Pergram/Discipline- Ement/Subdiscipline: HUMAN RESEARCHBiomedical countermeasures Joint Agency Name: rechPort: Yes Human Research Program Ellemett (1) HHC-Human Health Countermeasures Illeman Research Program Risks: (1) Aerobje-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 Special Category: None Space Biology Special Category: None Space Biology Special Category: None P1 Email: demotoric/Risk at edu P1 Granization Type: UNIVERSITY P1 Organization Name: Kansas State University P1 Address 1: Department of Kinesiology P1 Address 2: IA Natatorium, 920 Denison Ave. P1 Web Page: I City: Manhatan State: KS Soleitation / Funding Source: State Biologidates: Soleitation / Funding Source: Sole PhD Candidates: Sole Project Type: GROUND Sole/tation / Funding Source: Sole PhD Candidates: Sole Sole Sole Phat Deardidates: </th <th></th> <th></th> <th></th> <th></th>				
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Discipline:NoteSpace Biology Special Category:NonePI Email:thorshof/k-state.eduFax: FYPI Organization Type:UNIVERSITYPhone: 785-532-0712Organization Name:Kasses State UniversityPhone: 785-532-0712PI Address 12:Department of KinesiologyFax: FYPI Address 22:LA Natatorium, 920 Denison Ave.Fax: FSPI Web Page:State: KSCity:ManhattanState: KSZip Code:GROUNDCongressional District: IComments:GROUNDSolicitation / Funding Source: 2009 Crew Health NNJ092SA002NNo. of Phot Degrees:GROUNDSolicitation / Funding Source: 3No. of Phot Degrees:Solicitation / Funding Source: 5No. of Phot Candidates:2No. of Master' Degrees: 3No. of Bachelor's Candidates:4Monitoring Center: NASA JSCContact Homitor:Loereh, LindaContact Phone:Contact Fundi:Image: Solicitation / Funding Source: 5No. of Bachelor's Candidates:4Monitoring Center: NASA JSCContact Fundi:Image: Solicitation / Solic	Space Biology Element:	None		
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P1 Address 1: Department of Kinesiology P1 Address 2: IA Natatorium, 920 Denison Ave. P1 Web Page:	PI Organization Type:	UNIVERSITY	Phone:	785-532-0712
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Contact Monitor:Loerch, LindaContact Phone:Contact Email:inda.loerch-1@nasa.govFlight Program:NOTE: Extended to 6/30/2015 per PI and NSSC information; previously was 9/2/2014 (Ed., 5/19/14) NOTE: New end date is 9/2/2014 per NSSC information (Ed., 5/9/2013)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.:NNX10AK60GPerformance Goal No.:Varren (Varren (Varren Varren	No. of Master's Candidates:	3	No. of Bachelor's Degrees:	5
Contact Email:linda.loerch-1@nasa.govFlight Program:NOTE: Extended to 6/30/2015 per PI and NSSC information; previously was 9/2/2014 (Ed., 5/19/14) NOTE: New end date is 9/2/2014 per NSSC information (Ed., 5/9/2013)Flight Assignment: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.:NNX10AK60GPerformance Goal No.:	No. of Bachelor's Candidates:	4	Monitoring Center:	NASA JSC
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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	1:
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:	Phase I has been completed, with a total of 72 subjects (32 females) completing the entire protocol for Phase 1.1 (including all laboratory and field tests). 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. Analysis of the complete data set confirms previous conclusions based on a smaller sample size. Simple regression analysis revealed a modest correlation ($r = 0.64$) between average speed during the 10 km walk-back time and treadmill VO2max, but the correlation with gas exchange (or ventilatory) threshold (GET) was weaker ($r = 0.48$). In contrast, there was a highly significant relationship between 10 km average speed and critical speed ($r = 0.84$, p<0.0005). When examined by gender, women had a significantly lower relative VO2max (44.7 ± 6.8 vs. 50.4 ± 7.5 ml/kg/min), relative arm VO2peak (24.2 ± 5.7 vs. 27.8 ± 5.0 ml/kg/min), relative arm GET (12.3 ± 1.9 vs. 14.5 ± 2.8), CS (11.2 ± 2.0 vs. 12.5 ± 2.5 km/hr), CP (44.3 ± 13.7 vs. 73.3 ± 16.2 Wats). However, there was no significant difference for treadmill relative GET (27.7 ± 3.3 vs. 29.1 ± 5.0 ml/kg/min), arm GET (52.0 ± 1.0 vs. 52.0 ± 1.0 %VO2peak), CS (81.2 ± 1.0 vs. 79.3 ± 1.0 %Speak), CP (61.8 ± 1.0 vs. 66.8 ± 1.0 %Ppeak) 10-km Walkback time (66.0 ± 14.3 vs. 58.9 ± 12.7 min), and 10-km Walkback velocity (84.8 ± 1.0 vs. 66.8 ± 1.0 %CS). Importantly, simulated EVA performance was best predicted by the same laboratory assessment tests for both women and mem. With 72 subjects we have begun more sophisticated analyses using multiple regression and CART approaches. These approaches continue to reinforce that the most influential predictors of field test performance are critical speed and critical power, as previously found with a subset of subjects. We have begun collecting preliminary data from wireless biosensors
Bibliography Type:	Description: (Last Updated: 01/23/2020)
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