Largest asteroid sample ever collected is coming down to Earth

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Chunks of asteroid that could tell us about the earliest days of the 4.5 billion-year-old solar system and the possible origins of water on our planet are set to land in the Utah desert Sunday.

It's a moment more than a decade in the making for a NASA mission called OSIRIS-REx. Its goal was to scoop up a large sample of rocks and

dust from a near-Earth asteroid named Bennu and bring it to our planet to study. The spacecraft successfully snagged its prize in 2020 and this weekend will finally pass by Earth and release a capsule containing the sample and send it careening down to Utah.

"This is, of course, the moment we've all been waiting for," said Lori Glaze, director of NASA's Science Mission Directorate's Planetary Science Division.

The sample will help scientists get a snapshot of what materials were present when our solar system first formed. Researchers believe asteroids like Bennu haven't changed much since the birth of our cosmic neighborhood. They plan to study the recovered rocks and use the mission to inform future exploration.

"Asteroids, we believe, could have been the source material not just for building up the rocky parts of our planet, but also for delivering the water that makes up our hydrologic system," Glaze said.

Scientists don't know exactly how much sample is in the container, but suspect it's the most ever collected from an asteroid, weighing roughly 250 grams—or about as much as a hamster. That will give them more rocks to analyze than ever before.

OSIRIS-REx grabbed more rocks and materials than expected—so much, that it jammed the spacecraft's sample collector open and some of it went spewing out into space. NASA opted not to measure the sample and instead quickly stowed the rocks to keep them safe.

The spacecraft left Bennu with the sample in 2021, and has been en route to Earth ever since. On Sunday morning, OSIRIS-REx will come within 63,000 miles of Earth, which is when the last leg of the journey begins—and not one entirely without risks.

First, the probe will release the sample container—roughly the size of a tire—into space. If the container doesn't jettison as planned and gets stuck inside the OSIRIS-REx spacecraft, the team will have to wait until September 2025 to try again. The spacecraft will have to loop around the sun again before it can come close to Earth.

If that goes well, from there it will make its way down to the planet, taking roughly four hours to reach Earth's atmosphere. During that time, there's no way to control the capsule. "Once we release it, it's really just a ballistic object," Sandy Freund, OSIRIS-REx program manager at Lockheed Martin, said.

The container will come into the atmosphere at about 27,000 miles per hour and heat up to around 5,000 degrees Fahrenheit. It has a heat shield , a critical piece of hardware meant to prevent the sample from burning up—which would end the mission.

"That's really kind of your worst case scenario," Freund said. "Your samples are gone completely."

As it descends, the capsule will release a drogue parachute to keep it steady, followed by another parachute to slow it down. If all goes to plan, the capsule will gently touch down in Utah at 10 to 11 miles per hour. In the unlikely scenario that the parachutes don't work and the capsule doesn't slow down enough, the samples could still make it to the ground.

"We are prepared for the hard landing scenario," Freund said. "It's not ideal, but the samples are on the ground, right? They're not as pristine as the team would like, but they're still here."

From there, a helicopter will tow it via cable to a clean room, where a nitrogen purge will rid it of possible contaminants. Then it will head to NASA's Johnson Space Center in Houston, where the sample will be

revealed to the public in October.

Despite potential snags, Freund says she and her team are confident in the mission. They've done multiple rehearsals to prepare for the fall leading up to Sunday. During the fall, numerous aircraft will be tracking the container, as well as radar in the area. The team also has improved on technology used in past sample return missions.

"We've drawn a lot from heritage and have been super fortunate to be able to do that," Freund said.

OSIRIS-REx could also help inform future missions to asteroids—perhaps even ones to mine these rocks for resources.

"In the future, people have talked about perhaps being able to use asteroids as resources that we could take advantage of," Glaze said. "The operations of OSIRIS-REx around the vicinity of Bennu I think were really informative for how would you actually do something like that."