



National Aeronautics and
Space Administration

NASA Moon to Mars Updates and Division Space Labs Goal

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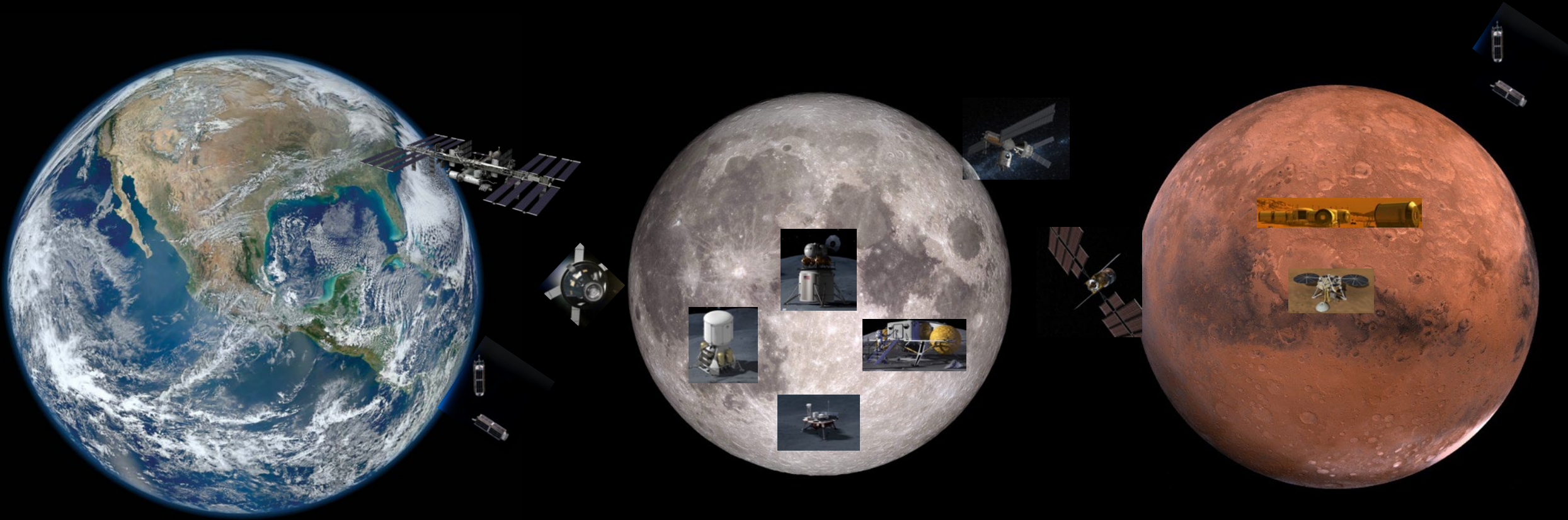
NASA Headquarters | Washington, DC

Oct. 9, 2024 | Committee on Biological & Physical Sciences in Space

Biological & Physical Sciences



BIOLOGICAL AND PHYSICAL SCIENCES ADVANCING THE FRONTIERS OF SPACE EXPLORATION



Earth-based and LEO research and technology to advance lunar exploration and habitats development

Lunar research and technology to advance Mars exploration and habitat development

Opportunities

Lunar Surface Science Solicitation:

Released by NASA SMD Exploration Science Strategy and Integration Office

All solicitations include funding for the science, instruments, and project management by the proposal team

1) F.13 Lunar Terrain Vehicle Instruments

- 1) \$44 million – at least 2 proposals will be selected
- 2) South Pole; delivered to the Moon before the launch of Artemis V
- 3) U.S.-led and Foreign-led proposals eligible
- 4) Currently in Step-1 proposal phase – Due Oct. 23, 2024
- 5) Step-2 proposals due Dec. 23, 2024

2) F.12 Artemis IV Deployed Instruments Program

- 1) \$25 Million – at least 1 proposal selected (or more if the total cost does not exceed the total maximum funding of the program)
- 2) Draft solicitation released for community comments – Due Oct. 15, 2024
- 3) South Pole – for lunar surface only
- 4) U.S.-led and Foreign-led proposals eligible
- 5) Selectin candidate payloads for Artemis IV payload manifest

3) PRISM Stand Alone Landing Site Agnostic Instruments Call (Commercial Lunar Payload Services) 2024

Opportunities

Lunar Surface Science Solicitation:

In planning:

- **PRISM 4 solicitation**
- **A4 Hand-Held Instruments RFP**
- **NASA Planetary Sciences Division Solar System Exploration Virtual Research Institute Cooperative Agreement 5**
 - Large science teams
 - Multi-year ground-only research investigations
 - Draft late fall 2024

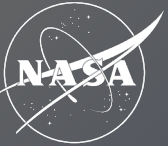
Lunar Exploration Analysis Group (LEAG) Executive Committee Search

- **LEAG announced call for Executive Committee positions for**
 - Community Liaison, Biological and Physical Sciences
 - Note: These liaisons are not representatives for the NASA SMD Divisions but are representative of the community itself
- **Closed September 30, 2024**


National Academy of Sciences Special Study on Human Exploration of Mars

- Requested by the NASA Science Mission Directorate and Exploration Systems Development Mission Directorate

New White Papers



Lunar Architecture



National Aeronautics and Space Administration

Lunar Surface Cargo

2024 Moon to Mars Architecture

white paper

Introduction

The exploration of the lunar surface, as described in NASA's Moon to Mars Architecture Definition Document (AOD), will require a wide variety of landed systems, including scientific instruments, habitats, mobility systems, infrastructure, and more. Given diverse cargo needs of various sizes, mass, cadence, and operational needs, access to a range of cargo/lander capabilities is a strategic benefit.

While current cargo/lander development activities will contribute to meeting some cargo delivery demands, a substantial gap in lander capability remains. This paper characterizes lunar surface cargo delivery needs, compares those needs with current cargo/lander capabilities, and outlines strategic considerations for filling this architectural capability gap.

Mothership Cargo Deliveries to Gateway are already intended in the Moon to Mars Architecture through the Gateway Logistics Element (GLE). GLE will supply Gateway with critical deliverables that meet the length of crew stays on Gateway. While one of the Gateway is a logistics cache for lunar exploration could be considered, this paper does not attempt to speculate on concepts of operations. Instead, it specifically addresses architectural gaps for cargo delivery to the lunar surface. The specific functions fulfilled by GLE may be found in Table 3-6 of AOD Revision A.¹

Cargo/Lander Architecture

Lunar surface exploration will require the delivery of assets, equipment, and supplies to the lunar surface.² While some landed supplies and equipment may be delivered alongside crew on NASA's Human Landing System (HLS), the breadth and scale of logistical needs for deep space exploration require additional surface cargo/lander capabilities.

NASA has developed a conceptual reference mission for cargo/lander delivery that will be added to the AOD in revision C. This reference mission:

- Delivers new orbit, orbit and/or orbit, orbit cargo to the lunar surface.
- Provides all services necessary to maintain cargo in space transit through landing on the lunar surface and to deliver cargo to the lunar surface or to any operational site where those services from the lander are no longer needed, in accordance with cargo/lander provider agreements.
- Ensures successful landing of cargo on the lunar surface at the location and time specified with sufficient precision.
- Establishes safe conditions on the lunar surface for the crew to approach the lander.
- Maintains health and functionality of the orbit, orbit and/or orbit, orbit cargo.
- Performs any other end-of-life operations—including potential relocation—ensuring that the cargo or other surface assets are not adversely affected by the lander's other landing operations.

As noted above, cargo deliveries will need support services interrelated to ensure safe delivery of cargo to the surface. Such services may support the off-loading of cargo, compatibility to surface mobility system interactions, and/or providing resources to the cargo, such as power, communications, data, and/or thermal protection. Services may be needed from landing to until the cargo is fully operational, including before or after the cargo is off-loaded to the surface.

Landers and cargo may also need additional, crew-focused lander interfaces such as extravehicular activity (EVA) launch interfaces to support crew interactions. Landers provide potential crew interaction at or near a lander. Landers must have the ability to safely land after landing and that crew are protected within a lander's vicinity.

2024 Moon to Mars Architecture Concept Review

Lunar Surface Cargo

This paper characterizes lunar surface cargo delivery needs, comparing them with current cargo/lander capabilities, and outlining strategic considerations for filling capability gaps.

Lunar Mobility Drivers and Needs

This paper outlines current lunar mobility capabilities expressed in the Moon to Mars Architecture and characterizes gaps where future demand for mobility services exist.



National Aeronautics and Space Administration

Lunar Mobility Drivers and Needs

2024 Moon to Mars Architecture

white paper

Introduction

NASA's new campaign of lunar exploration will see astronauts visiting sites of scientific or strategic interest across the lunar surface, with a particular focus on the near South Pole region.¹ After landing crew and cargo at these destinations, local mobility around landing sites will be key to movement of cargo, logistics, science payloads, and crew to remote exploration environments.

NASA's Moon to Mars Architecture Definition Document (AOD)² articulates the work needed to achieve the agency's human lunar exploration objectives by decomposing needs into use cases and functions. Ongoing analyses of human lunar exploration needs reveal the demand that will drive future concepts and elements.

Recent analyses of integrated surface operations have shown that the transportation of cargo on the surface from points of delivery to points of use will be particularly important. Exploration systems will often need to support deployment of cargo to locations proximately to other surface infrastructure. This cargo can range from the crew logistics and consumables described in the 2023 "Lunar Logistics Drivers and Needs" white paper,³ to science and technology demonstrations, to large-scale infrastructure that requires previous relocation.

The current defined mobility elements—the Lunar Terrain Vehicle (LTV) and Pressurized Rover (PRV)—are primarily for crew transportation, with limited cargo mobility functions. Conversely, planned near-term robotic missions—such as those being delivered through the Commercial Lunar Payload Services (CLPS) program—provide only small-scale mobility. This paper discusses the integrated cargo mobility drivers for consideration in future architecture and system studies, with a focus on the human lunar exploration architecture. Scientific demonstration, robotic missions could necessitate additional mobility needs beyond those discussed here.

The cadence, mass, and number of cargo/lander deliveries will be limited to meet the operational needs of NASA's lunar architecture, based on factors including science objectives, lighting conditions, and safety considerations. In many cases, cargo off-loading and manipulation will need to be conducted before the crew arrives at each landing location (point of origin) and then again at local lunar exploration and habitation sites (point of use). These exploration and habitation sites will likely be located away from each landing location. This need requires mobility capabilities to transport cargo of varying sizes and masses for full utilization within the architecture.

Current capabilities planned for lunar surface operations are limited to transporting approximately 1,500 kg of cargo. However, fulfilling other key exploration objectives could require cargo of sizes and masses beyond those planned capabilities, creating the need for additional mobility capabilities.

Identifying Risks

One of the largest drivers of mobility needs on the lunar surface is moving cargo from its landing site to its point of use. Numerous factors drive cargo point of use, many of which create unique separation from landing sites (e.g., darkness caused by a lander's shadow, point of use constrained by lander, or blast ejecta from lander plume surface interactions). These relocation distances can include the following factors:

- Separation from lander shadowing (time of mission)
- Lander blast ejecta constraints (>1,000 m) due either to separation between the lander and existing infrastructure or lander constraint
- Support for aggregation of elements in local habitation zones from available regional landing areas (up to 5,000 m)

For more insight into lunar lighting considerations, see the 2022 Moon to Mars Architecture "Lunar Site Selection" white paper.⁴

2024 Moon to Mars Architecture Concept Review



Read the White Papers Here:
<https://www.nasa.gov/moontomarsarchitecture-whitepapers/>

Architecture Workshops



Lunar Architecture

2024 Industry and Academia Workshop
National Academy of Sciences



2024 International Partner Workshop
National Academy of Sciences



Yearly Architecture Workshops

*2025 workshops tentatively scheduled
for February 11 to 13 in Washington, D.C.*

<https://socialforms.nasa.gov/Architecture-Updates>



**Subscribe to
Updates**

Lunar Discovery and Exploration Program (LDEP) Update

July 10, 2024 ¹⁰

National Aeronautics and
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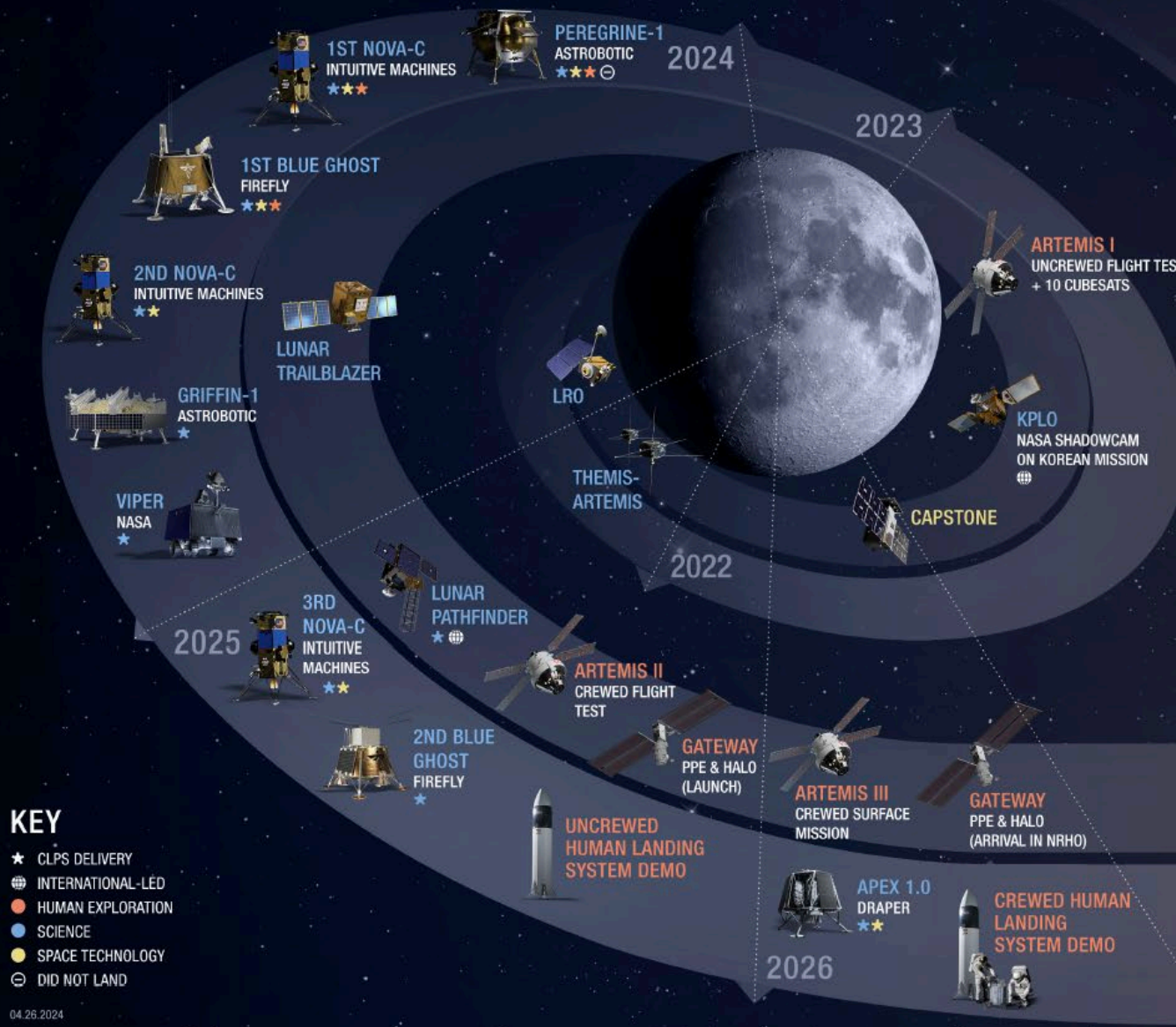
LUNAR MISSIONS 2022-2027

CLPS NASA PAYLOAD GOALS

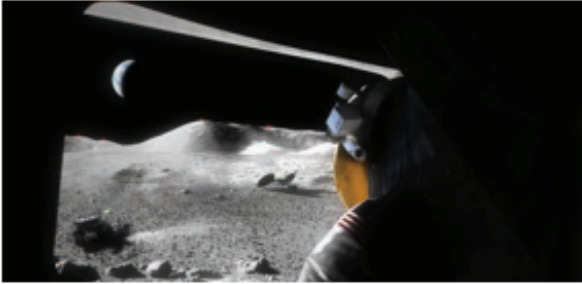
- | | |
|---|---|
| PEREGRINE-1 <ul style="list-style-type: none"> Regolith volatiles composition Local radiation environment | 3RD NOVA-C <ul style="list-style-type: none"> Lunar Magnetic Anomalies |
| 1ST NOVA-C <ul style="list-style-type: none"> Plume/surface interactions, charged particles near surface Lander prop tank gauge test | GRIFFIN-1 & VIPER <ul style="list-style-type: none"> Search for volatiles, below surface & shadowed regions |
| 2ND NOVA-C <ul style="list-style-type: none"> Drilling for volatiles | APEX 1.0 <ul style="list-style-type: none"> Geophysics of the Schrödinger Basin |
| 1ST BLUE GHOST <ul style="list-style-type: none"> Characterize Earth's magnetosphere and Moon's interior | 2ND BLUE GHOST <ul style="list-style-type: none"> Dark Ages observations from the lunar far side ESA lunar comm relay satellite deployment |

ORBITAL MISSIONS

SURFACE MISSIONS



ARCHITECTURE SEGMENTS

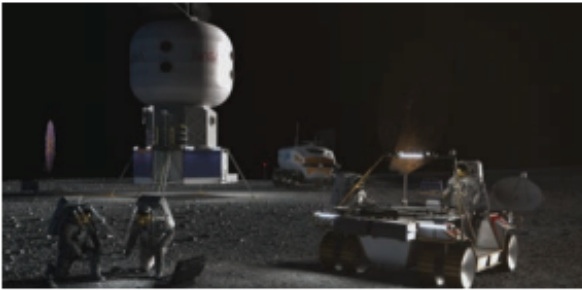


HUMAN LUNAR RETURN

Initial capabilities, systems, and operations necessary to re-establish human presence and initial utilization (e.g., science) on and around the Moon.



Orion, SLS, EGS, Gateway, HLS, Deep Space Logistics, xEVAS, CPNT



FOUNDATIONAL EXPLORATION

Expansion of lunar capabilities, systems, and operations supporting complex orbital and surface missions to conduct utilization (e.g., science) and Mars-forward precursor missions.



LTV, PR, MPH, Large Cargo



SUSTAINED LUNAR EVOLUTION

Enabling capabilities, systems, and operations to support regional and global utilization (e.g., science), economic opportunity, and a steady cadence of human presence on and around the Moon.



Power, ISRU, Expanded mobility/habitation,



HUMANS TO MARS

Initial capabilities, systems, and operations necessary to establish human presence and initial utilization (e.g., science) on Mars and continued exploration.



Transportation, EDL, Ascent, Science Ops, Return needs

FY 2025 President's Budget Request Moon to Mars Manifest



FY	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Exploration Systems Development Mission Directorate			Artemis II (Sep. 2025) Crewed Flight SLS Block 1/ Orion/ML1	Artemis III (Sep. 2026) Crewed Flight SLS Block 1/ Orion/ML1 HLS Crewed Lunar Demo xEVA Surface Suits HLS Uncrewed Lunar Demo Gateway -----> PPE/HALO Launch		Artemis IV (Sep. 2028) Crewed Flight SLS Block 1B/ Orion/ML2 I-Hab to Gateway Gateway Logistics Services Sustaining HLS Crewed Lunar Demo xEVA Surface Suits Sustaining HLS Uncrewed Lunar Demo		Artemis V (Mar. 2030) Crewed Flight SLS Block 1B/ Orion/ML2 ESPRIT to Gateway Sustaining HLS Crewed Lunar Demo xEVA Surface Suits LTV	Artemis VI (Mar. 2031) Crewed Flight SLS Block 1B/ Orion/ML2 Airlock to Gateway Gateway Logistics Services Gateway External Robotics System TBD Sustaining HLS Services xEVA Surface Suits	Artemis VII (Mar. 2032) Crewed Flight SLS Block 1B/ Orion/ML2 Gateway -----> Operations TBD Sustaining HLS Services xEVA Surface Suits Pressurized Rover
Space Operations Mission Directorate	DSN Upgrades (DLEU) Completed DSS-36 [Canberra]	Completed DSS-24 [Goldstone]	DSS-34 [Canberra] DSS-56 [Madrid]		Lunar Communications Relay and Navigation Services (LCRNS)—Increment Increment Alpha	Lunar Exploration Ground Sites 1-3 DSS-54 [Madrid] Lunar Communications Relay and Navigation Services (LCRNS)—Increment Increment Bravo	Ongoing Science, Human Research Program, and Technology Development in LEO (ISS transition to CLD) Lunar Communications Relay and Navigation Services (LCRNS)—Increment Increment Charlie			
Science Mission Directorate	LRO CLPS Flights Outlined Mars 2020:	ESCAPEADE Attempted TO 2-AB Completed TO 2-IM TO 19D	HERMES ready for integration ESA Lunar Pathfinder delivered for launch AVATAR (Artemis II) TO PRIME-1 Lunar Trailblazer TO CP-11	Artemis III Surface Science Instruments MMX (MEGANE/P-Sampler) TO CS-3&4 TO CP-12	LRO continued ops TO CS-06 TO CP-21 TO CP-22	Artemis IV Surface Science Instruments TO CS-6 TO CP-31	Rosalind Franklin Mission (RFM) Launch, Landing TO CP-41 TO CP-42 TO CP-51 TO CP-52 TO CP-61 TO CP-62	Artemis V Surface Science Instruments Artemis LTV Science Instruments	Artemis VI Surface Science Instruments	Artemis VII Surface Science Instruments
Space Technology Mission Directorate	MOXIE; MEDA DSOC		Surface Robotic Scouts (CADRE) TO PRIME-1: Drill; Nokia LTE/4G Comm; IM Deployable Hopper CFM ULA TP Flight Demo PPE SEP qual. environ. complete CFM Eta Space TP Flight Demo	CFM Lockheed Martin TP Flight Demo NEP Concept Design	DRACO Demonstration	TO LIFT-1: Lunar Surface Power Demo (i.e., RFC, VSAT, Wireless Charging); Lunar Surface Scaled Construction Demo 1; ISRU Pilot Excavator; ISRU Subscale Demo	SEP qual. complete			Fission Surface Power demo delivered for launch TO LIFT-2: Lunar Surface Scaled Construction Demo 2; Autonomous Robotics Demo; Deployable Hopper 2; ISRU Subscale Demo 2

Icons are representative only, and may not reflect final configurations, not to scale | Icons represent the fiscal year in which an event occurs | Based on FY 2025 President's budget request

Flammability of Materials on the Moon (FM²)

- Lunar surface ground truth of materials flammability data from drop tower-based partial gravity studies that also used the exploration atmospheric environment conditions
- Obtain new flammability data on different materials

SpaceX Starship Uncrewed Demonstration



Artemis III Science



- NASA has chosen the first science instruments designed for astronauts to deploy on the surface of the Moon
- Once installed near the lunar South Pole, the three instruments will collect valuable scientific data about the lunar environment, the lunar interior, and how to sustain a long-duration human presence on the Moon
- Lessons learned from these experiments will help prepare NASA to send astronauts to Mars

LEMS Lunar Environment
Monitoring Station

LEAF Lunar Effects on
Agricultural Flora

LDA Lunar Dielectric
Analyzer

LEAF

Lunar Effects on Agricultural Flora

Summary: LEAF will apply system biology and engineering to investigate the effects of the lunar surface environment on the short-term organism-wide physiological responses of model space crops.



Science Goals:

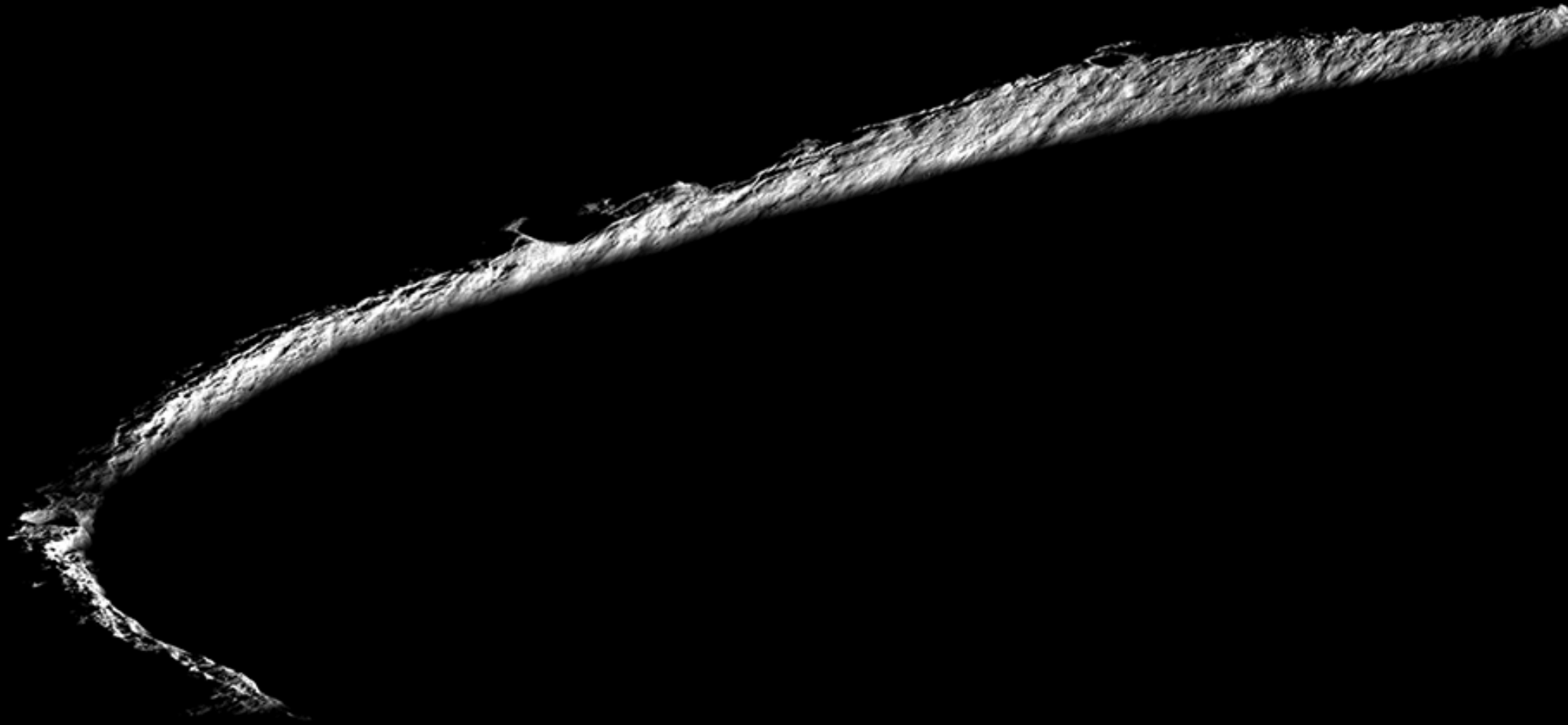
- Grow resilient model space-crops in lunar & Earth environments
- Compare crop phenotypes in lunar and Earth environments:
 1. Seed germination & clonal reproduction rates
 2. Crop morphology (size, orientation, and color) and growth
 3. CO₂ consumption and O₂ production
- Identify genome-wide biomolecular deviations in lunar grown crops
- Define future science hypotheses regarding crop potential for life support via photosynthetic gas exchange & nutrient production

PI: Christine Escobar, Space Lab Technologies LLC

Co-Sponsorship between ESSIO and Division



Where are we going?







National Aeronautics and
Space Administration

NASA Division Space Labs Goals Update

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Oct. 2024 | Committee on Biological & Physical Sciences in Space

Biological & Physical Sciences





Space Labs Overview

Space Labs Goal Overview

- **Goal Focus:** Spaceflight strategy and tactical implementation, and flight opportunities for Biological and Physical Sciences () Program Science
- Based on and incorporates all Goal roadmap capabilities & needs as well as Science Program objectives & priorities
 - **Goals:** Space Crops, Precision Health, Quantum Leaps, Foundations
 - **Programs:** Space Biology, Physical Sciences, Fundamental Physics, and Commercially Enabled Rapid Space Science (CERISS)
- Incorporates the National Academies 2023-2032 Decadal Survey Report for biological and physical sciences research recommendations and findings

Thriving in Space

Revolutionary research in extraordinary places.

Precision Health

Leveraging space to unlock the secrets of aging and disease

Space Crops

Boldly growing where no one has grown before

Quantum Leaps

Unraveling mysteries of the universe

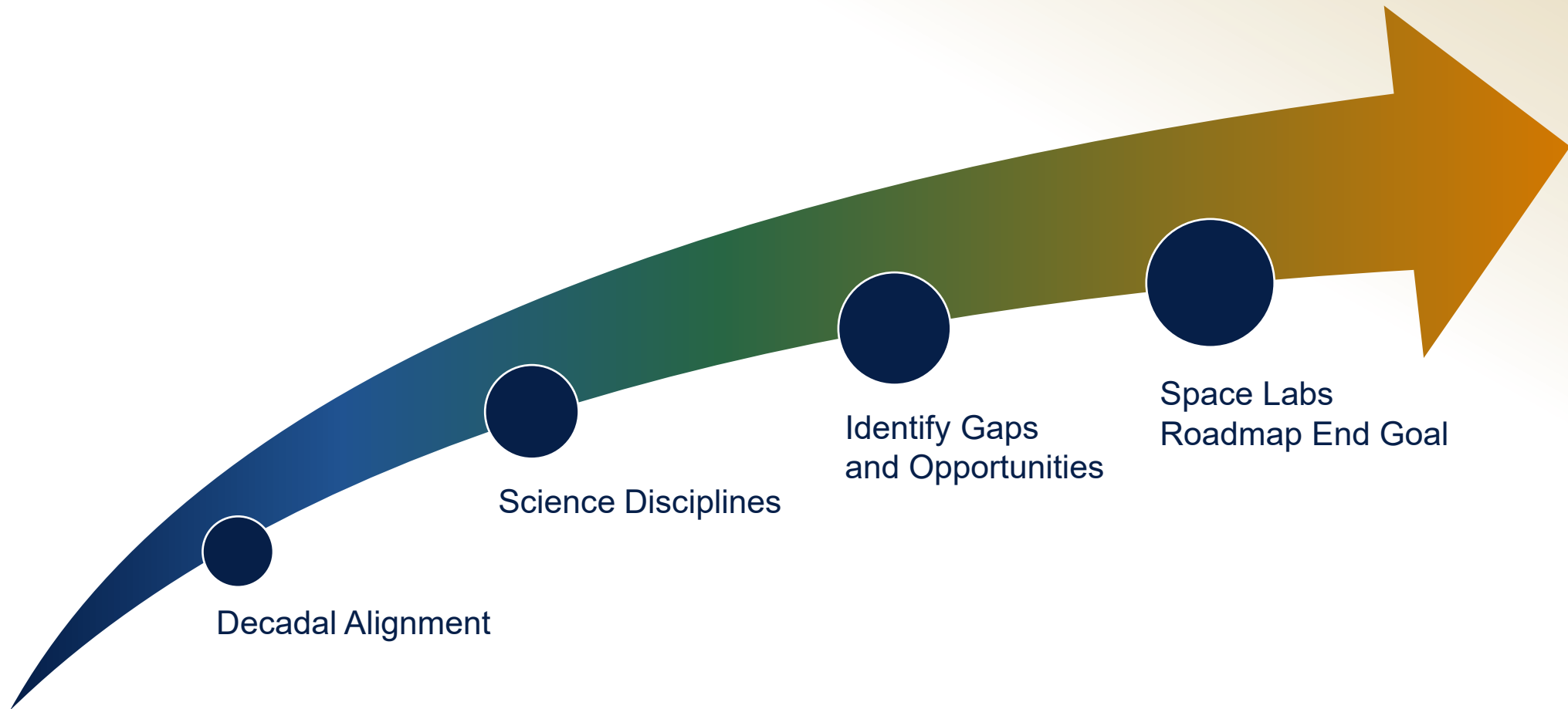
Foundations

Revealing the novel behaviors of fluids, fire, and materials in space

Space Labs

Accelerating the pace and productivity of research

Goal Overview: Space Labs



Decadal Alignment: Space Labs

Traceable to and aligns with the Decadal Survey Report recommendations, findings, and Key Science Questions (KSQ)

Adapting to Space

- Transition to/from space
- Genetic diversity & life history
- Interactions between organisms

Living and Traveling in Space

- Multigenerational effects
- Integration of biological & abiotic systems
- *In situ* utilization
- Behavior of fluids in space

Probing Phenomena Hidden by Gravity or Terrestrial Limitations

- Mechanisms for sensing & responding
- Structure & functionality of materials
- Systems far from equilibrium
- New physics

Research Campaigns:

- BLISS (Bioregenerative Life Support Systems)
- MATRICES (Manufacturing mATeRials & proCEsses for Sustainability in Space)
- PFaST (Probing the Fabric of Space Time)

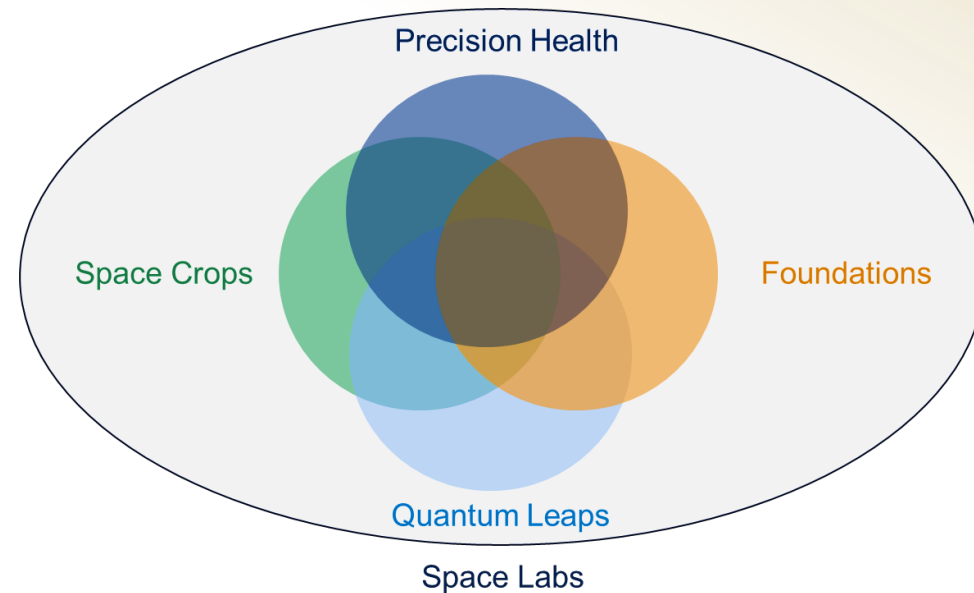
Note: For beyond low Earth Orbit studies, aligns to the Moon to Mars Strategy and Objectives document and Architecture Definition Document, as well as other community-based objectives and roadmap documents (e.g. Lunar Exploration Analysis Working Group Roadmap and Artemis III Science Definition Team Report)

Science Disciplines: Space Labs

- Incorporates and executes all of the Goals' roadmaps, capabilities/needs, objectives and priorities:

- **Goals:**

- Precision Health
- Space Crops
- Quantum Leaps
- Foundations



Identifying Gaps & Opportunities: Space Labs

- What are all known, future, and desired spaceflight platforms and extra-terrestrial surface facilities?
- What and where are the destinations to conduct and address science research?
- What enabling capabilities and needs are necessary to conduct the scientific investigations in space for each Goal? How do we conduct experiments as we've done on ISS and in Earth research labs?
 - Science technology considerations: examples- miniaturization, multiple-use, *in situ analysis*, sample processing, capabilities for crew ops and science experiment continuity, sample and hardware return, cross-platform standardization, experiment iterations in same and multiple platform locations, etc.
 - Lunar surface and Gateway facilities
 - Low Earth orbit facilities (ISS, CLD, free-flyers, suborbital)
 - Deep space facilities
 - CERISS initiative capabilities
- How do each of the Goal roadmaps for spaceflight research map or align to NASA timelines and roadmaps for spaceflight and exploration?
- What partnerships can we leverage?

BPS Landscape Highlights: Suborbital, LEO

- **Suborbital**

- Blue Origin flight with scientist payload specialist



- **International Space Station**

- Past and present research investigations
 - Science delivery on all commercial resupply missions
 - Commercial access to ISS



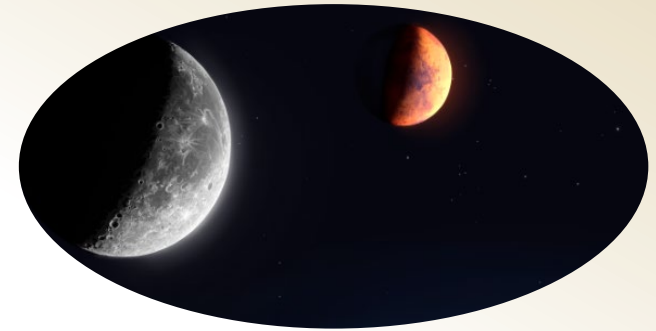
- **Commercial Low-Earth-Orbit Destinations (CLDs)**

- science capability needs submitted to CLD leads

BPS Landscape Highlights: M2M, Beyond

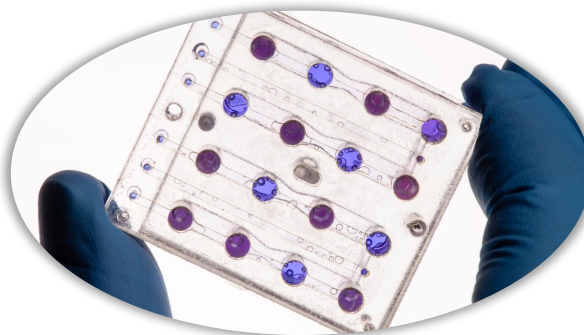
- **Moon to Mars (M2M)**

- M2M Architecture Definition Document
- BioExperiment-01 on Artemis I
- Regular solicitations for research on the Moon through Artemis and Commercial Lunar Payload Services (CLPS)
- Science payloads for Artemis II, SpaceX uncrewed demo
- Artemis III deployed instruments payload
- CLPS CP-22 LEIA (Lunar Explorer Instrument for space bio Applications)



- **Free-flyers:**

- BioSentinel
- X-37B for radiation studies

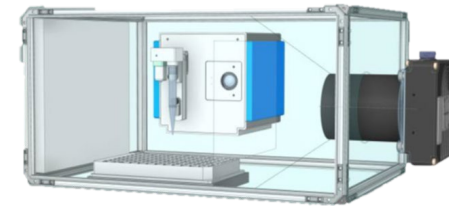


BPS Landscape Highlights: CERISS

Commercially Enabled RapId Space Science (CERISS)

- **CERISS developments and enabling capabilities**

- Lab capabilities under development (e.g. COTS-modified hardware, commercial hardware for CERISS activity)
- CERISS RFI Input received from community 2023
- 2023 TechFlights Award (SMD/STMD partnership)
- International space agencies and NASA investigating and developing *in situ* analysis capabilities
- Capabilities development within other Goals (e.g. Space Crops: spectrophotometer; Precision Health: *in situ* analysis studies, tissue chip longevity ground research enabling long duration studies)



Low Earth Orbit* and Suborbital

Low Earth Orbit

- International Space Station
- Commercial LEO Destinations
- Free-Flyers
 - Small Satellites
 - Large Multi-Payload Satellites

Suborbital

- Balloon Flights
- Sounding Rockets
- Suborbital Flights

*Standard LEO equatorial, polar orbit, high altitude / Van Allen Belts, etc.

Moon

Flight (Lunar Orbit & Surface)

- Orion
- Human Landing System
- Gateway Logistics Module
- Gateway
- Space Launch System
- ESPA Ring Payloads
- Free-Flyers (robotic)
 - Small Satellites
 - Large Multi-Payload Satellites

Lunar Surface

- Human Landing System
- Lunar Terrain Vehicle
- Pressurized Rover
- Multi-Purpose Habitat Lab
- Surface Habitat Lab
- Robotic Rover
- CLPS Landers
- Small Satellite Landers

Mars

Flight (Mars Orbit & Surface)

- Transit Vehicles
- Free-Flyers
 - Small Satellites
 - Large Multi-Payload Satellites
- Rideshare Payloads

Mars Surface

- Surface Habitat Lab
- Mobile Vehicle
- Robotic Rovers
- Large Robotic Landers
- Rideshare Payloads

Deep Space and Other Destinations*

- Free-Flyers
 - Small Satellites
 - Large Multi-Payload Satellites
 - Rideshare Payloads
- Robotic Vehicles

*Deep space, other worlds, other planetary moons, Lagrange points, heliocentric, etc.

Science Strategy

Division Science Goals

- Precision Health
- Space Crops
- Quantum Leap
- Foundations

Defines the Science Strategy to address Decadal recommendations and other science drivers for their Goal, including CERISS applications

• **Input Drivers:**
What, Where, When?

Science Implementation Strategy

Space Labs defines space facilities, capabilities, and timeline strategies for implementing the BPS research investigations

- Map to the current Moon to Mars exploration phases and timeline for the vehicles and facilities
- Map to the vehicle flight cadences
- Map to and define uncrewed vehicles
- Define and map critical vehicle and facility capabilities to timeline
- Identify vehicles that may not exist yet

Space Labs Input Drivers: What, Where, When?

- What is needed to do the science (**major GFE, facility capabilities, and resources to operate scientific research studies**)?
- Where to do the science (**location: facility, platform, geological/space**)?
- When to do the science (**timeline prioritization**)?

Mars

Moon

BIOLOGICAL & PHYSICAL SCIENCES FLEET

- FORMULATION
- IMPLEMENTATION
- OPERATIONAL
- *Partner-led

ARTEMIS III

FM²

LEIA LEAF*

ARTEMIS II

CAL
BRIC-LED
BRIC
APH
ELF*
SPECTRUM
VEGGIE
XROOTS
EML*
SOFIE
RR
FLARE*
MICRO
PH
MSRR
MHU*

International Space Station

ACES*

BECCAL*

FBCE-TL

T-REX*

COMPACT*

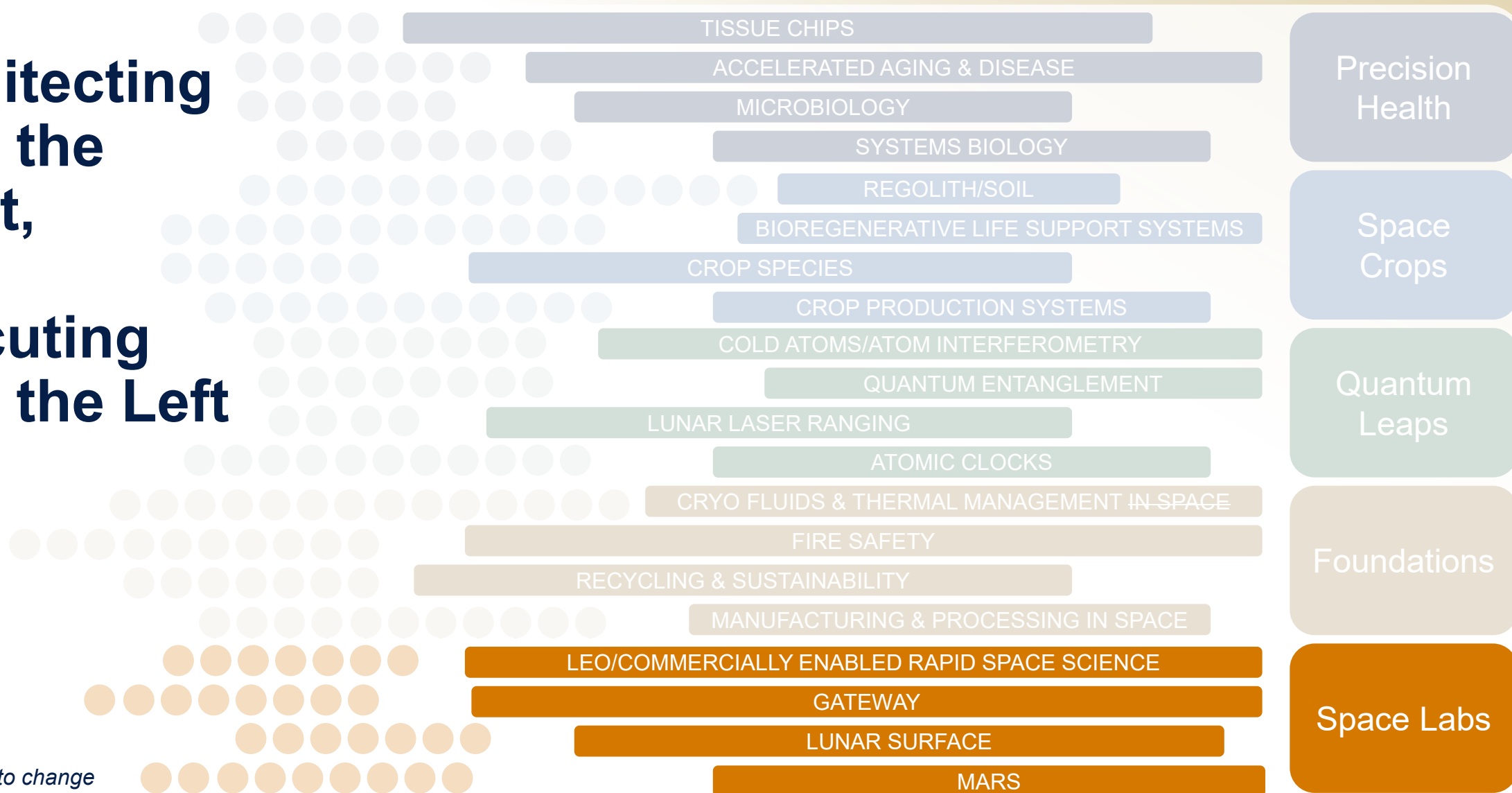
SEAQUE

Architecting from the Right, Executing from the Left

INVESTIGATIONS

THEMES*

GOALS



*Draft – subject to change