



The Invisible Universe

Prof. Lynn Cominsky

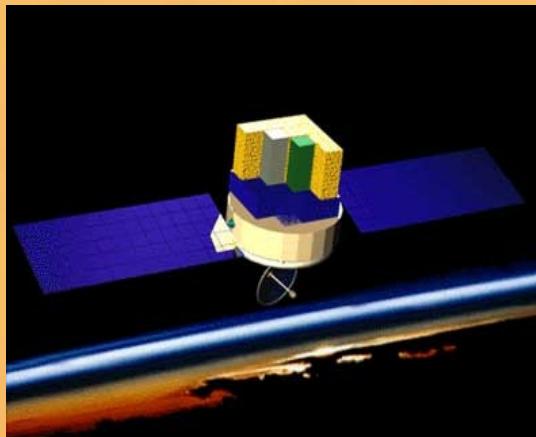
Sonoma State
University

The NASA E/PO Program at Sonoma State University



A group of ten people working collaboratively to educate the public about current and future NASA High Energy Astrophysics/Astronomy Missions.

GLAST

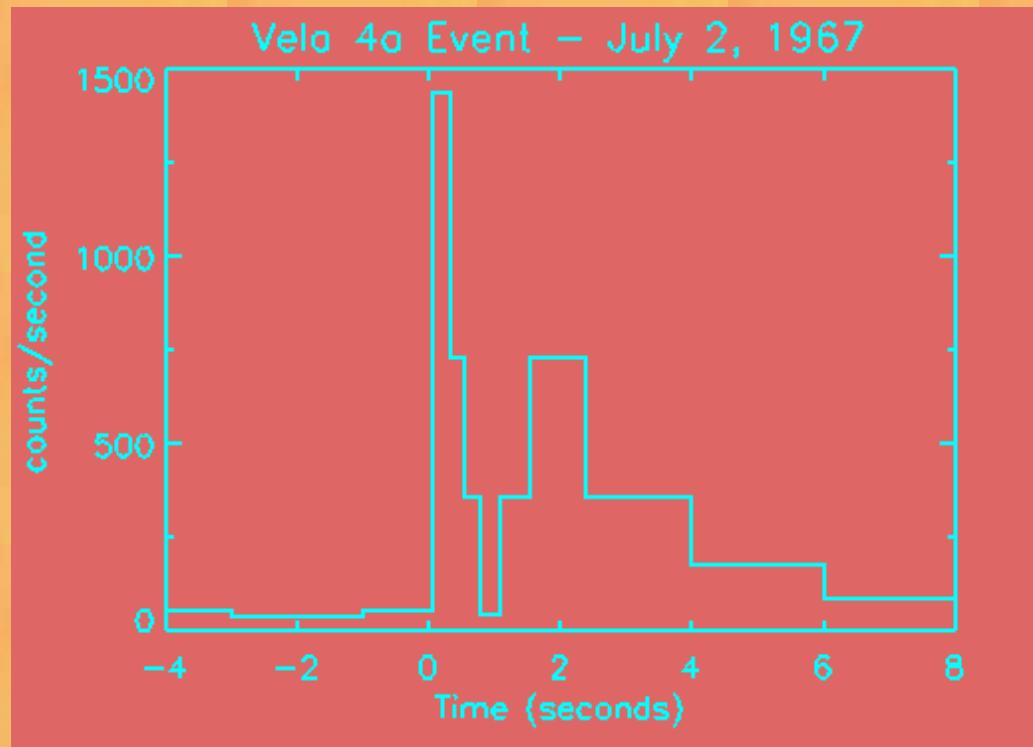


XMM Newton

**Space
Mysteries**

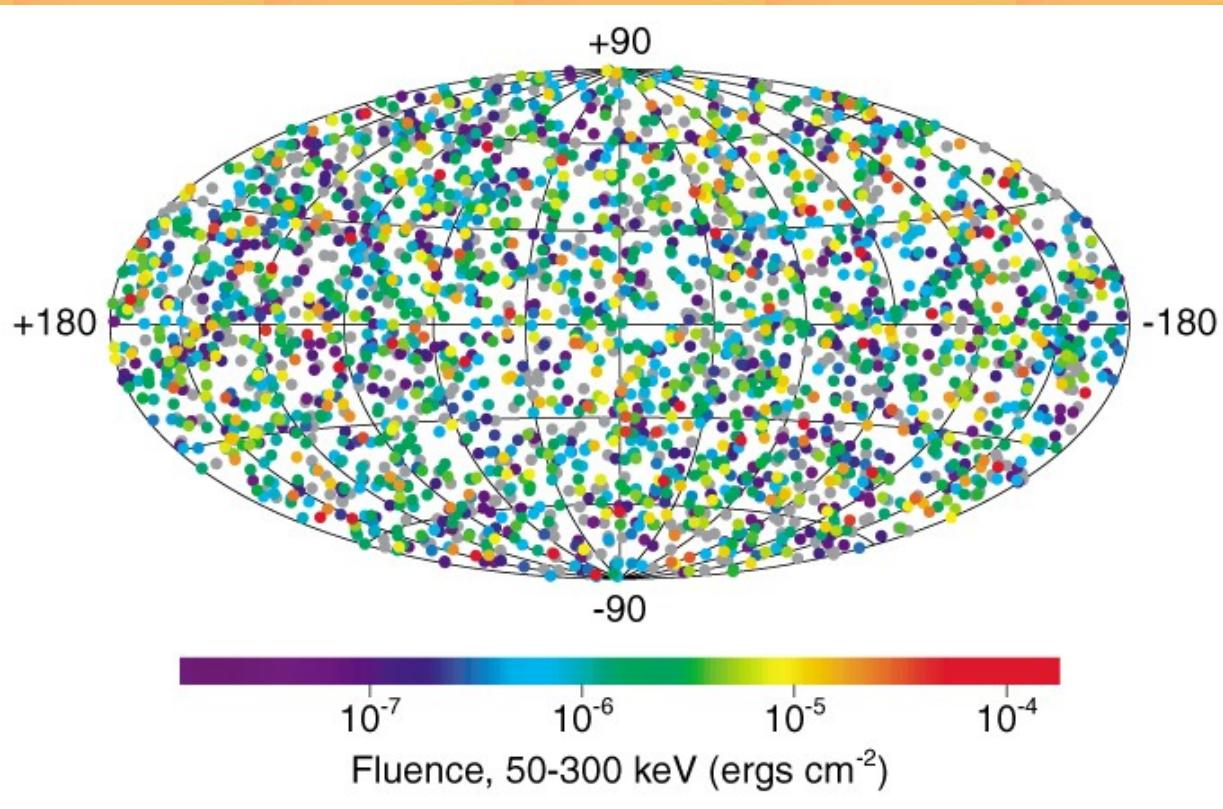


Gamma-ray Bursts



Discovered in 1967 while looking for nuclear test explosions - a 30+ year old mystery!

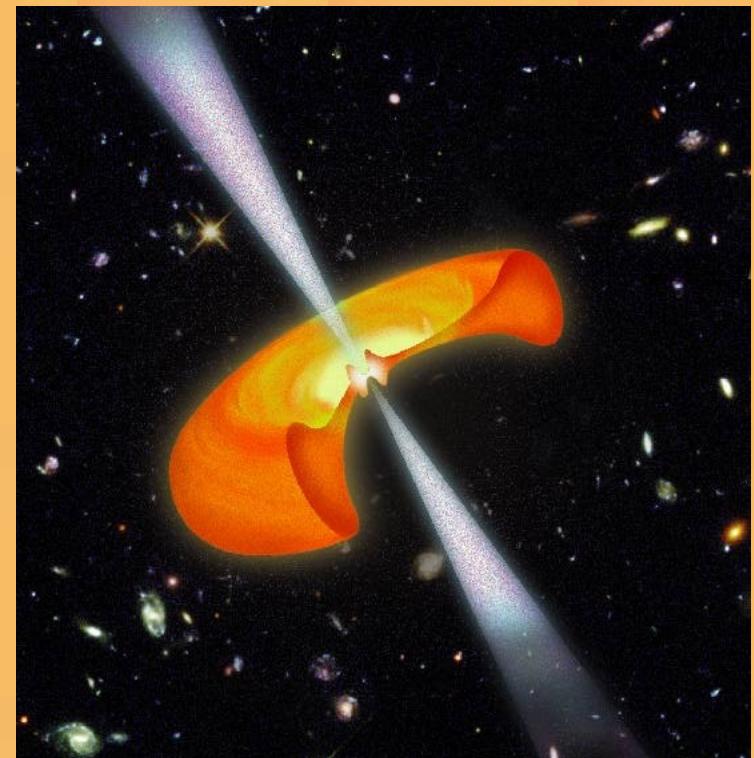
Gamma-ray Burst Sky



Once a day, somewhere in the Universe

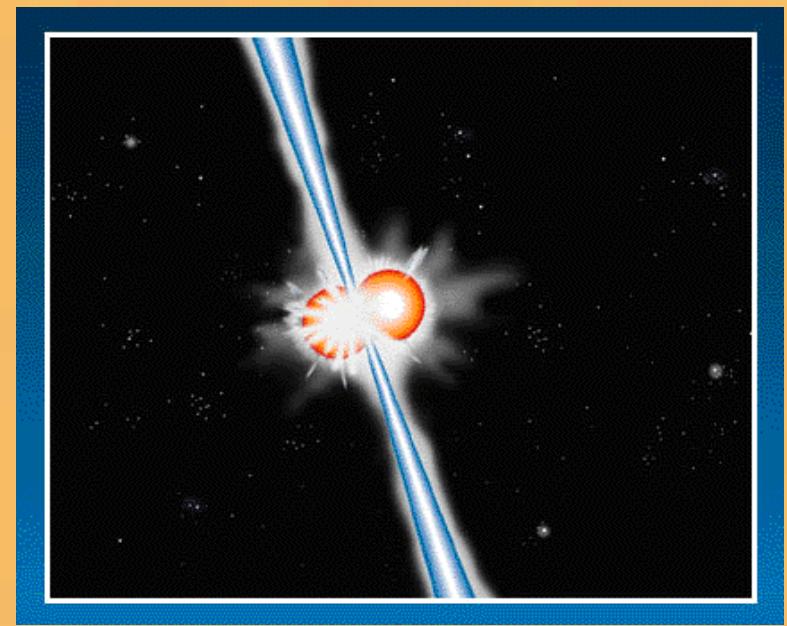
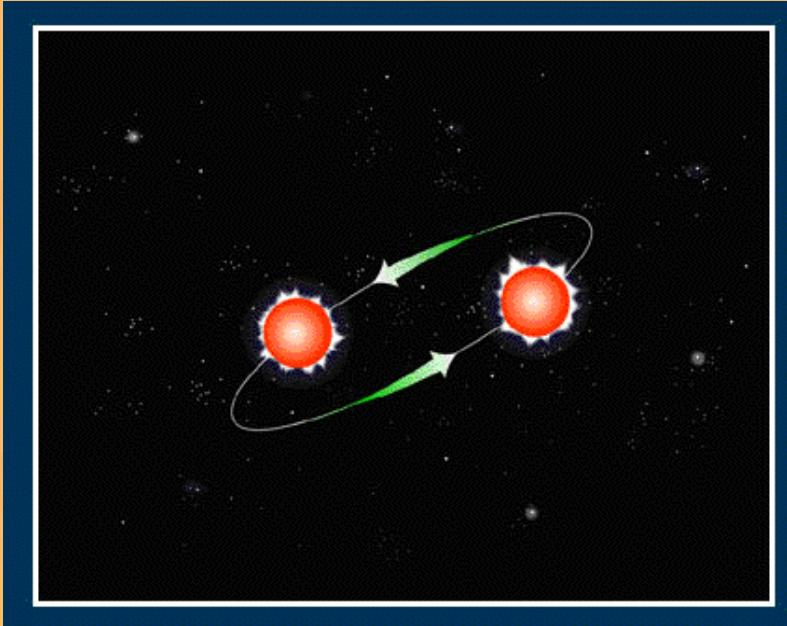
Hypernova

The end of the life of a star that had 100 times the mass of our Sun



A billion trillion times the power from the Sun

Catastrophic Mergers



Death spiral of 2 neutron stars or black holes

Gamma-ray Bursts

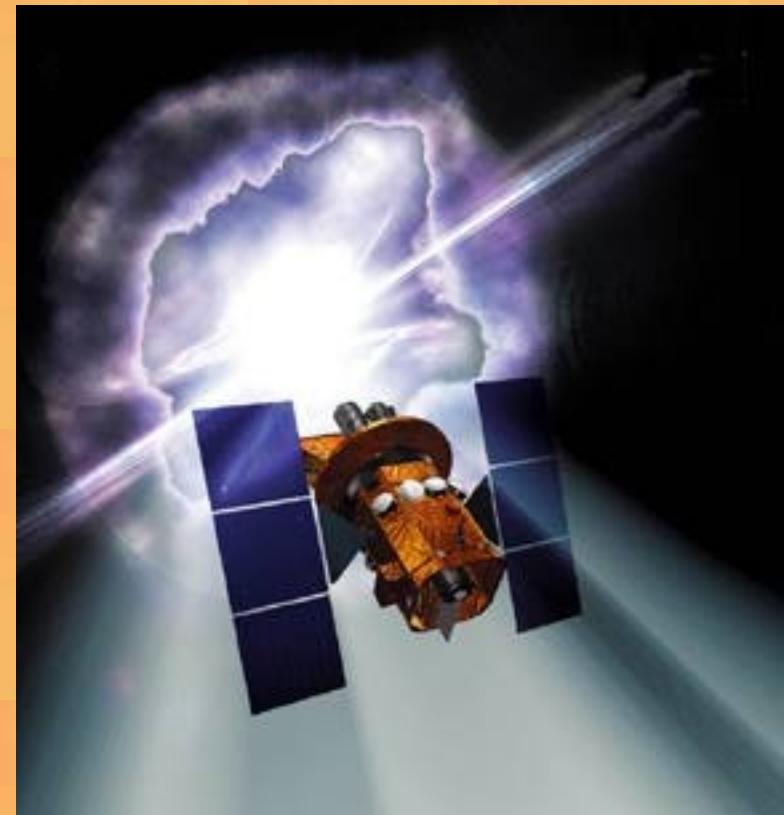


- Either way, when we see a GRB, we are seeing the birth of a black hole
- GRBs bring tremendous excitement to the classroom!

Swift Mission

To be launched in 2004

- Burst Alert Telescope (BAT)
- Ultraviolet/Optical Telescope (UVOT)
- X-ray Telescope (XRT)



Swift Mission

- Will study GRBs with “swift” response
- Survey of “hard” X-ray sky
- To be launched in 2004
- Nominal 2-year lifetime
- Will see ~150 GRBs per year



The GEMS Series

- The **Great Explorations in Math and Science** Program has developed over 70 educators guides for use in classrooms
- GEMS guides are tested in the classroom nationwide
 - Come with clear step-by-step instructions
 - Assessment suggestions
 - Ideas for further investigations

The Invisible Universe



The electromagnetic spectrum from radio waves to gamma rays...

A workbook and teachers guide inspired by the **Swift** mission and developed in collaboration with the GEMS Program.

Activities in this book:

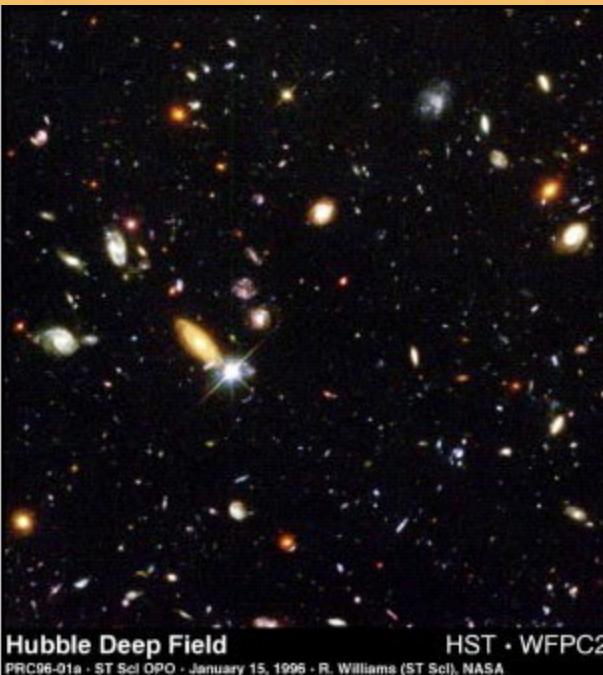
- Activity 1: Comparing Wave Makers
- Activity 2: Invisible Light Sources and Detectors
- Activity 3: Putting the Electromagnetic Spectrum Together
- Activity 4: Tour of the Invisible Universe
- Activity 5: The Most Powerful Explosions in the Universe

The Invisible Universe

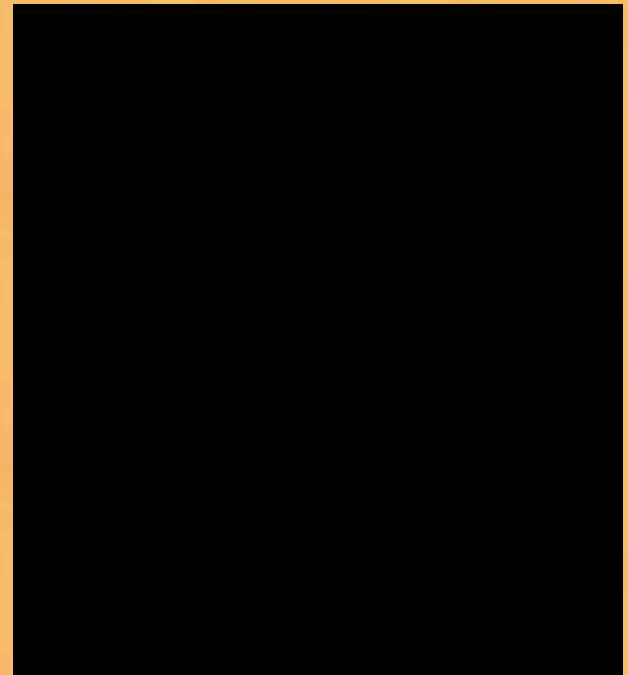


The electromagnetic spectrum from radio waves to gamma rays...

The Visible Universe



The Invisible Universe

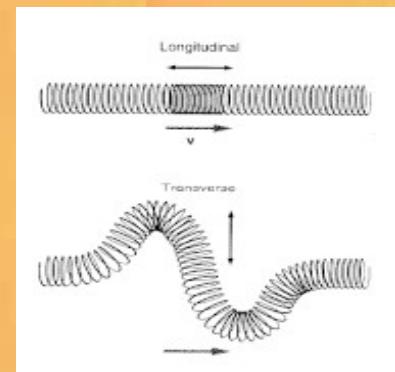


Activity 1

Activity 1: Comparing Wave Makers

A series of news flashes set the stage for the unit by introducing the mystery of gamma-ray bursts.

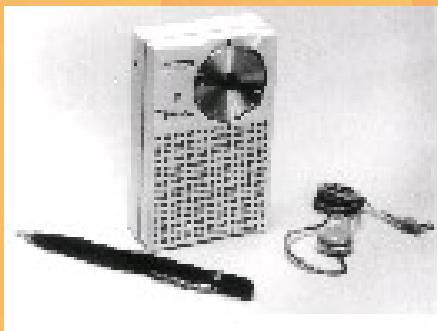
To work toward understanding gamma rays as very high energy waves, students first investigate properties of simple waves produced in different media.



Activity 2

Activity 2: Invisible Light Sources and Detectors

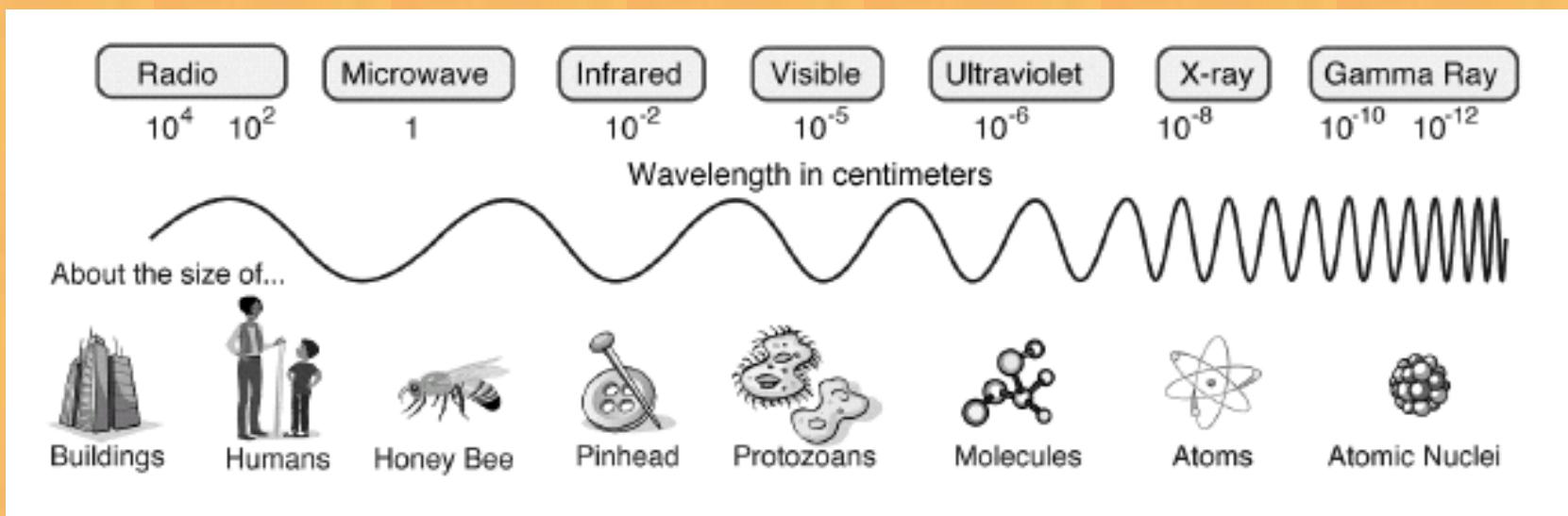
Students work at different learning stations to explore different kinds of light energy and how they can be detected, emitted, and absorbed.



Activity 3

Activity 3: Putting the Electromagnetic Spectrum Together

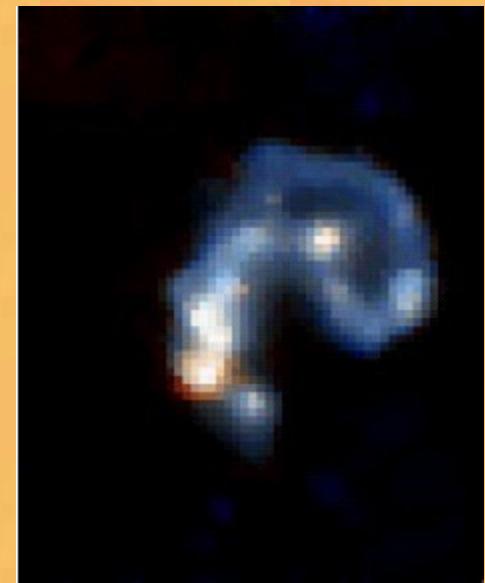
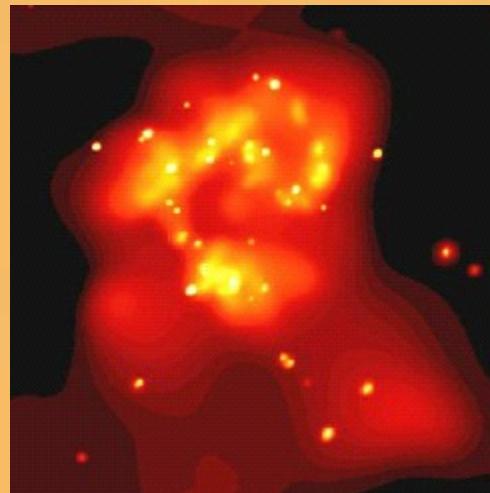
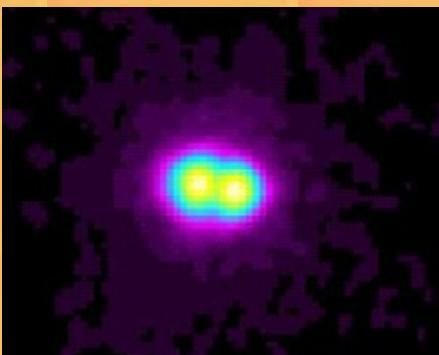
In this activity, students have an opportunity to sort cards that contain information about the main regions of the electromagnetic spectrum.



Activity 4

Activity 4: Tour of the Invisible Universe

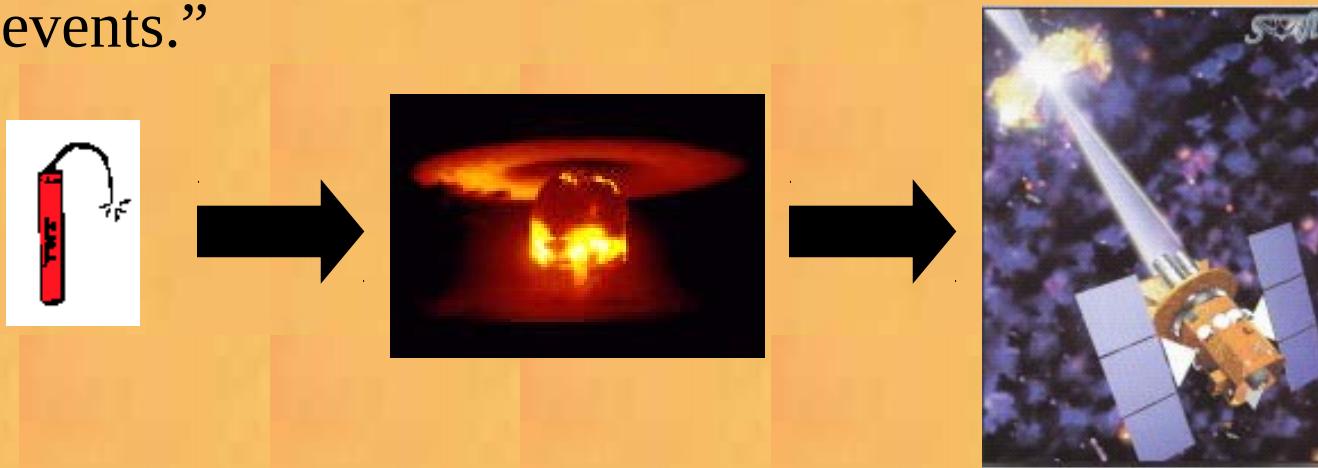
This presentation is intended to help students improve their understanding of objects in the Universe, including those connected with gamma-ray bursts.



Activity 5

Activity 5: The Most Powerful Explosions in the Universe

Students return to the gamma-ray burst mystery that opened the unit. Since it is so difficult for anyone to grasp the amount of energy unleashed every day in space, students climb a mental ladder of “energetic events.”



GEMS Activity 2 - Sources



Question: Name some visible sources of light in the room

Flashlight



Projector



Laptop Monitor



Question: Is the screen at the front of the room a light source?

But it seems to be emitting light?

Oh, I see the screen is reflecting the light, not emitting it.

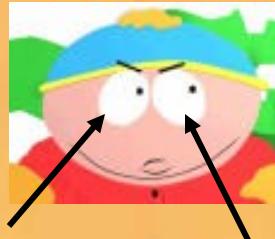
Definition: Sources of light are
objects that emit light energy

GEMS Activity 2 - Detectors

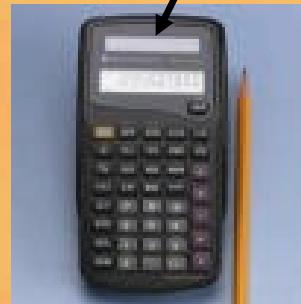


Question: Can you tell me where there are light detectors in this room?

Those two openings on either side of our noses!



Solar
Calculators



Motion Sensitive
Light Switches



Cameras



Question: Are there any other light detectors that you know of?

GEMS Activity 2 – Transmitters and Shields

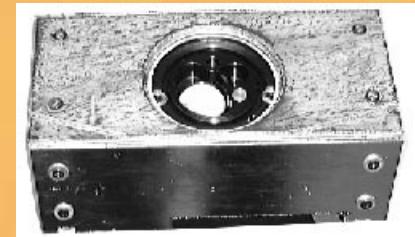
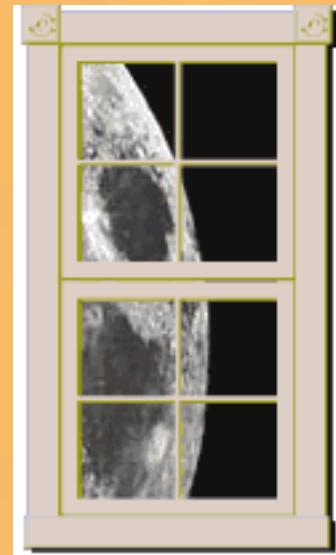


Question: What are some things that don't allow light through?

Is it safe to say these things “Shield the Light”?

Question: What are some materials we know of that do allow light to either completely or partially pass through it?

Is it safe to say these things “Transmit the Light”?



GEMS Activity 2 – Invisible Sources



In addition to visible sources of light in the room there are many invisible sources of light too.

Question: Can anyone name any invisible sources of light in the room?

Infrared Heat Lamps



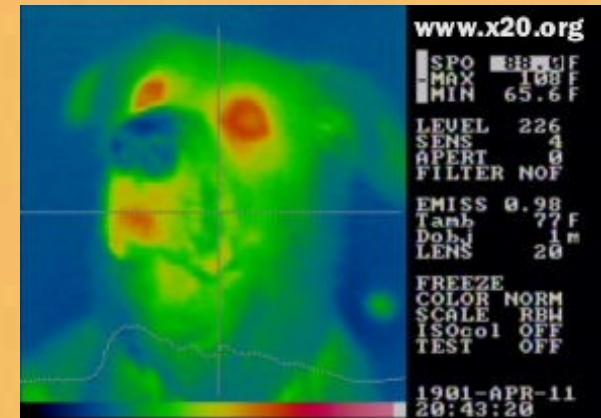
UV Black Light



Infrared Remote



Yes! Us.



GEMS Activity 2 –



Invisible Sources of Light

- There are 6 different stations throughout the room, each with three setups.
- They are equipped with a source of invisible light and a detector for detecting that light.
- In a moment we will break up into groups.
- Each station will have a set of materials.
- These materials are potential shields.

GEMS Activity 2 - Procedure



- Each group will go from station to station. You have about 5 minutes per station.
- As scientists we are obligated to make a prediction about how we think each material will behave. **DO THIS FIRST!**
- Then test each material at each station to see if it is a **Transmitter (T)** or a **Shield (S)** for that particular type of light.
- Try to determine the common properties of the materials that block the different types of light

Stations:

- AM Radio
- Infrared lamp
- Flashlight
- FM Radio
- Remote control
- “Black” light

Let's Get Busy!

GEMS Activity 2 – What did we learn?



Question: What property of the materials we tested caused radio waves to be blocked?

Question: Are all the plastics we tested translucent/transparent to infrared light?

Question: If someone had no sunscreen while at the beach what could they cover their face with to keep from getting sun burned by UV light?

GEMS Activity 2 – Reflection



- Each group should pick a station.
- Try to figure out which of your materials can reflect the invisible light of that station.
- Try and use what you have learned in the previous section to test your ideas in this section.

Question: What did you find out?

Other SSU E/PO events:

- **Dr. Phil Plait presents: Nature's Second Biggest Bangs: The Gamma Ray Burst Zoo in LBCC 202B Saturday 2 – 3 PM**
- **Sarah Silva presents: Huge Black Holes: Measuring the Monster in the Middle in LBCC 202B Saturday 3:30 – 4:30 PM**
- **Dr. Phil Plait's luncheon talk, “Seven Ways a Black Hole Can Kill You” in Regency Ballroom A on Sunday, 11:30 – 2:00 p.m.**

More Information

- Swift - <http://swift.sonoma.edu>
- GLAST – <http://glast.sonoma.edu>
- XMM Newton - <http://xmm.sonoma.edu>
- NASA EPO @ SSU – <http://epo.sonoma.edu>
- Space Mysteries – <http://mystery.sonoma.edu>
- **To order our materials:**

<http://epo.sonoma.edu/orderforms/orderformpublic.html>

