

Fiscal Year:	FY 2008	Task Last Updated:	FY 05/12/2008
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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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
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 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:			

<p>Task Description:</p>	<p>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 <i>Legionella pneumophila</i>, 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).</p> <p>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.</p> <p>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.</p> <p>See also http://www.nasa.gov/</p>
<p>Rationale for HRP Directed Research:</p>	
<p>Research Impact/Earth Benefits:</p>	<p>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."</p>
<p>Task Progress:</p>	<p>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) will begin in 2009.</p> <p>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 <i>Staphylococcus aureus</i> (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 <i>mecA</i> gene product that is responsible for methicillin resistance was isolated in other <i>Staphylococcus</i> species aboard ISS suggesting a potential of MRSA through gene transfer. 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. Future analyses will focus on more sensitive, targeted analysis of the DNA for specific pathogens. This study is providing 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.</p>
<p>Bibliography Type:</p>	<p>Description: (Last Updated: 03/24/2020)</p>
<p>Abstracts for Journals and Proceedings</p>	<p>Ott CM, Castro VA, Garcia VM, John J, Cruz P, Buttner MP, Pierson DL. "A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft Environment." NASA Human Research Program Investigators' Workshop, League City, TX, January 2008.</p> <p>Abstracts, NASA Human Research Program Investigators' Workshop, League City, TX, January 2008. , Jan-2008</p>
<p>Abstracts for Journals and Proceedings</p>	<p>Ott CM, John J, Castro VA, Cruz P, Buttner MP, Pierson DL. "A Comprehensive haracterization of Microorganisms and Allergens in Spacecraft Environment." NASA Human Research Program Investigators' Workshop, League City, TX, January 2007.</p> <p>Abstracts, NASA Human Research Program Investigators' Workshop, League City, TX, January 2007. , Jan-2007</p>
<p>Abstracts for Journals and Proceedings</p>	<p>Ott CM, John J, Castro VA, Cruz P, Buttner MP, Pierson DL. "Characterization of Microorganisms in Spacecraft Environments." 26th International Space Development Conference, Addison, Texas, May 25-28, 2007.</p> <p>Program and Abstracts, 26th International Space Development Conference, Addison, Texas, May 25-28, 2007. , May-2007</p>

Abstracts for Journals and Proceedings	Cruz P, Stetzenbach LD, Klima-Comba AK, Stevens VL, Castro VA, Ott CM, Pierson DL. "Enhanced Detection of Fungi in the Spacecraft Environment." 105th General Meeting of the American Society for Microbiology, Atlanta, GA, June 5-9, 2005. Program and Abstracts, 105th General Meeting of the American Society for Microbiology, Atlanta, GA, June 5-9, 2005. , Jun-2005
Abstracts for Journals and Proceedings	Ott CM, Castro VA, Bassinger VJ, Fontenot SL, Bruce RJ, Cruz P, Stetzenbach LD, Pierson DL. "A Comprehensive Characterization of Microorganisms and Allergens in Spacecraft Environment." NASA Bioastronautics Investigators' Workshop, Galveston, TX, January 2005. Abstracts, NASA Bioastronautics Investigators' Workshop, Galveston, TX, January 2005. , Jan-2005