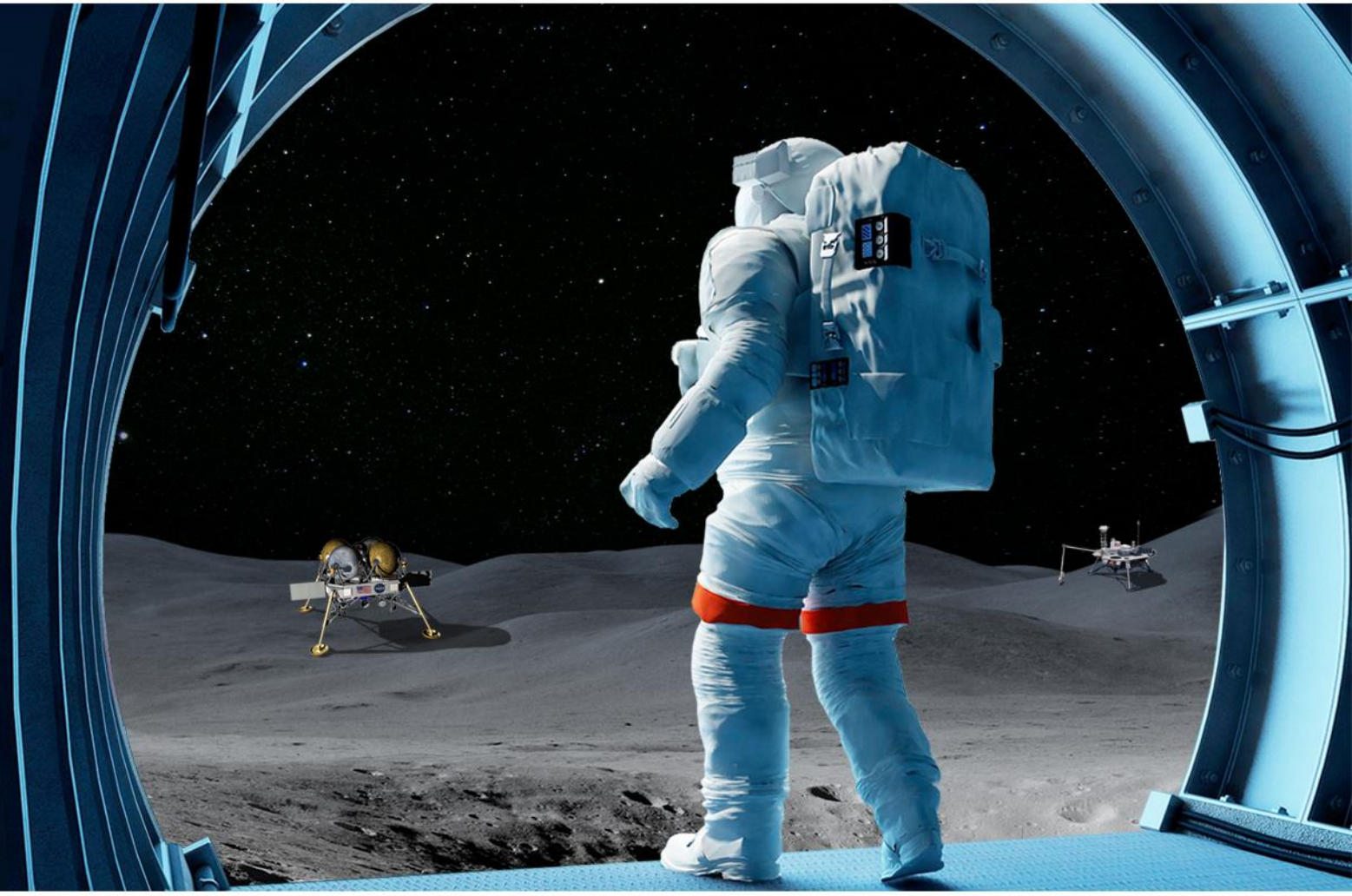
The NASA Exploration Campaign

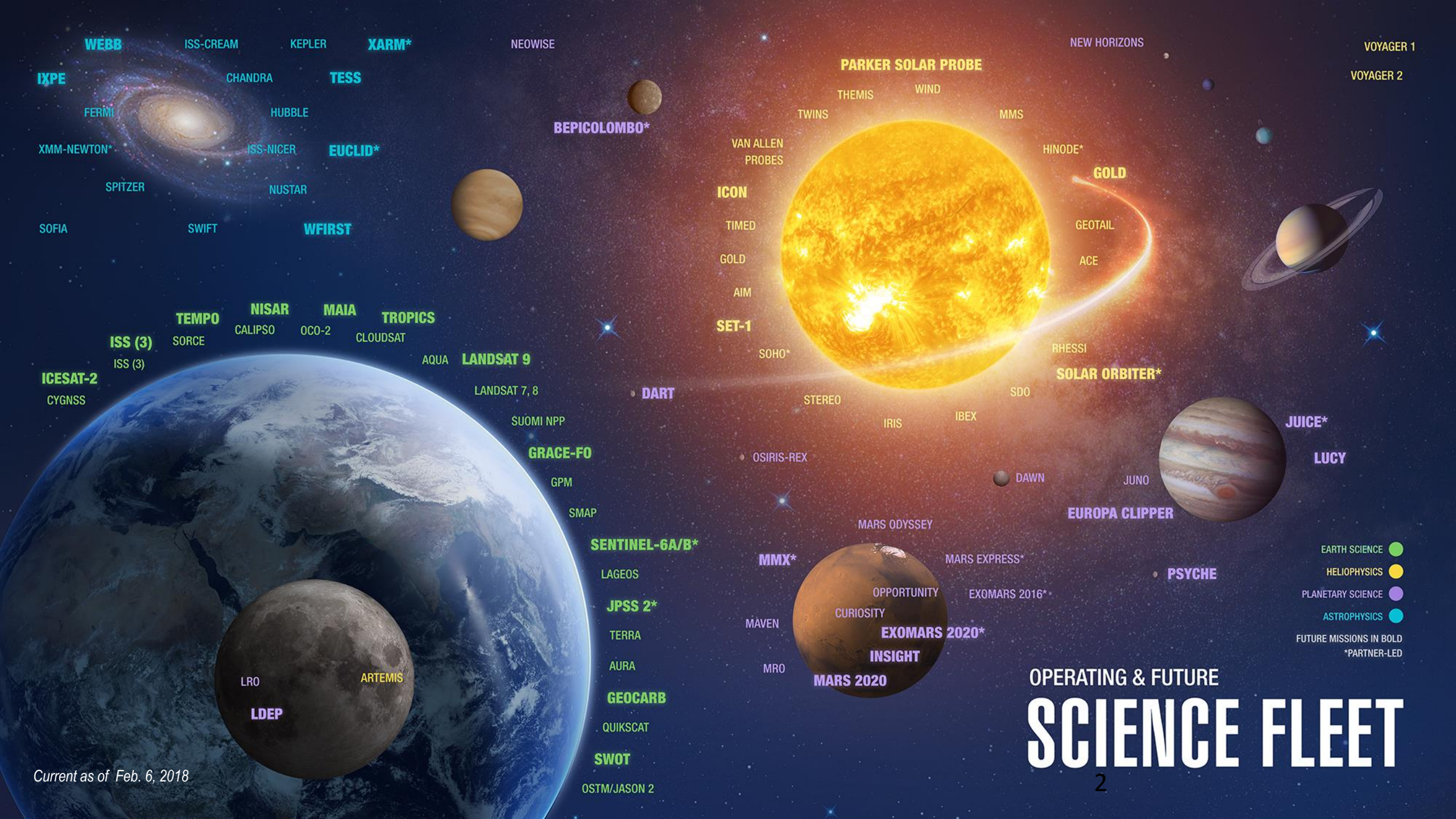
National Aeronautics and Space Administration

United Nations/Germany High Level Forum

Jim Green
NASA Chief Scientist

November 13, 2018





OPERATING & FUTURE

SCIENCE FLEET

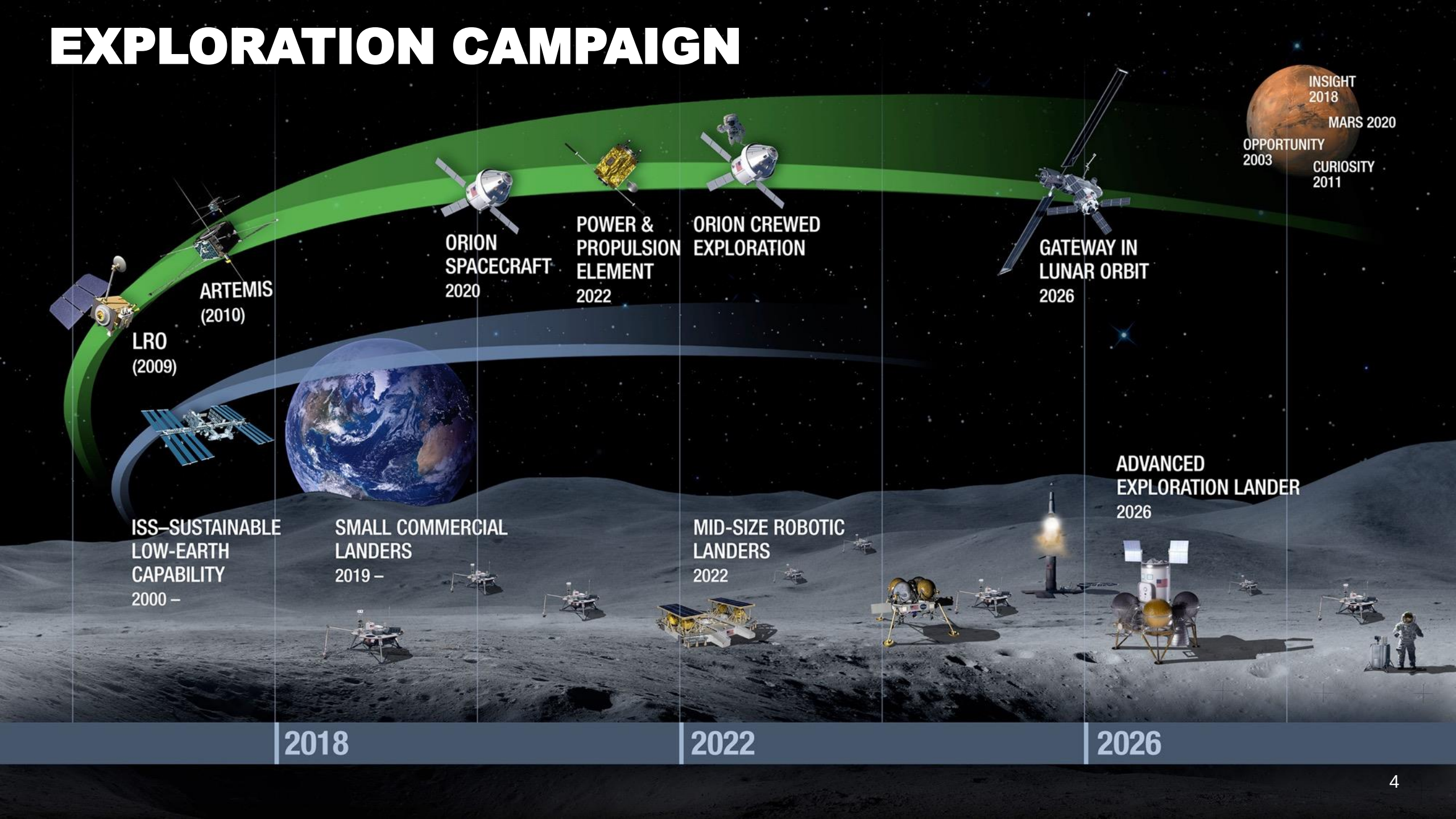
Current as of Feb. 6, 2018

Space Policy Directive-1

"Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities.

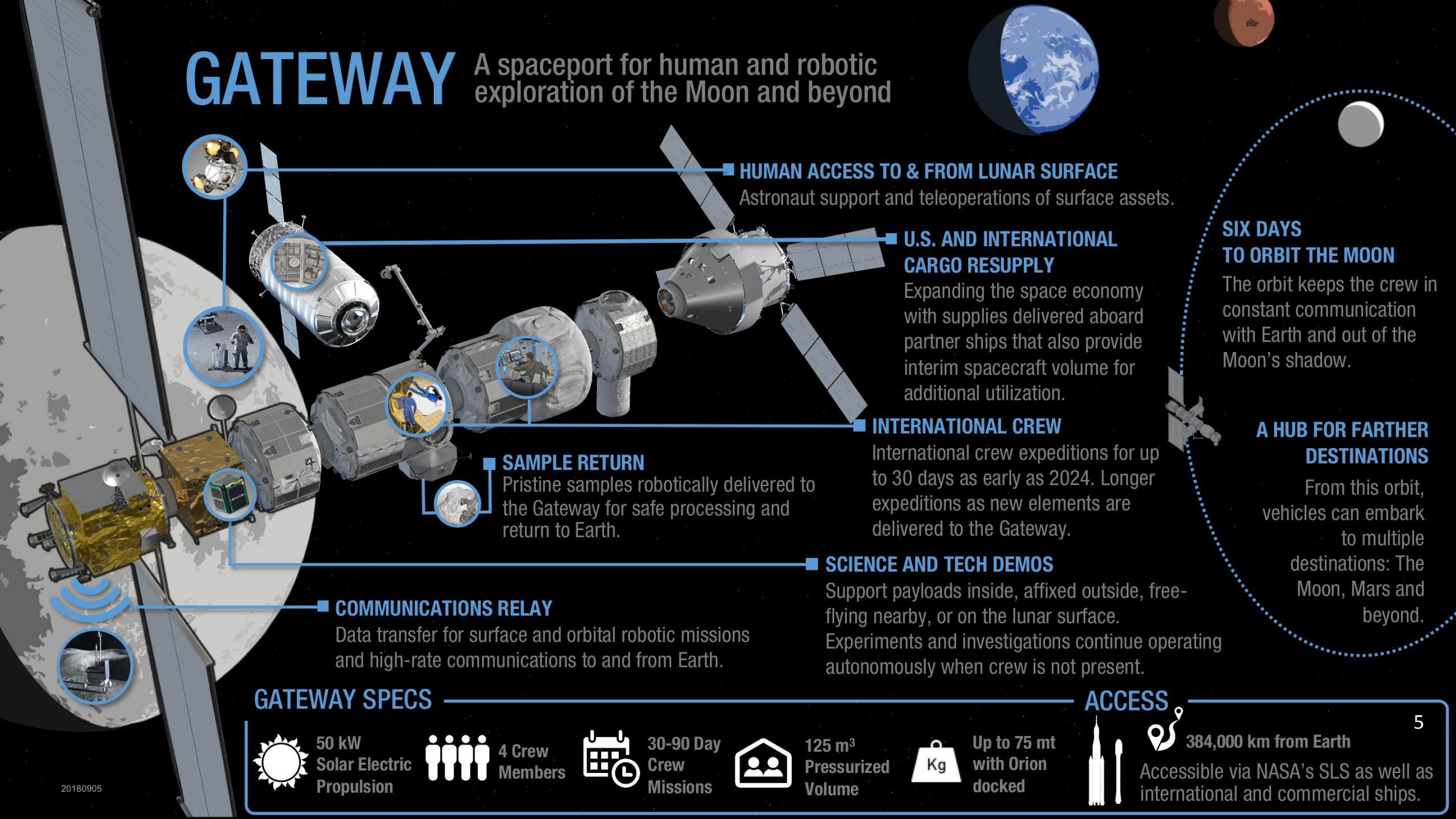
Beginning with missions beyond low-Earth orbit, ***the United States will lead the return of humans to the Moon for long-term exploration and utilization***, followed by human missions to Mars and other destinations."

EXPLORATION CAMPAIGN



GATEWAY

A spaceport for human and robotic exploration of the Moon and beyond



HUMAN ACCESS TO & FROM LUNAR SURFACE

Astronaut support and teleoperations of surface assets.

U.S. AND INTERNATIONAL CARGO RESUPPLY

Expanding the space economy with supplies delivered aboard partner ships that also provide interim spacecraft volume for additional utilization.

INTERNATIONAL CREW

International crew expeditions for up to 30 days as early as 2024. Longer expeditions as new elements are delivered to the Gateway.

SAMPLE RETURN

Pristine samples robotically delivered to the Gateway for safe processing and return to Earth.

SCIENCE AND TECH DEMOS

Support payloads inside, affixed outside, free-flying nearby, or on the lunar surface. Experiments and investigations continue operating autonomously when crew is not present.

COMMUNICATIONS RELAY

Data transfer for surface and orbital robotic missions and high-rate communications to and from Earth.

SIX DAYS TO ORBIT THE MOON

The orbit keeps the crew in constant communication with Earth and out of the Moon's shadow.

A HUB FOR FARTHER DESTINATIONS

From this orbit, vehicles can embark to multiple destinations: The Moon, Mars and beyond.

GATEWAY SPECS

- 50 kW Solar Electric Propulsion
- 4 Crew Members
- 30-90 Day Crew Missions
- 125 m^3 Pressurized Volume
- Up to 75 mt with Orion docked

ACCESS

- 384,000 km from Earth

Accessible via NASA's SLS as well as international and commercial ships.

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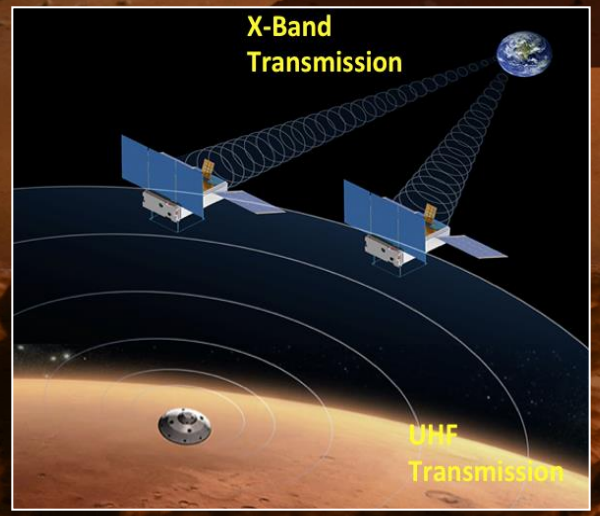
MARS MISSIONS

An Ancient Habitable Environment

Mineralogy indicates sustained interaction with liquid water also providing a source of energy for primitive biology.
Key chemical ingredients for life are present:
carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
Also the soil is moist and there are nitrates!

Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight)

Launched: May 5, 2018
Landing: November 26, 2018



Seeking Signs of Life: Mars 2020 Rover

A. GEOLOGIC EXPLORATION
B. HABITABILITY & BIOSIGNATURES
C. PREPARE A RETURNABLE CACHE
D. PREPARE FOR HUMAN EXPLORATION

LASER RETROREFLECTOR

SUPERCAM
A laser blaster that can investigate chemical compositions of Martian rocks and dirt from a distance.

RIMFAX
A ground-penetrating radar to explore beneath the surface.

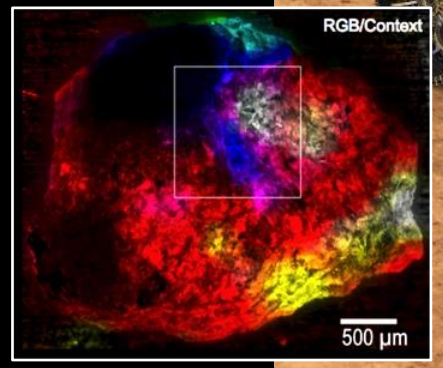
MMRTG
A plutonium power source supplies electricity to the rover.

MASTCAM-Z
A zoomable panoramic camera.

MEDA
The rover's weather station, to measure temperature, wind speed and other meteorological factors.

SHERLOC
An ultraviolet spectrometer to study mineralogy and chemistry. (Its camera is named WATSON.)

Returnable cache of samples



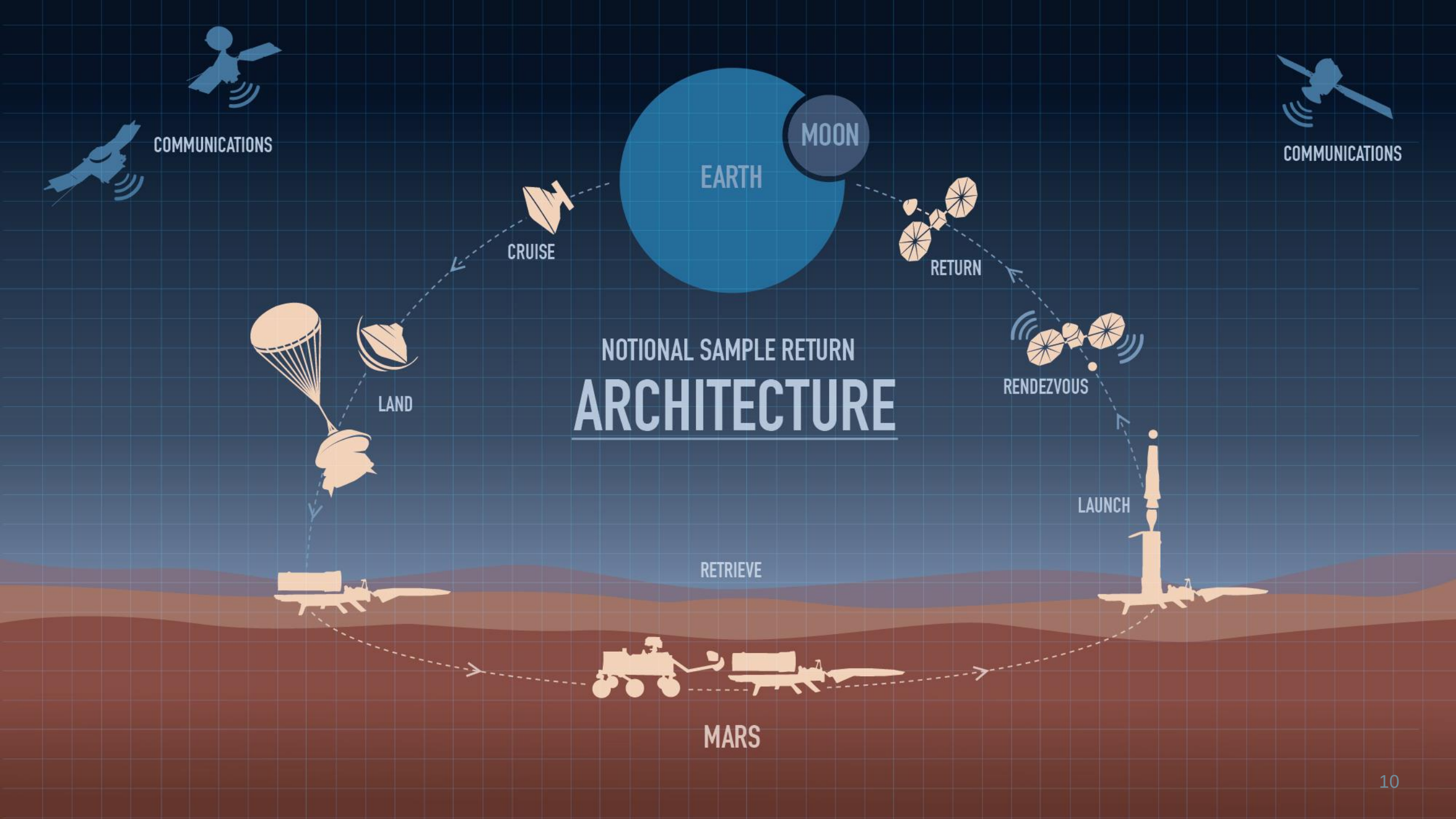
MOXIE
An instrument to produce oxygen from carbon dioxide in the Martian atmosphere, as a test for creating resources for future astronauts.

CACHING SYSTEM
Collects and deposits on the surface of Mars sealed tubes of rock and soil samples for future return to Earth

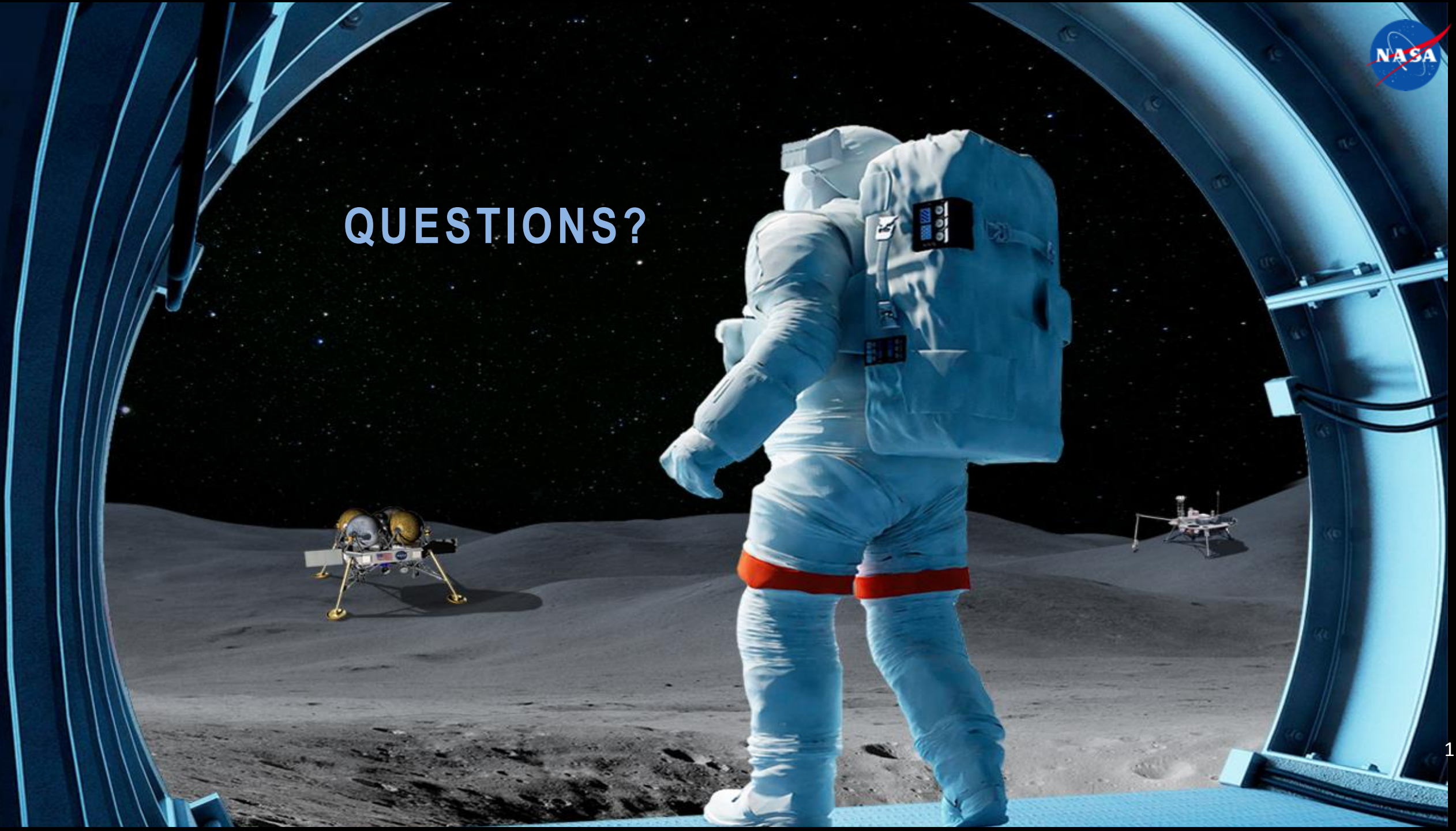
ROBOTIC ARM
The rover arm can extend outwards to make scientific measurements and gather samples. Its instruments can study, in detail, an area about the size of a postage stamp.

PIXL
An X-ray spectrometer for probing the chemical composition of rocks and dirt close up.

Image credit: Nature magazine


COMMUNICATIONS
COMMUNICATIONS
MOON
EARTH
CRUISE
RETURN
NOTIONAL SAMPLE RETURN
ARCHITECTURE
LAND
RENDEZVOUS
LAUNCH
RETRIEVE
MARS


ASSESS
[CENTER FOR NEAR EARTH OBJECT STUDIES]
IAU
Minor Planet Center
SEARCH, DETECT & TRACK
[SPACE-BASED & GROUND-BASED OBSERVATIONS, IAWN]
PLANETARY
DEFENSE
MITIGATE
[DART, FEMA EXERCISES]
CHARACTERIZE
[NEOWISE, GOLDSTONE, ARECIBO, IRTF]
PLAN & COORDINATE
[SMPAG, PIERWG, DAMIEN IWG]


QUESTIONS?