

The Hubble Space Telescope



For centuries, astronomers looking at the moon, the planets, and the stars have faced a basic problem: the earth's atmosphere. Although it provides the air we breathe and protection from the sun, the atmosphere interferes with astronomers' ability to see into space—even with the largest and most sophisticated telescopes.

Then came Lyman Spitzer, an astrophysicist with a remarkable idea: Put a large telescope in orbit around the earth, *outside* of the earth's atmosphere. Spitzer proposed this idea in 1946, 11 years before Russia launched the world's first man-made satellite and long before technology such as microprocessors, digital imaging, or the space shuttle existed. Spitzer claimed the telescope would serve not just to test and refine existing ideas, but also to spark entirely new ones. "The chief contribution of such a radically new and more powerful instrument," he predicted, "would be, not to supplement our present ideas of the universe we live in, but rather to uncover new **phenomena** not yet imagined, and perhaps to **modify** profoundly our basic concepts of space and time."

Spitzer was right. In 1993, NASA released the first images from the Hubble telescope. Since then, scientists have used Hubble to follow the impact of the 1994 comet Shoemaker-Levy 9 into the atmosphere of the giant planet Jupiter. They have produced images of the astonishing and unique beauty of planetary nebulae—the shells of gas produced by unstable, dying stars. They have proved the existence of black holes at the centers of galaxies. And just as Spitzer predicted, Hubble has provided new information that changes our ideas about the universe.

Astronomers already knew that the universe was **expanding**, but they expected this expansion to be slowing down due to the gravity of all the **matter** in the universe, just as a ball thrown into the air falls back to Earth. Instead, astronomers discovered that cosmic expansion is not slowing down at all—it is speeding up! It is as if a ball, thrown into the air, at first slowed but then sped up and simply flew away. No natural **force** on Earth can do this, but some kind of energy must be causing the **acceleration**.

Scientists are calling this unknown force *dark energy* and are working to learn more about it. However, Hubble is getting old, and its final scheduled service mission was completed in 2008. Fortunately, other orbiting telescopes such as the Spitzer Space Telescope and the Chandra X-ray Observatory are sending information to Earth, and the gigantic James Webb Space Telescope is scheduled for launch in 2013. Webb will gather infrared light with a mirror over 21 feet (6.4 meters) in diameter! Together with a growing network of ground-based telescopes and detectors, these space observatories promise, as Lyman Spitzer noted back in 1946, to alter not only what we know, but how we learn.

