# Frequently Asked Questions

**1. What does NEAR stand for?**

Near Earth Asteroid Rendezvous.

**2. Who's on the NEAR team?**

The NEAR team includes The Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Maryland; NASA's Jet Propulsion Laboratory (JPL); Cornell University; University of Maryland; Massachusetts Institute of Technology (MIT); University of Arizona; the National Oceanic and Atmospheric Administration's Space Environment Center; NASA's Goddard Space Flight Center; NASA's Solar Data Analysis Center; Malin Space Science Systems Inc.; Southwest Research Institute; Northwestern University; University of California, Los Angeles; Catholic University; Computer Science Corporation; and the Max Planck Institute for Chemistry.

Visit the Mission page on the NEAR Web site for a full list of team members.

**3. Why is the spacecraft named NEAR Shoemaker?**

As a tribute to the late Gene Shoemaker – a legendary geologist who influenced decades of research on the role of asteroids in shaping the planets – NASA renamed the NEAR spacecraft on March 14, 2000. Shoemaker, who died in a 1997 car accident while on an annual study of impact craters in

the Australian outback, said he wanted to tap a rock hammer on Eros. The NEAR mission and spacecraft that bears Shoemaker's name now aim to build on all he taught us about asteroids, comets and the origins of our solar system.

**4. When did NEAR Shoemaker launch?**

Feb. 17, 1996. The Delta-2 rocket used to launch NEAR Shoemaker from Cape Canaveral Air Station was the smallest rocket ever used for a planetary mission.

**5. Who built the spacecraft?**

The Johns Hopkins University Applied Physics Laboratory, which also manages the NEAR mission for NASA.

**6. How long did it take to design and build?**

APL designed and built NEAR Shoemaker in 26 months, shipping it to Kennedy Space Center in Florida a month ahead of schedule.

**7. How big is the NEAR Shoemaker spacecraft?**

About the size of a car. Made of eight 18-square-foot aluminum panels, NEAR Shoemaker is 9 feet, 2 inches long when you include its main antenna. Its four solar panels – each 6 feet long and 4 feet wide – surround the 5-foot (1.5-meter) diameter high-gain antenna on top of the spacecraft.

Including propellant and instruments, NEAR Shoemaker weighed 1,775 pounds (about 800 kilograms) at launch.

**8. What drove NEAR Shoemaker's**

**design?**

Scheduling, which in turn drove simplicity. Designers fixed and mounted three major components – the instruments, solar panels and main antenna – to the craft's body. While it made operating the spacecraft a bit more complex, this simple design helped meet schedule demands.

**9. What did NEAR Shoemaker do?**

NEAR Shoemaker conducted the first long-term, close-up study of an asteroid. Using innovative sensors and detection equipment (see question 22), NEAR Shoemaker collected information on Eros' mass, structure, geology, composition, and gravity.

The NEAR mission sought to answer fundamental questions about the nature and origin of the many asteroids and comets close to Earth's orbit. These "near Earth" objects may contain clues about the formation of Earth, other planets, even the whole universe. Eros' pristine surface offers a look at conditions in space when Earth formed more than 4.5 billion years ago.

**10. Why Eros?**

Basically, because it's big and close. Asteroid 433 Eros is one of the largest near-Earth asteroids, with a mass thousands of times greater than similar asteroids. Its orbit provided a launch opportunity at the right time and it allowed use of a medium-class launch vehicle instead of a much larger and more expensive rocket. (The number 433, by the way, means Eros was the 433rd asteroid to have its orbit calculated.)

**11. What are near-Earth asteroids?**

Asteroids that come within 121 million miles (195 million kilometers) of the sun are known as near-Earth asteroids. Theory holds that most of these objects broke away from the main asteroid belt between Mars and Jupiter. Aside from the moon they're our closest neighbors in the solar system.

**12. How big is Eros?**

Eros is about 21 miles (33 kilometers) long, 8 miles (13 kilometers) wide and 8 miles thick. Most of the near-Earth asteroids we know about are a little more than a half-mile (about 1 kilometer) across.

**13. Will Eros hit Earth?**

**Not anytime soon. Using telescope-mounted digital cameras, NASA researchers have found more than 350 near-Earth asteroids larger than 1 kilometer (about 0.6 miles) in diameter. From this information they estimate anywhere from 500 to 1,000 similar-sized NEAs could be spinning around our solar system. Good news is the scientists say none of the asteroids they're tracking will hit Earth in the near future. In addition, what the NEAR mission learns about Eros will help scientists if they ever do spot an asteroid headed our way.**

**14. Say an asteroid does come toward Earth. How will NEAR help?**

**NEAR will make important contributions in that regard. If people decide to deflect an asteroid, they'll need to know just where the center is (because an off-center push will set the asteroid spinning)**

**and need to know something about the mechanical strength (because they don't want to push so hard as to break up the asteroid). NEAR will measure or put a limit on density variations within the asteroid (which affect where the center of mass is). NEAR data may also allow an inference of surface strength in the regolith. So far, NEAR data clearly indicate that Eros is a consolidated object, not a loosely bound "rubble pile" of much smaller pieces.**

**15. Does Eros have gravity?**

**Gravity on Eros is weak, but it had enough pull to hold the NEAR Shoemaker spacecraft in orbit, and keep it on the surface. Depending on where they stood on Eros, a person who weighed 200 pounds (90 kilograms) on Earth would weigh about two ounces on the asteroid. A rock tossed from the asteroid's surface at 22 miles an hour could escape into space. A basketball player with a 36-inch vertical leap could jump about a mile on Eros – and risk putting himself in orbit!**

**Surface gravity depends on the distance from a spot on the surface to the center of a body's mass. The surface gravity on Eros varies a lot, since it is not a sphere but an elongated peanut-shaped (or potato-shaped, or shoe-shaped) object.**

**16. What is the temperature on Eros?**

**While NEAR Shoemaker has no instrument designed to measure temperature on Eros, scientists estimate this by knowing the distance of the asteroid from the sun and assuming some thermal**

**properties of Eros, derived from measuring its thermal emissions with telescopes on Earth. These estimates put the "day" temperature on Eros at about 212 degrees Fahrenheit (100 degrees Celsius), and "night" measurements at minus 238 F (minus 150 C).**

**17. How long did it take NEAR Shoemaker to get to Eros?**

**A few days shy of four years. A direct trip from Earth to Eros would have taken about a year, but the NEAR mission was designed to swing the craft around Earth for a gravity boost, which allowed use of the smaller, more economical Delta rocket. The extra time also gave mission planners and operators an opportunity to practice using the spacecraft's instruments. NEAR Shoemaker was supposed to reach Eros two years and 327 days after launch, but the failed orbit insertion attempt on Dec. 20, 1998, forced mission designers to add another year and 23 days to the trip.**

**18. Why was Feb. 14, 2000 selected as the rendezvous date?**

**Mostly for technical reasons. The asteroid's trajectory and orbital parameters determined the "window" (or best time) for NEAR Shoemaker to meet up with Eros. However, there was just enough flexibility in this calculation to set up a Valentine's Day date with the asteroid named after the Greek god of love.**

**19. How far were NEAR Shoemaker and Eros from Earth on Encounter Day?**

**The spacecraft and asteroid were about 160 million miles, or 258 million kilometers, from Earth. Scientifically speaking, this comes out to 1.7 astronomical units (1 AU – about 93 million miles – is the average distance from Earth to the sun).**

**20. Before landing, how close did NEAR Shoemaker get to Eros?**

**NEAR Shoemaker traveled at various distances around Eros. All told it spent more than 100 days orbiting 31 miles (about 50 kilometers) from the center of Eros; at other times its orbit extended to about 200 miles (320 kilometers). A low-altitude pass on Oct. 26, 2000, brought it to within 3 miles (about 5.3 kilometers) of the surface, before it headed back out to 125 miles (200 kilometers) for global observations. In mid-December 2000 it descended to 22 miles (35 kilometers) and operated from that distance (or closer) for the rest of the mission.**

**21. What science did NEAR conduct?**

**NEAR's many tasks fell under three main scientific goals:**

- **Determine the physical and geological properties of a near-Earth asteroid**
- **Provide information on the relationships between asteroids, comets and meteorites**
- **Further our understanding of how and under what conditions the planets formed and evolved**

**NEAR Shoemaker collected about 10 times more data than originally**

**planned, completing the most detailed scientific profile ever of a small celestial body. NEAR's portrait of Eros - a solid, undifferentiated, primitive relic from the solar system's formation - has already answered fundamental questions on a common class of asteroid.**

**NEAR's 160,000 images of Eros have shown asteroids can be incredibly diverse objects: NEAR scientists spotted more than 100,000 craters, about 1 million house-sized (or bigger) boulders, and a layer of debris resulting from a long history of impacts.**

**22. What are NEAR Shoemaker's scientific instruments?**

**NEAR Shoemaker carries six scientific instruments:**

- **A Magnetometer searched for a magnetic field on Eros (and didn't find one).**
- **The X-Ray/Gamma-Ray Spectrometer (consisting of two sensors) measured key chemical elements like silicon, magnesium, iron, uranium, thorium and potassium.**
- **The Multispectral Imager - NEAR Shoemaker's electronic camera - mapped the asteroid's shape, landforms and colors.**
- **The Laser Rangefinder scanned the precise shape of the asteroid.**
- **The Near-Infrared Spectrometer mapped most the mineral composition of the surface by measuring the spectrum of sunlight reflected by Eros. The NEAR team shut the instrument down in June 2000 after an unexplained power surge, but by then the "NIS" had mapped more than 70 percent of the surface.**

**Also, a radio science experiment determined the asteroid's mass by tracking tiny changes in NEAR Shoemaker's radio frequency. Dividing Eros' mass by its volume will tell its density – a critical clue to the makeup of the asteroid's interior.**

**23. How long was the mission?**

**Roughly five years from launch (Feb. 17. 1996) until the end of the extended mission on the surface of Eros (Feb. 28, 2001).**

**24. How did the NEAR mission end?**

**On Feb. 12, 2001 - after NEAR achieved all of its science goals during the year in orbit - a set of five de-orbit and braking maneuvers brought NEAR Shoemaker to the surface of Eros. NEAR Shoemaker snapped 69 detailed pictures during the final three miles (five kilometers) of its descent, the highest resolution images ever obtained of an asteroid. The camera delivered clear pictures from as close as 394 feet (120 meters) showing features as small as a golf ball.**

**The spacecraft touched down at a gentle 4 mph, just outside the asteroid's large saddle-shaped depression, Himeros. Despite being an orbiter that was not designed to land, NEAR Shoemaker continued operating and communicating with the NEAR mission team at the Johns Hopkins University Applied Physics Lab. Team members then commanded the craft's gamma-ray spectrometer to gather data on the elemental composition on and just below the asteroid's surface.**

**After two mission extensions and two weeks of operating on Eros, NEAR Shoemaker made its last call to Earth on Feb. 28, 2001, as NASA's Deep Space Network antennas pulled down their last bits of NEAR data and the first close-up study of an asteroid came to quiet end.**

**25. How far was NEAR Shoemaker from Earth when it landed on Feb. 12, 2001?**

**The spacecraft was about 197 million miles (about 315 million kilometers) from Earth, or a bit more than 2.11 astronomical units. NEAR Shoemaker was actually closer to the sun, which was a mere 133 million miles (213 million kilometers or 1.43 AU) away.**

**Click here to see where Eros is now.**

**26. How long did the controlled descent take?**

**About four and a half hours, from the first maneuver that brought NEAR Shoemaker out of its circular 22-mile (35-kilometer) orbit until the spacecraft touched down on Eros.**

**27. What part of the spacecraft touched first?**

**If all went according to plan, the tips of two of NEAR Shoemaker's solar panels. Check out this somewhat prophetic animation of NEAR Shoemaker's historic landing.**

**28. Was the team able to download any images from the surface?**

**No, and even the last part of the final image will remain a mystery. During the descent,**

**NEAR Shoemaker continually sent its two latest images to its data recorder, and recorded over the two images taken before them. Imaging continued for a few minutes after landing, so anything worth sending down (while the camera was still in focus) was recorded over. Even then, it would have taken a solid week of Deep Space Network antenna time to download an image through the low-gain antenna, which the spacecraft used to communicate with Earth once it landed.**

**29. Does this mean the end of the scientific analysis?**

**No way! NEAR Shoemaker's yearlong orbit of Eros was essentially a (busy) data-gathering phase; the science team now has the chance to systematically examine the huge amounts of information they haven't been able to process.**

**30. When NEAR Shoemaker touched down on Eros, how many miles had it traveled?**

**From launch on Feb. 17, 1996 until landing on Eros nearly five years later, NEAR Shoemaker traveled nearly 2.3 billion miles (3.7 billion kilometers) around the sun. This includes the 417 million miles (667 million kilometers) traveled during the spacecraft's yearlong orbit mission at Eros.**

**31. How many times did NEAR Shoemaker orbit Eros?**

**From Feb. 14, 2000 to Feb. 12, 2001, the spacecraft circled Eros 230 times from various distances.**

**32. Do scientists plan a return trip to Eros?**

**Not now, but if one is ever proposed, the NEAR mission has made it possible to conduct a return trip with a fraction of the risk and with many of the most important questions about the asteroid already answered.**

**33. What happens to the NEAR team now that the mission is over?**

**Though analysis on NEAR data will continue for years, many team members are moving on to their next adventures. The Johns Hopkins Applied Physics Lab is managing two more Discovery class missions: CONTOUR, which will launch in July 2002 and visit 2 (perhaps 3) comets; and MESSENGER, which launches in 2004 and will be the first spacecraft to orbit Mercury. Several members of NEAR's mission operations and science teams will participate in those missions.**

**34. Will the NEAR spacecraft bring back pieces of Eros?**

**No, NEAR Shoemaker will not return actual samples. The spacecraft's scientific instruments relayed data on and images of the asteroid through NASA's Deep Space Network, for analysis by NEAR scientists.**

**A future mission, however, does plan to collect samples from an asteroid. The Japanese Institute for Space and Astronautical Sciences is managing the MUSES-C mission, scheduled for launch in December 2002 with an arrival at asteroid 1998 SF36**

**in September 2005. The MUSES-C spacecraft will collect up to three asteroid surface samples and return them to Earth in June 2007 for laboratory analysis.**

**35. How much did the NEAR mission cost?**

**The total mission cost was about $224 million [including $124.9 million for spacecraft development, $44.6 million for launch support and tracking, and $54.6 million for mission operations and data analysis].**

**36. Who controlled the spacecraft?**

**Flight controllers and mission analysts controlled the spacecraft from the NEAR Mission Operations Center at the Applied Physics Laboratory. [NEAR was the first NASA planetary mission conducted by a non-NASA space center].**

**NASA's Jet Propulsion Lab in Pasadena, California, provided navigational support.**

**37. Who received the data?**

**The Mission Operations Center sent data to the NEAR Science Data Center, also located at APL. The Science Data Center distributes data to the scientific community on the Internet.**

**38. How long did a signal take to reach NEAR Shoemaker from Earth?**

**It typically took 15 minutes for a transmission to travel between the spacecraft and Earth.**

**39. Did NEAR use the NASA Deep Space Network?**

**Yes. With its three antenna stations – located in Goldstone, California; Canberra, Australia; and Madrid, Spain – the "DSN" supports interplanetary spacecraft missions and radio and radar astronomy observations. The network also supports selected Earth-orbiting missions.**

**40. What kind of computer is on NEAR Shoemaker?**

**The computer is a 16-bit machine called a 1750A. Based on a military standard that is about 10 years old, it runs at 12 MHz and has 256 KB of storage. This is equivalent to the PCs produced in the mid-1980s.**

**41. Where can the public view the data and images from NEAR?**

**On the NEAR Web site. Also the NEAR Science Data Center sends information to NASA's Planetary Data System; you'll find NEAR data under the "small bodies" section of the PDS Web site. Looking at the serious data requires special (yet free and readily available) software; check the data sites for details.**

**42. What other information did NEAR provide?**

**On its journey to Eros, NEAR Shoemaker took several unique images of Earth and the moon, Comet Hyakutake, and the Beehive and Pleiades star clusters. NEAR Shoemaker paid the first visit to a carbon-rich "C-type" asteroid, taking several images of 253 Mathilde in 1997.**

**NEAR also made an important**

**contribution to the study of cosmic gamma ray bursts as part of the Interplanetary Gamma Ray Burst Network, known as the IPN. NEAR Shoemaker's Gamma-Ray Spectrometer was modified after launch with a software patch that allowed it to detect gamma ray bursts. Check out NEAR Project Scientist Andrew Cheng's report on this feature for details.**

**43. What is the Discovery Program?**

**NEAR was the first launch in NASA's Discovery Program, the agency's innovative approach to better, faster, and cheaper planetary missions. Discovery grew from the science community's calls for a space exploration program that balances scientific return and mission costs in an era of tight budgets. Visit the NASA Discovery Web site for more information on the program.**

**44. What other missions are part of the Discovery Program?**

**The completed Mars Pathfinder and Lunar Prospector missions collected valuable information on the surfaces of Mars and the moon; the Stardust mission - launched in February 1999, led by Dr. Donald E. Brownlee of the University of Washington and managed by the Jet Propulsion Laboratory - will return the first samples of comet dust.**

**Future Discovery missions:**

- **Genesis will analyze particles from the sun known as solar wind. Led by Dr. Donald Burnett of the California Institute of Technology**

**and managed by the Jet Propulsion Laboratory, Genesis is scheduled to launch in July 2001.**

- **CONTOUR (short for Comet Nucleus Tour) will provide images of and collect samples from at least two near-Earth comets. Dr. Joseph Veverka of Cornell University leads CONTOUR, managed by the Applied Physics Laboratory and set to launch in July 2002.**
- **MESSENGER, scheduled for launch in spring 2004, will study Mercury and provide the first global images of the sun's closest neighbor. The Applied Physics Laboratory will build and manage MESSENGER (short for Mercury Surface, Space Environment, Geochemistry and Ranging); Dr. Sean Solomon of the Carnegie Institution is the principal investigator.**
- **Deep Impact, led by Dr. Michael A'Hearn of the University of Maryland and managed by the Jet Propulsion Laboratory, will launch in January 2004. On July 4, 2005, Deep Impact will send a projectile into comet P/Tempel 1, creating an explosion that will help scientists analyze the comet's interior.**

**Visit the NASA Discovery Missions Web page for more information.**

**45. What is the policy for using or reproducing NEAR images?**

**NEAR images are generally available for informational or educational purposes, so long as their use does not convey NASA's or The Johns Hopkins University Applied Physics Laboratory's implicit or explicit endorsement of any goods or services you might be offering. There is no fee required for their use, but please credit NASA/Johns Hopkins University Applied Physics Laboratory (or NASA/JHUAPL) in your materials.**

**NEAR is a NASA mission and adheres to the agency's guidelines for image use and reproduction. Visit http://www.nasa.gov/gallery/photo/guideline.html for more information.**

**46. How do I get the highest-resolution NEAR images?**

**The images on the NEAR Web site reflect the true resolution of NEAR Shoemaker's digital camera. If you scroll down to the bottom of each "Image of the Day" page on the NEAR Web site, the "TIFF image" link connects you to the highest-resolution file available. Mosaics, larger images compiled from multiple frames, offer the best resolution.**


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