Fiscal Year:	FY 2012	**Task Last Updated:**	FY 08/26/2011
PI Name:	LeBlanc, Adrian Ph.D.		
Project Title:	Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss: SMO-021		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight (No longer used, July 2020)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	adleblanc2@gmail.com	**Fax:**	FY
PI Organization Type:	NON-PROFIT	**Phone:**	281-244-2012
Organization Name:	Universities Space Research Association		
PI Address 1:	Division of Space Life Sciences		
PI Address 2:	3600 Bay Area Blvd		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/01/2006	**End Date:**	08/31/2015
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:	Baumann, David	**Contact Phone:**	
Contact Email:	david.k.baumann@nasa.gov		
Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date is 8/31/2015 per HRP Master Task List dtd 7/12/11 (Ed., 8/4/11) NOTE: Extended to 9/30/2013 per PI (Ed., 11/5/2010)		
Key Personnel Changes/Previous PI:	Toshio Matsumoto, M.D., Ph.D., is the Japanese Co-Principal Investigator of this study, a joint project between NASA and JAXA. Dr. Matsumoto is affiliated with the Department of Medicine and Regulatory Sciences, University of Tokushima Graduate School of Medicine. His contact information is: Phone 81-88-633-7119/Fax 81-88-633-7407; Toshimat@clin.med.tokkushima-u.ac.jp		
COI Name (Institution):	Jones, Jeffrey (NASA Johnson Space Center) Shapiro, Jay M.D. (Kennedy Krieger Institute) Lang, Tom Ph.D. (University of California at San Francisco) Kozlovskaya, Inessa M.D. (Institute of Biomedical Problems) Shackelford, Linda M.D. (NASA Johnson Space Center) Smith, Scott Ph.D. (NASA-Johnson Space Center) Evans, Harlan Ph.D. (Wyle Laboratories) Spector, Elisabeth (Wyle Laboratories) Sibonga, Jean Ph.D. (Universities Space Research Association (USRA)) Nakamura, Toshitaka M.D., Ph.D. (University of Occupational and Environmental Health) Kohri, Kenjiro M.D., Ph.D. (Nagoya City University)		

	Ohshima, Hiroshi M.D., Ph.D. (Japan Aerospace Exploration Agency (JAXA))
Grant/Contract No.:	Directed Research
Performance Goal No.:	
Performance Goal Text:	
Task Description:	The purpose of this Supplementary Medical Objective is to determine whether bisphosphonates, in conjunction with the routine in-flight exercise program, will protect ISS crewmembers from the regional decreases in bone mineral density documented on previous ISS flights. Two dosing regimens will be tested: (1) an oral dose of 70 mg alendronate taken weekly during flight and (2) and I.V. dose of zoledronic acid 4 mg, administered just once approximately 45 days before flight. Our rationale for including both alendronate and zoledronic acid is that two dosing options will: maximize crew participation, increase the countermeasure options available to flight surgeons, increase scientific opportunities, and minimize the effects of operational and logistical constraints. Use of both oral and I.V. options can accommodate both crew and flight surgeon preferences (e.g., based on individual drug sensitivity, relevant health conditions, or other considerations). Operational and logistical constraints may favor one option versus the other. For example, stowage limits may limit use of alendronate on certain flights, while the ability to titrate the in-flight dose in response to on-orbit measurements of bone resorption would favor the weekly dosing regimen. Long-duration (e.g., 2+ year) missions would require in-flight re-dosing of I.V. zoledronic acid. The purpose of this study is not to test one dosing option versus the other. Rather, we intend to show that bisphosphonates-plus-exercise will have a measurable effect versus exercise alone in preventing space flight induced bone loss. Secondary goals will be to document the return to normal bone remodeling post-flight in crewmembers who took bisphosphonates.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	While the primary purpose of this research is to develop a countermeasure to protect crewmembers against bone loss during long duration spaceflight, this research may provide insight into the mechanisms and prevention of bone atrophy in other disuse conditions.
Task Progress:	The original intent of this study was to test 10 long-duration crewmembers taking one of two bisphosphonate regimens: either 70 mg per week alendronate or a single infusion of 4 mg of zoledronic acid. After the study began testing in 2009, the JSC CPHS determined that only alendronate would be offered to U.S. crewmembers, while both dosing options could be offered to International Partners. It was further mandated that only 5 alendronate subjects, plus 2 insurance subjects, would be allowed. We have now enrolled all 7 of these alendronate subjects, and no further subjects will be tested with bisphosphonates. Of these 7 subjects, 5 have completed ISS flights. Four subjects have completed all post-flight testing through R+1 year, while the fifth has completed post-flight testing through R+30. The final 2 subjects are still in flight, and will return later this year. All scheduled testing sessions for the 7 enrolled subjects—pre-flight, in-flight and post-flight--have been completed on time. DXA, pQCT, QCT and blood and urine data have been collated and preliminary analyses of the major parameters of interest have been performed, including some initial statistical analyses. Preliminary results (n=4) were presented in a poster presentation at the annual International Academy of Astronautics (IAA) Humans in Space symposium in April of 2011, and a similar poster (n=5) will be presented at the annual meeting of the American Society for Bone and Mineral Research in September, 2011. A recent development in this project is the addition of a new control group to the study, which will consist of approximately 10 ISS crewmembers who will not take bisphosphonates, but who will participate in essentially the same pre-, in- and post-flight testing as the previous subjects. The reason for the new control group is that all 7 of the bisphosphonate subjects have exercised on ISS using the new Advanced Resistive Exercise Device (ARED), while the 14 historical controls all exercised using the older Interim Resistive Exercise Device (IRED). The skeletal loading capabilities are much greater with the ARED, and preliminary DXA results suggest that ARED may, in fact, be more beneficial than IRED for the preservation of bone mineral density. Because neither QCT nor pQCT data have been obtained on any crewmembers using ARED alone, the effects of bisphosphonates + ARED vs. ARED alone on compartmental bone loss, bone structure, and bone strength cannot be determined at this point. The addition of 10 new control subjects, all using ARED, should allow us to distinguish the relative effects of bisphosphonates vs. the confounder of ARED exercise, particularly at the level of trabecular vs. cortical bone. Testing on this new control group is scheduled to begin in 2012. Depending on participation levels by the eligible ISS crewmembers, it is anticipated that this group will complete testing in approximately 2015.
Bibliography Type:	Description: (Last Updated: 10/15/2019)
Abstracts for Journals and Proceedings	LeBlanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Shackelford LC, Smith SM, Evans HJ, Spector ER, Ploutz-Snyder R, Sibonga J, Nakamura T, Kohri K, Ohshima H. "Preliminary Results of Bisphosphonate ISS Flight Experiment." 18th IAA Humans in Space Symposium, Houston, TX, April 11-15, 2011. 18th IAA Humans in Space Symposium, Houston, TX, April 11-15, 2011. , Apr-2011
Abstracts for Journals and Proceedings	LeBlanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Smith SM, Shackelford L, Sibonga J, Evans H, Spector E, Nakamura T, Kohri K, Ohshima H. "Bisphosphonate as a Countermeasure to Space Flight-Induced Bone Loss." 2010 NASA Human Research Program Investigators' Workshop, Houston, TX, February 3-5, 2010. 2010 NASA Human Research Program Investigators' Workshop, Houston, TX, February 3-5, 2010. Abstract #1094. , Feb-2010
Abstracts for Journals and Proceedings	LeBlanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Shackelford LC, Smith SM, Evans HJ, Spector ER, Ploutz-Snyder R, Sibonga J, Nakamura T, Kohri K, Ohshima H. "Antiresorptive Treatment for Spaceflight Induced Bone Atrophy: Preliminary Results." 33rd Annual Meeting of the American Society for Bone and Mineral Research, San Diego, California, September 16-20, 2011. 33rd Annual Meeting of the American Society for Bone and Mineral Research, San Diego, California, September 16-20, 2011. , Sep-2011