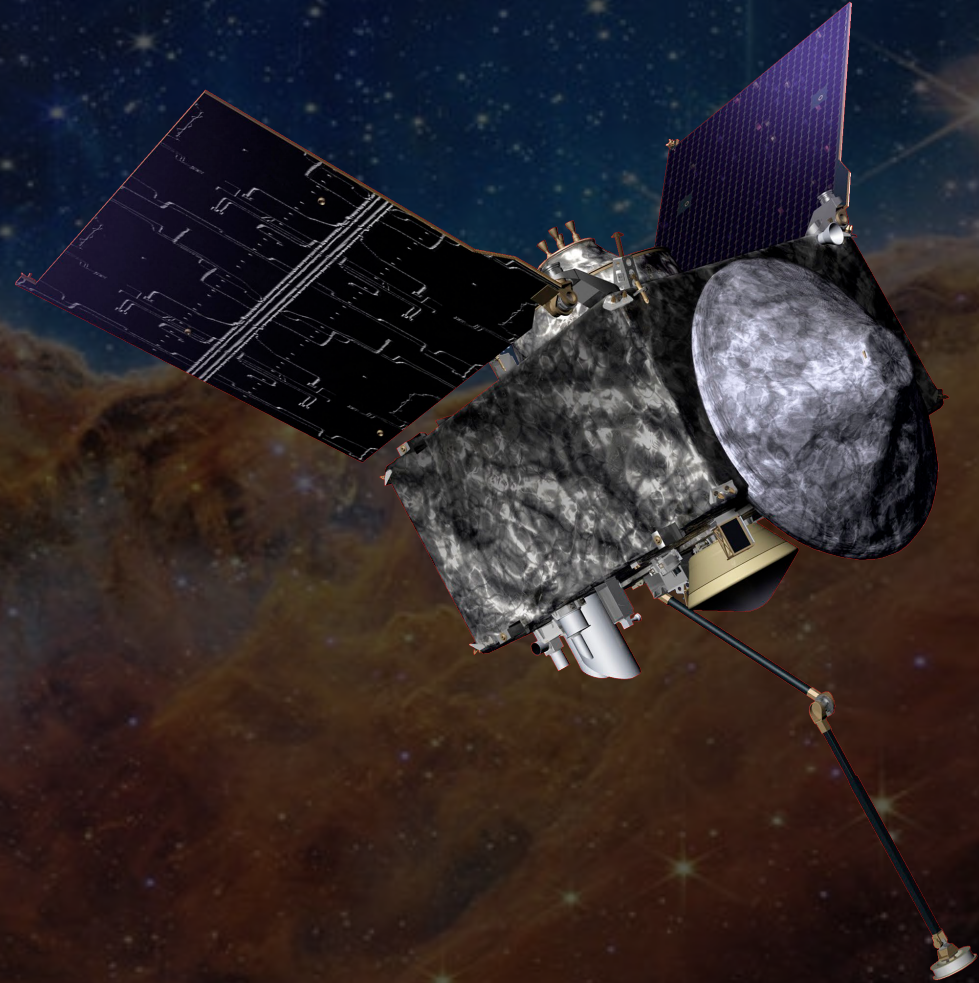


OSIRIS-Rex: Conception to Sample Return

Presented by Carter Cohen – August 9th, 2023
at the CATIE Institute





Origins of ARES - Curation





Stardust

Comet Wild 2
Interstellar dust
2006

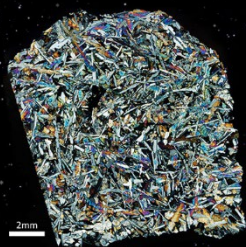


Comet nucleus ~5.5 km

Thousands of particles
~10 microns.

Apollo

The Moon
1969



Cross-polarized
thin section

382 kg of dust, rocks, and cores



Antarctic Meteorites

From the Moon, Mars, and asteroids
1978



Over 20,000 specimens

Genesis

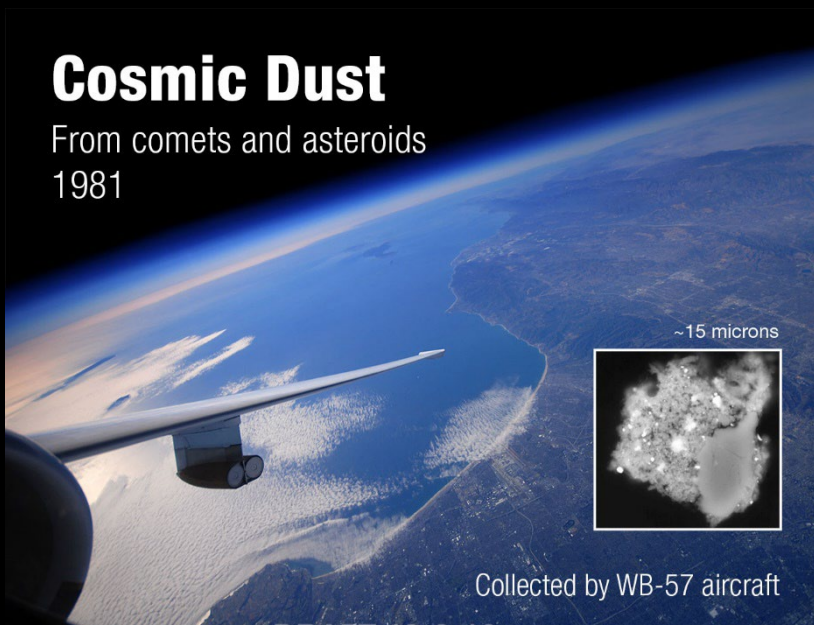
Solar Wind
2004

Atoms captured
in wafers

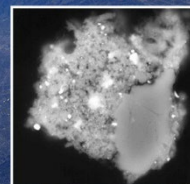


Cosmic Dust

From comets and asteroids
1981



~15 microns



Collected by WB-57 aircraft

September
2016

OSIRIS-REx

Asteroid Bennu
2023 (planned)
Regolith



Bennu, a carbon-bearing
asteroid, is ~0.48 km in diameter



O RIGINS

Like Carbonaceous Meteorites



S PECTRAL
I NTERPRETATION

Clay Minerals



R ESOURCE
I DENTIFICATION

Water-rich



S ECURITY

Mass, Density, and Orbit



R EGOLITH
E XPLORED

Many boulders



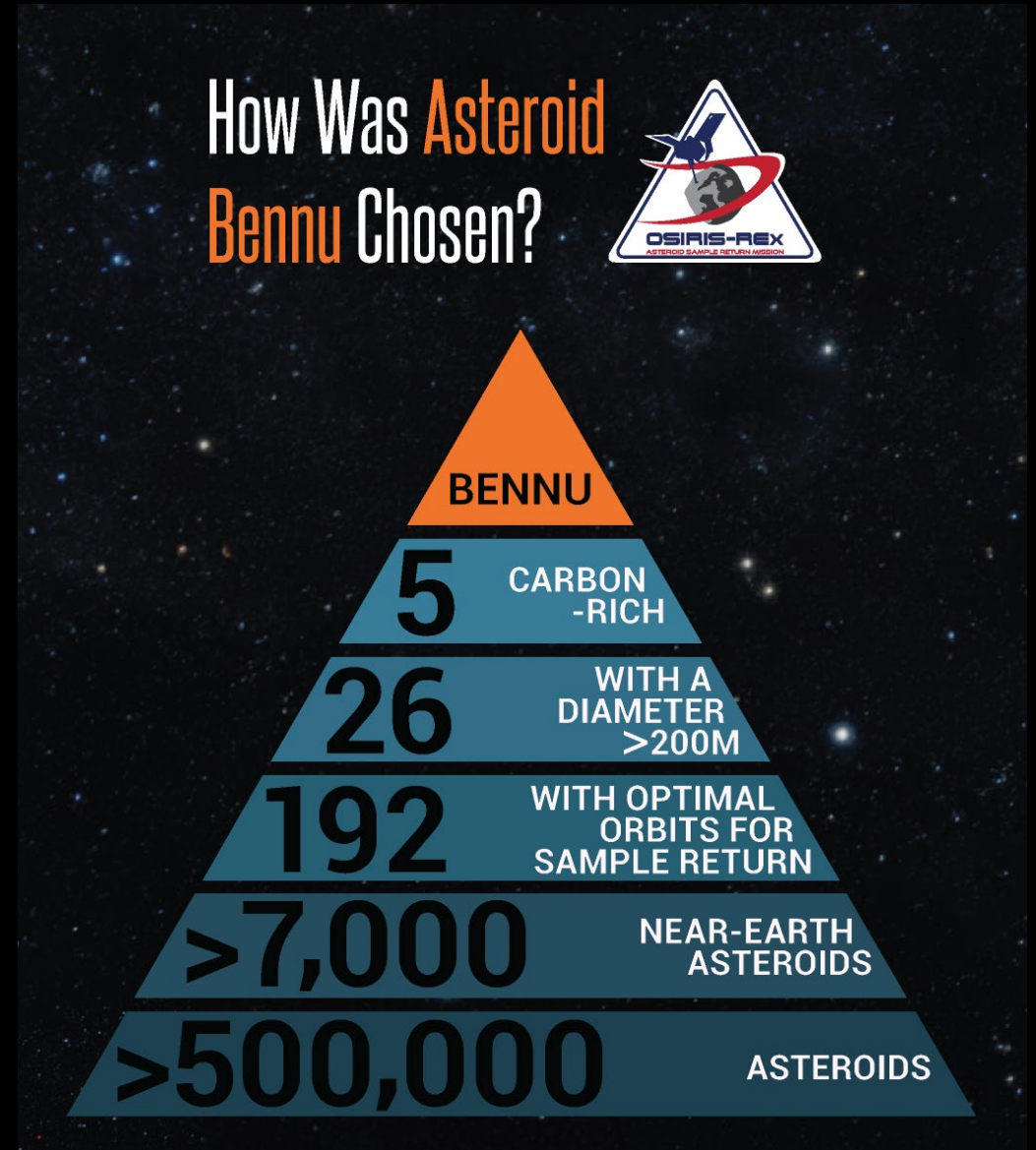
Etymology

Osiris: Egyptian spirit of fertility, the afterlife, and life

Bennu: A crane, created by Osiris, symbolizing creation and rebirth

Why have an OSIRIS-REx mission?

- Astromaterial samples inform us on the origins of life, solar system, and even the
- Understanding organic molecules (e.g. water) can lead to us understanding more about life on Earth
- Timing and location is everything when targeting a mission
- Cost: \$800 Million USD



*“Bennu may contain the **molecular precursors** to the origin of life and the **Earth’s oceans**. Bennu is also one of the most potentially hazardous asteroids. It has a relatively high probability of **impacting the Earth late in the 22nd century**. OSIRIS-REx will determine Bennu’s **physical and chemical properties**. This will be critical for future scientists to know when **developing an impact mitigation mission**.”*

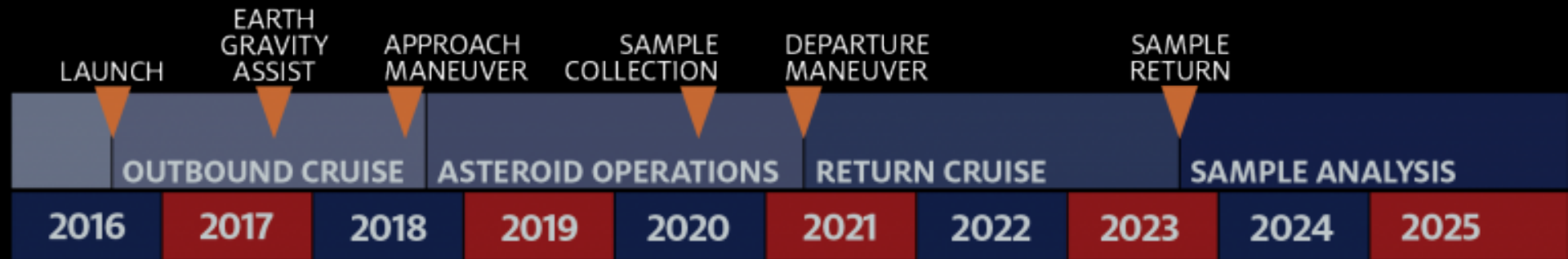


Launch - 2016



OSIRIS-REx

MISSION OPERATIONS TIMELINE



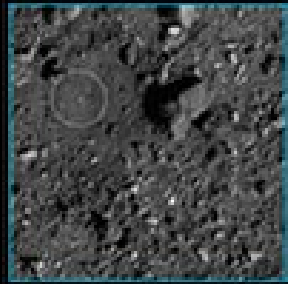


Bennu has a 437 day orbit!



Where to land?

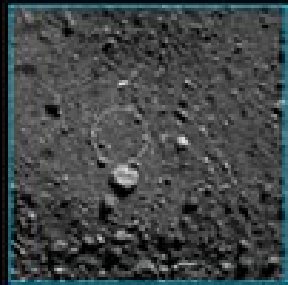
- Deliverability
- Safety of craft
- Resource richness / diversity
- Feasibility of sample recovery



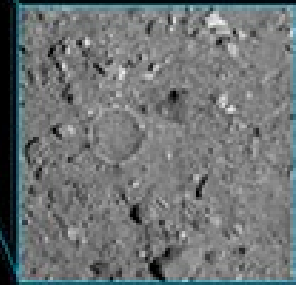
Nightingale



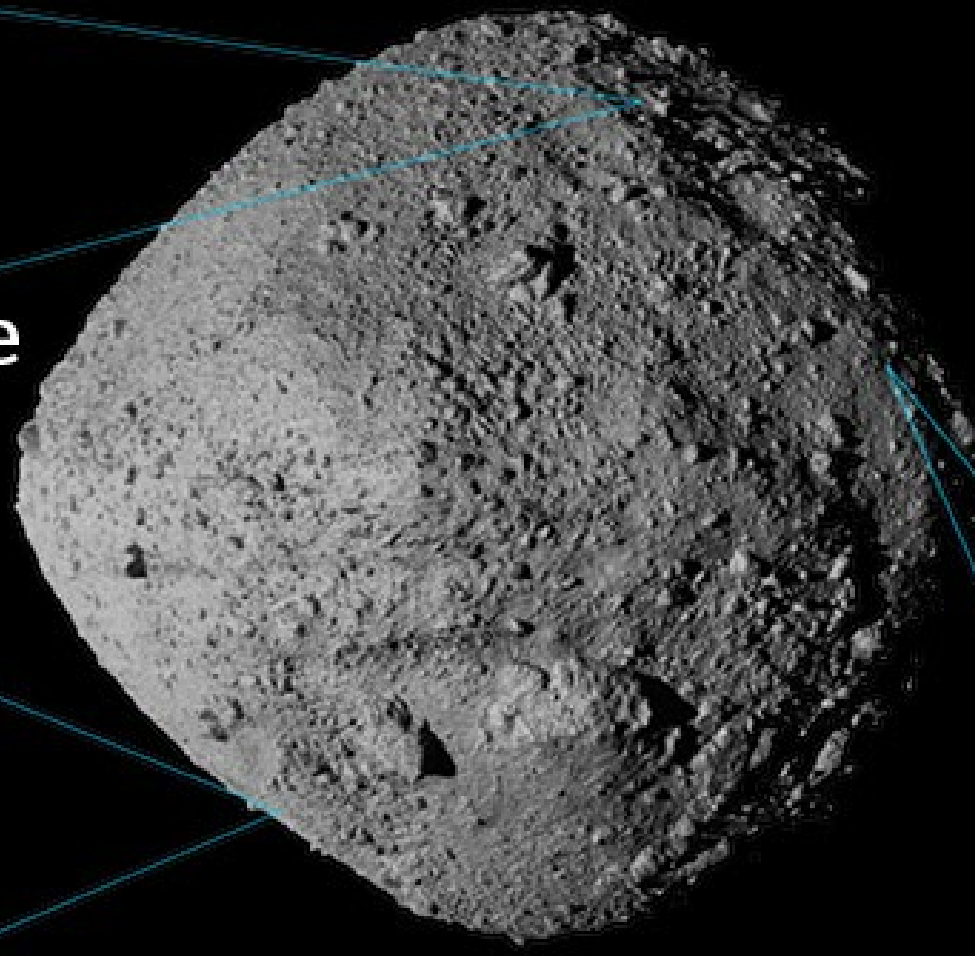
Osprey



Sandpiper



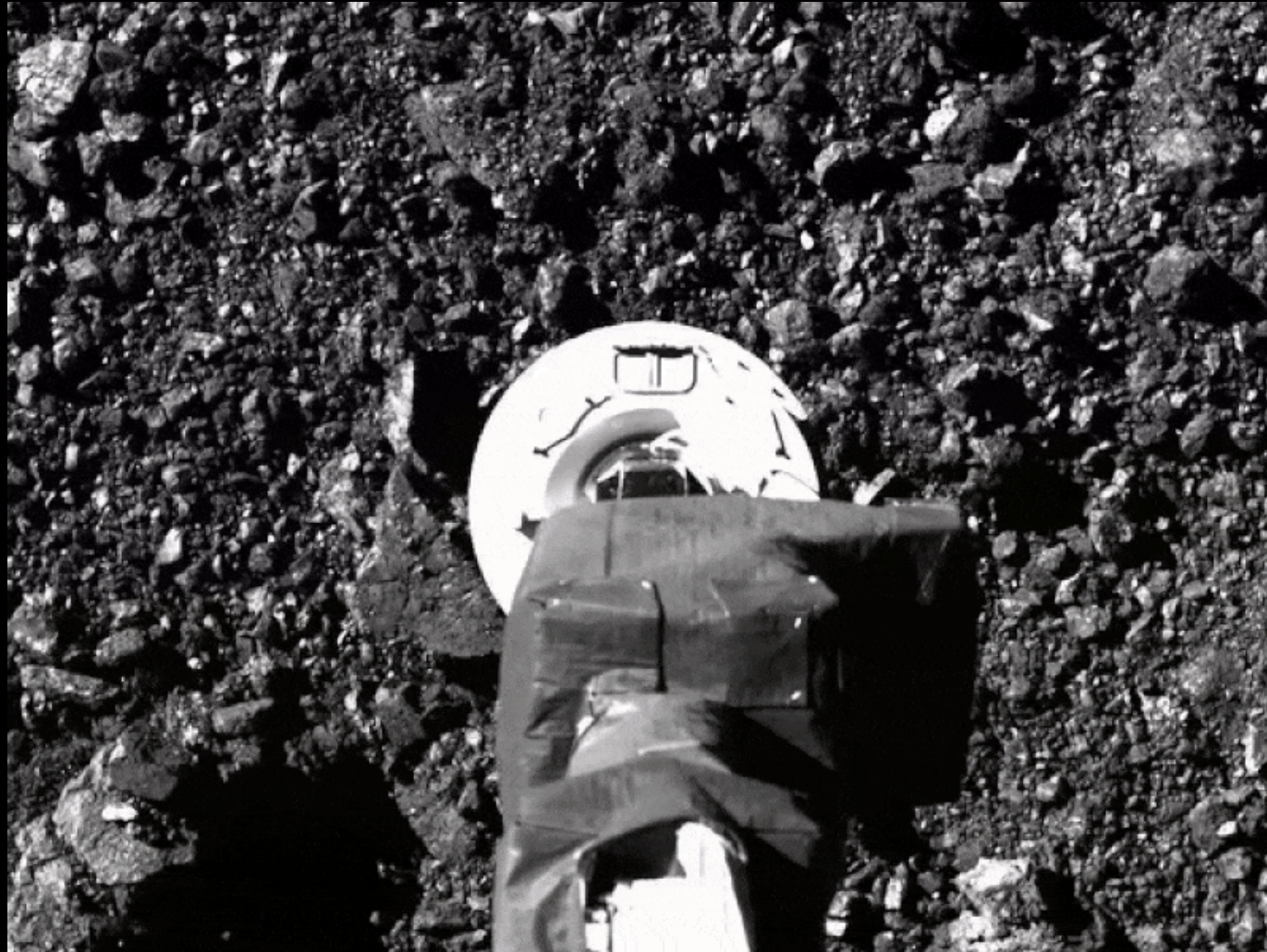
Kingfisher



SAMPLE SITE NIGHTINGALE

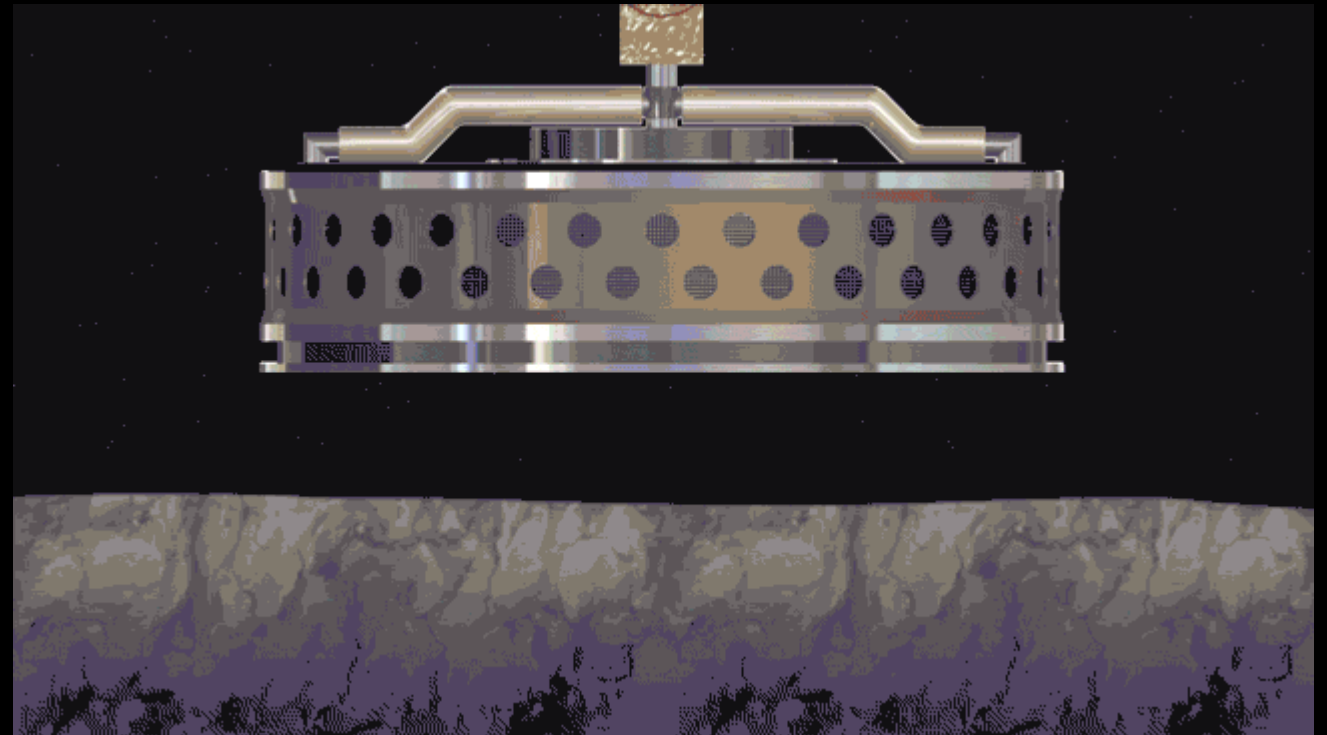


“Touch and Go collection”



TAGSAM works by using a “reverse vacuum”

- Collecting sample with a rocky surface poses a problem – difficult to drill reliably on surface
- N₂ tanks pump gas into the local environment, stirring the regolith, which is then collected in a trap





A military representative checks the mock sample capsule's landing site for unexploded ordnance. He will be the first person to approach the real capsule, with samples of asteroid Bennu, when it lands at the at the Department of Defense's Utah Test and Training Range



A helicopter practices transporting a mock sample capsule, packed for travel, at the Department of Defense's Utah Test and Training Range. On July 18-20, 2023, the team rehearsed retrieving a mock sample capsule at the location where the real one, with samples of asteroid Bennu, will land on Sept. 24. NASA's OSIRIS-REx spacecraft collected a sample from Bennu in October 2020 and has been traveling back to Earth with it since May 2021. This picture was taken on Wednesday, July 19. Credit: NASA/Keegan Barber.

My Role in OSIRIS-REx sample return

- The goal of Astromaterial Curation is to protect samples for preservation and future research
- Earth is littered with fungi and bacteria that can degrade these invaluable samples
- My team's job is to survey cleanrooms to ensure the samples are safe



Image of Chemotrophic
bacteria degrading Iron in a
rock sample

Experimentation with sample recovery

- Tests that lie ahead for the recovered sample varies, but will likely include
 - Optical studies
 - Mass spectrometry
 - Raman spectroscopy
 - X-Ray Diffraction
 - Ion beam studies
 - And more, curation will preserve the samples indefinitely until the right experiments emerge



Insight for future missions

- OSIRIS-Rex mission planning, execution, recovery, and curation helps to train and prepare for future missions
- Lessons will be learned for Mars sample return, and proposed missions such as astronaut led exploration of asteroids and Mars

Thank you!

Questions?