are digital readouts for Photon Count (8888888894), Integration Seconds (888895), Photons per Channel (avg) (8888888838), and Signal to Noise Ratio (888856). The interface also includes "Go" and "Stop" buttons for the integration process.

CLEA Exercise - X-Ray Astronomy of Supernova Remnants

File Slew Tools Help

March 30, 2004
Universal Time
21:52:55
Hrs Mins Secs
Grwch Sidereal Time
10:27:24
Hrs Mins Secs
J.D. 2453095.411752

Spacecraft has reached coordinates:
Right Ascension: 23h 23m 24.0s
Declination: 58° 48' 54.0"

Local Time
13:52:55

XMM-Newton
Satellite Control
Center

View
Control
Chart
Control

Spectrometer
Access

Slew Rate
1 2 4 8 16

Right Ascension
23:23:24.0
Hrs Mins Secs

Declination
+58:48:54
Degs Mins Secs

VIREO Reticon Spectrometer Reading

File Help

Intensity

X-Ray Energy (KeV)

Photon Count: 8888888894
Integration Seconds: 888895
Photons per Channel (avg): 8888888838
Signal to Noise Ratio: 888856

Integration
Go Stop

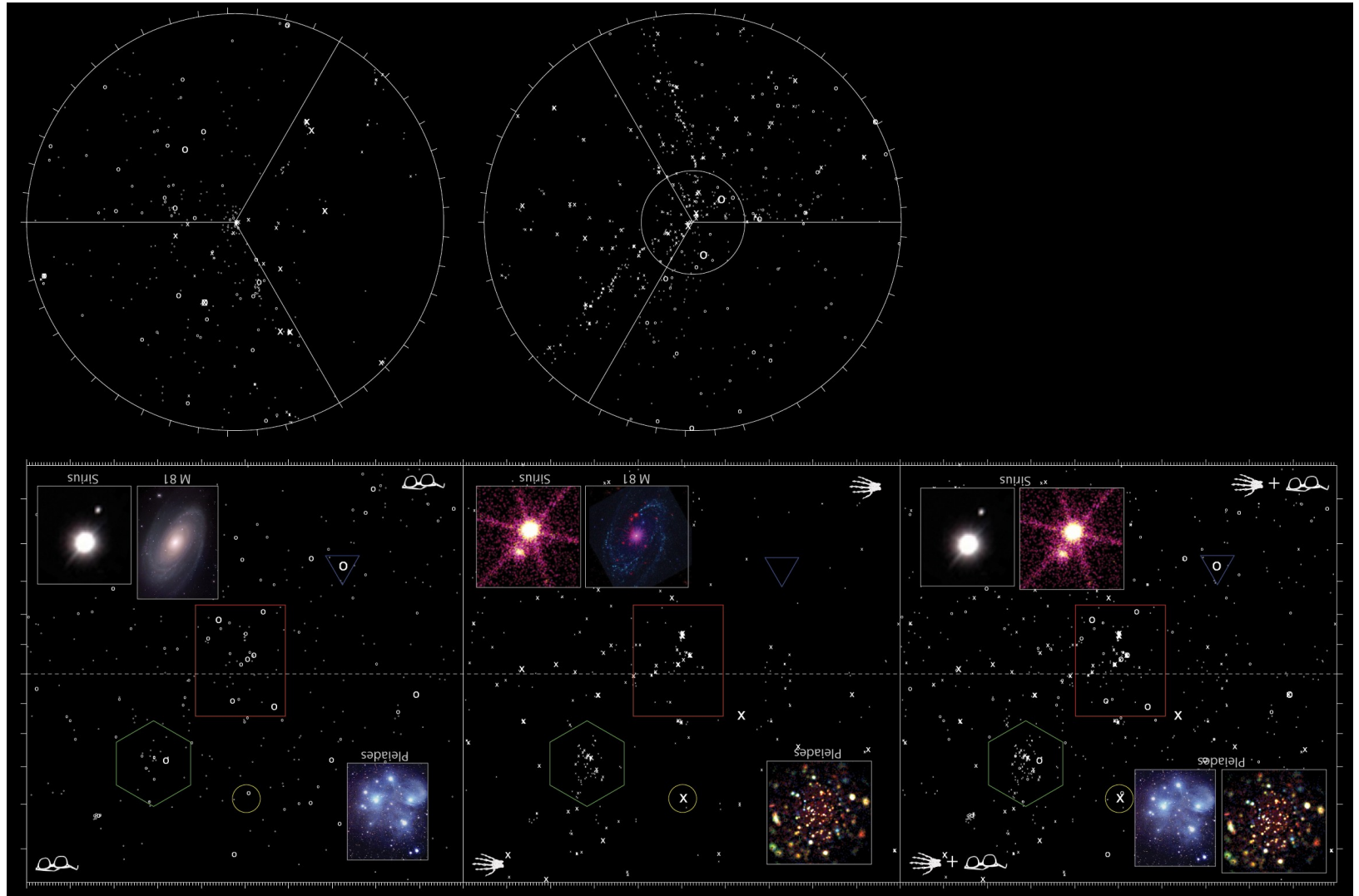


X-ray Sky Planetarium Show

- Planetarium show student manual and teacher's guide already completed
- [New plans](#)
- We are waiting for Digitalis to work with us on implementing software to use our graphics that compares optical and x-ray sky and images of several interesting regions

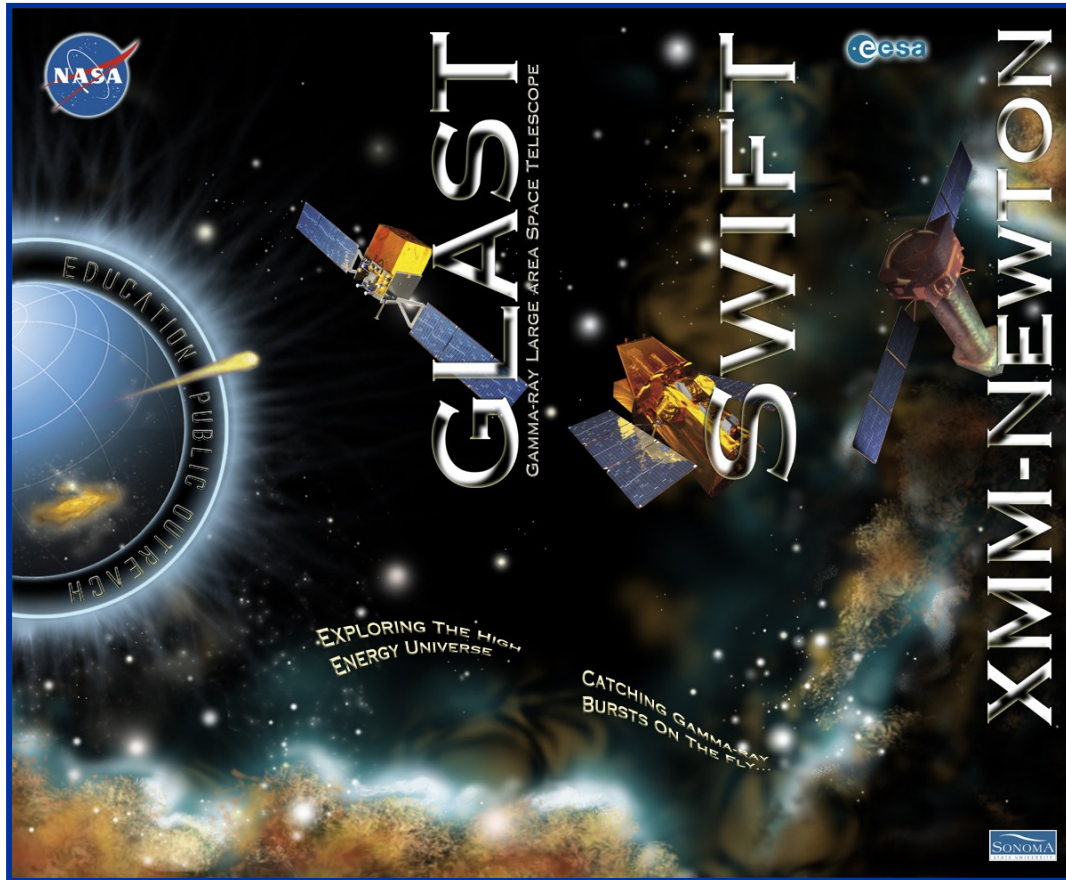


X-ray Sky Planetarium Skymap





SSU E/PO Exhibit Booth



Used for teacher conferences



Formal Education – New Plans

- Studies have shown that longer duration training is more effective than 1-hour workshops....hence we have proposed:
- 2-3 day Regional workshops with the NASA Broker/Facilitators and Space Grant centers using approved NASA materials from throughout Astrophysics division
- CLEA and SN workshops at educator conferences



Informal Education: Black Hole Rescue!

- New interactive black hole spelling game developed with JPL's the Space Place
- Joint with LISA
- After reading an article about black holes and XMM-Newton, vocabulary words appear, then letters are dropped near the black hole.
- Goal is to rescue the letters before they are swallowed up!
- Two levels of difficulty
- Featured in ITEA *Trendscout*, Vol. 6, #5



Black Hole Rescue Game

<http://spaceplace.nasa.gov/en/kids/blackhole/>

<http://spaceplace.nasa.gov/sp/kids/blackhole/>



Informal Education: Black Hole Rescue!

(Part of the web page in Spanish)

¡Rescate del agujero negro!

¡No dejes que el agujero negro trague tus palabras!

En este juego debes rescatar palabras, una letra a la vez, a que sean atraídas por la poderosa gravedad del agujero negro.



Haz clic aquí para jugar a Rescate del Agujero Negro

Ilustración artística del Telescopio Espacial XMM Newton . Imagen cortesía de D. Ducros y la Agencia Espacial Europea (ESA).



Informal Education: You are Here!

- 6 hour Mini-course for 8th-9th grade students
 - The Size and Scale of Things
 - How We See the Universe
 - Trip to the Sun
 - Solar System Travel Plans
 - Our Milky Way Galaxy and Beyond
- Uses materials from throughout Astrophysics Division
- Piloted with 2 groups of > 90% Hispanic students and also for teachers in rural Kentucky.

You Are Here



Come explore the very small to the very big with NASA. This six-session mini course will take you through a tour of the very microscopic and the very astronomic, viewing this, and everything in between with different eyes. Come and find your cosmic address in the Universe and see all of the many amazing things inside your atoms and above your head.

<http://epo.sonoma.edu/youarehere/>



Global Telescope Network

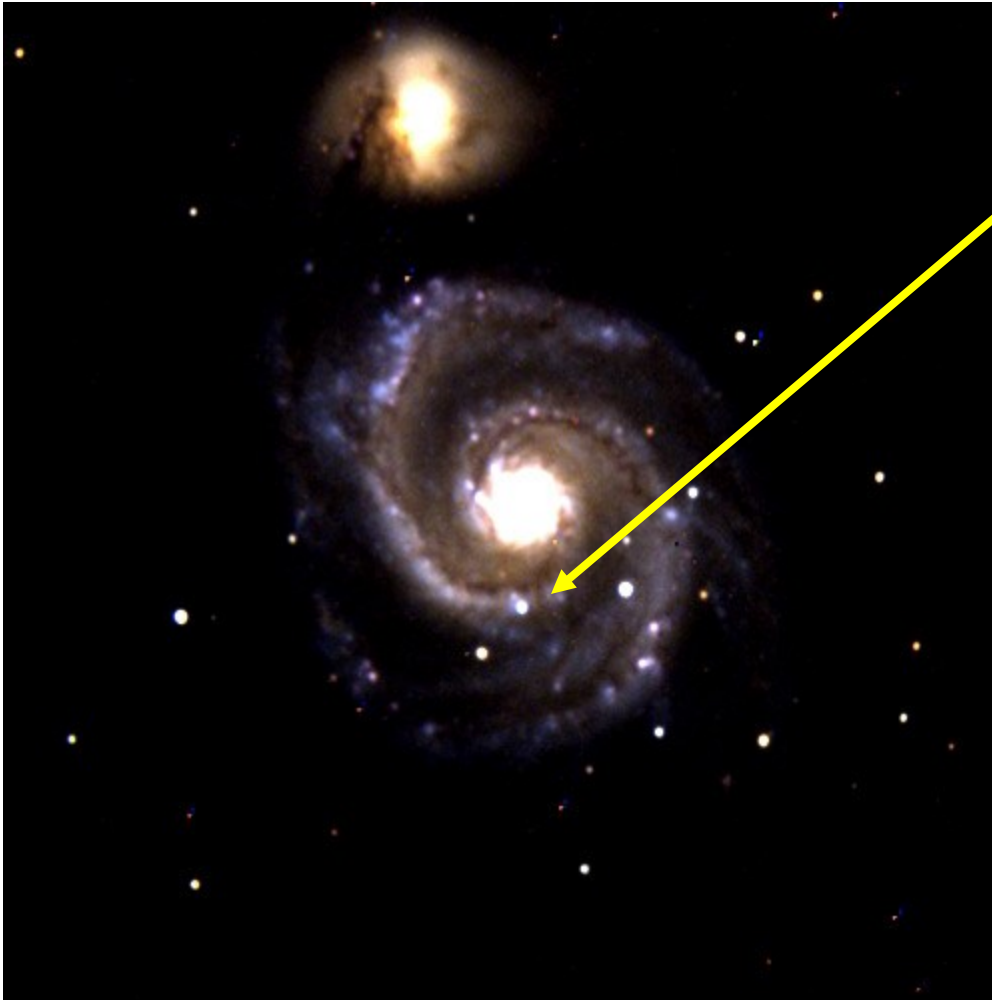
- Website: <http://gtn.sonoma.edu>
 - Educator activities
 - Partner and Associate information
 - Tools for generating scripts and importing program objects into telescope control software
- **GORT IS ONLINE!!**
- Remote demonstration at HEA
AAVSO meeting
- Scripted observations now running
- QQ Vul observations with GORT last summer



**GLAST Optical
Robotic Telescope
at the California
Academy of
Science's
Pepperwood
Natural Preserve**



Image from GORT



- Supernova in M51
- True color composite image from R, G & B



Global Telescope Network

- Simple image reduction and analysis of polars and AGN
- Hands-On Universe
- AAVSO participation
- Joint with GLAST and Swift

- Elk Creek Observatory at Holton, Kansas HS
- Agrupacion Astronomica de Sabadell. Barcelona, Spain
- Tonantzintla Observatory
Tonantzintla, Mexico
- Universidad Nacional de La Plata Buenos Aires, Argentina
- Bernard Heathcote. Victoria, Australia
- Carnes Hill Observatory.
Sydney, Australia
- Nyrola Observatory
Muurame, Finland
- Western Kentucky University





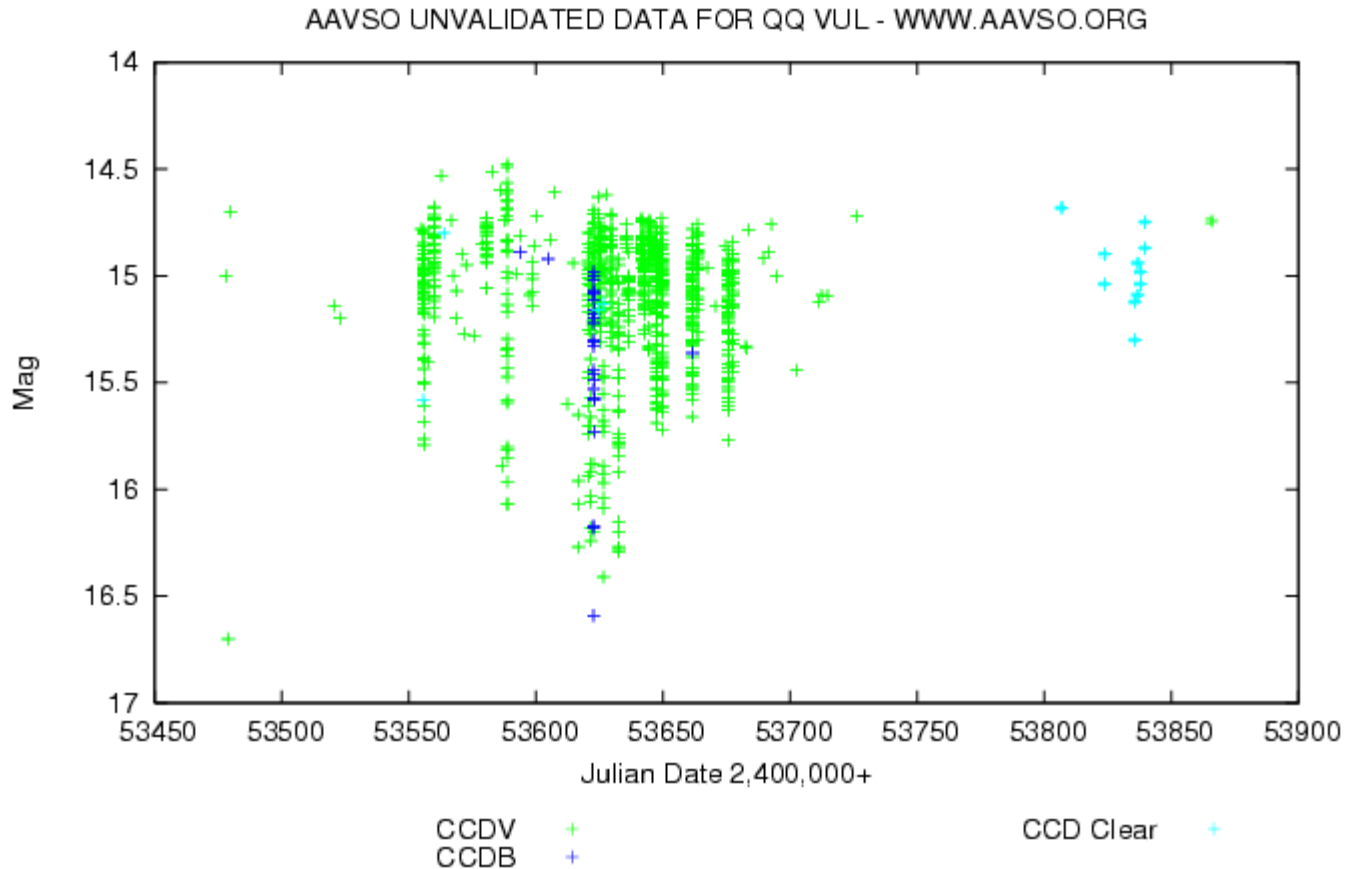
XMM-Newton GTN – Polar project

- Observations were begun in 2003 with GTN (but AAVSO were already monitoring many of the target objects.) Standard sequences are given for each.
- Validated data (usable for publication) are available upon request to AAVSO.
- *Polar list:* AN UMa, AR UMa, MR Ser, AM Her, QQ Vul, BL Hyi, EF Eri, VV Pup, GQ Mus, V834 Cen, V2214 Oph, V347 Pav
- <http://gtn.sonoma.edu/participants/catalog/query.php>
- *We currently have no XMM scientists partnering with us to use the visible light data that have been accumulated!*



XMM-Newton GTN – Polar project

- Unvalidated lightcurve for QQ Vul






GTN Flyer and business cards



JOIN THE GTN! (GLOBAL TELESCOPE NETWORK)




Amateurs and professionals alike are invited to join astronomers around the world in exploring our universe. We're looking for participants to help acquire, reduce, and interpret astronomical data relating to some of the most exotic and enigmatic objects in the sky. This program supports several space observatories, including Swift, and XMM-Newton (both already in orbit) and the Gamma-ray Large Area Space Telescope (GLAST, due for launch in 2007).

The Global Telescope Network provides:



- Involvement for students, teachers, and amateur astronomers in cutting-edge astronomical research.
- Activities and instructional materials for a range of levels and interests.
- Mentoring in research practices, telescope use, data analysis and educational resources.

Partner Or Associate? That Is The Question.

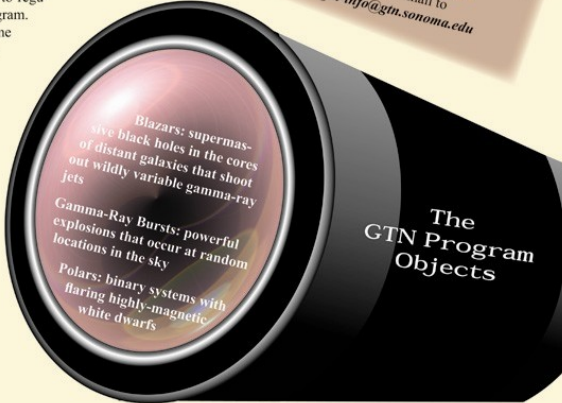
Partners are individuals or groups who dedicate some portion of their time and expertise on observatory hardware they already own to regularly observe astronomical targets that are part of the GTN program. Partners may occasionally be able or willing to offer telescope time to GTN participants. Of course, partners may also be involved with analyzing GTN data. If you have a telescope that you think might be useful in the continuing quest to understand gamma-ray events, sign up at:
http://gtm.sonoma.edu/public/join_partner.php





Associates are individuals, groups, or classrooms who dedicate some portion of their time to analyzing data taken with other people's telescopes. You can adopt your own program objects from our list, or request data for other objects by submitting a short proposal. If this sounds exciting to you, sign up at:
http://gtm.sonoma.edu/public/join_associate.php



For additional information visit the website:
<http://gtm.sonoma.edu>
or send email to
gtm-info@gtm.sonoma.edu





Global Telescope
Network

- First distributed at AAVSO in Fall 2005

Other printed materials



- XMM Ruler –w/classroom activity



- Heart of the Supernova Litho
- “High-Energy Classroom Learning in Astrophysics” Optics and Photonics News
- "The Unblinking Eye of GORT in California Wild magazine
- GTN Observing activities & tutorials

National Aeronautics and Space Administration

MAGNETIC GLOBE

Assembly:

1. Using the knife, cut a small (approximately one inch) slit to the center of the globe.
2. Insert the magnet into the center of the sphere.
3. Align the poles of the magnet as close as possible to the correct orientation of the Earth's real magnetic poles. This can be done by placing about 3 "clamped" staples on each end of the globe, then moving them over the sphere until they stick out almost straight off of the globe. Another way to determine the poles is by using a compass just as you would to find the real Earth's poles. Place the compass against the globe, and follow the needle to the north pole. Once you have located the poles, rotate the magnet until the north pole is in the approximate location of the Queen Elizabeth Islands.
4. Seal up the seam on the rubber ball using two or three pins with plastic heads to hold the sides together as one would with fabric.
5. Slowly drop the "clamped" staples on the sphere, placing them so that they do not cross-cross along the latitude direction of the Earth globe. Make sure your globe looks like the image shown here.

Materials:

- 1 – 2.5 inch diameter foam rubber Earth Globe (can be any similar foam rubber ball)
- 1 neodymium magnet – 1" sphere or cube
- Exacto or other very sharp cutting knife
- 2 or 3 pins with round plastic heads
- ~100 "clamped" staples (i.e. staples that have been produced by a stapler as if they were going thru rough paper, except without the paper)

What this globe ball demonstrates:

The staples provide a three dimensional representation of the magnetic field lines of our Earth. Our Earth's magnetic field is a configuration known as a "dipole field." This type of field is also observed from common magnets, such as bar magnets, but most representations of this field configuration appear in textbooks or are done on pieces of paper using iron filings, and therefore are only experienced in two dimensions.

Many objects in space have dipole magnetic fields that are geometrically similar to that of the Earth. However, the strength of magnetic dipoles fields in space vary dramatically – from fractions of a Gauss (at our surface) to billions of Gauss (magnetic white dwarf stars.) The most extreme magnetic fields in the Universe are seen from neutron stars known as magnetars (approximately one thousand billion or 10^{11} Gauss). The strength of the magnetic field is proportional to the density of field lines in a given region; areas with a greater density of field lines have stronger fields. In this case, the field lines are represented by staples and so the field is stronger where the staples are closer together.

Using the magnet in the globe you can show your students that a stronger magnetic field source will have the staples aligned closer to each other. To properly demonstrate this, the magnet must be spherical in shape. Use a second magnet, or pull the magnet out of the foam rubber globe, and repeat the experiment with the staples placed directly on the magnet.

Resources:
For more activities about Superstars see: <http://www.astronomy.edu.edu/superstars>

More about the Earth's Magnetic Field see: http://lbt/af.nsl.nasa.gov/education/epo/epo/ehg_field.html
http://en.wikipedia.org/wiki/Earth%27s_magnetic_field

NASA Education & Public Outreach
at www.nasa.gov





XMM-Newton E/PO website

- Redone by SSU in 2003
- Code 508 compliant



The screenshot shows the website's header with the text "XMM-NEWTON" in large, stylized letters. Below it, the text "EDUCATION AND PUBLIC OUTREACH" is centered. On the right side, there is an image of the XMM-Newton satellite and a circular portrait of Isaac Newton. On the left side, there is a vertical navigation menu with the following items: "HOME", "EPO PROGRAM", "ABOUT XMM", "XMM NEWS", "CLASSROOM MATERIALS", "RESOURCES", and "CONTACT".

NEW!

XMM-Newton scores 1000 top-class science results

Space Place Black Hole Rescue!

All classroom materials can be downloaded from this site



Artist's animation of a spinning black hole observed by XMM-Newton.

<http://xmm.sonoma.edu>



Informal Education and Public Outreach

- [New Plans](#)
- Several Space Place articles about XMM science to appear in 14 major metropolitan daily newspapers, in both English and Spanish languages and Astronomy Club newsletters
- A “live” interview with X-ray astronomer Ilana Harrus is planned for 2009-2010, hosted at the Space Place Live website. Scientists are portrayed as cartoon characters, but with their actual voices.
- Night Sky Network kit “Cosmic Explosions” partnership with Astronomical Society of the Pacific (ASP) (possibly joint with Suzaku)



Evaluation Process

- All XMM-Newton products are internally evaluated by SSU E/PO, then tested by EAs, then evaluated by our external evaluators, WestEd (led by Dr. Ted Britton)
- All products then sent through NASA product review, and entered into SSERD (<http://teachspacescience.org>)
- We started with evaluating our teacher training workshops, then our teachers' workshops, and now we are beginning to measure impacts of our work into the classrooms of our trained teachers



E/PO Summary

- **XMM-Newton E/PO is exciting the public and students of all ages**
- **We are on budget and moving ahead on all scheduled items**
- **Over 3,000 teachers have been trained in 2 years by XMM-Newton Educator Ambassadors**
- **Black Hole Rescue game page has been accessed by over 80,000 users in the past 4 months.**