

FY15 Q4 REPORT

Quarterly Report for the Period July 1st – September 30th, 2015

CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE (CASIS)



CONTENTS

Executive Summary.....	2
Research And Technology Development.....	4
Business Development And Partnerships	11
STEM Education.....	12
Outreach	14
Financials	16
Metrics	17
Q4 FY15 Project Pipeline	20
Conferences And Events In Q4 FY15	33

Subject to the terms and conditions of Cooperative Agreement NNH11CD70A, this report contains data and proprietary information related to CASIS' customers that shall not be duplicated, used, or disclosed outside of the government – in whole or in part – for any purpose other than evaluation purposes by the government. The government shall have the right to duplicate, use, or disclose the data to the extent provided in the Cooperative Agreement and pursuant to applicable law. This restriction does not limit the government's right to use information contained in the report if it is obtained from another source without restriction.

EXECUTIVE SUMMARY

As Fiscal Year 2015 (FY15) comes to a close, CASIS has seen measurable progress in both the success of its awarded projects and the validation of its strategies to maximize utilization of the International Space Station (ISS) as manager of the ISS U.S. National Laboratory.

CASIS continues to mature its strategies for research procurement, business development, partnerships, and leveraging of external resources to support the ISS National Lab research and development (R&D) portfolio. Two major successes for the ISS National Lab this quarter underscore the significant progress that has been made.

- In September 2015, CASIS formalized an agreement with the National Science Foundation (NSF) that involves \$1.8 million in NSF funding for a joint solicitation in support of fluids research on the ISS. This will be the largest "Sponsored Program" to date for CASIS, following closely on the heels of the Q4 grant awards from a \$500,000 Sponsored Program supported by the Massachusetts Life Sciences Center. Such partnerships and external financial support promote awareness of the value of the ISS research platform and augment the accessibility of this platform to the R&D community beyond the capabilities of CASIS alone.
- Commercial service provider NanoRacks, LLC, part of the ISS National Lab allocation, delivered their external platform to the ISS. This is the first commercial platform mounted on the exterior of the ISS for commercial testing of research payloads, sensors, and electronic components in space.

The CASIS strategic Campaigns Good Earth and Good Health also had substantial gains this quarter. Two project awards made by CASIS in Q4 will support Good Earth goals to improve satellite technology, and five awards will support Good Health projects to improve biomedical knowledge on Earth through spaceflight R&D. CASIS also issued a Good Health research solicitation in Q4, titled "3D Microphysiological Systems for Organs-On-Chips Research," based on robust response to a Q3 Request for Information on the same topic. Through such solicitations, in combination with targeted outreach activities, CASIS expects to further expand the 40+ Good Health projects (led by prominent pharmaceutical companies and top academic research institutions) currently in the ISS National Lab R&D portfolio.

Additional projects selected in Q4 for CASIS sponsorship include physical sciences studies and technology development initiatives. Q4 R&D project awardees, in total, include nine customers who are new to space-based research.

In parallel, ISS National Lab investigators continue to demonstrate the value of their work, with six newly published papers describe the promising results that are being produced by CASIS-sponsored projects. It was only two years ago that the first CASIS-sponsored payloads berthed to ISS (and only four years since CASIS became an organization), so it is impressive to consider that principle investigators have already produced a total of 10 papers

describing results funded or supported by CASIS and the ISS National Lab.

The new papers from Q4 advance knowledge in topics including the monitoring of red tide, 3-D bioprinting of tumor cells, drug development and toxicity testing, and immune response in wound healing. The nine publications to date represent work performed by academic institutions, commercial entities, other government agencies, and educational initiatives in science, technology, engineering, and mathematics (STEM). These are all of the major organizations identified in the congressionally mandated (PL 111-267) ISS National Lab planning and coordination research activities managed by CASIS.

CASIS STEM education activities have also had a landmark quarter, with 11 events and 10 executed projects reaching more than 80,000 students and educators in this quarter alone. In addition, five new STEM education projects were awarded in Q4, with diverse project areas including amateur radio use, life sciences, and ISS hardware improvements.

Finally, a notable success of Q4 was the fourth Annual ISS R&D Conference held in July. The conference saw a 100% increase in sponsorship and attendance, and conference demographics for the 700+ attendees showed an increase in new-to-space potential users, industry involvement, and state government interest. Many CASIS-sponsored investigators spoke about their research results at the conference, and there were more than 165,000 views of web-streamed sessions of such plenary talks.

Overall, Q4 successes for CASIS set a new bar heading into the next fiscal year. CASIS looks forward to continuing to grow its relationships, portfolio, and successes. The following sections provide more detail about this quarter's successes, including quarterly organizational metrics and progress toward key CASIS goals.

RESEARCH AND TECHNOLOGY DEVELOPMENT: ESTABLISH INNOVATION CYCLES AND UTILIZE THE ISS FOR DEVELOPING NEW CAPABILITIES

Campaign Good Earth

Good Earth is a collaborative campaign focused on maximizing ISS Earth observation capabilities for Earth benefit. As reported last quarter, Good Earth milestones were clarified in Q3—in concert with recommendations from NASA ISS Program Office leadership—to emphasize the role of ISS as a technology demonstration platform. To meet these milestones, CASIS awarded a subcontract for a study evaluating ISS remote sensing capabilities and assessing NASA science data and processes. During this 120-day study, an external subject matter expert conducted interviews and surveys with potential stakeholders, customers, and partners from NASA, the National Oceanic and Atmospheric Administration (NOAA), and the Department of Defense (DoD) as well as aerospace and earth science technology companies. The completed study addresses the following:

- Commercial applicability of, and access to, the NASA Remote Sensing Science Data archive.
- Evaluation of the ISS as a remote sensing platform with respect to capabilities, limitations, and priority infrastructure improvements.
- Identification of potential flight project contacts within the commercial remote sensing market.

The findings of this study are currently under internal review. Based on this study, CASIS will develop and employ an engagement strategy with commercial companies and other government agencies (OGAs) to identify and advance remote sensing and supporting technology flight projects. This engagement strategy will (1) further define the ideal parameters of the ISS as a remote sensing platform (infrastructure, data management, and optimal Earth viewing locations), (2) select projects that evaluate the commercial applicability of data collected from NASA Earth science missions, and (3) identify potential technology demonstration flight projects with broad benefit.

With respect to identification of possible projects, in Q4 CASIS evaluated a submitted proposal for a Synthetic Aperture Radar (SAR) project on the ISS. As part of this process, CASIS coordinated with NASA on potential mounting locations and infrastructure support and interfaced with Teledyne Brown regarding Implementation Partner Support and SAR/Hyperspectral data fusion. In parallel, CASIS evaluated an additional seven technical proposals for remote sensing supporting technologies, three of which moved forward in the proposal development process. Two of these projects were awarded in Q4, with the third pending final review:

- Dr. John Stryjewski from Vision Engineering Solutions will test a novel approach to track spacecraft, debris, and objects that have little to no radar cross-section (for collision avoidance in future satellite and commercial spacecraft applications).

- Trent Martin from Business Integra will execute technology-readiness-level (TRL) advancement of SG100, a single board computer platform that can support the much higher processor demands of the current and future scientific and aerospace applications in low Earth orbit (LEO). The test period will be 2 years, with interim data reports at 6-month intervals—culminating in achievement of TRL9. The technology will provide a low-risk solution to satellite and experiment developers.
- A third proposal involving a multimode antenna may also be supported in the future.

In addition, CASIS identified six quality leads for future flight projects (pending funding or completion of ground/lab-bench testing):

- A tactical radio-frequency (RF) communications relay—mounting a low-cost communications antenna on an LEO satellite to communicate with commercial geostationary communications satellites.
- A “Flash” Hyperspectral Camera—an instantaneous (rather than scanning) hyperspectral imager with 2–5m resolution.
- Four Laser Communications concepts—to address a primary ISS remote sensing limitation, the data downlink capacity.

Campaign Good Health

The objective of Good Health is to establish partnerships with NASA, OGAs, and industry to leverage funding that will enable open-source science on the ISS to improve human health on Earth. The campaign will generate longitudinal data from model organisms and cell lines exposed to the space environment, which will then be entered into the NASA GeneLab platform (an open-source database generated from spaceflight experiments) to enable community-driven reference experiments, generating standard reference datasets. The Good Health strategic effort will leverage the Precision Medicine Initiative, an enterprise to generate the scientific evidence needed to move precision medicine into everyday clinical practice, as well as digital medicine and systems biology to incentivize use of the ISS by the biomedical community. The Good Health Steering Committee includes ISS National Lab stakeholders representing the National Biomedical Space Research Institute (NSBRI), NASA Headquarters, NASA Human Research Program (HRP), NASA Space Life and Physical Sciences Research and Applications Division (SLPS), National Institutes of Health (NIH), NASA GeneLab Program, and external experts in the field of personal omics analyses.

Various outreach events were conducted in Q4 to raise community awareness about the objectives of Good Health. CASIS conducted two meetings at the National Science Foundation (NSF) with Division Directors for NSF Directorates and NASA Office of Chief Scientist to discuss future collaborations between CASIS and NSF related to Campaign Good Health. CASIS also presented Campaign Good Health in workshops at the NIH, including the Federal Working Group on Bone Diseases, the seventh NIH Microphysiological Systems (MPS) Investigator Review Meeting, and the first NIH MPS Workshop: Working with Industry Partners and Other Stakeholders.

In addition, two formal Good Health events were held in conjunction

with the fourth ISS Research and Development (R&D) Conference in Boston:

- A Good Health Panel Session moderated by Dr. Julie Robinson (ISS Chief Scientist, NASA) was a main broadcast plenary event at the conference. Panelists included Dr. Anita Goel (Chairman and Chief Executive Officer, Nanobiosym), Dr. Steven Steinhubl (Director, Digital Medicine, Scripps Translational Science Institute), Dr. Joan A. McGowan (Director, Division of Musculoskeletal Diseases, National Institute of Arthritis and Musculoskeletal and Skin Diseases, NIH), Dr. Mark Shelhamer (Chief Scientist, NASA HRP), and Dr. Timothy Yeatman (President, Gibbs Research Institute and Director, Gibbs Cancer Center).
- A closed Campaign Good Health Panel discussion was held on the final day of the conference, with invited stakeholders including individuals from NASA, the CASIS Board of Directors, the CASIS Science and Technology Advisory Panel, and select representatives from academia and industry. Panel members included Dr. Brad Carpenter (Deputy Chief Scientist, NASA SLPS), Dr. Mark Shelhamer (Chief Scientist, NASA HRP), Dr. Graham Scott (Chief Scientist and Institute Associate Director, NSBRI), Dr. Oana Marcu (Senior Scientist, NASA GeneLab Program), and Dr. Michael Roberts (Senior Research Scientist, CASIS). Discussion focused on the goals of Campaign Good Health to enable space-based projects to improve human wellness on Earth.

Following up from last quarter, in Q3, CASIS issued a request for information (RFI) on 3-D Microphysiological Systems for Organs-On-Chips Research. The RFI sought to capture expert input about cutting-edge micro-scale systems that mimic the structure and functions of living organs, toward developing a plan to support such research on the ISS National Lab. Using human cells in these microphysiological systems onboard the ISS will accelerate scientific advancements toward tissue engineering and regenerative medicine. CASIS received 33 formal written responses to the RFI and many additional informal indications of interest from the commercial sector. Based on this response, in Q4, CASIS released a Grand Challenge (solicitation for research proposals) in this area, seeking flight projects for the ISS National Lab. Responses are due in Q1 FY16. Awarded projects will complement the 40 flight experiments currently manifested for the ISS and sponsored by CASIS that already fall under Campaign Good Health.

Also from last quarter, CASIS distributed a "model systems" survey in Q3 to more than 150 strategically targeted subject matter experts—seeking expert input to help identify optimal model organisms (e.g., rodents, flies, cell cultures) for studying human disease onboard the ISS. Survey results are currently being reviewed internally, and CASIS expects to identify from these the most appropriate models and disease-specific focus areas for which to acquire subject matter experts for Good Health Science Definition Teams.

ISS National Lab Portfolio

Q4 held several major accomplishments with respect to strategic development of the ISS National Lab R&D portfolio. In a significant step toward collaboration with OGAs, CASIS finalized an MOU with the National Science Foundation (NSF) for a joint

research solicitation with \$1.8 million of NSF funding to support fluids research on the ISS National Lab. CASIS is working closely with NSF on implementation details and schedule milestones. This will be the first CASIS Sponsored Program in partnership with an OGA, and the largest Sponsored Program to date (a Sponsored Program is a grant solicitation in which funding is provided partly or entirely by an outside entity). Relatedly, the first fully-funded Sponsored Program, the *Massachusetts Life Sciences Center (MLSC) Galactic Grant Competition*, was awarded in Q4, with two flight-prize awardees announced at the ISS R&D Conference in July. The awardees (both Massachusetts-based commercial companies) will split a \$500,000 grant from the MLSC. Two education projects (discussed in more detail on page 12) were also awarded in Q4 as part of a parallel education competition from the MLSC.

An additional 13 projects were also selected in Q4 for CASIS sponsorship: three education projects, four in the life sciences, two in physical sciences, one in remote sensing, and three in technology development. Of the 17 total awarded projects in Q4, nine were from commercial companies, three were from academic institutions (one in partnership with a commercial entity), and five were educational initiatives. For more details on these newly awarded projects, see the "Q4 FY15 Project Pipeline" table on page 20 of this report.

With respect to previously awarded projects, six new academic papers resulting from CASIS-sponsored projects were published in Q4, bringing the total number of publications resulting from CASIS awards to ten. Below is a brief discussion of the newly published papers; citations and additional descriptive text can be found in the Metrics table "Contributions to Scientific Knowledge" on page 17.

- Published results in the *Journal of Applied Remote Sensing* discuss detection of algal blooms from space. Since the Hyperspectral Imager of the Coastal Ocean (HICO, the ISS-based sensor originally proposed for use in this project) became dysfunctional during the study period, the authors used other space-borne sensors to complete their CASIS-sponsored research. In this publication, the author (Principal Investigator [PI] Dr. Ruhul Amin, now with BioOptoSense, LLC) successfully distinguished regions with algal blooms from other bloom-like features such as sediment plumes—and was able to monitor the movement of the blooms, linking the movement patterns with tidal forces. Harmful algal blooms (HABs), which are best known as the cause of "red tide," are toxic to humans, and monitoring the trends in the presence and movement of these HABs may help us better combat their harmful health effects.
- CASIS awardee nano3-D Biosciences (n3D) published a milestone manuscript on its 3-D bioprinting and cell culture technologies in *Scientific Reports*, the open access journal from Nature Publications. The article describes how scientists from n3D (led by PI Dr. Glaucio Souza) have devised a novel test that uses 3-D cell aggregates (also known as spheroids) created with magnetic 3-D bioprinting. An ongoing challenge in biomedical research is the search for simple yet robust tests (termed "assays" in the field) using such 3-D cell cultures for toxicity screening—investigating the potential negative effects of drugs on human tissues.

This study addresses that challenge with a novel spheroid assay that

can detect the toxic effects of drugs with both accuracy and high-throughput to meet the needs of researchers in drug discovery and development. Moreover, the assay allows for fast and robust testing by simply using real-time imaging with a mobile device (an iPod Touch from Apple). This methodology can also be readily implemented to support biomedical research performed in space: the system is compact, lightweight, and equipped with a high-resolution camera and software capable of time-lapse imaging.

- On the heels of the article above in Scientific Reports, Promega, a major life sciences company, published another n3D paper on its PubHub page, which offers ground-breaking articles on new technologies. This publication demonstrates the n3D magnetic 3-D bioprinting method for rapidly and reproducibly printing cancer and liver cells into three-dimensional spheroids in high-throughput format. The publication proceeds to show how these spheroids can be successfully used together with existing products typically used to analyze cells. This recognition by Promega further validates the value of n3D's bioprinting technology.
- A manuscript published in Plos One in July reported the impact of simulated microgravity on a type cardiac stem cells isolated from human infants and adults. While no CASIS-sponsored stem cell projects have yet flown to the ISS, ground research experiments to develop flight experiments are ongoing. The primary focus of these experiments is to optimize experimental designs for spaceflight, but ground-based data from some "simulated" microgravity experiments are showing exciting trends—with cells behaving differently than they do under normal gravity conditions. This particular study (led by PI Dr. Mary Kearns-Jonker of Loma Linda University) showed that cardiac stem cell responses to microgravity might be influenced by age. The authors demonstrated that simulated microgravity could be used to manipulate the process whereby "young" cells activate a conserved regenerative microRNA (miRNA) program. MiRNAs are very small molecules that regulate protein synthesis in the body—and a "regenerative" program would be involved in maintaining healthy tissue and repairing any damaged tissue. Understanding how to activate this program, through evaluation of the aging of cardiac stem cells in microgravity, may advance progress toward improving cardiac cell therapy or treatments to promote repair of damaged heart tissue in adults. Because heart disease is the number one cause of death in the U.S., research into such therapies are paramount to human health on Earth.
- Recently published work in FASEB discussed ISS experiments that discovered that miR-21 (another miRNA) is dysregulated in spaceflight. The authors (led by PI Dr. Millie Hughes-Fulford of Northern California Institute for Research and Education) were able to define a new way that MiR-21 regulates the human immune system. MiRNAs attach themselves to other "target" RNAs and prevent the translation of this genetic material into proteins. In this ISS experiment, the team found that miR-21 targets of four key immune genes (BTG2, SPRY2, TAGAP, and FASLG) were differently regulated in spaceflight—and that gravity itself is responsible for part of the dysregulation of the immune system gene expression during spaceflight. Moreover, this team was able to discover a new way the immune system self regulates by inducing miR-21 to enact this inhibition of gene expression—which, notably, takes days to occur. This previously unknown mechanism controlling the immune response was

termed "self-limiting induction." This new mechanism is important because processes such as wound healing need to turn off once repair is made, and dysregulation could cause uncontrolled growth. Dysfunction of this self limited-induction mechanism also may apply to diseases like cancer, in which uncontrolled growth causes tumors and negative health effects. Removing the variable of gravity by performing research on the ISS may thus reveal new biological mechanisms and approaches for treatment of disease.

- A paper published in the Journal of Molecular Biology describes preflight work performed by a CASIS-sponsored team (led by PI Dr. Pamela Bjorkman) studying Huntington's disease. This inherited, neurodegenerative disease is caused by the expansion of a poly-amino-acid stretch, called a polyglutamine (polyQ) repeat, in the huntingtin protein. Most people with Huntington's disease develop symptoms of nerve cell breakdown in their 30s and 40s, gradually losing functional abilities and developing movement, cognitive, and psychiatric disorders. Two models exist to explain why expanded polyQ repeats cause Huntington's disease: 1) the expanded polyQ repeat is an extended random-coil structure that contains many binding sites, or 2) the expanded polyQ repeat forms a specific pathologic conformation. This paper analyzed binding of antibodies to normal and expanded polyQ repeats within huntingtin proteins—and results supported the first model above, which has important implications for drug development for Huntington's disease (i.e., it may not be feasible to design drugs that target a specific, common structure).

For more details on CASIS-sponsored projects and their progress, see the "Q4 FY15 Project Pipeline" table on page 20 of this report. This table includes preliminary findings and indications from ground-based and postflight CASIS-sponsored projects.

Finally, in conjunction with the fourth ISS R&D Conference held in Boston July 7-9, CASIS staff supported a quarterly (in-person) meeting of the CASIS Science and Technology Advisory Panel (STAP). In the Life Sciences, members were updated on Campaign Good Health and additional CASIS initiatives to expand utilization of the ISS National Lab for protein crystallization and next-generation agriculture. STAP member Dr. Charles Guy (University of Florida) invited CASIS staff to meet with Dr. David Norton (VP of the Office of Research, UF), Dr. David Nelson (Assistant VP of Collaborative Life Sciences, UF), and representatives of the Florida High Tech Corridor Council Program, Space Research Initiative, and the Florida Space Grant Consortium to help build a Florida component for CASIS development of a campaign in next-generation agriculture. In the physical sciences, STAP members were updated on the progress of the NSF MOU, and additional discussion focused on ways to capitalize on commercial interest in microfluidics research. The team also discussed opportunities to improve hardware, incorporate educational activities, and better utilize existing remote sensing capabilities on the ISS.

Operational Logistics Update

In Q4, CASIS manifested 22 new payloads for flight and initiated operations for the Increment Pair 45/46, in which the ISS National Lab has 38 payloads scheduled to operate. The U.S.

Commercial Resupply (CRS) missions continue to be off-nominal, with

expected return to flight to begin with OA-4 in December 2015. Of note, CASIS obtained ISS flight safety approval and flight certification for CASIS PCG-4 (a protein crystal growth project from pharmaceutical company Eli Lilly) on SpX-8. CASIS also supported the logistics planning/execution of the return of tissue samples from Rodent Research-2 (from life sciences company Novartis) via the Soyuz 42S return vehicle, a first for CASIS and the ISS National Lab.

In August, the most recent series of ISS National Lab payloads successfully berthed to the ISS onboard the Japanese H-II Transfer Vehicle (HTV-5). These Lab payloads were delivered in coordination with payload services provider, NanoRacks LLC, a private sector company that operates the only commercial research facility onboard the ISS via a Space Act agreement with NASA. Sponsored payloads that berthed to the ISS on this recent mission include:

- **NanoRacks-AAUSAT5:** A student-designed and constructed Automatic Identification System (AIS) receiver to track ship signals with a small satellite launched from the ISS. Results will validate the software and hardware for a space-based AIS system and will inspire students to develop a deeper connection to the space program.
- **NanoRacks-GOMX-3:** Testing of a small satellite with an advanced antenna-pointing system and a variety of communications capabilities. The satellite contains three radios, one of which receives beacons from commercial aircraft to improve air traffic monitoring. Two radios test reception and data downlink in the L-band, used by GPS satellites, and in the X-band, used by the military and for weather monitoring, air traffic control, and other uses.
- **NanoRacks-Planet Labs-Dove:** A fleet of nanosatellites deployed from the ISS to take images of Earth from space. The satellites are designed, built, and operated by Planet Labs Inc., which provides the imagery to a variety of users. The satellites focus on areas within 52 degrees of Earth's equator, where most human populations and agricultural areas are located. They revisit the same areas more frequently than any existing government or commercial satellites. The images have several humanitarian and environmental applications, from monitoring deforestation and urbanization to improving natural disaster relief and agricultural yields in developing nations.

In addition, HTV-5 also delivered the NanoRacks External Platform (NREP), the first commercial platform capable of leveraging the extreme conditions on the exterior of the ISS, which include temperatures that cycle between extreme hot and cold as well as exposure to vacuum conditions, radiation, and atomic oxygen (a damaging form of the oxygen molecule). Following a joint agreement with CASIS in 2012 for the development of this platform, the NREP will provide a variety of ISS National Lab researchers access to the extreme environment of space for research in disciplines such as materials science. This platform is the first permanent hardware on the outside of the ISS that allows researchers to take small experiments (shoe-box sized payloads) in and out of the space environment for long-term studies. The NREP is one of the largest private sector investments to date onboard the ISS, and CASIS is the first "customer" for the platform, with various CASIS-sponsored payloads scheduled for deployment on the platform during 2016.

BUSINESS DEVELOPMENT AND PARTNERSHIPS: EXPAND THE CASIS NETWORK, LEVERAGE FUNDING, AND DRIVE COMMERCIAL UTILIZATION

For the third year in a row, CASIS continued its partnership with MassChallenge, the largest startup accelerator to support high-impact, early-stage entrepreneurs without taking any equity. During this year's MassChallenge competition, CASIS is also partnering (for the second time) with Boeing, which is providing \$250,000 in funding to support a joint Sponsored Program with CASIS for innovative flight projects. This commitment from Boeing to support flight projects on the ISS National Lab is an additional example of success in expanding the CASIS network by leveraging external funding—in this case, to identify nontraditional flight projects through innovative start-up company ideas. This quarter, CASIS and Boeing executed the MassChallenge Pitch competition and worked with six final teams to develop project proposals (identified from 11 pitch presentations—previously down-selected from 16 project concepts during Q3). These six full proposals were submitted on September 25th and are currently under review.

In conjunction with NASA, CASIS executed two Destination Station events in Q4, resulting in more than 40 new project ideas that are currently being explored:

- In Boston, the event was integrated with the ISS R&D Conference and brought in nontraditional users for sessions on how to access the ISS National Lab. CASIS presented to more than 75 new users and built awareness through a Mobile Exhibit and press interviews.
- In Minneapolis, CASIS conducted four major "industry day" sessions, with General Mills, Cargill, Valspar, and Target. CASIS also supported "Nerd Night" with additional nontraditional users.

Further outreach and business development activities included participation in several key conferences and trade association events, detailed in the "Conferences and Events in Q4 FY15" table on page 33. Such targeted outreach continues to be effective for CASIS and the diversification of the ISS National Lab R&D portfolio, with 19 quality proposals being submitted in Q4 alone as a result of these efforts.

Additionally, in Q4, CASIS facilitated introductions between 16 companies and investor groups interested in supporting cutting-edge R&D—with four of these companies attaining investment. One of these successful company pitches (obtaining equity investment) came from Deep Space Industries, Inc., which was awarded by CASIS in Q4 (see the "Q4 FY15 Project Pipeline" table on page 20 for more details). CASIS also formalized three new investor partnerships, which will seek to further augment available funding avenues for CASIS-sponsored principal investigators (Florida Venture Forum, DreamIt Health, and Techstars). Part of the CASIS mission is to energize outside investment in companies using the ISS National Lab for R&D to solidify their business models for success in the terrestrial market. CASIS thus seeks to augment support of the companies that receive sponsorship through our review process to include access to investment capital and other sources of support.

Finally, CASIS continued its support of low Earth orbit (LEO) commercialization initiatives. In Q4, CASIS improved strategic direction for priority LEO research areas (i.e., those identified by CASIS as having shared public-private benefit, including protein crystallization, organ or tissue bioengineering, and in-orbit manufacturing). Strategy milestones include identification of early goals and methods to engage the larger community for developing infrastructure and a sustainable market. The currently open Grand Challenge also aligns with the organ bioengineering LEO commercialization priority area. The ISS National Lab is a critical platform to stimulate the use of LEO for sustained economic activity, and through these cumulative efforts, CASIS hopes to create demand for the future of LEO commercialization.

STEM EDUCATION:

ESTABLISH THE ISS AS THE LEADING LABORATORY AND ENVIRONMENT FOR STEM EDUCATION

Five new student projects were selected for CASIS sponsorship in Q4 (project descriptions listed in the "Q4 FY15 Project Pipeline" table on page 20). Information on the programs associated with these projects is detailed below.

- **ARISS, one award:** Amateur Radio on the International Space Station (ARISS) is an educational outreach program sponsored by NASA in which students in a science and technology curriculum speak with the ISS on-orbit crew. Using amateur radio, students ask questions about life in space or other space-related topics. Students fully engage in the ARISS contact by helping set up an amateur radio ground station at the school and then using that station to talk directly with the onboard crew member for approximately 10 minutes, the amount of time the ISS passes overhead. Preparation for the experience motivates the children to learn about radio waves, space technology, science, geography, and the space environment. In many cases, the students help write press releases and give presentations on the contact to their fellow students and to the local community. Through this hands-on experience, students are engaged in Science, Technology, Engineering and Mathematics (STEM) fields, and learn that STEM-related careers are within their reach.
- **Genes in Space, one award:** The Boeing Genes in Space national competition targeted grades 7–12, with 700 students participating. Proposed projects revolved around an on-orbit hardware kit that can be used by educators or other investigators to perform ISS-based research. The hardware consists of a mini polymerase chain reaction thermal cyclers to allow students to work with modern commercial off-the-shelf platforms onboard the ISS.
- **Space Station STEM Challenge (NDC-4), 2 awards:** The CASIS National Design Challenge (NDC) program provides educators and adult facilitators with the necessary training and ongoing technical support needed to provide their students with an experiential learning opportunity in engineering design and computer programming. NDC connects students with prominent scientists and encourages them to pursue STEM careers.

Resulting from a newly formed partnership between CASIS and the Massachusetts Life Science Center, one school was selected for NDC-4 via a competition to design, build, and send a life science experiment to the ISS. The flight team will involve the entire school of 800 students in the project. A ground team for NDC-4 was also selected from the runners-up. This team will assist the flight team with preliminary research, suggestions on experimental design and automation, ground testing of subsystems, media outreach, and mission patch design.

- **NASA HUNCH, one award:** The High School Students United with NASA to Create Hardware (HUNCH) program allows students to design and fabricate valued products for the ISS. CASIS and the ISS National Lab help to support this instructional partnership between NASA and educational institutions.

CASIS also continued managing existing STEM education programs and partnerships. The following took place in Q4.

- **Zero Robotics:** In August, the middle school competition finals events were held for ZERO Robotics, a student competition to program functions for mini-satellites on ISS. The final competition of each tournament (middle and high school) is held onboard the ISS yearly. This year the Middle School Summer Program was available to selected teams in Alabama, California, Colorado, D.C. Metro/ Maryland, Florida, Georgia, Idaho, Massachusetts, Ohio, Oregon, SEMAA, Texas, and West Virginia. More than 100 educators and mentors and 725 students from 11 states participated in the program this year, and 111 students participated in-person at the finals event at Kennedy Space Center.
- **Student Spaceflight Experiments Program (SSEP):** CASIS provides underwriting to close budget shortfalls for SSEP communities that would otherwise not be able to participate in SSEP. To date, CASIS underwriting has dramatically impacted participation in SSEP Missions 3 through 9 to the ISS. Across all seven missions, CASIS supported 85 communities and made possible participation by 40,100 students, resulting in 8,676 flight experiment proposals submitted by student teams (including the projected impact for Mission 9). CASIS supported SSEP Missions 7 and 8 in FY15 by sponsoring 28 of 38 total communities across 17 states.
- **Story Time from Space (STFS):** The STFS team is working to rebuild the demonstration payload that was lost in SpX-7. During Q4, they were able to increase the exposure of STFS by participating in a wide range of outreach events and conferences. The team has also continued to get media exposure with National Public Radio, Quest, CBC Media Centre, and the Penticton Herald.

Finally, CASIS acted to expand the reach of the ISS National Lab through a variety of STEM outreach events in Q4, including three CASIS Academy Live events (which feature presentations from CASIS-sponsored investigators and hands-on activities for student participants). These events are detailed in the "Conferences and Events in Q4 FY15" table on page 33.

OUTREACH:

PROMOTE THE VALUE OF THE ISS NATIONAL LAB TO THE NATION

In July, CASIS (in coordination with NASA and AAS) was a main sponsor of the fourth annual ISS R&D conference in Boston, MA. During this four-day event, more than 700 registrants (up from 300 last year) learned about recent advances in knowledge and commercial applications from R&D in space as well as opportunities for the future and programmatic direction. The event featured a wide range of speakers, including principal investigators, astronauts (active and retired), innovative aerospace executives, NASA and CASIS officials, and a variety of participants from STEM education initiatives. Associated outreach highlights include a keynote address by SpaceX's Elon Musk, more than 7,000 social media posts related to ISS R&D (#ISSRDC, 80 million impressions, and more than 165,000 views through all video and web-streamed sessions). Media coverage spanned some of the most recognizable publications and outlets in the world (Bloomberg, MSN, Yahoo News, Huffington Post, ABC News, CBS News, NBC News, Mashable, New York Post, Chicago Tribune, Reuters, The Verge, Boston Globe, and Washington Times), and in total, 576 media clips generated more than 3.2 billion impressions (3,249,554,600). At the conference, CASIS released two new features for the community:

- CASIS and NASA jointly unveiled a new web portal (www.spacestationresearch.com) that highlights the R&D capabilities on the ISS and provides an overview of space-based research, designed to serve the new-to-space potential user community.
- CASIS announced a state-of-the-art 3-D rendering of the ISS, giving researchers and the general public a view previously not provided to the public. This rendering provides an internal and external view of the ISS, a true "walk-through" highlighting major components, and examples of research onboard. CASIS is working with museums and similar facilities to feature this interactive display and educate the public on the ISS.

As mentioned on page 11, NASA and CASIS also partnered during ISS R&D to bring Destination Station to Boston. While this Destination Station had a different format (devoid of industry days to pre-determined commercial companies), it involved a strong outreach in the form of promoting the ISS to the general Boston community. In particular, during the "legislative day," astronaut Karen Nyberg, CASIS, and NASA personnel engaged more than 40 local staffers from the Boston area on the ISS, the roles of NASA and CASIS relative to microgravity research, and recent successes. The second Destination Station event in September followed the traditional format, and astronaut Mike Hopkins was key in multiple media and outreach opportunities to promote the ISS National Lab as a unique research environment capable of enhancing life on Earth. Local media outlet coverage included CBS, ABC, and CBS Radio. These and other events are detailed in the "Conferences and Events" table on page 33.

In August, CASIS and COBRA PUMA Golf made a joint announcement of a new golf club (the King COBRA LTD Driver) that was inspired by research conducted on the ISS (including a CASIS-sponsored payload delivered on SpaceX CRS-4 in 2014). The golf club

includes space-inspired technology that will mitigate the effects of torque relative to club impact on a ball. This product line will be the first that will leverage the CASIS trademarked "Space Is In It" seal, which is bestowed upon researchers and companies that develop consumer goods/products derived from research in a microgravity environment. Additionally, COBRA PUMA Golf brand ambassador Rickie Fowler will play with the club during the 2016 PGA Tour season, providing great visibility and storylines highlighting space-based research. Most major golf outlets covered the event and highlighted the new product (e.g., Golf, Golf Digest, Golf Channel).

Additional media coverage of CASIS activities during Q4 included TechCrunch, Bio Business Magazine, Medical Research.com, and Bioscience Technology. Overall media impact is discussed in the "STEM Education and Outreach Metrics" table on page 18.

FINANCIALS

BUSINESS STATUS REPORT (UNAUDITED)						
JUL 1-SEPT 30, 2015	ACTUALS Q4 2015	BUDGET Q4 2015	VARIANCE	ACTUAL YTD 2015	BUDGET YTD 2015	VARIANCE
Direct Labor	\$1,252,955	\$1,589,944	\$336,989	\$4,855,652	\$6,103,070	\$1,247,418 (a)
Subcontracts	\$454,222	\$822,451	\$368,229	\$1,650,382	\$3,277,196	\$1,626,814 (b)
Permanent Equipment > \$5k	\$34,172	\$6,000	(\$28,172)	\$152,638	\$130,000	(\$22,638)
Expendable Supplies and Equipment	\$76,355	\$71,085	(\$5,270)	\$212,017	\$277,400	\$65,383
Travel	\$236,114	\$244,906	\$8,792	\$842,066	\$986,706	\$144,640 (c)
Grants Awarded	\$2,026,350	\$2,323,274	\$296,924	\$5,648,088	\$9,300,098	\$3,682,010 (d)
Other Direct Costs	\$397,189	\$259,713	(\$137,476)	\$1,716,766	\$1,602,333	(\$114,433) (e)

(a) Budgeted headcount was 42 and actual was 37. (Currently, CASIS has nine positions open to be filled.)

(b) Subcontracts is lower in a few key areas:

- Project Good Earth budgeted for several consultants; postponed as the project was redefined.
- CASIS decreased the payment to external reviewers and decreased reliance on outside vendors to recruit reviewers on behalf of CASIS, which has lowered external review spending. Furthermore, CASIS reduced the number of formal request for proposals (RFP) and focused on unsolicited proposals generated from business development outreach efforts (reviewed ad hoc).
- Budgeted fundraising consultants were postponed as the strategy shifted to leveraged partnerships, reducing need for these consultants.

(c) Lower travel expense resulted from lower than budgeted headcount.

(d) Projected grant payments have been deferred because of delays in milestone payment resulting from launch slips, change in strategy of solicited RFPs, and NASA's assumption of certain mission, integration, and operational costs previously funded by CASIS.

(e) Higher other direct costs resulted from unbudgeted sponsorship of the SpaceCom conference and increased marketing costs for the ISS R&D Conference.

BREAKOUT OF COOPERATIVE AGREEMENT FUNDING				
	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
Direct	49%	46%	46%	39%
Indirect	21%	19%	18%	17%
Grants	30%	35%	36%	44%

BREAKOUT OF CASIS GRANTS				
	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
Private/Commercial	\$564,063	\$764,972	\$750,944	\$861,000
Academic	\$297,400	\$439,100	\$546,936	\$1,089,549
Mission Based Costs	\$83,787	\$131,242	\$48,294	\$54,802

METRICS

In addition to the quarterly metrics displayed on the following pages, CASIS will track several metrics on an annual basis and document them in the Annual Report. These metrics include:

- Leverage of CASIS Seed Funding — CASIS will measure the ratio of external contribution to project cost for all proposals versus CASIS seed funding.
- Operational Efficiency — CASIS will track the efficiency of reviews and operations by measuring the elapsed time from inquiry to award to flight.

Science Portfolio and Operations Metrics by Quarter

METRIC	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
CASIS RFPs and RFIs issued (excluding education)	2	0	1	1
Responses received from RFPs and RFIs (including Step-1 and Step-2 proposals)	17	1	0	33
Project proposals awarded from CASIS grant calls (solicited, excluding education)	6	1	0	4
Project proposals received (unsolicited, excluding education)	6	11	21	30
Project proposals awarded (unsolicited, excluding education)	10	3	6	8
Return customers: Proposals received from CASIS customers pursuing a re-flight or a flight for a new project	1	1	2	0
New customers: Projects awarded to principal investigators that have never flown	11	1	1	9
Flight projects manifested	33	12	16	37
Flight projects delivered to the ISS National Lab	0	8	29	4
Results published (e.g., in scientific journals)	0	2	0	6
Products or services created	0	0	1	0

Contributions to Scientific Knowledge — Results Published (e.g., in Scientific Journals)

CITATION	DESCRIPTION
Amin, R., & Shulman, I. (2015). Hourly turbidity monitoring using Geostationary Ocean Color Imager fluorescence bands. <i>Journal of Applied Remote Sensing</i> J. Appl. Remote Sens, 096024-096024.	A paper resulting from a project awarded in response to a CASIS solicitation promoting the use of imagery from the ISS-based sensor Hyperspectral Imager of the Coastal Ocean (HICO): PI Dr. Ruhul Amin's project sought to detect algal blooms from space. Since HICO became dysfunctional during the study period, authors used other space-borne sensors such as the Geostationary Ocean Color Imager to continue their research. In this study, the author successfully distinguished algal bloomed regions from other bloom-like features such as sediment plumes, monitoring their movement. This study also linked the dynamics of these organic and inorganic meters with tidal forces using modeled and in situ data.
Fuentes, T.I., Appleby N., Raya, M., Bailey, L., Hasaniya, N., Stodieck L., & Kearns-Jonker, M. (2015). Simulated Microgravity Exerts an Age-Dependent Effect on the Differentiation of Cardiovascular Progenitors Isolated from the Human Heart. <i>PLoS ONE</i> , 10(7).	A paper resulting from a project awarded in response to a CASIS solicitation promoting stem cell research: PI Dr. Mary Kearns-Jonker described the differential impact of simulated microgravity on isl-1+ cardiovascular progenitor cells isolated from human neonates and adults. The study showed that stem cell responses to microgravity may be influenced by age. The authors demonstrated that simulated microgravity can be used to manipulate the process whereby neonatal cardiovascular progenitor cells activate a conserved regenerative microRNA program. Future studies on the ISS will determine whether a similar effect occurs in the space environment.

CITATION	DESCRIPTION
Hughes-Fulford, M., Chang, T., Martinez, E., & Li, C. (2015). Spaceflight alters expression of microRNA during T-cell activation. <i>The FASEB Journal</i> , 15(277392).	A paper resulting from an ISS National Lab "transition payload," originally part of the NASA NIH-BioMed program and later subsidized by CASIS: PI Dr. Millie Hughes-Fulford described that key immune genes targeted by the microRNA miR-21 were differentially regulated in spaceflight, specifically showing that gravity itself is responsible for part of the dysregulation of the immune system during spaceflight. The team also discovered a new way that miR-21 regulates the human immune system. This previously unknown mechanism controlling the immune response was termed "self-limiting induction" and is expected to play a role in both wound healing and diseases such as cancer.
Owens, G., New, D., West, A., & Bjorkman, P. (n.d.). (2015) Anti-PolyQ Antibodies Recognize a Short PolyQ Stretch in Both Normal and Mutant Huntingtin Exon 1. <i>Journal of Molecular Biology</i> , 427(15): 2507-2519.	A paper resulting from a project awarded in response to a CASIS solicitation promoting protein crystal growth on ISS: PI Dr. Pamela Bjorkman described ground-based results from experiments performed in preparation for a flight experiment. In the paper, the team examined the structure of a polyglutamine (polyQ) repeat in the huntingtin protein, the expansion of which is the cause of Huntington's disease. A structural basis for the apparent transition between normal and disease-causing expanded polyQ repeats of huntingtin is unknown, and this paper uses protein binding studies to demonstrate that the expanded repeat is likely not a specific pathologic conformation and thus not a target for structure-based drug design.
Tseng, H., Gage, J.A., Shen, T., Haisler, W.L., Neeley, S.K., Shiao, S., Chen, J., Liao, A., Hebel, C., Raphael, R.M., Becker, J.L., & Souza, G.R. (2015). A spheroid toxicity assay using magnetic 3-D bioprinting and real-time mobile device-based imaging. <i>Sci. Rep. Scientific Reports</i> , 5:13987.	One of two papers resulting from a project award to a commercial company: PI Dr. Glauco Souza described a novel assay for using spheroids created with magnetic 3-D bioprinting. This study addresses current challenges in the field with the assay, wherein spheroids formed by magnetic 3-D bioprinting contract immediately as cells rearrange and compact the spheroid in relation to viability and cytoskeletal organization. Furthermore, this assay can detect the toxic effects of drugs with both accuracy and high-throughput to meet the needs of researchers in drug discovery and development for fast and robust models by simply using real-time imaging with a mobile device.
Tseng, H., Gage, J.A., Desai, P.K., Haisler, W.L., Shah, J.V., Li, W., & Souza, G.R. (2015). Luminescent Viability Assays in Magnetically Bioprinted 3-D Cultures. <i>Promega Corporate</i> .	The second of two papers resulting from a project award to a commercial company: PI Dr. Glauco Souza discusses his company's magnetic 3-D bioprinting method for rapidly and reproducibly printing cancer and liver cells into three-dimensional spheroids in high-throughput format. The paper, published on the PubHub page of the life sciences company Promega, shows how these spheroids can be successfully used with cell viability products.

STEM Education and Outreach Metrics by Quarter

METRIC	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
STEM projects executed	5	12	9	10
Total reach of STEM projects	7,265	7,412	25,320	80,695
CASIS outreach events				
Trade shows	6	2	7	3
Print advertisements	0	0	0	2
Total media impact				
You Tube posts	2	2	12	13
-Views (cumulative)	10,744	255,875	260,768	435,215
Twitter posts	166	235	268	259
-Followers (cumulative)	59,058	69,596	74,201	78,362
Facebook posts	123	175	142	87
-Likes (cumulative)	4,129	4,622	4,879	4,958
Website visitors	49,254	49,715	66,705	85,456
News releases	10	5	3	4
Media events	9	3	7	7
News mentions (clips, blogs)	1,379	733	953	669
Twitter mentions	620	957	1,134	698

Historical ISS National Lab Usage

During increment planning, NASA sets aside ISS utilization resources, including upmass, downmass, and crew time, for all partners. The ISS National Lab is granted half of NASA's share of the available USOS resources. Upmass and downmass vary based on the number and capabilities of cargo vehicles. Crew time is based on an average of 35 hours per week available for ISS utilization. Other resources such as power and cold stowage are shared and thus not considered in this metric.

INCREMENT	UPMASS (KG)			DOWNMASS (KG)			CREWTIME (HRS)			
	ALLOCATION	ACTUALS	USAGE	ALLOCATION	ACTUALS	USAGE	ALLOCATION	ACTUALS	RESERVE	USAGE
Inc 37/38	287	334.7	117%	6	7.9	132%	427	78.42	-	18%
Inc 39/40	766	389.1	51%	307	197.8	64%	386	70.75	-	18%
Inc 41/42	539	716	133%	498	705.5	142%	346	130.29	-	38%
Inc 43/44	906	660.7	73%	534	116	22%	229	199.56	15.33	87%
Inc 45/46	988	1258.6	127%	646	113.12	18%	297	336.86	125.5	113%
Inc 47/48	978	606.1	62%	326	107.65	33%	356	332.92	59.55	94%

(Data through 9/30/15)



Q4 FY15 PROJECT PIPELINE

PROJECTS AWARDED IN Q4 FY15

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	LOCATION	PROJECT DESCRIPTION
SIC Microgravity Enhanced Electrical Performance (MEEP)	Rich Glover	ACME Advanced Materials	Albuquerque, NM	Perform long-duration microgravity processing to determine whether spaceflight reduces defects in SiC-semiconductor substrates and epitaxial layers more significantly than modeled microgravity. SiC is a near perfect semiconductor material, but applications to large-scale devices have thus far been limited by the inability to make substrates and layers sufficiently free of defects.
ARISS (Amateur Radio from ISS)	Frank Bauer	AMSAT (Radio Amateur Satellite Corporation)	Kensington, MD	ARISS is an international working group formed in 1996 by request from NASA. NASA's vision was for ARISS to be a single internationally coordinated entity that would develop, operate, and conduct educational outreach on the ISS. In this way, a single focus and entry point would be created for all amateur radio activities on the ISS. Students are able to talk directly to astronauts on the ISS as a culminating educational activity. In preparation, students learn about radio communications, space technology, science experiments on the ISS, geography, and the space environment.
Cranial bone marrow stem cell culture in space	Dr. Yang D. Teng and Dr. Louis Yuge	Brigham and Women's and Space Bio Laboratories Co. Ltd	Boston, MA	Clarify microgravity's effects on the growth and differentiation of human cranial mesenchymal stromal stem cells (hCMSCs). The undifferentiated state of hCMSCs advocates pluripotency that enables efficient recovery from neural damage. Microgravity provides an advantage to produce pluripotent stem cells without any potential risk of genetic manipulations and chemical contamination.
SG100 Cloud Computing Payload	Trent Martin	Business Integra	Houston, TX	Technology-readiness-level (TRL) advancement of SG100, a single board computer platform that can support the much higher processor demands of the current and future scientific and aerospace applications in low Earth orbit. The test period will be 2 years, with interim data reports at 6-month intervals—culminating in achievement of TRL9. The technology will provide a low risk solution to satellite and experiment developers.
NDC-4: Space Station STEM Challenge	Matthew Weaver	Collins Middle School	Salem, MA	Ground-based student experiment mimicking the Talbot Middle School flight project Tadpole Morphology and Development in the Presence of UV-B Light in Microgravity.
Providing Spherical Video Tours of ISS	David Gump	Deep Space Industries	Moffett Field, CA	Capture content on the ISS via immersive spherical video technology.
NASA HUNCH	David Schlichting	Eaglecrest High School	Centennial, CO	Student experiment to analyze the three-dimensional structure of silver crystals in microgravity, compared to 1g, to determine whether elimination of gravity produces higher-quality crystals.
Proof-of-Concept for Gene-RADAR® Predictive Pathogen Mutation Study	Dr. Anita Gael	Nanobiosym	Cambridge, MA	Perform a proof-of-concept study to computationally predict bacterial mutations and to evaluate model organisms in space, and use the empirical results to validate and refine predictive algorithms. This proof-of-concept experiment will provide data that can be applied to future predictive models for antibiotic-resistant pathogen mutations, which will be of significant value to antibiotic drug development.



PROJECT	PRINCIPAL INVESTIGATOR	APPLICATION	LOCATION	PROJECT DESCRIPTION
Nemak Alloy Solidification Experiments	Dr. Glenn Byczynski	NEMAK	Southfield, MI	Elucidate critical parameters behind the formation of hot tearing by removing gravitational effects from the process and observing which phenomena and parameters emerge as dominant.
Efficacy & Metabolism of Azonafide Antibody-Drug Conjugates (ADCs)	Sourav Sinha	Oncolinx	Boston, MA	Test the efficacy and drug metabolism of Azonafide ADCs in microgravity 3-D cell cultures. Cultures in microgravity should serve as better in vivo models of tumors than terrestrial cultures and, as such, accelerate the timeline to translational applications of the research. ADCs are toxic therapeutics that target tumors through receptors on the surface of cancer cells, thereby reducing toxicity and increasing effectiveness of the therapy.
NDC-4: Space Station STEM Challenge	Benjamin Coleman	Talbot Middle School	Fall River, MA	Student experiment titled Tadpole Morphology and Development in the Presence of UV-B Light in Microgravity.
Soluble Corn Fiber to Improve bone mineral density	Dr. Patricia Williamson	Tate & Lyle	Hoffman Estates, IL	Demonstrate that Tate & Lyle's PROMITOR® Soluble Corn Fiber (SCF), a commercially available food ingredient, can enhance bone health of individuals on earth by using space flight as a model of accelerated aging. Bone loss occurs ~10x faster in space than on Earth, so significant effects can be seen in a shorter period of time.
ZGenes In Space	Anna-Sophia Boguraev	The Boeing Company (sponsor)	Houston, TX	Student experiment involving DNA Amplification using a miniPCR (Polymerase Chain Reaction) machine onboard ISS. This is the winning student experiment from the Genes in Space Innovation Challenge. This challenge invited participants to propose pioneering DNA amplification experiments using the unique environment of the ISS.
The Effect of Microgravity on Stem Cell-Mediated Recellularization	Dr. Jason Sakamoto	The Methodist Hospital Research Institute	Houston, TX	Study the effects of microgravity and radiation on mesenchymal stem cells grown on a novel scaffold of human acellularized lung tissue. More deeply understanding the kinetics and mechanisms of delivery and bio-distribution of the particles used for nanovector delivery of critical growth factors may impact how to administer these particles on Earth. The knowledge provided by this study will develop a stem cell mediated regeneration capability for human acellular lungs to engineer a functional new organ.
Decoupling Diffusive Transport Phenomena in Microgravity - Re-flight	Dr. Alessandro Grattoni	The Methodist Hospital Research Institute	Houston, TX	Modification to original project for re-flight (payload was lost on SpX-7). Examine the mechanisms of molecule transport across nanochannel membranes. These membranes can be developed for passive and active release of molecules, drugs, and nanoparticles using implants placed in the human body. The study examines these phenomena over an extended period of time.
Space Based Optical Tracker	Dr. John Strykowski	Vision Engineering Solutions	Orlando, FL	Test a novel approach to track spacecraft, debris, and objects that have little to no radar cross-section (for collision avoidance in future satellite and commercial spacecraft applications).
Continuous liquid-liquid separation in microgravity	Dr. Andrea Adamo	Zaiput Flow Technologies	Cambridge, MA	Explore the effects of gravity on Zaiput's device for continuous separation of immiscible liquids. While common separation methods rely on liquid sedimentation, their system has the unique characteristic of relying on surface forces to accomplish liquid-liquid extraction. To serve the needs of chemical production, the device needs to be scaled-up, which requires understanding the effect that gravity and length scales have on the flow path as it relates to separation efficiency.



GROUND PROJECTS

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS UPDATE
Longitudinal Assessment of Intracranial Pressure During Prolonged Spaceflight	Dr. Clifford Dasco	Baylor College of Medicine	(b) (4)
Optimizing Jammable Granular Assemblies in a Microgravity Environment	Jason Hill	Benevolent Technologies for Health	(b) (4) (b) (4)
Spacecraft-on-a-Chip Experiment Platform	Dr. Mason Peck	Cornell University	The Sprite hardware is under development, with multiple designs being considered. The design is intended to balance reusability of hardware, ease of use by astronauts, and minimal change from the KickSat architecture. For the Spacecraft-on-a-Chip Experiment Platform, the team is considering a programmer with minimal changes from that used by KickSat. (b) (4)
Generation of Cardiomyocytes from Human IPS Cell-derived Cardiac Progenitors	Dr. Chunhui Xu	Emory University	(b) (4) (b) (4)
Improving Astronaut Performance of National Lab Research Tasks	Dr. Jayfus Doswell	Juxtopia, LLC	
Viral Infection Dynamics and Inhibition by the Vecoy Nanotechnology	Dr. Drew Cawthon	Lovelace Respiratory Research Institute	(b) (4) (b) (4) (b) (4)



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS/UPDATE
Great Lakes Specific HICO Water Quality Algorithms	Dr. Robert Shuchman	Michigan Technological University	HICO experienced a fatal malfunction shortly after the initiation of this project. The team acquired preexisting HICO data from 2014 as well as a number of passes in the summers of 2012 and 2013, along with a series of near and coincident in situ measurements in the Western Basin of Lake Erie to adequately address project goals of monitoring the Great Lake ecosystem and drinking/recreational water sources. (b) (4) (b) (4) (b) (4)
Microbead Fabrication using Rational Design Engineering	Dr. Brian Plouffe	Quad Technologies	(b) (4)
Examine Bone Tumor and Host Tissue Interactions Using Microgravity Bioreactors	Dr. Carl Gregory	Texas A&M Health Science Center	(b) (4)
Generation of Mesoderm Stem Cell Progenitors in the ISS- National Laboratory	Dr. Robert Schwartz	University of Houston System	(b) (4)
Hyperspectral Remote Sensing of Terrestrial Ecosystem Carbon Fluxes	Fred Huemrich	University of Maryland Baltimore County	(b) (4)



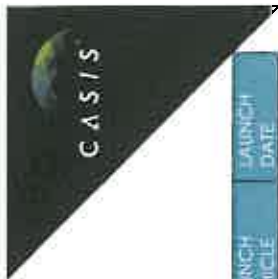
PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS UPDATE
HICO Identification of Harmful Algal Blooms	Dr. Richard Becker	University of Toledo	HICO experienced a fatal malfunction shortly after the initiation of this project. The team acquired preexisting HICO data from 2014 as well as a number of passes in the summers of 2012 and 2013, along with a series of near and coincident in situ measurements in the Western Basin of Lake Erie to adequately address project goals of monitoring Great Lake ecosystem and drinking/recreational water sources (b) (4)

IN PREFLIGHT DEVELOPMENT

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	LAUNCH VEHICLE	LAUNCH DATE
Story Time From Space	Patricia Tribe	T2 Science and Math Education Consultants	Orb-4	12/3/15
Milliken: Vertical Burn	Dr. Jeff Strahan	Milliken	Orb-4	12/3/15
Zero-G Characterization & On-Orbit Assembly for Cellularized Satellite	Talbot Jaeger	NovaWurks, Inc	Orb-4	12/3/15
ETech	Dr. Jeff Goldstein	NCESE/Tides Center	SpX-8	1/3/16
ESSEP-Odyssey	Dr. Florence Gold	Rocky Mountain College	SpX-8	1/3/16
HUNCH Chlorella/Billings Central Catholic High	Kristofer R. Gonzalez-DeWhitt, Michael Hickey	Eli Lilly and Company	SpX-8	1/3/16
Eli Lilly PCG	Dr. Rosamund Smith	Eli Lilly and Company	SpX-8	1/3/16
DEI Lilly-RR3 Myostatin	Dr. Kathleen Morse	Advanced Materials Applications, LLC	SpX-8	1/3/16
Materials Testing: The Evaluation of Gumsitx™ Modules in Low Earth Orbit	Dr. Jud Ready	Georgia Institute of Technology	SpX-8	1/3/16
Materials Testing - Earth Abundant Textured Thin Film Photovoltaics	Dr. Alessandro Grattoni	The Methodist Hospital Research Institute	SpX-8	1/3/16
Decoupling Diffusive Transport Phenomena in Microgravity	Anna-Sophia Boguraev	The Boeing Company (sponsor)	SpX-9	3/21/16
Genes In Space	Dr. Kasthuri Venkateswaran	Jet Propulsion Laboratory/Caltech	SpX-9	3/21/16
Molecules Produced In Microgravity from the Chernobyl Nuclear Accident	Dr. Mary Kearns-Jonker	Loma Linda University	SpX-9	3/21/16
Functional Effects of Spaceflight on Cardiovascular Stem Cells	Dr. Bruce Hammer	University of Minnesota	SpX-9	3/21/16
NIH-Osteo	Michael Fortenberry	Southwest Research Institute	SpX-9	3/21/16
Project Meteor	Dr. Joseph Wu	Stanford University	SpX-9	3/21/16
Effects of Microgravity on Stem Cell-Derived Heart Cells	Ron Dunklee	AIRBUS DS Space Systems, Inc.	SpX-9	3/21/16
Demonstration and TRL Raising of the Net Capture System on the ISS	Robert Carlson	JAMSS America, Inc. (JAI)	SpX-9	3/21/16
Global AIS on Space Station (GLASS)	Twyman Clements	Space Tango, Inc.	SpX-9	3/21/16
MultiLab: Research Server for the ISS	Dr. Scott A. Green	Controlled Dynamics Inc.	OA-5	5/31/16
Controlled Dynamics Locker for Microgravity Experiments on ISS	Dr. Edward Snell	Hauptman Woodward Medical Research Institute, Inc.	SpX-10	6/10/16
Growth Rate Dispersion as a Predictive Indicator for Biological Crystal Samples				
Application of Microgravity Expanded Stem Cells in Regenerative Medicine	Dr. Abba Zubair	Mayo Clinic	SpX-10	6/10/16



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	LAUNCH VEHICLE	LAUNCH DATE
The Effect of Macromolecular Transport on Microgravity PCG	Dr. Lawrence DeLucas	University of Alabama at Birmingham	SpX-10	6/10/16
Rodent Research-4 Validation Study	Dr. Melissa Kocena	Indiana University School of Medicine	SpX-10	6/10/16
NDC-3: Chicagoland Boy Scouts and Explorers	Christie Capelety	Three Fires Council of Chicago	SpX-11	8/15/16
NDC-3: Chicagoland Boy Scouts and Explorers	Norman McFarland	Three Fires Council of Chicago	SpX-11	8/15/16
NDC-3: Chicagoland Boy Scouts and Explorers	Dr. Sandra Rogers	Three Fires Council of Chicago	SpX-11	8/15/16
MUSES Imaging Platform	Bill Corley	Teledyne Brown Engineering	SpX-11	8/15/16
Magnetic 3-D Cell Culture for Biological Research in Microgravity	Dr. Glauco Souza	Nano3-D Biosciences, Inc.	SpX-11	8/15/16
Nanobiosym- Galactic Grant	Dr. Anita Goel	Nanobiosym	SpX-13	2/13/17
Zero Robotics - Middle School Competition	Dr. Alvar Saenz Otero	Massachusetts Institute of Technology	yearly	
Zero Robotics - High School Competition	Dr. Alvar Saenz Otero	Massachusetts Institute of Technology	yearly	
Use of Boron-Enhanced High-Density Polyethylene for Radiation Shielding - NDC Pilot potential re-flight	Angela Glidewell	Awty International School	TBD	
Carbon Dioxide Emissions of Yeast Cells in Microgravity Environment - WNDC Pilot potential re-flight	Jessika Smith	Awty International School	TBD	
WINDC Pilot Program - potential re-flight	Rev. Brian Reedy	Cristo Rey Jesuit College Preparatory of Houston	TBD	
WINDC Pilot Program - potential re-flight	Greg Adragna	Cristo Rey Jesuit College Preparatory of Houston	TBD	
WINDC Pilot Program - potential re-flight	Kathy Duquesnay	Duchesne Academy	TBD	
WINDC Pilot Program - potential re-flight	Susan Krizner	Duchesne Academy	TBD	
WINDC Pilot Program - potential re-flight	Brian Thomas	Centaurus High School	TBD	
WINDC Pilot Program - potential re-flight	Shanna Alzmler	Bell Middle School	TBD	
WINDC Pilot Program - potential re-flight	Joel Bertelsen	Chaffield Senior High School	TBD	
WINDC Pilot Program - potential re-flight	Dr. Luc Gervais	iDrop Diagnostics US Inc.	TBD	
WINDC Pilot Program - potential re-flight	Dr. Yang (Ted) D. Teng	Brigham and Women's and Space Bio Laboratories Co. Ltd	TBD	
WINDC Pilot Program - potential re-flight	Sourav Sinha	Oncolinx	TBD	
WINDC Pilot Program - potential re-flight	Harrison Bralower	SQZ Biotechnologies	TBD	
WINDC Pilot Program - potential re-flight	Patricia Williamson	Tate & Lyle	TBD	
WINDC Pilot Program - potential re-flight	Jason Sakamoto	The Methodist Hospital Research Institute	TBD	
WINDC Pilot Program - potential re-flight	Dr. Chia Soo	UCLA	TBD	
WINDC Pilot Program - potential re-flight	Dr. Anna-Lisa Paul	University of Florida	TBD	
WINDC Pilot Program - potential re-flight	Lauren Thompson Miller	A-76 Technologies, LLC	TBD	
WINDC Pilot Program - potential re-flight	Larry Alberts	Cam Med LLC	TBD	
WINDC Pilot Program - potential re-flight	Dr. Hulya Demiryont	Eclipse Energy Systems, Inc.	TBD	



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	LAUNCH VEHICLE	LAUNCH DATE
Eli Lilly Dissolution of Hard to Wet Solids	Dr. Richard Cope, Dr. Alison Campbell, Dr. Kenneth Savin	Eli Lilly and Company	TBD	
Eli Lilly Lyophilization	Jeremy Hinds, Dr. Evan Heifrick	Eli Lilly and Company	TBD	
Detached Melt and Vapor Growth of InI in SUBSA Hardware	Dr. Aleksandar Ostrogorsky	Illinois Institute of Technology	TBD	
Nemak Alloy Solidification Experiments	Dr. Glenn Byczynski	NEMAK	TBD	
Crystal Growth of Cs ₂ LYCl ₆ /Ce Scintillators in Microgravity	Dr. Alexei Churilov	Radiation Monitoring Devices, Inc.	TBD	
Faraday Waves and Instability-Earth and Low G Experiments	Dr. Ranga Narayanan	University of Florida	TBD	
Zaiput Flow Technologies-Galactic Grant	Dr. Andrea Adamo	Zaiput Flow Technologies	TBD	
Development and Deployment of Charge Injection Device Imagers	Dr. Daniel Batchelder	Florida Institute of Technology	TBD	
Space Based Optical Tracker	Dr. John Stryjewski	Vision Engineering Solutions	TBD	
SIC Microgravity Enhanced Electrical Performance (MEEP)	Rich Glover	ACME Advanced Materials	TBD	
The Universal Manufacture of Next Generation Electronics	Dr. Supriya Jaiswal	Astirleux Corporation	TBD	
SG100 Cloud Computing Payload	Mr. Trent Martin	Business Integra	TBD	
Providing Spherical Video Tours of ISS	Mr. David Gump	Deep Space Industries	TBD	
Ultra-Portable Remote-Controlled Microfluidics Microscopy	Dan O'Connell	HNU Photonics	TBD	
Microenvironment				
Honeywell/Morehead-DM Payload Processor	Dr. Benjamin Malphrus	Honeywell/Morehead State University	TBD	
Intuitive Machines-ISS Terrestrial Return Vehicle (TRV)	Steve Altemus	Intuitive Machines	TBD	
Map the Penetration Profile of a Contact-Free Transdermal Drug Delivery System	Dr. Robert Applegate	Novapix	TBD	

CURRENTLY IN ORBIT

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	RETURN VEHICLE	RETURN DATE	STATUS UPDATE
Windows On Earth	Dan Barstow	TERC	N/A	N/A	The WinEarth software continues to perform optimally and is providing the ISS crew with a valuable tool to facilitate Crew Earth Observations and Imaging.
Binary Colloidal Alloy Test - Low Gravity Phase Kinetics Platform	Dr. Matthew Lynch	Procter & Gamble, with ZIn Technologies, Inc.	TBD; originally SpX-7	TBD	The team presented their findings at the American Chemical Society conference in Denver, CO, in March. Initial results show that microscopic and macroscopic changes contribute to coarsening of their colloidal systems.
Bone Densitometer	John Vellingner	Techshot, Inc.	N/A	N/A	Validation experiments were a robust success, including completion of the first R&D payload from Novartis in April. The hardware continues to function as intended.
Synthetic Muscle: Resistance to Radiation	Dr. Lenore Rasmussen	Ras Labs	SpX-9	4/22/2016	Initial images are promising, and the team is preparing for analysis upon return of samples.
Espresso Cup	Dr. Mark Weislogel	IRPI LLC	N/A	N/A	Payload has performed as expected. HD video receipt pending.
National Lab Project: AMS	Dr. Samuel Ting	Department of Energy	N/A	N/A	The Alpha Magnetic Spectrometer continues to operate nominally and collect data on board the ISS. Dr. Ting's team continues to analyze data.



PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	RETURN VEHICLE	RETURN DATE	STATUS UPDATE
National Lab Projects: ISERV	Burgess Howell	Disaster Relief Charter	N/A	N/A	The ISERV camera is currently in stowage onboard the ISS awaiting required use in response to humanitarian or disaster response.

IN POSTFLIGHT ANALYSIS

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS UPDATE
Osteocytes and Mechanomechanotransduction (Osteo-4)	Dr. Paola Divieti Pajevic	Boston University	(b) (4)
Cobra Puma Golf Microgravity Electrodeposition	Mike Yagley	Cobra Puma Golf	(b) (4)
Kentucky Space/Exomedicine Lab – Flatworm	Dr. Mahendra Jain	Kentucky Space, LLC	Dr. Michael Levin (Tufts University) presented results at the ExoMed 2015 Conference held in Swampscott, MA, in ^{Int'l Mnv} (b) (4)
Novartis Rodent Research-1	Dr. David Glass	Novartis Institute for Biomedical Research	(b) (4)
Novartis Rodent Research-2	Dr. David Glass	Novartis Institute for Biomedical Research	(b) (4)

COMPLETED PROJECTS

PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS UPDATE
Collaborative Project – Protein Crystal Growth to Enable Therapeutic Discovery	Dr. Matt Clifton	Beryllium Discovery Corp.	Flight	This is a collaborative project with Protein BioSolutions (see below). (b) (4)



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS/UPDATE
Ants in Space, CSI-06	Stefanie Countryman	BioServe Space Technologies	Flight	The flight portion of this STEM program was completed in 2014. This is now a ground-based STEM program that leverages the data/findings/results of the flight project. A publication in Frontiers in Ecology and Evolution, described in a previous report, resulted from this project. (b) (4)
PCG-Crystallization of Huntington Exon-1 Using Microgravity	Dr. Pamela Bjorkman	California Institute of Technology	Flight	(b) (4)
Testing TIS12 Nanonet Based Lithium Ion Batteries for Safety in Outer Space	Emily Fannon	EnerLeap	Ground	(b) (4)
Exploring On-Orbit Crystal Properties for Medical and Economic Targets	Dr. Edward Snell	Hauptman Woodward Medical Research Institute, Inc.	Flight	(b) (4)
Architecture to Transfer Remote Sensing Algorithms from Research to Operations	Dr. James Goodman	HySpeed Computing	Ground	The Hyperspectral Imager for the Coastal Ocean (HICO) Image Processing System is now online: http://hyspeedgeo.com/HICO/ . The HICO Image Processing System is a prototype cloud computing application for on-demand remote sensing image analysis and data visualization. Users can interactively select images and algorithms, dynamically launch analysis routines in the cloud, and see results displayed directly in an online map interface. PI received samples from SpX-4 in October 2014. (b) (4)
PCG - IPPase Crystal Growth in Microgravity	Dr. Joseph Ng	iXpressGenes, Inc.	Flight	(b) (4) In April, Dr. Ng published a review article in an online journal, described in a previous report, that references his CASIS-sponsored project. Two additional papers describing the X-ray and neutron diffraction results, respectively, are in preparation.
Omega Hydrofuge Plant Growth Chamber – HUNCH Extreme Science – Lakewood	Matthew Brown	Lakewood High School	Flight	The experiment was flown and operated successfully onboard the ISS. The student team's payload met its experimental objectives, with an-orbit successful plant growth for 12 days. This is now a ground-based STEM program that leverages the data/findings/results of the flight project.



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS/UPDATE
Zero Robotics – Middle and High School Competitions	Dr. Alvar Saenz Otero	Massachusetts Institute of Technology	Flight	Middle and High school competitions are complete for this year. More than 650 students from 11 different states participated in the 28 Middle Schools finals competition. This year's challenge, Conducting Optical Research on Nearby Asteroids (CORONASPHERES), required students to program their robotic satellite to take pictures of an asteroid while avoiding the effects of solar flares in an engaging simulation.
Merck PCG-1 and -2	Dr. Paul Reichert	Merck Pharmaceuticals	Flight	(b) (4)
NCESE/SSEP (Student Spaceflight Experiments Program) – Orion, Falcon, Mixture Tube, Yankee Clipper	Dr. Jeff Goldstein	NCESE/Tides Center	Flight	The flight portion of these STEM projects is complete. These are now ground-based STEM initiatives that leverage the data/findings/results of the flight projects.
Impact of Increased Venous Pressure on Cerebral Blood Flow Velocity Morphology	Dr. Robert Hamilton	Neural Analytics	Ground	The data sharing agreement with NASA is complete; clinical data from the ISS should be delivered within 12-18 months. NASA (Ocular Health Study) will provide TCD and EKG data from pre-, in-, and post-flight sessions on no more than 12 astronaut subjects. (b) (4)
T-Cell Activation in Aging-1 and -2	Dr. Millie Hughes-Fulford	Northern California Institute for Research and Education, Inc.	Flight	(b) (4)
Collaborative Project – Protein Crystal Growth to Enable Therapeutic Discovery	Dr. Cory Gerdis	Protein BioSolutions	Flight	This is a collaborative project with Beryllium Discovery Corp. (see above). The payload returned on SpX-4 (b) (4)
Utilize ISS Energy Systems Data for Microgrid Design and Operation	Nicholas Kurlas	Raja Systems	Ground	(b) (4)
PCG – Crystallization of Medically Relevant Proteins Using Microgravity	Dr. Sergey Korolev	Saint Louis University	Flight	(b) (4)



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS UPDATE
Reducing Signal Interruption From Cosmic-Ray Background in Neutron Detectors	Dr. Andrew Inglis	Silverside Detectors	Ground	(b) (4)
Hyperspectral Mapping of Iron-bearing Minerals	Dr. William H. Farrand	Space Science Institute	Ground	(b) (4)
Commercial Space-Borne Hyperspectral Harmful Algal Bloom (HAB) Products	Dr. Ruhul Amin	United States Naval Research Laboratory	Ground	(b) (4)



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS UPDATE
PCG - Crystallization of Human Membrane Proteins in Microgravity	Dr. Stephen Aller	University of Alabama at Birmingham	Flight	(b) (4)
Antibiotic Effectiveness in Space-1	Dr. David Klaus	University of Colorado Boulder	Flight	(b) (4)
Molecular Biology of Plant Development (Petri Plants)	Dr. Anna-Lisa Paul	University of Florida	Flight	(b) (4)
Effects of Simulated Microgravity on Cardiac Stem Cells	Dr. Joshua Hare	University of Miami	Ground	(b) (4)
Protein Crystal Growth for Determination of Enzyme Mechanisms	Dr. Constance Schall	University of Toledo	Flight	(b) (4)



PROJECT	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS/UPDATE
Drug Development and Human Biology: Use of microgravity for drug development	Dr. Timothy Hammond	Veterans Administration Medical Center	Flight	(b) (4)
Cyclone Intensity Measurements from the International Space Station (CIMISS)	Dr. Paul C. Joss	Vistdyne, Inc.	Flight	(b) (4)



CONFERENCES AND EVENTS IN Q4 FY15

DATE	CONFERENCE/EVENT	LOCATION	AUDIENCE	DESCRIPTION
July 7-9, 2015	ISS R&D	Boston, MA	Aerospace, researchers, and scientists	The conference is bringing together leaders from industry, academia, and government for three days of detailed presentations and discussions about innovations and breakthroughs in microgravity research, life sciences, materials development technology development, human health, and remote sensing.
July 7-9, 2015	ISS R&D STEM Plenary	Boston, MA	Educators, Students, ISS R&D attendees	This presentation at the ISS R&D Conference focused on utilizing the ISS as a STEM platform. Student teams shared their participation in the NDC, HUNCH, and SSEP programs, followed by a panel discussion. NDC3 and NDC4 teams were acknowledged.
July 7-9, 2015	STEM Days Tours	Boston, MA	Students and parents	This interactive event, held in conjunction with the 2015 ISS R&D Conference, included tours of MIT, the Boston Museum of Science, and the McAuliffe Challenger Center.
July 7-10, 2015	Destination Station	Boston, MA	Public, local political community, and local researcher community	In conjunction with the ISS R&D Conference, CASIS and NASA Destination Station goals in Boston focused on educating the public, the local political community, and potential new users on the benefits of conducting research in a microgravity environment.
July 8, 2015	Genes In Space	Boston, MA	Educators, Students, ISS R&D attendees	The Boeing Genes in Space national competition challenges educators and students in grades 7-12 to design experiments that will solve real-life space exploration problems through DNA analysis. This year, 700 students participated, and the 2015 finalists were announced at the 2015 ISS R&D Conference.
July 9, 2015	Palo Alto Innovation Tour	Palo Alto, CA	50+ Ford R&D professionals	A seminar was given at the Ford Innovation Center in Palo Alto on opportunities for innovation with CASIS. A meeting was also held with Lux Capital to discuss collaboration opportunities.
July 10-15, 2015	Space Station STEM Challenge	Massachusetts Life Sciences Center, Boston, MA	Educators and students	Space Station STEM Challenge is a student research competition sponsored by CASIS and the Massachusetts Life Sciences Center in which awarded student team design, build, and send a life science experiment to the ISS. The winning school was announced at the 2015 ISS R&D Conference, and several kickoff workshops were conducted with the student teams following the announcement.
July 24-26, 2015	WorldFuture 2015	San Francisco, CA	World's leading futurists and foresight experts	CASIS gave a presentation on the forecast for the future of industrial activity in space. CASIS was recognized by the Association of Professional Futurists for the best individual project in foresight over the past year.

WWW.NASAWATCH.COM



DATE	CONFERENCE/EVENT	LOCATION	AUDIENCE	DESCRIPTION
August 31, 2015	CASIS Academy Live	Kennedy Space Center, FL	Educators, students, and parents	CASIS Academy Live is an interactive STEM presentation that educates students about the importance of ISS National Lab research and brings greater awareness to STEM careers. CASIS hosted several afterschool groups from the Space Coast area (from Wabasso and Melbourne, Florida) at the AMF Education Center at Kennedy Space Center. Dr. Jayfus Doswell was the featured speaker and discussed his CASIS-sponsored research focused on Situational Virtual Reality glasses. Participation included 30 students and 5 adults.
August 10-13, 2015	AIAA Small Satellite Conference	Logan, UT	Small satellite companies including bus providers to component manufacturers	Commercial aerospace companies in conjunction with NASA discussed the proliferation of small satellites.
August 14, 2015	Zero Robotics MS Competition	Kennedy Space Center, FL	Educators, students, and parents	Zero Robotics is a student competition that utilizes the SPHERES hardware (miniature satellites) on the ISS. The final competition of every tournament is held onboard the ISS. This year, the Middle School Summer Program was available to selected middle school teams in 14 regions/states (AL, CA, CO, D.C., Metro/MD, FL, GA, ID, MA, OH, OR, SEMAA, TX, and WV). CASIS supported the Florida finals event, which was held at Kennedy Space Center. Participation included 111 students; 38 teachers, mentors, and staff; and 38 VIP guests. There were 65 teams, 725 student participants, and more than 100 educators/mentors involved in the 2015 Zero Robotics Middle School program.
August 31-September 2, 2015	AIAA Space 2015	Pasadena, CA	Space industry executives and leaders	Presentation of CASIS industrial R&D efforts as part of a NASA panel on the use of the ISS as the world's only field laboratory in space.
September 3, 2015	Scaling STEM	Boston, MA	Educators, executives, government representatives	This event, hosted by MIT, focused on how to use technology to improve access to quality STEM education for all students. The afternoon featured demonstrations of new learning tools and outreach efforts, presentations by leading education experts, and a panel discussion.
September 9-10, 2015	Space 2.0	San Francisco Bay Area, CA	C-level executives from small/start-up aerospace and big data management firms, business development managers from large aerospace companies	Discussion on success stories and growth potential of next-generation aerospace firms (Space 2.0), with a focus on data products and analytics of remote sensing raw data. Discussion also focused on development of applications as the "product" and imagery data as the source rather than the end product. This was an excellent source for Good Earth flight project and data fusion ground project contacts.
September 15, 2015	Goodyear Innovation Session	Akron, OH	Goodyear R&D leadership	CASIS and Goodyear held a brainstorming session on collaboration opportunities.



DATE	CONFERENCE/EVENT	LOCATION	AUDIENCE	DESCRIPTION
September 16, 2015	LIFT Meeting	Detroit, MI	R&D and Manufacturing Directors of Innovation, CTOs, CSOs and other senior leaders in the efficient manufacturing space	Discussed how CASIS and the LIFT consortium can strategically join together to direct the ISS National Lab to serve the nation's metal lightweighting research needs. A research partnership proposal is in development.
September 16-17, 2015	IRI Fall Networks Meeting	Dearborn, MI	R&D management community representing more than half of all R&D spending in the U.S.	Participated in Innovation Leadership Network and External Technology Network sessions to learn how current industry leaders develop R&D and innovation portfolios.
September 19, 2015	NASA/KSC Community Day	Kennedy Space Center, FL	Educators, parents, general public	The KSC Community Day was a free, public outreach event held at the KSC Visitor Complex. The CASIS Education team supported this event and promoted ISS awareness and CASIS STEM programs.
September 22-24, 2015	Destination Station	Minneapolis, MN	Senior executives at General Mills, Cargill, Valspar, and Target	In partnership with NASA, Destination Station visited Minneapolis to meet with a variety of prominent companies to discuss the possibilities and opportunities on the ISS. CASIS and NASA presented a 90-minute plenary to each company's staff. This was followed by series of break-out sessions to brainstorm flight project ideas based on ISS capabilities and each respective company's research portfolio.
September 23-24, 2015	Florida Afterschool Alliance Annual Conference	Orlando, FL	Educators, school district administrators, informal science organization heads	This was the annual statewide conference for afterschool professionals in Florida to learn about quality STEM programs for children and youth during out-of-school hours. The CASIS Director of Education gave a keynote presentation about the importance of using space to motivate students about STEM. The CASIS Education team informed attendees of CASIS Education resources and programs. A representative from Windows On Earth, a CASIS Education partner, also gave a presentation on Amazing Earth, the newest feature of the CASIS Academy website.
September 25, 2015	CASIS Academy Live	Kennedy Space Center, FL	Educators, students	CASIS Academy Live is an interactive STEM presentation that educates students about the importance of ISS National Lab research and brings greater awareness to STEM careers. At this event, Dr. Jeffrey Bennett spoke to high school students about astrophysics, space, and the science of life. The NASA Digital Learning Network broadcasted an interview with Dr. Bennett to schools nationwide following the event.



DATE	CONFERENCE/EVENT	LOCATION	AUDIENCE	DESCRIPTION
September 26-29, 2015	Clinton Global Initiative 2015 Annual Meeting	New York City, NY	CEOs, Heads of Innovation, CTOs, COOs, and other executives	The Annual meeting brings together thought leaders to translate good ideas into real results on the ground. CASIS targeted this organization and event to meet philanthropists and large organizations committed to big challenges and problems that could be solved by using the ISS as the ultimate innovation platform.
September 27, 2015	CASIS Academy Live	San Jose, CA	Educators, students, parents	CASIS Academy Live is an interactive STEM presentation that educates students about the importance of ISS National Lab research and brings greater awareness to STEM careers. At this event, Dr. Deborah Gordon, ant expert and developer of the CASIS-sponsored Ants in Space experiment, spoke to high school students about foraging ant behavior in microgravity and how this research is linked to the development of algorithms used by computers to operate robots.