

ASTR 4800 - Space Science: Practice & Policy
 Today: Forward! To the Moon

- Reading for student presentation on the *Space Shuttle* – NASA website linked to Sep. 30 class website.



Astronomy 4800 – Space Science: Practice & Policy

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SCIENCE ON THE MOON

Astronomy 4800



NESS
NASA ESTABLISHED CENTER FOR WINDY SPACE SCIENCE

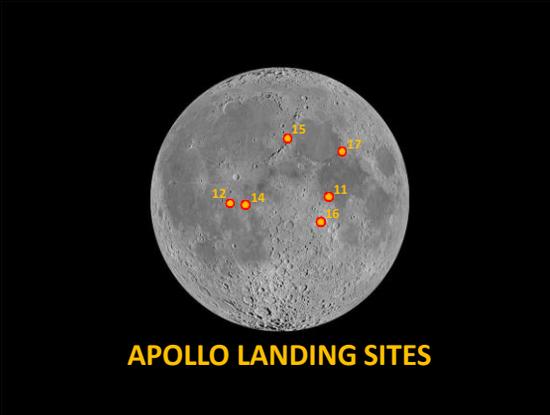
Burns et al., 2021, Low Radio Frequency Observations from the Moon Enabled by NASA Landed Payload Missions, Planetary Science Journal, 2-44, April 2021.

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APOLLO TO ARTEMIS



3



APOLLO LANDING SITES

4



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Lunar Rovers

Lunar Terrain Vehicle (LTV)



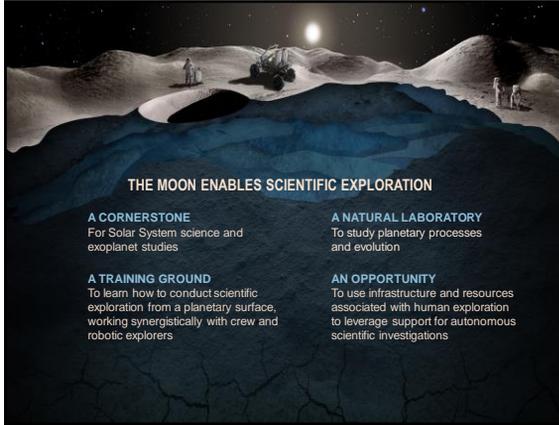
Human-rated, to move two suited astronauts across the lunar surface

Lunar Surface Science Mobility Systems (LSSMS)



Robotic vehicles to transport instruments across the lunar surface

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THE MOON ENABLES SCIENTIFIC EXPLORATION

- A CORNERSTONE**
For Solar System science and exoplanet studies
- A TRAINING GROUND**
To learn how to conduct scientific exploration from a planetary surface, working synergistically with crew and robotic explorers
- A NATURAL LABORATORY**
To study planetary processes and evolution
- AN OPPORTUNITY**
To use infrastructure and resources associated with human exploration to leverage support for autonomous scientific investigations

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VALUABLE LUNAR SCIENCE

- Study of Planetary Processes
- Understanding Volatile Cycles
- Impact History of Earth-Moon System
- Record of the Ancient Sun
- Fundamental Lunar Science
- Platform to Study the Universe

LUNAR SURFACE SCIENCE OBJECTIVES

- Field Geology with
- Collection & Return
- Ability to Access to
- Installation of Surface

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Class Exercise

VALUABLE LUNAR SCIENCE

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From the above list of lunar science topics, discuss a science project that you believe would be important to pursue from the Moon.

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UNDERSTANDING VOLATILE CYCLES



- 1 Moon represents a diversity of sources and sinks of water in the Solar System
- 2 Comets and asteroids impact the lunar surface and leave volatiles behind
- 3 The lunar surface is directly exposed to space, so volatile loss occurs by sublimation, UV ionization, sputtering, and micrometeorite impact
- 4 Solar wind (H) interacts directly with lunar surface (O in silicates), creating water molecules
- 5 Lunar samples contain tiny amounts of primordial volatiles that trace the history of Earth-Moon system formation
- 6 Lunar poles harbor extremely cold environments that may trap water and other volatiles

EXPLORATION REQUIREMENTS

- Access to persistently shadowed terrain
- Sealed collection canisters designed for cold sample curation

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IMPACT HISTORY OF EARTH-MOON SYSTEM



- 1 Craters are etched on the dynamic, eroded surface of Earth. The Moon retains this record
- 2 Both Earth and Moon reside at 1 AU, recording the impact and providing an absolute chronology that anchors the impact history of the inner Solar System
- 3 Impact Episodicity? K-Pg impact 65 My ago wiped out 85% of all fossil species. Incomplete statistics suggest such impacts may occur periodically
- 4 The Moon's impact record can be recovered and interpreted in terms of Earth-Moon history

EXPLORATION REQUIREMENTS

- Collection of several walnut-sized rocks for chronological analysis
- Identification of and collections of rocks from outcrops and boulders

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PLATFORM TO STUDY THE UNIVERSE

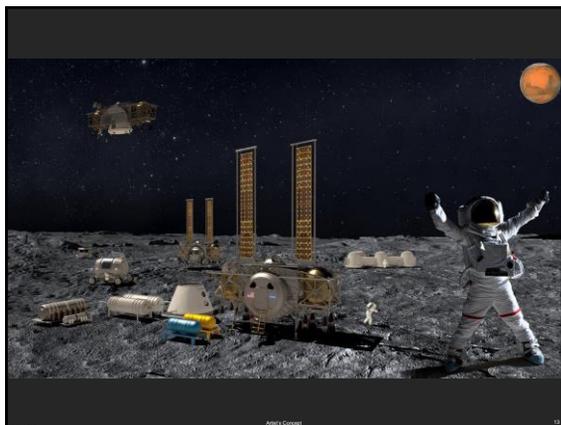


- 1 The lack of atmosphere allows the full electromagnetic spectrum to be visible from the lunar surface
- 2 The farside of the Moon is the only known place in the Solar System permanently shielded from Earth's radio noise
- 3 Opportunistic astronomy leveraging surface infrastructure

EXPLORATION REQUIREMENTS

- Dexterity to deploy delicate instrumentation
- Characterization of the local environment (dust, RF, plasma)

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