SCIENCE LEVERAGED BY A HUMAN LUNAR PRESENCE

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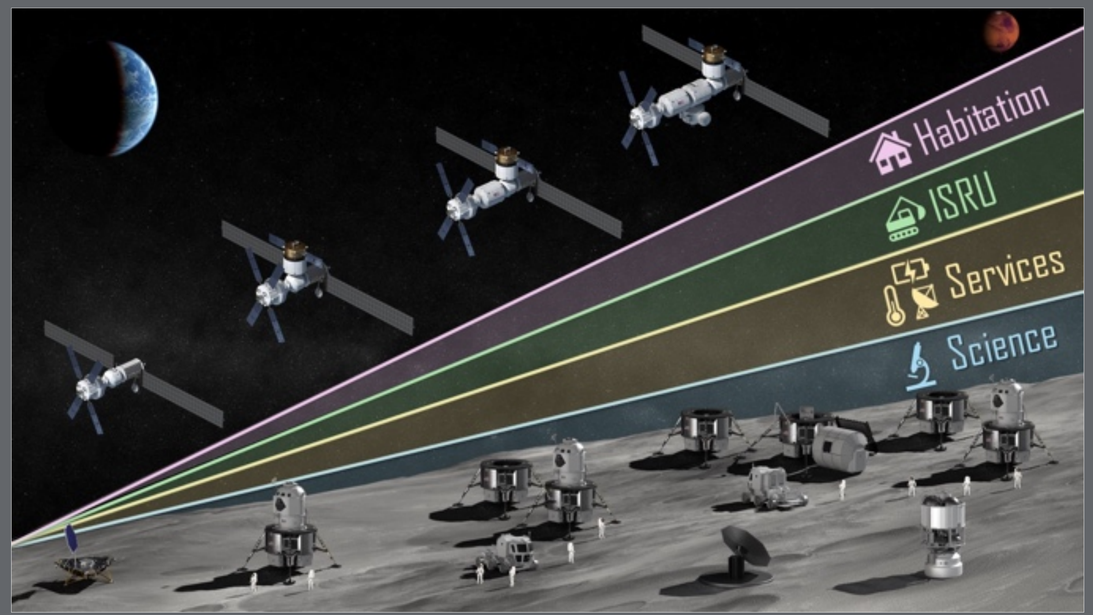


Gateway and Lunar surface infrastructure will evolve and expand over time.

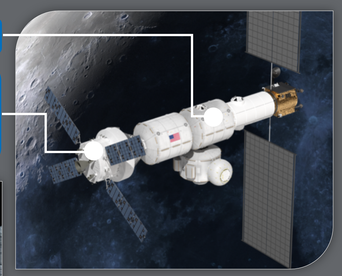
Why Sustained Lunar Presence?

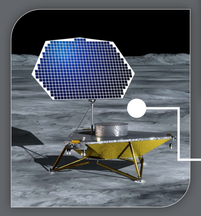
- Support NASA's key science goals
- Direct human presence for collecting data & executing sustainable surface operations
- Better understand impacts to biology

Deep Space Systems Supported through a Human-Derived Lunar Science Campaign:

Gateway

Orion: Deep Space Exploration





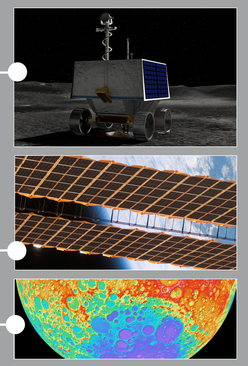
Commercial Lunar Payload Services (CLPS) – McCandless Lunar Lander

Exploration Maturation

To establish a sustainable lunar surface presence, exploratory investigations can be performed that encompass both human-directed and observed implementation of advanced science experiments with coordinated investigations taking place in orbit.

Payload Experimentation & Demonstration Topics:

- **ISRU**
- **Fluid Transfer**
- **Power Systems**
- **Locate optimal sites**
- **Distribute resources**



Extended Duration Surface Missions allow:

Future prognosis of long-term biological impacts of residing on lunar surface

Observation of environmental effects that are significant concerns, including Lunar Dust Intrusion & Radiation Exposure

Lunar Science Investigation

Example of "Real-Time" Observation Benefits

Future Excavation locations communicated to astronauts for data collection & feedback

Crew determines which tools and techniques to use

Crew efficiently collects ideal regolith samples

Each Surface Sortie will include:

- Capture of high-resolution imagery
- On-site characterization of unexplored landscapes for further definition of lunar geological scale
- In-situ measurements & analysis
- Sample Caching

Astronauts on EVA conducting lunar surface science.

Optimize Mission's Scientific Return by:

- Efficient Surface Sortie Navigation, including EVA and rover traversabiliy
- Tasking with in-mission adjustment of surface objectives, site investigations

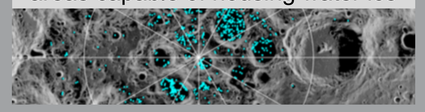
Reach Sample Return Goal requirement of: **100 kg**

Support of Lunar Rovers

Explore expanded region, >10 km, outside of lunar landing site

Access cold, cratered regions of lunar south pole in partnership with robotic rovers

Collect lunar volatiles from within areas capable of housing water ice



Advancements in deep space and lunar surface exploration technology will significantly impact lunar scientific research return and create a platform for a permanent human presence on the Moon, vastly expanding research scope and capabilities.

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