The Invisible Universe

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What do we see?

The Visible Universe

The Invisible Universe

Hubble Deep Field

HST • WFPC2

PRC96-01a • ST ScI 0PO • January 15, 1996 • R. Williams (ST ScI), NASA
The atmosphere as a “shield”
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.

• *Swift* is a NASA mission that studies Gamma-ray Bursts – the most energetic explosions observed in the Universe today. Occurring about 1/day, each GRB signals the birth of a black hole.

• Today’s workshop:
  
  Activity 2: Invisible Light Sources and Detectors
GEMS Activity 2 - Sources

Can you name some common sources of visible light?

Sources of light are objects that emit light energy

- Flashlight
- Projector
- Laptop Monitor
Can you name some common light detectors?

Film

Those two openings on either side of our noses!

Digital detector

What other types of detectors for invisible light do you know?
Transmitters and Shields

What are some materials or objects that block visible light? (We will call these “shields.”)

What are some materials that allow visible light to partially pass through?

What are some materials that transmit (almost all) visible light?
Invisible Light Sources

Can you name any invisible sources of light that are in the room (or your house) with you right now?

- Infrared Remote
- Microwave and conventional oven
- You!
In your kit...

- GEMS guide
- “Black light” with batteries
- UV beads
- Highlighter
- Worksheet for the activity
- Many materials to use as shields:
  - Cloth
  - Paper
  - Wax Paper
  - Clear Plastic
  - Black Plastic
  - Plastic Baggie
  - Plastic Screen
  - Metal Screen
  - Aluminum Foil
Modified Activity

- In this online version of the GEMS activity, we will use three different light sources:
  - Flashlight
  - TV remote control
  - “Black” light (provided to you)
- What energies of light are emitted by each of these sources?
Detectors

- What are good detectors for the flashlight?
- The highlighter is the detector to use for the “black” light – write something with it on your piece of white paper
- What happens to it when it is exposed to the “black” light?
- What is a good detector for the remote control?
Procedure

- We are going to investigate how well different materials shield the light sources.
- As scientists we are obligated to make a prediction about how we think each material will behave – so please fill out your worksheet before we start the experiment(s) – Indicate whether you think the material will be a **Transmitter (T)** or a **Shield (S)** or a **Partial Shield (P)** for that particular type of light.
- Try all the materials in your packets for each light source to determine the results and record them on your worksheet.
Other experiments you can do

• Online demonstrations using some other sources and detectors
  – FM Radio – is this a source or a detector?
  – Infrared heat lamp – what would be a good detector for this source?
  – UV bead detectors
What did we learn?

• Were you surprised by the behavior of some of the materials?
• If someone had no sunscreen while at the beach what could they cover their face with to keep from getting sunburned by UV light?
• Do you think your students would know that a (AM or FM) radio is a light detector? What would they say about an old-fashioned TV that has an antenna?
Other contents in the GEMS guide

- Activity 1: Comparing Wave Makers
- Activity 3: Putting the Electromagnetic Spectrum Together
- Activity 4: Tour of the Invisible Universe
- Activity 5: The Most Powerful Explosions in the Universe
- Also supplementary material including background for the teacher on the EMS and GRBs, supporting resources, glossary, units, the story of “Swift and an Astronomer”, and more!
- The guides that we provided to you are the new edition that is now available (2011) from LHS.
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 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.”
Homework 4

• Be sure to answer the Forum questions in Homework 4 before July 5:
  – Describe some aspect of the experiments that we did that was new or surprising to you.
  – Do people and ordinary objects give off electromagnetic radiation? How about X-rays?
  – How do you think Superman’s X-ray vision works? What is the source and what is the detector?
Additional resources

• Swift Education web site: http://swift.sonoma.edu
• GRB real time skymap: http://grb.sonoma.edu
• GRB Lotto game for your students to play: http://swift.sonoma.edu/grb_lotto/index.php
• The Global Telescope Network (internet access to a network of 14-inch telescopes to study GRB afterglows): http://gtn.sonoma.edu