U.S. NATIONAL LABORATORY

ISS National Lab Q1FY19 Report

Quarterly Report for the Period October 1 – December 31, 2018

Contents

Authorized for submission to NASA by:

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Signature

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Q1FY19 Metrics

SECURE STRATEGIC FLIGHT PROJECTS: Generate significant, impactful, and measurable demand from customers that recognize value of the ISS National Lab as an innovation platform

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	YTD FY19	TARGET FY19
ISS National Lab payloads manifested	17				17	80
ISS National Lab payloads delivered	36				36	80
Research procurement						
Solicitations/Competitions	2				2	5
# of days-Project Concept Submission to Formal Proposal Submission	173				173	***
# of days-Formal Proposal Submission to Project Selection	33				33	45
Project proposals generated	29				29	120
Projects and Programs awarded	18				18	50
By customer type						
ISS National Lab return customers	4				4	***
ISS National Lab new customers	14				14	***
By entity type						
Commercial	8				8	***
Academic/Nonprofit	8				8	***
Government agency	2				2	***
Total value of ISS National Lab grants awarded*	$809,921				$809,921	$5,250,000
Peer-reviewed scientific journal publications	3				3	***
Products or services created/enhanced	0				0	***
In-orbit commercial facilities (cumulative)	15				15	***
In-orbit commercial facility managers (cumulative)	9				9	***

SECURE INDEPENDENT FUNDING: Leverage external funding to support ISS National Lab projects through collaborative sponsorships and third-party investments

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	YTD FY19	TARGET FY19
Sponsored Program/external funding for grants	$2,000,000				$2,000,000	$10,000,000
Investor network participants (cumulative)	128				128	135
Investments reported from network (cumulative)	$1,650,000				$1,650,000	***

ISS UTILIZATION: The ISS National Lab to maximize and optimize utilization of the allocation of crew time, ascent flight resources, and in-orbit facilities

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	YTD FY19	TARGET FY19
Crew Time						
Actual vs. Increment pair-3 months allocation	N/A				N/A	90%
Resource Utilization						
Ascent Flight Resources	Q1/Q2^		Q3/Q4^		ACTUAL FY19	TARGET FY19
Up-mass	150%		145%			80%
Cold Stowage	100%		76%			80%
Big Bags	56%		72%			80%
Powered Lockers	100%		100%			80%
Facility Resources						
Commercial Facilities	92%		75%			80%
JEM Airlock	100%		100%			80%
Life Science Glovebox	33%		66%			80%
Micro-g Science Glovebox	100%		50%			80%

^Note: This is projected/estimated data based on payload requirements in the queue at the start of FY2019

INCREASE AWARENESS: Build positive perception of the ISS National Lab within key audience communities

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	YTD FY19	TARGET FY19
Outreach events						
Speaking engagements	20				20	60
Subject matter expert workshops and thought leader roundtables	2				2	6

BUILD REACH IN STEM: Create STEM programs, educational partnerships, and educational outreach initiatives using ISS National Lab-related content

	ACTUAL Q1	ACTUAL Q2	ACTUAL Q3	ACTUAL Q4	YTD FY19	TARGET FY19
STEM programs (active)	23				23	21
Participation in ISS National Lab STEM programs and educational outreach activities						
Students	676,677				676,677	500,000
Educators	42,611				42,611	50,000
Adults	9,512				9,512	250,000
Mixed Audience	228,584				228,584	450,000
Total	957,384				957,384	1,250,000
Total value of ISS National Lab STEM grants awarded ****	$202,267				$202,267	$400,000

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** Grants include awards to projects and programs as well as modifications and extensions.*
****Informational trend as they occur, not target.*
***** Total STEM grants awarded included in the Total Value of ISS National Lab Grants Awarded figure above.*

FINANCIALS

Business Status Report (unaudited)

Expenses	Q1 Actuals	Q1 Budget	Variance	Actual YTD FY19	Budget YTD FY19	Variance YTD FY19
Direct Labor	$1,844,671	$2,074,387	$(229,716)	$1,844,671	$2,074,387	$(229,716)[a]
Subcontracts	$255,296	$402,425	$(147,129)	$255,296	$402,425	$(147,129)[b]
Other Direct	$253,567	$355,459	$(101,892)	$253,567	$355,459	$(101,892)[c]
Travel	$199,360	$273,103	$(73,743)	$199,360	$273,103	$(73,743)[d]
Office Supplies and Equipment	$62,397	$100,000	$(37,603)	$62,397	$100,000	$(37,603)
Grants & Mission-Based Costs	$1,236,372	$2,002,685	$(766,313)	$1,236,372	$2,002,685	$(766,313)[e]
Total Expenses	**$3,851,663**	**$5,208,059**	**$(1,356,396)**	**$3,851,663**	**$5,208,059**	**$(1,356,396)**

a. *Direct Labor: Actual headcount was 51 versus a budget of 58.*
b. *Subcontracts: Lower than budget for legal, and elimination of value impact and government consultants.*
c. *Other Direct: Primarily decreased expenses in Marketing and Communications.*
d. *Travel: Primarily decreased headcount.*
e. *Grants: Recipient milestone payments shifted based on actual spend or delay in flights.*

Breakout of ISS National Lab Grants

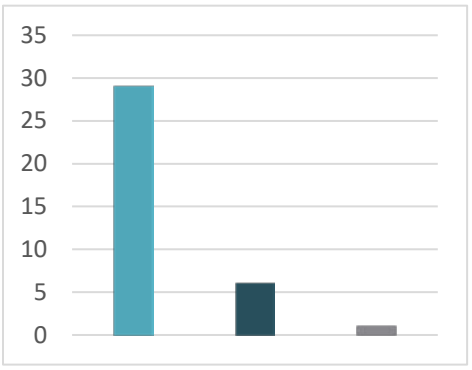
	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 YTD Total
Academic	$295,516				$295,516
Commercial	$840,755				$840,755
Other Government Agency	-				-
Mission-Based Costs	$100,101				$100,101
Total	**$1,236,372**				**$1,236,372**

Breakout of Cooperative Agreement Funding

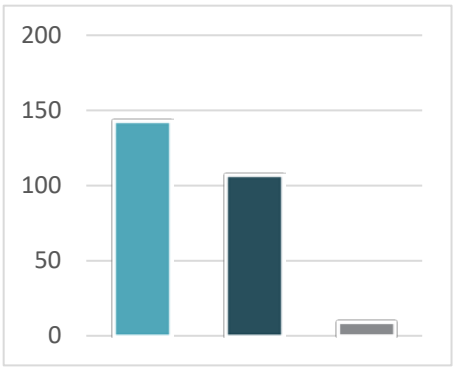
	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 YTD Total
Direct	51%				51%
Indirect	16%				16%
Grants	33%				33%

Key Portfolio Data Charts

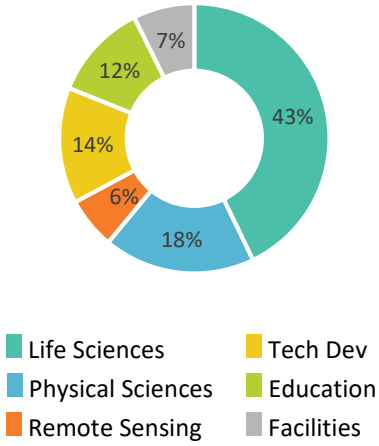
Payloads Launched in Q1



Projects Awarded to Date



R&D Objectives of Projects Awarded to Date



Program Successes

Three newly published journal articles:

- Krishnamurthy A, Ferl RJ, Paul AL. Comparing RNA-Seq and microarray gene expression data in two zones of the Arabidopsis root apex relevant to spaceflight. *Appl Plant Sci.* 2018;6(11):e01197.
- McNeill EP, Reese RW, Tondon A, Clough BH, Pan S, Froese J, Palmer D, Krause U, Loeb DM, Kaunas R, Gregory CA. Three-dimensional in vitro modeling of malignant bone disease recapitulates experimentally accessible mechanisms of osteoinhibition. *Cell Death Dis*. 2018;9(12):1161.
- Montague TG, Almansoori A, Gleason EJ, Copeland DS, Foley K, Kraves S, Saavedra EA. Gene expression studies using a miniaturized thermal cycler system on board the International Space Station. *PLoS ONE*. 2018;13(10):e0205852.

For the full list of journal publications related to the ISS National Lab, see www.issnationallab.org/publications

One new patent granted:

- Last year, three patent applications were published related to ISS National Lab research performed by Procter & Gamble (P&G)—two granted in September 2018 and the third granted during Q1FY19. Spaceflight has been a part of the P&G research portfolio for almost a decade, with experiments under NASA and ISS National Lab sponsorship studying complex fluid systems under time scales not possible on Earth. The patents describe proposed improvements related to consumer-product functional characteristics and shelf life.

Education-focused content set records:

- Nearly one million people reached in Q1 alone by Space Station Explorers partner content, including more than 600,000 students
- New low-cost experiments from three Space Station Explorers Consortium programs (Quest Institute, DreamUp, and Genes in Space) that break new ground in reducing costs to expand reach

In-Orbit Activities

In Q1, 36 ISS National Lab payloads were delivered by two CRS missions—highlights include:

- Layer-by-Layer Assembly of Protein-Based Artificial Retinas in Microgravity (Nicole Wagner, Lambda Vision; payload developer Space Tango)
- Investigation of the Effects of Microgravity on Controlled Release of Antibiotics and Curing Mechanism of a Novel Wound Dressing (Elaine Horn-Ranney, Tympanogen; payload developer NanoRacks)
- Linking Biofilm Thickness and Viability to an Elevated Microbial Corrosion Risk (Renato M. De Paula, and Vic Keasler, Nalco Champion; payload developer BioServe Technologies)
- Microgravity as Model for Immunological Senescence and its Impact on Tissue Stem Cells and Regeneration (Sonja Schrepfer and Tobias Deuse, University of California, San Francisco; payload developer STaARS)
- Crystallization of LRRK2 under Microgravity Conditions (Marco Baptista, The Michael J Fox Foundation; payload developer Space Tango)
- Microfluidic Lab-on-a Chip to Track Biomarkers in Skeletal Muscle Cells (Siobhan Malany, Micro-gRx; payload developer Space Tango)

Additionally, as of Q1 there is one new in-orbit commercial facility: SlingShot, a small satellite deployer system developed by new facility manager SEOPS, LLC and installed on Northrop Grumman's Cygnus spacecraft to enable smallsat deployment from Cygnus after it completes its primary mission and departs the ISS.

For information on SpX-16, see www.issnationallab.org/press-releases/spacex-crs-16-mission-overview
For NG-10, see www.issnationallab.org/press-releases/northrop-grumman-crs-10-mission-overview

Research Solicitations in Progress

Currently Open:

- Transport Phenomena Research on the ISS to Benefit Life on Earth, sponsored by the National Science Foundation (up to $4 million)
- Tissue Engineering and Mechanobiology on the ISS to Benefit Life on Earth, sponsored by the National Science Foundation (up to $2 million)

Closed, with awards expected in Q2:

- Microgravity Molecular Crystal Growth Utilization Solicitation, issued in collaboration with multiple service providers (non-monetary)

Closed, awarded in Q1 (awardees noted in report Appendix):

- Rodent Research Reference Mission-1: Applications for Spaceflight Biospecimens, issued in collaboration with Taconic Biosciences (rodent supplier, non-monetary) and BioServe Space Technologies (biospecimen administration, non-monetary) – 11 awardees to date
- FY19 Technology in Space Prize, co-sponsored by Boeing ($500K total) in association with MassChallenge Boston (non-monetary) – 3 awardees

For full information on research opportunities, see www.issnationallab.org/research-on-the-iss/solicitations

Appendix

Full R&D Portfolio

For full details about the projects listed here, see https://projects.issnationallab.org
New Q1 awardees are bolded

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Capillary-Driven Microfluidics in Space	1Drop Diagnostics US, Inc.	Dr. Luc Gervais	Preflight
Multipurpose Active Target Particle Telescope on the ISS	AIRBUS DS Space Systems, Inc.	Dr. Hans-Juergen Zachrau	Preflight
Materials International Space Station Experiment (MISSE) Flight Facility	Alpha Space	Stephanie Murphy	Preflight
ARISS (Amateur Radio from ISS) - 2019	**AMSAT (Radio Amateur Satellite Corporation)**	**Frank Bauer**	**Preflight**
Targeted Nanoparticles for Orphan and Chronic Diseases	Aphios Corporation	Trevor Castor	Preflight
The Universal Manufacture of Next Generation Electronics	Astrileux Corporation	Supriya Jaiswal	Preflight
Investigation of Deep Audio Analytics on the International Space Station	Astrobotic Technology Inc.	Andrew Horchler	Preflight
Thermally Activated Directional Mobility of Vapor Bubbles	Auburn University	Sushil Bhavnani	Preflight
Audacy Lynq	Audacy Corporation	Ellaine Talle	Preflight
Microgravity as Disruptor of the 12-hour Circatidal Clock	Baylor College of Medicine	Dr. Brian York	Preflight
Flow Chemistry Platform	Boston University	Dr. Aaron Beeler	Preflight
Cranial Bone Marrow Stem Cell Culture in Space	Brigham and Women's Hospital	Dr. Yang (Ted) D. Teng	Preflight
Structural and crystallization kinetics analysis of monoclonal antibodies	Bristol Meyers Squibb	Dr. Robert Garmise	Preflight
Electrolytic Gas Evolution under Microgravity	Cam Med, LLC	Mr. Larry Alberts	Preflight
Study of the Interactions between Flame and Surrounding Walls	Case Western Reserve University	Ya-Ting Liao	Preflight
Investigating Proliferation of NanoLaze Gene-edited Induced Pluripotent	Cellino Biotech, Inc.	Matthias Wagner	Preflight
Unlocking the Cotton Genome to Precision Genetics	Clemson University	Christopher A. Saski	Preflight
Effect of Environmental Stressors on Oral Biofilm Growth and Treatment	Colgate-Palmolive	Shira Pilch	Preflight
Microgravity Effects on Skin Aging and Health	Colgate-Palmolive	Laurence Du-Thumm	Preflight
Inertial Spreading and Imbibition of a Liquid Drop Through a Porous Surface	Cornell University	Dr. Michel Louge	Preflight
Unmasking Contact-line Mobility for Inertial Spreading using Drop Vibration	Cornell University	Dr. Paul Steen	Preflight
Space Development Acceleration Capability (SDAC)	Craig Technologies	Ryan Jeffrey	Preflight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Droplet Formation Studies in Microgravity	Delta Faucet	Garry Marty	Preflight
Microgravity Crystallization of Glycogen Synthase-Glycogenin Protein Complex	Dover Lifesciences	Dr. David S. Chung	Preflight
Generation of Cardiomyocytes from Induced Pluripotent Stem Cells	Emory University	Dr. Chunhui Xu	Preflight
Effects of Microgravity on Human Physiology: Blood-Brain Barrier Chip	Emulate, Inc.	Dr. Chris Hinojosa	Preflight
Organ-Chips as a Platform for Studying Human Enteric Physiology	Emulate, Inc.	Dr. Chris Hinojosa	Preflight
Fiber Optics Manufacturing in Space (FOMS)-No Cost Extension	FOMS Inc.	Dr. Dmitry Starodubov	Preflight
MISSE Variant 2 Exposure of Photovoltaic Cells on the ISS	Georgia Institute of Technology	Dr. Jud Ready	Preflight
Pushing the Limits of Silica Fillers for Tire Applications	Goodyear Tire & Rubber Co.	Derek Shuttleworth	Preflight
Convection-free Synthesis of 2D Nanomaterials	Guardion Technologies	Mr. Dan Esposito	Preflight
3-D printed RF Systems and Materials for High Frequency Communications	Harris Corporation	Dr. Arthur Paollela	Preflight
BioChip Spacelab	HNu Photonics, LLC	Dr. Dan O'Connell	Preflight
Influence of Microgravity on Neurogenesis	HNu Photonics, LLC	Dr. Caitlin O'Connell	Preflight
Ionic Liquid CO2 Scrubber and Liquid Containment in Microgravity	Honeywell International	Phoebe Henson	Preflight
Study of Lamborghini's Carbon Fiber Composites for Aerospace Applications	Houston Methodist Research Institute	Dr. Alessandro Grattoni	Preflight
Intuitive Machines-ISS Terrestrial Return Vehicle (TRV)	Intuitive Machines	Mr. Steve Altemus	Preflight
GLASS AIS Transponder Global AIS on Space Station (GLASS)	JAMSS America, Inc.	Rob Carlson	Preflight
Three-dimensional Microbial Mapping (3DMM) of ISS Environment	Jet Propulsion Laboratory/Caltech	Dr. Kasthuri Venkateswaran	Preflight
A Mouse Model to Characterize Ocular Risks of Spaceflight	**KBRwyle**	**Dr. Susana Zanello**	**Preflight**
Low-Earth Orbit Exposome by Holistic Multidimensional Chromatin Interrogation	**KBRwyle**	**Dr. Susana Zanello**	**Preflight**
Leveraging µg to screen onco-selective messenger RNAs	**Kernal Biologics**	**Dr. Yusuf Erkul**	**Preflight**
Remote Manipulator Small-Satellite System (RM3S)	LaMont Aerospace	Craig Walton	Preflight
AstroRad Vest - ISSNL Co-Sponsored Project	Lockheed Martin Corporation	Mr. Jerry Posey	Preflight
Test Multilayer Polymer Convection and Crystallization Under Microgravity	Lux Labs	Dr. Yichen Shen	Preflight
Commercial Polymer Recycling Facility (CPRS)	Made In Space	Mr. Matthew Napoli	Preflight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Utilizing the MISSE Platform Materials Science in Space	Made In Space	Mr. Paul Shestople	Preflight
AmpliRx: A Manufacturing Pharmaceutical Lightweight Instrument	MakerHealth	Anna Young	Preflight
Cartilage-Bone-Synovium Microphysiological System	Massachusetts Institute of Technology	Dr. Alan Grodzinsky	Preflight
Monoclonal Antibody Production and Stability in Microgravity	Medimmune, LLC	Dr. Albert Ethan Schmelzer	Preflight
Preparation of PLGA Nanoparticles Based on Precipitation Technique	Medimmune, LLC	Dr. Puneet Tyagi	Preflight
Crystallize an oncologically important protein to promote therapeutic discovery	**MicroQuin**	**Scott Robinson**	**Preflight**
Investigation of key signaling cascades involved in tumorigenesis	**MicroQuin**	**Scott Robinson**	**Preflight**
Crystallization on the Synchrony and Uniformity of an RNA Crystal Phase	National Cancer Institute	Dr. Yun-Xing Wang	Preflight
National Cancer Institute NExT Space Crystallization Program	National Cancer Institute	Dr. Barbara Mroczkowski	Preflight
Nemak Alloy Solidification Experiments	NEMAK	Dr. Glenn Byczynski	Preflight
Nonequilibrium Processing of Particle Suspensions	New Jersey Institute of Technology	Boris Khusid	Preflight
Non-Newtonian Fluids in Microgravity a.k.a. “Slime in Space”	Nickelodeon	Andrew Machles	Preflight
Map the Penetration Profile of a Contact-free Transdermal Drug Delivery System	Novopyxis	Dr. Robert Applegate	Preflight
Tissue Engineered Muscle as a Novel Platform to Study Sarcopenia	Palo Alto Veterans Research Institute	Dr. Ngan Huang	Preflight
Microgravity effect on Entomopathogenic Nematodes	Pheronym, Inc.	Dr. Fatma Kaplan	Preflight
Fiber Optic Production	Physical Optics Corporation	Mr. Amrit De	Preflight
Microgravity Crystal Growth of Photovoltaic Semiconductor Materials	Princeton University	Ms. Jessica Frick	Preflight
Faraday Research Facility Commercialization	ProXopS, LLC	Mr. Chad Brinkley	Preflight
Constrained Vapor Bubbles of Ideal Mixtures	Rensselaer Polytechnic Institute	Dr. Joel Plawsky	Preflight
Influence of Gravity on Human Immune Function in Adults and the Elderly	Sanofi Pasteur	Dr. Donald Drake	Preflight
MDCK Influenza Virus Infection	Sanofi Pasteur	Dr. Philippe-Alexandre Gilbert	Preflight
Slingshot Facility Commercialization	SEOPS, LLC	Chad Brinkley	Preflight
Project Meteor	Southwest Research Institute	Mr. Michael Fortenberry	Preflight
Effect of Microgravity on Drug Responses Using Engineered Heart Tissues	Stanford University	Dr. Joseph Wu	Preflight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Single-cell and whole-organ transcriptomics and proteomics of 20 mouse organs	**Stanford University**	**Mr. Nicholas Schaum**	**Preflight**
ISS Bioprinter Facility	Techshot, Inc.	Dr. Gene Boland	Preflight
Windows On Earth	TERC	David Libby	Preflight
Genes in Space - 6	The Boeing Company	David Li, Michelle Sung, Aarthi Vijayakumar, and Rebecca Li	Preflight
Lung Host Defense in Microgravity	The Children's Hospital of Philadelphia	Dr. G Scott Worthen	Preflight
ISS: Liver Tissue Engineering in Space	University of California, San Francisco	Dr. Tammy T. Chang	Preflight
Kinetics of Nanoparticle Self-assembly in Directing Fields	University of Delaware	Dr. Eric Furst	Preflight
An ISS Experiment on Electrodeposition	University of Florida	Dr. Kirk Ziegler	Preflight
Spaceflight Effects on Vascular Endothelial and Smooth Muscle Cell Processes	University of Florida	Dr. Josephine Allen	Preflight
Electrical Stimulation of Human Myocytes in Microgravity	University of Florida	Dr. Siobhan Malany	Preflight
Spherical Cool Diffusion Flames Burning Gaseous Fuels	University of Maryland	Peter Sunderland	Preflight
Gravitational Regulation of Osteoblast Genomics and Metabolism Supplement	**University of Minnesota**	**Dr. Bruce Hammer**	**Preflight**
The Impact of Nanostructure Geometry on Photo-Thermal Evaporation Processes	University of Notre Dame	Tengfei Luo	Preflight
Advanced Histological Analysis of the Effects of Microgravity	**University of Southern California**	**Dr. Mark Humayun**	**Preflight**
Microgravity Crystal Growth for Improvement in Neutron Diffraction	University of Toledo	Dr. Timothy Mueser	Preflight
Human iPSC-based 3D Microphysiological System for Modeling Cardiac Dysfunction	University of Washington	Dr. Deok-Ho Kim	Preflight
Structure of Proximal and Distal Tubule Microphysiological Systems	University of Washington	Dr. Jonathan Himmelfarb	Preflight
Crystal Growth STEM 2018	University of Wisconsin - Madison	Ilia Guzei	Preflight
Targeting the Roots of Cotton Sustainability	University of Wisconsin - Madison	Dr. Simon Gilroy	Preflight
Rodent Research - 4 (Wound Healing) Post Flight Analysis	US Army Center for Environmental Health Research	Dr. Rasha Hammamieh	Preflight
Neutron Crystallographic Studies of Human Acetylcholinesterase	UT Battelle Oak Ridge National Lab	Dr. Andrey Kovalevsky	Preflight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Transcriptomic analyses of age-related changes in muscle and bone	**Virginia Commonwealth University**	**Dr. Henry Donahue**	**Preflight**
Space Based Optical Tracker	Vision Engineering Solutions	Dr. John Stryjewski	Preflight
Bartolomeo External Platform Commercialization	AIRBUS DS Space Systems, Inc.	Mr. Kris Kuehnel	N/A
Axiom Space Partnership	Axiom Space, LLC	Christian Maender	N/A
Bigelow Expandable Activity Module (BEAM) Commercialization	Bigelow Space Operations, Inc.	Robert Bigelow	N/A
Made In Space Partnership	**Made In Space**	**Mr. Matthew Napoli**	**N/A**
Orion's Quest-Student Research on the ISS	Orions Quest	Peter Lawrie	N/A
Sierra Nevada Partnership	Sierra Nevada Corporation	Christopher Allison	N/A
STFS Blast Off! STFS: Engaging Young Learners in STEM and Literacy	**Twin Cities PBS**	**Rita Karl**	**N/A**
Growing Quality Crystals for Bio-Macromolecule Neutron Crystallographic Studies	UT Battelle Oak Ridge National Lab	Dr. Andrey Kovalevsky	N/A
3D Neural Microphysiological System	AxoSim Technologies	Dr. Michael Moore	Ground Validation Study
Microgravity As A Stress Accelerator for Omic Profiling of Human Disease	Baylor College of Medicine	Dr. Clifford Dacso	Ground Validation Study
Cellular and molecular changes induced by absence of gravity	**Biogen**	**Giulio Tomassy**	**Ground Validation Study**
Remote Controlled Nanochannel Implant for Tunable Drug Delivery	Houston Methodist Research Institute	Dr. Alessandro Grattoni	Ground Validation Study
Structural and Biochemical Changes of Craniofacial bones and Long bone	**LaunchPad Medical**	**Michael Brown**	**Ground Validation Study**
Unfolded Protein Response in Osteoporosis and Sarcopenia	Louisiana State University Health Sciences Center	Dr. Imran Mungrue	Ground Validation Study
RNA Profiling of Mouse Tissues to Support Open Science	**NASA ARC**	**Dr. Afshin Beheshti**	**Ground Validation Study**
Evaluation of the microbiota of the gastrointestinal tract	**Northwestern University**	**Martha Vitaterna**	**Ground Validation Study**
National Design Challenge - 4 Talbot	Talbot Innovation Middle School	Mr. Benjamin Coleman	Ground Validation Study
MALDI Imaging of Microgravity Exposed Rodent Brain	**United States Air Force**	**Correy Vigil**	**Ground Validation Study**

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Combined Evaluation of Mouse Musculoskeletal Data	University of Colorado Boulder	Dr. Virginia Ferguson	Ground Validation Study
Evaluation of Microgravity on Ovarian Estradiol Production	**University of Kansas Medical Center**	**Dr. Lane Christenson**	**Ground Validation Study**
Microphysiological System for Studying Composite Skeletal Tissues	University of Pittsburgh	Dr. Rocky S. Tuan	Ground Validation Study
Field Scale, Aggregated Best Management Practice Verification and Monitoring	Upstream Tech	Marshall Moutenot	Ground Validation Study
Commercialization of the GLASS Payload	Adcole Maryland Aerospace, LLC	Mr. Darko Filipi	Flight
Barley Germination and Malting in Microgravity Objective 3 (1 & 2 complete)	Budweiser	Gary Hanning	Flight
Design of Scalable Gas Separation Membranes via Synthesis under Microgravity	Cemsica	Ms. Negar Rajabi	Flight
Providing Spherical Video Tours of ISS	Deep Space Industries	Mr. David Gump	Flight
Crystallization of RAS in Space	Frederick National Laboratory for Cancer Research	Dr. Dhirendrea Shimanshu	Flight
Spaceborne Computer	Hewlett Packard	Mr. David Petersen	Flight
Detached Melt and Vapor Growth of Indium Iodide	Illinois Institute of Technology	Dr. Aleksandar Ostrogorsky	Flight
Enhancement of Performance and Longevity of a Protein-Based Retinal Implant	LambdaVision	Dr. Nicole L. Wagner	Flight
Additive Manufacturing Operations Program	Made In Space	Mr. Michael Snyder	Flight
Marvel STEM Competition-Team Groot	Marvel Custom Solutions	Mitch Dane	Flight
Marvel STEM Competition-Team Rocket	Marvel Custom Solutions	Mitch Dane	Flight
SPHERES-ReSwarm	Massachusetts Institute of Technology	Prof. David Miller	Flight
Spacewalk: A Virtual Reality Experience	Meredith Corporation	Mr. Mia Tramz	Flight
Microfluidic Lab-on-a Chip to Track Biomarkers in Skeletal Muscle Cells	Micro-gRx, Inc.	Dr. Siobhan Malany	Flight
Biofilm Thickness/Viability and Elevated Microbial Corrosion Risk	Nalco Champion	Dr. Vic Keasler	Flight
NanoRacks External Platform	NanoRacks, LLC	Michael Johnson	Flight
Metal Additive Manufacturing Aluminum Alloy Satellite Antennas	Optisys	Michael Hollenbeck	Flight
Furphy-Residual Momentum and Tank Dynamics	Orbit Fab	Mr. Daniel Faber	Flight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Orbital Sidekick ISS Hyperspectral Earth Imaging System Trial	Orbital Sidekick	Mr. Daniel Katz	Flight
A SiC UV Sensor for Reliable Operation in Low Earth Orbit	Ozark Integrated Circuits, Inc.	Jim Holmes	Flight
Crystal Growth of Cs2LiYCl6:Ce Scintillators in Microgravity	Radiation Monitoring Devices, Inc.	Joshua Tower	Flight
TangoLab-1: Research Server for the ISS	Space Tango, Inc.	Twyman Clements	Flight
TangoLab-2	Space Tango, Inc.	Twyman Clements	Flight
STaARS-1 Research Facility	Space Technology and Advanced Research Systems Inc. (STaARS)	Dr. Heath Mills	Flight
Bone Densitometer	Techshot, Inc.	Mr. John Vellinger	Flight
Tympanogen - Wound Healing	Tympanogen, LLC	Dr. Elaine Horn-Ranney	Flight
Space-Based Ubiquitous Cellular Phone Connectivity	UbiquitiLink, Inc.	Mr. Tyghe Speidel	Flight
Microgravity Model for Immunological Senescence on Tissue Stem Cells	University of California, San Francisco	Dr. Sonja Schrepfer	Flight
Quantifying Cohesive Sediment Dynamics for Advanced Environmental Modeling	University of California, Santa Barbara	Dr. Paolo Luzzatto-Fegiz	Flight
Tropical Cyclone Intensity Measurements from the ISS (CyMISS) 2017/2018/2019	Visidyne, Inc.	Dr. Paul Joss	Flight
Comparative Real-time Metabolic Activity Tracking	490 Biotech, Inc.	Dr. Gary Sayler	Postflight
SPHERES Tether - Slosh	AIRBUS DS Space Systems, Inc.	Dr. Hans-Juergen Zachrau	Postflight
Endothelial Cells In Microgravity for Evaluation of Cancer Therapy Toxicity	Angiex	Dr. Shou-Ching Jaminet	Postflight
Implantable Glucose Biosensors	Biorasis, Inc.	Dr. Michail Kastellorizios	Postflight
SG100 Cloud Computing Payload	Business Integra Technology Solutions (BI Tech)	Mr. Trent Martin	Postflight
National Design Challenge - 1 Cristo Rey	Cristo Rey Jesuit College Preparatory of Houston	Rev. Brian Reedy	Postflight
Tomatosphere Aims 1 & 2	First the Seed Foundation	Ann Jorss	Postflight
Development and Deployment of Charge Injection Device Imagers	Florida Institute of Technology	Dr. Daniel Batcheldor	Postflight
Materials Testing Earth Abundant Textured Thin Film Photovoltaics (Post flight)	Georgia Institute of Technology	Dr. Jud Ready	Postflight
Implantable Nanochannel System for Delivery of Therapeutics for Muscle Atrophy	Houston Methodist Research Institute	Dr. Alessandro Grattoni	Postflight
Assessing Osteoblast Response to Tetranite	LaunchPad Medical	Brian Hess	Postflight
Effects of Microgravity on Production of Fluoride-Based Optical Fibers	Made In Space	Mr. Michael Snyder	Postflight

Project/Program Title	Affiliation	Principal Investigator	Payload Status
Merck Protein Crystal Growth - 3	Merck Pharmaceuticals	Dr. Paul Reichert	Postflight
Crystallization of LRRK2 under Microgravity Conditions (Reflight)	Michael J. Fox Foundation	Dr. Marco Baptista	Postflight
Magnetic 3D Cell Culture for Biological Research in Microgravity	Nano3D Biosciences, Inc.	Dr. Glauco Souza	Postflight
Efficacy and Metabolism of Azonafide Antibody-Drug Conjugates (ADCs)	Oncolinx Pharmaceuticals LLC	Mr. Sourav Sinha	Postflight
Intraterrestrial Fungus Grown in Space (iFunGIS)	Space Technology and Advanced Research Systems Inc. (STaARS)	Dr. Heath Mills	Postflight
Windows on Earth - Earth Videos with a Related Education Program	TERC	David Libby	Postflight
Enhance the Biological Production of the Biofuel Isobutene (Reflight)	University of Alaska - Anchorage	Mr. Brandon Briggs	Postflight
Conversion of Adipogenic Mesenchymal Stem Cells into Mature Cardiac Myocytes	University of Houston	Dr. Robert Schwartz	Postflight
Crystal Growth STEM 2017	University of Wisconsin - Madison	Ilia Guzei	Postflight
Materials Testing: The Evaluation of Gumstix Modules in Low Earth Orbit	Yosemite Space	Dr. Kathleen Morse	Postflight
Corrosion Inhibitor Exposed to the Extreme Environments in Space	A-76 Technologies, LLC	Ms. Lauren Thompson Miller	Complete
SiC Microgravity Enhanced Electrical Performance	ACME Advanced Materials	Rich Glover	Complete
Technology Readiness Level Raising of the Net Capture System	AIRBUS DS Space Systems, Inc.	Mr. Ron Dunklee	Complete
BCM-Dept. of Molecular & Cellular Biology OMICS Seed Grant (original)	Baylor College of Medicine	Dr. Clifford Dacso	Complete
Longitudinal Assessment of Intracranial Pressure During Prolonged Spaceflight	Baylor College of Medicine	Dr. Clifford Dacso	Complete
National Design Challenge - 2 Bell	Bell Middle School	Ms. Shanna Atzmiller	Complete
Optimizing Jammable Granular Assemblies in a Microgravity Environment	Benevolent Technologies for Health	Jason Hill	Complete
Protein Crystal Growth to Enable Therapeutic Discovery (Clifton)	Beryllium Discovery Corp.	Dr. Matt Clifton	Complete
Commercial Space-borne Hyperspectral Harmful Algal Bloom (HAB) Products	BioOptoSense, LLC	Dr. Ruhul Amin	Complete
Ants in Space	BioServe Space Technologies	Ms. Stefanie Countryman	Complete
Osteocyte Response to Mechanical Forces	Boston University	Dr. Paola Divieti Pajevic	Complete
National Design Challenge - 3 McFarland	Boy Scouts of America	Norman McFarland	Complete
National Design Challenge - 3 Rogers	Boy Scouts of America	Dr. Sandra Rogers	Complete
ARQ: A Platform for Enhanced ISS Science and Commercialization	bSpace Corporation	Mr. Jason Budinoff	Complete

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Crystallization of Huntington Exon-1 Using Microgravity	California Institute of Technology	Dr. Pamela Bjorkman	Complete
National Design Challenge - 2 Centaurus	Centaurus High School	Mr. Brian Thomas	Complete
National Design Challenge - 2 Chatfield	Chatfield Senior High School	Mr. Joel Bertelsen	Complete
Microgravity Electrodeposition Experiment	Cobra Puma Golf	Mr. Michael Yagley	Complete
National Design Challenge - 4 Collins	Collins Middle School	Matthew Weaver	Complete
Controlled Dynamics Locker for Microgravity Experiments on ISS	Controlled Dynamics Inc.	Dr. Scott A. Green	Complete
Spacecraft-on-a-Chip Experiment Platform	Cornell University	Dr. Mason Peck	Complete
DexMat CASIS CNT Cable Project	DexMat, Inc.	Dr. Alberto Goenaga	Complete
National Design Challenge - 1 Duchesne Duquesnay	Duchesne Academy of the Sacred Heart	Kathy Duquesnay	Complete
National Design Challenge - 1 Duchesne Knizner	Duchesne Academy of the Sacred Heart	Susan Knizner	Complete
Survivability of Variable Emissivity Devices for Thermal Control Applications	Eclipse Energy Systems, Inc.	Dr. Hulya Demiryont	Complete
Dissolution of Hard-to-Wet Solids	Eli Lilly and Company	Alison Campbell	Complete
Eli Lilly - Protein Crystal Growth 1	Eli Lilly and Company	Mr. Kristofer Gonzalez-DeWhitt	Complete
Eli Lilly - Protein Crystal Growth 2	Eli Lilly and Company	Michael Hickey	Complete
Lyophilization in Microgravity (Reflight)	Eli Lilly and Company	Mr. Jeremy Hinds	Complete
Rodent Research - 3	Eli Lilly and Company	Dr. Rosamund Smith	Complete
Generation of Cardiomyocytes from Human Induced Pluripotent Stem Cells	Emory University	Dr. Chunhui Xu	Complete
Testing TiSi2 Nanonet Based Lithium Ion Batteries for Safety in Outer Space	EnerLeap	Emily Fannon	Complete
Exploiting On-orbit Crystal Properties for Medical and Economic Targets	Hauptman Woodward Medical Research Institute, Inc.	Dr. Edward Snell	Complete
Growth Rate Dispersion as a Predictive Indicator for Biological Crystal Samples	Hauptman Woodward Medical Research Institute, Inc.	Dr. Edward Snell	Complete
Decoupling Diffusive Transport Phenomena in Microgravity	Houston Methodist Research Institute	Dr. Alessandro Grattoni	Complete
The Effect of Microgravity on Stem Cell Mediated Recellularization	Houston Methodist Research Institute	Dr. Alessandro Grattoni	Complete
Architecture to Transfer Remote Sensing Algorithms from Research to Operations	HySpeed Computing	Dr. James Goodman	Complete
Rodent Research-4 Validation Study	Indiana University Research	Dr. Melissa Kacena	Complete
IPPase Crystal Growth in Microgravity	iXpressGenes, Inc.	Dr. Joseph Ng	Complete
Global Receive Antenna and Signal Processor (GRASP)	JAMSS America, Inc.	Rob Carlson	Complete

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Molecules Produced in Microgravity from the Chernobyl Nuclear Accident	Jet Propulsion Laboratory/Caltech	Dr. Kasthuri Venkateswaran	Complete
Improving Astronaut Performance of National Lab Research Tasks	Juxtopia, LLC	Dr. Jayfus Doswell	Complete
Role Of Gravity And Geomagnetic Field In Flatworm Regeneration	Kentucky Space, LLC	Dr. Mahendra Jain	Complete
Functional Effects of Spaceflight on Cardiovascular Stem Cells	Loma Linda University	Dr. Mary Kearns-Jonker	Complete
Viral Infection Dynamics and Inhibition by the Vecoy Nanotechnology	Lovelace Respiratory Research Institute	Dr. Drew Cawthon	Complete
Classrooms in Space	Magnitude.io	Mr. Ted Tagami	Complete
Application of Microgravity Expanded Stem Cells in Regenerative Medicine	Mayo Clinic	Dr. Abba Zubair	Complete
Great Lakes Specific HICO Water Quality Algorithms	Michigan Technological University	Dr. Robert Shuchman	Complete
Vertical Burn	Milliken	Dr. Jeff Strahan	Complete
Dependable Multi-processor Payload Processor Validation	Morehead State University	Dr. Benjamin Malphrus	Complete
Proof-of-Concept for Gene-RADAR Predictive Pathogen Mutation Study	Nanobiosym	Dr. Anita Goel	Complete
Validation of WetLab-2 System for qRT-PCR capability on ISS	NASA ARC	Ms. Julie Schonfeld	Complete
National Ecological Observatory Network (NEON)	National Ecological Observatory Network (NEON)	Brian Penn	Complete
The Effects of Microgravity on Synovial Fluid Volume and Composition	National Jewish Health	Dr. Richard Meehan	Complete
Impact of Increased Venous Pressure on Cerebral Blood Flow Velocity Morphology	Neural Analytics	Dr. Robert Hamilton	Complete
T-Cell Activation in Aging-1 & 2	Northern California Institute for Research and Education, Inc.	Dr. Millie Hughes-Fulford	Complete
Rodent Research - 1	Novartis Institute for Biomedical Research	Dr. David Glass	Complete
Rodent Research - 2	Novartis Institute for Biomedical Research	Dr. David Glass	Complete
Zero-G Characterization & OnOrbit Assembly for Cellularized Satellite Tech	NovaWurks, Inc	Talbot Jaeger	Complete
Low Phase Gravity Kinetics	Procter and Gamble Company	Dr. Matthew Lynch	Complete
Protein Crystal Growth to Enable Therapeutic Discovery (Gerdts)	Protein BioSolutions	Dr. Cory Gerdts	Complete
Microbead Fabrication using Rational Design Engineering	Quad Technologies	Dr. Brian Plouffe	Complete
Utilize ISS Energy Systems Data for Microgrid Design and Operation	Raja Systems	Nicholas Kurlas	Complete
Synthetic Muscle: Resistance to Radiation	Ras Labs	Dr. Lenore Rasmussen	Complete

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Using the ISS to Evaluate Antibiotic Efficacy and Resistance (AES-1)	Regents of the University of Colorado	Dr. David Klaus	Complete
Crystallization of Medically Relevant Proteins Using Microgravity	Saint Louis University	Dr. Sergey Korolev	Complete
High Data Rate Polarization Modulated Laser Communication System	Schafer Corporation	Dr. Eric Wiswell	Complete
Reducing Signal Interruption from Cosmic Ray Background in Neutron Detectors	Silverside Detectors	Dr. Andrew Inglis	Complete
Hyperspectral Mapping of Iron-bearing Minerals	Space Science Institute	Dr. William H. Farrand	Complete
Intracellular Macromolecule Delivery and Cellular Biomechanics in Microgravity	SQZ Biotechnologies	Mr. Harrison Bralower	Complete
Effects of Microgravity on Stem Cell-Derived Heart Cells	Stanford University	Dr. Joseph Wu	Complete
Mutualistic Plant/Microbe Interactions	SyNRGE, LLC	Dr. Gary Stutte	Complete
Examine Bone Tumor and Host Tissue Interactions Using Micro-Gravity Bioreactors	Texas A&M Health Science Center	Dr. Carl Gregory	Complete
National Design Challenge - 1 Awtry Glidwell	The Awty International School	Angela Glidwell	Complete
National Design Challenge - 1 Awty Smith	The Awty International School	Jessika Smith	Complete
Genes In Space	The Boeing Company	Anna-Sophia Boguraev	Complete
Genes in Space - 2	The Boeing Company	Julian Rubinfien	Complete
Genes in Space - 5 Lakeside	The Boeing Company	Sophia Chen	Complete
Genes in Space - 5 Stuyvesant	The Boeing Company	Elizabeth Reizis	Complete
Street View Imagery Collect on ISS	ThinkSpace	Anna Kapusta	Complete
Crystallization of Human Membrane Proteins in Microgravity	University of Alabama at Birmingham	Dr. Stephen Aller	Complete
The Effect of Macromolecular Transport on Microgravity PCG	University of Alabama at Birmingham	Dr. Lawrence ("Larry") DeLucas	Complete
Systemic Therapy of NELL-1 for Osteoporosis (Rodent Research - 5)	University of California, Los Angeles	Dr. Chia Soo	Complete
Domesticating Algae for Sustainable Production of Feedstocks in Space	University of Florida	Dr. Mark Settles	Complete
Characterizing Arabidopsis Root Attractions (CARA) Grant Extension	University of Florida	Dr. Anna-Lisa Paul	Complete
Molecular Biology of Plant Development	University of Florida	Dr. Anna-Lisa Paul	Complete
Faraday Waves and Instability-Earth and Low G Experiments	University of Florida	Dr. Ranga Narayanan	Complete
Generation of Mesendoderm Stem Cell Progenitors in the ISS-National Laboratory	University of Houston	Dr. Robert Schwartz	Complete

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Hyperspectral Remote Sensing of Terrestrial Ecosystem Carbon Fluxes	University of Maryland Baltimore County	Dr. K. Fred Huemmrich	Complete
Effects of Simulated Microgravity on Cardiac Stem Cells	University of Miami	Dr. Joshua Hare	Complete
Gravitational Regulation of Osteoblast Genomics and Metabolism	University of Minnesota	Dr. Bruce Hammer	Complete
Protein Crystal Growth for Determination of Enzyme Mechanisms	University of Toledo	Dr. Constance Schall	Complete
Identification of Harmful Algal Blooms	University of Toledo	Dr. Richard Becker	Complete
Drug Development and Human Biology: Use of Microgravity for Drug Development	Veterans Administration Medical Center	Dr. Timothy Hammond	Complete
Tropical Cyclone Intensity Measurements from the ISS (CyMISS)	Visidyne, Inc.	Dr. Paul Joss	Complete
Tropical Cyclone Intensity Measurements from the ISS (CyMISS) 2015 Season	Visidyne, Inc.	Dr. Paul Joss	Complete
Continuous Liquid-Liquid Separation in Microgravity	Zaiput Flow Technologies	Dr. Andrea Adamo	Complete