ASTR 4800: Space Science - Practice & Policy

• Today's Topic: NASA’s Lunar Exploration Roadmap.
• Homework: Review NASA's Mars Exploration Program website (link on class website).

Themes

The roadmap for Lunar exploration created by Lunar Exploration Analysis Group (LEAG) consists of 3 themes covering many aspects of science and engineering but there are 4 “Crosscutting Themes” driving the objectives of each:

- Learn to live and work successfully on another world.
- Expand Earth’s economic sphere to encompass the Moon, and pursue lunar activities with direct benefits to life on Earth.
- Strengthen existing and create new global partnerships.
- Engage, inspire, and educate the public.

1st Theme

Pursue scientific activities to address fundamental questions about the solar system, the universe, and our place in them.

Objective 1a

• Understand the formation, evolution, and current state of the Moon.
  - Study the thermal evolution and geological history of the Moon.
  - Study the human impact on the lunar environment.

Objective 1b

• Use the Moon as a “witness plate” for the solar system evolution
  - Allow for better understanding of the early impact environment of Earth and the inner solar system
  - Study the history of flux from the Sun and Cosmic sources
  - Search for meteors and possible debris from past meteor-Earth impacts.
Objective 1c

• Use the Moon as a platform for astrophysical, heliophysical and earth-observing studies.
  – Radio astronomy on the “radio quiet” far side of the moon
  – High precision laser ranging to further study gravity and any deviation from traditional thought
  – Study of variability in Earth’s upper atmosphere along with the Sun’s effects on global climate

Objective 1d

• Use the unique lunar environment as a research tool.
  – Combustion behavior
  – Water vapor and fluid dynamics
  – Nearly anything that would be worth studying in a low gravity setting or the extremes of the lunar environment.

2nd Theme

Use the Moon to prepare for future missions to Mars and other destinations.

Objective 2a

• Identify and test technologies on the Moon to enable robotic and human solar system science and exploration.
  – Develop air, water, waste, food storage and general life support systems for Mars missions (long term closed-loop processes)
  – Develop systems to maintain human physical and mental in long-term isolated/low gravity environments

Objective 2a Continued

– Test effects of long term exposure to the lunar environment on assorted materials
– Develop ways to protect the crews and systems from radiation, meteorite impacts and dust
– Develop methods to procure and process local materials for various uses

Objective 2b

• Use the Moon as a test bed for systems flight operations, and exploration techniques to reduce the risks and increase the productivity of the future missions to Mars and beyond.
• Training
• Problems
  – Radiation
  – Equipment Failure
  – Reduced Gravity
  – Critical Cost Overrun

• Question:
  Do you think a Lunar Base is necessary or should the problems be worked out on Earth and plan on going straight to Mars?
3rd Theme

- Extend sustained human presence on the Moon to enable eventual Settlement.

Objective 3a

- Identify, develop, and mature technologies and deploy initial infrastructure capabilities
  - Lunar Base (Long term Living)
  - Dust
  - Energy Sources and Storage
  - Life Support
    - Water Recovery System
    - Waste Management System
    - Air Revitalization System

Objective 3b

- Reduce the cost of re-supply and dependency on Earth
  - Food
    - Photosynthesis
    - Conditions on the Lunar Surface
    - Processing
  - Power
  - In-Situ Resource Utilization

Objective 3c

- Keep humans healthy and safe off-planet.
  - Bone loss
  - Muscle atrophy
  - Cardiac deconditioning
  - Food

Objective 3d

- Facilitate development of self-sustaining economic activity
  - He³
  - Metal Mining
    - Annealing or “forming” metals
  - Tourism and Research
    - Disabled
    - Sports?
  - Technology Spin-off

- IF NASA NEEDS MONEY