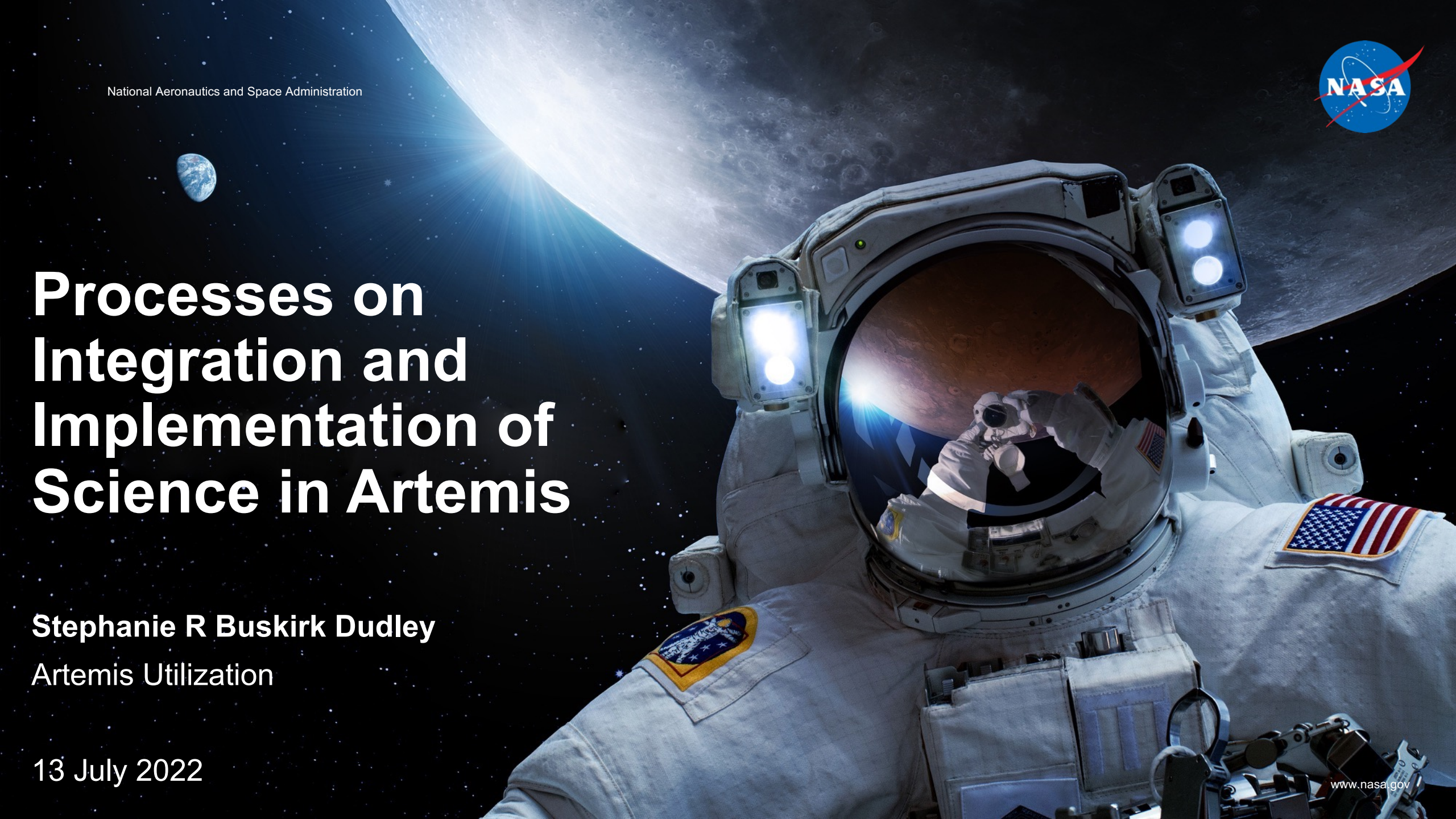
National Aeronautics and Space Administration



Processes on Integration and Implementation of Science in Artemis

Stephanie R Buskirk Dudley

Artemis Utilization

13 July 2022

Artemis Utilization

- Enabling cutting edge science is a foundational Artemis tenet
- NASA's Artemis Campaign Development Division (ACD) is making this happen
  - Strong relationships between the Artemis Campaign and the Science Mission Directorate (SMD)
  - Incorporation of SMD based utilization requirements, affecting both Artemis hardware/software and mission designs, in Artemis Campaign requirements
  - Allocation of key mission resources (e.g., mass to the lunar surface, logistics, crew time) to science and technology users
  - Definition of a utilization planning process that jointly led by science and technology users, and the Artemis Campaign at the Directorate level, early in the mission definition cycle
  - Definition of a common Artemis user interface, allowing science and technology users to operate seamlessly across Artemis Programs
- Science utilization begins on Artemis I!
  - Gateway will launch with multiple science payloads
  - Initial planning for Artemis III surface utilization has begun

Artemis Utilization Planning Process

Mission parameters: vehicles, Sortie/ABC, #crew, #EVAs, launch date

Strategic Planning

- **ACD** determines resource estimates
- **ESDMD-SOMD-SMD-STMD co-chaired working group** releases call for Artemis utilization and negotiates resource allocations between Mission Directorates
- Results documented in **HEOMD-006 Annex 4** which is approved by Quad DPMC

~L-5 to 4 years

Tactical Planning

Solicitation & Selection for utilization w/ new HW

- **Mission Directorates / Payload Sponsors** release solicitations and make selections or direct research
- **ACD** assists with feasibility consultations as needed

~L-4.5 to 1.5 years

Solicitation & Selection for utilization using existing HW

Late selection w/agreement

- **ACD** coordinates detailed resource needs with selected teams and represents the selected payloads to Artemis forums
- **Artemis Utilization Plan** documents each selected payload's detailed resource needs and relative priority and is approved by joint ACB/ECB

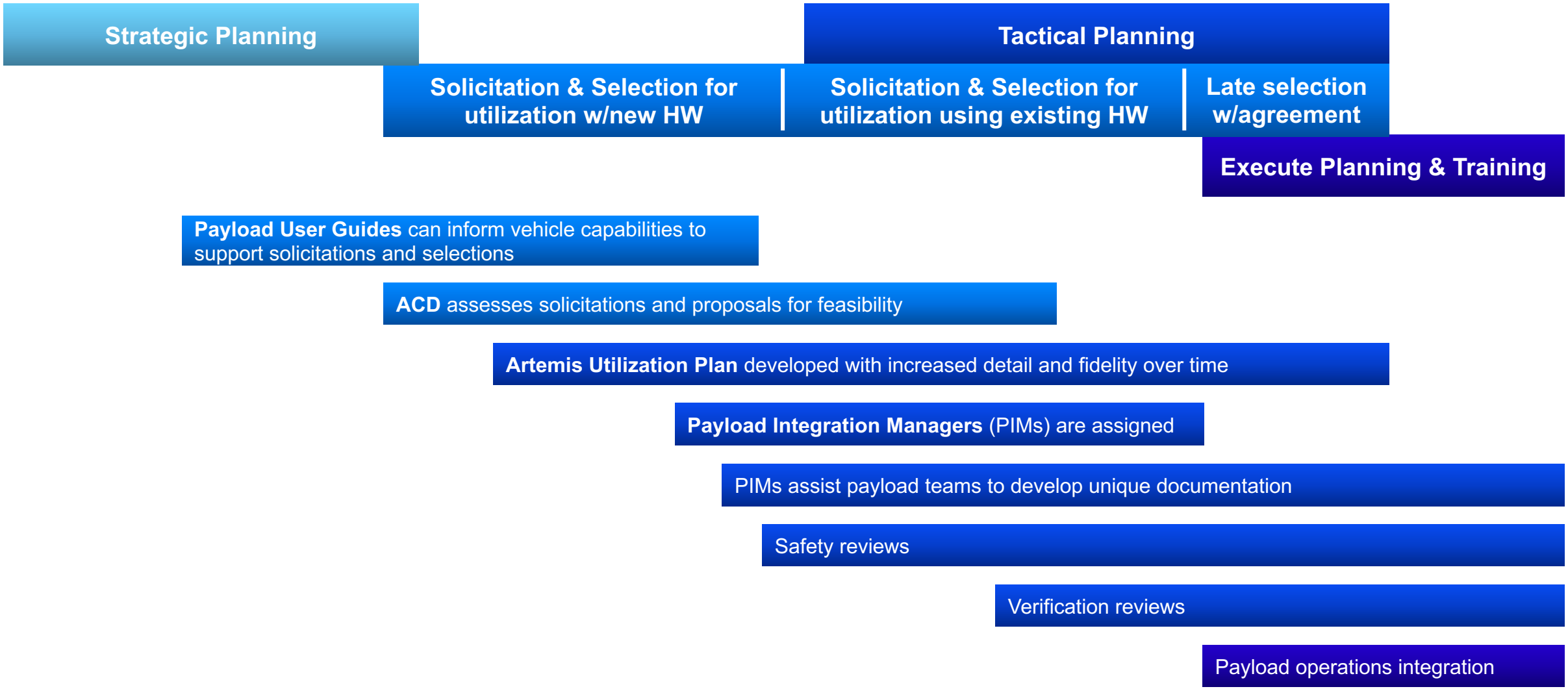
~L-3.5 to 1.5 years

Execute Planning & Training

- Crew assignment and training
- Procedures, manifest, and timeline matures
- Flight and operations readiness reviews occur

~L-2 years to ~L-6 months

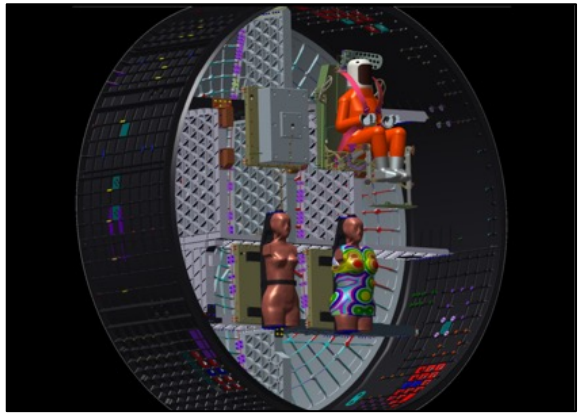
Artemis Payload Integration Process



Artemis I

Artemis I Pressurized Payloads

Payloads that will fly inside of the Orion crew module, returning data during and after the mission



ESA Active Dosimeters *

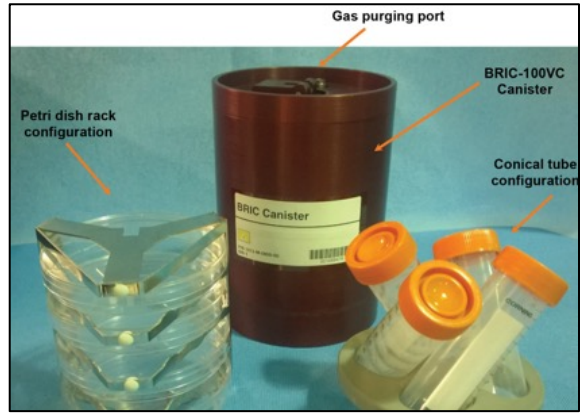
Radiation monitoring system that will fly up to 5 monitoring units

Crew Interface Technology Payload (CITP)

Creates an interactive experience between Orion and the public during the mission

Matroshka AstroRad Radiation Experiment (MARE) *

Radiation shielding Personal Protection Equipment (radiation vest) for astronauts



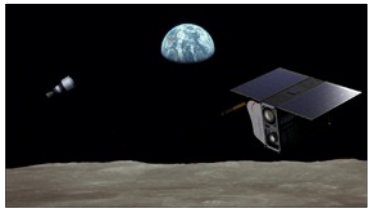
Bio-Experiment-1

Battery-powered life sciences payload for biology research beyond low-Earth orbit (LEO)

*International Collaboration

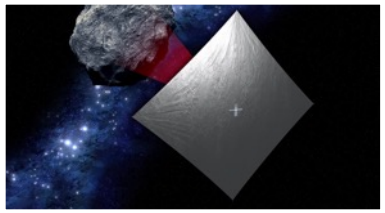
Artemis I Secondary Payloads

Science and technology investigations and demonstrations paving the way for deep space human exploration



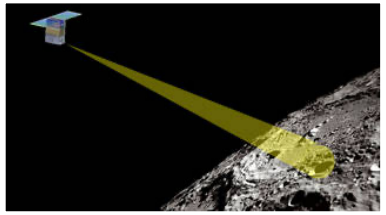
ArgoMoon *

Photograph the Interim Cryogenic Propulsion Stage (ICPS) CubeSat deployment, the Earth and Moon using HD cameras and advanced imaging software.



Near-Earth Asteroid Scout (NEA Scout)

Detect target NEA, perform reconnaissance and close proximity imaging.

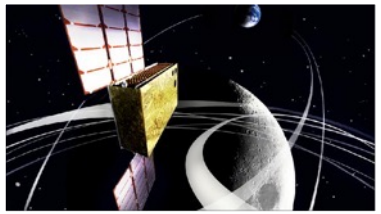


LunIR

Use a miniature high-temperature Mid-Wave Infrared (MWIR) sensor to characterize the lunar surface.

LunaH-Map

Perform neutron spectroscopy to characterize abundance of hydrogen in permanently shaded craters.

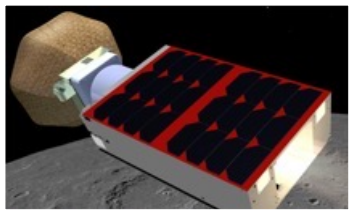


EQUULEUS *

Demonstrate trajectory control techniques within the Sun-Earth-Moon region and image Earth's plasmasphere.

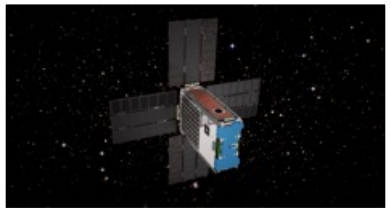
Team Miles

Demonstrate propulsion using plasma thrusters; compete in NASA's Deep Space Derby.



OMOTENASHI *

Develop world's smallest lunar lander and observe lunar radiation environment.

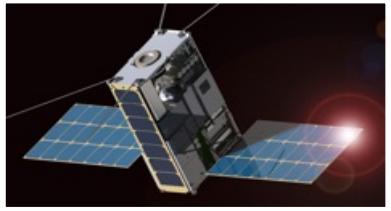


BioSentinel

Use yeast as a biosensor to evaluate the effects of ambient space radiation on DNA.

CubeSat to Study Solar Particles (CuSP)

Measure incoming radiation that can create a wide variety of effects on Earth.



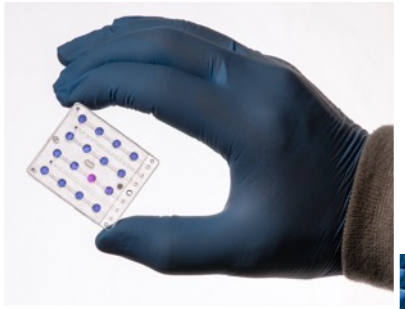
Lunar IceCube

Search for water (and other volatiles) in ice, liquid and vapor states using infrared spectrometer.

*International Collaboration

ESDMD Artemis I CubeSats

BioSentinel



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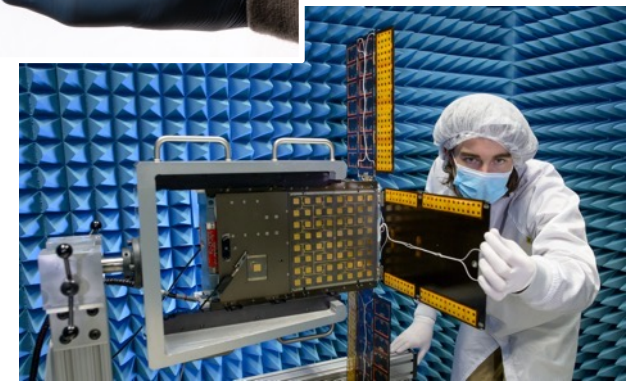

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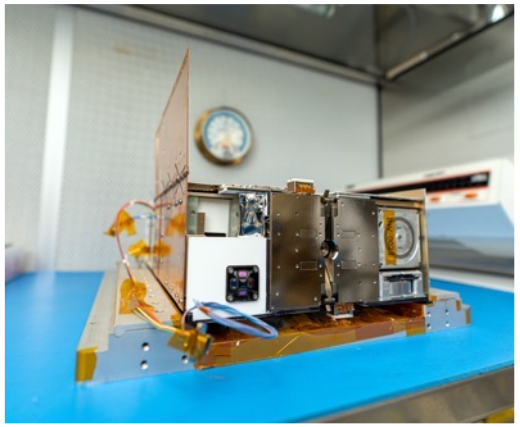

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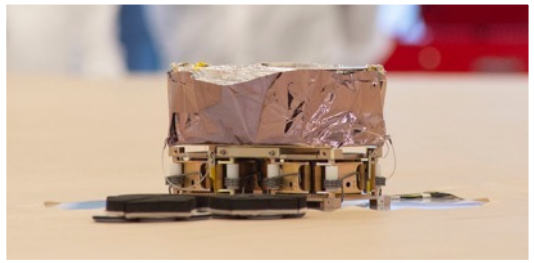
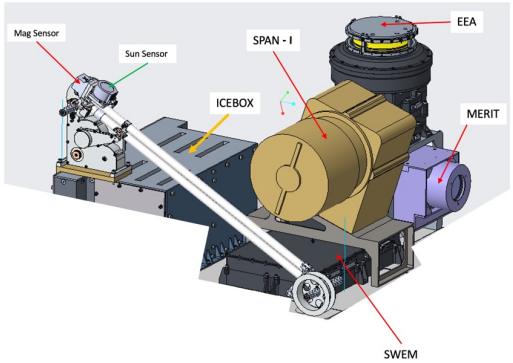


Detect target NEA, perform reconnaissance and close proximity imaging.

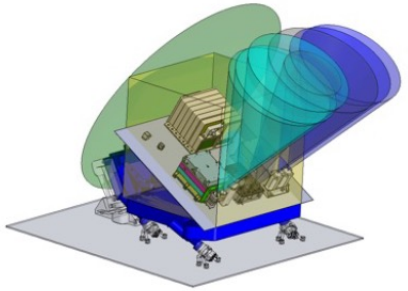
Initial Gateway Science Payloads

Gateway's orbit will offer unique opportunities for heliophysics, human health research, space biology and life sciences, astrophysics, and fundamental physics investigations. As new modules are added, science capability will increase.

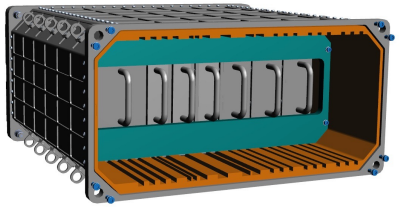
Heliophysics Environmental Radiation Measurement Experiment Suite (HERMES): NASA's space weather instrument suite will observe lower energy solar particles critical to scientific investigations of the Sun including the solar winds



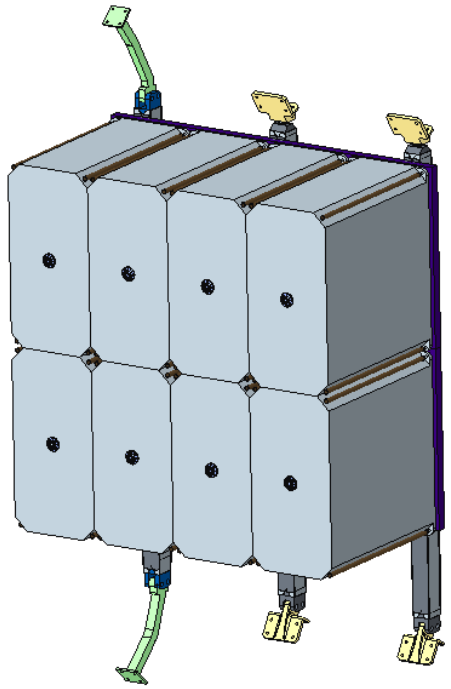
European Radiation Sensors Array (ERSA): The European Space Agency's (ESA) radiation instrument package will help provide an understanding of how to keep astronauts safe by monitoring the radiation at higher energies with a focus on space weather



ESA's Internal Dosimeter Array (IDA): Instruments including those provided by Japan Aerospace Exploration Agency (JAXA) will inform for improvements in radiation physics models for cancer, cardiovascular, and central nervous system effects, helping assess crew risk on exploration missions



Artemis Utilization Interface Definition Examples



Internal Mounted Payload Bank

Power and data connector example

In-Space External Attached Payload Interface (International Space Station example)

Summary

- The Artemis Campaign is actively working to accommodate cutting edge science and technology utilization today
- SMD and STMD utilization requirements are worked together with the Artemis Campaign at the NASA Directorate level
- Utilization begins on Artemis I!
  - Gateway will launch with multiple science payloads
  - Initial planning for Artemis III surface utilization has begun