Fiscal Year:	FY 2009	**Task Last Updated:**	FY 12/28/2010
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:**	09/30/2011
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
Contact Monitor:	Woolford, Barbara	**Contact Phone:**	218-483-3701
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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 9/30/2011, per HRP information (Ed., 10/20/2011) 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 (National Aeronautics and Space Administration-JSC)		
Grant/Contract No.:	None		
Performance Goal No.:			
Performance Goal Text:			

	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).
Task Description:	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. See also http://www.nasa.gov/
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. Early accomplishments from this grant also 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 this hardware, sample collection for SWAB was initiated in August 2006. Air and surface samples, including 9 in-flight sessions and multiple preflight samples, were completed in March 2008. ISS water sample collection from the U. S. water regeneration system called the Water Process Assembly (WPA) began in August 2009 and was completed in March of 2010. Analyses of air and surface samples have already begun to provide new information. Early analyses 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. The first technique used to evaluate DNA from the flight samples was 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. The results indicate the presence of microorganisms not commonly isolated from surface and air samples using culture based techniques. Fortunately, none of the organisms isolated would be considered medically significant. More recent analyses focused on more sensitive, targeted analysis of the DNA for specific viruses including Varicella Zoster Virus (VZV), Cytomegalovirus (CMV), and Epstein Barr Virus (EBV). Real Time PCR assays detected the presence of the VZV and EBV DNA in a number of the surface and air samples, and investigators are continuing to analyze the data. An assay for PCR detection of MRSA developed using custom designed primers and probes is also currently being performed on all of the surface and air DNA samples. This study continues to 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)
Abstracts for Journals and Proceedings	Castro VA, Garcia VM, John BJ, Pierson DL, Ott CM. "Surface Water and Air Biocharacterization (SWAB) Flight Experiment." 6th International Space Life Sciences Working Group (ISLSWG) Workshop on Space Microbiology, Rohnert Park, CA, August 2009. 6th International Space Life Sciences Working Group (ISLSWG) Workshop on Space Microbiology, Rohnert Park, CA, August 2009. , Aug-2009