Task Book Report Generated on: 07/14/2025

Prince Title: Mobile Gravity Stitl (an Integrative Countermeasure Device)  Prince Title: Mobile Gravity Stitl (an Integrative Countermeasure Device)  Prince Title: Mobile Gravity Stitl (an Integrative Countermeasure Device)  Program/Discipline-  Remeat/Subdiscipline-  Research Program Relace  Remeat/Subdiscipline-  Research Program/Relace  Research Progr	Fiscal Year:	FY 2022	Task Last Updated:	FY 11/09/2023
Project Title: Mobile Gravity Suit (an Integrative Countermeasure Device)  Prission Name: Human Research  Program/Discipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Program/Discipline:  Ituman Research Program Elsements: (I) IHIC/Isuman Health Countermeasures  Ituman Research Program Elsements: (I) SANS/Risk of Spaceflight Associated Neurs-scalar Syndrome (SANS)  Space Biology Element: None  Space Biology Element: None  Space Biology Special Category: None  Pr Email: Spacessandiaest edu Fax: FY  Programization Type: UNIVERSITY Phone: \$58-263-6365  Programization Type: University of California, San Diego  Pr Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery  Pr Address 2: 9452 Medical Center Dr, 11.2 West 417  Pt Web Page:  City: La Jolla State: CA  Zalifornia, San Diego  City: La Jolla State: CA  Zalifornia, San Diego  Project Type: Ground Solicitation Familiag  Source: Source Source Solicitation Familiag  Project Type: Ground Solicitation Familiag  Source So			rusk Last Opuateu.	11 071 2023
Division Name: Illuman Research Program Discipline: Program Discipline- Element/Subdiscipline- Element/Subdiscipli				
Program/Discipline: Program/Discipline- Element/Subducyline: Joint Agency Name:  TechPort: Yes  Human Research Program Elements: (I) HHC-Human Health Countermeasures  Human Research Program Risket: (I) SANS/Risk of Spaceflight Associated Neuro-scular Syndrome (SANS)  Space Biology Cross-Element None  Space Biology Cross-Element Riscipline: Space Biology Special Category: None  PI Familt: Beseinent/Superal Category: None  PI Formalt: Beseinent/Superal Category: None  PI Formalization Type: UNIVERSITY Phone: SSS-263-6365  Organization Name: University of California, San Diego  PI Address 1: Clinical Physiology Laborotory, Department of Orthopedix Surgery  PI Address 2: 9452 Medical Center Dr, 11.2 West 4117  PI Web Page:  City: La Jolla State: City: La Jolla State: City: Comments:  Project Type:  Ground Solicitation / Funding Solicitation / Funding None Start Date: 10042018 Sear Solicitation / Funding None of Post Does: No. of Bachelor's Candidates: 2 No. of Master's Candidates: 2 No. of Master's Candidates: 40 Monitoring Center: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Research of Solicitation (Ed., 43/23) NOTE: End date changed to 10/3/2023 per NSSC information (Ed., 43/23) NOTE: End date changed to 10/3/2023 per NSSC information (Ed., 43/23) NOTE: End date changed to 10/3/2023 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2023 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2023 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2029 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 82/120) NOTE: End date changed to 10/3/2021 per NSSC	Troject rine.	Mobile Gravity Suit (an integrative Countermeasure Device)		
Program Discipline-  Elements Subdiscipline-  Elements Subdiscipline-  Ilements Subdiscipline-  Ilements Subdiscipline-  Ilements Subdiscipline-  Ilements Subdiscipline-  Ilements Research Program Risks: (1) III C: Human Health Countermeasures	Division Name:	Human Research		
Elementz/Suddiscipline:  Joint Agency Name:  TechPort: Yes  Human Research Program Risks: (I) HHC-Human Health Countermeasures  Human Research Program Risks: (I) SANS/Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)  Space Biology Element: None  Space Biology Element: None  Space Biology Special Category: None  PI Email: Bystersen/guesd.edu Pf Egy Organization Type: UniVERSITY Phone: S88-263-6365  Organization Name: University of California, San Diego PI Address 1: Clinical Physiology Laboratory, Department of Orthopedie Surgery PI Address 2: PI Address 2: PI Meb Page:  Clinical Physiology Laboratory, Department of Orthopedie Surgery PI Address 3: PI Web Page:  Cliy: La Jolia State: CA  Zip Code: Ogograsional District: Source  Comments:  Project Type:  Ground Sulicitation / Funding Source Source Source Source Source No. of Phot Degress: No. of Phot Degress: No. of Phot Degress: No. of Phot Degress: No. of Phot Dedidates: No. of Master's Candidates: No. of Rachedor's Candid	Program/Discipline:			
Human Research Program Elements: (1) BHC:Human Health Countermeasures  Human Research Program Risks: (1) SANS-Risk of Spaceflight Associated Neuro-neular Syndrome (SANS)  Space Biology Cross-Element: None  Space Biology Cross-Element: None  Space Biology Special Category: None  PI Email: Begeterne@used.edu Fax: FY  PI Organization Type: UNIVERSITY Phone: 858-263-6365  Organization Name: University of California, San Diego  PI Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery  PI Address 2: 9452 Medical Center Dr. LL2 West 417  PI Web Page:  City: La Jolia State: CA  Zijo Code: 92037-1337 Congressional District: 52  Comments:  Project Type: Ground Solicitation / Funding and Performance (FLAGSIIPI). OMNIBUS). Source: Appendix A-Flagship1, Appendix B-Omnibus  Start Date: 1004/2018 End Date: 1001/2023  No. of PAD Deardidates: 2 No. of Master' Degrees: 20  No. of PAD Candidates: 2 No. of Master' Degrees: 20  No. of Master's Candidates: 40 Monitoring Center: NASA JSC  Contact Email: becky brocator@usea.sov  Flight Program:  NOTE: End date changed to 101/2023 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2022 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2022 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2022 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2022 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4/2/23)  NOTE: End date changed to 101/2020 per NSSC information (Ed., 4	Program/Discipline Element/Subdiscipline:			
Human Research Program Risks: (1) SANS-Risk of Spaceflight Associated Neuro-neular Syndrome (SANS)  Space Biology Cross-Element  None  Space Biology Cross-Element  Biology Gross-Element  Space Biology Special Category: None  PI Email:   Boodsrsen/duesd.edu	Joint Agency Name:		TechPort:	Yes
Space Biology Cross-Element Space Biology Cross-Element None Space Biology Special Category: None PI Email:    Renterient/futesd_odu    Fax: FY   Pl Organization Type:   UNIVERSITY   Phone: 858-263-6365   Organization Name:   University of California, San Diego   PI Address 1:   Clinical Physiology Luboratory, Department of Orthopedic Surgery   PI Address 2:   9452 Medical Center Dr., LL2 West 417   PI Web Page:	<b>Human Research Program Elements:</b>	(1) <b>HHC</b> :Human Health Countermeasures		
Space Biology Cross-Element Discipline:  Space Biology Cross-Element Discipline:  None  PI Email:  Becterson@uesd.edu  Fax: FY  Phome: 858-263-6365  Organization Type:  UNIVERSITY  Phome: 858-263-6365  Organization Name:  University of California, San Diego  PI Address 1:  Clinical Physiology Laboratory, Department of Orthopedic Surgery  PI Address 2:  9452 Medical Center Dr. LL2 West 417  PI Web Page:  City:  La Jolla  State: CA  Zip Code:  92037-1337  Congressional District:  52  Comments:  Project Type:  Ground  Solicitation / Funding Source:  Appendix A-Flagship1, Appendix H-Ommibus  Start Date:  10/04/2018  End Date:  10/04/2018  End Date:  10/04/2018  End Date:  10/04/2018  End Date:  10/04/2018  No. of PhD Degrees:  No. of Master' Degrees:  No. of Master' Degrees:  No. of Master's Candidates:  2  No. of Master's Degrees:  20  No. of Bachelor's Candidates:  40  Monitoring Center:  No. of Bachelor's Candidates:  40  Monitoring Center:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI:  Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution):  Levins, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.:  80NSSC19K0020	Human Research Program Risks:	(1) SANS:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Special Category: None   Space Biology Special Category: Pl Address 1: University of California, San Diego   Pl Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery   Pl Address 2: 9452 Medical Center Dr. LL2 West 417	Space Biology Element:	None		
PI Email: Repetersent@uesd.edu Fax: FY PI Organization Type: UNIVERSITY Phone: 858-263-6365 Organization Name: University of California, San Diego PI Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery PI Address 2: 9452 Medical Center Dr. LL2 West 417 PI Web Page: City: La Jolla State: CA Zip Code: 92037-1337 Congressional District: 52 Comments:  Project Type: Ground Solicitation / Funding and Performance (FLAGSHIP1, OMN/BUS), Appendix A-Flagship1, Appendix B-Omnibus Start Date: 10-04/2018 End Date: 10-01/2023 No. of Post Does: 0 No. of PhD Degrees: No. of Master's Candidates: 2 No. of Master' Degrees: 20 No. of Master's Candidates: 2 No. of Bachelor's Degrees: 20 No. of Bachelor's Candidates: 40 Monitoring Center: NASA JSC Contact Monitor: Brocato, Becky Contact Phone: Contact Email: becky-brocato@nass.gov Flight Program:  NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)	Space Biology Cross-Element Discipline:	None		
PI Organization Type: UNIVERSITY Phone: 858-263-6365  Organization Name: University of California, San Diego  PI Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery  PI Address 2: 9452 Medical Center Dr, LL2 West 417  PI Web Page:  City: La Jolla State: CA  Zip Code: 92037-1337 Congressional District: 52  Comments:  Froject Type: Ground Solicitation / Funding and Performance (FLAGSHIP), ONNIBUS). Appendix A-Flagship1, Appendix B-Omnibus  Start Date: 10/04/2018 End Date: 10/01/2023  No. of PhD Candidates: 2 No. of Master' Degrees: No. of Master's Degrees: 20  No. of Master's Candidates: 40 Monitoring Center: NASA JSC  Contact Email: becky brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.: 80NSSC19K0020	Space Biology Special Category:	None		
Organization Name:  Clinical Physiology Laboratory, Department of Orthopedic Surgery  Pl Address 1:  Office Section 1:  Office Section 2:  Office Section 2:  Office Section 3:  Office	PI Email:	18petersen@ucsd.edu	Fax:	FY
PI Address 1: Clinical Physiology Laboratory, Department of Orthopedic Surgery  PI Address 2: 9452 Medical Center Dr. LL2 West 417  PI Web Page:  City: La Jolla State: CA  Zip Code: 92037-1337 Congressional District: 52  Comments:  Project Type: Ground Solicitation / Funding Source: Appendix A-Flagship1, Appendix B-Omnibus  Start Date: 10/04/2018 End Date: 10/01/2023  No. of PhD Degrees:  No. of PhD Candidates: 2 No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Candidates: 2 No. of Bachelor's Degrees: 20  No. of Master's Candidates: 40 Monitoring Center: NASA JSC  Contact Monitor: Brocato, Becky Contact Phone: becky, brocato/@inasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.: 80NSSC19K0020	PI Organization Type:	UNIVERSITY	Phone:	858-263-6365
PI Address 2: 9452 Medical Center Dr, LL2 West 417  PI Web Page:  City: La Jolla State: CA  Zip Code: 92037-1337 Congressional District: 52  Comments:  Project Type: Ground Solicitation / Funding Source: Appendix A-Hagship1, OMNiBUS). Appendix A-Hagship1, Appendix B-Omnibus Start Date: 10/04/2018 End Date: 10/01/2023  No. of Post Does: 0 No. of PhD Degrees: No. of Master' Degrees: No. of Master's Candidates: 2 No. of Master' Degrees: No. of Bachelor's Candidates: 2 No. of Bachelor's Degrees: 20  No. of Bachelor's Candidates: 40 Monitoring Center: NASA JSC  Contact Monitor: Brocato, Becky Contact Phone: Contact Email: becky brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 8/21/20)	Organization Name:	University of California, San Diego		
Pl Web Page:   City:	PI Address 1:	Clinical Physiology Laboratory, Department of Orthopedic Surgery		
City: La Jolla State: CA  Zip Code: 92037-1337 Congressional District: 52  Comments:  Project Type: Ground Solicitation / Funding Project Type: Bround Solicitation / Funding Sourcer: 10/04/2018 End Date: 10/01/2023 [Congressional District: 52]  Start Date: 10/04/2018 End Date: 10/01/2023  No. of Post Does: 0 No. of PhD Degrees: No. of Master' Degrees: 10/01/2023  No. of PhD Candidates: 2 No. of Master' Degrees: 20  No. of Master's Candidates: 2 No. of Bachelor's Degrees: 20  No. of Bachelor's Candidates: 40 Monitoring Center: NASA JSC  Contact Monitor: Brocato, Becky Contact Phone: Contact Email: becky-brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-1 Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	PI Address 2:	9452 Medical Center Dr, LL2 West 417		
Zip Code: 92037-1337 Congressional District: 52  Comments:  Project Type: Ground Solicitation / Funding and Performance (FLAGSHIP1, OMNIBUS). Appendix A-Flagship1, Appendix B-Omnibus  Start Date: 10/04/2018 End Date: 10/01/2023  No. of PbD Degrees: No. of PbD Candidates: 2 No. of Master' Degrees: No. of Master's Candidates: 2 No. of Bachelor's Degrees: 20  No. of Bachelor's Candidates: 40 Monitoring Center: NASA JSC  Contact Monitor: Brocato, Becky Contact Phone:  Contact Email: becky.brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-1 Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	PI Web Page:			
Comments:  Project Type:  Ground  Grou	City:	La Jolla	State:	CA
Project Type:  Ground  Ground  Solicitation / Funding Source:  All Performance (FLAGSHIP1, OMNIBUS). Appendix A-Flagship1, Appendix B-Omnibus Start Date:  10/04/2018  End Date:  10/01/2023  No. of Post Docs:  0 No. of PhD Degrees:  No. of PhD Candidates:  2 No. of Master' Degrees:  No. of Master's Candidates:  40 Monitoring Center:  No. of Bachelor's Candidates:  40 Monitoring Center:  No. of Bachelor's Candidates:  Contact Monitor:  Brocato, Becky  Contact Phone:  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23)  NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 4/3/23)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous P1:  Change (FY2021 report): Co-1 Alan Hargens is no longer affiliated with this project.  COI Name (Institution):  Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.:  80NSSC19K0020	Zip Code:	92037-1337	<b>Congressional District:</b>	52
Project Type:  Ground	Comments:			
No. of Post Docs:  No. of PhD Candidates:  No. of Master' Degrees:  No. of Master's Candidates:  No. of Master's Candidates:  No. of Bachelor's Degrees:  No. of Bachelor's Candidates:  No. of Bachelor's Degrees:  No. of Master' Degrees:  No. of	Project Type:	Ground		and Performance (FLAGSHIP1, OMNIBUS).
No. of PhD Candidates:  2	Start Date:	10/04/2018	End Date:	10/01/2023
No. of Master's Candidates:  2 No. of Bachelor's Degrees: 20  No. of Bachelor's Candidates:  40 Monitoring Center: NASA JSC  Contact Monitor:  Brocato, Becky Contact Phone:  Contact Email:  becky.brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	No. of Post Docs:	0	No. of PhD Degrees:	
No. of Bachelor's Candidates: 40 Monitoring Center: NASA JSC  Contact Monitor: Brocato, Becky Contact Phone:  Contact Email: becky.brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas)  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	No. of PhD Candidates:	2	No. of Master' Degrees:	
Contact Monitor: Brocato, Becky Contact Phone:  Contact Email: becky.brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	No. of Master's Candidates:	2	No. of Bachelor's Degrees:	20
Contact Email: becky.brocato@nasa.gov  Flight Program:  NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	No. of Bachelor's Candidates:	40	<b>Monitoring Center:</b>	NASA JSC
NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21) NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020	Contact Monitor:	Brocato, Becky	<b>Contact Phone:</b>	
NOTE: End date changed to 10/1/2023 per NSSC information (Ed., 4/3/23) NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20) NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	Contact Email:	becky.brocato@nasa.gov		
NOTE: End date changed to 10/1/2022 per NSSC information (Ed., 9/19/21)  NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)  NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	Flight Program:			
NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:				
NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)  Key Personnel Changes/Previous PI: Change (FY2021 report): Co-I Alan Hargens is no longer affiliated with this project.  COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:	Flight Assignment:	NOTE: End date changed to 10/3/2021 per NSSC information (Ed., 8/21/20)		
COI Name (Institution): Levine, Benjamin M.D., Ph.D. (University of Texas Southwestern Medical Center at Dallas )  Grant/Contract No.: 80NSSC19K0020  Performance Goal No.:		NOTE: End date changed to 10/3/2020 per NSSC information (Ed., 10/28/19)		
Grant/Contract No.: 80NSSC19K0020 Performance Goal No.:	Key Personnel Changes/Previous PI:	Change (FY2021 report): Co-I Alan Harge	ens is no longer affiliated with t	his project.
Performance Goal No.:	COI Name (Institution):	Levine, Benjamin M.D., Ph.D. (University	ty of Texas Southwestern Medic	cal Center at Dallas )
	Grant/Contract No.:	80NSSC19K0020		
Performance Goal Text:	Performance Goal No.:			
	Performance Goal Text:			

Task Book Report Generated on: 07/14/2025

Because all parts of human physiology are affected by microgravity, an integrative countermeasure strategy is needed. Loss of muscle and bone mass along with deconditioning of the heart and vessels are well described effects of microgravity. More recently structural and functional changes of the eye, experienced by some astronauts during long-term missions, have been described and summarized in the Spaceflight Associated Neuro-ocular Syndrome (SANS). While the exact etiology of SANS remains unknown, the microgravity induced headward fluid shift is likely part of the pathophysiology and countermeasures that can reverse this fluid shift are prioritized. Based on our experimental data from short-term microgravity by parabolic flights and 24-hour simulated microgravity, we suggest that fluid redistribution in space may not give rise to a pathological increase in intracranial pressure, but rather the lack of diurnal fluctuations in intracranial volume and pressures may be responsible for the remodeling of the eye. In ambulatory neurosurgical patients with pressure sensors inserted in the brain tissue, we therefore demonstrated the feasibility of lower body negative pressure to reduce intracranial pressure as means of re-introducing diurnal pressure variability. Extending on this, in a recent 3-day, 6° head-down tilt bedrest trial we applied lower body negative pressure (LBNP) for 8 hours every day, to demonstrate safety and efficacy to significantly reduce long-term swelling at the back of the eye believed to be early symptoms of SANS.

Task Description:

At the Aerospace Physiology Lab at University of California San Diego (UCSD) we have developed and tested a mobile "Gravity Suit" comprised of pressurized-trousers and attached vest. The suit simulates the effects of gravitational stress by application of low-levels lower body negative pressure to re-introduce an Earth-like fluid shift while at the same time inducing a ground reaction force at the bottom of the feet and a mechanical load along the entire body axis. Preliminary tests involving healthy human subjects in simulated microgravity have demonstrated the efficacy of 20 mmHg lower body negative pressure within the suit to reduce internal jugular vein cross-sectional area by some 45% and induce mechanical load of 57% bodyweight.

The intravehicular suit is comfortable enough to wear 8-10 hours a day and flexible enough to be combined with daily activity and even exercise with the overall aim to provide an integrative countermeasure. As an overall long-term aim, we suggest that use of the Gravity Suit will 1) re-introduce the diurnal variability of intracranial pressure and volume to help prevent development of SANS; 2) stimulate the cardiovascular system to maintain cardiac muscle mass and vascular compliance; 3) counteract loss of postural muscle mass and bone density; 4) finally, the axial loading may preserve curvature of the spine, paraspinal muscle, and disc morphology to both ameliorate in-flight back pain, and reduce risk of post-flight disc herniation.

Within the scope of this proposal, we will finalize and further test our prototype by integrating vacuum- and monitoring systems within the waist-belt to increase safety and allow for free and un-tethered movement. Comfort, range of motion, and gait will be assessed during relevant activities simulating daily work tasks on the International Space Station (ISS) and in combination with resistive exercise device relevant for cislunar and deep space missions. High levels and/or prolonged exposure to lower body negative pressure can potentially compromise blood flow to the brain; however, activity and use of the muscle pump increases orthostatic tolerance. To establish a safe range and optimize the user scenario, we will test cardiovascular responses and cerebral perfusion during graded lower body negative pressure with and without a combined ground reaction force and in combination with rowing exercise. Successful funding of this proposal will bring our Gravity Suit to Countermeasure Readiness Level 7.

## Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

While designed as a countermeasure for use in space, LBNP may hold benefits for life on Earth. One specific example is reduction of pressure inside the brain which may hold potential for patients on Earth with elevated intracranial pressure.

Ed. Note -- May 2023 Update Compiled from January 2023 report to NASA 2022/23 UPDATE -- COVID IMPACT:

University of California, San Diego (UCSD) closed down early in 2020 and regrettably did not fully open for human-subject testing until 2022 (only COVID-related research could be done). The Aerospace Physiology lab (Petersen lab) submitted, and was approved for, onsite research ramp-up; however, all work has been under significant restrictions and 6 feet distance has to be maintained at all times. Thus, research with human subjects has been close to impossible. Based on this, I was granted a no-cost extension on this grant.

Because no human subject research was possible for a significant period, I focused efforts on work that was possible; therefore significant technical / engineering advances have been made.

Based on feedback from NASA's Human Research Program (HRP), it is important to move away from a lithium battery-based system. However, this poses a challenge for weight, size, and lifetime of the alternative batteries. My team and I have tested multiple vacuum systems and customized functionality to be specifically tailored towards a wearable lower body negative pressure (LBNP) device. Additionally, much experimental work has gone into material selection. Based on this, my recommendation is a two-layer softshell with the inner lining being a soft material with

Mobility across the individual joint has also been a focus and we have created a knee design that allows for full mobility without contact with the skin. We are currently evaluating materials for the structural support of the knee joint.

Bibliography Type: Description: (Last Updated: 03/21/2025)

Task Progress:

optimized wicking capacity and an outer layer of more robust and airtight material.