



NASA SBIR 2009 Phase I Solicitation

X11 Exploration Crew Health Capabilities

Human space flight is associated with losses in muscle strength, bone mineral density and aerobic capacity. Crewmembers returning from the International Space Station (ISS) can lose as much as 10-20% of their strength in weight bearing and postural muscles. Likewise; bone mineral density is decreased at a rate of ~1% per month. Although aerobic capacity has not been formally measured in returning ISS crew, short duration Space Shuttle crewmembers have been shown to undergo a 22% reduction in VO₂max in response to space flight. During future exploration missions such physiological decrements represent the potential for a significant loss of human performance which could lead to mission failure and/or a threat to crewmember health and safety. The ability to estimate the physical cost of exploration tasks, monitor crew health and fitness, and to provide effective hardware for exercise countermeasures use will be valuable in supporting safe and successful space exploration. Exercise systems is seeking technologies or devices to provide resistive and aerobic exercise in flight or simulate an Extra Vehicular Activity (EVA) suit on the ground. Visit the following for additional information:

<http://hacd.jsc.nasa.gov/projects/ecp.cfm>

<http://hacd.jsc.nasa.gov/projects/eva.cfm>

Subtopics

X11.01 Crew Exercise System

Lead Center: GRC

Participating Center(s): JSC

Human space flight is associated with losses in muscle strength, bone mineral density and aerobic capacity. The ability to estimate the physical cost of exploration tasks, monitor crew health and fitness, and to provide effective hardware for exercise countermeasures use will be valuable in supporting safe and successful space exploration.

Exercise Systems is seeking technologies or devices to provide resistive and aerobic exercise in flight.

-
- Compact, reliable, multi-function exercise devices/systems are required to protect bone, muscle, and cardiovascular health during lunar outpost missions (missions with total duration less than 6 months). This device should be easily configured and stowed, require minimal power to operate, include instrumentation to document exercise session parameters including portable electronic media, and require minimum periodic calibration (no more than 2 times per year). The device must be capable of providing whole body axial loading and individual joint resistive loading that ideally simulates free weights. If unable to match the inertial properties of free weights, then the device must achieve an eccentric to concentric load ratio greater than 90%. The load must be adjustable in increments no greater than 2.5 kgs and provide adequate loading to protect muscle strength and bone health such that post-mission muscle strength is maintained at or above 80% of baseline values. The same device must be capable of providing whole-body aerobic exercise levels necessary to maintain aerobic capacity at or above 75% of baseline VO2max. Finally, the ideal device should also stimulate the sensory-motor system which controls balance and coordination.
 - Identify compact, multi-function exercise devices to protect muscle and cardiovascular health during lunar sortie missions (missions with a total duration of less than 30 days). This device must be 20 lbs or less including all accessories (or demonstrated to be within this allotment for a flight unit if the ground prototype exceeds 20 lbs), require no vehicle power to operate, include materials/components that can be flight certified and do not pose risk to the crew vehicle/habitat, and can be stowed within 1 cubic foot of space aboard the Orion vehicle. The device must require no crew calibration or maintenance (for missions less than 30 days), require minimal deployment/setup time (easily portable between vehicles), and ideally include instrumentation to document exercise session parameters using portable electronic media. The device must be capable of providing whole body and individual joint resistive loading that ideally simulates free weights.

Phase 1 Requirements: a fully developed concept, complete with feasibility analyses and top-level drawings. A breadboard or prototype is highly desired.

X11.02 EVA Suit Simulator

Lead Center: GRC

Participating Center(s): JSC

Human space flight is associated with losses in muscle strength, bone mineral density and aerobic capacity. The ability to estimate the physical cost of exploration tasks, monitor crew health and fitness, and to provide effective hardware for exercise countermeasures use will be valuable in supporting safe and successful space exploration.

Exercise Systems is seeking technologies or devices to simulate an Extra Vehicular Activity (EVA) suit on the ground.

A wearable system that simulates the mechanical properties of the current extravehicular activity (EVA) space suit is sought. System should be lightweight (less than 30 pounds), easy to don/doff (especially in the supine position), replicate the mechanical properties of a space suit (in terms of resistance to motion and mass and inertia), and able to be worn during conduct of simulated lunar tasks that last up to 4 hours. Suit system must be adjustable to accommodate individuals of different height and weight. Joints of primary interest to simulate in this system are the shoulder, elbow, trunk, hip, and knee.

Phase 1 Requirements: a fully developed concept, complete with feasibility analyses and top-level drawings. A breadboard or prototype is highly desired.