Fiscal Year:	FY 2023	**Task Last Updated:**	FY 02/07/2023
PI Name:	Norcross, Jason M.S.		
Project Title:	Validation of Fitness for Duty Standards Using Pre- and Post-Flight Capsule Egress and Suited Functional Performance Tasks in Simulated Reduced Gravity		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **EVA**:Risk of Mission Impacting Injury and Compromised Performance and Long-Term Health Effects due to EVA Operations (2) **Sensorimotor**:Risk of Altered Sensorimotor/Vestibular Function Impacting Critical Mission Tasks		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	NASA CENTER	**Phone:**	281-483-7114
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Zip Code:	77058-3711	**Congressional District:**	36
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	01/30/2019	**End Date:**	12/01/2027
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Brocato, Becky	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 12/1/2027 per HHC element/JSC (Ed., 12/14/20)		
Key Personnel Changes/Previous PI:	Several changes in personnel have been made since the inception of this project, including the departure of several Co-Investigators. Dr. Millard Reschke retired. Dr. Marissa Rosenberg left KBR for another position. Dr. Jeffrey Ryder has changed roles within KBR and is no longer supporting this project. In place of Drs. Reschke and Rosenberg, we added Dr. Brian Peters from the NASA Johnson Space Center (JSC) Neurosciences Laboratory as a subject matter expert in Neuroscience; and in place of Dr. Rosenberg's deputy PI and study coordinator role, Dr. Taylor Schlotman of the JSC H-3PO Laboratory has been added. Dr. Ryder's role was taken over by Dr. Eric Rivas of H-3PO, who has since also left KBR for another position and his role will likely transition to Dr. Nicole Strock as she has taken over PI responsibilities for the Space Phys study. Dr. Lauren Cox has been added as part of the research and data test team.		

COI Name (Institution):	Abercromby, Andrew Ph.D. (NASA Johnson Space Center) Young, Millennia Ph.D. (NASA Johnson Space Center) Schlotman, Taylor (KBR) Peters, Brian (KBR) Cox, Lauren (JES Tech) Rivas, Eric (KBR)
Grant/Contract No.:	Internal Project
Performance Goal No.:	
Performance Goal Text:	
Task Description:	Rigorous adherence to available inflight countermeasures has effectively mitigated losses or maintained muscle strength and aerobic capacity in some returning long-duration International Space Station (ISS) crewmembers; however, all astronauts demonstrate significant decrements in functional performance upon return to a gravity environment. These losses in functional performance can be largely attributed to neurovestibular / sensorimotor deficits that can take days or weeks from which to recover and for which there is no current operational countermeasure. Although these losses are tolerable for current land-based returns to Earth, where ground personnel can quickly support the crew at the landing site, this will not be the case for future off-nominal water-based Orion landings or for nominal Mars surface landings, both of which will require crewmembers to be capable of egressing their landing vehicle unassisted. Quantification of astronauts' post-landing functional capacity including ability to perform an unassisted capsule egress and critical planetary extravehicular activity (EVA) tasks is necessary to design concepts of operation for Moon and Mars exploration mission systems and ultimately to promote exploration mission success. These results can then be reviewed in combination with other pre-flight, in-flight, and post-landing measures and determinants of health and performance (e.g., sleep, nutrition, exercise) to help develop and select necessary countermeasures capable of protecting all crewmembers or to identify characteristics (both behavioral and inherent) that might allow for selection of crew dependent on mission objectives. Data collected in this proposal will provide unique data on unassisted capsule egress while wearing an unpressurized launch, entry, abort (LEA) suit in Earth's gravity and on EVA-relevant functional task performance by testing astronauts shortly after return to Earth while suited and pressurized in a simulated reduced gravity analog. The research product will be a temporal profile of unassisted capsule egress and planetary EVA task performance pre-flight and at multiple post-landing intervals, the timing of which will be determined based on post-landing logistics and coordination with other investigations. Data will be collected for spaceflight missions ranging from 2 months, 6 months, and up to 1 year in duration. Results of the proposed study will be used in combination with subsequent definition and design of exploration mission systems and operations concepts to define data-based Fitness for Duty standards.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The core focus of this study is to facilitate safe exploration of Mars and return back to Earth, which albeit has limited direct impact to the people on Earth, but to the extent that space exploration is for the good of all humanity, this study will facilitate more successful missions to Mars.
Task Progress:	Institutional Review Board (IRB) Approval has been completed and maintained for the pilot study (JSC eIRB STUDY00000242) and Complement of Integrated Protocols for Human Research (CIPHER) Egress Fitness (JSC eIRB STUDY00000169) and test readiness review (TRR) documentation has been completed and maintained for both studies. Pilot Egress Fitness has enrolled 8 total subjects (4 complete, 2 dropped, 2 in progress). Hardware development for the capsule egress task is on the new revision, with general design approved and further modifications only for reduction of mass and volume to allow for much easier deployment when traveling to different landing sites. Hardware development and task instructions have been finalized for all tasks incorporating lessons learned and feedback from the crew and test subjects in other related studies. With the start of CIPHER, we have added the Exploration Extravehicular Mobility Unit (xEMU) extravehicular activity (EVA) suit for use in our small to medium-sized crew, but still rely on the MKIII for larger crews. Working with teammates from the Anthropometry and Biomechanics Facility (ABF), we have determined the final gimbal settings and necessary added mass to simulate the weight of the portable life support system (PLSS). Final gimbal settings determine where the gimbal axis of rotation aligns with the suited subject’s overall system center of gravity. Data collected for both tasks include task completion time, photo, and video. The EVA portion also includes a collection of metabolic and heart rate. Pilot Egress Fitness study has completed both baseline and post-flight testing on four astronaut subjects, with all four able to complete post-flight EVA testing and three able to complete post-flight capsule egress testing. Preliminary results observe individual physiological variations, which were to be expected but also suggest the need to carefully track the timeline from undocking to landing to testing. Furthermore, some task performance instructions and equipment needed to be adjusted to ensure results were primarily physiological. The following results are applicable to the Pilot Phase of this study only. Capsule egress times increased from post-flight to pre-flight for all subjects who completed post-flight testing, with the larger increase coming during the capsule egress portion. There is also very wide variability in task duration for the 3 subjects who completed testing. Planetary EVA testing was completed for all 4 subjects. All subjects were able to complete all tasks. Spotters were eager to help during the very first post-flight session and although we do not think it affected the data, we have changed instructions to the crew subjects and spotters that they are not to help unless the crew specifically asks or if the crew is at risk of falling. For tasks with very clear instructions and completion criteria, the trend is that tasks typically take longer to complete, but that the crew can and will perform near the same average metabolic rate. For some tasks, namely the umbilical task board, some subjects had trouble with clearance and positions and the original task instructions included operational relevance that contributed to task duration diversity. The task instruction has been simplified and clearances for suited helmets and hands have been provided in hopes of reducing the variability surrounding the task duration and metabolic rate.

Bibliography Type:	Description: (Last Updated: 02/12/2025)