Fiscal Year:	FY 2016	**Task Last Updated:**	FY 11/08/2015
PI Name:	Delp, Michael Ph.D.		
Project Title:	Effects of Spaceflight on Ocular Oxidative Stress and the Blood-Retinal Barrier		
Division Name:	Space Biology		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	SPACE BIOLOGY--Cellular and molecular biology		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	(1) Cell & Molecular Biology (2) Animal Biology: Vertebrate		
Space Biology Cross-Element Discipline:	(1) Developmental Biology (2) Neurobiology		
Space Biology Special Category:	(1) Translational (Countermeasure) Potential		
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Comments:	Previous affiliations were University of Florida (mid-2007-June 2014), West Virginia University (mid-2005 to mid-2007), and Texas A&M University (1995 to mid-2005).		
Project Type:	Flight	**Solicitation / Funding Source:**	2014 Space Biology Flight NNH14ZTT001N
Start Date:	02/01/2015	**End Date:**	01/31/2017
No. of Post Docs:	1	**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:		**Monitoring Center:**	NASA ARC
Contact Monitor:	Taylor, Elizabeth	**Contact Phone:**	650.604.1783
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Flight Program:	ISS		
Flight Assignment:	Tissue Sharing		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Pecaut, Michael Ph.D. (Loma Linda University) Mao, Xiao Wen M.D. (Loma Linda University)		
Grant/Contract No.:	NNX15AE86G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Approximately 29% of astronauts on short-term (~2 wk) space shuttle flights and 60% on long-duration (~6 mo) missions to the International Space Station (ISS) are reported to have experienced some impairment in distant or near visual acuity. These visual disturbances have been hypothesized to be related to increases in intracranial pressure (ICP) and intraocular pressure. Modeling studies have shown that a compromise in the integrity of the vascular blood-brain barrier (BBB) would serve to elevate ICP. While much attention has been directed toward the role of the cerebral vasculature in elevating ICP, little work has been done to examine conditions of the vasculature in the eye and the potential role of microgravity in altering the blood-retinal barrier (BRB), which maintains a similar function in the eye for regulating intraocular pressure as the BBB in the cranium. One condition known to compromise the BRB is oxidative stress. For example, in diabetic retinopathy, the leading cause of blindness in Western society, elevations in oxidative stress compromise the BRB and increase vascular permeability in the eye. The proposed studies through the ISS Rodent Tissue Sharing Opportunity will provide new and important information regarding the effects of spaceflight on oxidative stress in the eye and its potential deleterious effects on the BRB.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Through the collection of 300 post-flight questionnaires, it has recently been reported that that approximately 29% of astronauts flying short-duration missions and 60% of astronauts on long-duration missions experience an impairment of distance and near visual acuity. Furthermore, some of these changes remain degraded for years after flight. It is hard to imagine a more severe, prevalent and potentially intractable condition threatening human space exploration than the loss of visual acuity. In 2010, NASA Space Life Sciences at Johnson Space Center in Houston held a Visual Impairment Intracranial Pressure (VIIP) Summit of leading clinicians and scientists with expertise in ophthalmology and cerebral fluid dynamics, and it was hypothesized that the visual impairment experienced by astronauts was the result of a microgravity-induced cephalad fluid shifts and corresponding increases in ICP and intraocular pressure. The proposed studies will provide new and important information regarding the effects of spaceflight on oxidative stress in the eye, its potential deleterious effects on the blood-retinal barrier and, consequently, factors that may function to increase intraocular pressure. In addition, understanding the relation between oxidative stress in the eye and disruption of the blood-retinal barrier may provide new insight into other conditions that affect visual acuity, including diabetic retinopathy, the leading cause of blindness in Western society, where elevations in oxidative stress compromise the blood-retinal barrier and increase vascular permeability in the eye.
Task Progress:	Flight studies have yet to be conducted. Therefore, there are no scientific results to report. However, several preflight activities have been undertaken. A NASA “Brain Fixation Kit” was tested to make sure that the fixation procedure to fix brains and eyes harvested from mice on the International Space Station would not damage the tissues. It was confirmed in ground-based studies that the methods and hardware to be used on the ISS did not damage the brain and eye tissues. A pilot collaboration for tissue (eye) sharing between the Japanese Space Exploration Agency (JAXA) and NASA is in progress. This collaboration is with Dr. Satoru Takahashi, M.D., Ph.D. (Professor, Tsukuba Univ.) serving as the Principal Investigator for this JAXA project. This investigation will focus on 1) Comparison between micro-G and artificial-G (1G) conditions in space by providing the world’s first long-term artificial gravity environment for mammals in space, and 2) will return mice to the ground in a living condition for the sharing of eye tissue from these animals.
Bibliography Type:	Description: (Last Updated: 07/09/2025)