Fiscal Year:	FY 2009	**Task Last Updated:**	FY 06/05/2009
PI Name:	Prisk, G. Kim Ph.D., D.Sc.		
Project Title:	Clearance of Particles Depositing in the Human Lung in Low Gravity		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Human Factors and Performance Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SHFH**:Space Human Factors & Habitability (archival in 2017)		
Human Research Program Risks:	(1) **Dust**:Risk of Adverse Health and Performance Effects of Celestial Dust Exposure (2) **Medical Conditions**:Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (3) **Renal Stone**:Risk of Renal Stone Formation		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	92093-0852	**Congressional District:**	53
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2007 Crew Health NNJ07ZSA002N
Start Date:	06/01/2008	**End Date:**	05/31/2012
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bennett, William (University of North Carolina at Chapel Hill) Darquenne, Chantal (University of California, San Diego)		
Grant/Contract No.:	NCC 9-58-HFP01604		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Original Aims: The deposition of particulate matter (PM) in the human lung is known to bring with it both long-term and short-term adverse health consequences. The deposition of particles in the lung is strongly influenced by gravitational sedimentation. Studies by our group have shown that normal gravity provides a screening effect whereby inhaled PM larger than 0.5 micron is mainly deposited in the larger airways where it is cleared by mucociliary clearance transport within ~one day. However in low-gravity, such as that on the surface of the Moon (~1/6G) and Mars (~3/8G), this protective 'gravitational screening' is less efficient, and as a result particles are deposited in the sensitive alveolar regions of the lung where residence times are very much longer. Further, there is evidence that the dust present on the surface of the Moon may possess potent toxicological properties. We hypothesize that clearance rates from the lung of particles deposited in low-gravity will be substantially reduced compared to that in 1G, resulting in increased residence times of these particles in the periphery of the lung, enhancing their potential to cause lung damage. In order to test this hypothesis we propose to measure the clearance rates (measured in 1G) over a few hours to ~1-2 days, of radio-labeled particles deposited in healthy humans both in 1G and in low-gravity corresponding to the lunar surface (~1/6G) during parabolic flight. These data will provide a comprehensive assessment of alterations in the clearance rate of particles inhaled under normal 1G conditions compared to particles inhaled under conditions of lunar gravity (1/6G). Such an assessment is needed to determine the degree of effort and cost required to control lunar dust within a planned lunar outpost. Key Findings: In this first year we have been exclusively engaged in technical work, and as such there are no scientific results yet available. In addition to the necessary technical accommodation work required to fly the gamma camera in the Reduced Gravity Aircraft, we have utilized existing flights (those funded by NSBRI under TD-00701) to verify the following technical objectives by flying small elements of hardware at no additional cost: * Verified the functionality of two aerosol generation systems (on for each size range planned to be studied) under zero-gravity conditions. Both systems worked well. * Measured the aerosol droplet size under flight conditions in the Reduced Gravity Aircraft to account for change in cabin pressure, g-level, and humidity. Verified only a minor influence of the flight environment compare to ground studies. Impact of Recent Findings: The ability of both aerosol generators to work adequately in reduced gravity, and the altered flight environment (especially reduced cabin pressure) is important. These tests verify aspect of our experiment design and confirm that control data to be collected on the ground will be directly comparable to those collected in flight. Year 2 Plan: By the completion of year 1 we expect to have largely fabricated the flight system. The beginning of year 2 will comprise ground-based tests of the actual flight system to verify functionality both in terms of standard function and in terms of usability in flight. These tests will occur at the University of North Carolina (Dr Bennett). Later in year 2 we plan the first flight studies using 4 micron particles (we will start with the larger particle size as this will provide the higher activity scans). Flight dates are currently subject to negotiation with NASA although we are hopeful of the first flights occurring in the second half for CY 2009.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Airborne particulate matter is a health hazard. The deposition of particulate matter (PM, often referred to as aerosols) in the human lung is known to bring with it both long-term and short-term adverse health consequences. On Earth, effects of PM-induced lung injury are most readily seen in individuals with pre-existing lung disease (i.e. asthma, chronic obstructive pulmonary disease). Studies suggest that particle-induced inflammation or edema likely enhance underlying pulmonary disease, leading to a worsening of already abnormal pulmonary ventilation/perfusion relationships and gas exchange. Such worsening can result in hypoxemia leading to fatal cardiac arrhythmia. There is also little question, that even healthy individuals exposed to PM for extended periods are susceptible to PM-induced lung injury. For example, the increase in risk of death from long-term exposure to PM in six US cities has been shown to be in the area of 17% for the general population for a modest increase in total PM load of 24.5 micro-g/m3. These studies will directly determine the consequences of a more peripheral site of aerosol deposition on the subsequent clearance of PM from the lung. It is well-established that the negative health consequences of exposure to environmental PM increase as particle size is reduced. These studies will provide insight into how much of this effect is a consequence of the increased residence time of particles that are deposited more peripherally in the lungs. Such peripheral deposition occurs not only on the Lunar surface but here on Earth.
Task Progress:	Nearing the first year of this 4-year project, we have a list of completed technical milestones, all of which are important stepping stones to permit us to fly these challenging studies in the Reduced Gravity Aircraft. In this first year we have been exclusively engaged in technical work, and as such there are no scientific results yet available. In this first year we have: * Selected and ordered the gamma camera head from the manufacturer. * Worked with the manufacturer to modify the computer system, making it suitable for parabolic flight. * Obtained a non-functional gamma camera head from the manufacturer, to permit design of the structural accommodation. * Designed the structural accommodation for the gamma camera head. * Submitted the structural design to NASA for approval. * Submitted the required documentation to the NASA Committee for the Protection of Human Subjects (CPHS).

	* Submitted the required documentation to the NASA Radiation Safety and Use Committee. * Verified the functionality of two aerosol generation systems (on for each size range planned to be studied) under zero-gravity conditions (hardware flown at no cost as part of other NSBRI-funded studies). * Measured the aerosol droplet size under flight conditions in the Reduced Gravity Aircraft to account for change in cabin pressure, g-level, and humidity (hardware flown at no cost as part of other NSBRI-funded studies).
Bibliography Type:	Description: (Last Updated: 03/11/2021)
Significant Media Coverage	Burton A. "Research described in science article on the health hazards of lunar dust exposure in a major scientific publication. Title of article: Lunar lung disease." Environmental Health Perspectives. 2008 Oct;116(10):A423. PMID: 18941555, Oct-2008