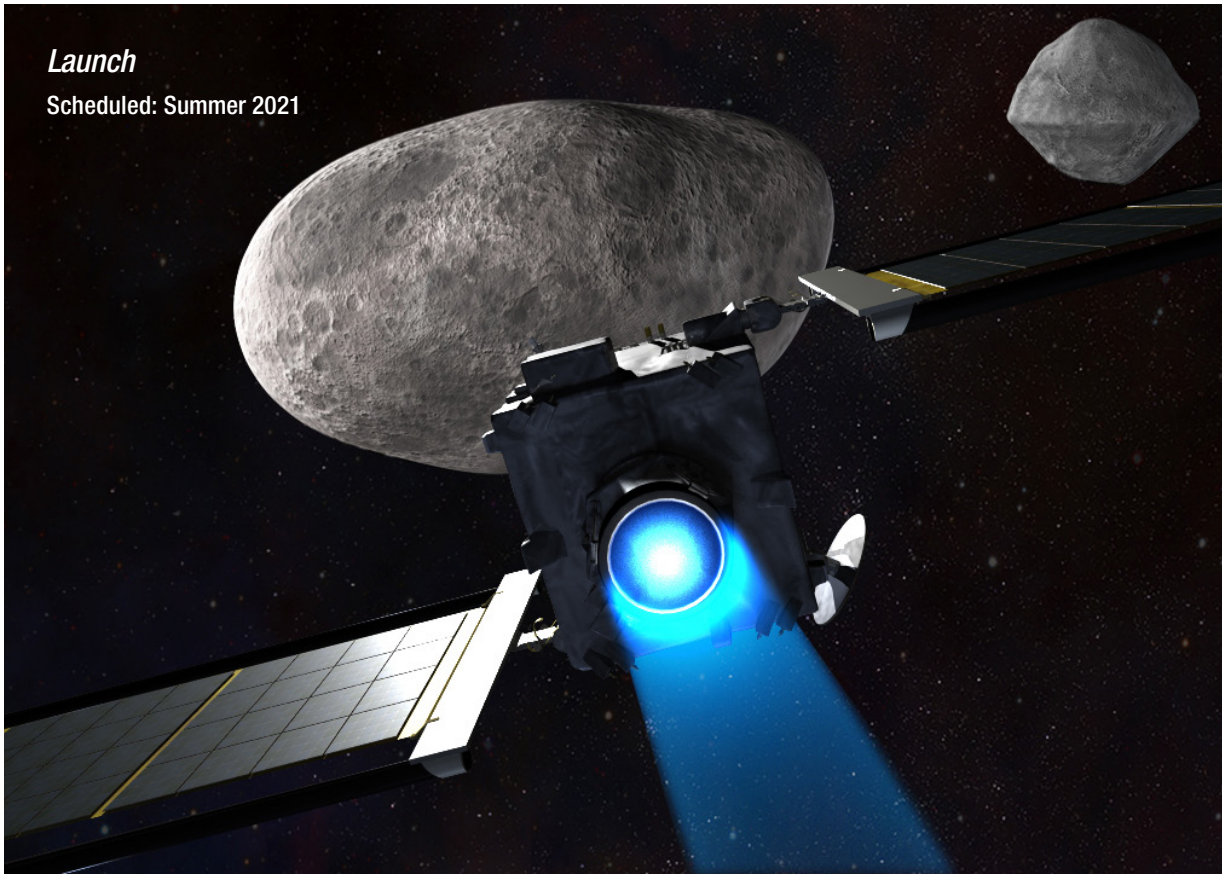
National Aeronautics and Space Administration

DART

The Double Asteroid Redirection Test

NASAfacts



Planetary Defense

About 100 tons of extraterrestrial matter fall onto Earth every day. Most of it is harmless dust and an occasional meteorite. But Earth moves through a dangerous neighborhood: Astronomers estimate there are about 1,000 near-Earth asteroids close to a half-mile wide and larger—big enough to cause a global disaster if they struck Earth. About 95 percent of these large asteroids have been identified. In contrast, it is predicted that there are roughly 25,000 near-Earth asteroids that are 500 feet wide or larger, but only about a third of these asteroids have been found.

On February 15, 2013, a bolide—a meteor that explodes in the atmosphere—entered over Chelyabinsk, Russia, creating an airburst whose shockwave struck six cities across the country. Scientists have determined that the Chelyabinsk bolide was a 60-foot-wide asteroid, illustrating that even small asteroids can be of concern. Potential threats like this make actual tests of planetary defense systems, especially those in space, all the more important.

The Double Asteroid Redirection Test (DART)

Developed and led for NASA by the Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Maryland, the Double Asteroid Redirection Test (DART) will demonstrate the kinetic impact: a technique to strike an asteroid in order to shift its orbit. This test is a critical step in demonstrating one means to protect our planet from a potential impact.

DART's target is the asteroid Didymos (Greek for "twin"), a binary system that consists of Didymos A, about one-half mile in size, and a smaller asteroid orbiting it called Didymos B, about 530 feet across. After launch (scheduled for summer 2021), DART will fly to Didymos and use an onboard targeting system to aim itself at Didymos B. Then the spacecraft, roughly the size of a small car, would strike the smaller body at approximately 3.7 miles per second. Earth-based telescopes will be used to measure the change in the orbit of Didymos B around Didymos A produced by DART's impact.

The Spacecraft

APL is building the spacecraft and DART's single instrument, the Didymos Reconnaissance and Asteroid Camera for Op-nav (DRACO). Not only will DRACO image Didymos, but it will also provide optical navigation for the DART spacecraft. As a technology demonstration mission, DART incorporates several new technologies.

To meet the challenge of reliably targeting and impacting a small target, APL has developed a Small-body Maneuvering Autonomous Real-Time Navigation (SMART Nav) algorithm for DART, which includes image processing and guidance, navigation and control (GNC) algorithms. In the spacecraft's final hours, navigation is handed over to the onboard SMART Nav system to guide DART to impact Didymos B. In addition to precision navigation, fuel management logic can determine the appropriate times for course corrections to optimize the efficient use of a limited propellant supply.

The DART spacecraft will use NASA's Evolutionary Xenon Thruster-Commercial (NEXT-C) ion engine, developed by Glenn Research Center. Electric propulsion systems are powered by electromagnetically accelerating ions formed from the propellant. This technology can achieve high speeds over long periods and thus can be more efficient for some deep space missions.

The Team

Planetary defense is an international concern; that's why DART pulls expertise from around the world into working groups to evaluate the mission's results and enable planning for future planetary defense efforts. Mission plans recommend a SmallSat provided by the Italian Space Agency, and ESA has contributed much to the mission concept.

NASA's Planetary Defense Coordination Office supervises NASA-sponsored projects to find and characterize asteroids and comets that pass near Earth's orbit and coordinates development of techniques and technologies to respond to an identified impact threat. In addition to managing the mission and building and operating the DART spacecraft, APL is coordinating the investigation teams.

Current partner institutions include NASA Goddard Space Flight Center, Johnson Space Center, Langley Research Center, Glenn Research Center, Marshall Space Flight Center, and Planetary Defense Coordination Office; Jet Propulsion Laboratory; Lawrence Livermore National Laboratory; Aerojet Rocketdyne; University of Maryland; University of Colorado; Northern Arizona University; Auburn University; and Planetary Science Institute.

For more information about DART, visit:

nasa.gov/planetarydefense/dart
dart.jhuapl.edu