

Space: *Discussion Guide*

Overview

Space, the final frontier—or a never-ending source of fascination? Bring the wonders of the universe down to Earth with this discussion guide and its related videos and activities.

Students will begin with a look at celestial bodies and humans' discoveries of them. Then, they'll investigate the electromagnetic spectrum and the many types of telescopes used to scan the skies. Bill Nye profiles three important discoveries in astronomy, introducing students to William Herschel, Albert Einstein, and Edwin Hubble. The guide ends with an examination of gravity in space, including the moon's orbit and black holes.

Classroom Activities

1. Show the “Celestial Bodies: Moons, Stars, and Planets” segment from the *Earth Science: The Universe* program.
 - **Discussion:** Is our moon unique? (*No, moons orbit planets throughout our solar system.*) What is the sun? (*A star*) How many stars are there in our galaxy? (*Hundreds of billions*) What holds planets in their orbits and stars in their galaxies? (*The force of gravity*)
 - **Science Investigation:** In the video, students hear that “in the past decade, scientists have found planets orbiting other stars.” Explain that these “extrasolar” planets are planets *outside our solar system*. Working in small groups, have students research and report on the methods scientists use to find extrasolar planets. The following Web sites are good starting points:
 - http://planetquest.jpl.nasa.gov/science/finding_planets.cfm (The animated *Four Ways to Find a Planet* tutorial is particularly good.)
 - http://www.esa.int/esaSC/SEMYZF9YFDD_index_0.html
 - **Are We Alone?:** Have students learn more about the quest to find an Earth-like planet at http://planetquest.jpl.nasa.gov/overview/overview_index.cfm and by viewing the video *PlanetQuest: The Search for Another Earth*.

2. Show the “Studying the Stars” segment from the *TLC Elementary School: Exploring Stars* program. (Access to *unitedstreaming* is required.)
 - **Discussion:** What is an optical telescope? (*Telescopes that gather light from celestial objects to produce an image.*) Describe the difference between a refracting and a reflecting telescope. (*Refracting telescopes use lenses to collect light. Reflecting telescopes use mirrors rather than lenses to collect light.*)
 - **Graphic Organizer:** Have students complete the following chart using the information provided in the video and at the *Telescopes From the Ground Up* Web site: <http://amazing-space.stsci.edu/resources/explorations/groundup/>

Telescope	Type	What It Monitors	What It Has Shown Us
Chandra			
COBE			
Compton			
Galileo’s			
Hubble			
Newton’s			
VLA			

- **Electromagnetic Spectrum:** Divide the class into small groups and have each create a poster showing the electromagnetic spectrum. The posters should define each type of radiation and give examples of objects that emit it. The following NASA Web pages offer good introductions, if needed:
 - http://imagine.gsfc.nasa.gov/docs/science/know_11/emspectrum.html
 - http://imagine.gsfc.nasa.gov/docs/science/know_12/emspectrum.html
3. Show the “Observing Movement in Space” segment from the *Greatest Discoveries With Bill Nye: Astronomy* program. (Access to *unitedstreaming* is required.)
 - **Discussion:** What three space discoveries did Bill Nye select? (*William Herschel’s discovery that the Milky Way was a gigantic disk of stars, Albert Einstein’s theory of general relativity, and Edwin Hubble’s discovery that the universe was expanding*)

- **Science Investigation:** Divide the class into three groups, one for each of the discoveries profiled in the video segment. Using the information provided in the video along with library resources and Internet research, have each group script and deliver a five-minute documentary-style presentation. The presentation should begin with an “interview” with the scientist, in which he explains his discovery. It then should be followed by an assortment of “interviews” that express the range of initial reactions to the discovery.
 - **Helping Einstein:** Students can learn more about Arthur Eddington—the astrophysicist whose observation of a solar eclipse confirmed Einstein’s General Theory of Relativity—at the American Museum of Natural History’s online Einstein exhibit for kids:
<http://ology.amnh.org/einstein/spaceandtime/light.html>
4. Show the “Strange Attractions” segment from the *Understanding: The Universe* program. (Access to *unitedstreaming* is required.)
- **Discussion:** Why does the moon go around the Earth? (*It’s trapped in a dimple in space—a gravity pit created by the mass of the Earth.*) Does gravity create or kill stars? (*Both*) What is a black hole? (*Formed by the collapse of some stars, black holes are infinitely small points with a gravity so powerful that not even light can escape.*) What is the VLA? (*Short for very large array of telescopes, it is the huge radio telescope created by 27 giant radio dish antennas positioned over 13 miles in New Mexico.*)
 - **Time Travel Stories:** Introduce students to the idea of wormholes and how they have been used in science fiction. Then challenge students to write a short story in which a wormhole provides a portal for time travel. Collect the stories and create a classroom anthology.
 - **Swift Viewing:** Introduce students to NASA’s Swift satellite, which is investigating gamma-ray bursts and the birth of black holes. The satellite was recognized with a Best of What’s New in 2005 award by *Popular Science* magazine. Pennsylvania State University produced a series of videos about Swift for its “What’s in the News?” television show. An archive of the shows can be found at <http://swift.sonoma.edu/program/witn.html>.

Academic Standards

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K–12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This discussion guide addresses the following national standards:

- History and Nature of Science (K–8): Science as a human endeavor
- Earth and Space Science (K–4): Objects in the sky, Changes in the Earth and sky
- Earth and Space Science (9–12): Origin and evolution of the universe

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K–12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following national standards:

Earth and Space Sciences

- Understands the composition and structure of the universe and the Earth's place in it

Nature of Science

- Understands the scientific enterprise

Language Arts

- Writing: Uses grammatical and mechanical conventions in written compositions; Gathers and uses information for research purposes
- Viewing: Uses viewing skills and strategies to understand and interpret visual media