

CSB IAS ACADEMY

TOPIC OF THE DAY (DATE: 26.09.2023)

OSIRIS-REx Mission

WHY IN NEWS?

NASA's Origins, Spectral Interpretation, Resource Identification, Security– Regolith Explorer (OSIRIS-REx) mission returns to Earth carrying an estimated 250 grams (8.8 ounces) of material gathered from the surface of an asteroid.

ABOUT OSIRIS-REX MISSION

- OSIRIS-REx launched from Cape Canaveral, Florida on **8th September 2016** and spent two years traveling to **Bennu, a carbon-rich asteroid** that orbits between Earth and Mars. The spacecraft arrived at the asteroid in December 2018 and orbited for two years, measuring the asteroid's mass, density, albedo, surface composition and particle environment.
- The landing site on Bennu was named: **Nightingale**.

KEY OBJECTIVES OF THE MISSION

Sample Collection

- The primary objective of Osiris-Rex is to collect at least **60 grams of pristine regolith (loose rocks and dust) from the surface of Bennu** using a robotic arm called the Touch-And-Go Sample Acquisition Mechanism (TAGSAM).
- The spacecraft will approach the asteroid at a low speed and briefly touch the surface with the TAGSAM head, which will release a burst of nitrogen gas to stir up and capture the regolith. The spacecraft will then store the sample in a capsule for return to Earth.

Studying Bennu's Composition

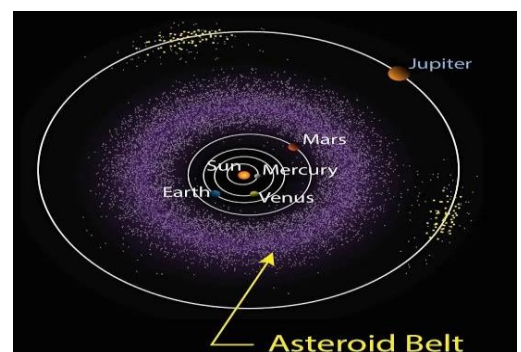
- To characterize Bennu's **surface, composition, mineralogy, and shape using a suite of instruments onboard the spacecraft**. These include cameras, spectrometers, a laser altimeter, and a radio science experiment. The instruments will map Bennu's geology, chemistry, morphology, and thermal properties, as well as identify potential sample sites and hazards.

Understanding Asteroid Properties

- To improve our knowledge of the physical and orbital properties of near-Earth asteroids, especially those that are potentially hazardous to Earth. **Bennu has a 1 in 2700 chance of impacting the Earth in the late 22nd century, according to current estimates.**

CHALLENGES

- After seven long years in space, the mission now faces one of its most daunting challenges—actually delivering the samples to Earth.
- The spacecraft itself **will not enter the planet's atmosphere but it will “drop” the parcel in a precise trajectory to make it land at a predetermined location in the Utah desert**. While doing so, the capsule must protect the sample from heat, vibrations and any contamination from our planet.



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ABOUT ASTEROID BENNU

- The Asteroids are rocky objects that orbit the Sun, much smaller than planets.
- Bennu is an asteroid about as tall as the Empire State Building, located about 200 million miles away from the Earth.
- The asteroid was discovered by a team from the **NASA-funded Lincoln Near-Earth Asteroid Research team in 1999.**
- It is believed to have **been born in the Main Asteroid belt between Mars and Jupiter.**
- The asteroid is coming closer to Earth because of gravitational tugs from other celestial objects and the slight push asteroids get when they release absorbed sunlight.
- It is a B-type asteroid, implying that it contains significant amounts of carbon and various other minerals.
- Around 20-40 percent of Bennu's interior is empty space, and scientists believe that it was formed in the first 10 million years of the solar system's creation, implying that it is roughly 4.5 billion years old.

REGOLITH

- Regolith refers to the *layer of loose, unconsolidated material that covers the solid bedrock on the surface of a planet, moon, or other celestial body.*

WHY ASTEROID BENNU?

- **Proximity to Earth** -The closest asteroids to Earth are called Near-Earth Objects (NEOs).
- NEOs are objects that orbit within 1.3 AU of the Sun. (1 AU = the distance between Earth and the Sun, or ~93 million miles).
- For a sample return mission like OSIRIS-REx, the most accessible asteroids for a spacecraft to reach are located between 1.6 AU and 0.8 AU.
- It completes an **orbit around the Sun every 436.604 days (1.2 years) and every 6 years comes very close to Earth, within 0.002 AU.**
- These close encounters give Bennu a **high probability of impacting Earth in the late 22nd century.**
- Asteroids with small diameters rotate more rapidly than those with large diameters.
- With a diameter less than 200 meters, an asteroid spin so rapidly that the loose material on its surface (regolith) can be ejected from it.
- The ideal asteroid has a **diameter larger than 200 m (Bennu's diameter – 490 m).**

PREVIOUS MISSIONS TO STUDY ASTEROIDS

HOYABUSA -2

- It is a Japanese spacecraft that studied the asteroid **Ryugu**, collected samples, and brought them to Earth for analysis. It was the first to deploy rovers to operate on an asteroid.
- It was launched by the Japan Aerospace Exploration Agency (JAXA) in December 2014.
- It arrived at asteroid **Ryugu on June 2018**, collected samples from the asteroid during two touchdowns in 2019, and **delivered the sample capsule back to the Earth on December 2020.**
- Hayabusa2 is a follow-up to Japan's original Hayabusa mission, which was the first spacecraft to take samples from an asteroid, and was also the first mission to **successfully land and take off from an asteroid. It returned samples from asteroid 25143 Itokawa to Earth on June 13, 2010.**