

Double Asteroid Redirection Test (DART)

October 11, 2022

Manifest Pedagogy

A spacecraft named Dart will zero in on the asteroid, intent on slamming it head-on at 14,000 mph (22,500 kph). It is the first Kinetic Impactor Method of planetary defence, where a DART spacecraft will be colliding with the asteroid Dimorphos. The collision was a technology demonstration, and an experiment to assess the capabilities to do such manoeuvres in future should a need arise.

In News: NASA has deliberately crashed a spacecraft into an asteroid.

Placing it in the Syllabus: Science and Technology

Static Dimensions

- The Asteroid target

Current Dimensions

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Content

More on news

- In the first-of-its kind, save-the-world experiment, NASA collided a small, harmless asteroid millions of

miles away. A spacecraft named Dart will zero in on the asteroid Monday, intent on slamming it head-on at 14,000 mph (22,500 kph).

- The impact should be just enough to nudge the asteroid into a slightly tighter orbit around its companion space rock – demonstrating that if a killer asteroid ever heads our way, we'd stand a fighting chance of diverting it.
- Cameras and telescopes will watch the crash, but it will take months to find out if it actually changed the orbit.
- The **\$325 million** planetary defence test began with Dart's launch last fall.

The Asteroid target

- The asteroid with the bull's-eye on it is **Dimorphos**, about 7 million miles (9.6 million kilometres) from Earth.
- It is actually the puny sidekick of a 2,500-foot (780-metre) asteroid named Didymos, Greek for twin.
- Discovered in **1996**, Didymos is spinning so fast that scientists believe it flung off material that eventually formed a moonlet.
- Dimorphos – roughly **525 feet (160 metres) across** – orbits its parent body at a distance of less than a mile (1.2 kilometres).
- It is about asteroid deflection, not disruption. Dart isn't going to blow up the asteroid.
 - Rather, the impact will dig out a crater tens of yards (metres) in size and hurl some 2 million pounds (1 million kilograms) of rocks and dirt into space.
- NASA insists there is a zero chance either asteroid will threaten Earth – now or in the future. That's why the pair was picked.

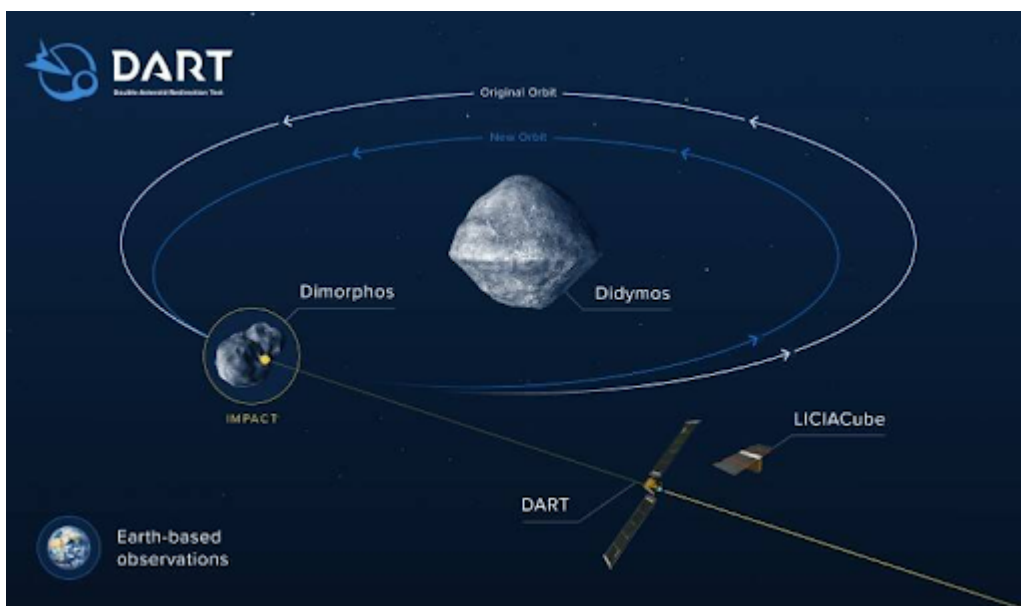
Why Dimorphos was chosen?

- Didymos is a perfect system for the test mission because it is an eclipsing binary which means it has a moonlet that regularly orbits the asteroid and we can see it when it passes in front of the main asteroid.
- Earth-based telescopes can study this variation in brightness to understand how long it takes Dimorphos to orbit Didymos.
- The timing for the DART impact is when the Didymos system is closest to the Earth. So the telescopes can really make the most precise measurement possible.

About DART- The impactor

- DART is a low-cost spacecraft.
- The size of a small vending machine at **1,260 pounds (570 kilograms)**, the spacecraft will slam into roughly 11 billion pounds (5 billion kilograms) of asteroid.
- It has two solar arrays and uses hydrazine propellant for manoeuvring the spacecraft.
- It also carries about 10 kg of xenon which will be used to demonstrate the agency's new thrusters called **NASA Evolutionary Xenon Thruster-Commercial (NEXT-C)** in space.
- NEXT-C gridded ion thruster system provides a combination of performance and spacecraft integration capabilities that make it uniquely suited for deep space robotic missions.
- The spacecraft carries a high-resolution imager called Didymos Reconnaissance and Asteroid Camera for Optical Navigation (DRACO).
- Images from DRACO will be sent to Earth in real-time and will help study the impact site and surface of Dimorphos (the target asteroid).
- Believed to be essentially a rubble pile, Dimorphos will emerge as a point of light an hour before impact, looming larger and larger in the camera images beamed back to Earth.

- The spacecraft's navigation is designed to distinguish between the two asteroids and, in the final 50 minutes, target the smaller one.
- Unless Dart misses – NASA puts the odds of that happening at less than 10% – it will be the end of the road for Dart. If it goes screaming past both space rocks, it will encounter them again in a couple years for Take 2.
- DART also carried a small satellite or CubeSat named LICIACube (Light Italian CubeSat for Imaging of Asteroids).
 - It will be deployed ten days before the impact on Dimorphos. LICIACube is expected to capture images of the impact and the impact crater formed as a result of the collision.
 - It can also capture images of any dust cloud formed during the impact.



Objectives of the mission

- The mission is to test the new technology to be prepared in case an asteroid heads towards Earth in the future.
- The aim is to test the newly developed technology that would allow a spacecraft to crash into an asteroid and change its course.

- The target of the spacecraft is a small moonlet called Dimorphos (Greek for “two forms”).
- Dimorphos orbits a larger asteroid named Didymos (Greek for “twin”).
- It is a suicide mission and the spacecraft will be completely destroyed.

Need for such a mission

- Though there was no threat to Earth from this particular asteroid and NASA says there is no real danger to Earth from asteroids for the next 100 years at least – asteroid collisions are real, and can happen.
- The dinosaurs, and most other life forms at that time, are known to have become extinct following an asteroid collision about million years ago.
- As recently as 2013, an asteroid entered the earth’s atmosphere and exploded over Russia, causing injuries to hundreds of people, and causing widespread damage.
- Small asteroids – millions of them orbit the Sun – keep entering the earth’s atmosphere fairly regularly, but burn out due to friction before they reach the surface. Some of them do drop to the surface but are not large enough to cause harm.
- The danger is from bigger asteroids. The one that destroyed the dinosaurs was about 10 km in width. According to NASA, an asteroid that big comes towards the Earth only in about 100 to 200 million years.
- But smaller ones are more frequent. There is a probability that an asteroid of the size of 25 metres would come once every 100 years. The one that exploded over Russia in 2013 was a little smaller, about 18 metres in size.
- The problem is that these calculations are based on asteroids that we know about, only about 26,000. There are many asteroids that we haven’t discovered yet. And these could surprise us.

After mission follow up

- Little Dimorphos completes a lap around big Didymos every 11 hours and 55 minutes. The impact by Dart should shave about 10 minutes off that.
- Although the strike itself should be immediately apparent, it will take months to verify the moonlet's tweaked orbit.
- Cameras on Dart and a mini tagalong satellite will capture the collision up close. Telescopes on all seven continents, along with the Hubble and Webb space telescopes and NASA's asteroid-hunting Lucy spacecraft, may see a bright flash as Dart smacks Dimorphos and sends streams of rock and dirt cascading into space.
- The observatories will track the pair of asteroids as they circle the sun, to see if Dart altered Dimorphos' orbit.
- In 2024, a European spacecraft named **Hera** will retrace Dart's journey to measure the impact results.
- Although the intended nudge should change the moonlet's position only slightly, that will add up to a major shift over time.
- Even if Dart misses, the experiment still will provide valuable insight to NASA. It has to be done now rather than when there's an actual need.

Other Asteroid mission

- Planet Earth is on an asteroid-chasing roll.
- NASA has close to a pound (450 grams) of rubble collected from asteroid Bennu headed to Earth.
 - The stash should arrive next September.
- Japan was the first to retrieve asteroid samples, accomplishing the feat twice.
- China hopes to follow suit with a mission launching in 2025.
- **NASA's Lucy spacecraft**, meanwhile, is headed to asteroids near Jupiter, after launching last year.

- Another spacecraft, Near-Earth **Asteroid Scout**, is loaded into NASA's new moon rocket awaiting liftoff; it will use a solar sail to fly past a space rock that's less than 60 feet (18 metres) next year.
- In 2026, NASA will launch a census-taking telescope to identify hard-to-find asteroids that could pose risks. One asteroid mission is grounded while an independent review board weighs its future.
- NASA's Psyche spacecraft should have launched this year to a metal-rich asteroid between Mars and Jupiter, but the team couldn't test the flight software in time.

DART Importance to planetary defence

- NASA established the Planetary Defence Coordination Office to manage its ongoing mission of planetary defence.
- The PDCO's goals are to provide early detection of potentially hazardous objects, track and characterise the objects, study strategies and technologies for mitigating possible impacts, and play a leading role in U.S. government response planning for an actual impact.
- DART is the first planetary defence test mission for PDCO.

Mould your thoughts

1. NASA recently collided a spacecraft with an asteroid. Discuss the mechanism, need and significance of such a mission.

Approach to the answer.

- Introduction about DART
- Mechanism of DART
- Need for such a mission
- Significance of such a mission
- Wayforward and conclusion.