



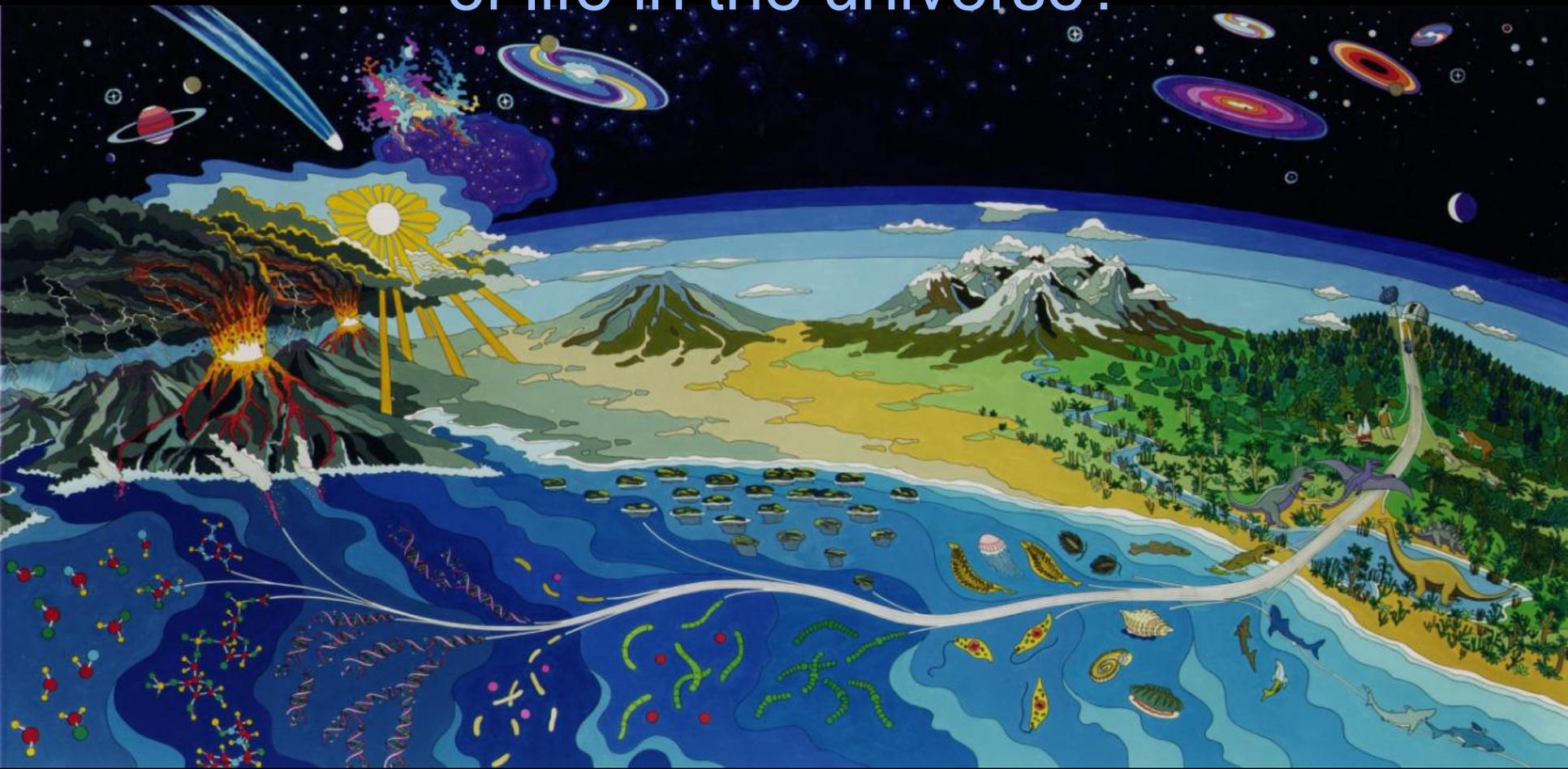
# Planetary Protection for the Moon

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C. A. Conley, Ph.D.  
Planetary Protection Officer  
NASA Headquarters

# Astrobiology's Big Questions:

What are the origins, distribution, and future of life in the universe?



**We're already convinced there's no life on the Moon!**



# International Agreements on Planetary Contamination/Protection



## The Outer Space Treaty of 1967:

- Proposed to the UN in 1966
- Signed by the US and Soviet Union in January 1967
- Ratified by the US Senate on Apr. 25th, 1967



## International Planetary Protection Policy:

- “The conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized.”
  - Preserves science opportunities directly related to NASA’s goals
  - Preserves our investment in space exploration
  - Can preserve future habitability options
- “The Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from another planet.”
  - Preserves Earth’s biosphere, upon which we all depend...
- Assignment of categories for each specific mission/body is to “take into account current scientific knowledge” via recommendations from advisory groups, “most notably the Space Studies Board.”



# Planetary Protection: What, Us Worry?



- Avoid contaminating target bodies that could host Earth life (e.g., Mars, Europa, Enceladus)
- Ensure biohazard containment of samples returned to Earth from bodies that could support native life (e.g., Mars and possibly moons, Europa, Enceladus)
- On human missions, characterize and monitor human health status and microbial populations (flight system microbiome) over the mission time, to support recognition of alterations caused by exposure to planetary materials



Earth's Moon,  
Most Solar System  
Bodies

Documentation only;  
No Operational  
Constraints on *in situ*  
activities or sample  
return



Phobos/Deimos

Document *in situ*  
activities;  
Possible return  
constraints



Mars, Europa, Enceladus

Documentation and  
operational restrictions to  
avoid introducing Earth life;  
Strict biohazard  
containment of returned  
samples



# NASA Documentation Requirements for the Moon



- Categorization Letter
  - Where are you going?
  - What do you want to do?
  - Where will you leave your hardware?
- Planetary Protection Plan
  - Describe mission profile and anticipated End of Mission
  - List organic materials carried in quantities over 1 kg.
- Pre-launch and Post-launch Reports
  - Provide updates to PP Plan as of launch
  - Confirm nominal launch or describe any off-nominal events
- End of Mission Report
  - Describe disposition of hardware at End of Mission

Commercial missions with NASA partnerships may use NASA documentation in communications with the FAA



# Non-habitable target: *Unrestricted Return*



There are no planetary protection restrictions for operations on the Moon, or returning material from the Moon.

However, information gained from operations on the Moon could benefit future human activities on Mars.

Currently, planetary protection requirements for human Mars missions are in development: lunar research could help.

They had carried in considerably more lunar dust than Armstrong and Aldrin had reported; Conrad told Houston they looked like “a couple of bituminous coal miners right at the moment, but we're happy.”





Lunar missions can support testing and development of human support systems that facilitate exploration of Mars.



Robotic  
Exploration

Early Human  
Exploration

Future  
Use



*We Are Here...*



**Phased Approach:** Be careful early; tailor later constraints to exploration or other goals, using knowledge gained on previous missions

- Humans have many interests at Mars; understanding potential hazards supports all of them
- Searching for Mars life or biohazards becomes more difficult because Earth contamination can overprint biosignatures and reduce signal-to-noise ratios
- Future colonization could be challenged, if unwanted Earth invasive species are introduced
  - Blocking aquifers
  - Consuming resources
  - Interfering with planned introductions

**NASA Policy Instruction in place:  
Human mission requirements under  
development by HEO and SMD**



We don't want bad neighbors...

