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2013 IN REVIEW

PREEMINENCE AT RISK
AIAA President-Elect Jim Albaugh
on the industry's future, **page B5**



NASA examines health effects of spaceflight

by Joe Chambliss

The Life Sciences and Systems Technical Committee advances technologies required to keep people healthy and safe as they explore space.

The life sciences and systems community is actively conducting aerospace-related efforts focused on enabling **human exploration** of space. Science, technology and outreach efforts have been under way at space organizations around the world to address the life science and support needs anticipated for future space endeavors.

In support of life sciences, the community participated in the annual AIAA congressional visits day to inform members of **Congress** of space life sciences research priorities, and to assess the current direction of Congress relative to the space program. While there has been less emphasis on this area in the past few years, all indications point to a recovery and a great future for life sciences on the **International Space Station**.

In February, the non-profit Inspiration Mars Foundation proposed taking advantage of a rare flight opportunity in 2018 to send a human crew on a **501-day flyby of Mars**. The initiative has caught the aerospace community's attention and has resulted in a Space Act Agreement between NASA and the organization to investigate the technical features of the mission. In July, Taber MacCallum, co-founder of Paragon Space Development, presented the mission concept as the keynote speech at the 2013 AIAA International Conference on Environmental Systems in Vail, Colorado.

NASA's **Flight Opportunities Program** is in its fourth year of flying competitively selected technology payloads in space-relevant environments on parabolic aircraft, high-altitude balloons, suborbital reusable launch vehicles, and other commercial craft. NASA's goals include technology advancement with potential broad application to future NASA missions, stimulation of the commercial space industry, and Earth benefits. Many innovative life sciences-related technologies have been or will soon be flown in support of areas such as grey water purification; sensorimotor adaptation; space medicine and

Twin brothers Scott Kelly (left) and Mark Kelly will be monitored, one on the ISS and the other on Earth, for comparison of their physiological responses during Scott's year-long space station mission. Credit: NASA.

surgery; autonomous 3D cell culture; telemetric bio-imaging; and cerebral hemodynamics monitoring.

Russia initiated and NASA has started planning a **Mars mission simulation** on the ISS to start in 2015.

NASA is using an idea proposed by **twin brothers** Mark Kelly and Scott Kelly to perform a study that has been confined to science fiction until now. The agency will be monitoring the biological states of both brothers over the span of a year, with a twist: Scott will be aboard the ISS for the duration of that period, while Mark, a former astronaut who retired from NASA in 2011, will remain on Earth. Blood samples will be taken from Scott at regular intervals before, during and after the ISS mission. Corresponding samples will be taken from Mark, who will maintain his normal lifestyle. NASA will be seeking research proposals that focus on specific biological attributes, including the effects of space on genetic mutations in Scott, protein levels in the two men's bodies, levels of other biological molecules, and differences in astronaut psychology on Earth versus in space.

The **European Space Agency** (ESA) has partnered with NASA to start a contract for a biology experiment dubbed **NIH.1a**, to be carried out on the ISS. The experiment will test the hypothesis that the inhibition of the **immune response** in spaceflight is similar to that of aging. Also in preparation is an analysis of ESA's BICE experiment, which is short for Biomechanical quantification of bone and muscle loading to Improve the quality of 0-g Countermeasure prescriptions for resistive Exercise. BICE involves a combined use of NASA's Advanced Resistance Exercise Device and the Italian Space Agency's ELaboratore Immaginari TElevisevi (ELITE) S2.

In the U.S., NASA made significant progress this year in Advanced Exploration System and **Game Changing Development** projects for life sciences-related areas: the Multi-Mission Space Exploration Vehicle, extravehicular activity suit and life support, Suitport, Deep Space Habitat, analog missions, logistics reduction and repurposing, water recovery, spacecraft fire safety demonstrations, radiation protection, and atmosphere resource recovery and environmental monitoring.

NASA's continued development of technology for **CAMRAS**, the CO₂ and Moisture Removal Amine Swingbed, overcame startup and on-orbit integration problems and has now been operated on the ISS. ▲

