CASIS

FY18 Q1 REPORT

Quarterly Report for the Period October 1 – December 31, 2017

CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE (CASIS)

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EXECUTIVE SUMMARY

The Center for the Advancement of Science in Space (CASIS) started off strong in the new fiscal year, carrying momentum from a highly productive year in 2017 as managers of the U.S. National Laboratory on the International Space Station (ISS). The first quarter of fiscal year 2018 contained multiple rocket launches carrying ISS National Lab research, valuable repeat collaborations with government organizations, and new partnerships with commercial companies.

HIGHLIGHTS FROM THE QUARTER INCLUDE:

- Orbital ATK conducted its eighth space station cargo resupply mission in November, ferrying a variety of projects sponsored by the ISS National Lab. Student experiments looking at biological components, new hardware systems validating enabling capabilities, cube satellites carrying biological experiments, and nontraditional payloads from prominent entertainment entities such as National Geographic all seek to use the ISS to benefit life on Earth. Media coverage of this launch was visible in multiple prominent outlets including *Wired* and space industry publications.
- Over the past four years, CASIS has partnered with The Boeing Company to fund research opportunities onboard the ISS National Lab through the world's largest startup accelerator, MassChallenge. During the MassChallenge Boston competition awards ceremony, CASIS and Boeing leadership selected three flight concepts as part of the "Technology in Space" sidecar prize to the competition. Including this latest collaboration, CASIS and Boeing have jointly partnered to fund 11 innovative startups through MassChallenge.
- The continued growth of multi-year research programs with both the National Institutes of Health (NIH) and the National Science Foundation (NSF) underscore the increasing value that these esteemed organizations are seeing in their spaceflight research portfolio. In Q1, CASIS and the NSF announced two solicitations to fund space-based research in tissue engineering and fluid dynamics, respectively. These complement two previous successful solicitations that the NSF has funded in partnership with CASIS. Additionally, CASIS and the National Center for Advancing Translational Sciences (NCATS) and the National Institute of Biomedical Imaging and Bioengineering (NIBIB)—both part of the NIH—issued a funding opportunity building on a previous CASIS–NCATS solicitation supporting tissue chip research. These "Sponsored Programs" with NIH, NSF, and others have committed more than $30 million in funding toward ISS National Lab R&D to date.
- CASIS participated in a number of conferences and events to promote new research, partnerships, and opportunities associated with the ISS National Lab, including the annual meeting for the American Society for Gravitational and Space Research and SpaceCom. Additionally, CASIS partnered with NASA's ISS Program Science Office to meet with multiple luminary companies including IBM Watson, PepsiCo, and Colgate-Palmolive during a recent Destination Station in the New York City area.
- SpaceX's 13th ISS resupply mission marked the 2nd successful ISS commercial resupply launch of the quarter and carried a variety of compelling research payloads. These included a project in technology development for a glucose biosensor for day-to-day diabetes management (sponsored by Boeing through the MassChallenge), new in-orbit manufacturing capabilities from service provider Made In Space, and rodent research using implantable devices for drug delivery. The launch also featured non-traditional research partner Budweiser, who is growing and evaluating barley strains in space to better enhance its products and agricultural knowledge on Earth. These various investigations brought an incredible amount of publicity to the ISS National Lab, including coverage from *Time Magazine, CNN, Yahoo, The Washington Post, Popular Mechanics,* and *Forbes* (among many others). This launch was a powerful example of how combining cutting-edge research with recognizable brand partnerships brings heightened awareness to the opportunities available through R&D onboard the ISS National Lab.

These highlights demonstrate continued progress toward ISS National Lab objectives for demand creation, sponsored program expansion, outreach and awareness, and ISS utilization. CASIS is encouraged by the growing interest in the ISS as a research platform from both CASIS-facilitated customers as well as direct user business from a growing number of commercial services providers. In recognition of this dynamic marketplace, CASIS will host a dedicated workshop in January 2018 with implementation partners and commercial services providers to explore additional ways for the ISS National Lab to support the growth and development of these innovative companies. This workshop is another positive step forward in the engagement and development of the ISS as a thriving platform for commercial opportunities.

RECENT ACTIVITIES WITHIN THE ISS NATIONAL LAB R&D PORTFOLIO

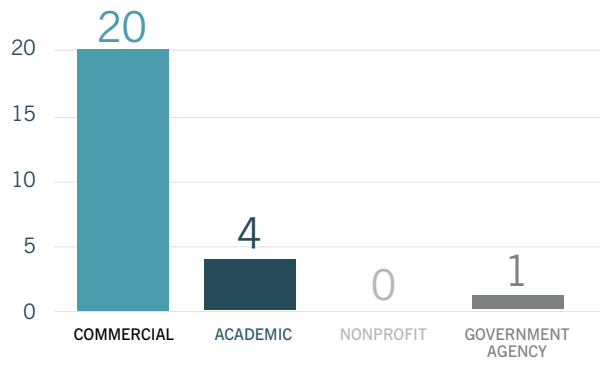
MAXIMIZING UTILIZATION AND DEMONSTRATING MEASURABLE IMPACT

As manager of the International Space Station (ISS) U.S. National Laboratory, CASIS seeks to maximize both utilization of in-orbit resources and downstream value to life on Earth. As part of these efforts, CASIS has developed methods of assessing the value creation of the projects in its portfolio. The projected value of the ISS National Lab portfolio (as of year-end FY17) has now exceeded $900 million in incremental revenue tied directly to ISS National Lab projects, and these projects address established markets of more than $110 billion in estimated value. Additional parameters indicating positive value to the nation include a time-to-market acceleration of 1–3 years and more than 20 new solution pathways (a measure of innovation that can lead to a major advance in knowledge or new intellectual property). These data are updated annually.

Operational Update: Launched Payloads

In quarter one of fiscal year 2018 (Q1FY18), 25 payloads were launched to the ISS National Lab, many containing multiple research experiments.

FIGURE 1: PAYLOADS LAUNCHED IN Q1, BY AFFILIATION



The majority of payloads launched in Q1 were from the commercial sector and included projects from Fortune Global 500 company Budweiser and a commercial collaboration with global nonprofit National Geographic. Projects were supported by payload developers NanoRacks, Space Tango, and STaARS, and several projects had educational outreach goals.

FIGURE 2: SELECTED HIGHLIGHTS FROM LAUNCHED PAYLOADS.

Note: not inclusive.

Launch Vehicle: Orbital ATK's 8th Commercial Resupply Services Mission (OA-8)

PROJECT INFORMATION	DESCRIPTION AND POTENTIAL IMPACT
NanoRacks-Cavalier Space Processor Michael Jones, U.S. Air Force (VA) *Payload Developer:* NanoRacks	A passive Earth remote sensor with onboard processing capability, developed in collaboration with the U.S. Department of Defense. Once positioned on the Japanese Experiment Module (JEM) Exposed Facility, following initial hosting on the NanoRacks External Platform, it will collect data for approximately six months.
Genes in Space-3 (Demo) Dr. Sarah Wallace, NASA Johnson Space Center (Houston, TX) *Payload Developer:* Boeing	This project seeks to demonstrate a robust DNA sample preparation process to enable biological monitoring aboard the ISS. The project joins two previously spaceflight-tested molecular biology tools, miniPCR and the MinION, along with some additional enzymes, to demonstrate DNA amplification, sample preparation for DNA sequencing, and sequencing of actual samples from the ISS. The Genes in Space-3 experiments demonstrate ways in which portable, real-time DNA sequencing can be used to assay microbial ecology, diagnose infectious diseases, and monitor crew health aboard the ISS.
LEMUR-2 Jenny Barna, Spire Global, Inc. (San Francisco, CA) *Payload Developer:* NanoRacks	About 90 percent of global trade is shipped by sea, but tracking of oceangoing ships is inefficient; many ships are unmonitored as they transit the world's oceans, far from land and out of range of ground-based beacons. The NanoRacks-LEMUR-2 satellites are part of a remote sensing satellite constellation that provides global ship tracking and weather monitoring. The satellites in this investigation are deployed from both the ISS and the visiting space vehicle, demonstrating the technology at a range of altitude bands.
The Effects of Microgravity on the Life Cycle of *Tenebrio molitor* Michelle Lucas, Higher Orbits (Leesburg, VA) *Payload Developer:* Space Tango	This experiment, which utilizes the TangoLab-1 facility aboard the ISS, is investigating how the microgravity environment of space affects the mealworm life cycle. Mealworms represent good test subjects because they are well-studied organisms with many of their genetic elements conserved in higher organisms. An automated laboratory apparatus images mealworm growth from larval to adult life stages and then returns samples to Earth-based labs for more detailed analysis. Higher Orbits is a nonprofit that supports educational objectives in science, technology, engineering, and mathematics (STEM), including a competition for high school students. This project was conceived by the Higher Orbits AIAA Division winning team – Operation Galaxy X (Herndon, VA).

Launch Vehicle: SpaceX's 13th Commercial Resupply Services Mission (SpX-13)

PROJECT INFORMATION	DESCRIPTION AND POTENTIAL IMPACT
Continuous Liquid-Liquid Separation in Microgravity Dr. Andrea Adamo, Zaiput Flow Technologies (Cambridge, MA) *Payload Developer:* Space Tango	This investigation is using a unique liquid-separation system that relies on surface forces to separate immiscible fluids and accomplish liquid-liquid extraction. Separation based on surface tension is thought to be a method independent of gravity; however, this has never been tested and the physics of the process remains, to some extent, unclear. By exploring the microgravity effects on the process, the system is further developed and understanding of the physics refined, potentially leading to use in chemical production on earth. This project originated from the Galactic Grant Competition, a Sponsored Program in collaboration with the Massachusetts Life Sciences Center.
Barley Germination and Malting in Microgravity Dr. Gary Hanning, Budweiser (Fort Collins, CO) *Payload Developer:* Space Tango	This project is exploring the effects of spaceflight on the germination of various strains of barley (*Hordeum vulgare*), including proprietary strains under development. Barley is the 4th largest cereal grain grown in the world and is grown in the most diverse environments. Barley is not only a human food source; it is also used in beer production and animal feed. Potential changes in climate may cause stressors that could impact where barley can be grown, as well as the amount of starch and the balance of proteins within the grain. Studying barley in microgravity may reveal new information regarding the germination process or confirm the stability of the grain in harsh environments of Earth-based stressors, such as temperature extremes or water shortage/overage.
DreamUp Xtronaut Crystal Growth Carie Lemack, DreamUP (Washington, DC) *Payload Developer:* NanoRacks	This program teaches students about the effects of microgravity on crystal formations using near-identical flight kits flown and operated aboard the ISS. With access to crew member videos and data on the same experiment, students are able compare crystal formations in space to those in their classrooms. The investigation aims to promote STEM fields to the next generation of students.

PROJECT INFORMATION	DESCRIPTION AND POTENTIAL IMPACT
National Geographic Channel – Virtual Reality Educational Video for Television Series – "One Strange Rock" Matthew Zymet, National Geographic (Washington, DC) *Payload Developer:* NanoRacks	This project is transporting a virtual reality camera to the ISS for recording of a National Geographic special on the Earth as a natural life-support system. Crew aboard the ISS record a series of virtual reality pieces for incorporation into a larger documentary about natural history and the solar system. Each episode features a different crew member and addresses different topics using next generation virtual reality technology to raise awareness about the Earth system and the space program.
Characterizing Arabidopsis Root Attractions - 2 Dr. Anna-Lisa Paul and Dr. Robert J. Ferl, University of Florida (Gainesville, FL) *Payload Developer:* NA	Plants cultivated in microgravity look mostly normal, but space-grown plants have a number of distinct features compared to plants grown in comparable habitats on Earth, most notably in the way their roots grow. This investigation is studying the molecular signals that can cause these changes, including the genetic underpinnings of how a plant senses the direction of gravity. Results can improve efforts to grow plants in microgravity on future space missions, enabling crews to use plants for food and oxygen.
STaARS Bioscience-5 Dr. Sarah Wallace, NASA Johnson Space Center (Houston, TX) *Payload Developer:* STaARS	This project is studying how *Staphylococcus aureus* loses its harmful properties and changes color in microgravity. Automated culturing equipment grows *S. aureus* before the cultures are delivered to an observation chamber for data collection at predetermined time points. To understand the growth rates and morphology of the bacterium for an extended growth period, a microscope and spectrophotometer are both used. Therapy derived from data collected during the study potentially helps the 30% of humans that naturally have *S. aureus* growing on their skin and may help in controlling the spread of this opportunistic pathogen.
The Life Cycle of *Arabidopsis thaliana* in Microgravity Ted Tagami, Magnitude.io (Berkeley, CA) *Payload Developer:* Space Tango	This project is studying the morphology and physiology of a common plant species using specialized modular growth chambers aboard the ISS. The plants will grow from germinated seeds under automated light, temperature, and nutrient conditions. Automated cameras image growth at every stage to determine both plant viability and effectiveness of cultivation modules, which return to Earth for further post-mission analysis. Results will influence plant cultivation strategies for future long-term space missions.

Updates from Commercial Facility Operators

- On October 24, 2017, **NanoRacks** successfully deployed the Kestrel Eye IIM microsatellite via the Kaber Microsatellite Deployer from the ISS. This is the largest satellite that NanoRacks has deployed to date and the first deployed from the Kaber. NanoRacks' Kaber Deployment Program allows for a larger class of satellites (up to 100 kilograms) to be deployed from the ISS.
- On November 17, 2017, the Kentucky Entrepreneur Hall of Fame recognized **Space Tango** CEO Twyman Clements as a member of the Emerging Entrepreneur Class of 2017. Space Tango, Inc. is an aerospace company that specializes in designing complex autonomous systems that use microgravity for research and manufacturing. For more information, see http://www.spacetango.com/blog/.
- On December 15, 2017, **NanoRacks and DreamUp** launched "Crystals in Space," marking a successful end to a Kickstarter campaign for a new STEM initiative. For more information, see http://nanoracks.com/nanoracks-launches-crystals-in-space-and-marks-successful-end-to-kickstarter-campaign/.
- On December 27, 2017 the **Made In Space** – Fiber Optics (MISFO) payload was successfully activated for the first time onboard the ISS. The CASIS-selected MISFO payload was launched on Space-X 13 and is designed to demonstrate the scientific and commercial merit of manufacturing exotic optical fiber in microgravity. MISFO contains a ZBLAN material from which the optical fiber is drawn, a small furnace, and mechanisms for drawing, measuring, and spooling the fiber. ZBLAN is the most stable heavy metal fluoride glass, with a broad transmission window, low refractive index, and many other characteristics beneficial to optical data transmission. Upon completion of operations, the payload will be returned to Earth on SpX-13.

Additional Project Updates

- The CASIS-selected **NovaWurks** SIMPL satellite was deployed from the ISS in October. For this program, principal investigator (PI) Talbot Jaeger pioneered the Hyper-Integrated Satlet technology, a concept to assemble larger satellites from small independent "cells" called satlets. In other words, SIMPL was delivered to the ISS in a few larger groups and then assembled by the astronaut crew utilizing some smaller components. (Payload Developer: NanoRacks)
- Selected by CASIS in collaboration with Boeing and the MassChallenge business accelerator, the payload "Assessing Osteoblast Response to Tetranite™ in Microgravity Conditions to Induce Osteoporosis," from **LaunchPad Medical**, initiated in-orbit operations this quarter. PI Dr. Nikolaos Tapinos is exploring the ability of Tetranite, a synthetic bone material, to accelerate bone repair. Ten million Americans are living with osteoporosis, and the Tetranite™ bone adhesive is expected to significantly benefit these patients, improving outcomes for those who experience a bone fracture and reducing the overall healthcare costs. (Payload Developer: Bioserve)
- Also selected by CASIS in collaboration with Boeing and MassChallenge, the "Deconvolution of Biosensor Glucose Diffusion Contributions in Microgravity" payload, from **Biorasis**, initiated in-orbit operations this quarter. PI Dr. Michail Kastellorizios seeks to improve the accuracy of an implantable glucose biosensor (Glucowizzard) for day-to-day diabetes management. Slow glucose transport within human tissue can create delays of up to 20 minutes in real-time monitoring of glucose levels, which is detrimental in achieving the tight glycemic control that is necessary to avoid serious complications in patients with diabetes. Microgravity provides reduced fluid movement to allow precise monitoring of the role of diffusion in glucose transport, improving the mathematical models that determine the accuracy of the Glucowizzard in mitigating this monitoring issue. (Payload Developer: Space Tango)
- Launched on SpX-13 and marking the 6th CASIS-selected rodent research (RR) mission, the RR-6 study from PI Dr. Alessandro Grattoni at **Houston Methodist Research Institute** is testing an implantable drug delivery system. The drug formoterol (an adrenalin substitute) is being administered by controlled release from a nanochannel implant in rodents with spaceflight-induced muscle atrophy. Muscle wasting is a condition that affects more than 50% of the geriatric population, yet therapeutics used to treat this condition are limited. The most commonly used pharmaceutical intervention is formoterol, administration of which requires an inconvenient daily injection. In collaboration with Novartis and NanoMedical Systems, validation of this alternative nanochannel system may rapidly translate into a commercial product to safely administer formoterol over a long period of time without requiring daily injection, improving patient quality of life. (Payload Developer: Bioserve)
- Nominal in-orbit operations continue for Project Meteor, from the **Southwest Research Institute**, which is making the first ever space-based observations (using a visible spectroscopy instrument) of the chemical composition of meteors entering Earth's atmosphere. Meteors are relatively rare and difficult to monitor from the ground because of the interference created by Earth's atmosphere. PI Michael Fortenberry is investigating the elemental composition of meteors, which is important to our understanding of how the planets developed. Continuous measurement of meteor interactions with the Earth's atmosphere could also spot previously unforeseen meteor showers. (Payload Developer: Southwest Research Institute)

FIGURE 3: CONTRIBUTIONS TO SCIENTIFIC KNOWLEDGE – RESULTS PUBLISHED

Two peer-reviewed publications in Q1 showcase results related to ISS National Lab projects. One details results from a ground study following successful in-orbit crystal growth of a medically important protein, and the other details student research from the first awardee of the annual Genes in Space education competition, sponsored by Boeing.

PROJECT AND PUBLICATION INFORMATION	KEY MESSAGES
ISS National Lab Project Title: **Microgravity Crystal Growth for Improvement in Neutron Diffraction** *Principal Investigator:* **Timothy Mueser, University of Toledo (Toledo, OH)** *Article Citation:* Dajnowicz S, Johnston RC, Parks JM, Blakeley MP, Keen DA, Weiss KL, Gerlits O, Kovalevsky A, Mueser TC. Direct visualization of critical hydrogen atoms in a pyridoxal 5'-phosphate enzyme. Nat Commun. 2017 Oct 16;8(1):955. doi: 10.1038/s41467-017-01060-y. PubMed PMID: 29038582; PubMed Central PMCID: PMC5643538.	*Summary:* This article reports the structure of aspartate aminotransferase (AAT), an enzyme related to vitamin B6 function. Mueser and his team used a technique called neutron diffraction to determine the location of hydrogen atoms in the structure of AAT. Neutron diffraction is similar to X-ray diffraction crystallography but uses neutrons rather than X-rays to generate an image of a molecule in a crystalline form. Hydrogen atoms are difficult to detect using X-ray crystallography, but knowing the location of hydrogen atoms in an enzyme's structure is key to understanding how the enzyme functions. The paper reports results from ground-based research related to an ISS National Lab project. *Potential Earth Benefit:* Determining the distribution and location of hydrogen atoms in an enzyme allows scientists to understand enzyme activity and function. Neutron crystallography has the unique ability to precisely visualize the positions of hydrogen atoms in macromolecules, providing better maps for drug targets. Results from this study may lead to the development of new drugs to treat diseases such as drug-resistant tuberculosis, malaria, and diabetes.
ISS National Lab Project Title: **Genes in Space** *Principal Investigator:* Anna-Sophia Boguraev, Yale University (New Haven, Connecticut); sponsored by Boeing (Chicago, IL) *Article Citation:* Boguraev AS, Christensen HC, Bonneau AR, Pezza JA, Nichols NM, Giraldez AJ, Gray MM, Wagner BM, Aken JT, Foley KD, Copeland DS, Kraves S, Alvarez Saavedra E. Successful amplification of DNA aboard the International Space Station. NPJ Microgravity. 2017 Nov 16;3:26. doi: 10.1038/s41526-017-0033-9.	*Summary:* This article discusses results from experiments performed on the ISS National Lab to validate the in-orbit use of a miniPCR system to perform polymerase chain reaction (PCR), an analytical tool using chemical reactions to amplify DNA. This work resulted from the inaugural Genes in Space student competition. Boguraev's winning investigation validated the miniPCR system for research on the ISS. The investigation also successfully used the miniPCR system to detect epigenetic changes in DNA methylation patterns in zebra fish embryos. Epigenetic changes like methylation affect gene expression but do not involve changes in the sequence of nucleotides in the DNA. *Potential Earth Benefit:* The miniPCR system is one of several tools used to monitor DNA and the genes that provide the operating instructions for all living things. Cells and organisms respond to changes in their environment and these changes can often be first identified at the DNA level. Technologies that enable insight into DNA, such as PCR, provide researchers with the ability to monitor health and prevent disease. These experiments help to validate the use of PCR onboard the ISS National Lab, thus opening a wide-range of potential research opportunities aimed at better understanding fundamental biology and human health.

STIMULATING AND CULTIVATING DEMAND FOR THE ISS AND BEYOND

EXPANDING THE ISS NATIONAL LAB NETWORK AND DRIVING COMMERCIAL UTILIZATION

Q1 featured new CASIS partnerships with two giants in the aerospace industry, Airbus DS North America and Bigelow Space Operations (a division of Bigelow Aerospace), as commercial users and suppliers of the ISS National Lab. These multi-year umbrella user agreements provide each company with expedited access to ISS National Lab resources required for their in-orbit facilities, supporting their respective R&D objectives and fostering expanded commercial use of the ISS National Lab. Bigelow and Airbus, with their respective track records and expertise in designing, deploying, and operating space-based assets, will expand and improve the capabilities of the ISS National Lab, thereby ensuring that its users can derive the maximum benefit from this powerful LEO innovation platform. These new partnerships will support new-to-space investigators, startup companies, and small- and medium-sized enterprises whose business cases depend on the availability of space access and infrastructure at low cost and under reliable conditions.

Opportunities for Idea Submission

Four Sponsored Programs are currently open for submission of research proposals to perform R&D onboard the ISS National Lab. A Sponsored Program is a research competition funded by a non-CASIS, non-NASA organization—in this case, the National Institutes of Health (NIH), the National Science Foundation (NSF), and Target Corporation (whose Sponsored Program opened in Q4FY17 and is ongoing). Three new collaborations with NIH and NSF represent a continuation of a growing trend of non-NASA government partnerships to advance space-based R&D, with both of these organizations having successfully sponsored research opportunities with CASIS in the past.

The newly opened Sponsored Programs this quarter represent $11.4 million in committed funding toward ISS National Lab research, bringing the total committed funding to date through the Sponsored Program model to more than $30 million.

FIGURE 4: RECENT AND UPCOMING OPPORTUNITIES

SPONSOR ORGANIZATION AND FUNDING DETAILS	**ISS Cotton Sustainability Challenge** *(opened in Q4FY17; full proposals due Q2 FY18)*
SPONSOR ORGANIZATION AND FUNDING DETAILS	**Target Corporation** has committed up to $1 million to support flight projects
GOALS	Cotton is a natural plant fiber produced in many countries and one of the most important raw materials required for the production of textiles and clothing. Cotton cultivation requires sustainable access to natural resources such as water that are increasingly threatened. This challenge seeks to engage the creative power of the research community to leverage the ISS National Lab and generate ideas across multiple sectors that may improve the utilization of ground-based natural resources for sustainable cotton production. Related links: https://www.iss-casis.org/cottonsustainabilitychallenge/
IMPORTANT DATES	**Open Date:** 9/5/2017; **1-Pagers Due:** 11/08/2017 **Down-Select Announcement:** 12/1/2017; **Full Proposals Due:** 2/16/2018
SPONSOR ORGANIZATION AND FUNDING DETAILS	**NIH-CASIS Coordinated Microphysiological Systems Program for Translational Research in Space** ***(newly open**; proposals due Q2FY18)*
SPONSOR ORGANIZATION AND FUNDING DETAILS	**NIH** has committed up to $7.6 million, subject to funding availability, to support flight projects
GOALS	CASIS, the National Center for Advancing Translational Sciences (NCATS), and the National Institute of Biomedical Imaging and Bioengineering (NIBIB) are collaborating to support a funding opportunity focused on human physiology and disease onboard the ISS National Lab. Both the NCATS and the NIBIB are part of the NIH. Data from this research—which will feature tissue chips—will help scientists develop and advance novel technologies to improve human health. This announcement is part of a four-year collaboration through which NCATS will provide funding for space-based research investigations to benefit life on Earth. This is a reissue of the opportunity released in FY16 that subsequently resulted in the award of five projects. Recent advances in bioengineering have enabled the manufacture of microphysiological systems using human cells on chips representing functional units of an organ, which replicate the physical and biochemical environment in tissues. In parallel, recent developments in stem cell technology now make it possible to cultivate tissues from humans with specific genotypes and/or disease phenotypes. Advancing this research on the ISS National Lab promises to accelerate the discovery of molecular mechanisms that underlie a range of common human disorders, as well as improve understanding of therapeutic targets and treatments in a reduced fluid shear, microgravity environment that recapitulates cellular and tissue matrices on Earth. Related links: *Information on the new opportunity:* ▶ http://casistissuechip.blogspot.com/ ▶ https://grants.nih.gov/grants/guide/rfa-files/RFA-TR-18-001.html *Information on the previous program and awards:* ▶ https://grants.nih.gov/grants/guide/rfa-files/RFA-TR-16-019.html ▶ https://ncats.nih.gov/tissuechip/projects/space2017
IMPORTANT DATES	**Posted Date:** 11/30/2017; **Open Date:** 12/15/2017; **Application Due Date:** 02/08/2018; **Scientific Merit Review:** April 2018; **Advisory Council Review:** August 2018; **Earliest Start Date:** September 2018; **Expiration Date:** 02/09/2018

SPONSOR ORGANIZATION AND FUNDING DETAILS	**NSF/CASIS Collaboration on Fluid Dynamics and Particulate and Multiphase Processes Research on the International Space Station to Benefit Life on Earth** ***(newly open****, proposals due Q2FY18)*
SPONSOR ORGANIZATION AND FUNDING DETAILS	**NSF** has committed up to $2 million for flight projects
GOALS	CASIS and NSF are sponsoring a joint solicitation wherein researchers will have the ability to leverage resources onboard the ISS National Lab for R&D in fluid dynamics and particulate and multiphase processes. This is the second collaboration between the NSF and CASIS dedicated towards the funding of fluid dynamics and multiphase process concepts in space to benefit life on Earth, and one of four total collaborations to date between NSF and CASIS to fund ISS National Lab R&D, following a successful first solicitation in 2016. There is also the possibility that projects awarded from this solicitation will lead to the development of new hardware that can be used for not only these studies but also future experiments onboard the ISS. Related links: ▶ https://www.iss-casis.org/research-on-the-iss/solicitations/fluid-dynamics-2017/ ▶ https://www.nsf.gov/pubs/2018/nsf18521/nsf18521.htm
IMPORTANT DATES	**Issued Date:** 11/29/2017; **Feasibility Form Due Date:** 01/24/2018; **CASIS Timeline to Review Forms:** 4 weeks **Submission Window for Full Proposals:** 02/01/2018 – 03/05/2018; **Earliest Start Date:** June/July 2018
SPONSOR ORGANIZATION AND FUNDING DETAILS	**NSF/CASIS Collaboration on Tissue Engineering on ISS to Benefit Life on Earth** ***(newly open****, proposals due Q2FY18)*
SPONSOR ORGANIZATION AND FUNDING DETAILS	**NSF** has committed up to $1,800,000 to support flight projects
GOALS	CASIS and NSF are sponsoring a joint solicitation wherein researchers will have the ability to leverage resources onboard the ISS National Lab for R&D to support enhancements in the fields of transformative tissue engineering. Any research that fits within the scope of the NSF Engineering of Biomedical Systems Program and requires access to experimental facilities on the ISS may be considered. This includes cellular engineering, tissue engineering, and modeling of physiological or pathophysiological systems in topic areas that include but are not limited to scaffolds and matrices, cell-cell and cell-matrix interactions, stem cell engineering and reprogramming, cellular immunotherapies, cellular biomanufacturing, and system integration between biological components and electromechanical assemblies. As noted above, this is one in a series of four collaborations between NSF and CASIS to explore research concepts on the ISS National Lab, with the other three focused on the physical sciences (fluid dynamics and thermal combustion). Related links: ▶ https://www.iss-casis.org/research-on-the-iss/solicitations/tissue-engineering-2017/ ▶ https://www.nsf.gov/pubs/2018/nsf18514/nsf18514.pdf
IMPORTANT DATES	**Issued Date:** 11/8/2017; **Feasibility Form Due Date:** 01/5/2018; **CASIS Timeline to Review Forms:** 2 weeks; **Submission Window for Full Proposals:** 01/30/2018 – 02/12/2018; **Earliest Start Date:** July 2018

CASIS seeks to fully utilize the ISS National Lab, enabling cutting-edge research on the ISS from every corner of the country. In support of the ISS National Lab mission, CASIS partners to issue the formal solicitations and Sponsored Programs listed above and also works with investigators to develop additional project ideas and proposals, which are accepted as part of a rolling submission process. CASIS-selected projects for flight (discussed in the next section) result from these two inroads, and CASIS further manifests additional ISS National Lab payloads from commercial service providers through a separate process.

Newly Selected Projects

Newly selected projects this quarter include R&D in the life and physical sciences as well as a technology development initiative. Projects include a collaboration with the National Cancer Institute and six projects from the commercial sector.

FIGURE 5: R&D OBJECTIVES OF NEW PROJECTS

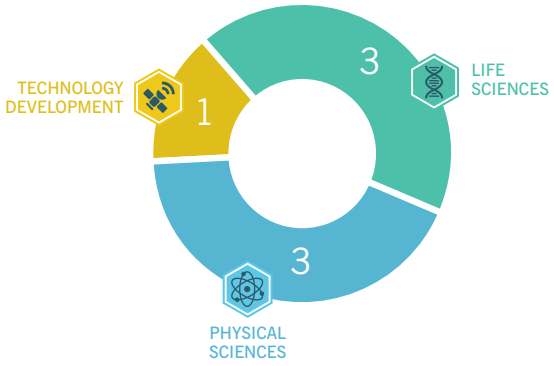


FIGURE 6: NEW PROJECTS, BY ORGANIZATION TYPE

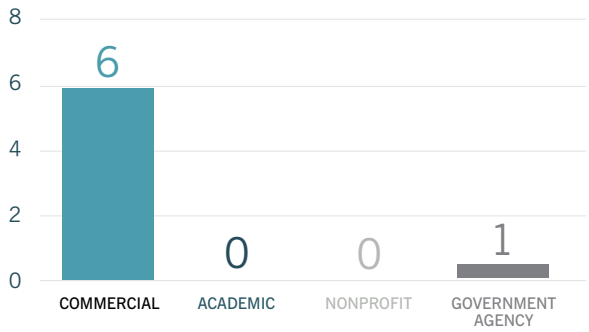


FIGURE 7: NEW PROJECT DETAILS

In Q1, 70% of newly selected projects originated from new-to-space organizations, including three startup companies awarded as part of the Technology in Space Prize co-sponsored by Boeing (a Sponsored Program in collaboration with the MassChallenge Business Accelerator Competition in Boston): Cellino Biotech, MakerHealth, and Guardion Technologies. Of note, one additional project awarded in Q1 (from Lux Labs) also originated from the MassChallenge competition in a previous year.

PROJECT INFORMATION	DESCRIPTION	EARTH BENEFIT
Test Multilayer Polymer Convection and Crystallization Under Microgravity Dr. Yichen Shen, Lux Labs (Cambridge, MA)	Lux Labs will use the microgravity environment of the ISS to test conditions for the manufacture of their Broadband Angular Selective Material (BASM). BASM is an optical material with the ability to control light based on the angle of its propagation. A 0.01-mm thick film allows light of any color (i.e., wavelength) to be transmitted from one specific angle while reflecting or absorbing all light coming in from other directions. BASM has applications in areas such as polymer packaging, optical films, solar power, and electronic displays. In order to commercialize BASM, Lux Labs is developing a process to fabricate the film using a multilayer polymer process that is both inexpensive and scalable. The ISS offers a unique environment to examine how the fabrication process using multilayer polymer formation is affected by the absence of gravity and buoyancy-driven convection. This project aims to increase fundamental understanding of the physics behind multilayer polymer formation and crystallization, which would benefit the broader polymer industry, and to improve fabrication methods for BASM to produce more durable films with improved properties, thus accelerating the material's successful entry into market for Lux Labs.	Solar power and electronic display applications are two examples of large market opportunities for this technology. In the U.S., the solar power industry is $296 billion per year and the mobile electronics market is $220 billion per year. In solar power technology, both solar cells (SC) and solar thermal (ST) systems lose significant portion of sunlight due to incomplete absorption, radiative recombination, and blackbody radiation. By applying BASM to the top of the SC or ST, the re-emitted and non-absorbed photons can be efficiently recycled back to the SC or ST system, resulting in a 25% increase in efficiency. BASM can also be used to increase the brightness of mobile electronic displays by emitting light directly to the viewer (light that would otherwise be emitted away from the viewer's eyes is recycled), resulting in a display that is five times more efficient. This improved efficiency would result in approximately 50% improved battery life in a standard smartphone.

PROJECT INFORMATION	DESCRIPTION	EARTH BENEFIT
NCI NExT Space Crystallization Program Dr. Barbara Mroczkowski, National Cancer Institute Frederick National Laboratory for Cancer Research (Frederick, MD)	Through this program, the NIH National Cancer Institute's (NCI) Chemical Biology Consortium (CBC) will conduct multiple protein crystallization experiments on the ISS aimed at drug discovery. The goal is to develop an accelerated drug discovery pipeline that takes advantage of macromolecular crystallization in microgravity and fits within the CBC's established drug discovery process. In order to achieve this goal, the CBC will utilize commercial-off-the-shelf (COTS) microgravity crystallization platforms and establish a queue of multiple high-value cancer-related proteins allowing for efficient resource utilization and late-stage selection of payloads. The CBC will utilize its consortium of scientists to identify and prepare crystallization experiments for flight and analyze post-flight samples.	The CBC's mission is to increase the flow of early-stage drug candidates into NCI's drug development pipeline. CBC's integrated network of chemical biologists and molecular oncologists from government, industry, and academia enables CBC associate organizations and the NCI to further address the unmet needs in therapeutic oncology, focusing on areas such as "undruggable" targets and under-represented malignancies. This ISS program to conduct several high-value cancer-related protein crystallization experiments in microgravity could result in the expedited discovery of novel therapeutics for a number of different cancers.
Investigating Proliferation of NanoLaze Gene-edited induced Pluripotent Stem Cells aboard the ISS Matthias Wagner, Cellino Biotech, Inc. (Cambridge, MA)	For this project, Cellino Biotech will use its proprietary NanoLaze™ gene-editing platform to deliver CRISPR/Cas9-modified genes to induced pluripotent stem cells (iPSCs) on the ground. The project will then investigate the proliferation of the gene-edited iPSCs in the microgravity environment on the ISS to determine if the cells remain pluripotent through multiple cell divisions. Data resulting from this investigation could unlock the potential to generate the 200 to 500 million stem cells needed for cell-based therapies, which is not possible with currently available stem cell technologies on Earth. Demonstrating stemness in iPSCs in microgravity will enable Cellino Biotech and therapeutic partnering companies to develop techniques on Earth to supply stem cells to more patients for the treatment of debilitating diseases like Alzheimer's, Parkinson's, and hemophilia.	Of the estimated 6,000 genetic diseases, 95% have no approved therapies. The delivery of gene-editing tools, such as CRISPR/Cas9, into cells enables the targeting of genetic defects and the potential to develop new therapeutics. Results from this project could help supply the millions of stem cells needed for cell-based therapies to treat critical genetic diseases such as Alzheimer's, Parkinson's, and hemophilia.
AmpliRx: A Manufacturing Pharmaceutical Lightweight Instrument Anna Young, MakerHealth (Boston, MA)	This project seeks to use the microgravity environment of the ISS to explore gravity's effects on the MakerHealth AmpliRx modular biochemical manufacturing platform. The AmpliRx platform enables the distributed, affordable, and scalable production of medications using a membrane-to-membrane continuous flow reactor system that can operate without pumps or advanced instrumentation and runs using minimal power. The AmpliRx platform transforms the drug manufacturing process from large scale, batch-type equipment to a modular, Lego-like dynamic desktop system utilizing the advantages of flow chemistry. Conducting experiments in space allows MakerHealth to understand the fundamental physics of membrane-to-membrane flow and reaction times in the AmpliRx system in the absence of gravity. These results will then be leveraged to optimize membrane material properties and geometries to increase process performance by decreasing reaction times and increasing resource utilization efficiency.	Current drug manufacturing relies on large-scale, centralized processes that have high infrastructure cost and lack flexibility for precision medicine. The MakerHealth AmpliRx system decreases the amount of infrastructure needed to manufacture drugs and significantly lowers the capital required for research and distribution in the precision medicine market, which is estimated to grow to $87.7 billion by 2023. The AmpliRx platform can also be used to manufacture cost-prohibitive medications, such as Daraparim, a medication to treat life-threatening infections in immune-suppressed patients. Hospitals could use the AmpliRx platform to manufacture daraparim onsite for $1 per pill. Sales from the AmpliRx platform and MakerHealth's daraparim-manufacturing kits alone represent potential revenue of $79 million over the next five years and could provide 1.8 million patients with access to a life-saving medicine at accessible prices.
Convection-free Synthesis of 2D Nanomaterials Dr. Dan Esposito, Guardion Technologies (Boston, MA)	For this project, Guardion Technologies aims to utilize the microgravity environment on the ISS to synthesize improved 2D materials for use in the development of miniaturized ionizing radiation detectors. These detectors can be deployed in large numbers to provide real-time, active-monitoring networks for detecting radioactive sources. Such networks will enable early and/or remote detection of possible radiological threats, and will serve as a highly effective triage mechanism for emergency responders. At the core of the miniaturized detection technology is a novel patent-pending process that utilizes the quantum properties of certain nanomaterials such as carbon nanotubes, graphene, and other atomically-thin materials such as 2D monolayers. Guardion Technologies hypothesizes that convection-free synthesis of such 2D materials in microgravity will result in samples with greater crystallinity, higher electronic mobility, and lower electronic noise, which would enable an enhanced signal-to-noise ratio in radiation detectors.	Early, remote, and trace-amount detection of ionizing radiation is critical for averting catastrophes, protecting lives, and preventing economic losses in the case of radiological threats and accidental radiological events. Compared with conventional radiation detectors, Guardion Technologies' miniaturized detectors have dramatically reduced size, weight, power needs, and cost without compromised performance. Higher-quality 2D nanomaterials would lead to detectors with more reliable performance at lower costs. Such technology could enable the deployment of large-scale networked radiation monitoring systems in strategic areas such as borders or security checkpoints, across cities, or at power plants or hospitals. The detectors can also be mounted on drones for covert operations.

PROJECT INFORMATION	DESCRIPTION	EARTH BENEFIT
Commercial Polymer Recycling System (CPRS) Demonstrating a Regenerative Manufacturing Ecosystem for Space Matthew Napoli, Made In Space (Moffett Field, CA)	This project aims to demonstrate the plastic recycling capabilities of the Commercial Polymer Recycling System (CPRS) on the ISS. The CPRS, developed by Made In Space, is designed to take plastic waste, such as expended polymer parts and plastic bags, and process the excess material into a uniform feedstock suitable for use in additive manufacturing. The CPRS would augment the commercial Additive Manufacturing Facility (AMF) on the ISS and create a "regenerative materials" cycle that turns used broken parts and excess packaging into new parts. The in-orbit demonstration will include recycling of 3D prints made from Braskem North America's Green Polyethylene (Green PE), a plastic derived from sugarcane. Green PE is ideal for use in a regenerative materials cycle on the ISS because it reduces material waste in orbit without increasing the carbon footprint on Earth.	Feedstock (raw material for 3D printers), as well as trash and waste, take up valuable mass and storage volume in an environment such as the ISS that requires optimal resource allocation. The ability to reuse plastic items and transform them into feedstock without need for terrestrial resupply will mean less space required for raw material storage, as well as greater overall printing capacity to produce needed parts and tools. Terrestrial versions of the CPRS could be used for recycling of 3D printed materials in hardware stores or for expeditionary manufacturing on small surface ships and submarines and on offshore oil and gas platforms. For the U.S. Navy alone, this is an opportunity across 461 commissioned, non-commissioned, support, and reserve ships that could generate more than $69 million in unit sales.
MDCK Influenza Virus Infection Dr. Philippe-Alexandre Gilbert, Sanofi Pasteur (Swiftwater, PA)	In this project, Sanofi Pasteur seeks to grow MDCK (Madin-Darby Canine Kidney) cell cultures infected with the influenza virus in microgravity to explore the mechanisms involved in viral replication and production, with the ultimate goal of applying the results to Earth-based, cell-based manufacturing of influenza vaccines. Cell-based methods for influenza vaccine production enable a more rapid scalable response to pandemic outbreaks, allow greater process control, and result in a more reliable and well-characterized product than traditional egg-production methods; however, current cell-culture based methods are cost-prohibitive to implement. The research team hypothesizes that microgravity may enhance influenza replication, leading to potential insights on how to improve viral yield in cell cultures—the most important cost driver in vaccine manufacturing. Results from this project could help improve cell-based production methods, making them more cost-effective.	The influenza virus is responsible for a global epidemic every year that infects millions of people and causes serious illness and death worldwide. In the United States, infection by flu viruses results in a cumulative hospitalization rate of 35.5 per 100,000 people, mostly affecting the elderly (88.1 per 100,000 population) or very young (46.7 per 100,000 population), with 107 pediatric influenza-associated deaths. Vaccination remains the primary and most effective strategy for the prevention and control of influenza. The ability to produce and supply vaccines that prevent influenza outbreaks has the potential to improve global health and save lives, while also protecting against the associated economic losses.

Strategic Areas of Focus

Through Sponsored Programs and proactive targeted outreach to new customers, CASIS is accelerating success for a diverse range of ISS National Lab users, providing tangible return to U.S. taxpayers. To maximize this return, CASIS has developed a methodology to quantitatively assess value and impact of the CASIS portfolio and has infused this methodology into all aspects of operations, including targeting new customers, review and selection of project proposals, ensuring utilization, and communicating results to the nation. The new value assessment construct quantitatively measures impact, including economic, innovation and human/social measures, balanced against feasibility, which include elements of project risk including technical risk and commercialization feasibility.

CASIS has continued to focus on building new-to-space user demand and, in doing so, has productized its offering, relevant for commercial organizations, in four key vertical areas. These propositions correlate with customer needs and are mapped back to the value impact framework to drive towards a balanced view of the portfolio:

Life sciences

- Drug discovery, development, and delivery (including manufacturing and process optimization)
- Cell biology and higher models of aging and chronic disease
- Regenerative medicine (e.g., stem cell biology, tissue engineering, and 3D bioprinting)
- Crop science

Physical sciences

- Novel materials development and improved manufacturing
- Telecommunication materials
- Semiconductor manufacturing
- Fluid dynamics and transport phenomena
- Reaction chemistry
- Combustion science

Technology development

- In-orbit production
- Additive manufacturing
- Quantum satellite technology
- Information technology and communications
- Robotics
- Technology readiness level (TRL) advancement

Remote sensing

- Data collection (e.g., applications for weather, agriculture, energy, and urban development)
- Infrastructure development for imaging/tracking (e.g., maritime security)
- Smallsat deployment

CASIS executes individual targeted outreach to potential new customers in these sectors and participated in a variety of industry events in Q1 to increase outreach and awareness in these communities.

FIGURE 8: CASIS-ORGANIZED EVENTS

Four CASIS-organized events in Q1 brought together thought leaders to discuss ways to expand innovation onboard the ISS National Lab—through new project ideas and expansion of existing programs.

EVENT INFORMATION	PARTICIPANTS/AUDIENCE	GOALS AND OUTCOMES
ISS Cotton Sustainability Challenge Webinar Series 10/3/2017 & 10/12/17 (location N/A)	Virtual attendees included researchers and technologists from universities, startups, and industry associations	This webinar series sought to educate the new user community about the ISS Cotton Sustainability Challenge, a Sponsored Program in collaboration with Target. These two events generated more than 40 one-page submissions that were then down-selected to 16 semi-finalists, who were invited to submit full project proposals.
Expanding Horizons Silicon Valley Salon 10/16 (Portola Valley, CA)	Approximately 65 corporate senior executives, venture capitalists, investors, academic researchers, and government employees	The Expanding Horizon Salon series is a regular series of informal networking events aimed at bringing together a small group of curious, creative, and ambitious innovators to make new connections, share ideas, and potentially result in ideas for novel ISS National Lab projects/initiatives. At this invitation-only event, CASIS brainstormed potential projects with these local thought leaders, increasing awareness of space-based R&D among attendees. Follow-on discussions with attendees regarding future projects and sponsored programs are ongoing.
Rodent Research 2 Workshop 10/23 (Seattle, WA)	Approximately 50 NASA and JAXA representatives and rodent researchers	This workshop was a continued discussion on the rodent research capability on the ISS. Topics discussed included the introduction of standard measures for each mission, the biospecimen sharing program, future large-scale missions, and results of completed rodent research missions. Specific workshop achievements included: ▶ Updating the scientific community on the current status of NASA and CASIS-sponsored rodent research capabilities and opportunities. ▶ Discussing experimental details and scientific findings from the implementation and execution of long-duration rodent research missions. ▶ Identifying methods and opportunities to define mutually beneficial research, share tissues, maximize science return through standard measures, and develop formal and informal collaborations that maximize rodent research scientific return.
Space Manufacturing Workshop In conjunction with SpaceCom 2017 12/5/17 – 12/7/17 (Houston, TX)	150+ attendees for an initial panel presentation and 40+ attendees for the formal workshop session (government agencies, corporations/private industry, investors, and academia)	This workshop discussed the future of space manufacturing, which will start with robotic pods processing precious materials for deorbit and sale on Earth. The evolution of manufacturing will make use of space transportation highways and access to raw materials on the moon and asteroids. Attendees discussed how businesses today engage in the emerging space manufacturing arena and next steps necessary to catalyze a cislunar marketplace. The goal was to build initial pathways for space manufacturing by assembling experts in the field to identify challenges, present solutions, and coordinate efforts at all levels (from funding to research initiatives to maturing technologies) towards future development. Outcomes included overall excitement about the prospects of manufacturing in space, despite known challenges. Attendees agreed there is definitely a business case for proceeding, even without government subsidies providing launches, room and support on ISS, etc. Next steps include forming a public-private consortium to map a strategy for forward motion and investment.

FIGURE 9: INDUSTRY OUTREACH THROUGH EVENT SPONSORSHIP

CASIS sponsored three industry events in Q1, which included 12 speaking opportunities to the aerospace and emerging low Earth orbit (LEO) communities.

EVENT INFORMATION	PARTICIPANTS/AUDIENCE	GOALS AND OUTCOMES
American Society for Gravitational and Space Research 10/25/17 – 10/28/17 (Seattle, WA)	The scientific community, students, and educators CASIS speaking opportunities = 3	CASIS conducted two plenary sessions focused on the ISS National Lab, discussing the research portfolio and ISS National Lab capabilities, and held a symposium on space-based crystal growth. Additionally, CASIS conducted meetings and discussions with researchers, potential new users, and Implementation Partners—in some cases connecting users and service providers with NASA collaborators. Discussions with existing users and service providers focused on understanding how cutting-edge research aligns with ISS National Lab capabilities and what upcoming hardware or new technologies may bridge any gaps. Separate conversations with NASA focused on rodent models and upcoming experiments. https://asgsr.org/index.php/meetings/2017-meeting
SpaceCom 2017 12/5/17 – 12/7/17 (Houston, TX)	Executives from terrestrial and aerospace industries, policymakers, space and defense analysts and consultants, technology entrepreneurs, venture capitalists, other investors news media, scientists, and researchers CASIS speaking opportunities = 8	CASIS participated in an entrepreneur workshop and led three thought-leadership panels focused on (1) how the ISS is helping to create new markets, (2) space-based manufacturing (see Figure 8), and (3) public-private partnerships. CASIS also provided its large-scale booth for the event, meeting with attendees to provide further education on the breadth of capabilities that the ISS can enable. Outcomes included new ongoing discussions with potential customers, partners, and investors. http://spacecomexpo.com/
Next-Generation Suborbital Researchers Conference 12/18/17 – 12/20/17 Broomfield, CO	Researchers from government, industry, and academia CASIS speaking opportunities = 1	CASIS presented on ISS National Lab capabilities and the continuum of research opportunities from suborbital to LEO, highlighting current collaborations with NSF and NIH, as they demonstrate R&D activities in near space that create demand for human-tended sub-orbital and orbital vehicles (i.e., engineers/scientists need to validate analytical platforms and/or flight hardware for use on ISS and commercial laboratories operating in LEO). CASIS had a booth to engage with the suborbital research community, and this presence helped to impress upon the industry that there is a market and a pipeline from suborbital to orbital, and potentially from orbital to suborbital. http://www.boulder.swri.edu/NSRC2017/Site4/Home2017.html

FIGURE 10: ADDITIONAL STRATEGIC EVENT PARTICIPATION

EVENT INFORMATION	PARTICIPANTS/AUDIENCE	GOALS AND OUTCOMES
Industry Insights 10/6/2017 (Stanford, CA)	Approximately 30 medical and post-doctoral students, researchers, and faculty CASIS speaking opportunities = 1	The goal of this event was to educate Stanford students, professors, and researchers about the unique opportunities aboard the ISS and how CASIS can help bring research experiments and technology development projects to the ISS National Lab. Two attendees are now working on project concepts. http://med.stanford.edu/bioscicareers/resources/previous-events/vid-casis-nasa-industry-insights.html
Wernher von Braun Memorial Symposium 10/24/17 – 10/26/17 (Huntsville, AL)	Government, industry, academia, business representatives CASIS speaking opportunities = 1	This event brings together the aerospace community to discuss the latest topics in space exploration and research. CASIS executives continued to inform and engage this community about the latest developments and opportunities available on the ISS National Lab. http://astronautical.org/events/vonbraun/

EVENT INFORMATION	PARTICIPANTS/AUDIENCE	GOALS AND OUTCOMES
MassChallenge Awards Ceremony 11/2/2017 (Boston, MA)	Approximately 3000 executives, small startups, venture capitalists, and journalists	This event represents the culmination of the Boeing Sponsored Program through which $500,000 in funding from CASIS and Boeing is committed toward flying innovative start-up concepts. The "Technology in Space" sidecar prize to the MassChallenge competition continues to build awareness of CASIS and the ISS National Lab while also enabling innovative startups to participate in space-based R&D. https://www.iss-casis.org/press-releases/boeing-and-casis-award-500000-for-microgravity-research-through-masschallenge/
ISS on the Hill Day 11/2/2017 (Washington, DC)	Members of Congress, their staff, and guests	Coinciding with the 17th anniversary of continuous U.S. human presence in LEO, the 2018 ISS on the Hill Day was a NASA-orchestrated exhibit and networking event in Washington, D.C. to bring awareness and education about the ISS to the legislative community. CASIS featured an exhibit on the ISS National Lab. The event provided strong networking opportunities with many congressman, senators, and staffers.
International Space Medicine Summit 2017 11/2/2017 – 11/5/2017 (Houston, TX)	Approximately 100 physicians, space biomedical scientists, engineers, astronauts, cosmonauts, and educators CASIS speaking opportunities = 1	CASIS presented introductory content regarding its role in managing the ISS National Lab, highlighting opportunities focused on astronaut health in space. Outcomes included discussions with NASA program managers in the Office of the Chief Medical Officer regarding crew data sharing for ISS National Lab customers. https://www.bakerinstitute.org/space-policy-program/international-space-medicine-summit/
Destination Station 11/27/17 – 11/29/17 (New York, NY)	Senior executives, scientists, researchers, academic leaders, and commercial companies CASIS speaking opportunities = 3	CASIS and NASA conducted three major industry days at IBM Watson, Colgate, and PepsiCo as part of this event, speaking with approximately 100–200 employees at each location and brainstorming with senior executives about new project concepts. Individual break-out sessions focused on priority R&D areas within the life sciences, remote sensing, technology development, and materials and physical sciences. Outcomes include ongoing conversations that may result in proposal submission or program sponsorship.

Looking forward to Q2, CASIS will be holding its annual Public Board Meeting on January 30, 2018 in League City, TX (https://www.iss-casis.org/about/public-board-meetings/2018-public-board-meeting/), which will be followed by an ISS National Lab Implementation Partners and Commercial Services Providers Workshop.

OUTREACH AND EDUCATION

PROMOTE THE VALUE OF THE ISS AS A LEADING ENVIRONMENT FOR R&D AND STEM EDUCATION

Increasing Awareness and Positive Perception

Promoting awareness and utilization of the ISS National Lab is a multifaceted and vast effort, and it requires partnership and collaboration to reach new audiences and new heights. Every conference attended, project awarded, partnership formed, and communication issued helps expand the ISS National Lab network deeper into the scientific community and more expansively throughout the country. CASIS-produced videos and written materials complement robust business development activities to promote innovation and awareness.

FIGURE 11: THOUGHT LEADERSHIP PRODUCTS

Two CASIS-published documents in Q1 outlined successes and programs onboard the ISS National Lab.

PUBLICATION/PRODUCT INFORMATION	DESCRIPTION AND PURPOSE
Upward (Volume 2, issue 3) *Authors:* Multiple, including CASIS staff and external contributors *Publisher:* CASIS	In this issue of *Upward*, magazine of the ISS National Lab, CASIS Director of Operations and NASA Liaison Ken Shields shared his perspective on the growth of commercial activity in space and the evolution of a new economy in low Earth orbit, and the issue's cover story discussed how in-orbit commercial facility operators such as Space Tango, one of the many successful companies doing business onboard the ISS National Lab, are serving as pathfinders for this economic development. Additionally, this issue highlights a recent collaboration between CASIS and NASA to refurbish a retired furnace onboard the ISS, enabling materials science research with potential U.S. Department of Homeland Security applications. Also included in the issue is an article discussing how ground validation studies can inform microgravity research with exciting results prior to flight, as illustrated by an Emory University researcher's stem cell research with translational applications. https://upward.iss-casis.org/volume-2/issue-3/
Microgravity Molecular Crystal Growth Onboard the ISS National Lab: A Program Overview *Authors:* Marc Giulianotti, Amelia W. Smith, and Debbie Wells *Publisher:* CASIS	This paper serves as technical correspondence discussing the demonstrated value of crystallization research in microgravity and providing an overview the CASIS Microgravity Molecular Crystal Growth (MMCG) Program. The paper gives a brief history of crystallization in microgravity and an overview of crystal growth investigations within the ISS National Lab R&D portfolio. It also discusses key expert recommendations resulting from the technical interface meeting held by CASIS in 2015 to gather input from experts in the field of protein crystallography. The paper highlights the goals and implementation of the CASIS MMCG Program and provides a summary of applications for molecular crystal growth in microgravity, an overview of continued interest in microgravity molecular crystal growth research, and a discussion of future directions. http://www.spacestationresearch.com/research-library/reports/mmcg/

FIGURE 12: MAINSTREAM MEDIA COVERAGE

SpX-13, the 2nd launch of the quarter, featured non-traditional research partner Budweiser, who was growing and evaluating barley strains to better enhance its products and agricultural knowledge on Earth. This partnership, along with other innovative R&D that launched in the quarter, brought record-breaking publicity for the ISS National Lab around Q1 launches.

PROJECT INFORMATION	MEDIA OUTLETS		KEY POINTS
ISS National Lab Project/Program: **Barley Germination in Microgravity** *Partners/Investigator Affiliation:* Budweiser, Space Tango	▶ *Time* ▶ *CNN* ▶ *Daily Mirror* ▶ *IBTimes* ▶ *The State* ▶ *Tech Times* ▶ *Food and Wine* ▶ *BizJournals* ▶ *Fast Company* ▶ *Seattle Times* ▶ *Los Angeles Times* ▶ *Associated Press* ▶ *Aviation Week* ▶ *Mashable* ▶ *New York Daily News* ▶ *Florida Today*	▶ *Chicago Sun Times* ▶ *Fox Business* ▶ *ABC News* ▶ *CBS News* ▶ *Yahoo* ▶ *US News and World Report* ▶ *Star Tribune* ▶ *Houston Chronicle* ▶ *MSN* ▶ *L.A. Biz* ▶ *Popular Mechanics* ▶ *New York Post* ▶ *Washington Post* ▶ *Engadget* ▶ *Forbes*	Budweiser put forth an aggressive public relations campaign to promote its R&D on barley that launched to the ISS National Lab aboard SpX-13. While the company was open about their aspirations to become the first beer on Mars, the research also provided an avenue to talk about the power of plant science on station and how the company will be evaluating the response of barley to the stressors of the space environment. The understanding of how this critical commercial crop reacts in space could have applications to not only improving Budweiser's product and processes on Earth but also revealing insights into broad topics regarding crop sustainability.

PROJECT INFORMATION	MEDIA OUTLETS		KEY POINTS
ISS National Lab Project/Program: **Go For Launch!** *Partners/Investigator Affiliation:* Higher Orbits	▶ *Wired* ▶ *Businesswire* ▶ *Phoenix Local CBS Affiliate*	▶ *Space.com* ▶ *Spaceflight Insider* ▶ *Universe Today*	Multiple media outlets covered students from Arizona sending payloads to the ISS National Lab on OA-8. Additionally, the media covered Orbital ATK's financial sponsorship of the students and their experiment.
ISS National Lab Project/Program: **EcAMSat** *Partners/Investigator Affiliation:* NanoRacks, Stanford University	▶ *Satellite Today* ▶ *Reddit* ▶ *Space.com*	▶ *Aviation Week* ▶ *Spaceflight News* ▶ *Spaceflight Insider*	While CubeSats are not an uncommon payload as part of the ISS National Lab flight manifest, this particular partnership between NASA, Stanford University, and NanoRacks drew interest because of the content within the CubeSat onboard OA-8. This experiment was looking at *E. coli* strains and their reaction to the extreme environment of space.
ISS National Lab Project/Program: **Technology in Space Prize (Sponsored Program)** *Partners/Investigator Affiliation:* Boeing, MassChallenge, Cellino Biotech, Guardion Technologies, and MakerHealth	▶ *GeekWire* ▶ *Yahoo News* ▶ *Spaceflight Insider*		CASIS and Boeing have partnered together over the last four years to award innovative startup companies through the MassChallenge startup accelerator contest. Articles focused on the three awarded companies from this year, their research aspirations, and the CASIS–Boeing partnership to fund innovative research.
ISS National Lab Project/Program: **Implantable Nanochannel System for Delivery of Therapeutics for Muscle Atrophy (Rodent Research-6)** *Partners/Investigator Affiliation:* Houston Methodist Research Institute, Novartis	▶ *Aerospace America* ▶ *Digital Journal* ▶ *Associated Press* ▶ *Financial Express*	▶ *First Spot* ▶ *The Economic Times* ▶ *Value Walk*	ISS rodent research was covered by many major publications as a payload of interest onboard SpX-13. This investigation was a joint mission between NASA and the ISS National Lab and is investigating implantable device technologies to improve patient care on Earth.
ISS National Lab Project/Program: **Effects of Microgravity on Production of Fluoride-Based Optical Fibers** *Partners/Investigator Affiliation:* Made In Space, Inc.	▶ *Newsweek Europe* ▶ *CBS News* ▶ *Spaceflight Insider* ▶ *Inquisitr* ▶ *PR Newswire* ▶ *GeekWire*	▶ *Florida Today* ▶ *Futurism* ▶ *Space.com* ▶ *Popular Science* ▶ *Orlando Business Journal*	The latest ISS National Lab project from Made In Space focused on in-orbit manufacturing capabilities, specifically of ZBLAN fibers. The innovative company made a strong push with media to promote the unique variables of ISS as an evolving research platform now capable of in-orbit manufacturing capabilities.

Additionally, a feature story on CASIS in *Aerospace America* looked at the evolution and maturation of the organization, along with many of the key commercial research partnerships that have been forged over the years.

STEM Initiatives

The Space Station Explorers consortium (SSE) supports 22 active programs, most in collaboration with partner organizations who manage these programs nationwide. Highlights from some of these partner programs are detailed below.

FIGURE 13: PARTNER PROGRAM UPDATES

PROGRAM INFORMATION	EVENT/ACTIVITY	RELATIONSHIP TO CASIS MISSION
Higher Orbits (Leesburg, VA) http://higherorbits.org/student-programs/go-for-launch/	Higher Orbits launched a student-led project aboard OA-8 in November. The research team consisted of four students from Gilbert High School (Phoenix, AZ), awarded through a STEM camp competition conducted by Higher Orbits in early 2017. The project is a plant biology experiment utilizing micro clovers and the team's idea was inspired by the movie *The Martian.* *Note: The National Lab resources required for this project are scheduled as "reserve" and will not displace any R&D priorities.*	This program engages middle- and high-school students in an immersive three-day program that uses the ISS and the excitement of space-based research and exploration as a tool to engage students with STEM. The program also develops skills in teamwork, communication, project management, problem solving, and leadership—critical skills to educating and preparing a STEM workforce that will lead the future U.S. economy.

PROGRAM INFORMATION	EVENT/ACTIVITY	RELATIONSHIP TO CASIS MISSION
Orion's Quest (Williamsburg, MI) https://www.orionsquest.org/	SSE Partner Orion's Quest CEO Pete Lawrie was given the opportunity to explain his program's goals to Secretary of the U.S. Department of Housing and Urban Development Dr. Benjamin Carson and the special guests at a Life Remodeled meeting in December (Detroit, MI). The overview focused on the program's mission, what they do, and how they are partnering with Life Remodeled, a nonprofit in Detroit that invests in neighborhoods to combat poverty. Related Links: https://www.orionsquest.org/2017/12/14/orions-quests-new-partner-detroit-based-life-remodeled/	Orion's Quest is an internet-based education program for students in upper elementary, middle, and high school. The program employs current ISS research to reach and inspire the next generation of explorers. As a part of this new collaboration, Orion's Quest will be providing a K-12 STEM activity program for teachers and students in the community, in an effort to build skills critical to educating and preparing a future STEM workforce.
Magnitude.io (Berkeley, CA) https://magnitude.io/product/exolab-on-iss/	This program launched EXOLAB 2 on OA-8, and related ground-based activities will represent 7500 students in 61 schools across 10 states. The program also hosted five Teacher Professional Development events and attended four education conferences (California Science Education Conference, Association of Science - Technology Centers Conference, Space Exploration Educators Conference, and California STEAM Symposium).	ExoLab is a growth chamber with a camera and a number of sensors that is used in the classroom. An experiment is run aboard the ISS simultaneously. All ExoLabs are networked and share data. The program introduces middle school biology in an extraordinary way using the Next Generation Science Standards framework, developing science research and data analysis skills and inspiring students to pursue STEM careers by making the ISS real, relevant, and accessible.

FIGURE 14: STEM ENGAGEMENT THROUGH EVENT OUTREACH

EVENT INFORMATION	PARTICIPANTS/AUDIENCE	GOALS AND OUTCOMES
Association of Science-Technology Centers 2017 10/21/17 – 10/24/17 (San Jose, CA)	Approximately 2,000 leaders and decision makers from the world's cutting-edge science centers and museums, nature centers, and natural history and children's museums.	CASIS exhibited to showcase the SSE program and services and seek new partner opportunities.
Astronomical Society of the Pacific 2018 Annual Meeting 12/5/17 – 12/8/17 (St. Louis, MO)	Researchers, educators, and amateur astronomers	CASIS exhibited at this STEM outreach conference with a special emphasis on working with and engaging diverse and underserved communities. The Astronomical Society of Pacific is the largest general astronomy education society in the world, with members from more than 40 countries. CASIS featured SSE offerings in its booth and recruited ambassadors to become involved in SSE.
McAuliffe Center Open House 10/17/2017 (Framingham, MA)	STEM professionals, educators CASIS speaking opportunities = 1	CASIS representatives participated in the announcement of a new initiative with the McAuliffe Center to provide SSE and other STEM education programming to out-of-school time organizations serving financially disadvantaged youth. The Open House showcased the ISS virtual tour exhibit and many other SSE education resources.
Students for the Exploration and Development of Space SpaceVision FY18 11/16/17 – 11/18/17 (Cape Canaveral, FL)	Young professional and college/university students	Students for the Exploration and Development of Space (SEDS) is a 501(c)3 non-profit that empowers young people to participate and make an impact in space exploration. SEDS helps students develop their technical and leadership skills by providing opportunities to manage and participate in national projects as well as to attend conferences, publish their work, and develop their professional network, in order to help students become more effective in their present and future careers in industry, academia, government, and education. CASIS co-sponsored this event.

Looking forward to Q2, CASIS will be holding its Annual STEM Education Summit on February 12–14, 2018 in Titusville, FL and participating in Family Science Days at the 2018 annual meeting of the American Association for the Advancement of Science (AAAS), February 17–18, 2018 in Austin, TX.

Q1 FY18 METRICS

Secure Strategic Flight Projects: Generate significant, impactful, and measurable demand from customers willing to pay for access and therefore recognize the value of the ISS as an innovation platform.

	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 TO DATE
ISS National Lab payloads manifested	15				**15**
ISS National Lab payloads delivered	25				**25**
Research Procurement					
Solicitations / Competitions	3				**3**
Project proposals generated	23				**23**
Projects awarded	7				**7**
ISS National Lab return customers	2				**2**
ISS National Lab new customers	5				**5**
Total Value of CASIS Grants Awarded*	$585,558				**$585,558**
Peer-reviewed scientific journal publications	2				**2**
Products or services created/enhanced	0				**0**
In-orbit commercial facilities	12				**12**
In-orbit commercial facility managers	7				**7**

* Grants include awards to projects and programs as well as modifications and extensions.

Secure Independent Funding: Leverage external funding to support ISS National Lab projects through collaborative sponsorships and third-party investments.

	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 TO DATE
Sponsored Program/external funding for grants	$11,400,000				**$11,400,000**
Investor network participants (cumulative count to date)	80				**80**
Investments reported from network (cumulative count to date)	$1,285,000				**$1,285,000**

Build reach in STEM: Create STEM programs, educational partnerships, and educational outreach initiatives using ISS National Lab-related content.

	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 TO DATE
STEM programs (active)	22				**22**
Participation in ISS National Lab STEM Programs and educational outreach activities					
Students	117,528				**117,528**
Educators	6,129				**6,129**
Mixed Audience	143,270				**143,270**
Total STEM engagement via programs and outreach activities	266,927				**266,927**
Total value of CASIS STEM grants awarded **	$0.00				**$0.00**

** Total STEM grants awarded included in the Total Value of CASIS Grants Awarded figure above.

Increase Awareness: Build positive perception of the ISS National Lab within key audience communities.

	Q1FY18	Q2FY18	Q3FY18	Q4FY18	FY18 TO DATE
Outreach events					
Conferences and industry event sponsorships	3				**3**
Speaking engagements	19				**19**
Subject matter expert workshops and thought leader roundtables/salons	2				**2**
Total media impact					
Thought leadership publications (e.g., white papers, trade articles, technical papers, magazine issues)	2				**2**
News mentions (clips, blogs)	4,142				**4,142**
Twitter followers	117,833				**117,833**
Website unique visitors	27,073				**27,073**
Social media engagement, cumulative (Facebook, Twitter, and Instagram)	40,386				**40,386**

Maximize Utilization: CASIS to use 50% of U.S. allocation onboard the ISS.

INCREMENT	UPMASS (KG)	DOWNMASS (KG)	CREWTIME (HRS)			
	ACTUALS+	ACTUALS+	ALLOCATION*	ACTUALS++	RESERVE	USAGE**
Inc 37/38 (Sep 2013-Mar 2014)	334.7	7.9	427	78.42	-	18%
Inc 39/40 (Mar 2014-Sep 2014)	389.1	197.8	386	70.75	-	18%
Inc 41/42 (Sep 2014-Mar 2015)	716	705.5	346	130.29	-	38%
Inc 43/44 (Mar 2015-Sep 2015)[1]	538.3	165.93	229	223.33	-	98%
Inc 45/46 (Sept 2015-Mar 2016)	384.6	0	293	125.75	-	43%
Inc 47/48 (Mar 2016-Sept 2016)	760.9	313.54	356	314.25	-	88%
Inc 49/50 (Sept 2016-Mar 2017)	392	83	4032	311.58	-	77%
Inc 51/52 (Mar 2017-Sept 2017)	931	300	328	446.58	-	136%
Inc 53/54 (Sept 2017-Mar 2018)	*743*	*936*	*502.86*	*344*	*120*	*68%*

Data through 1/3/2018

\+ **"Actuals"** are based on the summation of payload mass for ascent and descent as reported by the NASA ORBIT RIFD tool for the National Lab sponsor.

* **"Allocation"** is defined as the baselined number of crew time hours allocated by NASA at increment minus 3 months to the ISS National Lab for prioritized utilization to directly support in-orbit ISS National Lab payload utilization operations.

++ **"Actuals"** are defined as the definite and verified number of crew time hours that were utilized to support in-orbit ISS National Lab payload utilization operations. This data is collected reported and verified by NASA after the actual in-orbit operations have been completed. The crew time hours do not include crew time spent on shared resources or facilities.

** **"Usage"** is defined as the percentage of ISS National Lab allocated crew time hours that were actually utilized during a given increment pair.

Notes:

1. Includes upmass/downmass from the SpX-7 launch failure.
2. Inc 49/50 I-3 crewtime allocation was 312 hours. Additional crewtime allocation was added over the course of the increment pair.

FINANCIALS

Business Status Report (unaudited)

OCT 1 TO DEC 30, 2017	ACTUAL Q1FY18	BUDGET Q1FY18	VARIANCE Q1FY18	ACTUAL YTD FY18	BUDGET YTD FY18	VARIANCE YTD FY18
Direct Labor	$1,530,235	$1,805,992	$(275,757)	$1,530,235	$1,805,992	$(275,757)[1]
Subcontracts	$291,199	$464,625	$(173,426)	$291,199	$464,625	$(173,426)[2]
Permanent Equipment	$12,242	$33,750	$(21,508)	$12,242	$33,750	$(21,508)
Office Supplies & Equipment	$52,135	$66,676	$(14,541)	$52,135	$66,676	$(14,541)
Travel	$277,642	$258,320	$19,322	$277,642	$258,320	$19,322
Grants	$1,177,849	$2,272,915	$(1,095,066)	$1,177,849	$2,272,915	$(1,095,066)[3]
Other	$436,261	$446,268	$(10,007)	$436,261	$446,268	$(10,007)
Total	**$3,777,563**	**$5,348,546**	**$(1,570,983)**	**$3,777,563**	**$5,348,546**	**$(1,570,983)**

(1) Direct Labor: Actual headcount was 47 versus a budget of 54.
(2) Subcontracts: Lower than budget for Legal, Science and Technology, and Business Development.
(3) Grants: Recipient milestone payments shifted based on actual spend or delay in flights.

Breakout of Cooperative Agreement Funding

	Q1 FY18	Q2 FY18	Q3 FY18	Q4 FY18	FY18 TOTAL
Academic	$236,603				$236,603
Commercial	$763,120				$763,120
Other Governmaent Agency	$ -				$ -
Mission Based Costs	$178,126				$178,126
Total	**$1,177,849**				**$1,177,849**

Breakout of CASIS Grants

	Q1 FY18	Q2 FY18	Q3 FY18	Q4 FY18	FY18 TOTAL
Direct	53.4%				53.4%
Indirect	15.5%				15.5%
Grants	31.1%				31.1%

APPENDIX 1: FULL CASIS-SELECTED R&D PORTFOLIO

FLIGHT MANIFEST DETAILS AS OF DECEMBER 31, 2017

Validation Studies and Ground Testing

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	CITY	STATE	IMPLEMENTATION PARTNER
3D Neural Microphysiological System	Dr. Michael Moore	AxoSim Technologies	New Orleans	LA	N/A
BCM-Dept. of Molecular & Cellular Biology OMICS seed grant (original)	Dr. Clifford Dacso	Baylor College of Medicine	Houston	TX	N/A
National Design Challenge - 4 Collins	Matthew Weaver	Collins Middle School	Boston	MA	N/A
Remote Controlled Nanochannel Implant for Tunable Drug Delivery	Dr. Alessandro Grattoni	Houston Methodist Research Institute	Houston	TX	N/A
Improving Astronaut Performance of National Lab Research Tasks	Dr. Jayfus Doswell	Juxtopia, LLC	Baltimore	MD	N/A
Unfolded Protein Response in Osteoporosis and Sarcopenia	Dr. Imran Mungrue	Louisiana State University Health Sciences Center	New Orleans	LA	N/A
Classrooms in Space	Ted Tagami	Magnitude.io	Berkeley	CA	Space Tango, Inc.
National Ecological Observatory Network (NEON)	Brian Penn	National Ecological Observatory Network (NEON)	Boulder	CO	N/A
Orion's Quest-Student Research on the ISS	Peter Lawrie	Orions Quest	Canton	MI	N/A
National Design Challenge - 4 Talbot	Benjamin Coleman	Talbot Innovation Middle School	Fall River	MA	N/A
Combined Evaluation of Mouse Musculoskeletal Data	Dr. Virginia Ferguson	University of Colorado Boulder	Boulder	Co	N/A
Faraday Waves and Instability-Earth and Low G Experiments	Dr. Ranga Narayanan	University of Florida Board of Trustees	Gainesville	FL	N/A
Microphysiological System for Studying Composite Skeletal Tissues	Dr. Rocky S. Tuan	University of Pittsburgh	Pittsburgh		N/A

Preflight

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
National Design Challenge - 3 McFarland	Norman McFarland	Boy Scouts of America	SpX-14	3/13/18	Chicago	IL	NanoRacks, LLC
Fiber Optics Manufacturing in Space (FOMS)	Dr. Dmitry Starodubov	FOMS Inc.	SpX-14	3/13/18	San Diego	CA	Space Tango, Inc.

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
Tympanogen - Wound Healing	Dr. Elaine Horn-Ranney	Tympanogen, LLC	SpX-14	3/13/18	Norfolk	VA	NanoRacks, LLC
Spaceflight Effects on Vascular Endothelial and Smooth Muscle Cell Processes	Dr. Josephine Allen	University of Florida	SpX-14	3/13/18	Gainesville	FL	Space Technology and Advanced Research Systems Inc. (STaARS)
Microgravity Crystal Growth for Improvement in Neutron Diffraction	Dr. Timothy Mueser	University of Toledo	SpX-14	3/13/18	Toledo		TBD
Crystal Growth STEM 2017	Illa Guzei	University of Wisconsin - Madison	SpX-14	3/13/18	Madison	WI	TBD
Neutron Crystallographic Studies of Human Acetylcholinesterase	Dr. Andrey Kovalevsky	UT Battelle Oak Ridge National Lab	SpX-14	3/13/18	Oak Ridge	TN	TBD
Biofilm Thickness/ Viability and Elevated Microbial Corrosion Risk	Dr. Vic Keasler	Nalco Champion	SpX-15	6/9/18	St. Paul	MN	BioServe Space Technologies
Pushing the Limits of Silica Fillers for Tire Applications	Derek Shuttleworth	Goodyear Tire & Rubber Co.	OA-10	11/8/18	Akron	OH	BioServe Space Technologies
Influence of Gravity on Human Immune Function in Adults and the Elderly	Dr. Donald Drake	Sanofi Pasteur	SpX-16	11/18/18	Orlando	FL	TBD
Structure of Proximal and Distal Tubule Microphysiological Systems	Dr. Jonathan Himmelfarb	University of Washington	SpX-17	2/1/19	Seattle	WA	BioServe Space Technologies
Capillary-Driven Microfluidics in Space	Dr. Luc Gervais	1Drop Diagnostics US, Inc.	TBD	TBD	Boston	MA	Zin Technologies, Inc.
Comparative Real-time Metabolic Activity Tracking	Dr. Gary Sayler	490 Biotech, Inc.	TBD	TBD	Knoxville	TN	BioServe Space Technologies
Corrosion Inhibitor Exposed to the Extreme Environments in Space	Lauren Thompson Miller	A-76 Technologies, LLC	TBD	TBD	Houston	TX	NanoRacks, LLC
SiC Microgravity Enhanced Electrical Performance	Rich Glover	ACME Advanced Materials	TBD	TBD	Albuquerque	NM	TBD
SPHERES Tether - Slosh	Dr. Hans-Juergen Zachrau	AIRBUS DS Space Systems, Inc.	TBD	TBD	Webster	TX	AIRBUS DS Space Systems, Inc.
Materials International Space Station Experiment (MISSE) Flight Facility	LD Stevenson	Alpha Space	TBD	TBD	Houston	TX	Alpha Space

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
Endothelial Cells In Microgravity for Evaluation of Cancer Therapy Toxicity	Dr. Shou-Ching Jaminet	Angiex	TBD	TBD	Cambridge	MA	BioServe Space Technologies
Monoclonal Antibody Production and Stability in Microgravity	Dr. Albert Ethan Schmelzer	AstraZeneca-MedImmune	TBD	TBD	Gaithersburg	MD	TBD
Preparation of PLGA Nanoparticles Based on Precipitation Technique	Dr. Puneet Tyagi	AstraZeneca-MedImmune	TBD	TBD	Gaithersburg	MD	TBD
The Universal Manufacture of Next Generation Electronics	Supriya Jaiswal	Astrileux Corporation	TBD	TBD	La Jolla	CA	NanoRacks, LLC
Thermally Activated Directional Mobility of Vapor Bubbles	Sushil Bhavnani	Auburn University	TBD	TBD	Auburn,	AL	TBD
Audacy Lynq	Ellaine Talle	Audacy Corporation	TBD	TBD	Mountain View	CA	NanoRacks, LLC
Cranial Bone Marrow Stem Cell Culture in Space	Dr. Yang (Ted) D. Teng	Brigham and Women's Hospital	TBD	TBD	Boston	MA	TBD
ARQ: A Platform for Enhanced ISS Science and Commercialization	Jason Budinoff	bSpace Corporation	TBD	TBD	Seattle	WA	bSpace Corporation
Electrolytic Gas Evolution under Microgravity	Larry Alberts	Cam Med, LLC	TBD	TBD	West Newton	MA	Zin Technologies, Inc.
Study of the Interactions between Flame and Surrounding Walls	Ya-Ting Liao	Case Western Reserve University	TBD	TBD	Cleveland	OH	TBD
Investigating Proliferation of NanoLaze Gene-edited induced Pluripotent	Matthias Wagner	Cellino Biotech, Inc.	TBD	TBD	Cambridge	MA	BioServe Space Technologies
Design of Scalable Gas Separation Membranes via Synthesis under Microgravity	Negar Rajabi	Cemsica	TBD	TBD	Houston	TX	TBD
Unmasking Contact-line Mobility for Inertial Spreading using Drop Vibration	Dr. Paul Steen	Cornell University	TBD	TBD	Ithaca	NY	Zin Technologies, Inc.
Inertial Spreading and Imbibition of a Liquid Drop Through a Porous Surface	Dr. Michel Louge	Cornell University	TBD	TBD	Ithaca	NY	Zin Technologies, Inc.
Space Development Acceleration Capability (SDAC)	Ryan Jeffrey	Craig Technologies	TBD	TBD	Cape Canaveral	FL	Craig Technologies

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
Droplet Formation Studies in Microgravity	Garry Marty	Delta Faucet	TBD	TBD	Indianapolis	IN	Zin Technologies, Inc.
Rodent Research - 4 (Wound Healing) Post Flight Analysis	Dr. Rasha Hammamieh	Department of Defense	TBD	TBD	Fort Detrick	MD	NASA ARC
DexMat CASIS CNT Cable Project	Dr. Alberto Goenaga	DexMat, Inc.	TBD	TBD	Houston	TX	NanoRacks, LLC
Microgravity Crystalization of Glycogen Synthase-Glycogenin Protein Complex	Dr. David S. Chung	Dover Lifesciences	TBD	TBD	Dover	MA	CASIS/Bionetics
Survivability of Variable Emissivity Devices for Thermal Control Applications	Dr. Hulya Demiryont	Eclipse Energy Systems, Inc.	TBD	TBD	St. Petersburg	FL	NanoRacks, LLC
Generation of Cardiomyocytes from Induced Pluripotent Stem Cells	Dr. Chunhui Xu	Emory University	TBD	TBD	Atlanta	GA	Techshot, Inc.
Effects of Microgravity on Human Physiology: Blood-Brain Barrier Chip	Dr. Chris Hinojosa	Emulate, Inc.	TBD	TBD	Cambridge	MA	Space Tango, Inc.
Convection-free synthesis of 2D nanomaterials	Dan Esposito	Guardion Technologies	TBD	TBD	Cambridge	MA	TBD
BioChip Spacelab	Dan O'Connell	HNu Photonics	TBD	TBD	Wailuku	HI	HNu Photonics
Influence of Microgravity on T-Cell Dysfunction and Neurogenesis	Dr. Caitlin O, Connell-Rodwell	HNu Photonics	TBD	TBD	Wailuku	HI	HNu Photonics
Ionic Liquid CO2 Scrubber and Liquid Containment in Microgravity	Phoebe Henson	Honeywell International	TBD	TBD	Glendale	AZ	TBD
Intuitive Machines-ISS Terrestrial Return Vehicle (TRV)	Steve Altemus	Intuitive Machines	TBD	TBD	Houston	TX	Intuitive Machines
Enhancement of Performance and Longevity of a Protein-Based Retinal Implant	Dr. Nicole L. Wagner	LambdaVision	TBD	TBD	Farmington	CT	Space Tango, Inc.
Remote Manipulator Small-Satellite System (RM3S)	Craig Walton	LaMont Aerospace Inc.	TBD	TBD	Houston	TX	LaMont Aerospace Inc.
Test Multilayer Polymer Convection and Crystallization Under Microgravity	Dr. Yichen Shen	Lux Labs	TBD	TBD	Cambridge	MA	TBD

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
Commercial Polymer Recycling Facility (CPRS)	Matthew Napoli	Made In Space	TBD	TBD	Moffett Field	CA	Made In Space
AmpliRx: A Manufacturing Pharmaceutical Lightweight Instrument	Anna Young	MakerHealth	TBD	TBD	Boston	MA	Techshot, Inc.
Cartilage-Bone-Synovium Microphysiological System	Dr. Alan Grodzinsky	Massachusetts Institute of Technology	TBD	TBD	Cambridge	MA	Techshot, Inc.
Microfluidic Lab-on-a Chip to Track Biomarkers in Skeletal Muscle Cells	Dr. Siobhan Malany	Micro-gRx, Inc.	TBD	TBD	Orlando	FL	Space Tango, Inc.
National Cancer Institute NExT Space Crystallization Program	Dr. Barbara Mroczkowski	National Cancer Institute	TBD	TBD	Frederick	MD	TBD
The Effects of Microgravity on Synovial Fluid Volume and Composition	Dr. Richard Meehan	National Jewish Health	TBD	TBD	Denver	CO	Wyle Integrated Science and Engineering Group
Nemak Alloy Solidification Experiments	Dr. Glenn Byczynski	NEMAK	TBD	TBD	Southfield	MI	TBD
Map the Penetration Profile of a Contact-Free Transdermal Drug Delivery System	Dr. Robert Applegate	Novopyxis	TBD	TBD	Boston	MA	NanoRacks, LLC
Constrained Vapor Bubbles of Ideal Mixtures	Dr. Joel Plawsky	Rensselaer Polytechnic Institute	TBD	TBD	Troy	NY	Zin Technologies, Inc.
MDCK Influenza virus infection	Dr. Philippe, Alexandre Gilbert	Sanofi Pasteur	TBD	TBD	Orlando	FL	HNU NANO Point
Windows on Earth - Earth Videos with a Related Education Program	David Libby	TERC	TBD	TBD	Cambridge	MA	NanoRacks, LLC
ISS Bioprinter Facility	Dr. Eugene Boland	Techshot, Inc.	TBD	TBD	Greenville	IN	Techshot, Inc.
Genes in Space - 5 Lakeside	Sophia Chen	The Boeing Company	TBD	TBD	Chicago	IL	The Boeing Company
Genes in Space - 5 Stuyvesant	Elizabeth Reizis	The Boeing Company	TBD	TBD	Chicago	IL	The Boeing Company
Lung Host Defense in Microgravity	Dr. G Scott Worthen	The Children's Hospital of Philadelphia	TBD	TBD	Philadelphia	PA	Space Technology and Advanced Research Systems Inc. (STaARS)

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED LAUNCH VEHICLE	ESTIMATED LAUNCH DATE	CITY	STATE	IMPLEMENTATION PARTNER
Spacewalk: A Virtual Reality Experience	Mia Tramz	Time Inc.	TBD	TBD	New York	NY	TBD
Microgravity Model for Immunological Senescence on Tissue Stem Cells	Dr. Sonja Schrepfer	University of California, San Francisco	TBD	TBD	San Francisco	CA	Space Technology and Advanced Research Systems Inc. (STaARS)
Quantifying Cohesive Sediment Dynamics for Advanced Environmental Modeling	Dr. Paolo Luzzatto-Fegiz	University of California, Santa Barbara	TBD	TBD	Santa Barbara	CA	Zin Technologies, Inc.
Kinetics of Nanoparticle Self-assembly in Directing Fields	Dr. Eric Furst	University of Delaware	TBD	TBD	Newark	DE	Zin Technologies, Inc.
Domesticating Algae for Sustainable Production of Feedstocks in Space	Dr. Mark Settles	University of Florida	TBD	TBD	Gainesville	FL	TBD
An ISS Experiment on Electrodeposition	Dr. Kirk Ziegler	University of Florida	TBD	TBD	Gainesville	FL	Space Tango, Inc.
Spherical Cool Diffusion Flames Burning Gaseous Fuels	Peter Sunderland	University of Maryland	TBD	TBD	College Park	MD	TBD
The Impact of Nanostructure Geometry on Photo-Thermal Evaporation Processes	Tengfei Luo	University of Notre Dame	TBD	TBD	Notre Dame	IN	TBD
Space Based Optical Tracker	Dr. John Stryjewski	Vision Engineering Solutions	TBD	TBD	Orlando	FL	TBD
Providing Spherical Video Tours of ISS	David Gump	Deep Space Industries	TBD	TBD	Moffett Field	CA	TBD

In Orbit

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED RETURN VEHICLE	ESTIMATED RETURN DATE	CITY	STATE	IMPLEMENTATION PARTNER
Barley Germination and Malting in Microgravity	Gary Hanning	Budweiser	SpX-13	1/13/18	New York	NY	Space Tango, Inc.
Implantable Glucose Biosensors	Dr. Michail Kastellorizios	Biorasis, Inc.	SpX-13	1/13/18	Storrs/ Mansfield	CT	Space Tango, Inc.
Implantable Nanochannel System for Delivery of Therapeutics for Muscle Atrophy	Dr. Alessandro Grattoni	Houston Methodist Research Institute	SpX-13	1/13/18	Houston	TX	BioServe Space Technologies
Assessing Osteoblast Response to Tetranite	Dr. Nikolaos Tapinos	LaunchPad Medical	SpX-13	1/13/18	Boston	MA	BioServe Space Technologies

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED RETURN VEHICLE	ESTIMATED RETURN DATE	CITY	STATE	IMPLEMENTATION PARTNER
Effects of Microgravity on Production of Fluoride-Based Optical Fibers	Michael Snyder	Made In Space	SpX-13	1/13/18	Moffett Field	CA	Made In Space
Continuous Liquid-Liquid Separation in Microgravity	Dr. Andrea Adamo	Zaiput Flow Technologies	SpX-13	1/13/18	Cambridge	MA	Space Tango, Inc.
SG100 Cloud Computing Payload	Trent Martin	Business Integra Technology Solutions (BI Tech)	SpX-14	4/14/18	Houston	TX	Business Integra Technology Solutions (BI Tech)
Development and Deployment of Charge Injection Device Imagers	Dr. Daniel Batcheldor	Florida Institute of Technology	SpX-14	4/14/18	Melbourne	FL	NanoRacks, LLC
Dependable Multi-processor Payload Processor Validation	Dr. Benjamin Malphrus	Morehead State University	SpX-14	4/14/18	Morehead	KY	NanoRacks, LLC
Multipurpose Active Target Particle Telescope on the ISS	Dr. Hans-Juergen Zachrau	AIRBUS DS Space Systems, Inc.	TBD	TBD	Webster	TX	AIRBUS DS Space Systems, Inc.
Spaceborne Computer	David Petersen	Hewlett Packard	TBD	TBD	Milpitas	CA	Hewlett Packard
Detached Melt and Vapor Growth of Indium Iodide	Dr. Aleksandar Ostrogorsky	Illinois Institute of Technology	TBD	TBD	Chicago	IL	Teledyne Brown Engineering
GLASS AIS TransponderGlobal AIS on Space Station (GLASS)	Rob Carlson	JAMSS America, Inc.	TBD	TBD	Houston	TX	JAMSS America, Inc.
Crystal Growth of Cs2LiYCl6:Ce Scintillators in Microgravity	Dr. Alexei Churilov	Radiation Monitoring Devices, Inc.	TBD	TBD	Watertown	MA	Teledyne Brown Engineering
Project Meteor	Michael Fortenberry	Southwest Research Institute	TBD	TBD	Boulder	Co	Southwest Research Institute
Additive Manufacturing Operations Program	Michael Snyder	Made In Space	N/A	N/A	Moffett Field	CA	Made In Space
NanoRacks External Platform	Michael Johnson	NanoRacks, LLC	N/A	N/A	Houston	TX	NanoRacks, LLC
TangoLab-1: Research Server for the ISS	Twyman Clements	Space Tango, Inc.	N/A	N/A	Lexington	KY	Space Tango, Inc.
TangoLab-2	Twyman Clements	Space Tango, Inc.	N/A	N/A	Lexington	KY	Space Tango, Inc.
STaARS-1 Research Facility	Dr. Heath Mills	Space Technology and Advanced Research Systems Inc. (STaARS)	N/A	N/A	Houston	TX	Space Technology and Advanced Research Systems Inc. (STaARS)

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PLANNED RETURN VEHICLE	ESTIMATED RETURN DATE	CITY	STATE	IMPLEMENTATION PARTNER
Windows On Earth	David Libby	TERC	N/A	N/A	Cambridge	MA	TERC
Bone Densitometer	John Vellinger	Techshot, Inc.	N/A	N/A	Greenville	IN	Techshot, Inc.
Characterizing Arabidopsis Root Attractions (CARA) grant extension	Dr. Anna-Lisa Paul	University of Florida Board of Trustees	N/A	N/A	Gainesville	FL	CASIS/Bionetics
Tropical Cyclone Intensity Measurements from the ISS (CyMISS)	Dr. Paul Joss	Visidyne, Inc.	N/A	N/A	Burlington	MA	Visidyne, Inc.

Postflight/Complete

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	CITY	STATE	IMPLEMENTATION PARTNER
Technology Readiness Level Raising of the Net Capture System	Ron Dunklee	AIRBUS DS Space Systems, Inc.	Webster	TX	NASA ARC
Longitudinal Assessment of Intracranial Pressure During Prolonged Spaceflight	Dr. Clifford Dacso	Baylor College of Medicine	Houston	TX	N/A
National Design Challenge - 2 Bell	Shanna Atzmiller	Bell Middle School	Golden	CO	NanoRacks, LLC
Optimizing Jammable Granular Assemblies in a Microgravity Environment	Jason Hill	Benevolent Technologies for Health	Boston	MA	N/A
Protein Crystal Growth to Enable Therapeutic Discovery (Clifton)	Dr. Matt Clifton	Beryllium Discovery Corp.	Bedford	MA	NanoRacks, LLC
Commercial Space-borne Hyperspectral Harmful Algal Bloom (HAB) Products	Dr. Ruhul Amin	BioOptoSense, LLC	Metairie	LA	N/A
Ants in Space	Stefanie Countryman	BioServe Space Technologies	Boulder	CO	BioServe Space Technologies
Osteocyte Response to Mechanical Forces	Dr. Paola Divieti Pajevic	Boston University	Boston	MA	Calm Technologies, Inc
National Design Challenge - 3 Rogers	Dr. Sandra Rogers	Boy Scouts of America	Chicago	IL	NanoRacks, LLC
Crystallization of Huntington Exon-1 Using Microgravity	Dr. Pamela Bjorkman	California Institute of Technology	Pasadena	CA	University of Alabama, CBSE
National Design Challenge - 2 Centaurus	Brian Thomas	Centaurus High School	Lafayette	CO	NanoRacks, LLC
National Design Challenge - 2 Chatfield	Joel Bertelsen	Chatfield Senior High School	Littleton	CO	NanoRacks, LLC
Microgravity Electrodeposition Experiment	Michael Yagley	Cobra Puma Golf	Carlsbad	CA	NanoRacks, LLC
Controlled Dynamics Locker for Microgravity Experiments on ISS	Dr. Scott A. Green	Controlled Dynamics Inc.	Huntington Beach	CA	N/A

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	CITY	STATE	IMPLEMENTATION PARTNER
Spacecraft-on-a-Chip Experiment Platform	Dr. Mason Peck	Cornell University	Ithaca	NY	N/A
National Design Challenge - 1 Cristo Rey	Rev. Brian Reedy	Cristo Rey Jesuit College Preparatory of Houston	Houston	TX	NanoRacks, LLC
National Design Challenge - 1 Duchesne Knizner	Susan Knizner	Duchesne Academy of the Sacred Heart	Houston	TX	NanoRacks, LLC
National Design Challenge - 1 Duchesne Duquesnay	Kathy Duquesnay	Duchesne Academy of the Sacred Heart	Houston	TX	NanoRacks, LLC
Dissolution of Hard-to-Wet Solids	Alison Campbell	Eli Lilly and Company	Indianapolis	IN	Zin Technologies, Inc.
Eli Lilly - Protein Crystal Growth 2	Michael Hickey	Eli Lilly and Company	Indianapolis	IN	CASIS/Bionetics
Eli Lilly - Protein Crystal Growth 1	Kristofer Gonzalez-DeWhitt	Eli Lilly and Company	Indianapolis	IN	CASIS/Bionetics
Rodent Research - 3	Dr. Rosamund Smith	Eli Lilly and Company	Indianapolis	IN	BioServe Space Technologies
Lyophilization in Microgravity: Physical Properties and Quality Attributes	Jeremy Hinds	Eli Lilly and Company	Indianapolis	IN	Zin Technologies, Inc.
Generation of Cardiomycocytes from Human Induced Pluripotent Stem Cells	Dr. Chunhui Xu	Emory University	Atlanta	GA	Techshot, Inc.
Testing TiSi2 Nanonet Based Lithium Ion Batteries for Safety in Outer Space	Emily Fannon	EnerLeap	Newton	MA	N/A
Tomatosphere Aims 1 & 2	Ann Jorss	First the Seed Foundation	Alexandria	VA	CASIS/Bionetics
Materials Testing: Earth Abundant Textured Thin Film Photovoltaics	Dr. Jud Ready	Georgia Institute of Technology	Atlanta	GA	NanoRacks, LLC
Exploiting On-orbit Crystal Properties for Medical and Economic Targets	Dr. Edward Snell	Hauptman Woodward Medical Research Institute, Inc.	Buffalo	NY	CASIS/Bionetics
Growth Rate Dispersion as a Predictive Indicator for Biological Crystal Samples	Dr. Edward Snell	Hauptman Woodward Medical Research Institute, Inc.	Buffalo	NY	Zin Technologies, Inc.
Decoupling Diffusive Transport Phenomena in Microgravity	Dr. Alessandro Grattoni	Houston Methodist Research Institute	Houston	TX	BioServe Space Technologies
The Effect of Microgravity on Stem Cell Mediated Recellularization	Dr. Alessandro Grattoni	Houston Methodist Research Institute	Houston	TX	BioServe Space Technologies
Architecture to Transfer Remote Sensing Algorithms from Research to Operations	Dr. James Goodman	HySpeed Computing	Miami	FL	N/A
Rodent Research-4 Validation Study	Dr. Melissa Kacena	Indiana University Research	Indianapolis	IN	N/A
IPPase Crystal Growth in Microgravity	Dr. Joseph Ng	iXpressGenes, Inc.	Huntsville	AL	CASIS/Bionetics

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Global Receive Antenna and Signal Processor (GRASP)	Rob Carlson	JAMSS America, Inc.	Houston	TX	JAMSS America, Inc.
Molecules Produced in Microgravity from the Chernobyl Nuclear Accident	Dr. Kasthuri Venkateswaran	Jet Propulsion Laboratory/Caltech	Pasadena	CA	Vencore
Role Of Gravity And Geomagnetic Field In Flatworm Regeneration	Dr. Mahendra Jain	Kentucky Space, LLC	Lexington	KY	Vencore
Functional Effects of Spaceflight on Cardiovascular Stem Cells	Dr. Mary Kearns-Jonker	Loma Linda University	Loma Linda	CA	BioServe Space Technologies
Viral Infection Dynamics and Inhibition by the Vecoy Nanotechnology	Dr. Drew Cawthon	Lovelace Respiratory Research Institute	Albuquerque	NM	N/A
Application of Microgravity Expanded Stem Cells in Regenerative Medicine	Dr. Abba Zubair	Mayo Clinic	Rochester	MN	BioServe Space Technologies
Merck Protein Crystal Growth - 1	Dr. Paul Reichert	Merck Pharmaceuticals	Whitehouse Station	NJ	CASIS/Bionetics
Crystallization of LRRK2 under Microgravity Conditions	Dr. Marco Baptista	Michael J. Fox Foundation	New York	NY	CASIS/Bionetics
Great Lakes Specific HICO Water Quality Algorithms	Dr.Robert Shuchman	Michigan Technological University	Houghton	MI	N/A
Vertical Burn	Dr. Jeff Strahan	Milliken	Spartanburg	SC	Zin Technologies, Inc.
Magnetic 3D Cell Culture for Biological Research in Microgravity	Dr. Glauco Souza	Nano3D Biosciences, Inc.	Houston	TX	BioServe Space Technologies
Proof-of-Concept for Gene-RADAR Predictive Pathogen Mutation Study	Dr. Anita Goel	Nanobiosym	Cambridge	MA	BioServe Space Technologies
Validation of WetLab-2 System for qRT-PCR capability on ISS	Julie Schonfeld	NASA ARC	Mountain View	CA	NASA ARC
Impact of Increased Venous Pressure on Cerebral Blood Flow Velocity Morphology	Dr. Robert Hamilton	Neural Analytics	Los Angeles	CA	N/A
T-Cell Activation in Aging-1 & 2	Dr. Millie Hughes-Fulford	Northern California Institute for Research and Education, Inc.	San Francisco	CA	NASA ARC
Rodent Research - 1	Dr. David Glass	Novartis Institute for Biomedical Research	Cambridge	MA	BioServe Space Technologies
Rodent Research - 2	Dr. David Glass	Novartis Institute for Biomedical Research	Cambridge	MA	BioServe Space Technologies
Zero-G Characterization & OnOrbit Assembly for Cellularized Satellite Tech	Talbot Jaeger	NovaWurks, Inc	Los Alamitos	CA	NanoRacks, LLC
Efficacy and Metabolism of Azonafide Antibody-Drug Conjugates (ADCs)	Sourav Sinha	Oncolinx Pharmaceuticals LLC	Boston	MA	BioServe Space Technologies

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Advanced Colloids Experiment-Temperature Controlled-6	Dr. Matthew Lynch	Procter and Gamble Company	West Chester	OH	Zin Technologies, Inc.
Protein Crystal Growth to Enable Therapeutic Discovery (Gerdts)	Dr. Cory Gerdts	Protein BioSolutions	Gaithersburg	MD	NanoRacks, LLC
Microbead Fabrication using Rational Design Engineering	Dr. Brian Plouffe	Quad Technologies	Beverly	MA	N/A
Utilize ISS Energy Systems Data for Microgrid Design and Operation	Nicholas Kurlas	Raja Systems	Boston	MA	N/A
Synthetic Muscle: Resistance to Radiation	Dr. Lenore Rasmussen	Ras Labs	Hingham	MA	CASIS/Bionetics
Using the ISS to Evaluate Antibiotic Efficacy and Resistance (AES-1)	Dr. David Klaus	Regents of the University of Colorado	Denver	CO	BioServe Space Technologies
Crystallization of Medically Relevant Proteins Using Microgravity	Dr. Sergey Korolev	Saint Louis University	Saint Louis	MO	CASIS/Bionetics
High Data Rate Polarization Modulated Laser Communication System	Dr. Eric Wiswell	Schafer Corporation	Huntsville	AL	N/A
Reducing Signal Interruption from Cosmic Ray Background in Neutron Detectors	Dr. Andrew Inglis	Silverside Detectors	Cambridge	MA	N/A
Hyperspectral Mapping of Iron-bearing Minerals	Dr. William H. Farrand	Space Science Institute	Boulder	Co	N/A
Intraterrestrial Fungus Grown in Space (iFunGIS)	Dr. Heath Mills	Space Technology and Advanced Research Systems Inc. (STaARS)	Houston	TX	Space Technology and Advanced Research Systems Inc. (STaARS)
Intracellular Macromolecule Delivery and Cellular Biomechanics in Microgravity	Harrison Bralower	SQZ Biotechnologies	N/A	N/A	N/A
Effects of Microgravity on Stem Cell-Derived Heart Cells	Dr. Joseph Wu	Stanford University	San Francisco	CA	BioServe Space Technologies
Mutualistic Plant/Microbe Interactions	Dr. Gary Stutte	SyNRGE, LLC	Titusville	FL	NanoRacks, LLC
Examine Bone Tumor and Host Tissue Interactions Using Micro-Gravity Bioreactors	Dr. Carl Gregory	Texas A&M Health Science Center	College Station	TX	N/A
National Design Challenge - 1 Awtry Glidwell	Angela Glidwell	The Awty International School	Houston	TX	NanoRacks, LLC
National Design Challenge - 1 Awty Smith	Jessika Smith	The Awty International School	Houston	TX	NanoRacks, LLC
Genes In Space	Anna-Sophia Boguraev	The Boeing Company	Chicago	IL	The Boeing Company
Genes in Space - 2	Julian Rubinfien	The Boeing Company	Chicago	IL	The Boeing Company
Street View Imagery Collect on ISS	Anna Kapusta	ThinkSpace	Mountain View	CA	ThinkSpace

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Crystallization of Human Membrane Proteins in Microgravity	Dr. Stephen Aller	University of Alabama at Birmingham	Birmingham	AL	University of Alabama, CBSE
The Effect of Macromolecular Transport on Microgravity PCG	Dr. Lawrence ("Larry") DeLucas	University of Alabama at Birmingham	Birmingham	AL	Zin Technologies, Inc.
Systemic Therapy of NELL-1 for Osteoporosis (Rodent Research - 5)	Dr. Chia Soo	University of California, Los Angeles	Los Angeles	CA	BioServe Space Technologies
Molecular Biology of Plant Development	Dr. Anna-Lisa Paul	University of Florida Board of Trustees	Gainesville	FL	CASIS/Bionetics
Generation of Mesendoderm Stem Cell Progenitors in the ISS-National Laboratory	Dr. Robert Schwartz	University of Houston	Houston	TX	N/A
Conversion of Adipogenic Mesenchymal Stem Cells into Mature Cardiac Myocytes	Dr. Robert Schwartz	University of Houston	Houston	TX	Techshot, Inc.
Hyperspectral Remote Sensing of Terrestrial Ecosystem Carbon Fluxes	Dr. Fred Huemmrich	University of Maryland Baltimore County	Baltimore	MD	N/A
Effects of Simulated Microgravity on Cardiac Stem Cells	Dr. Joshua Hare	University of Miami	Miami	FL	N/A
Gravitational Regulation of Osteoblast Genomics and Metabolism	Dr. Bruce Hammer	University of Minnesota	Minneapolis	MN	BioServe Space Technologies
Protein Crystal Growth for Determination of Enzyme Mechanisims	Dr. Constance Schall	University of Toledo	Toledo	OH	N/A
Identification of Harmful Algal Blooms	Dr. Richard Becker	University of Toledo	Toledo	OH	N/A
Drug Development and Human Biology: Use of Microgravity for Drug Development	Dr. Timothy Hammond	Veterans Administration Medical Center	Durham	NC	BioServe Space Technologies
Materials Testing: The Evaluation of Gumstix Modules in Low Earth Orbit	Dr. Kathleen Morse	Yosemite Space	Groveland	CA	NanoRacks, LLC