Landing on the Moon and What We'll Do When We Get There

NASA's Artemis Human Landing System Program and Lunar Surface Activities

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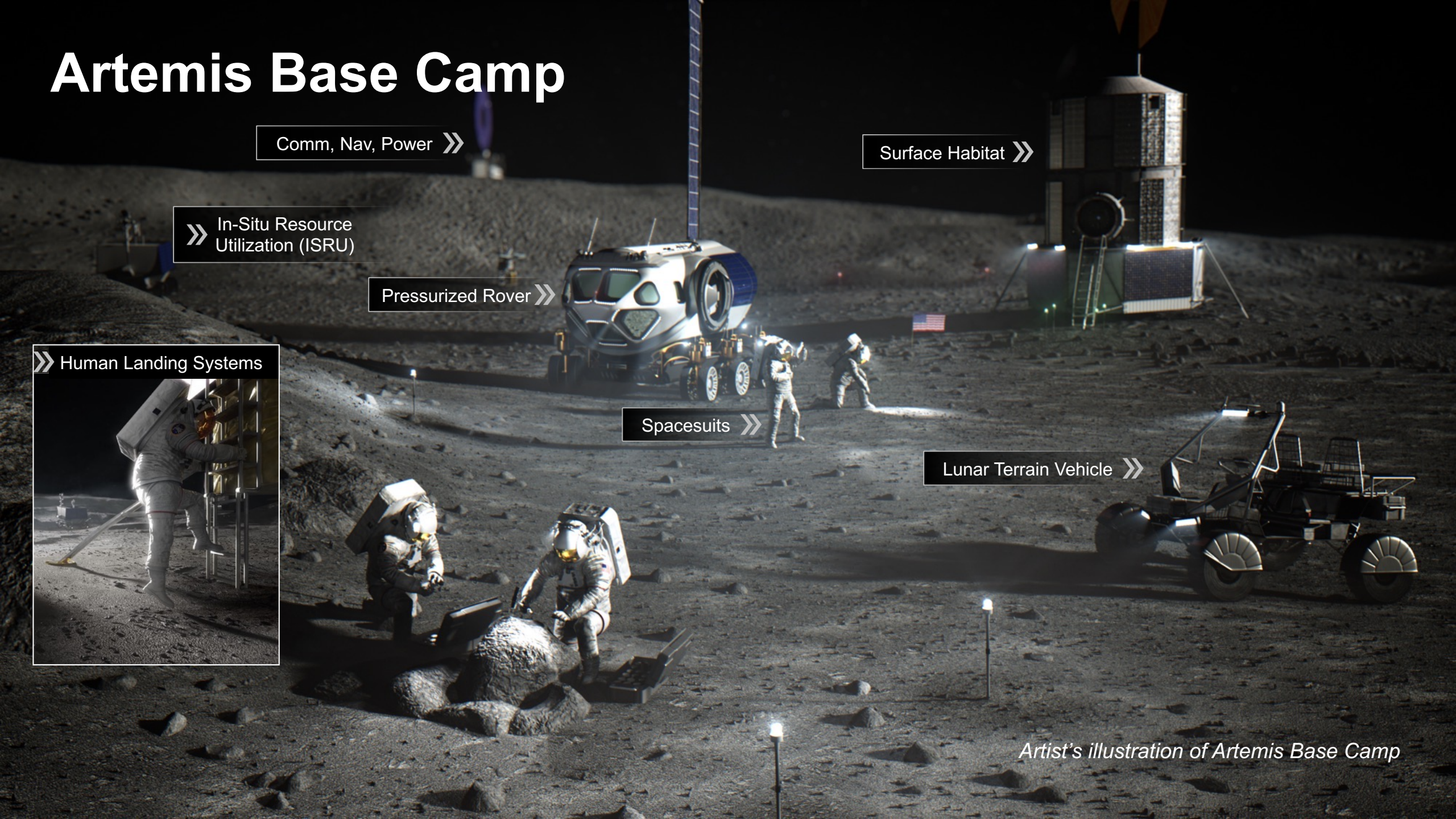
When we went before, indeed,
with pride, we planted our flag.
It was rather temporary, that visit.

With Artemis, it's not just to visit,
but *to live and work on the Moon*.

Artemis will establish the first space station in lunar orbit and the *first lunar base camp* where astronauts will train for the first mission to Mars.

- **Vice President Kamala Harris**
  National Space Council Meeting
  September 9, 2022

Artemis Base Camp



Artist's illustration of Artemis Base Camp

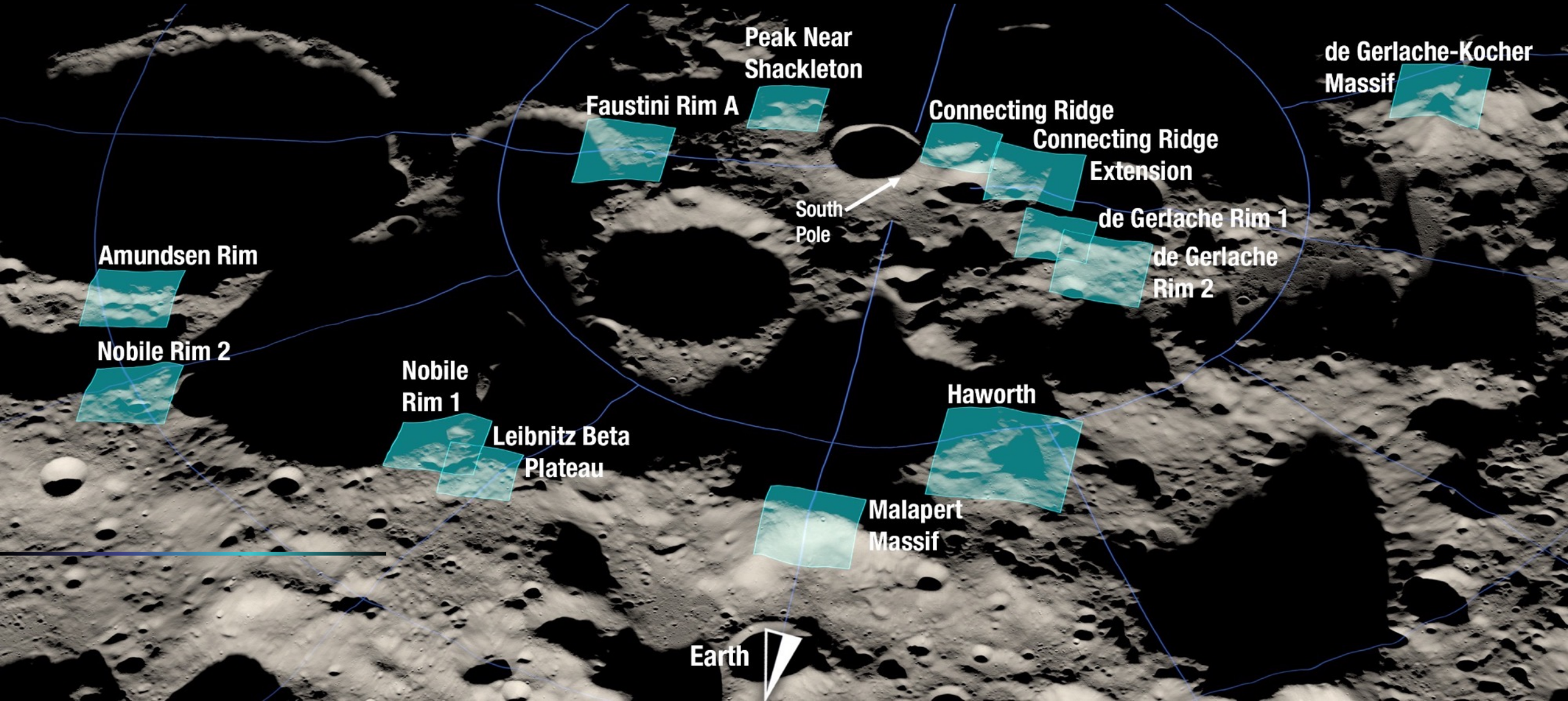
Artemis III: Human Lunar Return

NASA is partnering with SpaceX to develop its Human Landing System (HLS) Starship for use on Artemis III, the mission that will put the next two Americans, including the first woman, on the surface of the Moon.

SpaceX will demonstrate an uncrewed HLS Starship landing in 2024 with the crewed mission in 2025.

Image Credit: SpaceX

Artemis III Candidate Landing Regions



Starship Vehicle Configurations for NASA Human Landing System

With the same core design serving many purposes, Starship will accumulate significant flight heritage before the Artemis III crewed lunar landing.

Storage Depot + Booster

Optimized for propellant storage in Earth orbit. Based on core Starship design with landing systems removed.

Tanker + Booster

Delivers propellant to storage depot for later use by HLS Starship.

HLS Starship + Booster

Based on core Starship design and optimized for Moon operations (crew area, surface access, docking to Orion). Earth recovery hardware removed.

Human Landing System (HLS) Starship Artemis III Concept of Operations

Near Rectilinear Halo Orbit (NRHO)

Earth Orbit

HLS propellant fill

Fast trans-lunar injection (TLI)

Crew board Starship from Orion

Crew board Orion from Starship

Storage depot launch

Propellant aggregation

HLS Starship launch

Extended loiter if needed

Artemis III launch

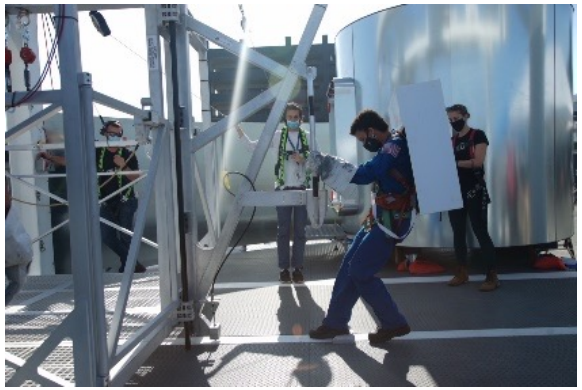
Surface expedition

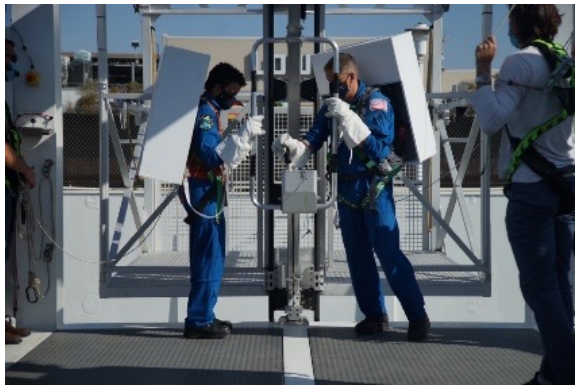
Crew returns in Orion

Initial HLS Starship Progress

Image Credit: SpaceX

Crew and cargo elevator



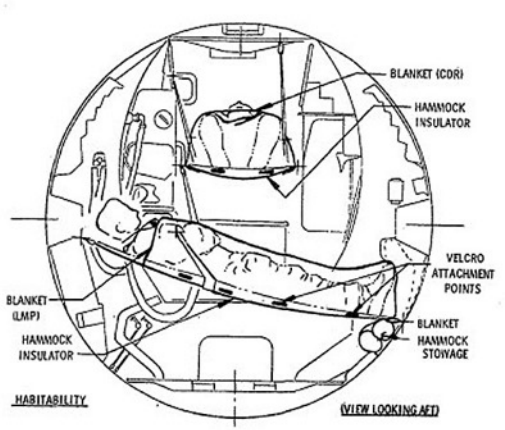


Crew cabin VR evaluation

Airlock

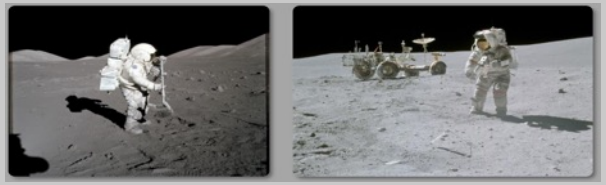
Artemis III Starship HLS Capabilities

- SpaceX Starship very different than Apollo LEM!
- Sleeping/eating/hygiene
- Dust (airlock)
- Surface access (elevator)
- Science/Geology capabilities



Lunar Destination Class EVA Mission Scenarios

Partial-gravity in a vacuum (Lunar EVA)



Minimal Stay

- "Flags & Footprints"
- Two Crew
- < 3 days
- Traverse 1.5-2km walking

Early Apollo Equivalent

Initial Short Stay

- Lunar Daylight Sortie
- Two Crew
- 6 days
- Traverse 1.5-2km walking
- Traverse 7.5-10km with unpressurized rover

Artemis III

"Sustaining" Short Stay

- Lunar Daylight Sortie
- Four Crew
- 14 days
- Traverse 7.5-10km with unpressurized rover
- Traverse 12km with single pressurized rover

Extended Stay

- Lunar Day & Night
- Four Crew
- 42 days
- Traverse 7.5-10km with unpressurized rover
- Traverse 12km with single pressurized rover
- Traverse 100km with dual pressurized rovers

Long Duration

- Four+ Crew
- 6+ months

Future Artemis Missions

Prep/Post EVA Ops

- Road to EVA
  - xEVA System Prep
  - Lander/Airlock Prep
  - EVA Task & Systems Prep
- Day of EVA
  - EVA Prep
  - EVA Prebreathe
  - EVA
  - Post EVA

EVA Ops

- Depress
- Egress
- Setup
- Surface Tasks
  - Engineering Tasks
  - Science Tasks
- Cleanup
- Ingress

EVA Surface Engineering Tasks

- Prepare Equipment for Exploration
- Construct Surface Infrastructure
- Assemble and Maintain Equipment
- Prepare Ascent Vehicle

EVA Surface Science Tasks

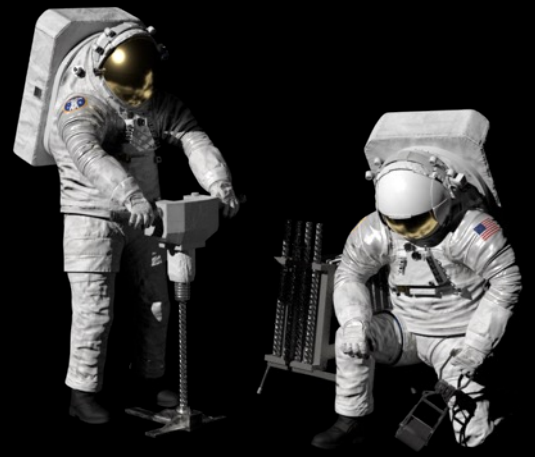
Observations

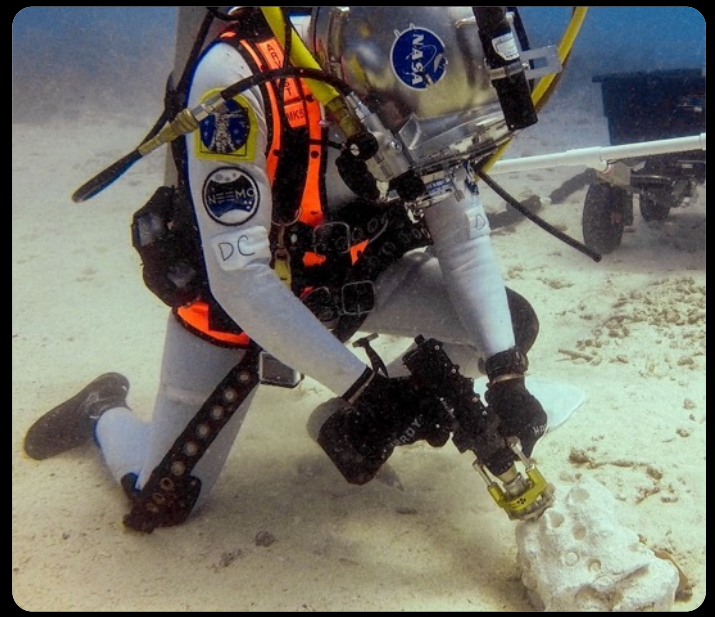
Data Collection

Emplacement

EVA Surface Science Tasks

- Rock Sample Acquisition & Curation
- Regolith Samples Acquisition & Curation
- Specialized Sample Acquisition & Curation





Contingency EVA and Rescue Operations

- EVA self-rescue (suit issue)
- Incapacitated crewmember rescue
- Decompression Sickness (DCS) and emergency recompression
- Contamination
- Radiation
- Loss of communication