Task Book Report Generated on: 04/25/2024

Fiscal Year: PY 2018 Task Last Updated: FY 07/11/2018 PI Name: Mancinelli, Rocco Ph.D.  Project Title: MitOrILMS: Testing the Efficacy of Biofilm Formation by Antimicrobial Metal Surfaces under Spaceflight Condition An Effective Stuniegy to Prevent Microbial Biofilm Formation  Program/Discipline:  Rement'Shodbiscipline:  Space Biology  (1) Call & Molecular Biology (2) Microbiology (3) Microbiology (3) Microbiology (4) Microbiology (5) Microbiology (6) Transhitional (Countempouncy Potential (6) Biosegnetative Life Support  PI Famili:  Programization Type:  (1) Call Calune (3) Transhitional (Countempouncy Potential (6) Biosegnetative Life Support  PI Corganization Nume:  Programization Type:  NON-PROFIT  Phone: (650) 604-6165  Organization Nume:  Pasa Environmental Research (BAER) Institute  Project Type:  PI Address 1:  Project Type:  PI Address 1:  Project Type:  PI CollTI,GROUND  Solicitation / Funding Source:  Opportunition of Syspec Life Sciences (non-US proposes)  Start Date:  No. of Past Desc:  No. of Past Desc:  No. of Past Desc:  No. of Past Degree:  No. of Bachelor's Candidates:  No. of Bachelor's				
Project Title:  BIOTLMS: Testing the Liftnessy of Biofilm Formation by Antimicrobial Metal Surfaces under Spaceflight Condition An Effective Strategy to Prevent Microbial Biofilm Formation  Division Name:  Program/Discipline:  Program/Discipline- Element/Suddiscipline:  Joint Agency Name:  None  Human Research Program Elements:  None  Human Research Program Elements:  (1) Cell & Molecular Biology (2) Microbiology  Space Biology Special Category:  (1) Reproductive Biology (2) Microbiology  Space Biology Special Category:  (2) Translational (Countemeasure) Potential (3) Bioregenerative Life Support  PI Corganization Type:  Non-PROFIT  Phone: (650) 604-6165  Organization Type:  Non-PROFIT  Phone: (650) 604-6165  Organization Name:  Bay Area Environmental Research (BAER) Institute  PI Address 1:  Mail Stop 239-4, NASA Arms Research Center  PI Web Page:  City:  Moffett Field  Sutte: CA  Comments:  City:  Moffett Field  Sutte: CA  Comments:  Project Type:  FLIGHT,GROUND  Solicitation / Funding Source:  Organization / Funding Source:  Project Type:  No. of Pab Decres:  No. of Bachelor's Degrees:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Degrees:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidat	Fiscal Year:	FY 2018	Task Last Updated:	FY 07/11/2018
Division Name: Space Biology Program/Discipline- Element/Subdiscipline- Element/Subdiscipline-Element/Element-Element/Subdiscipline-Element/Element-Element-Elem	PI Name:	Mancinelli, Rocco Ph.D.		
Program/Discipline: Program/Discipline- Element/Subdiscipline- Element/Subdiscipline- Element/Subdiscipline- Element/Subdiscipline- Human Research Program Elements: None Human Research Program Risks: None Human Research Program Research Risk Plane Human Research (RART) Institution Research Risk Plane Human Research (RART) Instit	Project Title:	BIOFILMS: Testing the Efficacy of Biofilm Form An Effective Strategy to Prevent Microbial Biofilm	nation by Antimicrobial Metal Surfa m Formation	ces under Spaceflight Conditions -
Program/Discipline-  Element/Subdiscipline-  Subdiscipline-	Division Name:	Space Biology		
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Human Research Program Elements None  Human Research Program Risks: None  Space Biology Element: (2) Microbiology  Space Biology Cross-Element (2) (1) Cell Colle Molecular Biology (2) Microbiology  Space Biology Cross-Element (2) (1) Cell Colluture  Space Biology Special Category: (2) Cirranslational (Countermeasure) Potential (3) Bioregenerative Life Support  PI Email: manicullificateriory: phone: (650) 604-6165  Organization Type: NON-PROFIT Phone: (650) 604-6165  Organization Name: Bay Area Environmental Research (BAER) Institute  PI Address I: Plandis State: CA  Organization Name: Moffent Field State: Virolate				
Human Research Program Risks: None   Space Biology Element: (1) Cell & Molecular Biology (2) Microbiology (2) Microbiology (2) Microbiology (3)   Space Biology Cross-Element (3) Reproductive Biology (3)   Space Biology Special Category: (3) Tanadational (Countermeasure) Potential (3) Bioregenerative Life Support (2) Translational (Countermeasure) Potential (3) Bioregenerative Life Support (4) Translational (4) Bioregenerative Life Support (4) Translational (4) Bioregenerative Life Support (4) Bioregenerati	Joint Agency Name:		TechPort:	No
Space Biology Element:  (1) Cell & Molecular Biology (2) Microbiology  Space Biology Cross-Element Discipline:  (1) Reproductive Biology  (2) Translational (Countermeasure) Potential (3) Bioregenerative Life Support  PI Email:  manninallike baser ore PI Organization Type: NON-PROFIT NON-PROFIT Bay Area Environmental Research (BAER) Institute PI Address 1: Hail Stop 239-4, NASA Ames Research Center  PI Address 2: PI Web Page: City: Moffett Field State: CA Zip Code: 94035 Congressional District: 18  Comments:  Project Type: FLIGHT,GROUND Solicitation / Funding Source: O406/2018 Fand Date: No. of PhD Degrees: No. of PhD Degrees: No. of PhD Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Master's Candidates: No. of Master' Degrees: Flight Assignment:  Flight Assignment:  Recontact Email: Recontact Canter (DLR), Institute of Aerospace Medicine, Radiation Florogy Department. COI Name (Institution): Moller, Ralf PhD. (Principal Investigator-German Aerospace Center (DLR), Institute of Aerospace Medicine, Radiation Florogy Department. COI Name (Institution): Moller, Ralf PhD. (Principal Investigator-German Aerospace Center (DLR), Institute of Aerospace Medicine, Radiation Florogy Department. COI Name (Institution): Moller, Ralf PhD. (Principal Investigator-German Aerospace Center (DLR), Institute of Aerospace Medicine, Radiation Florogy Department.	<b>Human Research Program Elements:</b>	None		
Space Biology Cross-Element Discipline:  Space Biology Cross-Element Discipline:  (1) Cell Culture  Space Biology Special Category:  (2) Translational (Countermeasure) Potential (3) Bioregenerative Life Support  PI Email:  mancinellize/bueri.org  NoN-PROFIT  NON-PROFIT  NoN-PROFIT  Phone: (650) 604-6165  Organization Type:  NON-PROFIT  Bay Area Environmental Research (BAER) Institute  PI Address 1:  PI Address 2:  PI Web Page:  City:  Moffett Field  State: CA  Zip Code:  94035  Congressional District: 18  Comments:  Project Type:  FLIGHT.GROUND  Solicitation / Funding Source:  Opportunities for Space Life Sciences (non-US proposers)  Start Date:  04-06-2018  End Date: 04-05-2023  No. of PhD Candidates:  No. of Master's Candidates:  No. of Master's Candidates:  No. of Bachelor's Candidates:  No.	Human Research Program Risks:	None		
Discipline:    Discipline:   City Replacements Biology   Counter   City Replacements	Space Biology Element:			
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Pl Organization Name: Bay Area Environmental Research (BAER) Institute  Pl Address 1: Mail Stop 239-4, NASA Ames Research Center  Pl Address 2: Pl Web Page: City: Moffett Field State: CA  Zip Code: 94035 Congressional District: 18  Comments:  Project Type: FLIGHT,GROUND Solicitation / Funding Source: O4/06/2018 End Date: No. of PhD Dagrees: No. of PhD Dagrees: No. of PhD Candidates: No. of Master's Candidates: No. of Master's Candidates: No. of Master's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Master's Candidates: No	Space Biology Special Category:	(2) Translational (Countermeasure) Potential		
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PI Address 1: Mail Stop 239-4, NASA Ames Research Center  PI Address 2:  PI Web Page:  City: Moffett Field State: CA  Zip Code: 94035 Congressional District: 18  Comments:  Project Type: FLIGHT,GROUND Solicitation / Funding Source: Sciences (non-US proposers)  Start Date: 04/06/2018 End Date: 04/05/2023  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: No. of Bachelor's Center (DLR) ARC Contact Monitor: Sato, Kevin Contact Monitoring Center: NASA ARC Contact Monitor: Sato, Kevin Contact Phone: 650-604-1104  Contact Email: kevin.y.sato@nasa.gov  Flight Program:  Flight Assignment:  Rocco L. Mancinelli, Ph.D., is U.S. Co-Investigator on this German Aerospace Center (DLR), Institute of Aerospace Medicine, Radiation Biology Department.  COI Name (Institution): Möller, Ralf Ph.D. (Principal Investigator-German Aerospace Center (DLR e.V.))  Grant/Contract No.: 80NSSC18K0751	PI Organization Type:	NON-PROFIT	Phone:	(650) 604-6165
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Grant/Contract No.: 80NSSC18K0751	Key Personnel Changes/Previous PI:	Medicine project. Principal Investigator is Ralf M		
	COI Name (Institution):	Möller, Ralf Ph.D. ( Principal InvestigatorGerm	nan Aerospace Center (DLR e.V.) )	
	Grant/Contract No.:	80NSSC18K0751		
Performance Goal No.:	Performance Goal No.:			
Performance Goal Text:	Performance Goal Text:			

Task Book Report Generated on: 04/25/2024

Funding is for Dr. Rocco Mancinelli's role as U.S. Co-Investigator for this German Aerospace Center (DLR), Institute of Aerospace Medicine project, "BIOFILMS: Testing the Efficacy of Biofilm Formation by Antimicrobial Metal Surfaces under Spaceflight Conditions - An Effective Strategy to Prevent Microbial Biofilm Formation."

As Co-Investigator on the project, Dr. Mancinelli will provide his experience and expertise in microbiology and spaceflight to help design the flight experiment as well as the ground controls. He will also help trouble-shoot the system should it be necessary. He will play a major role in data interpretation, data analysis, and data management. He will help guide the ground control design and construction both on site (at the DLR) as well as remotely at NASA Ames. In addition, Mancinelli will take the lead in developing a conceptual model describing the effects of micro-gravity on the growth and development of biofilms as well as for the biofilms grown on metallic inhibitor surfaces.

To achieve many of the goals of NASA's and ESA's space programs requires an enduring human presence in space. Long term human missions require sustained crew health and safety. A research area that is important in sustaining crew health is the development of improved spaceflight-suitable methods for microbiological monitoring, as well as contamination control and reduction. The International Space Station (ISS) is a confined and isolated habitat in an extreme, hostile environment. The human and habitat microflora varies in response to changes in environmental conditions aboard the ISS. Changes in the microflora may result in an increased health risk for the crew. Microorganisms including microbial biofilms have been found on various habitat surfaces, inside the air and water handling systems as well as the hardware used on the ISS. Biofilms are known to cause damage to equipment from polymer deterioration, metal corrosion, and bio-fouling. The primary concern regarding crew health is characterized by activity of opportunistic pathogenic microorganisms that have been noted to accumulate in the closed environments of the ISS and other spacecraft on long-duration missions. Understanding the effects of the space environment, especially altered gravity, on microbial biofilms is crucial for the success of long-term human space missions. Surface-associated biofilm communities were abundant on the Mir space station and continue to be a challenge on the ISS. The health and safety hazards linked to the development of biofilms are of particular concern due to the suppression of human immune function observed during spaceflight. Various studies have shown that certain metals reduce the number of contact-mediated microbial infections. Antimicrobial surfaces are defined as materials that contain an antimicrobial agent (such as silver, copper, and their alloys) that inhibits or reduces the ability of microorganisms to grow on the surface of a material. Antimicrobial surfaces are functionalized in a variety of different processes. The introduction of antimicrobial surfaces for medical, pharmaceutical, and industrial purposes has shown their unique potential for reducing and preventing microbial contamination. The contact killing of several types of microorganisms by copper has been assessed in multiple laboratory in-vitro studies. For sustained crew health and safety additional studies on the mechanisms involved in the formation of microbial biofilms and their efficient destruction under spaceflight conditions, i.e., long-term growth and adaptation to low gravity environments, are needed.

The hypothesis to be tested by this project is that surfaces containing copper and/or silver will inhibit biofilm formation under altered gravity regimes to a lesser extent than in  $1 \times g$  due to the fact that the interaction with the metal ions on the surface is slower because their movement around the cell is restricted to diffusion. The objective is to determine the effect and the rate, if any, of copper and/or silver surfaces on microbial growth rate, total biomass accumulation, and biofilm formation. The goal is to develop a conceptual model describing the effect of micro-gravity on biofilm formation grown on non-inhibiting surfaces as well as on metal surfaces that are potential biofilm growth inhibitors.

The approach will be to test three different microbial model systems (i.e., Escherichia coli K12, a Staphylococcus sp. isolate from the ISS, and the heavy metal resistant strain Cupriavidus metallidurans CH34) for biofilm formation on various copper- and silver-surfaces, as well as inert surfaces as controls. These surfaces differ in their antimicrobial activity based on chemical composition and/or geometric nanostructures. These surfaces will be tested for biofilm formation rates under different spaceflight relevant gravitational regimes (e.g., Moon 0.16~x~g, Mars 0.38~x~g,  $\mu g$  ISS and 1~x~g control). Microbial growth will occur under optimal biofilm-inducing conditions conducted in the KUBIK incubator inside the European Drawer Rack under defined gravitational influences. Biofilm/metal surface samples and controls will be subjected to an intense analysis program, including various microbiological, genetic, molecular biological, chemical, material-science, and structural investigations. The data generated will be of immense importance for understanding the influence of  $\mu g$  and the ISS environment on biofilm formation as well as for the evaluation and production of improved antimicrobial additives, coating, components, surfaces and textiles for short- and long-term utilization for present and future astronaut-/robotic-associated activities in space exploration.

Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2018.
Bibliography Type:	Description: (Last Updated: 02/22/2023)

Task Description: