



XMM-Newton



Sonoma State University Education and Public Outreach

November 2005

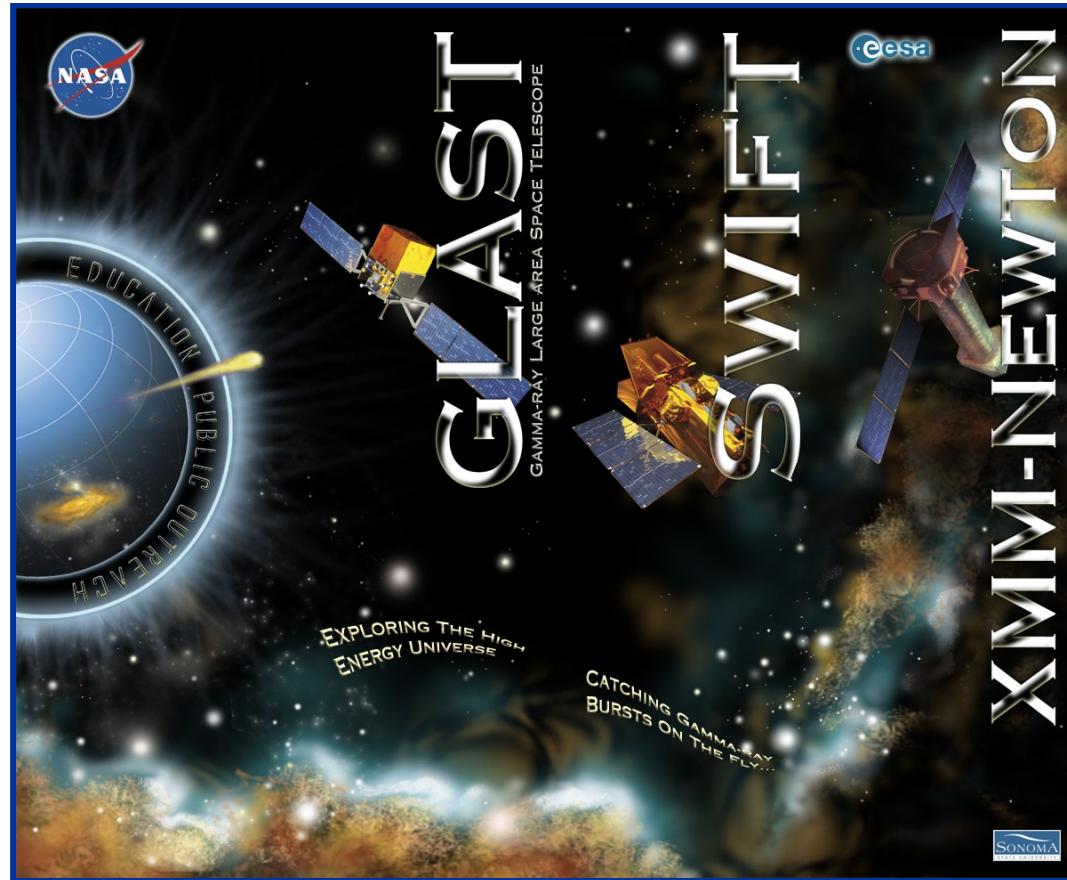
Lynn Cominsky
Sonoma State University



Swift: Catching Gamma Ray Bursts on the Fly



E/PO Exhibit Booth



Used for teacher conferences



Educator Ambassador Program

- 20 Master educators selected in national competition
- Trained bi-yearly at SSU – next in 2006
- Help develop, test, and disseminate our materials
- Did over 140 workshops nationally last year, reached over 10,000 teachers directly



You are Here!

- 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 Scale the Universe and GEMS

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.



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 NOW ONLINE!!
- Remote demonstration at HEA AAVSO meeting
- Scripted observations now running
- Mkn 501 campaign with VERITAS
- 4C 29.45 campaign with Spitzer



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



Global Telescope Network

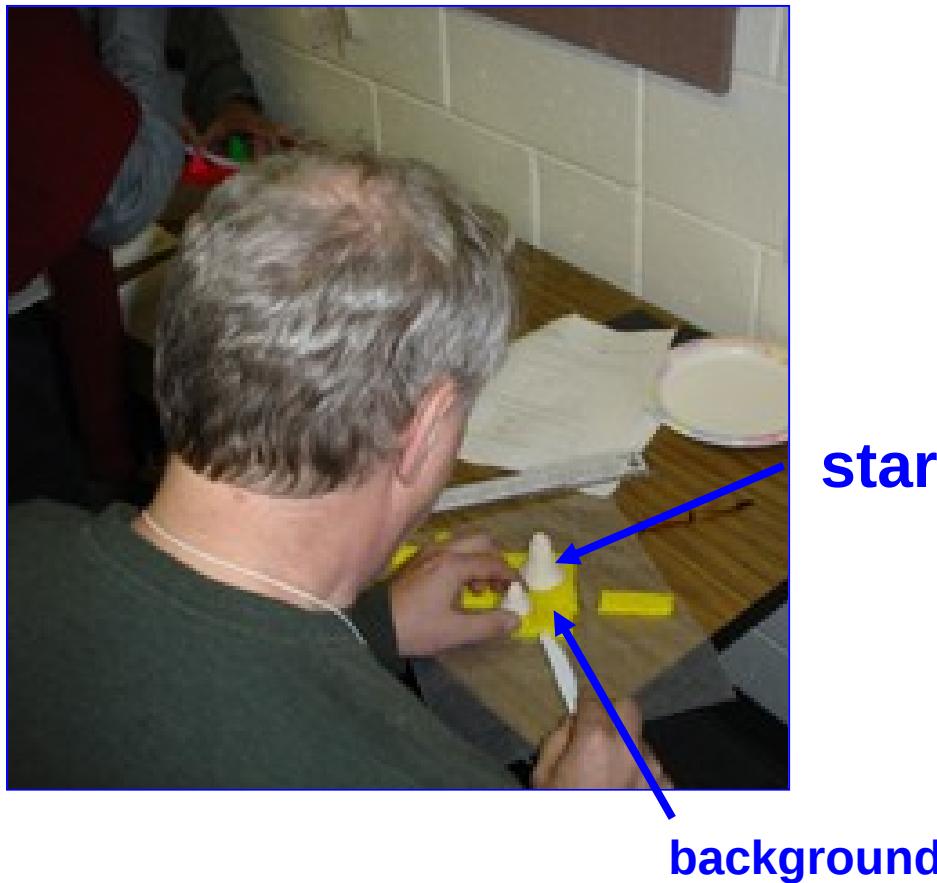
- Simple image reduction and analysis of ~15 AGN to establish variability baselines
- Hands-On Universe
- AAVSO participation



- 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



Cookie Cutter Photometry



- Goal is to remove background from stellar image
- Must also compare the brightnesses of the two stars in the “image”
- Tools: scale, ruler and plastic knife
- Also: Jelly Bean Spectroscopy – coming soon!

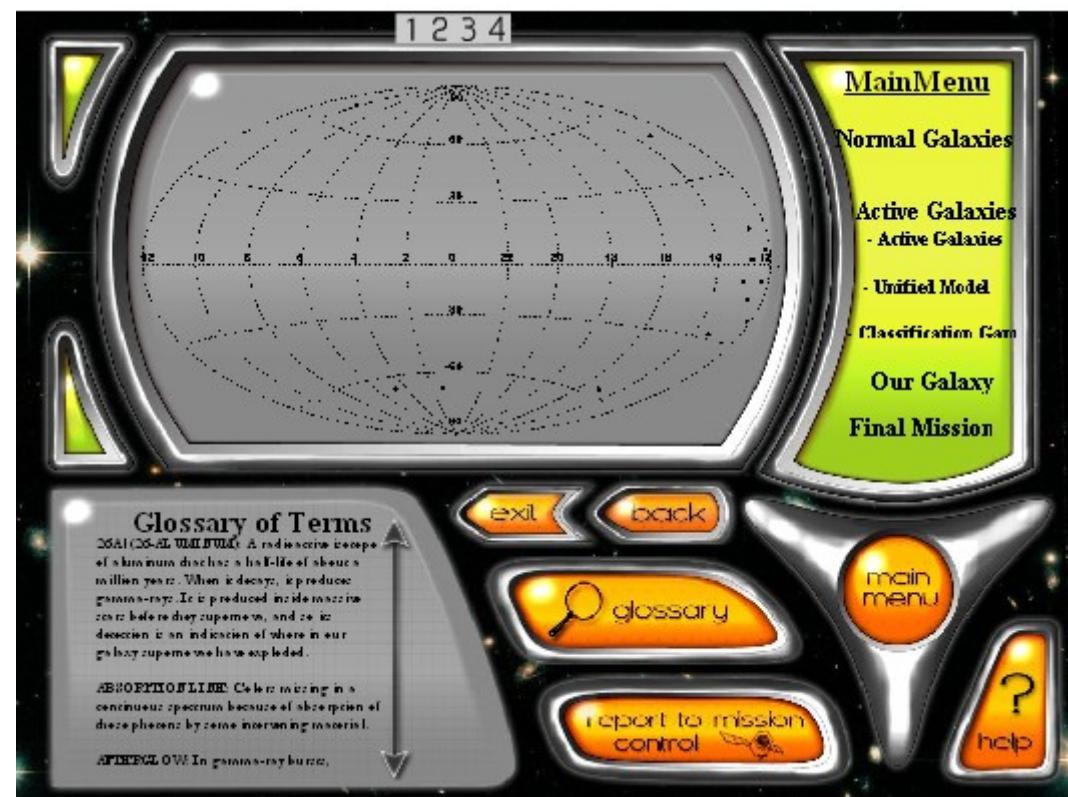


Space Mysteries



- <http://mystery.sonoma.edu>
 - Galactic Doom?
 - Solar Supernova?

New console
Still under
development





TOPS Learning Systems

► Far Out Math

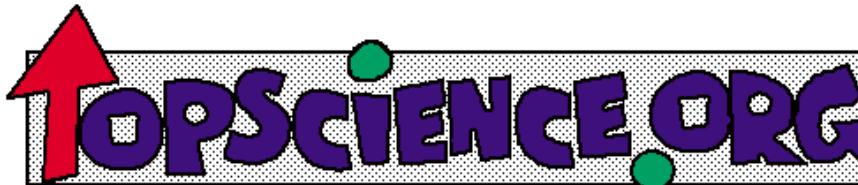
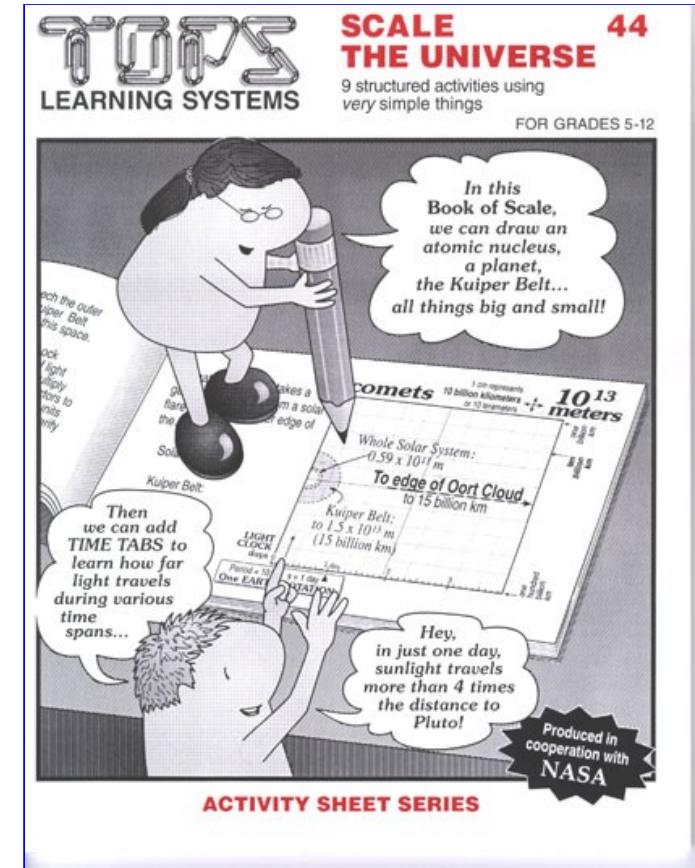
- Released in 2002
- Very widely in use now

► Scale the Universe

- Released in 2004
- Basis of You Are Here

► Pi in the Sky

- Now in print

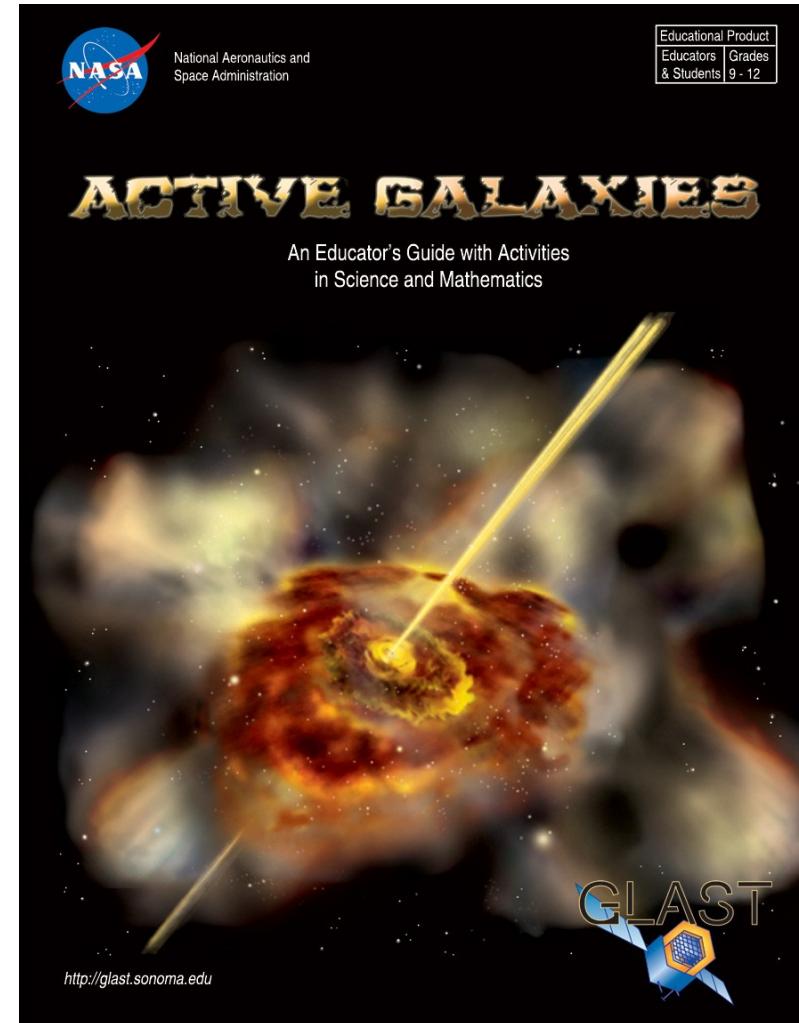


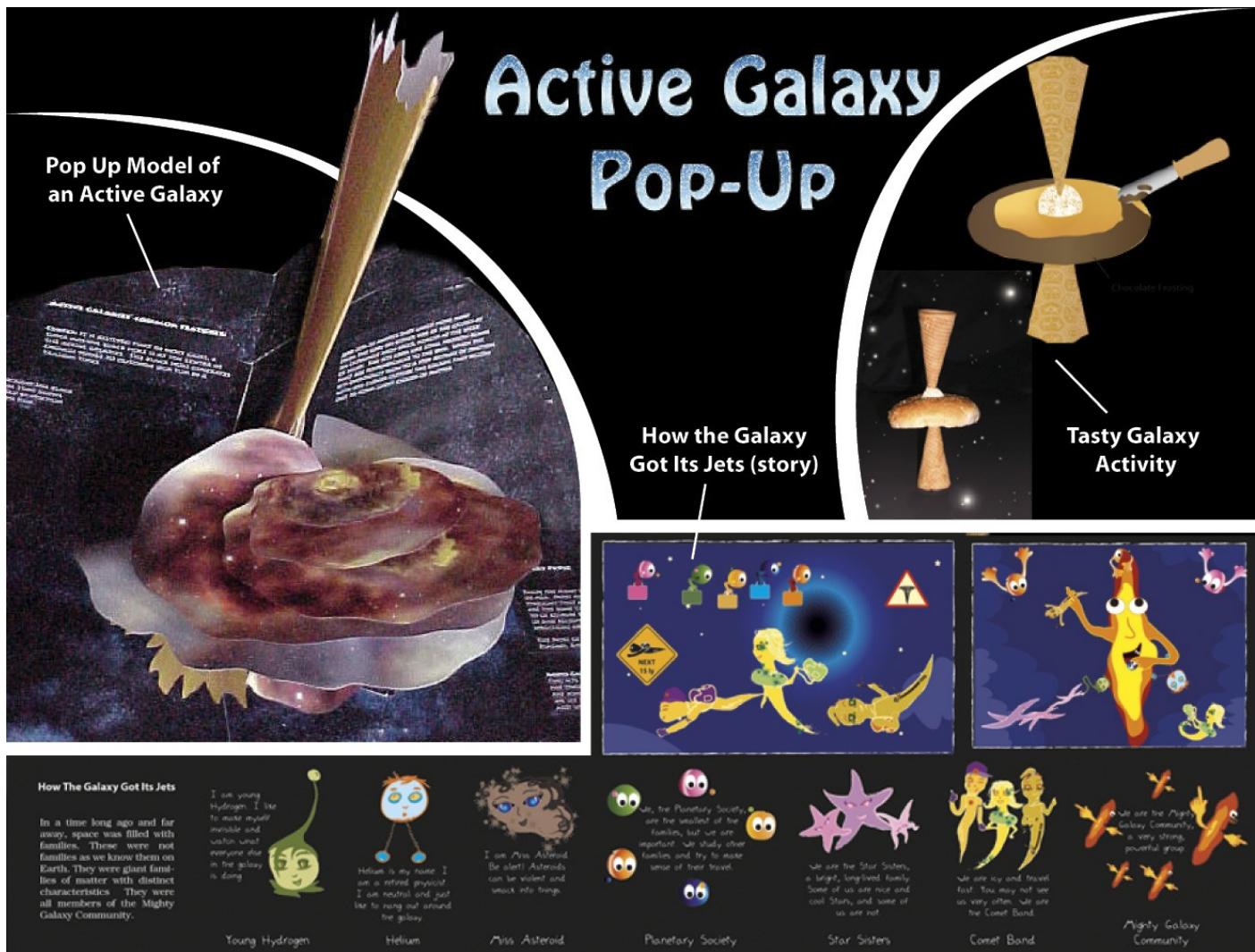
<http://www.topscience.org/>



Active Galaxy Educator's Guide

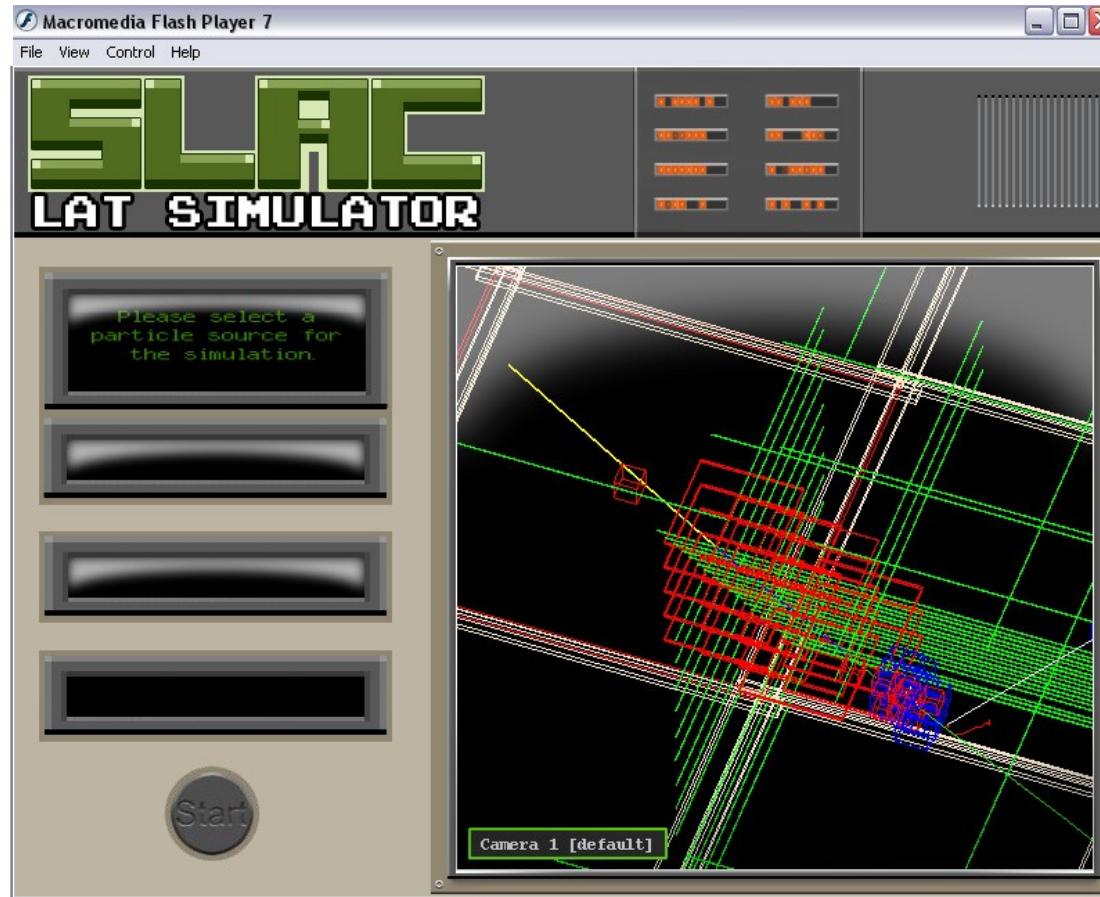
- Released in 2003
- 3 activities
 - Building Perspectives with Active Galaxies
 - Zooming in on Active Galaxies
 - Light Travel Time and the Size of Active Galaxies
- Poster of AGN
 - Widely used in many venues
 - Shows different angles, different zooms







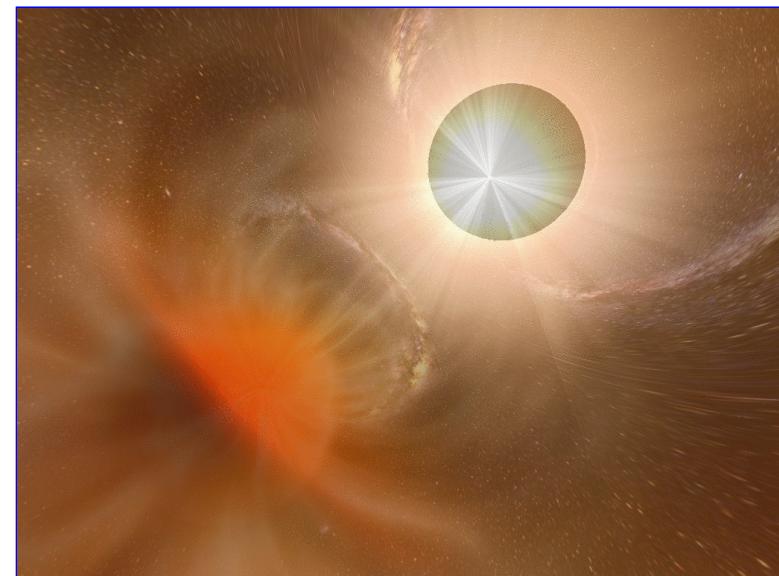
SLAC Virtual Visitor's Center



New console image – uses FRED to do simulation runs

- Tom Lucas productions - \$1M NSF grant to augment GLAST E/PO funds
- Program script now in development
 - NOVA Contract
 - Should air summer of 2006
- Planetarium show almost done

Still image
from black
hole flight
simulator
sequence





Supernova Educator Unit



Joint with

- 3 activities XMM-Newton

- Decaying Supernovae
- The Crawl of the Crab
- At the Heart of a Supernova



- Poster of Supernovae

- Images of supernovae at different wavelengths
- Shows what a Supernova looks like during different stages of the explosion



Supernova poster





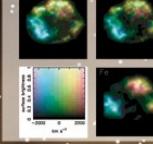
NASA

As shock waves from the explosion rip through the gas, it is heated and glows. Most of the emission comes from atoms in the gas that have been stripped of some of their electrons. The interaction of these electrons with the atoms, plus other very complicated physical processes, causes them to emit photons of visible light. Each atom glows at a characteristic color: oxygen produces mostly green and blue, hydrogen emits red and green, while





When the gas in the remnant is shocked and compressed, it can be heated to incredible temperatures, up to 100 million degrees. Given this temperature, it emits X-rays. Elements that are difficult to detect in visible light are easily seen in X-rays, such as calcium, iron, and argon. By carefully measuring the strength of the X-ray emission of these elements, scientists have been able to determine the amount of each element in the gas. Data like that clinched the





Supernova remnants are known to emit gamma rays, but only low-resolution, fuzzy images have been taken. There are three possible sources of gamma rays in a supernova remnant. 1) A neutron star in the collapsed core of the star that exploded — may give off gamma rays if it has a very strong magnetic field. This field can create and accelerate particles of high-energy matter, creating gamma rays. 2) A supernova remnant indicates powerful shock waves passing through the gas of the remnant also create gamma rays. 3) The radioactive decay of some elements, including nickel and cobalt, produce gamma rays as their nuclei disintegrate. GLAST will take the first high-resolution images of these gamma rays, giving scientists their first details on the sites where gamma rays are produced.



1. Time equals zero: The core of the star collapses.

2. Up to a few weeks: Expanding supernova increases in brightness because it grows in size.

3. After a few weeks: Expanding star cools, drops in brightness.

4. Several hundred to several thousand years: Expanding parts of star run into surrounding gas and dust. The collisions heat the gas to millions of degrees. Remnant glows in x-rays.

5. Thousands of years: Remnant continues to sweep up interstellar material, gradually slowing to a stop. Shocks weaken. Outer shell glows in emission lines from sulfur, oxygen, nitrogen, other elements.

6. Millions of years: Outer shell has stopped expanding. No longer radiates. The gas that was heated by shocks slowly radiates in x-rays. Can radiate in synchrotron emission if a pulsar is present.



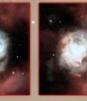




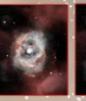


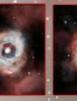


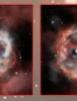


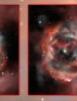


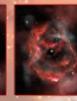


















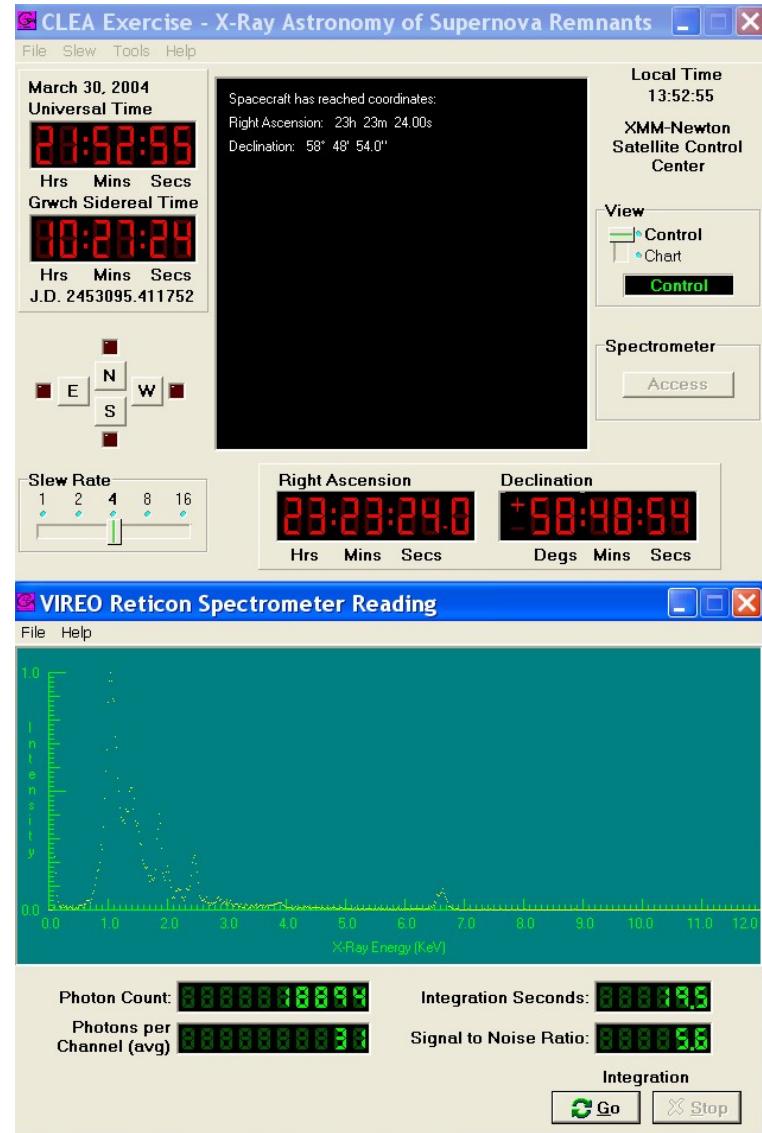


SUPERNOVAE



CLEA Laboratory

- Dying Stars and the Birth of the Elements
- Just returned from testing by WestEd
- Will be released in early 2006
- Uses simulated x-ray spectra to teach about the abundances of chemical elements in supernovae



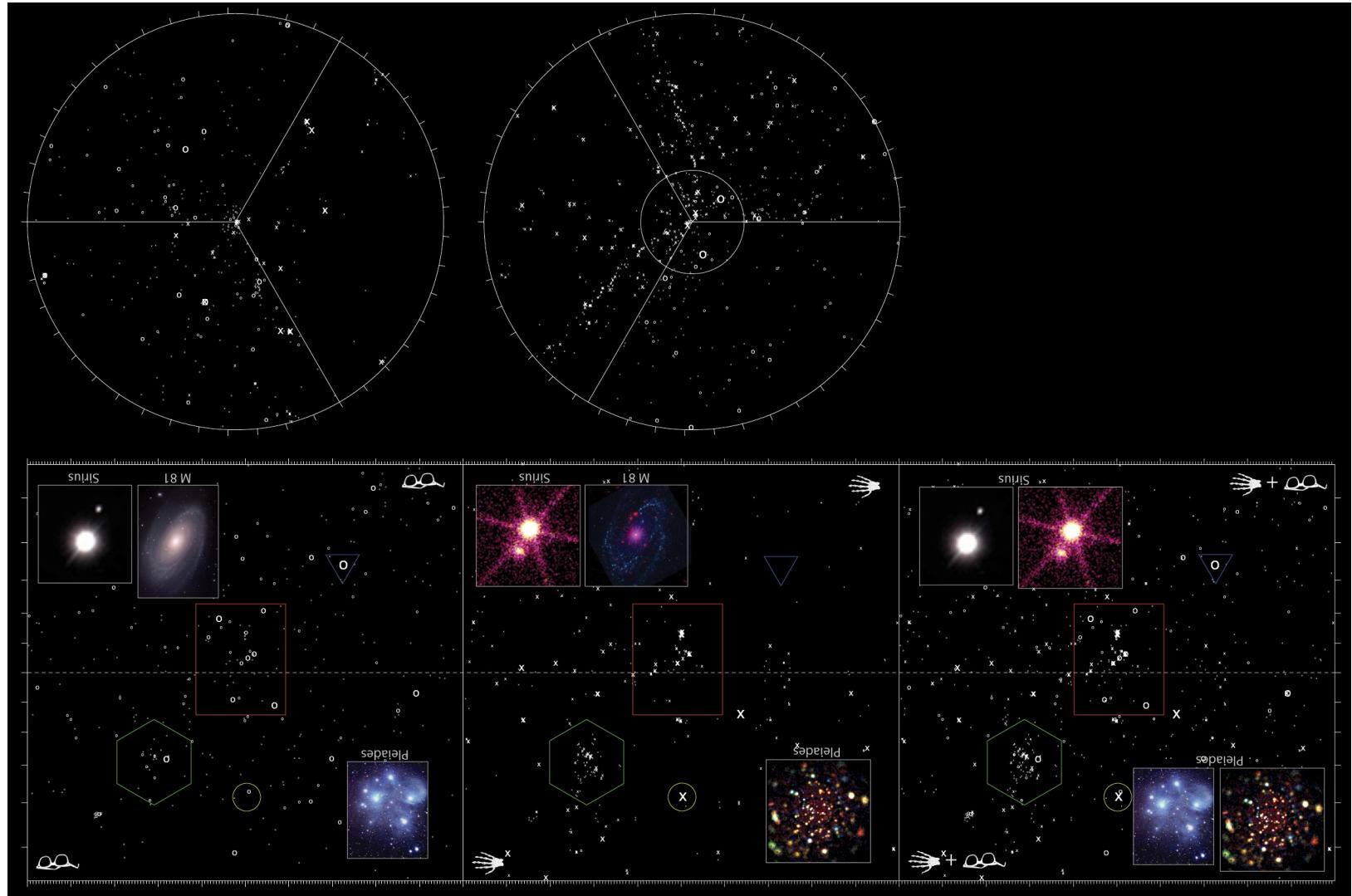


X-ray Sky Planetarium Show

- Being developed for Starlab or Digitalis portable planetaria
- Includes student manual and teacher's guide
- Compares optical and x-ray sky and images of several interesting regions



X-ray Sky Planetarium Show





Partnership with Space Place

- Black Hole Rescue!
- <http://spaceplace.nasa.gov/en/kids/blackhole>
- New interactive black hole spelling game
- Catch the letters to spell words before they disappear!

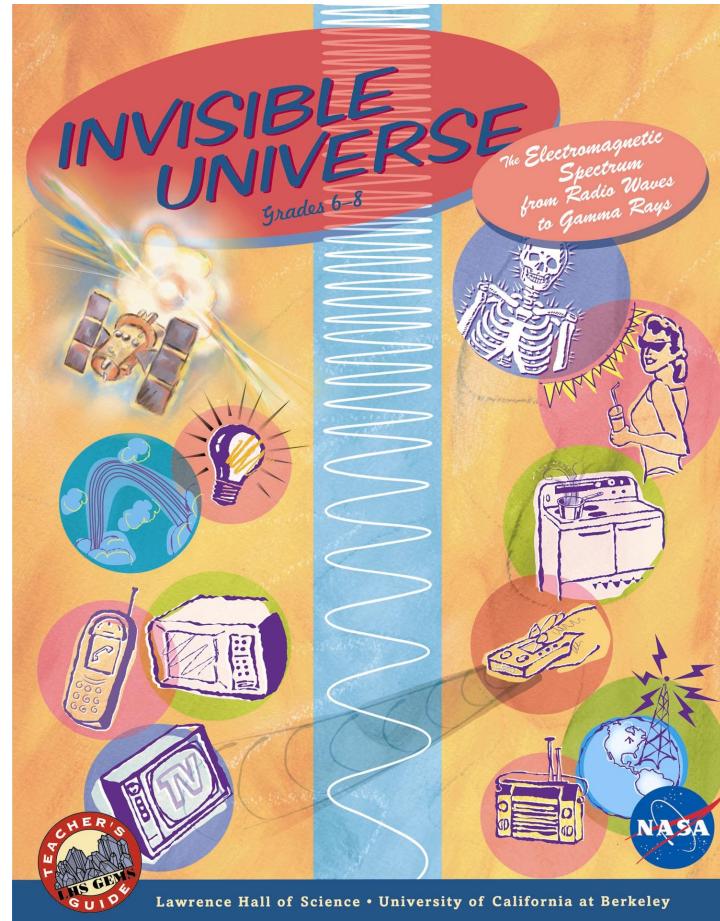




Swift: Catching Gamma Ray Bursts on the Fly

GEMS Invisible Universe

- Developed by SSU and GEMS for Swift
- Very popular!

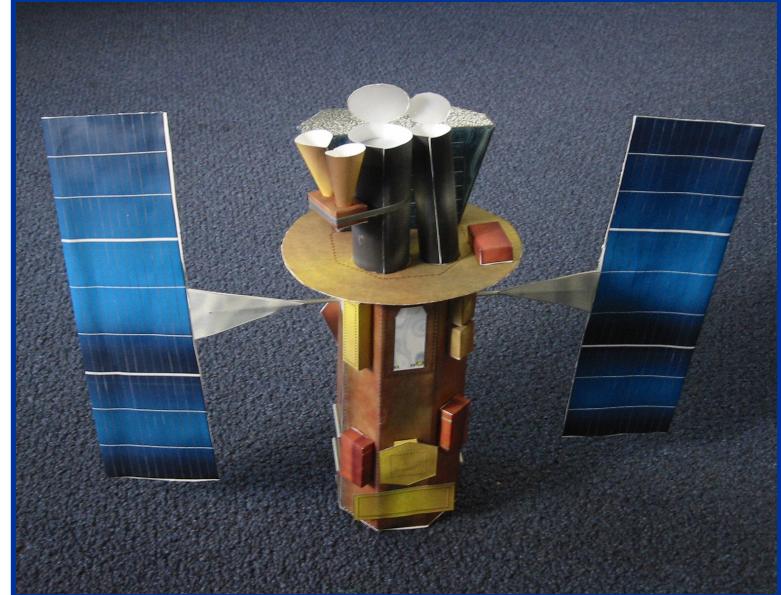
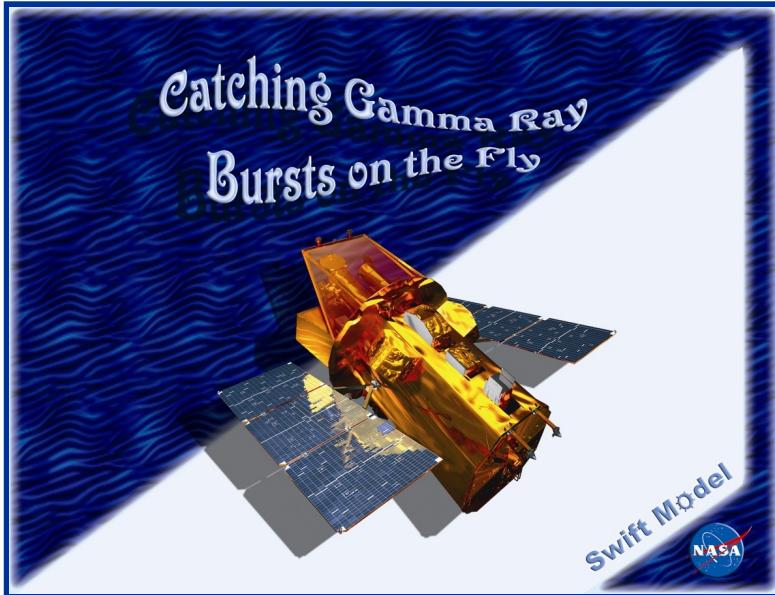


Lawrence Hall of Science • University of California at Berkeley



Swift model booklet

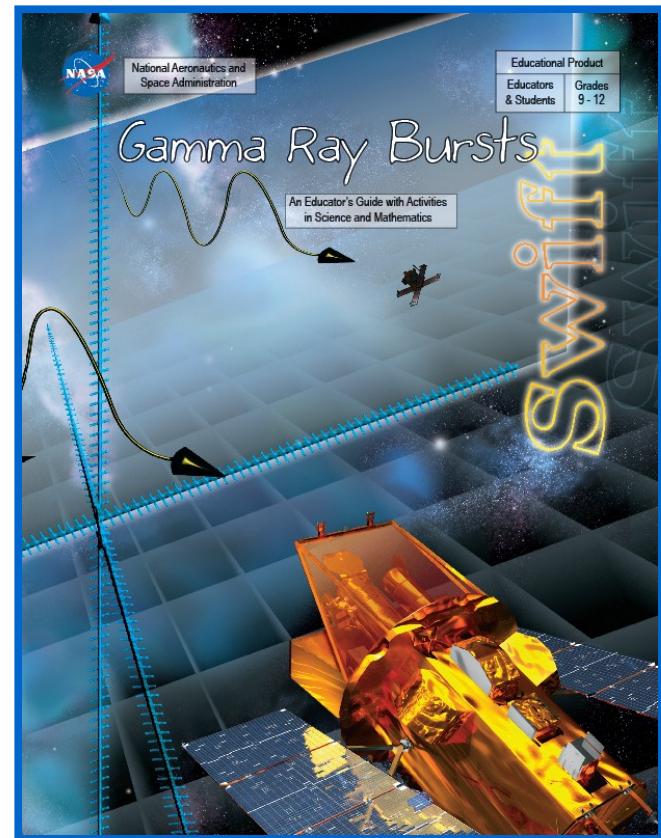
- Build a model of Swift – launch product





GRB Educator's Guide

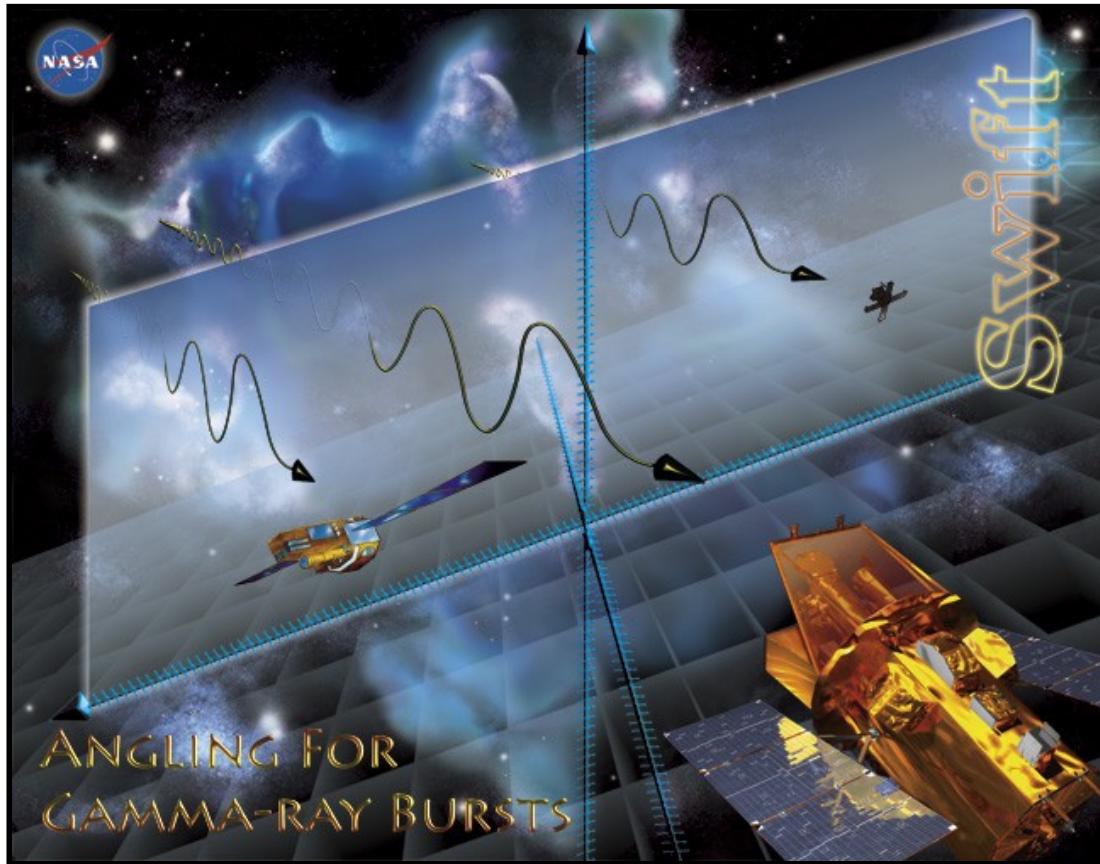
- Aligned with national mathematics and science standards
- Four classroom tested activities
 - Sorting out the Cosmic Zoo
 - Angling for GRBs
 - GRB Distribution on the Sky: The Plots Thicken
 - Beam Me Up!





Angling for GRBs poster

- Classroom poster that accompanies GRB guide





Swift: Catching Gamma Ray Bursts on the Fly

Swift Newsletter

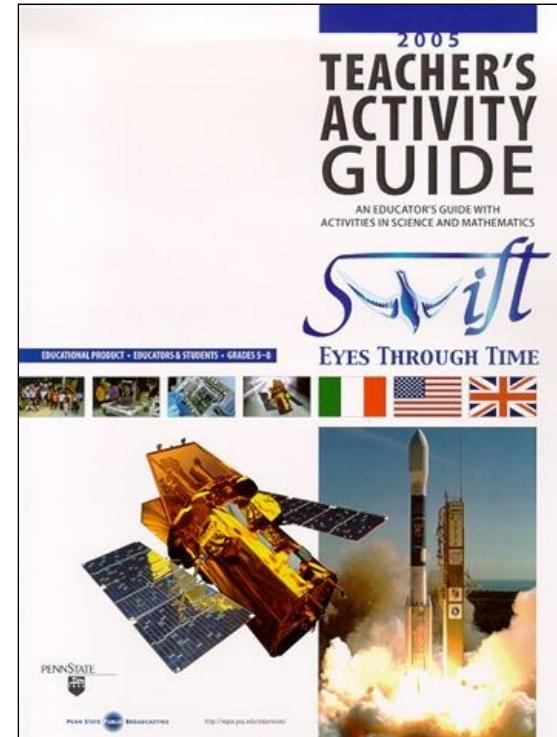
- <http://swift.sonoma.edu/resources/multimedia/newsletter/>
- Second issue now online:
- To subscribe:
<http://swift.sonoma.edu/resources/multimedia/newsletter/signup.html>





New from Penn State E/PO: Eyes through Time

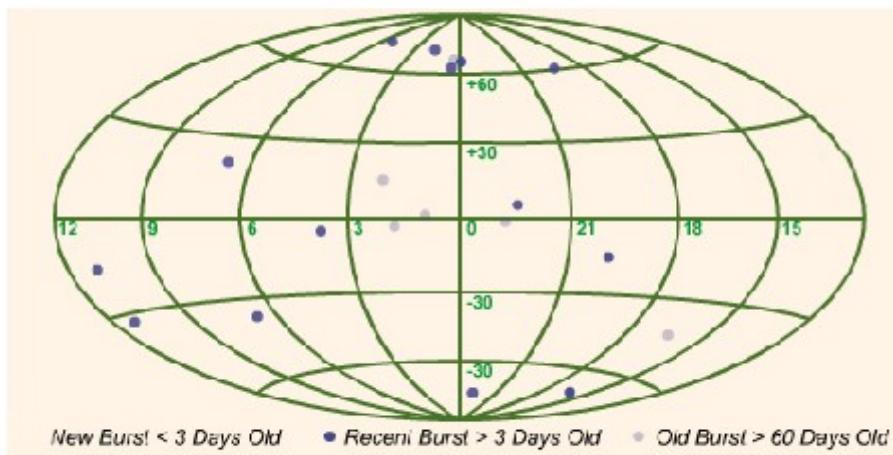
- Six 5-minute video segments on a DVD, each with activity – some from WITN?
- Focus is process of Science
 - Earth, the Universe and Culture
 - Theories
 - Accidental Discoveries
 - The Relationship Between Science and Technology
 - Looking Back in Time
 - Creativity in Science
- Being field-tested this summer by PSU Astronomy Workshop teachers and EAs





GRB SkyMap: <http://grb.sonoma.edu>

- New version coming soon – will include expanded burst table
- Over 250,000 unique hits to date





External Evaluation

- All formal educational products are evaluated by WestEd
- Some informal educational products also
- Scientific review by team members
- Dissemination studies now underway
- Tracking results of teacher training into classroom effectiveness



For more information

- **GLAST:** <http://glast.sonoma.edu>
- **Swift:** <http://swift.sonoma.edu>
- **XMM-Newton:** <http://xmm.sonoma.edu>
- **GRB Sky:** <http://grb.sonoma.edu>
- **Space Mysteries:** <http://mystery.sonoma.edu>
- **GTN:** <http://gtn.sonoma.edu>
- **Our group:** <http://epo.sonoma.edu>
- **Ordering materials:**
<http://epo.sonoma.edu/orderformpublic.html>