



Beyond **ARTEMIS III** EVA Gap Update & Overview

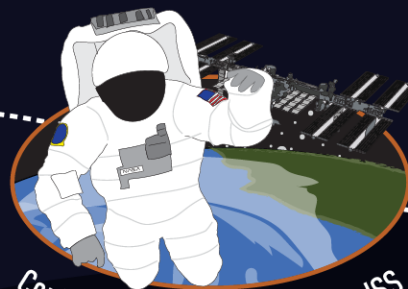
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EVA Strategic Planning & Architecture Lead

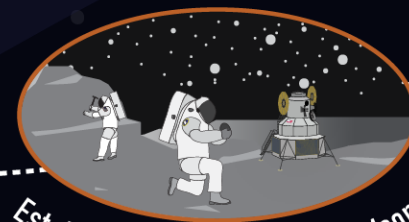
Exploration EVA Technology Workshop

September 30, 2021

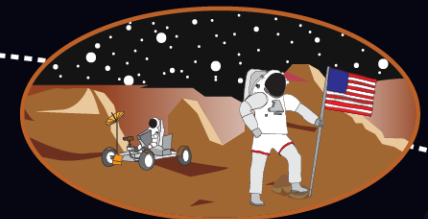
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Continue EVA Advancement on ISS



Establish EVA Presence on the Moon



Exploration EVA on Mars

The Year 2025 and beyond...



ARTEMIS III

CREWED SURFACE OPERATIONS

Two crew live in the landing system cabin for 6.5 days on the lunar surface

Goal of up to four moonwalks, with reserves for a fifth contingency moonwalk

Collect a variety of samples to return to Earth for later research:

- Rock samples to help date the sequence of impact events on the Moon
- Core tube samples to capture ancient solar wind trapped in regolith layers
- Paired samples of material within and outside a permanently shadowed region



Unpressurized Rover

Lunar Terrain Vehicle



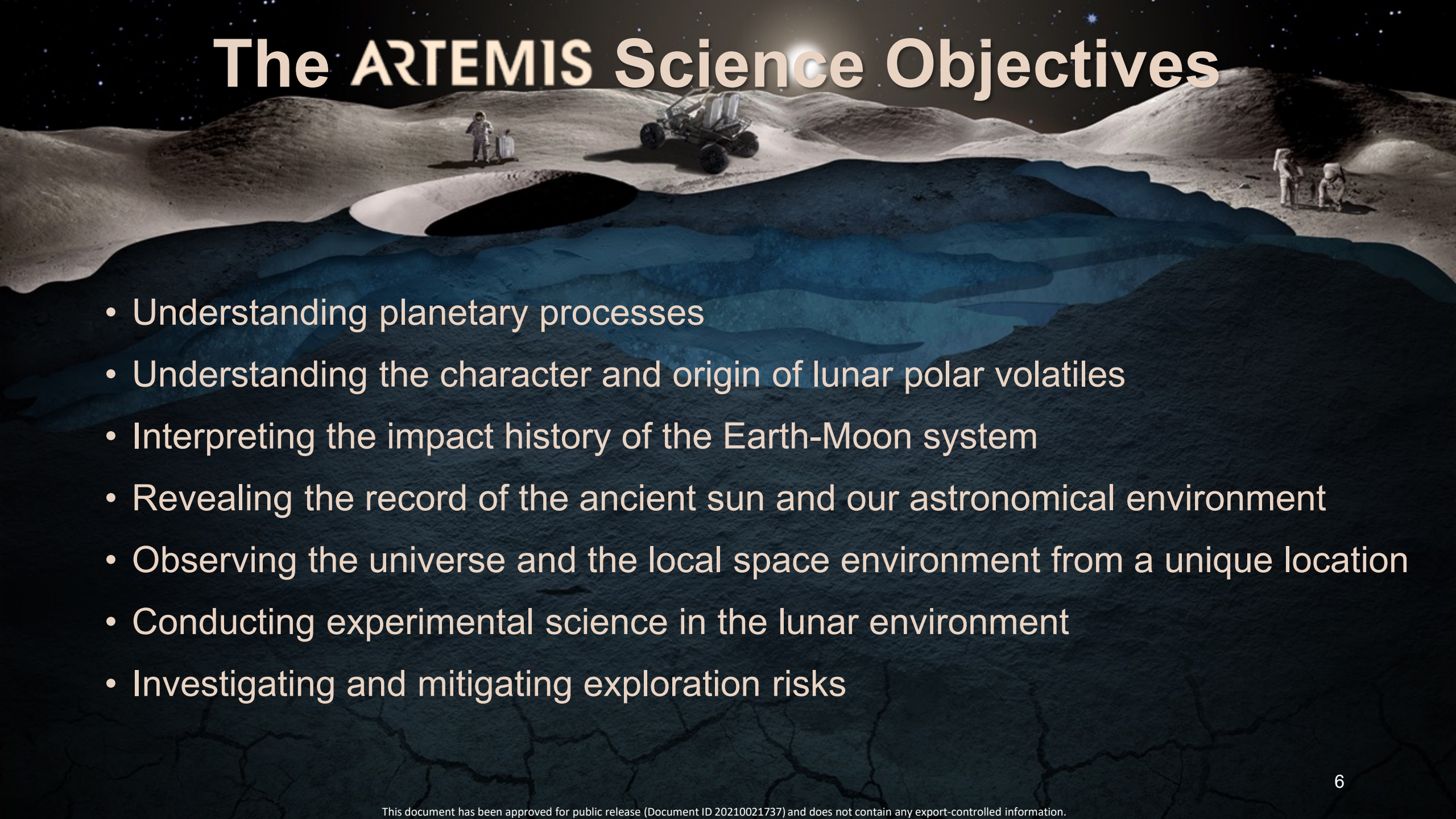
Pressurized Rover



ARTEMIS Base Camp



The ARTEMIS Science Objectives



- Understanding planetary processes
- Understanding the character and origin of lunar polar volatiles
- Interpreting the impact history of the Earth-Moon system
- Revealing the record of the ancient sun and our astronomical environment
- Observing the universe and the local space environment from a unique location
- Conducting experimental science in the lunar environment
- Investigating and mitigating exploration risks

FIRST THE MOON, MARS NEXT

Space Policy Directive-1 calls on NASA to return to the Moon with commercial and international partners to get ready for humanity's next giant leap – human exploration of Mars.

NASA has been exploring Mars for more than 50 years – including a continuous robotic presence since 1997.

Planned human exploration of the Moon under the Artemis program offers a unique opportunity to test, refine, and perfect many of the technologies and complex operations that will be needed to land humans on Mars, perform their work on the surface, and safely return them to Earth.



What technologies and operational capabilities are necessary for safe, effective, and affordable EVA that enhance the human experience as we explore the Martian Surface?



Three types of gaps



Gap Definition: The comparison of actual performance with potential or desired performance for future system capabilities.

1. Knowledge: Unknown data or mission parameters that will ultimately drive hardware requirements
 - Worked with the relevant architecture and requirements teams to resolve
2. Development: At least one potential solution has been identified but additional work is required to ensure feasibility of the options (TRL 3-5)
3. Technology: No known viable solution and new technology must be developed (TRL 0-3)
 - In some cases, the existence of a hardware/technology gap cannot be determined until a preceding knowledge gap is answered



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Exploration EVA on Mars

There are greater than 100 gaps across the NASA exploration architecture that affect EVA

- Many of them overlap needed lunar and Mars operational capability
- ~88 affect Mars EVA operations



Current EVA Gaps are available at
nasa.gov/suitup/reference

Four Large Buckets of EVA Technology Development



Mass Reduction

- Will drive increased reliability
- Corresponding potential decrease in redundant systems needed
- Improved maintainability
- Robust wear resistance minimizing needed spares

Suitport System Implementation

- Mass and CG optimization
- Modified PGS & PLSS packaging
- Improved maintainability (including potential changeout in environment)
- Docking/seal systems & integrated ops
- Dust mitigation & planetary protection

Informatics

- Crew autonomy (software/hdwr. dev.)
- Communication (scalable/range/data)
- Navigation
- Lighting (worksite & field lighting)
- Radiation hardened systems (CPU, GPU/displays, memory, etc.)

Vacuum/Partial Atmosphere Systems (ideally optimized system capable of operation in both environments)

- CO2 Removal
- Thermal Management



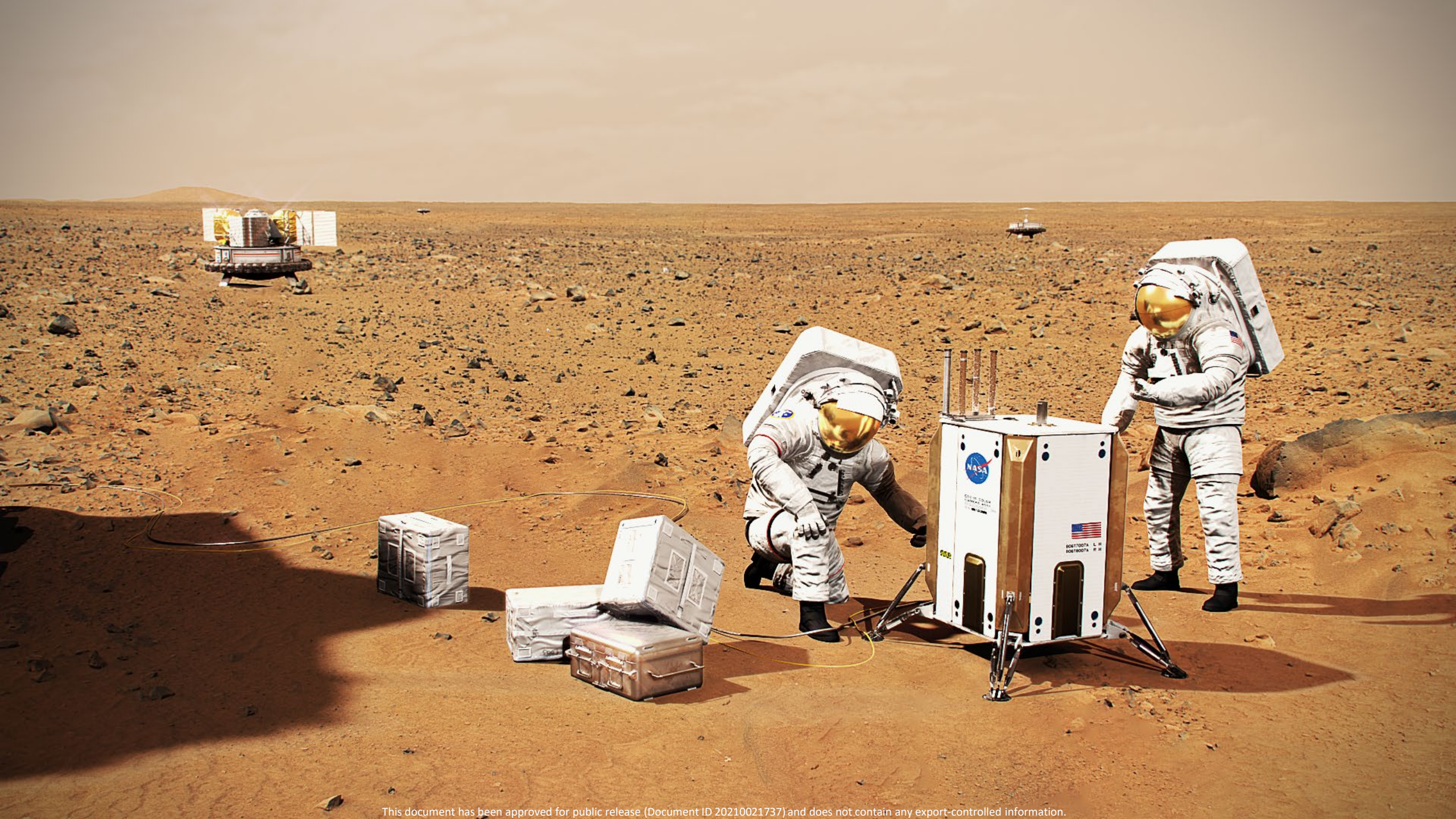
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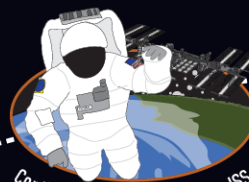
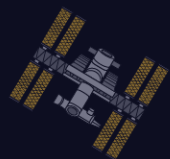
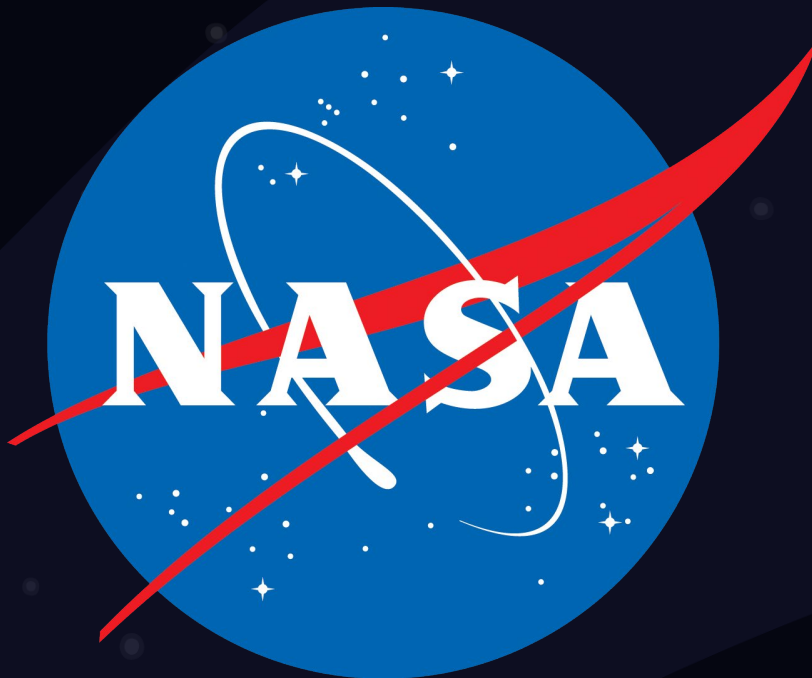


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Exploration EVA on Mars





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Exploration EVA on Mars¹³