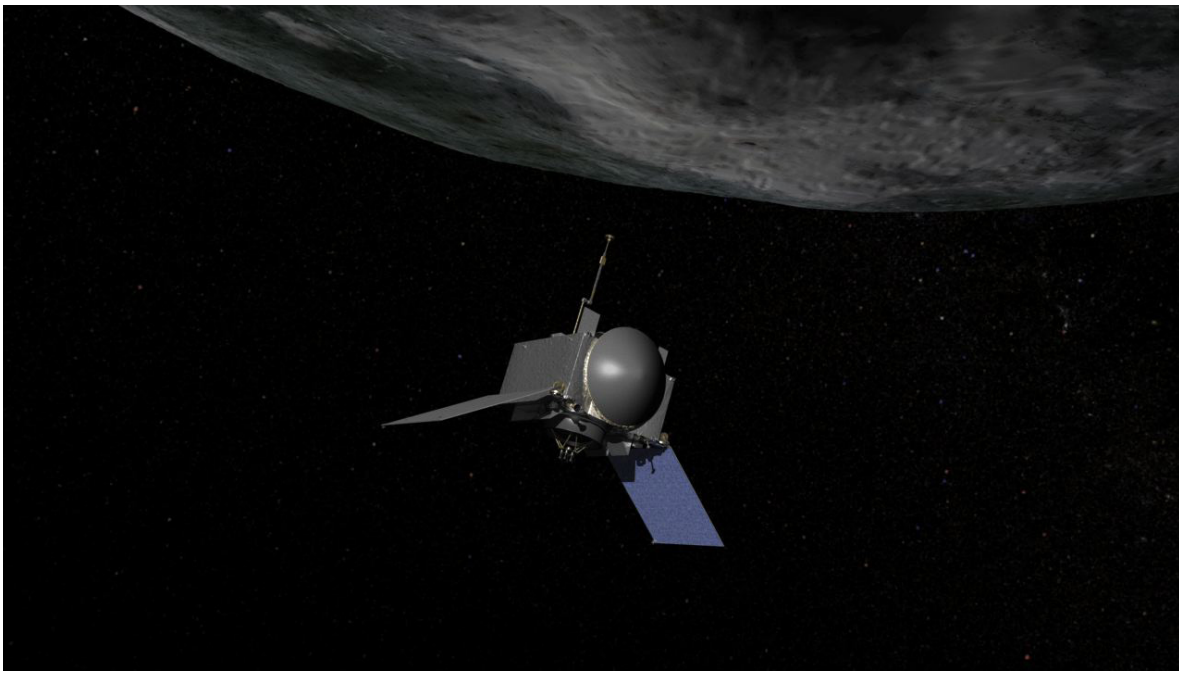
NASAfacts

NASA's OSIRIS-REx Asteroid Sample Return Mission



Artist concept of OSIRIS-REx at Bennu. Credit: NASA/Goddard

NASA's Origins, Spectral Interpretation, Resource Identification, Security - Regolith Explorer asteroid sample return mission (OSIRIS-REx), is the first U.S. mission to collect a sample of an asteroid and return it to Earth for study. Analyzing the sample will help scientists understand the early solar system, as well as the hazards and resources of near-Earth space.

Asteroids are remnants of the building blocks that formed the planets and enabled life. Those like Bennu contain natural resources such as water, organics and metals. Future space exploration and economic development may rely on asteroids for these materials.

SCIENCE GOALS AND OBJECTIVES

The OSIRIS-REx name is an acronym of the mission objectives, which are:

- Origins: Return and analyze a pristine carbon rich asteroid sample
- Spectral Interpretation: Provide ground truth or direct observations for telescopic data of the entire asteroid population
- Resource Identification: Map the chemistry and mineralogy of a primitive carbon rich asteroid
- Security: Measure the effect of sunlight on the orbit of a small asteroid, known as the Yarkovsky effect—the slight push created when the asteroid absorbs sunlight and re-emits that energy as heat
- Regolith Explorer: Document the regolith (layer of loose, outer material) at the sampling site at scales down to the sub-centimeter

MISSION OVERVIEW

OSIRIS-REx will launch from Cape Canaveral, Florida, on an Atlas V 411 rocket during a 34-day launch period starting Sept. 8, 2016. OSIRIS-REx will orbit the sun for a year, then use Earth's gravitational field to assist it on its way to Bennu. In August 2018, OSIRIS-REx's approach to Bennu will begin. It will use an array of small rocket thrusters to match the velocity of Bennu and rendezvous with the asteroid.

The spacecraft will begin a detailed survey of Bennu two months after slowing to encounter Bennu. The process will last over a year, and, as part of it, OSIRIS-REx will map potential sample sites. After

the selection of the final site, the spacecraft will briefly touch the surface of Bennu to retrieve a sample. The sampling arm will make contact with the surface of Bennu for about five seconds, during which it will release a burst of nitrogen gas. The procedure will cause rocks and surface soil to be stirred up and captured in the sampler head. The spacecraft has enough nitrogen to allow three sampling attempts, to collect between 60 and 2000 grams 2–70 ounces (60–2000) grams.

In March 2021, the window for departure from the asteroid will open, and OSIRIS-REx will begin its return journey to Earth, arriving two and a half years later in September 2023. The sample return capsule will separate from the spacecraft and enter the Earth's atmosphere. The capsule containing the sample will be collected at the Utah Test and Training Range. For two years after the sample return (from late 2023-2025) the science team will catalog the sample and conduct the analysis needed to meet the mission science goals. NASA will preserve at least 75% of the sample at NASA's Johnson Space Flight Center in Houston for further research by scientists worldwide, including future generations of scientists.

SCIENCE PAYLOAD

OSIRIS-REx contains five instruments to explore Bennu, each of which provides important information for the mission. This suite of instruments is used for remote sensing or scanning the surface of the asteroid. They will map Bennu and establish the composition of the asteroid, including the distribution of elements, minerals and organic material.

OSIRIS-REx Camera Suite (OCAMS) – a system consisting of three cameras provided by the University of Arizona in Tucson will observe Bennu and provide global image mapping, as well as sample site image mapping. The suite consists of these cameras:

- MapCam – a camera that will map the surface of the asteroid in four colors
- PolyCam – an 8-inch (20 centimeter) telescope that will be the first to image the asteroid from 1.24 million miles (2 million kilometers) away and also provide high-resolution microscope-like images of the surface
- SamCam – a camera that will image (as fast as 1.6 seconds) the sample acquisition event and examine the sample collector to verify successful acquisition

OSIRIS-REx Laser Altimeter (OLA) – a scanning LIDAR (Light Detection and Ranging) contributed by the Canadian Space Agency in Saint-Hubert, QC will be used to measure the distance between the spacecraft and Bennu's surface and map the shape of the asteroid.

OSIRIS-REx Thermal Emission Spectrometer (OTES) – an instrument provided by Arizona State University in Tempe that will provide mineral and temperature information by observing the thermal infrared spectrum.

OSIRIS-REx Visible and Infrared Spectrometer (OVIRS) – an instrument provided by NASA's Goddard Space Flight Center in Greenbelt, Maryland will measure visible and infrared light from Bennu to identify mineral and organic material.

Regolith X-ray Imaging Spectrometer (REXIS) – a student experiment provided by Massachusetts Institute of Technology and Harvard University, both in Cambridge, that will observe the x-ray spectrum to determine what elements are present on Bennu's surface and how abundant they are.

SAMPLE COLLECTION AND RETURN

Touch-And-Go Sample Acquisition Mechanism (TAGSAM) – an articulated robotic arm with a sampler head, provided by Lockheed Martin Space Systems Company, to collect a sample of Bennu's surface.

OSIRIS-REx Sample Return Capsule (SRC) – a capsule with a heat shield and parachutes through which the spacecraft will return the asteroid sample to Earth, provided by Lockheed Martin Space Systems Company.

SPACECRAFT

Lockheed Martin Space Systems Company is building the spacecraft at its facility near Denver.

Spacecraft specifications:

- Length: 20.25 feet (6.2 meters) with solar arrays deployed
- Width: 8 feet (2.43 meters) x 8 feet (2.43 meters)
- Height: 10.33 feet (3.15 meters)
- TAGSAM Length: 11 feet (3.35 meters)
- Dry Mass (unfueled): 1,940 pounds (880 kilograms)
- Wet Mass (fueled): 4,650 pounds (2,110 kilograms)
- Power: Two solar panels generate between 1,226 watts and 3,000 watts, depending on the spacecraft's distance from the sun.

NAVIGATION

KinetX in Simi Valley, California, in partnership with NASA's Goddard Space Flight Center and Lockheed Martin Space Systems Company, will provide mission navigation.

OSIRIS-REx PARTNERS

Partners include: NASA's Goddard Space Flight Center, University of Arizona, Lockheed Martin Space Systems Company, NASA's Marshall Space Flight Center, Arizona State University, Massachusetts Institute of Technology, Harvard University, KinetX, NASA's Johnson Space Center, NASA's Kennedy Space Center, United Launch Alliance, NASA's Ames Research Center, NASA's Langley Research Center, Canadian Space Agency, France's Centre National d'Études Spatiales (CNES) and Japan Aerospace Exploration Agency (JAXA).

For more information, please visit find OSIRIS-REx online:

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