

Science Enabled by Future Robotic and Crewed Missions to Mars

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EMIS

First CLPS Mission

CAPSTONE CubeSat

In 2021, the first Commercial Lunar Payload Services deliveries will begin with two companies delivering 16 instruments to the lunar surface that will pave the way for human explorers.

VIPER

This golf-cart-sized rover will be the first to investigate lunar polar soil samples to characterize the distribution and concentrations of volatiles, including water, across a large region on the Moon.



This small satellite will be the first spacecraft to enter the lunar Near Rectilinear Halo Orbit the future home of the Gateway. There it will test new navigation techniques to validate predictive models, reducing uncertainties about the orbit.

Artemis I

The uncrewed, maiden flight of the integrated Space Launch System rocket and Orion spacecraft will verify spacecraft performance and test Orion's heat shield during its high-speed Earth reentry at nearly 5,000 degrees Fahrenheit.



The Power and Propulsion Element (PPE) and the Habitation and Logistics Outpost (HALO) are the first pieces of the Gateway. On-board science investigations from NASA and the European Space Agency will conduct early characterization of the deep space environment.



On this 10-day crewed test flight, NASA astronauts will set the record for the farthest human travel from Earth. They will validate deep space communication and navigation systems and ensure that life support systems keep them healthy and safe.



Artemis III

With confidence gained through Artemis I and Artemis II, Orion and its crew will once again travel to the Moon, this time boarding the Human Landing System that will bring the first woman and next man to the lunar surface.

EARLY GATEWAY SCIENCE PAYLOADS

Every scientific and technological breakthrough made in space informs human missions; Gateway provides a research platform to help plan them

- The European Space Agency's 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

ARTEMIS SURFACE TECHNOLOGY OBJECTIVES

The Lunar Surface Innovative Initiative works across industry, academia and government through in-house efforts and public-private partnerships to develop transformative capabilities for lunar surface exploration.

- In-situ resource utilization technologies for collecting, processing, storing, and using material found or manufactured on the Moon or other planetary bodies
- Surface power technologies that provide the capability for sustainable, continuous power throughout the lunar day and night
- **Dust mitigation technologies** that diminish dust hazards on lunar surface systems such as cameras, solar panels, space suits, and instrumentation

- Extreme environment technologies that enable systems to operate throughout the range of lunar surface temperatures
- Extreme access technologies that enable humans or robots to efficiently access, navigate, and explore previously inaccessible lunar surface or subsurface areas
- Excavation and construction technologies that enable affordable, autonomous manufacturing or construction

Sustainable Power T



Surface Excavation/Construction

In-Situ Resource Utilization

Lunar Dust Mitigation

Extreme Access

Extreme Environments

ANALOG EQUIVALENTS FOR MARS MISSIONS





QUESTIONS?