

Fiscal Year:	FY 2023	Task Last Updated:	FY 03/01/2023
PI Name:	Galazka, Jonathan Ph.D.		
Project Title:	Responses of Microbes and Microbial Communities to Prolonged Exposure to Space Radiation		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline-- Element/Subdiscipline:			
Joint Agency Name:		TechPort:	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Microbiology		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	jonathan.m.galazka@nasa.gov	Fax:	FY
PI Organization Type:	NASA CENTER	Phone:	605-604-3950
Organization Name:	NASA Ames Research Center		
PI Address 1:	Space Biosciences Research Division		
PI Address 2:	Bldg. N239, Rm. 265, MS239-11		
PI Web Page:			
City:	Moffett Field	State:	CA
Zip Code:	94035	Congressional District:	18
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2020 Space Biology NNH20ZDA001N-SB E.12. Flight/Ground Research
Start Date:	03/01/2022	End Date:	03/01/2024
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA ARC
Contact Monitor:	Griko, Yuri	Contact Phone:	650-604-0519
Contact Email:	Yuri.V.Griko@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date has changed to 03/01/2024 per F. Hernandez/ARC (Ed., 3/30/23)		
Key Personnel Changes/Previous PI:	No changes.		
COI Name (Institution):	Barrick, Jeffrey Ph.D. (University of Texas, Austin)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	<p>The built environment of spaceships is host to a microbial community that affects crew and craft alike. While the static composition of this community has been characterized, and its temporal dynamics examined, the mechanisms controlling its make-up and evolutionary trajectory are not understood. Systematic analyses of microbial diversity such as the "Earth Microbiome Project" and the "Human Microbiome Project" have shown consistent patterns in community composition and function. Understanding the ecological origins of these patterns remains a major challenge, as it requires connecting processes that occur at varying temporal and spatial scales. However, it is clear that the state and trajectories of microbial communities are in-part determined by their physical environments. In this regard, the spaceflight environment includes numerous interacting factors that differentiates it from Earth environments, including an altered atmospheric composition, reduced gravity (and thus altered fluid dynamics), and increased ionizing radiation. These factors impart selective pressures on microbial communities that effect their evolutionary trajectories and thus, the risks and benefits these communities represent to crew and craft. The radiation environment of space leads to chronic exposure to low doses (<0.1 Gy/hr) and is difficult to mimic on Earth. Thus, little is known about how microbial communities in spacecraft will respond and evolve. Therefore, given the limitations of existing studies, we propose to empirically determine how exposure to low doses of ionizing radiation for thousands of cell divisions affects rates of mutation accumulation in microbes and the trajectory of microbial evolution. In this way, we will provide a critical set of data for the design of safe and robust space missions.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>Our research on the impacts of chronic low dose rate irradiation on microbial mutation rates and evolution will impact our understanding of how terrestrial microbes respond to analogous environments. This includes naturally occurring environments and those impacted by human activities. Moreover, our research will help understand how human associated microbes and microbiomes respond to radiotherapies.</p>
Task Progress:	<p>Our objectives are to empirically determine how chronic exposure to low doses of ionizing radiation for thousands of cell divisions affects rates of mutation accumulation in microbes and the trajectory of microbial evolution. In this way, we will provide a critical set of data for the design of safe and robust space missions. Key accomplishments to date include the design and construction of the leaded acrylic box for containment of 57Co plates for long-term exposure experiments; the procurement of incubators for long-term exposure experiments; and the development of culturing protocols. Overall, progress has been limited by delays in procurement of leaded acrylic and construction of the leaded acrylic containment box. Now that the leaded acrylic boxes are in place, long-term exposure experiments can begin to measure both mutation accumulation rates and long-term adaptation.</p>
Bibliography Type:	Description: (Last Updated:)