ASTR 4800 - *Space Science: Practice & Policy*

Today: Report from the Artemis Science Definition Team with Professor Paul Hayne sitting in

- Next Class: *Life on Mars* – guest lecture by Prof. Bruce Jakosky. Read article on class website for Oct. 14.
- Space Scientist Interview info due to me by Oct. 19 & paper due on Oct. 28.

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The Artemis Science Plan

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ASTR 4800
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History of Science on the Moon

- The Apollo Program
  - Geological sampling
  - Surface exploration
  - Seismic activity

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Artemis Program and Architecture

- Robotic landers will deliver science investigation payloads prior to human missions to the South Pole region in 2024
- 2021: robot precursor mission deployed to lunar orbit surface to return information about environment

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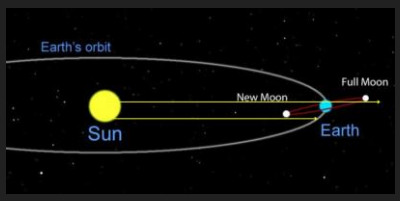
Why the Moon's South Pole?



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Artemis Science Objectives

- Understanding planetary processes
- Understanding character and origin of lunar polar volatiles
- Interpreting impact history of the Earth-Moon system
- Revealing the record of the ancient sun and our astronomical environment
- Observing the universe and the local space environment from a unique location
- Conducting experimental science in the lunar environment
- Investigating and mitigating exploration risks

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Class Exercise

Which of these objectives do you think is most important?

- Understanding planetary processes
- Understanding character and origin of lunar polar volatiles
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1. Understanding Planetary Processes

GOAL 1a: Formation of the Earth Moon system

- Moon's formation affected the early thermal state of itself and Earth which affected geologic evolution
- Continues to affect Earth's rotation rate, controlling the tides and the length of a day

GOAL 1e: Impact processes: basins and craters, mixing of the crust

GOAL 1f: Regolith process and weathering

Question: How does the Moon experience weathering?

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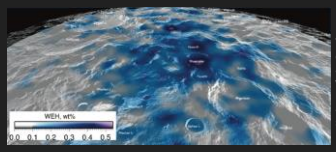
2. Character and Origin of Lunar Volatiles

Goal 2a: Determine the compositional state and compositional distribution of the volatile component in the lunar polar regions

Goal 2b: Determine the source(s) for lunar polar volatile deposits



View of the estimated abundance of water equivalent hydrogen around lunar south pole.

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2. Character and Origin of Lunar Volatiles

Goal 2f: Understand the impact of exploration on the lunar volatile record across the surface

- Robotic and human activity on the lunar surface will alter the current natural state of the region

Q: Do you think there are any ethical concern with disrupting the natural environment on the Moon and eventually Mars?

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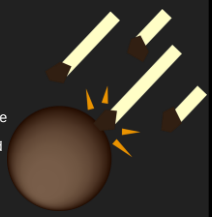
3. Interpreting Impact History of the Earth-Moon System

Goal 3a: Test Cataclysm hypothesis

- Fundamental Science goal for entire solar system, particularly for understanding surface conditions of early Earth and Mars

Goal 3c: Understand impact history of the landing site

- Learn more about impact crater morphology and modification processes that would help analysis of geological record of impact events of that landing site



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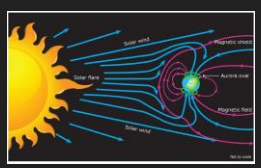
4. The Ancient Sun and Astronomical Environment

Goal 4a: Understand the history of the Sun, including the composition and flux of the solar wind

Goal 4c: Understand the changing composition of impactors with time, and the nature of early Earth



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5. Observing the Universe from a Unique Location

Goal 5a: Astrophysical and basic Physics investigations using the moon

- Provides unique advantages because of a large surface and a large mass that provides shielding

Goal 5b: Heliophysical investigations using the moon

- Falls into 2 categories:
  - Observations of non-lunar plasma environments
  - Lunar electrodynamics

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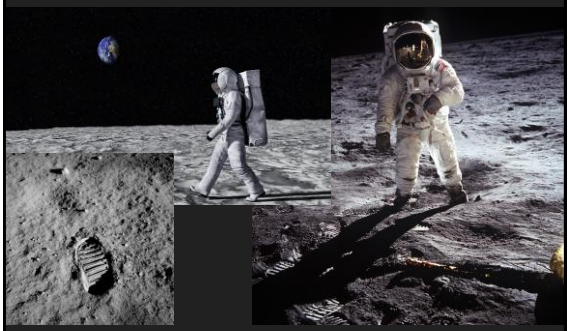

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6. Experimental Science in the Lunar Environment

Goal 6d: Use the unique environment of the lunar surface to perform experiments in the area of fundamental physics

- Examples:
  - Cosmic rays
  - Neutrinos
  - Gravitational waves

Q: What aspects of the Moon's environment make it interesting to conduct these experiments?

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6. Experimental Science in the Lunar Environment

Goal 6i: Investigate the production of oxygen from lunar regolith in lunar gravity

Goal 6n: Study the conversion of water-ice to gaseous hydrogen and oxygen, and liquefaction of gasses for propellant storage

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7. Investigating and Mitigating Exploration Risks

Goal 7c: Evaluate consequences of long-duration exposure to lunar gravity on the human musculoskeletal system

Goal 7d: Study the effects of lunar radiation on biological model systems

Q: How is radiation different on the Moon than on Earth or on the ISS?

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