National Aeronautics and Space Administration

Breakout Session: Mars Science and Architecture

Mars Science Drivers

- Decadal-level science objectives and decades of community input
- NASEM study underway - A Science Strategy for the Human Exploration of Mars
- MEPAG Tiger Team on Mars Human-Mission Science Objectives
  - Local discovery responsiveness: geological site investigation, sample selection
  - Access wide variety of terrain in short amount of time: quickly identify scientifically compelling sites, diverse sample collection
  - Local surface measurements & laboratory analysis : discovery responsive to maximize quality observations and collections, prioritize samples for return
  - Optimize placement of science instrumentation
  - Operating and troubleshooting complex science instruments
- Crew Health and Performance Research (driven by Health and Medical Technical Authority risk reduction priorities and not decadal surveys)
  - Minimal architectural drivers for characterizing crew health and performance on Mars. Most measures will be done in coordination with Space Medicine Operations and done in-situ.
  - Architectural drivers for the human are covered in the Human Health and Performance White Paper (e.g. Radiation exposure, gravity changes, closed environments)

Mars Architecture Considerations

- In-situ field measurements and sample collection
- Deploying instrumentation networks (in advance of humans and by humans)
- Robotics, scientific tools/instruments, and remote sensing to assess Martian environments
- Responsive communications between Earth & Mars (disruption and delay tolerant)
- Surface power, mobility systems
- Planetary protection
- Mission duration, crew size

Potential Discussion Topics

Session Objective
How well does the architecture effort address science drivers

Architecture Website
For the Architecture Definition Document, White Papers, and More.
nasa.gov/architecture

1. Is there a gap in how NASA is collecting information for science and crew health and performance characterization and countermeasures?
2. Are there communities of practice that we should engage?
3. What types of scientific discoveries and objectives can be accomplished on the surface/locality of Mars with proximal human explorers (vs analysis on Earth)? What architecture components need to be considered to enable these capabilities?
4. What science and human health observations are necessary to be conducted in LEO and on Artemis Missions to be ready for humans to perform science on Mars?

Backup

High-Level Objectives:

- ***Astrobiology:*** Determine if life ever developed on Mars, including assessment of the extent organic, abiotic chemical evolution and the distribution of liquid-water environments and their habitability over time
- ***Climate and Volatiles:*** Understand the processes and history of water and climate change on Mars, including the timing of major events and transitions form the ancient environment through more recent geological time sand into the modern climate
- ***Geology/Geophysics/Geochemistry:*** Understand the physical record of planetary evolution from planetary formation until today and the processes driving the evolution of the surface, crust, and interior of Mars and how they compare to Earth and other planets

Backup – CHP high level objectives

OBJ	DESCRIPTION
OP-1L	Conduct human research and technology demonstrations on the surface of Earth, low-Earth orbit platforms, cislunar platforms, and on the surface of the Moon, to evaluate the effects of extended mission durations on the performance of crew and systems, reduce risk, and shorten the timeframe for system testing and readiness prior to the initial human Mars exploration campaign.
OP-6L	Evaluate, understand, and mitigate the impacts on crew health and performance of a long deep space orbital mission, followed by partial gravity surface operations on the Moon.
OP-7LM	Validate readiness of systems and operations to support crew health and performance for the initial human Mars exploration campaign.
HBS-01LM	Understand the effects of short- and long-duration exposure to the environments of the Moon, Mars, and deep space on biological systems and health, using humans, model organisms, systems of human physiology, and plants.
HBS-02LM	Evaluate and validate progressively Earth-independent crew health & performance systems and operations with mission durations representative of Mars-class missions.
HBS-03LM	Characterize and evaluate how the interaction of exploration systems and the deep space environment affect human health, performance, and space human factors to inform future exploration-class missions.