

WHAT ASTROBIOLOGY INVESTIGATIONS ARE NEEDED AND POSSIBLE ON THE MOON?

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Abstract: The Moon played a key role in early Earth evolution and provides a unique platform to perform Life Sciences and Astrobiology research [1-16]. We discuss Astrobiology investigations that are needed and possible on the Moon. Furthermore we review how to acquire knowledge to make the Moon habitable (using advanced and sustained technological support), and expand life beyond planet Earth.

Moon and Astrobiology: The Moon presents compelling science opportunities. The major Astrobiology science goals include the investigation of the

- Bombardment history
- Solar history recorded in regolith
- Origin of the Moon
- Volatiles (sources and prebiotic chemistry)

Studying the bombardment history of the Earth-Moon system help us to determine how impacts affected the habitability on the early Earth. The lunar regolith acts as a recorder of our Sun's history. Organic material may be found in the permanently shadowed polar environment. The Moon can also be used as a science platform for astronomy, Earth and solar activity observations. Opportunities for Astrobiology investigations that support future exploration missions include:

- Chemical and microbiological studies on the effects of terrestrial contamination and microbial survival
- Future in situ investigations on the Moon by highly sensitive instruments designed to search for biologically derived organic compounds
- Use of the Moon and lunar transit/orbits as testbeds for procedures and technology involved with implementing human Mars mission requirements, prior to Mars missions being flown
- Developing technologies for effective containment of samples collected by humans to prevent forward and backward contamination (preliminary to Mars use)

Astrobiology and Life Sciences on the Moon: The Moon can be used for life sciences, astrobiology laboratories, human bases and biospheres that will play a key role in the future space exploration. Investigations that can be conducted through robotic missions are:

- Analysis of organics from extraterrestrial samples
- Bacteria and extremes of life
- Survival, replication, mutation and evolution
- Extraterrestrial botanics: Growing lunar plants
- Animals: physiology and ethology
- Closed Ecological Life Support Systems

- Greenhouses and Food production
- Living off the land

Expanding Life & Humans on the Moon: Having reached maturity in human space-flight with the development and operation of the International Space Station (ISS), the next step for humankind is to reach out to other planets in the solar system. Humans will start first as explorers and then spend extended living and working periods on lunar and planetary bases. Testing life support systems, EVA technology, mission operations and science objectives on the Moon support the development of future human missions to explore Mars, including the search for life. Current lunar missions will continue to answer open questions about the origin of the Earth-Moon system, the early evolution of life, the planetary environment and habitability. Already in the next decade a series of soft landing missions to the Moon could ensure a global robotic presence performing precursor life science experiments.

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