Classroom Activity

10 Big Question: How did the Universe begin?

Quiz: Gamma-rays

To extent your knowledge about gamma-rays, do some research and find the answers to the following questions-

1. What are Gamma-rays?
2. What natural processes on Earth produce gamma-rays?
3. Which astronomical process can produce gamma-rays?
4. At what frequency will you typically find gamma-rays?
5. Who was the first person to discover gamma radiation? What did they discover?
6. What are the 3 basic processes that gamma-rays could undergo when they pass through matter?
7. Name some examples of gamma-ray observing and measuring platforms.
8. What is a gamma-ray burst?
9. How many more times does a gamma-ray burst shine compared to a typical supernova and our sun?
10. What are the two classes of gamma-ray bursts?
11. On which satellite was the first gamma-ray telescope carried into orbit?
12. What is the name of the current gamma-ray observatory in orbit?

Answers

1. Gamma-rays (or gamma radiation) are the highest energy, shortest wavelength electromagnetic radiation, with over 10,000 times more energy than visible light protons.

2. Natural processes on Earth that produce gamma-rays include gamma decay from naturally occurring radioisotopes and secondary radiation from various atmospheric interactions with cosmic ray particles. Lightning strikes and terrestrial gamma-ray flashes, which produce high energy emissions from natural high-energy voltages, are rare sources of gamma-rays on Earth.

3. Gamma-rays can be produced astronomically during, but not limited to, cosmic ray interactions with interstellar gas, supernova explosions, and interactions of energetic electrons with lower energy light such as starlight, infrared light, and the cosmic microwave background (relic of the Big Bang).

4. Gamma-rays typically have frequencies above 10 exahertz (or >1019 Hz)

5. Paul Villard, French chemist and physicist, discovered gamma radiation in 1900. He found that gamma-rays differed from x-rays because they had a much greater penetrating depth.

6. Compton scattering, photoabsorption and pair production.

7. Some examples are:

    - High-altitude balloons
    - Gamma-ray Imaging Platform (GRIP)
    - Satellites
    - Detectors and telescopes
    - Spectrometers (GRIS – Gamma-ray Imaging Spectrometer)
    - Photometers
    - Scintillation detectors
    - Solid state detectors
    - Compton scattering detectors
    - Pair telescopes
    - Air Cerenkov detectors (ground-based)

8. A short lived burst of gamma-ray photons, usually associated with special types of supernovae, the explosions of a dying star.

9. Gamma-ray bursts shine hundreds of times brighter than a typical supernova and about a million trillion times brighter than our sun.

10. Long-duration (bursts that last more than 2 seconds) and short-duration (bursts that last less than 2 seconds).

11. Explorer XI satellite, launched in 1961.

12. The Fermi Gamma-ray Space Telescope, formally known as the Gamma-ray Large Area Space Telescope (GLAST).