Fiscal Year:	FY 2024	**Task Last Updated:**	FY 01/05/2024
PI Name:	Macias, Brandon Ph.D.		
Project Title:	Investigating Structure and Function of the Eye		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	brandon.r.macias@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	281-483-2026
Organization Name:	NASA Johnson Space Center		
PI Address 1:	Johnson Space Center Cardiovascular and Vision Laboratory		
PI Address 2:	2101 NASA Parkway, HAC/B21N-1207		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	36
Comments:	NOTE: Became civil servant fall 2020; previously KBR/NASA Johnson Space Center. Prior to that until 2016, was at the University of California, San Diego.		
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	01/30/2019	**End Date:**	09/30/2033
No. of Post Docs:	0	**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:**	NASA JSC
Contact Monitor:	Stenger, Michael	**Contact Phone:**	281-483-1311
Contact Email:	michael.b.stenger@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 9/30/2033 per HHC element/JSC (Ed., 12/16/21) NOTE: End date changed to 1/24/2026 per HHC element/JSC (Ed., 4/8/21) NOTE: End date changed to 9/30/2025 per PI (Ed., 12/21/19)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Brunstetter, Tyson O.D., Ph.D. (NASA Johnson Space Center) Huang, Alex M.D., Ph.D. (Doheny Eye Institute) Karanjia, Rustum M.D., Ph.D. (Doheny Eye Institute) Laurie, Steven Ph.D. (KBR/NASA Johnson Space Center) Martin, Bryn Ph.D. (University of Idaho, Moscow) Sadda, Srinivas M.D. (Doheny Eye Institute) Smith, Scott Ph.D. (NASA Johnson Space Center) Zwart, Sara Ph.D. (University of Texas, Galveston) Lee, Stuart Ph.D. (KBR/NASA Johnson Space Center)		

	Gibson, Charles O.D. (Coastal Eye Associates) Kramer, Larry M.D. (University of Texas Health Science Center, Houston) Lytle, Jason Ph.D. (KBR/NASA Johnson Space Center) Young, Millennia Ph.D. (NASA Johnson Space Center)
Grant/Contract No.:	Internal Project
Performance Goal No.:	
Performance Goal Text:	
Task Description:	This proposal will identify if ocular structure and function alterations occur at a greater frequency and magnitude during one-year missions compared to six-month and two-month expeditions and whether the recovery profile is dependent upon mission duration. In addition, this project will determine if changes in vascular structure and function are greater after one-year missions and if they contribute to alterations in ocular structure and function. The identification of structural and functional changes related to the development, progression, and recovery of Spaceflight Associated Neuro-ocular Syndrome (SANS) will provide NASA the information necessary to inform the risk posture for future interplanetary expeditions with duration of up to three years and to identify possible countermeasures. SPECIFIC AIMS: Conducting SANS research on two-month, six-month, and one-year crewmembers will enable us to objectively generate data to help NASA determine if and how SANS findings change with mission duration. Data from these missions will enable the development of a non-linear trend model that can be extrapolated to make predictions for spaceflights that are up to three years in duration. Therefore, the results of the "Investigating Structure and Function of the Eye" (iSAFE) study will help NASA to define the risk posture for future interplanetary expeditions and to identify possible countermeasures. Specific Aim 1: To determine if ocular structural changes develop to a greater degree (frequency or magnitude) during long-duration one-year spaceflight missions compared to findings during shorter length missions, and if recovery is prolonged after longer missions. Specific Aim 2: To determine if ocular vascular structure is altered to a greater degree during long-duration one-year spaceflight missions, and if recovery is more prolonged. Specific Aim 3: To determine if ocular function is altered to a greater degree during long duration one-year spaceflight missions, and the recovery profile. Specific Aim 4: To determine if measures of vascular structure and function are altered to a greater degree during long-duration one-year spaceflight missions, and if these vascular adaptations correlate with alterations in ocular structure and function. RELEVANCE AND MAP TO THE NASA HUMAN RESEARCH ROADMAP: This multi-project proposal is in response to NASA research announcement Human Exploration Research Opportunities (HERO), 80JSC017N0001-BPBA, Appendix C, Topic 1: Analyses of the Temporal Nature of Human Adaptation to Long-Duration Low-Earth Orbit Mission Virtual NASA Specialized Center of Research (VNSCOR). This proposal addresses multiple Human Research Program (HRP) Integrated Research Plan Gaps, including: • SANS101: Determine the relationship between fluid shifts (intravascular, interstitial, CSF) and ocular manifestations in astronauts during spaceflight. • SANS102: Determine the relationship between the fluid-shifts induced ocular changes and fluid shifts in the CNS, including whether elevated intracranial pressure or brain edema play a role.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The Investigating Structure and Function of the Eye (iSAFE) research study will advance NASA's understanding of Spaceflight Associated Neuro-ocular Syndrome (SANS), an important human health and performance risk. This goal will be accomplished by quantifying how ocular alterations develop, progress, and recover as a function of spaceflight duration and by identifying underlying mechanisms. Results from this study are anticipated to lead to a temporal model of SANS progression during long-term missions and to inform the development of countermeasures. Given the unique environment of the International Space Station, commonly used ophthalmic instruments are being implemented in novel operational environments (e.g., electroretinography (ERG), optical coherence tomography (OCT) angiography, pneumotonometry). This work may lead to the adoption of these new hardware, software, or protocol elements in clinical practice, benefiting patients on Earth. SANS shares characteristics with several terrestrial ophthalmic diseases, such as papilledema, and iSAFE study results could provide new insights into mechanisms underlying these conditions.
Task Progress:	PROGRESS IN THIS REPORTING PERIOD Within the past year, "Investigating Structure and Function of the Eye" (ISAFE) has achieved multiple milestones, including successful completion of the first preflight ground sessions, first inflight sessions with the first use of new electroretinography (ERG) and pneumotonometry (PTM, intraocular pressure (IOP)) hardware for data collection on the International Space Station (ISS), first implementation of the postflight optical coherence tomography (OCT) intravenous fluorescein angiography (IVFA) test, and first postflight ground sessions. As it was the first use of several of the modalities (ERG, PTM, and dynamic vessel analysis (DVA)) with crewmembers and, for ERG and PTM, on the ISS, several issues were encountered during early sessions which have since been mitigated through modifications to procedures and the operators' approach. The first OCT IVFA session was successfully completed. Preparation for this session included the data collection team traveling to University of California, San Diego (UCSD) to train with collaborators at the Shiley Eye Institute, as well as training activities at NASA Johnson Space Center (JSC). FORWARD WORK In the next year, we will continue inflight and postflight data collection with our current crew, as well as begin data collection with 1-2 additional crewmembers. We anticipate this support to include the following training and testing sessions: • 8 ERG/PTM crew classes • 3 Ultrasound crew classes • Certification of 1 additional trainer each for ERG/PTM and ultrasound crew classes • 2 Preflight BDC sessions • 10 Inflight sessions • 3 Postflight IVFA sessions • 9 Postflight sessions
Bibliography Type:	Description: (Last Updated: 04/04/2024)

Abstracts for Journals and Proceedings	Macias BR, Basner M, Bershad EM, Seidler R, Stahn AC, Pardon LP, Laurie SS. "Investigating long-term structural and functional changes to the eye and brain after spaceflight." 2023 NASA Human Research Program Investigators' Workshop, "To the Moon: The Next Golden Age of Human Spaceflight", Galveston, TX, February 7-9, 2023. Abstracts. 2023 NASA Human Research Program Investigators' Workshop, "To the Moon: The Next Golden Age of Human Spaceflight", Galveston, TX, February 7-9, 2023. , Feb-2023
Abstracts for Journals and Proceedings	Macias BR, Laurie SS, Pardon LP, Brunstetter T, Young M, Huang A, Karanjia R, Lee SMC, Martin BA, Kramer LA, Sadda S, Smith SM, Zwart SR. "Investigating Structure and Function of the Eye (ISAFE)." 2023 NASA Human Research Program Investigators' Workshop, "To the Moon: The Next Golden Age of Human Spaceflight", Galveston, TX, February 7-9, 2023. Abstracts. 2023 NASA Human Research Program Investigators' Workshop, "To the Moon: The Next Golden Age of Human Spaceflight", Galveston, TX, February 7-9, 2023. , Feb-2023