Fiscal Year:	FY 2022	**Task Last Updated:**	FY 06/22/2022
PI Name:	Lee, Jessica Ph.D.		
Project Title:	Microbial Eco-evolutionary Dynamics in Simulated Microgravity and Space Radiation		
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Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
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Human Research Program Risks:	None		
Space Biology Element:	(1) Cell & Molecular Biology (2) Microbiology		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
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Flight Program:			
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COI Name (Institution):	Broddrick, Jared Ph.D. (NASA Ames Research Center)		
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	We propose a hypothesis-driven study to investigate the effect of simulated microgravity and galactic cosmic ray (GCR) radiation on microbial communities. A dominant hypothesis for the mechanism of the microgravity effect in fluid is that the lack of density-driven convection makes mixing and diffusion limited, and therefore slower. This affects both the physiology of individual microbes and the dynamics of communities, as many interspecies interactions involve the exchange of soluble metabolites (cross-feeding). Ground-based research has shown that environments with poor mixing have localized interactions, leading to slower growth in microbial cross-feeding communities, but also greater stability of cooperative relationships. And while little is known about the effect of GCR on actively metabolizing microorganisms, work on stressors in microbial communities frequently support a "weakest link" hypothesis: in a community where organisms are mutually interdependent, direct damage to one organism indirectly affects its dependent partner. In the		

Task Description:	face of stress, therefore, the growth of the entire community is reduced in a manner predictable by the resistance of the weaker partner. We will test hypotheses based on these observations using a well-characterized model microbial cross-feeding community, in which members are mutually dependent on exchanged growth substrates. The relationship between metabolite mass transfer and community growth has been quantitatively predicted using genome-scale metabolic modeling in diverse environments. We will culture the community in simulated microgravity in Rotating Wall Vessels (RWVs), where the degree of mixing, and thus the fidelity of the microgravity simulation, can be adjusted by adjusting rotation rate; GCR simulation will be carried out at the NASA Space Radiation Laboratory. Growth assays will be paired with metabolic modeling, as well as RNA sequencing for gene expression analysis. We propose the following hypotheses: Hypothesis 1) On short (ecological) timescales, metabolic exchange between cells is reduced in simulated microgravity relative to a well-mixed environment, slowing the growth of a cross-feeding community. Hypothesis 2) On longer (evolutionary) timescales, simulated microgravity creates a spatially-structured environment in which a cooperating strain of Salmonella enterica (S. enterica) is favored, whereas well-mixed environments favor the non-cooperating strain. Hypothesis 3) Exposure to simulated GCR causes cell damage or stress, and the effect on the community is greater if cells are metabolically interdependent. This is exacerbated in simulated microgravity. Results of this study will further our understanding of how microorganisms in communities experience deep-space radiation and the microgravity fluid environment.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2022.
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