

History and Discovery of Asteroids

I Can See You More Clearly Now

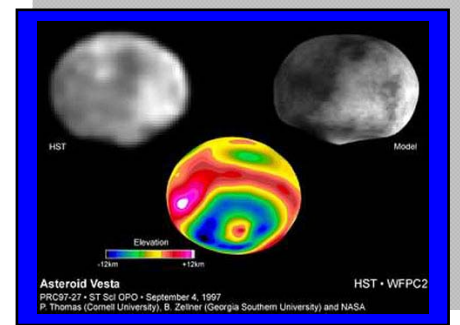
FLASHBACK—ASTEROID RESEARCH IN MODERN TIMES

What is the size of a school bus, travels at a speed of five miles per second, and orbits the Earth every 97 minutes? The answer is the **Hubble Space Telescope**. In April 1990, the space shuttle *Discovery* lifted the Hubble Space Telescope into orbit. People expected that this high-tech telescope would provide a “window on the universe.” At first, Hubble did not live up to these hopes. The telescope’s primary mirror was slightly distorted, which reduced the quality of the images. Fortunately, in December 1993, astronauts from the shuttle *Endeavour* flew to the rescue. They installed replacement parts, including different mirrors, which restored the telescope’s razor-sharp viewing capabilities. Since that time, the Hubble Space Telescope has functioned well and has provided incredible images of exploding stars, colliding galaxies, and asteroids such as **Vesta**.



Hubble Space Telescope
STScI

Viewing Vesta through telescopes on Earth is like standing at one end of a football field and looking at a potato hovering at the other end of the field. If your vision is good and the conditions are right, you may be able to see the potato. However, would you expect to be able to see lumps and dimples on the potato from this distance? Definitely not. Now imagine walking the length of the football field so that you are only a few feet away from the potato. Most likely, you could see clearly the details on the potato’s surface. In effect, this is what the Hubble Space Telescope has done for views of Vesta. It has closed the distance visually so that surface details on the asteroid as small as 55 kilometers across are visible. To continue the potato analogy, we might say that if you were the Hubble Space Telescope and Vesta were an average-sized potato, then you would be able to see lumps and bumps—as small as 1 cm across—on the potato’s surface.



Hubble Space Telescope
Images of Vesta
STScI

Hubble images of Vesta have revealed some fascinating features. With a cross section about the same size as the state of Arizona, Vesta appears to have a complex surface. Ben Zellner of Georgia Southern University describes Vesta as, “far more interesting than simply a chunk of rock in space as most asteroids are.” Features such as an exposed **mantle**, ancient lava flows, and **impact basins** were found in 1994. Furthermore, astronomers observed another intriguing feature; one side of Vesta appeared flattened.

In May 1996, Vesta made its closest approach to Earth in a decade—a distance of 177 million kilometers. During this time, Hubble captured detailed images of Vesta. These images helped astronomers determine that Vesta did not have a flattened side as previously observed. It is actually a gigantic impact crater about 460 kilometers across, which is nearly equal to Vesta’s diameter! The

crater is thought to be about 13 kilometers deep and may go almost all the way through the crust to expose the asteroid's mantle. Astronomers believe the blast that created the crater was so powerful it caused the asteroid to shift its rotation axis. As a result, the crater is now located near one pole. Finally, through the eyes of Hubble, we can see Vesta more clearly now.

In 2002, scientists were able to get a Hubble Telescope image of **Ceres** as well. The picture is fuzzy and looks something like a doughnut. Certainly, Ceres is an interesting asteroid that needs further study.

The Hubble Space telescope has provided new information about Ceres and, particularly, Vesta. However, much remains to be learned about these space potatoes. The Dawn mission will answer many of the questions that remain about the origin and nature of these asteroids.

Additional Resources

<http://hubblesite.org/newscenter/>

Check out the latest news and pictures captured by the Hubble Space Telescope.

<https://asd.gsfc.nasa.gov/archive/hubble/>

Visit The Hubble Project Web site, sponsored by NASA Goddard Space Flight Center, to learn about the history, technology, and operations of the Hubble Space Telescope.

<http://passporttoknowledge.com/hst/lounge/nov-deb.html>

Learn more about the "Passport to Knowledge Project" in which elementary and secondary students had an opportunity to engage in real-world science learning activities using the Hubble Space Telescope. This site also features links to teacher's resources and interactive games for kids.

<http://amazing-space.stsci.edu/news/>

Amazing Space provides a variety of Internet-based activities for classroom use. The site also features a section entitled "The Star Witness" which offers the latest information captured by the Hubble Space Telescope for space enthusiasts of all ages.

Questions relating to "I Can See You More Clearly Now"

1. When was Hubble first used? What space shuttle lifted it into orbit around Earth?
2. How long does it take the Hubble Space Telescope to orbit the Earth?
3. What changes were made to the Hubble Space Telescope three years after it was lifted into space? Why was it necessary to make these changes?
4. Compare the images seen from an Earth-based telescope with the images captured by the Hubble Space Telescope. How close was Vesta to Earth when Hubble was able to capture the most "close-up" images?
5. What have scientists learned about Vesta from Hubble?
6. What have scientists learned about Ceres?
7. Why is a space telescope needed at all? What benefits do scientists gain from having such a powerful telescope?
8. If Hubble offers a more close-up "window on the universe," then why is the Dawn mission necessary?