| Fiscal Year:                                 | FY 2022  | Task Last Updated:                  | FY 03/24/2022  |
|--|--|-------------------------------------|--|
| PI Name:                                     | Vanapalli, Siva  | ·                                   |  |
| Project Title:                               | Impact of the Gut Microbiome on the Integrative Physiology of Genetically Diverse Invertebrates  |                                     |  |
|  |  |                                     |  |
| Division Name:                               | Space Biology  |                                     |  |
| Program/Discipline:                          |  |                                     |  |
| Program/Discipline<br>Element/Subdiscipline: |  |                                     |  |
| Joint Agency Name:                           |  | TechPort:                           | No   |
| Human Research Program Elements:             | None   |                                     |  |
| Human Research Program Risks:                | None   |                                     |  |
| Space Biology Element:                       | <ol> <li>(1) Microbiology</li> <li>(2) Animal Biology: Invertebrate</li> </ol>   |                                     |  |
| Space Biology Cross-Element<br>Discipline:   | None   |                                     |  |
| Space Biology Special Category:              | None   |                                     |  |
| PI Email:                                    | siva.vanapalli@ttu.edu   | Fax:                                | FY   |
| PI Organization Type:                        | UNIVERSITY   | Phone:                              | 806-742-1757   |
| Organization Name:                           | Texas Tech University  |                                     |  |
| PI Address 1:                                | Chemical Engineering   |                                     |  |
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| PI Web Page:                                 |  |                                     |  |
| City:  | Lubbock  | State:                              | TX   |
| Zip Code:                                    | 79409-0001   | <b>Congressional District:</b>      | 19   |
| Comments:                                    |  |                                     |  |
| Project Type:                                | Flight,Ground  | Solicitation / Funding<br>Source:   | 2020 Space Biology NNH20ZDA001N-SB<br>E.12. Flight/Ground Research |
| Start Date:                                  | 03/01/2022   | End Date:                           | 02/28/2025   |
| 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:                             |  | <b>Contact Phone:</b>               |  |
| Contact Email:                               |  |                                     |  |
| Flight Program:                              |  |                                     |  |
| Flight Assignment:                           | NOTE: End date changed to 02/28/2025 per H 12/1/2021 - 11/30/24, but not finalized as suc  | F. Hernandez/ARC (Ed., 4/25/2<br>h. | 2). Original POP was anticipated to be                             |
| Key Personnel Changes/Previous PI:           |  |                                     |  |
| COI Name (Institution):                      | Driscoll, Monica Ph.D. (Rutgers University, New Brunswick)<br>Samuel, Buck S. Ph.D. (Baylor College of Medicine, Inc)<br>Szewczyk, Nathaniel Ph.D. (Ohio University) |                                     |  |
| Grant/Contract No.:                          | 80NSSC22K0250  |                                     |  |
| Performance Goal No.:                        |  |                                     |  |
| Performance Goal Text:                       |  |                                     |  |

|  | The gut microbiome is a complex community of microbes that exert considerable influence over host physiology, development, metabolism, and predisposition to the disease on Earth. Recent spaceflight investigations in both humans and rodents show that the microbiome community structure is altered under microgravity, posing risk factors for crew health. Thus, understanding the impact of the gut microbiome on long-term physiological changes will be crucial for long-duration space missions to Mars and beyond. The current project is centered around addressing two major knowledge gaps in space biology research. First, fundamental understanding is lacking as to how differences in microbiomes contribute to changes in gut colonization, organ-level physiology, and whole-organism function under microgravity. Second, even though it is recognized on Earth that individual genetic variation can have a large impact when organisms within a species are exposed to new environmental conditions, very little knowledge exists on how genetic diversity within individual species impacts the integrative physiology of organisms when exposed to microgravity since most flight studies to date have focused on genetically homogenous rodent models or cell cultures. |
|--|--|
| Task Description:                      | To address these knowledge gaps, we plan to use C. elegans, which is an established and low-cost invertebrate model for space-biology, microbiome studies, and genetic diversity research. We plan to use recently established gut microbial communities to investigate the impact of the gut microbiome on host physiology. In a parallel advance, using genetically diverse wild isolates of C. elegans, we will study host-microbome interactions in spaceflight.   |
|  | Our project plan involves testing the following hypotheses in International Space Station (ISS) flight studies with ground study components: (i) Microbial membership of C. elegans gut influences host transcriptional response, tissue-level physiology, and whole-organism function, (ii) Genetic diversity of host influences gut membership of individual microbes, tissue-level physiology, and whole-organism function, and (iii) Insulin signaling pathway play a central role in driving microbiome-induced host response in spaceflight.   |
|  | The proposed studies are aligned with the stated strategic goals of NASA Space Biology, which defines over-arching guiding questions focused on integrated biological approaches to understand physiological and molecular mechanisms in living systems that respond to space exploration environments. Pre-biotic and probiotic therapies could be potentially realized from our investigations to improve crew health, along with the dissemination of new flight-tested protocols and molecular characterization tools for the spaceflight community.   |
| Rationale for HRP Directed Research:   |  |
| <b>Research Impact/Earth Benefits:</b> |  |
| Task Progress:                         | New project for FY2022.  |
| Bibliography Type:                     | Description: (Last Updated: 10/09/2024)  |