

#9236

HUBBLE—GATEWAY TO THE UNIVERSE

ALLEGRO PRODUCTIONS

1996

Grade Levels: 10-13+

24 minutes



DESCRIPTION

The Hubble Space Telescope, flawed when launched in 1990 and repaired in 1993, helps scientists study the universe. Highlights Hubble from design, construction, and repair to a range of spectacular images taken from beyond earth's atmosphere.

ACADEMIC STANDARDS

Subject Area: Science

- Standard: Understands the composition and structure of the universe and the Earth's place in it
 - Benchmark: Knows ways in which technology has increased our understanding of the universe (e.g., visual, radio, and x-ray telescopes collect information about the universe from electromagnetic waves; space probes gather information from distant parts of the Solar System; mathematical models and computer simulations are used to study evidence from many sources in order to form a scientific account of events in the universe)

INSTRUCTIONAL GOALS

1. To depict how the Hubble Space Telescope was designed, built, and placed in orbit.
2. To emphasize the need for an orbiting observatory.
3. To illustrate what is the Hubble Space Telescope.
4. To compare ground-based photographs, pre-repair, and post-repair mission images.

BACKGROUND INFORMATION

This program blends the applied science and technology that was used to design, build, and place the Hubble Space Telescope in orbit with the pure science of astronomy.

Beginning with a brief history of ground-based optical telescopes, the program explains the need for an orbiting observatory, free from the distorting effects of the Earth's atmosphere.

The Hubble Space Telescope (HST) is a reflecting telescope with an 8-foot-wide primary mirror to focus and magnify light. It carries two cameras and two spectrographs that use electronic detectors to record light, which is converted into numbers by the onboard computers. The numbers are beamed to the Space Telescope Institute on Earth as radio signals, recorded on computer disk, and turned back into pictures.

The HST was designed for periodic maintenance while in orbit, but after the error in the curvature of its primary mirror was discovered, plans for the first servicing mission were accelerated and broadened.

Side-by-side comparisons of ground-based photos, pre-repair, and post-repair mission images are shown. Among the Hubble photos are shots of Comet Shoemaker-Levy crashing into Jupiter, huge storms on Saturn, the rotation of Uranus, and Pluto and its moon Charon.

Although Hubble is considered to be one of the most important instruments for gathering new information about the cosmos, it is not making other types of observatories obsolete. Ground-based optical and radio telescopes, as well as other satellites like the Cosmic Background Explorer (COBE), are all increasing our understanding of the universe.

VOCABULARY

1. black hole
2. blue straggler
3. charged coupled device
4. Charon
5. COSTAR
6. Doppler shift
7. Einstein Cross
8. focal plane
9. globular cluster
10. gravitational lenses
11. gyroscope
12. micron
13. photons
14. quasar
15. reflecting telescope
16. simulator
17. solar panel
18. spectrograph
19. supernova

AFTER SHOWING

Discussion Items and Questions

1. What advantage does an orbiting telescope have over a ground-based telescope?
2. Since Hubble's cameras don't use film, how do they "take" pictures?
3. What can astronomers learn about distant objects through spectral analysis of their light?
4. Why did the astronauts practice for the servicing mission in an underwater simulator?
5. How was the problem with the Hubble Space Telescope's primary mirror corrected?
6. To help explain the need for an orbiting space telescope, give the example of how heat rising off a dark object, such as a car hood or pavement on a hot summer day, causes objects beyond to shimmer. The same thing happens on a global scale when astronomers try to look at distant stars through the Earth's atmosphere. The stars appear to winkle, making it impossible to get a clear picture.
7. Discuss the differences between *refracting* and *reflecting* telescopes. Identify the locations of the major ground-based optical telescopes. Many are located on mountaintops. What might be the reason? Which are refractors? Which are reflectors?
8. The Hubble Space Telescope can "see" only within the visible light part of the electromagnetic radiation spectrum. Talk about the spectrum, and the types of telescopes and observatories used to "see" other radiations. Discuss why astronomers rely on information from all types to get "the big picture" of our universe.



9. Astronomers say that the Hubble Space Telescope is like a time machine, making it possible for us to look back millions of years in time and study our universe as it was then. How can this be so?
10. Have a class discussion about why many people think it is important to learn more about the universe.
11. Discuss whether it is reasonable to believe that there is life on planets circling stars in other galaxies somewhere in the universe. We have transmitted messages and sent probes into space attempting to communicate with intelligent life elsewhere. Have students investigate the nature of these attempts. How well do they think we would be able to communicate if these messages did reach other life forms? If students were to send a message into space, what information would they try to communicate, and how?

Applications and Activities

1. The Hubble Space Telescope's cameras function much like TV or video cameras, and the images it shoots are transmitted to Earth via satellite. Have the class research how images get from a studio camera onto their TV screens.
2. Since the Hubble Space Telescope is constantly gathering new data, have students watch newspapers and publications for any new discoveries that are reported by the media.

RELATED RESOURCES



Captioned Media Program

- The Universe #3310



World Wide Web

The following Web sites complement the contents of this guide; they were selected by professionals who have experience in teaching deaf and hard of hearing students. Every effort was made to select accurate, educationally relevant, and "kid safe" sites. However, teachers should preview them before use. The U.S. Department of Education, the National Association of the Deaf, and the Captioned Media Program do not endorse the sites and are not responsible for their content.

- **STARCHILD**

<http://starchild.gsfc.nasa.gov/docs/starchild/>

A NASA-related site, click on one of the two different grade levels to read information about the Hubble Space Telescope, space probes, and link to the main NASA page.

- **LIVE FROM THE HUBBLE SPACE TELESCOPE**

<http://quest.arc.nasa.gov/hst/>

View images from the gallery, meet the Hubble Space Telescope team, ask project staff questions, and more from this NASA Quest site.

- **HUBBLESITE**

<http://hubble.stsci.edu/>

From the Space Telescope Science Institute site, take a peek "Behind the Pictures," meet "Team Hubble," see Hubble's newest image, and much more.