NASA’s OSIRIS-REx Returns to Earth along with New Clues regarding the Origin of Life

Jan 24. 2026

The origins of life on Earth have always been a mystery that has stumped scientists for generations. However, samples brought back to Earth by NASA’s OSIRIS-REx could permanently change our understanding of our solar system, and how the ingredients for life ended up on Earth.

OSIRIS-REx stands for Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer and was the first US mission that successfully took a sample from an asteroid and returned it safely back to Earth. The mission involved collecting rock and dust samples from a carbon rich Near Earth Object known as Bennu.

OSIRIS-REx launched on September 8th, 2016 into an orbit around the Sun. Then, on September 22, 2017, it completed a gravitational assist around Earth, launching itself towards the asteroid and arriving on December 3rd, 2018. After roughly two years of orbiting Bennu, OSIRIS-REx did a brief touchdown to collect a sample on October 20, 2020. Finally, the probe returned to Earth on September 24, 2023.

Throughout OSIRIS-REx’s journey, many autonomous systems, phases where the robot had to operate on its own without human help, played a critical role in making the journey a success. At the peak of its travel, the probe was roughly 200 million miles away from Earth. This meant the radio signals used to communicate with the probe would take roughly 18 minutes to travel. And any

response to these inputs would take another 18 minutes to travel back to Earth. Such a high delay made it impossible to manually operate the probe.

Fortunately, NASA engineers designed other solutions. The probes Natural Feature Tracking (NFT), for example, used scans to develop a 3d map of the asteroid that it could then cross reference with sensor data during descent to ensure proper alignment. A major issue with landing on the asteroid was that the terrain was much more rough and jagged than NASA had originally anticipated. Fortunately, OSIRIS-REx was able to fully map the asteroid and find multiple contenders for suitable landing spots.

Another key issue OSIRIS-REx faced was the gravity on Bennu, or lack thereof. Bennu's gravity is about 0.001% of Earth's gravity, meaning that the probe could not rely on the gravity of Bennu for stability. Thus, instead of landing, OSIRIS-REx used an autonomous method known as Touch-And-Go (TAG), where the spacecraft slowly descended, making contact with Bennu for ~5 seconds. During this time, the onboard Touch-And-Go Sample Acquisition Mechanism (TAGSAM) quickly extended, used a burst of Nitrogen gas to disturb and collect rocks, and quickly retracted all within a matter of seconds, and entirely autonomously.

Artist's rendition of OSIRIS-REx's TAGASM making contact with, and collecting samples from the asteroid Bennu

Credit: NASA/Goddard Space Flight Center

Despite the immense challenges faced during this mission, it was a blazing success, and the spacecraft set two Guiness World Records: One for orbiting the smallest body ever, and the other for the closest orbit radius of a spacecraft to a celestial body.

Early analysis of the samples brought back from Bennu show signs of key ingredients for life, supporting the idea that Earth got many of its biomolecules from Asteroids Early on. Microcrystals of Trona, a mineral primarily used to produce baking soda, indicate that Bennu was once home to sodium-rich water, which fosters organic molecules. Another key ingredient to life is Amino Acids, and, of the 20 needed for life on Earth, 14 of which were found on Bennu. Finally, Nucleotide bases, the building blocks of DNA and RNA were abundant on the Bennu samples, a first for any sample taken from outer space.

“This is the clearest indication of life’s ingredients coming from asteroids we have yet,” said NASA planetary scientist Dr. Harper. “Bennu is the first in a long series of key advancements in understanding the origin of life on Earth.”

With this mission complete, rather than retiring the spacecraft, NASA is re-employing the probe, now named OSIRIS-APEX(Apophis Explorer). OSIRIS-APEX is currently aimed at a new asteroid called Apophis, which will have a close encounter with Earth in April 2029. The probe will both study the subsurface composition of the Asteroid, and analyze how its trajectory will be altered by Earth's gravity.

All in all, OSIRIS-REx, and now OSIRIS-APEX, are lighting the flames to further exploration of our solar system, and an even clearer understanding of the origin of life on Earth.

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