Fiscal Year:	FY 2022	**Task Last Updated:**	FY 01/19/2022
PI Name:	Settles, Andrew Ph.D.		
Project Title:	Feasibility of Synthetic Biology Countermeasures for Human Exploration Beyond Low Earth Orbit		
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:	andrew.m.settles@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	352-283-2767
Organization Name:	NASA Ames Research Center		
PI Address 1:	AST Life Support Studies		
PI Address 2:			
PI Web Page:			
City:	Moffett Field	**State:**	CA
Zip Code:	94035-1000	**Congressional District:**	18
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2021 Space Biology NNH21ZDA001N-LEIA E.10. Lunar Explorer Instrument for Space Biology Applications
Start Date:	12/01/2021	**End Date:**	11/30/2023
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 ARC
Contact Monitor:	Loftus, David	**Contact Phone:**	650-604-1011
Contact Email:	david.j.loftus@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: Project dates (POP) changed; now 12/1/2021-11/30/2023 per F. Hernandez/ARC (Ed., 1/19/22)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Hindupur, Aditya Ph.D. (KBR/NASA Ames Research Center)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Microbial production of bioactive compounds, such as vitamins or pharmaceuticals, can reduce risks for deep-space crewed missions. Yeast are excellent chassis organisms to express countermeasure products due to their long shelf-life viability. Yeast have robust synthetic biology technology to transfer whole biosynthesis pathways for synthesis of desired products. NASA has invested in yeast production of micronutrients that are known to have a short shelf-life in prepackaged foods, with demonstrated success on the International Space Station. However, low-Earth orbit does not test yeast for resistance to higher radiation levels and the more extreme environment of deep space. The goal of this proposal is to develop methods to preserve, grow, and measure production of desired synthetic biology products from edible yeast, using the BioSensor platform. BioSensor automates yeast culture activation and monitors growth with light absorbance of specific wavelengths produced by light emitting diodes (LED). The project goal is to expand the capability of BioSensor to enable monitoring synthetic biology traits along with cell growth and metabolism. The central objectives are: 1) Develop methods to predict synthetic biology production traits, namely carotenoids and recombinant proteins, using multivariate statistical models based on three wavelength light absorbance. We anticipate that the BioSensor platform will need to be modified to replace one of the current wavelengths to a blue LED; 2) Yeast may be overly sensitive to deep space radiation, and we will engineer carotenoid producing strains to express a DNA damage protection protein from tardigrades; 3) Non-conventional, yeast species may be more efficient for recombinant protein expression in deep space conditions. We will engineer three edible species to produce a target protein that absorbs blue light, to enable monitoring of recombinant protein and carotenoids in the same BioSensor device; and 4) Determine strain and media storage conditions as well as test the multiwavelength light monitoring strategy to establish the requirements and methodology for a future lunar surface mission. The project is expected to advance the remote sensing technology in the BioSensor platform. A future flight experiment is expected to develop fundamental knowledge on the effects of deep space on protein expression and metabolite production. In addition, the project directly addresses critical gaps to advance crewed missions in deep space exploration. The specific carotenoids, beta-carotene and zeaxanthin, are important micronutrients to prevent macular degeneration and have been identified as potential countermeasures to maintain vision in astronauts during deep space missions. Recombinant protein expression in non-conventional yeast will demonstrate feasibility for production of bioactive protein therapies in deep space missions. These synthetic biology approaches are critical to provide products that are sensitive to radiation and have short shelf lives in prepackaged foods and medicines.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2022.
Bibliography Type:	Description: (Last Updated:)