Fiscal Year:	FY 2012	**Task Last Updated:**	FY 05/14/2012
PI Name:	Barstow, Thomas Ph.D.		
Project Title:	Standardized 'Pre-flight' Exercise Tests to Predict Performance during Extravehicular Activities in a Lunar Environment		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Aerobic**:Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity (2) **Muscle**:Risk of Impaired Performance Due to Reduced Muscle Size, Strength and Endurance		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	tbarsto@k-state.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	785-532-0712
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City:	Manhattan	**State:**	KS
Zip Code:	66506-0109	**Congressional District:**	1
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2009 Crew Health NNJ09ZSA002N
Start Date:	07/01/2010	**End Date:**	06/30/2013
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	2	**No. of Master' Degrees:**	
No. of Master's Candidates:	3	**No. of Bachelor's Degrees:**	5
No. of Bachelor's Candidates:	9	**Monitoring Center:**	NASA JSC
Contact Monitor:	Loerch, Linda	**Contact Phone:**	
Contact Email:	linda.loerch-1@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	May 2012 report: Chris Lewis, Ph.D. has left Kansas State University and is no longer on the project. We are actively pursuing a replacement engineer.		
COI Name (Institution):	Warren, Steven (Kansas State University) Schinstock, Dale (Kansas State University)		
Grant/Contract No.:	NNX10AK60G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The original Apollo missions and more recent extravehicular activities on the International Space Station have provided basic information that can be applied to activities that may occur during future long-duration lunar missions. However, despite these previous efforts, significant gaps remain in our understanding of the more complex physiological costs of different activities in a true lunar environment. Recently a ground-based simulation of a 10-kilometer Lunar Walkback was conducted to better understand the physical capabilities of a suited astronaut in partial gravity. Unfortunately, this study was limited because of the use of a stationary treadmill that did not accurately simulate the lunar environment (i.e. landscape and terrain). To date this overall lack of physiologic data collected during true lunar activities or their accurate simulation has limited the ability of NASA physicians and scientists to predict if an astronaut candidate is physically capable of completing the multiple lunar activities that may be required during long-duration missions. Therefore, the goals of this proposal are to 1) develop a mobile testbed to accurately simulate partial-gravity lunar activities, and 2) determine subject performance and the concomitant physiological responses to these activities, which will allow us to 3) create a series of standardized tests that can be performed in a pre-flight setting to determine the readiness of the astronaut to perform physically demanding activities during a lunar mission.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The results of these studies will help identify which key components of physical fitness are required to perform different physical tasks. These results will, therefore, be applicable in a wide variety of settings, from rehabilitation to athlete evaluation, to determining the relative preparedness of astronauts for in-flight and destination EVAs. These insights will be especially important when astronauts return to a gravitational environment, either on Earth or at their destination. These results will provide target information regarding minimum required strength and endurance from which in-flight and destination exercise countermeasures can be based. The strategy employed here can also function as a template for approaching the establishment of field tests for other occupations in which there is a demand for minimal physical performance, such as what has been done for firefighters and police officers.
Task Progress:	To date, 45 subjects (28 males) have completed the entire protocol for Phase 1.1 (including all laboratory and field tests). An additional 10 subjects will complete all testing by the end of May. We have recruited subjects with an intentionally wide range of fitness levels. The purpose of this wide range of fitness levels is to improve our ability to predict relative success in the lunar field tests from one or more fitness characteristics. Simple regression analysis of the results to date has produced some exciting insights. There was a modest correlation ($r = -0.71$) between 10 km walk-back time and VO2max, but the correlation with gas exchange (or ventilatory) threshold (GET) was weaker ($r = -0.43$). In contrast, there were highly significant relationships between both 10 km time ($r = 0.90$, $p<0.0005$) and average pace ($r = 0.91$, $p<0.001$) with critical speed or velocity. The total time to perform the material transport test was inversely, significantly correlated with upper body critical power ($r = -0.71$) and gas exchange threshold ($r = -0.65$). With 45 subjects we have been able to begin more sophisticated analyses using multiple regression and CART approaches. Even with these approaches, the most influential predictor of field test performance are critical speed and critical power. Significant progress has been made identifying wireless biosensors (EMG, respiration, accelerometer, etc.). We have begun collecting preliminary data from these sensors while subjects are performing the field tests. The goal of this work is to characterize the cardiorespiratory and metabolic responses to the field tests, and to identify how these signals change as the subject fatigues. In addition, we have made significant progress with the suspension system which will eventually permit the creation of a microgravity setting for the subjects while they perform certain of the field test tasks.
Bibliography Type:	Description: (Last Updated: 01/23/2020)
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Abstracts for Journals and Proceedings	Ade CJ, Broxterman RM, Gadbury GL, Schinstock D, Warren S, Barstow TJ. "Physiological responses during simulated planetary field test." American College of Sports Medicine 59th Annual Meeting, San Francisco, CA, May 29-June 2, 2012. Medicine and Science in Sports and Exercise, 2012 May;44(5 Suppl). , May-2012
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