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Life sciences and systems

The life sciences and systems (LSS) community's aerospace-related activities are focused on enabling human exploration of space. Science and technology efforts at space organizations around the world are addressing life support needs for future space endeavors.

Anticipation of future visits to a near-Earth asteroid and/or Mars are driving some current life support efforts to address requirements for such missions. Without clearly stated goals, however, integrated systems cannot be defined. Life sciences (LS) efforts are addressing problems associated with long-duration space stays, including physiological deconditioning, and the effects of radiation on crews.

Advanced exploration system projects have been proposed and accepted, with project management named, and are nearly ready for implementation for LSS related areas—the multimission space exploration vehicle (MMSEV), EVA suit and life support; suitport; deep space habitat definition; analog missions; logistics reduction and repurposing; water recovery; spacecraft fire safety demonstrations; radiation protection; atmosphere resource recovery; and environmental monitoring. The CO_2 and moisture removal amine sorbent technology has been flown to the ISS and implemented as a development test objective.

NASA centers are working to develop the systems needed to maintain breathable air in spacecraft: Johnson tested a pressure swing amine bed technology for potential use on Orion and EVA systems; Ames continued development of a closed-loop CO_2 removal system to reduce power associated with water recovery and integrate CO_2 compression; and Marshall has made progress on technologies for recovery of O_2 from CO_2 and H_2 derived from methane.

The deep space habitat simulation in Arizona featured a testing lab, experimental habitation module, and hygiene and airlock modules, with multimission space exploration vehicles in the vicinity.

by **Jeff Johnson**

An Office of the Chief Technologist project, next-generation life support systems, will sponsor follow-on work on Bosch-related CO_2 reduction beginning in FY12.

Desert RATS (research and technology simulation) testing in the Arizona desert simulated operations for exploration of a near-Earth asteroid. Desert RATS featured two MMSEVs and a deep space habitat that included a laboratory module, a University of Wisconsin-provided inflatable habitat, an airlock/dust mitigation module, and a hygiene module. Simulations involved asteroid MMSEV activities, EVAs, and support activities based in the habitat for multiday missions. Crews occupied the habitat for most of the two-week testing period.

The plant signaling experiment, conducted on board the ISS in July, was a collaboration by NASA Ames and North Carolina State University to understand the molecular mechanisms plants use to sense and respond to changes in their environment. *Arabidopsis* plants were grown in the European modular cultivation system to allow comparison of global transcript and protein profiles of the wild type and transgenic plants under microgravity and 1-*g* conditions. The goal is to use this knowledge to improve crops on Earth and design plants to tolerate extreme and extraterrestrial environments.

Two Italian astronauts, Paolo Nespoli and Roberto Vittori, executed eight LS experiments sponsored by the Italian space agency, which has begun work on an external platform devoted to exobiology.

The Mars500 project continued simulating the operations and confinement of a 500-day mission from Earth to Mars. The 'mission' has generated unique data—nobody has been isolated as long as these six marsonauts. Their stay ended on schedule when the hatch opened on November 4.

The emerging commercial spaceflight industry is adding an exciting new dimension to space activities. In late 2010, the FAA formed a new Center of Excellence for Commercial Space Transportation, charged with conducting research across areas such as space traffic management, launch vehicles and technologies, human spaceflight, and industry viability. Future transport of crew and cargo to and from LEO is now envisioned to be provided by the private sector, which broadens the role of the life sciences and support community and opens the door for NASA to set its sights on deep space exploration.