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Robotic Lunar Ecopoiesis Test Bed

A science and technology roadmap (architecture) will be developed to determine the feasibility of implanting and operating a robotically-tended ecopoiesis test-bed on the moon. Ecopoiesis research, an early precursor to terraforming studies for Mars, consists of testing concepts in which photosynthetic organisms and chemoautotrophic microorganisms gain energy from sunlight and regolith, producing organic matter for fungi, which produce CO2 for algae, which will produce O2 for some simple invertebrate animals. The Ecopoiesis Test Bed facilitates an evolution of the environment, starting with water and nitrogen and spores or inactive cells of appropriate prokaryotes, seeds, and eggs of organisms that eventually occupy the regolith. The long-term concept allows a living ecosystem to create itself in an engineered enclosed environment on the moon under controlled Mars-like conditions. Experimental ecopoiesis will begin in the laboratory and evolve to ISS in at least three phases before a lunar module is considered. A stepwise multi-year approach is proposed, beginning with Phase I, a pre-feasibility planning study (successfully completed). Phase II comprises laboratory experiments and spaceflight planning, to determine feasibility and develop a 100-year vision, and Phase III, under independent support, will be a multi-institution undertaking culminating with a decision concerning the creation of a robotic lunar ecopoiesis laboratory. Phase II comprises four tasks: (1) build an ecopoiesis chamber for 1g experiments in a 4-liter volume, based on Phase I design; (2) run tests, by a multi-institutional team, using organism communities selected in Phase I; (3) build a community of prototype ecopoiesis-chamber users, and design future laboratory small-scale (80 ml) equipment (manufactured under separate funding) to stimulate interest in experimental ecopoiesis and prepare for experiments on ISS using SHOT's variablegravity space centrifuge technology; and (4) refine requirements for extraterrestrial test beds and decide upon the feasibility and scientific value of a robotic lunar test bed.

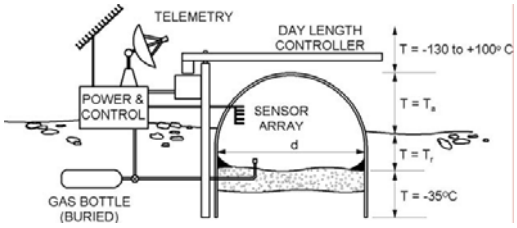
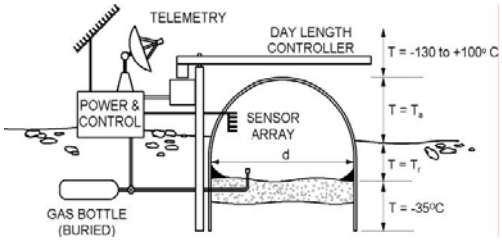


Figure 1. Artistic concept of a robotic lunar ecopoiesis test bed, the long-range goal of the proposed program, showing position of the in situ inflated dome to take advantage of lunar thermal characteristics. Stippled layer is conditioned regolith sealed above lunar regolith. The day length controller provides a Mars-length sol during the lunar day. Proposed value of "d" is 1 m.



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