Fiscal Year:	FY 2007	**Task Last Updated:**	FY 04/21/2007
PI Name:	Pierson, Duane L Ph.D.		
Project Title:	A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft Environment		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Environmental health		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	(1) **Microhost**:Risk of Adverse Health Effects Due to Host-Microorganism Interactions		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	99-HEDS-03
Start Date:	07/01/2002	**End Date:**	09/30/2009
No. of Post Docs:	0	**No. of PhD Degrees:**	
No. of PhD Candidates:	0	**No. of Master' Degrees:**	
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
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Flight Program:	Shuttle/ISS		
Flight Assignment:	ISS STS-115, STS-116, STS-117. STS-118, STS-120, STS-121 NOTE: End date is now 9/30/2009 per CoI (4/08)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Cruz, Patricia (Harry Reid Center for Environmental Studies) Ott, C. Mark Mark (National Aeronautics and Space Administration-JSC)		
Grant/Contract No.:	None		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	This study of microorganisms, allergens, and microbial toxins in the spacecraft environment was initiated to ensure the health, safety, and performance of crewmembers during flight. As all previous methods evaluating spacecraft ecology utilized culture-based methodology, this study focuses on techniques that can identify most of the previously omitted microorganisms, such as the pathogen Legionella pneumophila, the etiological agent of Legionnaires' disease. Likewise, culturable bacteria and fungi have been the only potential allergens studied; the more potent allergens, such as dust mites, have never been analyzed in spacecraft environments. No previous study has targeted microbial toxins. This study utilizes modern molecular biology, advanced microscopy, and immunochemical techniques to examine air, surface, and water samples for bacteria and fungi (total composition and specific pathogens), allergens (e.g., dust mites), and microbial toxins (e.g., endotoxin and volatile organic compounds). This study of the International Space Station (ISS) will include (1) sampling and analysis of ISS modules immediately prior to launch to develop baseline levels of contamination, (2) direct on-orbit sampling of the ISS and subsequent ground analysis. This study will reveal previously undetected microorganisms, allergens, and microbial toxins in the spacecraft environment, which we anticipate will result in a more comprehensive health assessment of spacecraft during extended missions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The results of this study will provide insight into changes that occur in the microbial ecology of semi-closed systems. While this study is designed to predict trends in spacecraft, it can be applied to terrestrial systems such as office buildings and residential homes. The development of specific primers for bacterial enumeration and fungal identification during this study will also advance the ability of ground-based investigators to diagnose the potential sources of microbial contamination and give insight into the causes of "sick building syndrome."
Task Progress:	The development of techniques for this flight experiment, operationally named SWAB, has already provided advances in NASA laboratory processes and beneficial information toward human health risk assessment. The first accomplishment of the SWAB experiment was the incorporation of 16S ribosomal DNA sequencing for the identification of bacteria. The use of this molecular technique has increased bacterial speciation of environmental isolates from previous flights three fold compared to conventional methodology. This increased efficiency in bacterial speciation provides a better understanding of the microbial ecology and the potential risk to the crew. Additional SWAB studies focused on the use of molecular-based DNA fingerprinting using repetitive sequence-based polymerase chain reaction (rep-PCR). This technology has allowed contamination tracking of microorganisms between crewmembers and their environment. This study not only demonstrated that ISS has a greater diversity of organisms than originally expected, but also provided insight into possible routes of infection to the crew. Additional ground-based studies used rep-PCR and protein based assays to determine the potential of methicillin resistant Staphylococcus aureus (MRSA) aboard ISS. MRSA has become increasingly common on Earth and pose a treatment problem for infections during flight. While no MRSA have been isolated from ISS to date, the mecA gene product that is responsible for methicillin resistance was isolated in other Staphylococcus species aboard ISS suggesting a potential of MRSA through gene transfer. Early accomplishments from this grant included the development of flight hardware that could acquire samples and preserve them for later molecular analysis months later with no substantial loss of sample quality. Using these improved sample collection technologies, flight sampling for SWAB was initiated in August 2006 and will continue at least through fall of 2007. Mission samples which have already been collected include those from STS-121 and its logistic module, STS-115, STS-116 and its SpaceHab cargo, and 3 separate ISS in-flight sampling sessions. Future sample collection opportunities include STS-117, STS-118 and its SpaceHab cargo, STS-118, the Node 2 module preflight analysis, the Columbus module preflight analysis, and 5 separate ISS in-flight sampling sessions. The focus of these flight samples is the collection of DNA for evaluation by Denaturing Gradient Gel Electrophoresis (DGGE). Unlike other techniques, DGGE does not depend on any microbial growth on culture media allowing a more comprehensive assessment of the spacecraft interior. Preliminary results from the first few sample sessions confirmed the successful acquisition of microorganisms/DNA using the new air and surface sample collection techniques. Early processing results suggest the techniques will identify organisms that are not commonly identified using media based techniques. Water samples from ISS are yet to be collected as sampling agreements are still being negotiated. This study should provide insight into the true microbial ecology that is experienced by the crew during flight. This information will lead toward an accurate microbial risk assessment to help set flight requirements to protect the safety, health, and performance of the crew.
Bibliography Type:	Description: (Last Updated: 03/24/2020)