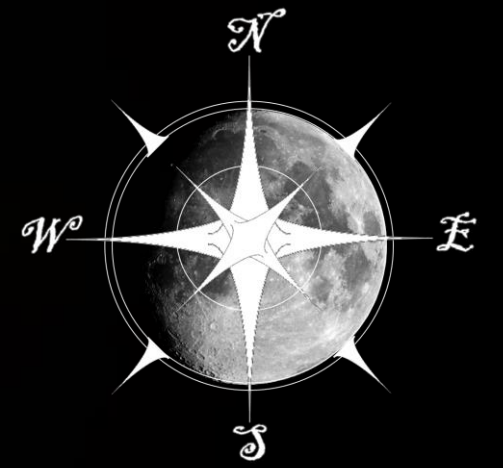
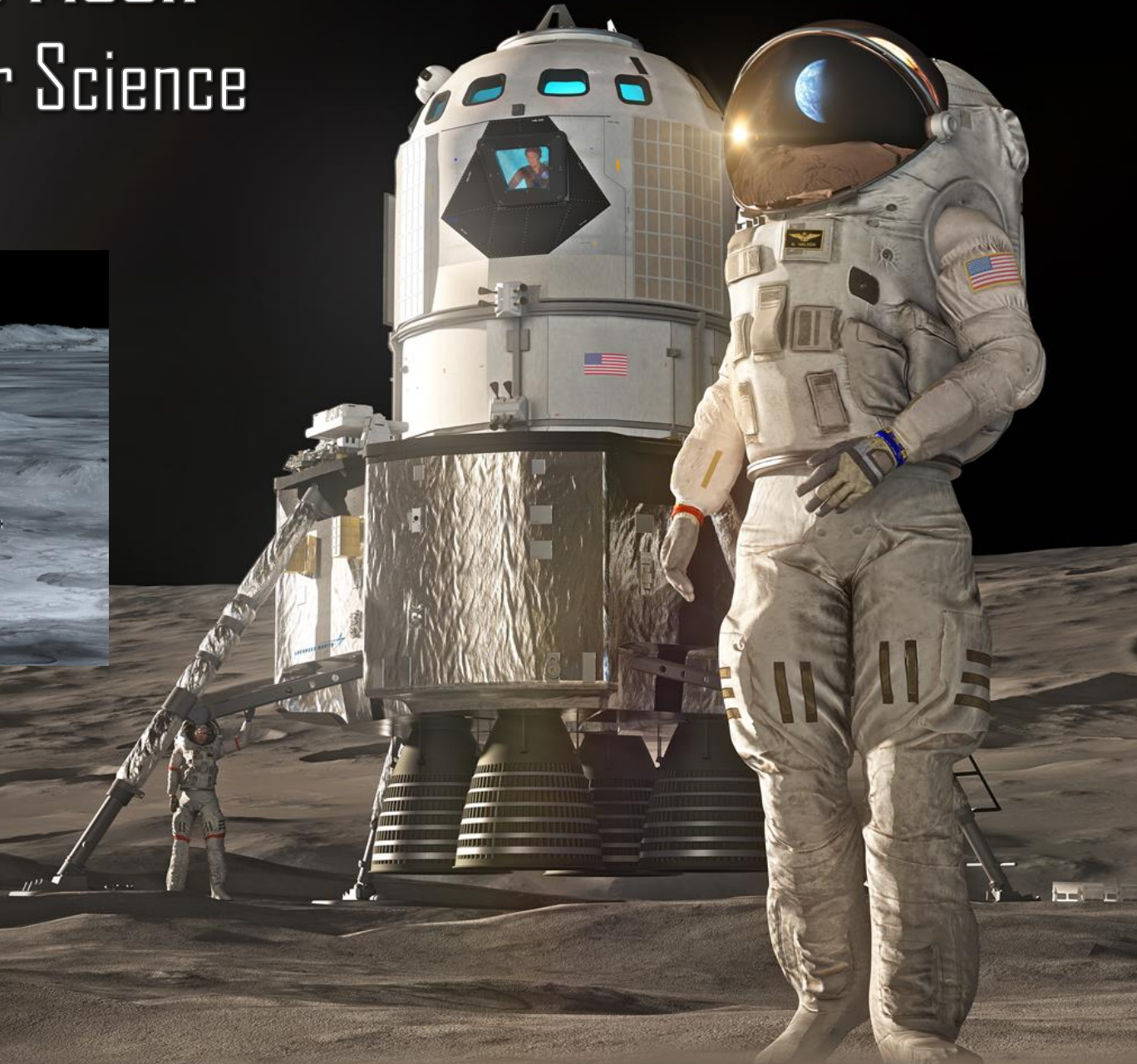
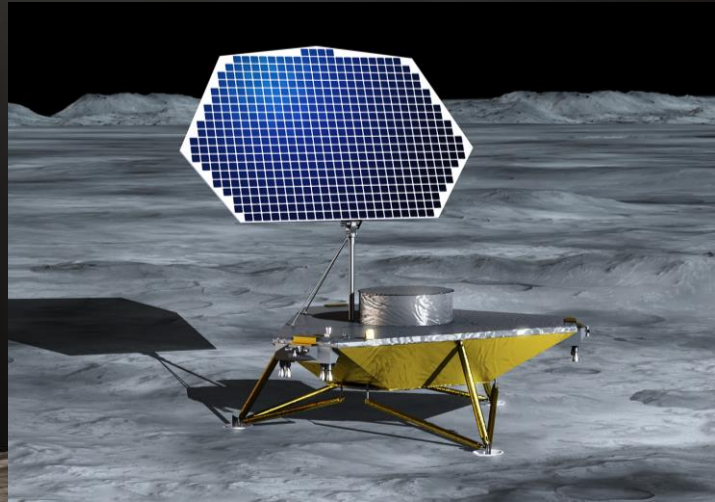


Forward to the Moon

Lunar Landers for Science and Exploration



LOCKHEED MARTIN



Artemis Phase 1: To The Lunar Surface by 2024

Artemis I: First human spacecraft to the Moon in the 21st century

Artemis II: First humans to orbit the Moon in the 21st century

Artemis Support Mission: First high-power Solar Electric Propulsion (SEP) system

Artemis Support Mission: First pressurized module delivered to Gateway

Artemis Support Mission: Human Landing System delivered to Gateway

Artemis III: Crewed mission to Gateway and lunar surface

Commercial Lunar Payload Services

- CLPS-delivered science and technology payloads

Early South Pole Mission(s)

- First robotic landing on eventual human lunar return and In-Situ Resource Utilization (ISRU) site
- First ground truth of polar crater volatiles

Large-Scale Cargo Lander

- Increased capabilities for science and technology payloads

Humans on the Moon - 21st Century

First crew leverages infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

2020

Courtesy of NASA

2024

Achieving 2024 – A Parallel Path to Success

Artemis will see government and commercial systems moving in parallel to complete the architecture and deliver crew



CREW

NASA Programs SLS and Orion



Artemis I

First flight test of SLS and Orion as an integrated system

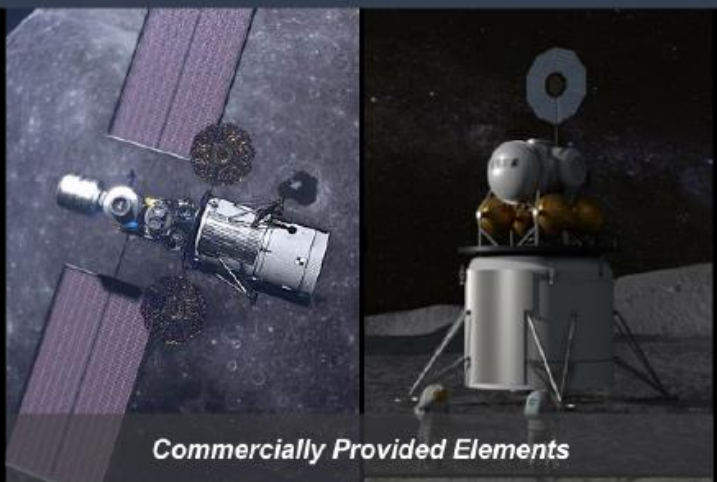
Artemis II

First flight of crew to the Moon aboard SLS and Orion

Artemis III

First crew to the lunar surface; Logistics delivered for 2024 surface mission

Between now and 2024, U.S. industry delivers the launches and human landing system necessary for a faster return to the Moon and sustainability through Gateway.



Commercially Provided Elements

CARGO

PPE

Power and Propulsion Element arrives at NRHO via commercial rocket

Pressurized Module

Small area for crew to check out systems prior to lunar transfer and decent

Human Landing System

Transfer

Transfers lander from Gateway to low lunar orbit

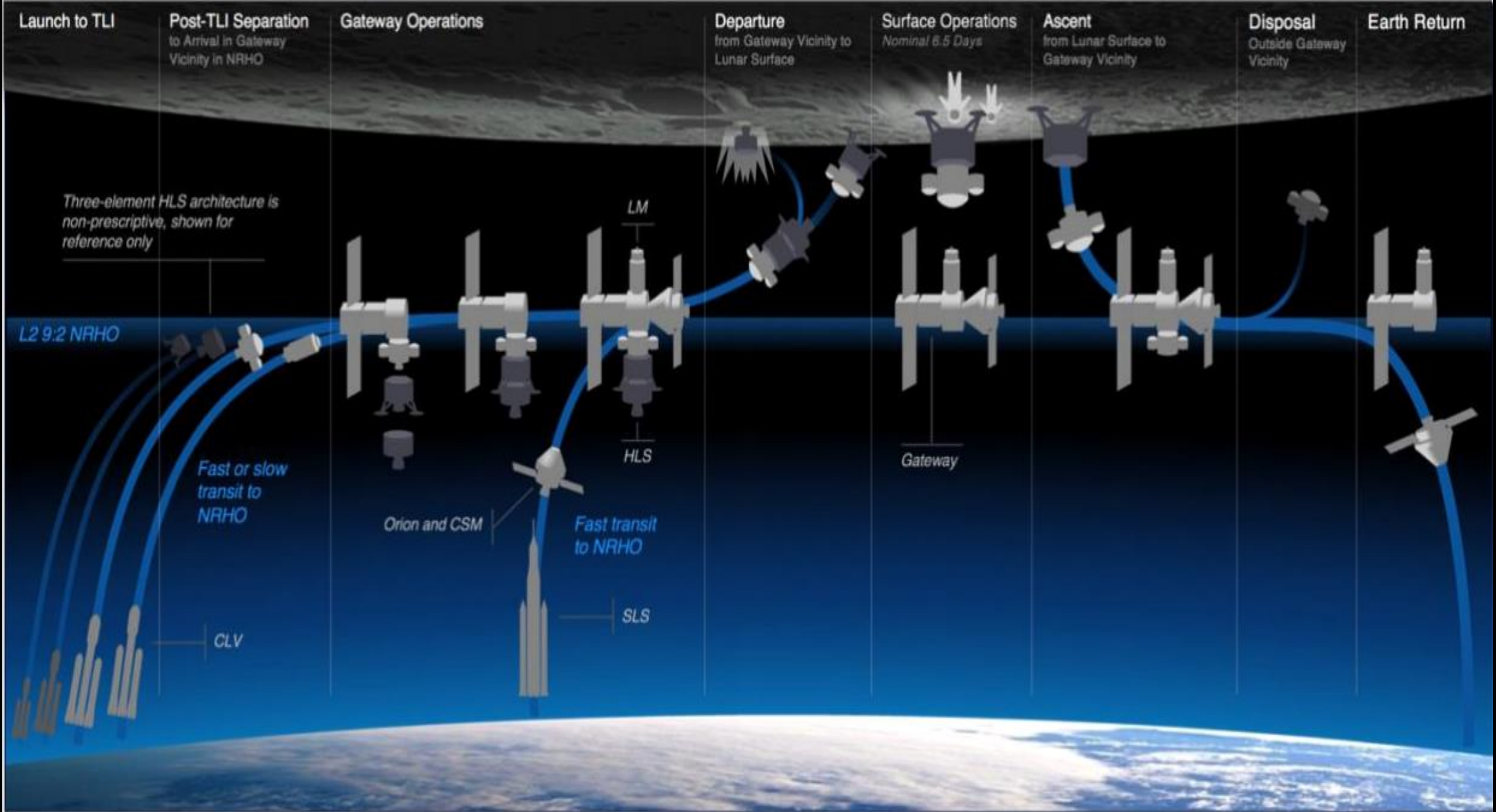
Descent

Descends from Transfer Vehicle to lunar surface

Ascent

Ascends from lunar surface to Gateway

Up to three commercial rocket launches, depending on distribution of the Transfer, Descent, and Ascent functions



Lunar Science by 2024

POLAR LANDERS AND ROVERS

- First direct measurement of polar volatiles, improving understanding of lateral and vertical distribution, physical state, and chemical composition
- Provide geology of the South-Pole Aitken basin, largest impact in the solar system

NON-POLAR LANDERS AND ROVERS

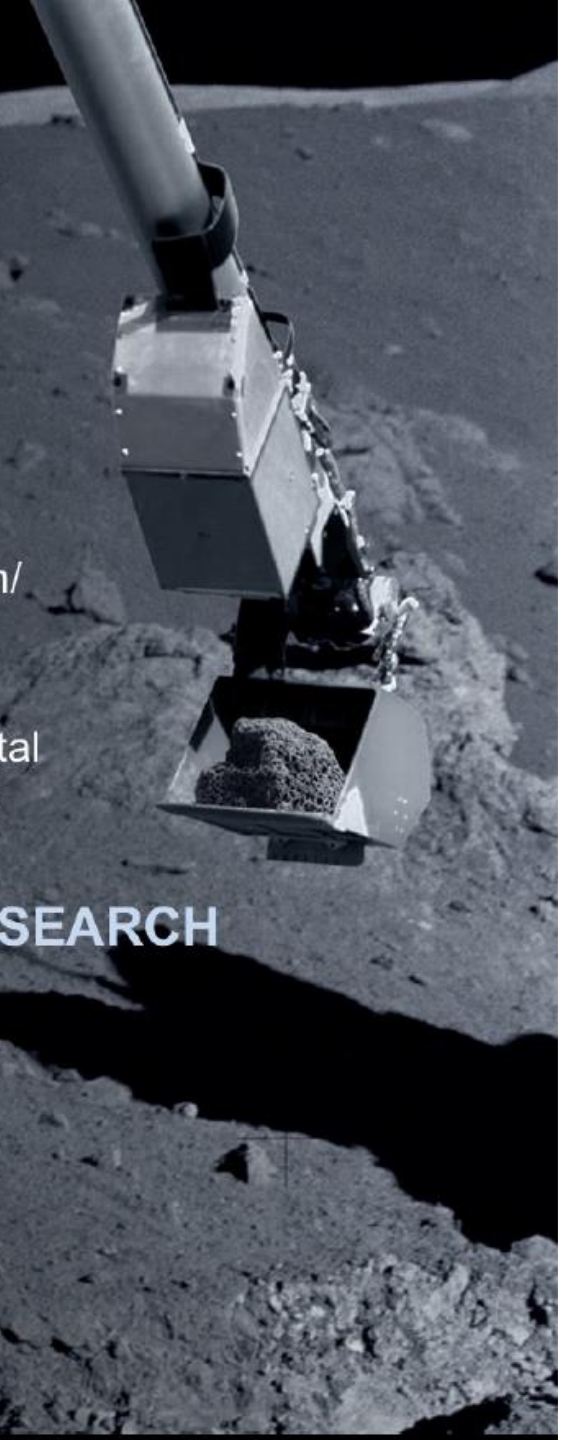
- Explore scientifically valuable terrains not investigated by Apollo, including landing at a lunar swirl and making first surface magnetic measurement
- Using PI-led instruments to generate Discovery-class science, like establishing a geophysical network and visiting a lunar volcanic region to understand volcanic evolution

ORBITAL DATA

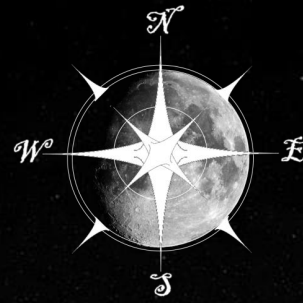
- Deploy multiple CubeSats with Artemis I
- Potential to acquire new scientifically valuable datasets through CubeSats delivered by CLPS providers or comm/relay spacecraft
- Global mineral mapping, including resource identification, global elemental maps, and improved volatile mapping

IN-SITU RESOURCE INITIAL RESEARCH

- Answering questions on composition and ability to use lunar ice for sustainment and fuel



Existing Plans and Systems with a New Focus



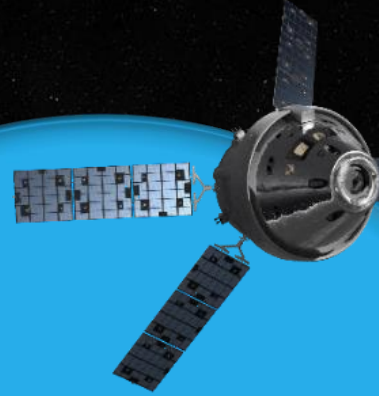
SLS Block 1

*Heavy Lift for Launching Orion
and Lunar Elements*



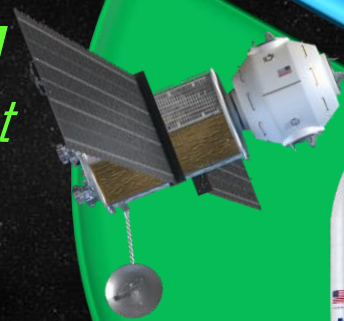
Orion

*Crew Transport to and from Gateway;
Safe Haven; Gateway Command Deck*



Phase 1 Gateway

*Power/Propulsion Element
and*



Gateway

Commercial LVs

Launch PPE and Lunar Elements



Orion/SLS

Lander



Command Deck

Orion-Derived

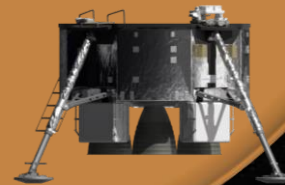
Ascent Propulsion

ESM Propulsion



Descent Stage

New Cryogenics or Storable Propulsion



A Polar Destination

Shackleton Crater Region

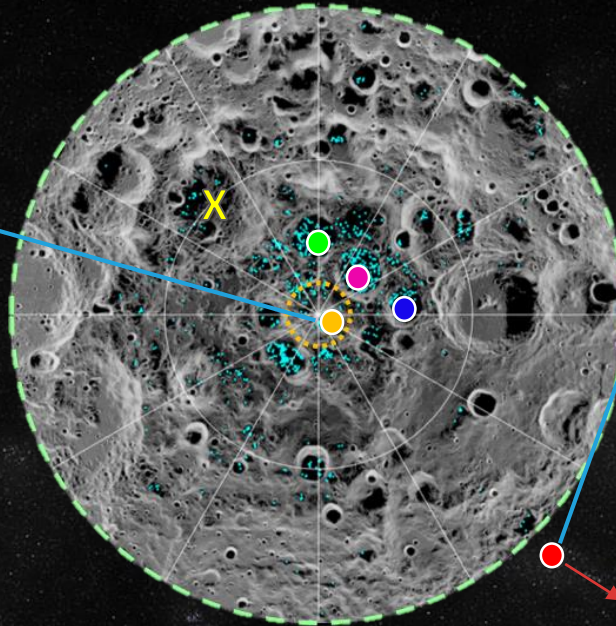


Volatiles in the Permanently Shadowed Regions

Test models of lunar "water cycle"

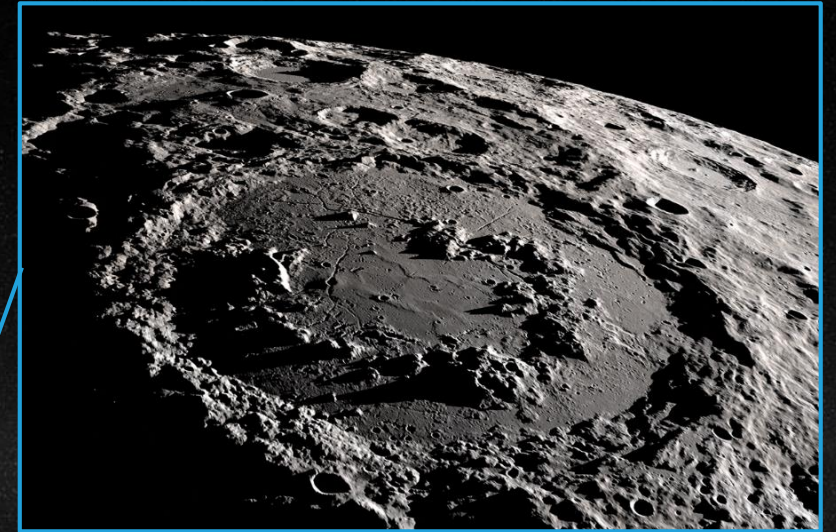
Potential Landing Sites of Scientific Interest

- South Pole Area - 10°
- Polar Regions
- LCROSS Impact Site
- Shackleton
- Haworth
- Shoemaker
- Faustini
- Schrödinger



Surface water ice deposits at the South Pole.

Schrödinger Basin



Crater fractures and bedrock exposure

Volcanic deposits and impact evidence

Possible location for a low radio frequency array



Science Questions

How does bombardment at the Moon illuminate Solar System evolution?

What is the Moon's past and present geologic history?

Where and how deep is the water on the Moon located?

McCandless Lunar Lander

www.lockheedmartin.com/McCandlessLunarLander

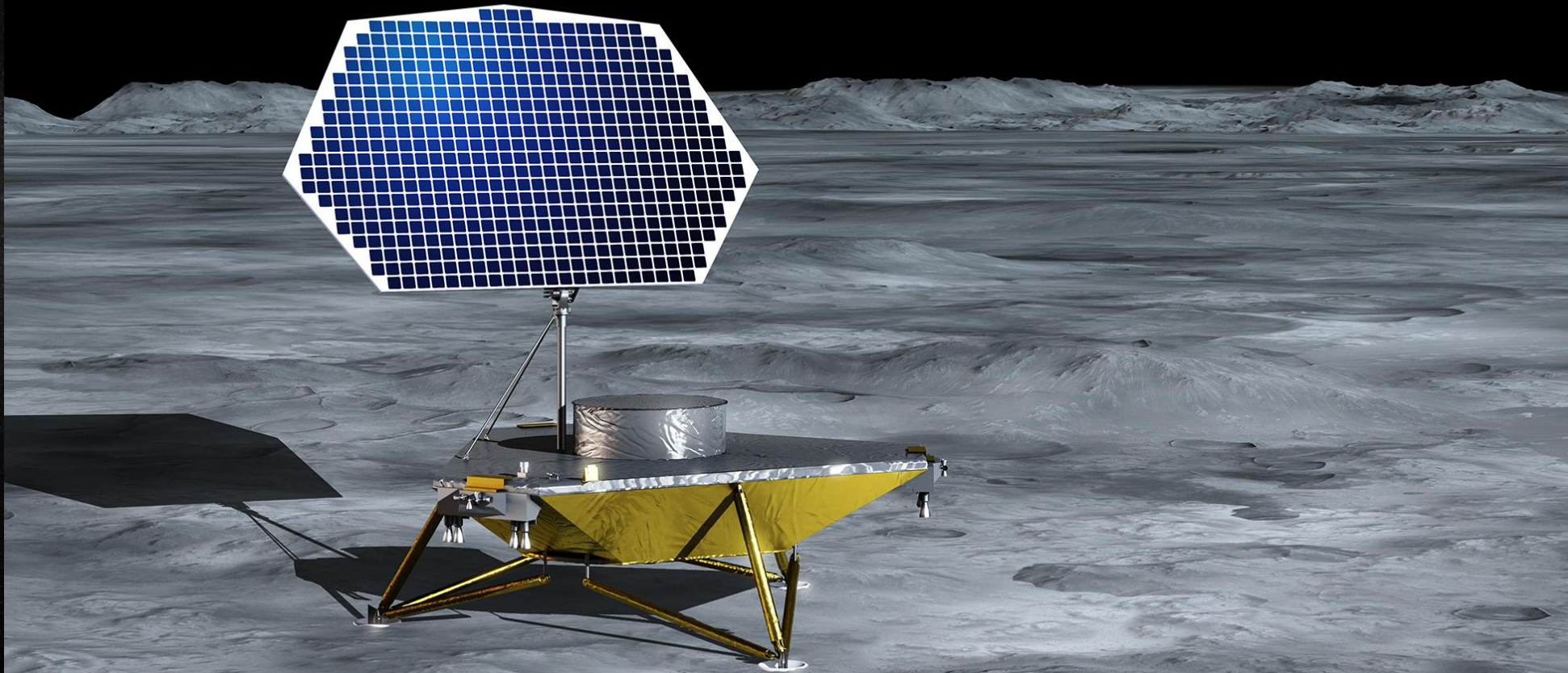
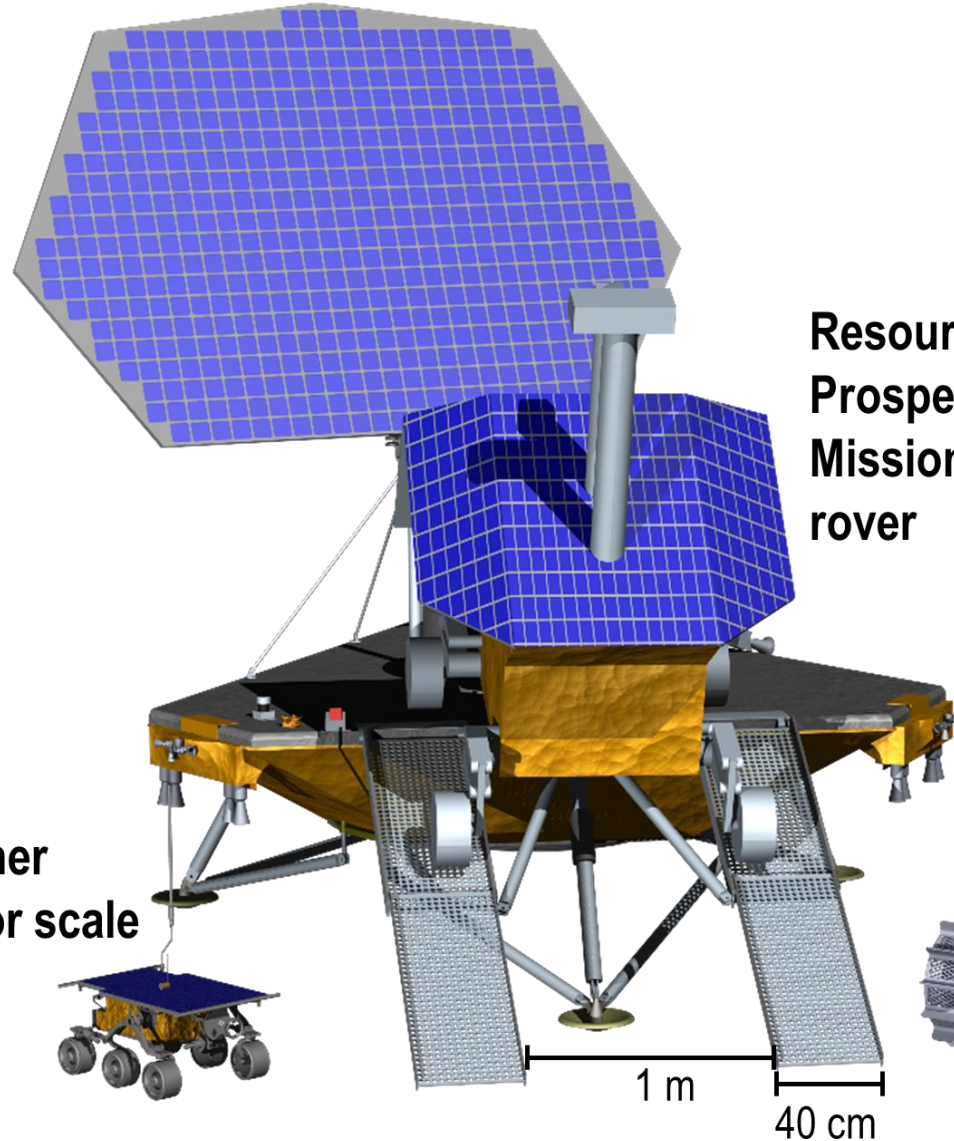


Image Credit: NASA

The McCandless Lunar Lander can accommodate large, high-power payloads and deployable rovers, such as the examples below



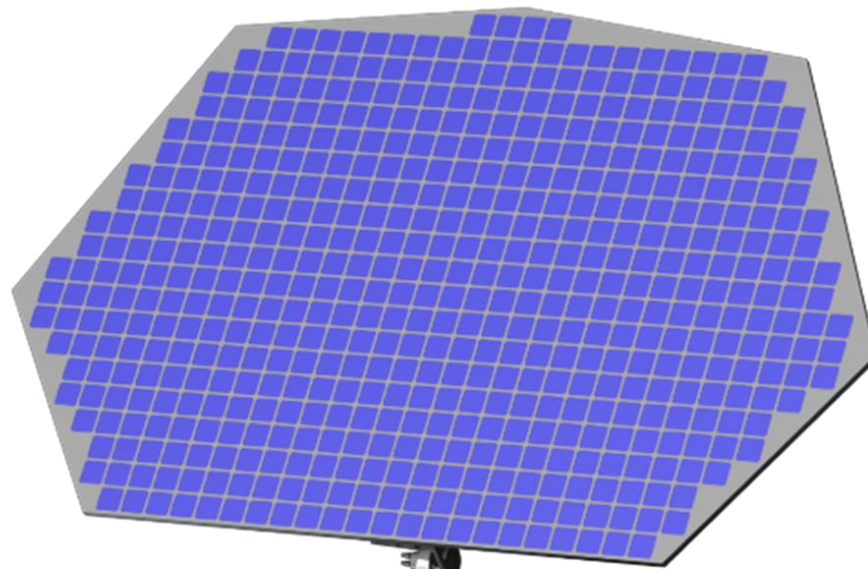
Resource
Prospector
Mission
rover

Sojourner
rover for scale



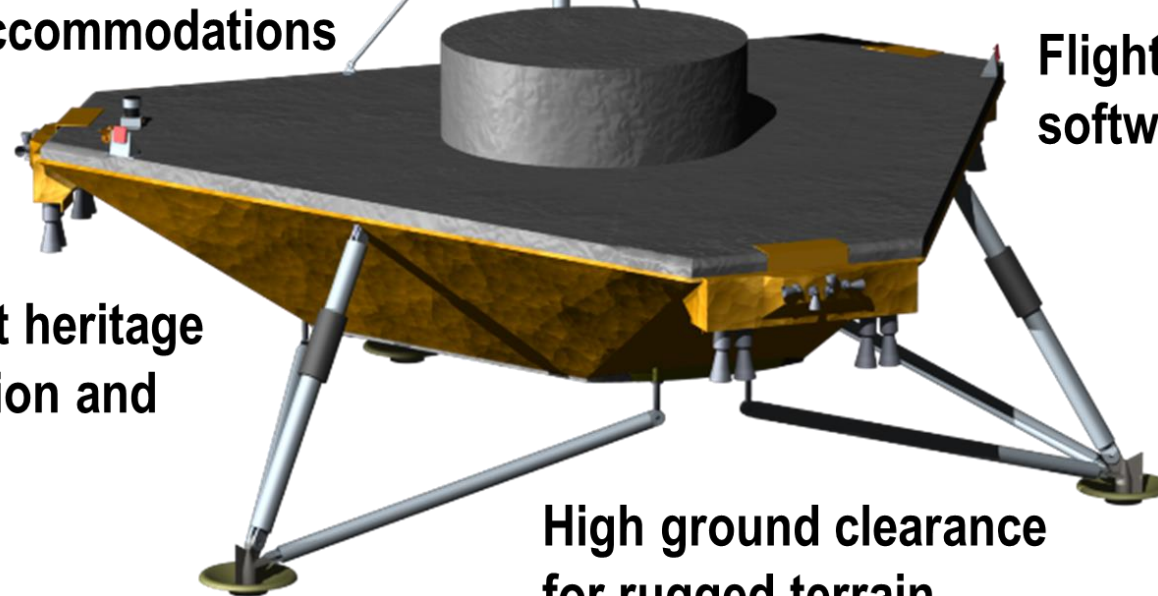
Lunar Outpost
HL-MAPP rover

McCandless is based on Lockheed Martin's experience developing, testing, and/or operating many of planetary spacecraft in collaboration with NASA and JPL. For example, the landing gear and propulsion are closely derived from the InSight lander on Mars



Gimbaled solar array provides 400 W payload power all lunar day

Large payload deck for adaptable accommodations

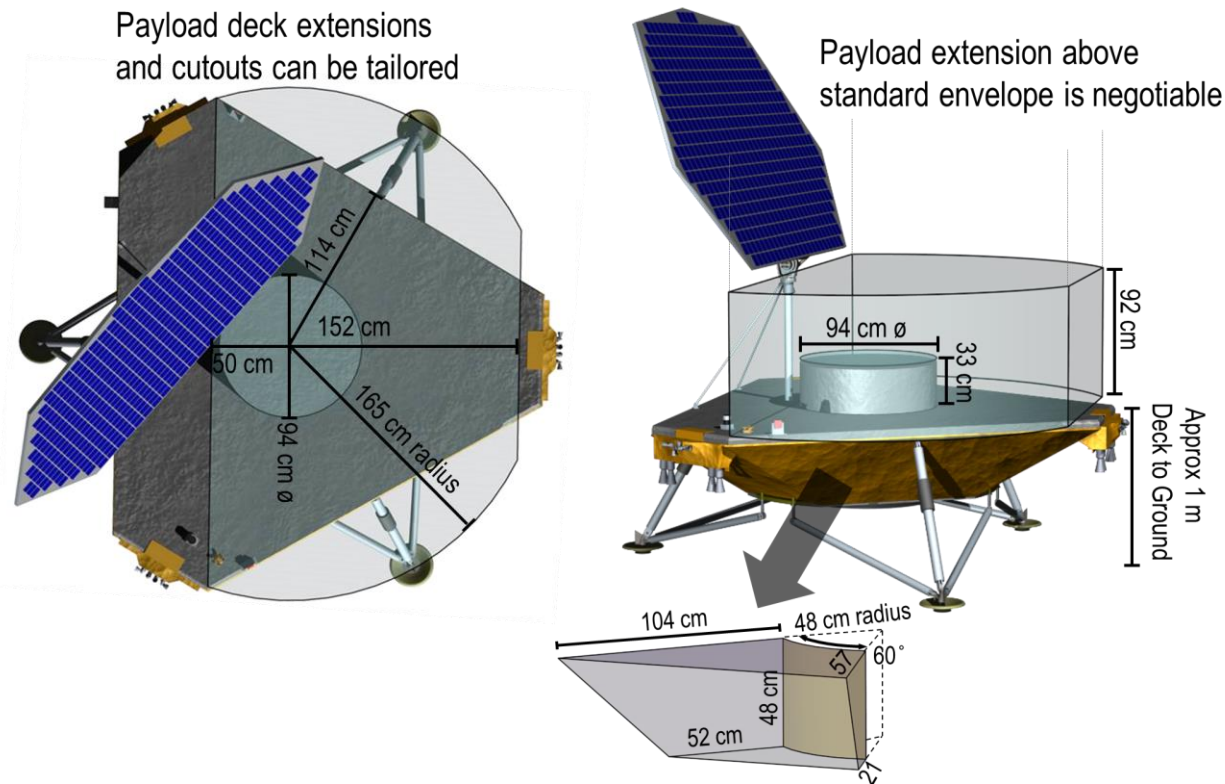


Flight-proven software and avionics

Phoenix / InSight heritage descent propulsion and landing gear

High ground clearance for rugged terrain

Payloads can attach externally on the large upper deck, or internally in two payload bays protected from the space environment



Capability	Standard	Optional Enhancements
Cargo mass	Up to 350 kg	Evolvable to > 1000 kg
Payload power (landed)	400 W, 28 Vdc	
External payload volume	>4 m ³ external, above deck	Deployment Mechanisms
Internal payload bay volume	Two 0.4 m ³ internal compartments	Deployment Mechanisms
Surface mission duration	300 hours, nearly a full lunar daylight period	Lunar night survival or lunar night operations
Landing precision	< 2 km landing zone	< 100 m landing zone
Return data rate to Earth	100 kbps	>1 Mbps
Data storage	48 gigabits	
Payload data interfaces	LVDS, RS-422, MIL-STD-1553, Spacewire	WiFi, Ethernet

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