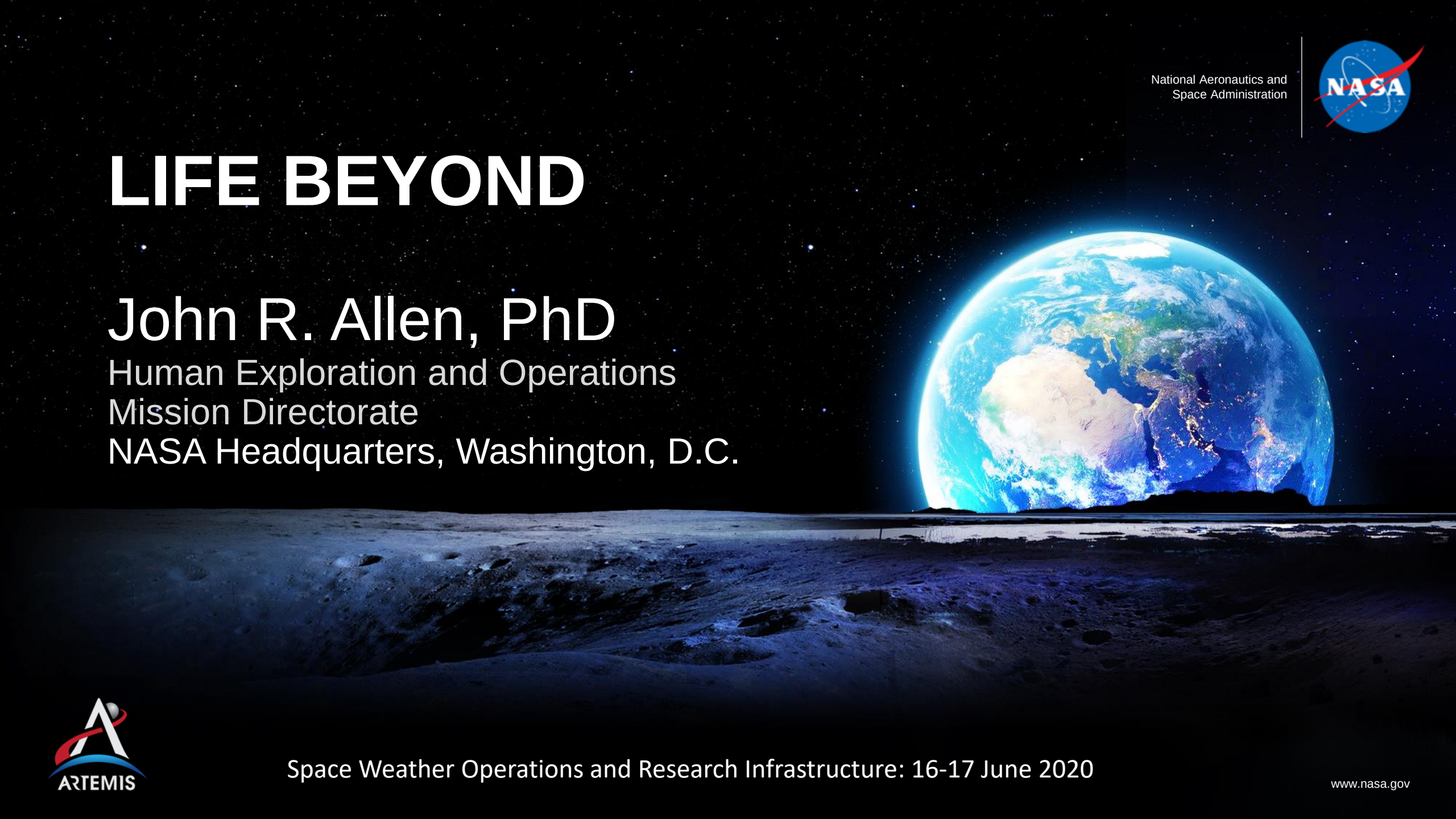
National Aeronautics and Space Administration

LIFE BEYOND

John R. Allen, PhD
Human Exploration and Operations Mission Directorate
NASA Headquarters, Washington, D.C.



ARTEMIS

Space Weather Operations and Research Infrastructure: 16-17 June 2020

Life Beyond…

…Low Earth Orbit

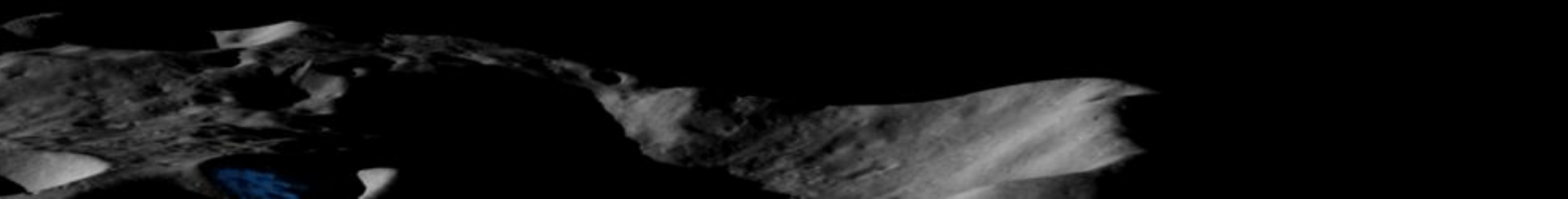
The NASA Charge to the Moon

Land the first American woman and next American man on the Moon by 2024; sustained presence on and around the Moon by 2028

“Use all means necessary” to ensure mission success

The Moon Has Helped us to Understand…

– History, formation, and our place in the solar system
– A chronology for solar system events
– Plasma interactions with the lunar surfaces
– Lunar interior
– The lunar water cycle
– Use vantage of lunar farside to view the universe



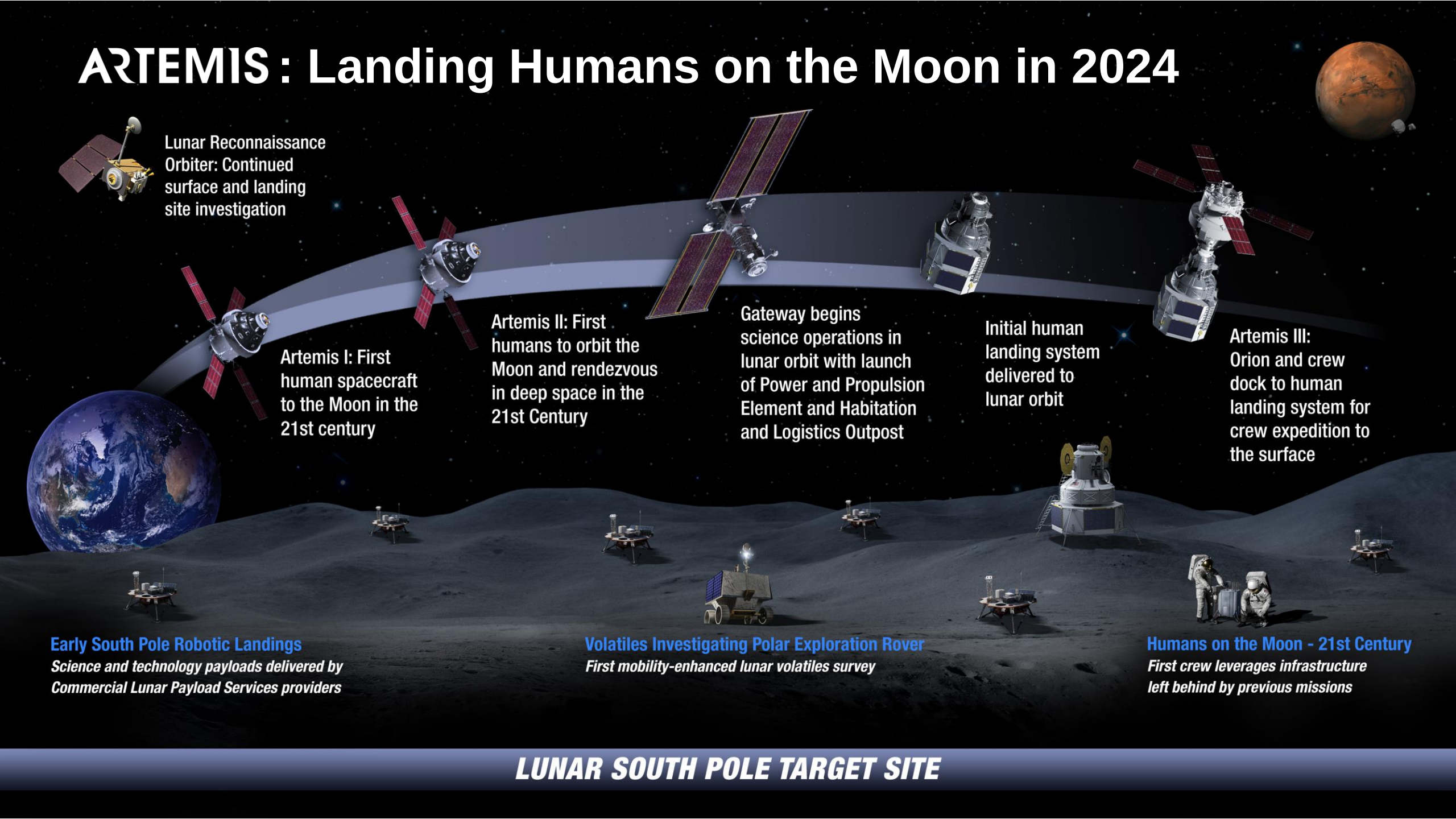
The Artemis Program

Artemis is the twin sister of Apollo and goddess of the Moon in Greek mythology. Now, she personifies our path to the Moon as the name of NASA's program to return astronauts to the lunar surface by 2024.

When they land, Artemis astronauts will step foot where no human has ever been before: the Moon's South Pole.

With the horizon goal of sending humans to Mars, Artemis begins the next era of exploration.

ARTEMIS : Landing Humans on the Moon in 2024



LOW EARTH RETURN

250 MILES
3 HOURS
17,500 MPH
3,000°F

LUNAR RETURN

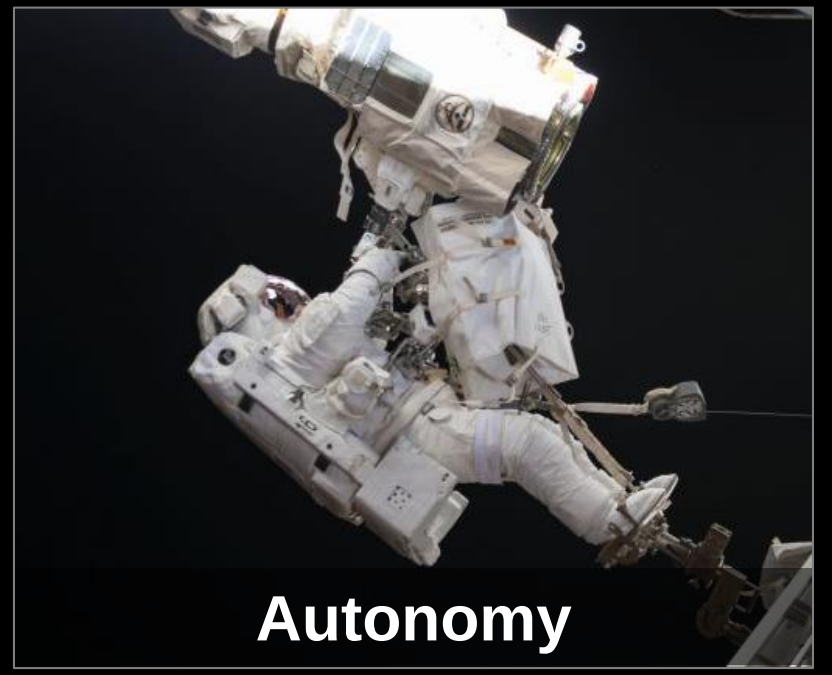
240,000 MILES
3 DAYS
24,700 MPH
5,200°F

MARS RETURN

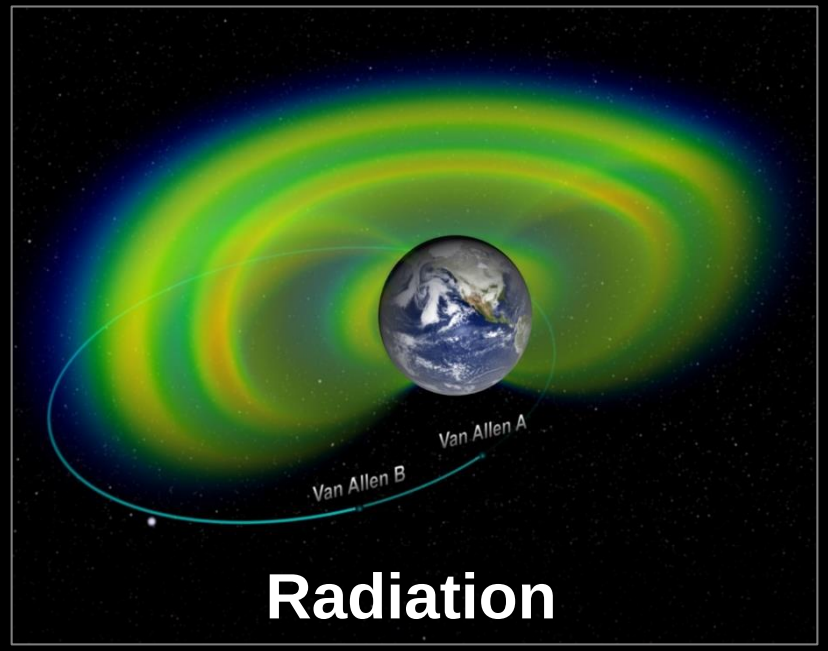
39,000,000 MILES
9 MONTHS
26,800 MPH
6,200°F


Launch


Reentry & Recovery


Autonomy


Communications

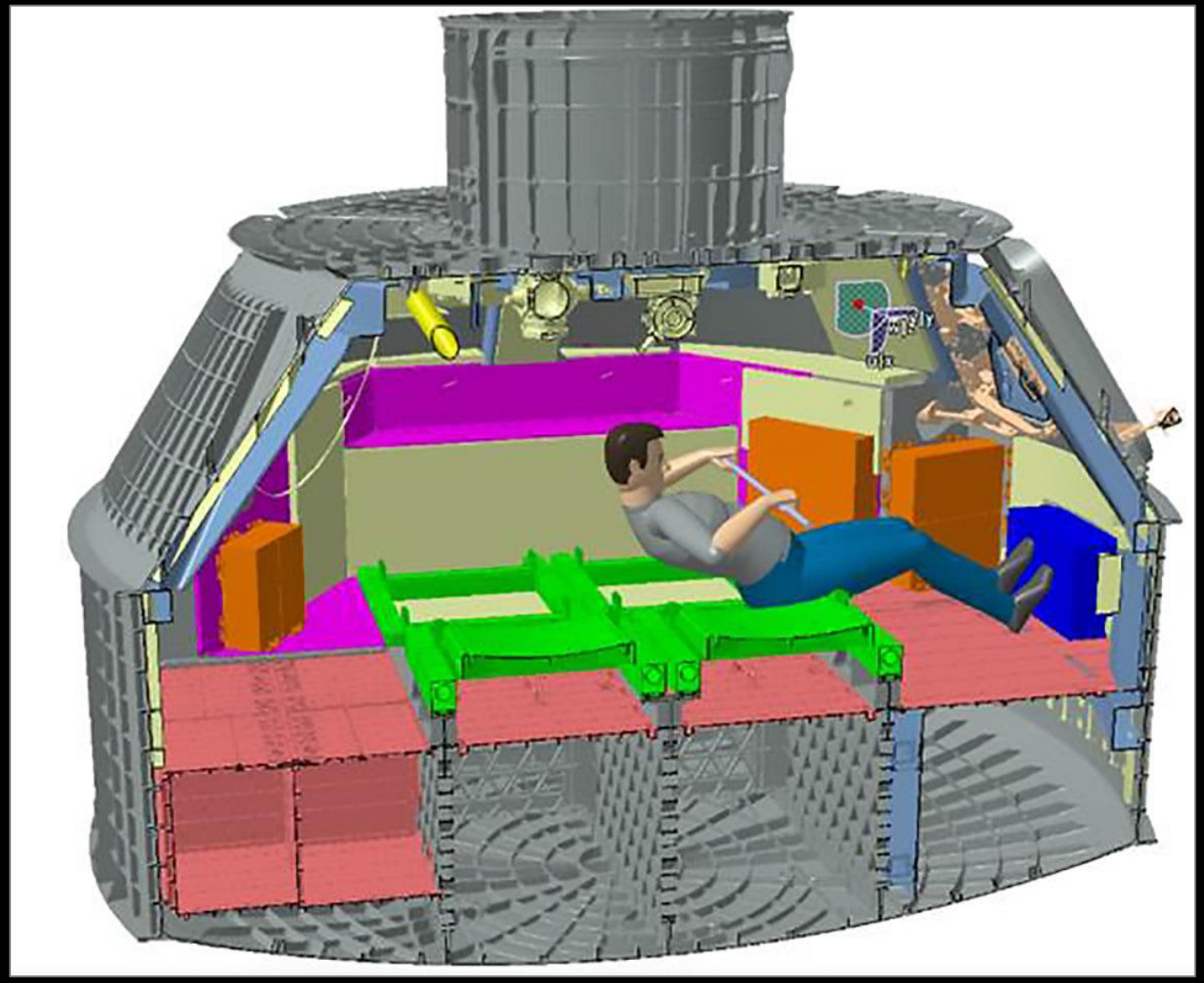

Van Allen A
Van Allen B
Radiation


Human Health

ORION CREW SURVIVAL SYSTEM SUITS

Protects astronauts during launch, reentry and emergency situations during Artemis missions • Custom-fit for each crew member • Lighter, more comfortable helmet with noise reduction and easier connection to the communications system

Astronaut Health



Astronaut Nutrition

ARTEMIS I

PREPARING FOR ARTEMIS I

The first integrated flight test of NASA's Orion spacecraft and Space Launch System rocket, launching from a modernized Kennedy Space Center.

The maiden voyage will fly without crew and is designed to push the system to its limit and return it safely to Earth to ensure safety on future crewed missions.

Building, launching, and flying the system requires a highly skilled workforce, enables growth for small businesses, revitalizes communities, and inspires our nation and world.

ARTEMIS I

Artemis 1 Mission Priorities

Mission objectives and priorities that will enable NASA to fly crew to the Moon and back on Artemis 2:

1. **Demonstrate Orion heatshield at lunar entry velocities**
2. **Operate Systems in Flight Environment**
3. **Retrieve Spacecraft**
4. **Complete Remaining Objectives**: Perform residual mission in the absence of system failures and conduct all mission content as planned

THE GATEWAY

- A platform to establish a sustained human presence on and around the Moon in the next decade
- Will remain in lunar orbit enabling access to the lunar surface while opening the solar system to further exploration
- Built by NASA, industry and international partners

First Gateway Components Will be Integrated for Launch in 2023

MAXAR

POWER AND PROPULSION ELEMENT (PPE)

- 60-kilowatt solar electric propulsion spacecraft
- Provides Gateway with electrical power, propulsion, and communication capabilities
- Accommodates science and technology demonstration payloads

NORTHROP GRUMMAN

HABITATION AND LOGISTICS OUTPOST (HALO)

- Initial crew cabin for astronauts visiting the Gateway
- Multiple docking ports for visiting spacecraft
- Cargo space for science and stowage

Early Gateway Science Payloads – International Endeavor

On March 12, NASA announced the first two science payloads to fly on Gateway

- ESA's (European Space Agency) radiation instrument package will help provide an understanding of how to keep astronauts safe by monitoring the radiation exposure in Gateway's unique orbit
- NASA's space weather instrument suite will observe solar particles and solar wind created by the Sun

Remote Gateway operations and research will continue when uncrewed

GATEWAY LOGISTICS SERVICES (GLS)

SPACEX

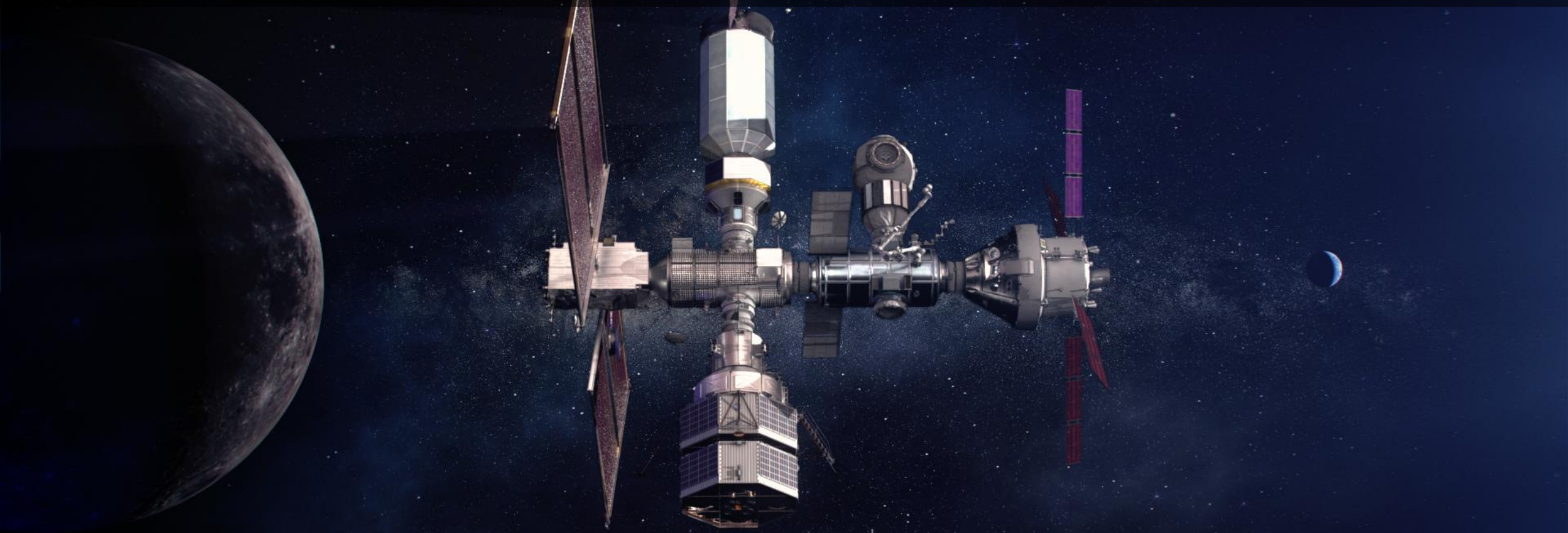
NASA selected SpaceX as the first U.S. commercial provider under the Gateway Logistics Services contract to deliver cargo, experiments and other supplies to the Gateway in lunar orbit.

Multiple supply missions are planned in which the cargo spacecraft will stay at the Gateway for 6-12 months at a time.

- 5 MT delivered cargo capability
- Power to internal and external payloads
- Trash removal
- Automated RPOD (docking/undocking)

Gateway International Partners

Building on ISS partnerships to expand deep space capabilities



NASA

CSA ASC

esa European Space Agency

JAXA

ROSCOSMOS

THE HUMAN LANDING SYSTEM

– The final mode of transportation in deep space carrying humans to the surface of the Moon

– Designed and developed by American companies for the Artemis program

– Necessary for meeting 2024 deadline

xEVA System: Spacesuits, Tools, Vehicle Interfaces

Exploration Extravehicular Activity System

Testing suit on ISS in 2023 • In-house build for 2024 lunar mission • xEVA services contracts with U.S. industry for missions beyond 2024

Elements For First Human Mars Mission

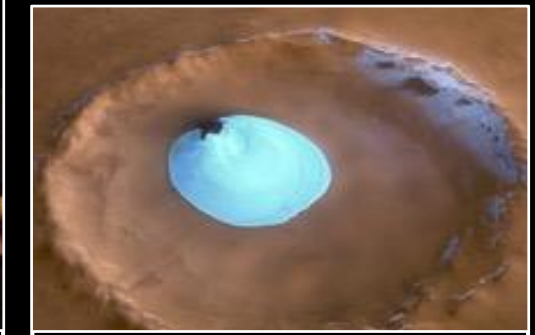


LUNAR SURFACE ANALOG SYSTEMS (Mobile Hab, Suits, Access Systems)

MARS SAMPLE RETURN

EVOLVED GATEWAY HABITATION

DEEP SPACE AGGREGATION

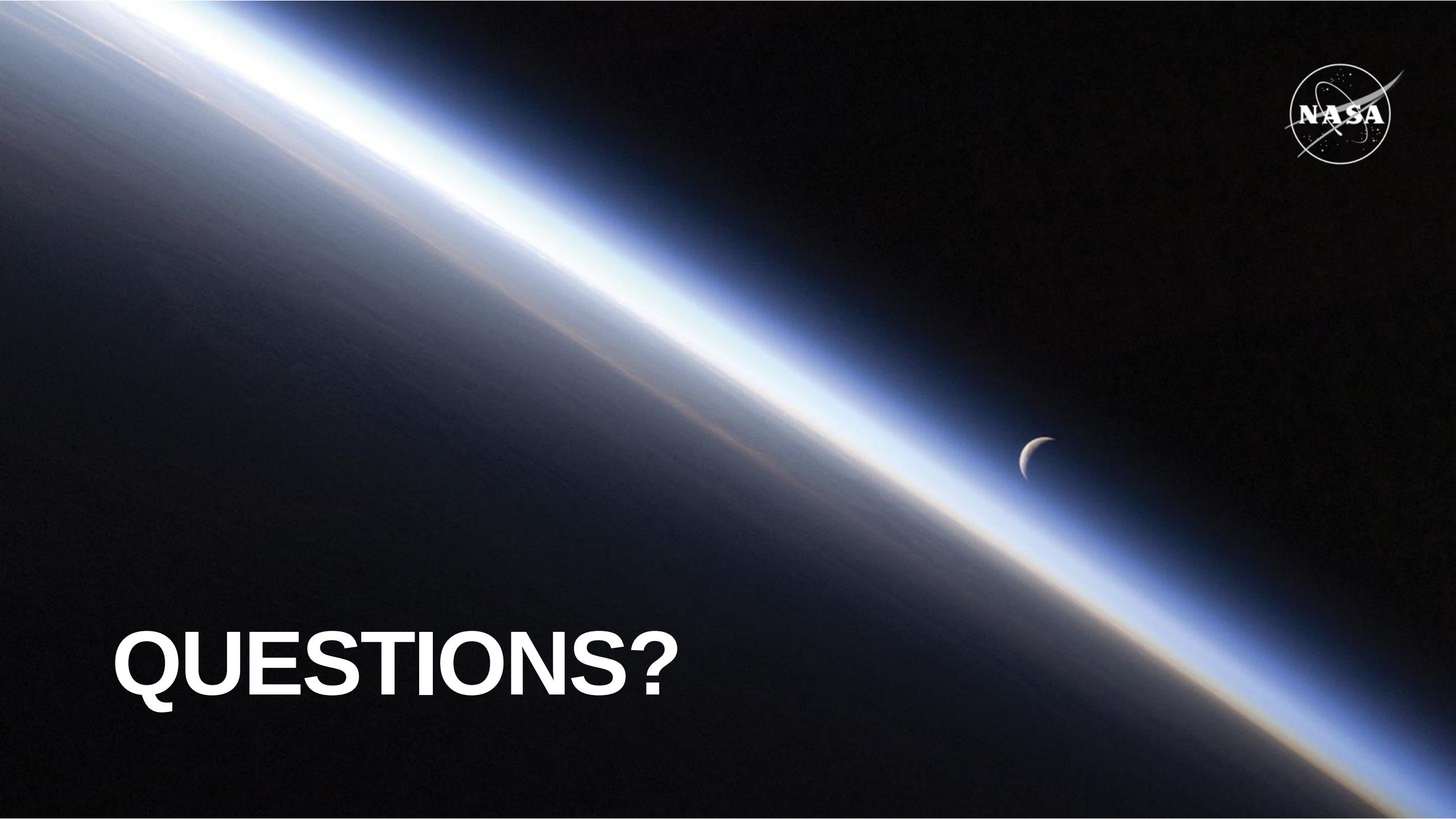


MARS ICE MAPPER

ENTRY DESCENT & LANDING

NUCLEAR PROPULSION

CREW SCIENCE AT MARS


QUESTIONS?