



## FY15 Q3 REPORT

C A S I S

Quarterly Report for the Period April 1st – June 30th, 2015

**CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE (CASSIS)**

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## EXECUTIVE SUMMARY

*During the third quarter of fiscal year 2015 (Q3 FY15), the Center for the Advancement of Science in Space (CASIS) demonstrated continued commercial development—including deeper penetration in key segments—and saw an increase in published results from International Space Station (ISS) U.S. National Laboratory projects.*

*CASIS continued its progress in Q3 to diversify the research and development (R&D) portfolio of the ISS National Lab, awarding six flight opportunities to researchers from commercial and academic institutions, and receiving an additional 21 proposals, which are under review as future ISS National Lab projects. CASIS also issued a request for information, seeking input from tissue engineering and regenerative medicine subject matter experts that may be adapted for use onboard the ISS National Lab.*

*Returned/completed ISS National Lab projects are showing significant results and impact. Last quarter, two journal articles based on results from CASIS-sponsored R&D were published.*

*Additionally, because of CASIS leveraging, a new online web tool will enable analysis of ISS Earth imaging data (from the Hyperspectral Imager for the Coastal Ocean) by the global user community, allowing translation of ISS National Lab data into benefits for life on Earth. Finally, an experiment using a commercially built rodent bone density scanner onboard the ISS validated the availability of this instrument for future ISS research. This capability furthers ISS National Lab research utilization, and such use of commercial off-the-shelf equipment saves development costs traditionally associated with space-bound specialized equipment.*

*CASIS continued efforts to leverage existing resources and collaborations to enable groundbreaking campaigns and ongoing initiatives. Some key examples include:*

- *Campaign Good Health (an initiative to benefit human health on Earth through space-based inquiry). CASIS continued to engage leading subject matter experts regarding cutting-edge trends in terrestrial research—focusing on problems that can be solved or accelerated on the ISS. In parallel, CASIS explored opportunities for collaborations and institutional partnerships with existing NASA programs and commercial laboratories.*
- *Campaign Good Earth (an initiative to improve Earth imaging from the ISS). CASIS contracted an Earth observation industry expert to analyze existing resources and capabilities toward developing a strategic approach for maximizing resource investment and return.*
- *CASIS education initiatives. Five student projects in science, technology, engineering, and mathematics (STEM) were awarded as part of a partnership with the Boy Scouts of America—an organization that has existed for more than a century and is now composed of nearly 2.5 million youth members.*

*CASIS continues to gain credibility and visibility with the broad U.S. R&D community via industry conferences and events, including a real-time event featuring the ISS National Lab during the New York Stock Exchange closing bell. CASIS engaged with more*

*than 2,000 researchers during Q3 and is currently working with nearly 150 companies to develop flight project ideas across a wide variety of disciplines.*

*CASIS STEM education programs reached 25,000 students and educators in Q3. Sadly, among these students were those whose experiments were lost during the launch anomaly of the SpaceX-7 commercial resupply services mission on June 28, 2015. Of the ten CASIS-sponsored payloads lost in this anomaly, nine contained student experiments. Although the launch anomaly is a stark reminder of the challenges of spaceflight commercialization, the power of the ISS as an R&D platform compels us to carry on. CASIS is committed to re-manifesting the lost payloads at the earliest possible opportunity. Additional STEM activity this quarter included the kickoff for the CASIS co-sponsored Zero Robotics Middle School Competition that will involve almost 1,000 students. The competition itself will occur in Q4 onboard the ISS.*

*The following report details the specific progress of CASIS and its management of the ISS U.S. National Lab during Q3 FY15.*

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

### **Campaign Good Earth**

*Good Earth is a large-scale collaborative campaign focused on maximizing ISS Earth observation capabilities for Earth benefit. Following a presentation to NASA ISS Program Office leadership in late April, Good Earth milestones were clarified to emphasize the role of ISS as a technology demonstration platform. Q4 FY15 milestones include:*

1. Understand the capabilities and limitations of the ISS as a remote sensing platform.
2. Determine the best use of the ISS as a remote sensing platform given current and planned remote sensing projects and supporting technology capabilities.
3. Evaluate access requirements and potential utility of NASA remote sensing science data to contribute to the development of data fusion products with commercial value.
4. 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.

*To meet these milestones, in June, CASIS awarded a subcontract for a study to evaluate ISS remote sensing capabilities and assess NASA science data and processes. During this 120-day study, interviews and surveys will be conducted with potential stakeholders, customers, and partners from NASA, aerospace, and Earth science technology companies. Based on the results of this study, CASIS will meet milestone 4 and establish a business development engagement strategy to (1) evaluate the ISS as a remote sensing platform (infrastructure, data management, and ideal 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.*

### **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. To complement a potential astronaut longitudinal study, the campaign will generate longitudinal data from model organisms and cell lines exposed to the space environment. These will 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 unveiled by President Obama 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.*

*In support of Good Health, CASIS issued a request for information (RFI) in Q3 on 3D Microphysiological Systems for Organs-On-Chips Research (<http://www.iss-casis.org/Opportunities/Solicitations/RFIOrgansOnChipsResearch2015.aspx>). The RFI seeks 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.*

*In another major Good Health initiative, CASIS distributed a “model systems” survey 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. Research opportunities using these models will be prioritized as part of Good Health, and opportunities for related collaborations with NASA, the National Space Biomedical Research Institute (NSBRI), and the NASA GeneLab platform will be explored. Survey results continue to be submitted (25 in Q3), and a second wave of surveys in Q4 is planned.*

**Additional Q3 accomplishments include:**

- Developed a baseline strategy document, including a detailed description of Good Health and its objectives and an execution plan and a Charter defining stakeholder roles and responsibilities.
- Connected with key U.S. commercial laboratories to leverage institutional partners for rodent model resources and engaged with Merck regarding use of rodent disease models.
- Engaged with the NASA Space Life and Physical Sciences (SLPS) Research and Applications Division to collaborate on a longitudinal rodent reference mission.
- Engaged with the NASA Human Research Program (HRP) regarding expansion of the NASA Biological Specimen Repository to include samples for omics-based analyses.
- Participated in the National Research Council Space Week omics panel focused on data management.

**Goals and objectives for Q4:**

- Continue biweekly meetings of the Good Health Steering Committee and on-board National Institutes of Health (NIH) members.
- Coordinate with the Steering Committee to complete signing of Good Health Charter and to identify subject matter experts for Good Health Science Definition Teams.
- Support Precision Medicine Initiative meetings at NIH and develop a proposal to integrate an astronaut longitudinal study into the Precision Medicine Initiative.
- Complete a Good Health Strategic Plan, integrating results of CASIS and NASA RFIs, surveys, market research, and the GeneLab Strategic Plan, as well as addressing identification of extramural funding sources and mechanisms.

## **ISS National Lab Portfolio**

CASIS awarded flight opportunities to four projects across diverse disciplines in Q3: one in life sciences (rodent research, in collaboration with the Department of Defense), one in fluid physics, one in technology development, and one in remote sensing—the last of which is a re-flight by a returning customer. In addition, CASIS awarded ISS National Lab allocation to two NASA SLPS-funded investigators for protein crystal growth experiments—a successful example of promoting ISS utilization through synergies and collaboration with NASA centers (in this case, Marshall Space Flight Center and Glenn Research Center). Finally, CASIS supported the launch of two NanoRacks commercial payloads to the ISS National Lab in April and an additional ten NanoRacks payloads in June that were sadly lost in the SpaceX-7 launch anomaly. Details of the CASIS impact from this anomaly are discussed in the Operations Logistics Update below.

Four papers have been published in academic journals as a result of CASIS-sponsored investigations, two in FY2014 and two on March 30, 2015. The first of these two most recent papers resulted from a science, technology, engineering, and mathematics (STEM) education payload, “Ants in Space,” that launched on Orb-1 in January 2014 and studied ant collective search behavior in microgravity. When ants search for food, they do so as a highly coordinated community with complex behavior. For example, the density of ants in a search area influences how an individual moves (the degree to which its path is curved or wandering). Algorithms describing this behavior are critical to understanding group foraging in social insects and other systems of collective behavior, including technology applications. Studying this behavior in social insects may help to refine collective behavior algorithms for use in other systems; for example, in the programming of swarms of robots to optimize search-and-rescue capabilities. In the paper, the authors explain that ants in microgravity explored search areas less thoroughly and took paths that are more convoluted. This project continues as a ground-based STEM education program, leveraging results from the flight project.

The second paper results from a foundational project awarded in response a CASIS solicitation promoting protein crystal growth. The paper, a review article in an online journal, discusses different methods of growing very large protein crystals—including growth in microgravity onboard the ISS National Lab. Understanding a protein’s function in the body and its susceptibility to various drug treatments requires determining the protein’s structure, which in some cases requires very large protein crystals for analysis. The authors describe ways to produce such crystals and show images of space-grown crystals as an example of how a lack of buoyancy-driven convection onboard the ISS allows improved crystal formation and growth. Additional publications detailing structural information obtained from these space-grown proteins are expected.

Citations and additional descriptive text for these two papers can be found in the Metrics table “Contributions to Scientific Knowledge — Results Published in Scientific Journals” on page 14.

*In addition, a project awarded in response to a CASIS-issued solicitation focused on Earth imaging produced a web tool that is now available online: The Hyperspectral Imager for the Coastal Ocean (HICO) Image Processing System (IPS), <http://hypspeedgeo.com/HICO/>. HICO, though now retired from use on ISS, was the first space-borne imaging spectrometer designed to study the coastal ocean. HICO IPS is a computing application for image analysis and data visualization of the more than 10,000 images of Earth HICO collected during its five years of operations (September 2009 – September 2014). HICO IPS differs from other online map services because it is an application-server, so results are dynamically generated on-demand per the user's request. The system can support various remote sensing instruments and applications in addition to HICO images and data, providing an adaptable framework for implementing new algorithms and making new applications available to the global user community. This tool advances the CASIS mission by enabling a broader audience to translate data acquired in space into applications to benefit life on Earth.*

*Additional foundational projects also continue to produce positive results. Of the 28 projects currently completed or in postflight analysis, approximately half are from commercial companies, with academics, other government agencies, and STEM education institutions represented in the other half. The vast majority of these projects are in the life sciences, and preliminary findings show a majority met their experimental objectives, with many groups preparing scientific journal papers. For example, in addition to the review paper described above, three other CASIS-sponsored groups have successfully crystallized proteins of interest from spaceflight experiments and are currently working on structural determination. Preflight and ground-based projects also are showing some exciting preliminary indications, including multiple groups who have seen improved differentiation of cardiac stem cells in simulated microgravity systems. For more details on CASIS-sponsored projects and their progress, see the “Q3 FY15 Project Pipeline” table on page 16 of this report. This table includes preliminary findings and indications from ground-based and postflight CASIS-sponsored projects.*

### NASA Collaborations

*In June, CASIS and NASA SLPS personnel met to define new pathways to mutually support flight projects sponsored by either organization and Reference Missions using model organisms (e.g., rodents). The goal is to accelerate R&D payloads to ISS within planned research increments. This collaborative and strategic sharing of ISS resources boosts the potential for return on investment to the U.S. taxpayer and benefits the science objectives of both CASIS and NASA.*

*Also in June, at the invitation of HRP Chief Scientist Dr. Mark Shelhamer, CASIS Senior Scientist Dr. Michael Roberts presented to program management, scientists, and staff at NASA-JSC in the HRP Human Health Countermeasures, Behavioral Health and Performance, Space Radiation, Space Human Factors and Habitability, and Exploration Medical Capability elements. The presentation of the CASIS mission and the Good Health campaign is another step in improving communication with NASA ISS stakeholders to advance shared research objectives related to human health and disease prevention.*

## Operational Logistics Update

During Q3, two commercial resupply services (CRS) missions launched to ISS. The April 14, 2015 launch of the SpaceX-6 Dragon capsule delivered nine CASIS-sponsored payloads to the ISS, including the Novartis Biosciences' Rodent Research-2 mission and the NIH-CASIS funded Osteo-4 project, both of which returned to Earth on the SpaceX-6 return mission. The successful Novartis payload operation using the bone densitometer is a landmark achievement for microgravity research. This validation experiment for the facility serves as a pathfinder to future commercial rodent research projects. Furthermore, the dissection operations were completed in less time than allocated in mission planning.

The second attempted CRS mission on June 28, 2015, SpaceX-7, experienced a catastrophic anomaly shortly after liftoff from the launch pad; all payloads were lost. The SpaceX-7 Dragon manifest featured 20 ISS National Lab payloads from both commercial and academic organizations. Of these payloads, the ISS National Lab commercial services provider NanoRacks, LLC, supplied half. CASIS grant funding investment in the lost payloads is approximately a half million dollars, and the loss to the space community and the commercial space market affected many others as well. CASIS is working with all sponsored investigators affected by the launch failure and will support re-flights on future missions. Sadly, some of the student projects lost in the anomaly were re-manifested from the Orb-3 launch, which also resulted in loss of vehicle and payloads. CASIS will prioritize these student projects, as well as other research and commercial flight projects onboard, for re-flight, inserting them into the existing manifest at the earliest opportunity. For more details on the specific payloads lost in the anomaly, see the "Q3 FY15 Project Pipeline" table on page 16.

## BUSINESS DEVELOPMENT AND PARTNERSHIPS:

### EXPAND THE Casis NETWORK, LEVERAGE FUNDING, AND DRIVE COMMERCIAL UTILIZATION

During Q3, CASIS continued commercial market penetration with key industry events, Destination Station Roadshows, brainstorming sessions with key targeted companies, and Sponsored Program management (described below). The main vertical areas of focus for Q3 were life sciences, industrial and materials R&D, and aerospace and technology development.

Industry events reached more than 50 companies and close to 2,000 interested individuals in Q3, increasing the CASIS pipeline of potential commercial projects to reflect more than 140 companies. Moreover, many of the brainstorming sessions with five Key Accounts (Fortune 500 companies and other strategic partners with R&D that can be enabled by space) this quarter included collaboration with teams from various NASA centers, furthering CASIS and NASA efforts to exploit shared resources and maximize ISS utilization. See the Conferences and Events table on page 27 for details.

CASIS also promoted the Massachusetts Life Sciences Galactic Grant Competition, the first-ever CASIS Sponsored Program, through roadshows generating commercial interest in ISS as a bioscience research platform. A Sponsored Program is a grant solicitation in which funding is provided partly or entirely by an outside entity. CASIS worked with more than 20 companies to generate proposals in response to the Galactic Grant solicitation. Of these, nine were selected as finalists, and two flight prize awardees will be announced at the ISS R&D Conference in July 2015. These awardees will split a \$500,000 grant from the Massachusetts Life Sciences Center. Additionally, CASIS submitted five proposals for future sponsored programs and external funding opportunities in Q3.

Additionally, CASIS facilitated introductions between five companies and investor groups interested in supporting cutting-edge R&D. CASIS also formalized three new investor partnerships, which will seek to further augment available funding avenues for CASIS-sponsored principal investigators:

- InQtel (VC firm, Washington, DC)
- Lux Capital (VC firm, Menlo Park, CA)
- NextGen Angels (angel network, Washington, DC/NYC/Boston)

Finally, CASIS increased its strategic support of low Earth orbit (LEO) commercialization. A joint NASA/CASIS committee dedicated to LEO commercialization has selected preliminary focus areas for the first coordinated efforts to stimulate the use of LEO for sustained economic activity. The ISS National Lab is a critical platform in this regard and CASIS is participating in developing a tactical plan supporting identified focus areas. Specific progress in Q3 included preliminary identification of LEO research areas and technology platforms with shared public-private benefit, including protein crystallization, organ or tissue bioengineering, and in-orbit manufacturing.

## **STEM EDUCATION:**

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

During Q3, CASIS acted to expand the reach of the ISS National Lab through additional STEM projects and collaborations. A new Christa McAuliffe Challenger Center partnership and CASIS STEM education grant with Framingham State University in Framingham, Massachusetts, provides access for 720 under-represented students to a "CASIS Earth Odyssey Mission" simulation at the Center. The Center will also feature ISS National Lab STEM content to an estimated 10,000 visitors annually.

In addition, five new student projects were selected for CASIS sponsorship in Q3:

- Boy Scouts Space Station Design Challenge in Chicago, Illinois, – The Boy Scouts of America and Exploring Scouts program were awarded three student flight projects scheduled for launch in 2016.

- Massachusetts Life Science Centers Space Station STEM Challenge, Boston, Massachusetts – CASIS selected one flight and one ground project proposed by student teams from under-represented communities in Massachusetts, to be awarded during the ISS R&D Conference in July. This STEM Challenge was in parallel to the Galactic Grant Competition described on page 9.

CASIS also continued managing existing STEM education programs and partnerships. The following took place in Q3:

- Kickoff for the 2015 Zero Robotics Middle School Competition, titled Coronospheres. The 2015 summer program involves 62 schools, 930 students, and 372 adults. The Coronospheres Mission (i.e., the student challenge) is to use a robotic satellite to photograph points of interest on an asteroid and upload as many pictures as possible while avoiding effects of solar flares.
- 100 disadvantaged students in Seattle, Washington, participated in a 4-week Space Station Academy program in collaboration with the Seattle Museum of Flight.

Q3 also featured a SpaceX Dragon launch to the ISS on June 28, 2015, that transported more than 30 student experiments representing more than 10,000 student/educator participants in CASIS STEM programs and partnerships. Despite the anomaly associated with this launch, this is likely the highest total number of student/educator experiments and participants ever recorded on a single launch to the ISS—a huge accomplishment for ISS as an education platform.

## OUTREACH:

### PROMOTE THE VALUE OF THE ISS NATIONAL LAB TO THE NATION

Leveraging existing conferences and events to raise awareness about the ISS National Lab produced two examples of successful promotion:

- As part of a Destination Station event in early June, CASIS joined NASA at the New York Stock Exchange to ring the closing bell. CASIS Directors, Astronaut Joe Acaba, and members of the ISS research and operations community including Merck, Boeing, Orbital, and SpaceX joined NASA leadership on stage. CASIS and NASA held several media interviews during the event and spoke with traders and other stakeholders on the floor of the exchange. The event increased ISS National Laboratory visibility and branding to Fortune 500 companies and potential funders—a critical non-traditional target sector. Joint NASA/CASIS presence established the credibility of CASIS and the relevance of spaceflight research to this critical audience.
- Also in June, CASIS executed a live downlink from the ISS for the BIO International Conference in Philadelphia, Pennsylvania. The event featured a conversation between CASIS Executive Director Greg Johnson (present at the conference) and in-orbit Astronaut Scott Kelly. During the 15-minute downlink, attended by more than 3,500 pharmaceutical and biotechnology industry executives, Johnson and

*Kelly discussed ISS capabilities and how to leverage the ISS National Lab for R&D advancements. The downlink greatly enhanced the overall visibility of CASIS to the 15,000 BIO attendees: booth traffic increased dramatically after the event, and requests for media interviews and meetings tripled versus prior years. Of the conferences and events CASIS attends, BIO traditionally generates the most potential project leads. The dramatic visibility boost from the downlink increased traction in this target-rich audience and further established CASIS as a gateway to advanced R&D. For more on this and other events, see the "Conferences and Events" table on page 27.*

*In addition, CASIS outreach campaigns related to the two Q3 CRS missions were demonstrably successful:*

- Targeted SpaceX-6 mission promotion resulted in feature placements in highly respected publications, including *Information Week*, *Popular Science*, and *R&D Magazine*.
- A CASIS video highlighting a SpaceX-6 mission payload from Fortune 100 company Merck reached hundreds of thousands of new eyes through joint promotion by NASA and CASIS social media channels. [https://www.youtube.com/watch?v=fplZDP8kc\\_g](https://www.youtube.com/watch?v=fplZDP8kc_g)
- A video produced to leverage the SpaceX-7 mission to raise awareness of the ISS National Lab as a conduit for promoting student interest in STEM reached thousands of viewers.

*CASIS also invited two students to participate in the SpaceX-7 ISS Science and Technology briefing, which included a televised panel discussion, and interviews discussing the role of ISS in promoting STEM literacy. Unfortunately, due to the launch anomaly, many of these interviews will not be publicly released.*

*Nearing the end of Q3, CASIS increased final promotion for the ISS R&D Conference in July and finalized products, planned activities, and strategic approaches to be executed at the conference. CASIS played a more active role in the Planning Committee for the conference this year managing many aspects of the conference planning and execution. By the close of Q3, outside investment in the conference was double that of last year, and pre-conference registration was more than double any previous year. The increased pre-conference registration reflects successes in attracting new-to-space potential users, commercial industry, and government representatives.*

*Overall media impact, discussed in the "STEM Education and Outreach Metrics" table on page 14, reflects continued incremental but steady growth in Q3. Continued web traffic, increased traction via social media, and various events and conferences metrics are detailed in the "Conferences and Events" table on page 27).*

## FINANCIALS

### BUSINESS STATUS REPORT

APR 1-JUN 30, 2015	ACTUALS Q3 2015	BUDGET Q3 2015	VARIANCE	ACTUAL YTD 2015	BUDGET YTD 2015	VARIANCE
<i>Direct Labor</i>	\$1,205,126	\$1,589,944	\$344,818	\$3,602,697	\$4,531,126	\$928,429 (a)
<i>Subcontracts</i>	\$439,604	\$821,051	\$381,447	\$1,196,162	\$2,454,744	\$1,258,582 (b)
<i>Permanent Equipment &gt; \$5k</i>	\$4,931	\$37,500	\$32,569	\$118,466	\$124,000	\$5,534
<i>Expendable Supplies and Equipment</i>	\$44,307	\$79,485	\$35,178	\$136,662	\$206,315	\$69,653
<i>Travel</i>	\$215,588	\$255,194	\$39,606	\$605,952	\$741,800	\$135,848
<i>Grants Awarded</i>	\$1,346,174	\$2,115,080	\$768,906	\$3,406,738	\$7,006,824	\$3,600,086 (c)
<i>Other Direct Costs</i>	\$419,144	\$544,623	\$125,479	\$1,319,576	\$1,342,622	\$23,046

(a) Budgeted headcount at Jun 30, 2015 was 42 and actual was 33; CASIS has 12 positions currently open to be filled.

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

- Project Good Earth had budgeted for several consultants that were 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 have 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) 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.

### BREAKOUT OF COOPERATIVE AGREEMENT FUNDING

	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
<i>Direct</i>	49%	46%	46%	
<i>Indirect</i>	21%	19%	18%	
<i>Grants</i>	30%	35%	36%	

**BREAKOUT OF CASIS GRANTS**

	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
<b>Private/Commercial</b>	\$564,063	\$764,972	\$750,944	
<b>Academic</b>	\$297,400	\$439,100	\$546,936	
<b>Other Government</b>	\$0	\$0	\$0	
<b>Mission Based Costs</b>	\$83,787	\$131,242	\$48,294	

 **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 our 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
<b>CASIS RFPs and RFIs issued</b>	2	0	1	
<b>Responses received from RFPs and RFIs (including Step-1 and Step-2 proposals)</b>	17	1	0	
<b>Project proposals awarded from CASIS grant calls (solicited)</b>	6	1	0	
<b>Project proposals received (unsolicited)</b>	6	11	21	
<b>Project proposals awarded (unsolicited)</b>	10	3	6	
<b>Return customers: Proposals received from CASIS customers pursuing a re-flight or a flight for a new project</b>	1	1	2	
<b>New customers: Projects awarded to principal investigators that have never flown</b>	11	1	1	
<b>Flight projects manifested</b>	33	12	16	
<b>Flight projects delivered to the ISS NL</b>	0	8	29	
<b>Results published in scientific journals</b>	0	2	0	
<b>Products or services created</b>	0	0	1	

**Contributions to Scientific Knowledge — Results Published in Scientific Journals**

Two papers resulting from CASIS-sponsored payloads were published on March 30, 2015—details not included in the Q2 FY2015 report due to time constraints.

CITATION	DESCRIPTION
Countryman SM, Stumpf MC, Crow SP, Adler FR, Greene MJ, Vonshak M and Gordon DM (2015) Collective search by ants in microgravity. <i>Front. Ecol. Evol.</i> 3:25.	A paper resulting from a STEM education payload that launched on Orb-1 in January 2014, discussing the findings from the "Ants in Space" project: Principal Investigator Stefanie Countryman describes how ants ( <i>Tetramorium caespitum</i> ) perform collective search in microgravity: "In the ISS experiment, the ants explored a small arena in which a barrier was lowered to increase the area and thus lower ant density. In microgravity, relative to ground controls, ants explored the area less thoroughly and took more convoluted paths. It appears that the difficulty of holding on to the surface interfered with the ants' ability to search collectively. Ants frequently lost contact with the surface, but showed a remarkable ability to regain contact with the surface."
Ng JD, Baird JK, Coates L, Garcia-Ruiz JM, Hodge TA and Huang S. (2015) Large-volume protein crystal growth for neutron macromolecular crystallography. <i>Acta Crystallogr F Struct Biol Commun.</i> Apr;71(Pt 4):358-70.	A paper resulting from a foundational project awarded in response a CASSIS solicitation promoting protein crystal growth: Principal Investigator Dr. Joe Ng described lessons learned from growing large-volume protein crystals on the ground in preparation for flight, during their first year of CASSIS-sponsored research. A brief section in the publication reports the preliminary findings of the space-flown experiment (i.e., the production of high-quality, large crystals).

### Commercial Impact — Products or Services Created

TYPE OF PRODUCT	DESCRIPTION
Online web tool	A project awarded in response to a CASSIS-issued solicitation focused on Earth imaging produced a web tool that is now available online: The Hyperspectral Imager for the Coastal Ocean (HICO) Image Processing System (IPS), <a href="http://hypspeedgeo.com/HICO/">http://hypspeedgeo.com/HICO/</a> . Principal Investigator Dr. James Goodman created the HICO IPS, a prototype cloud computing application for on-demand remote sensing image analysis and data visualization. The system can be configured for various remote sensing instruments and applications, providing an adaptable framework for implementing new algorithms and making new applications available to the global user community.

### STEM Education and Outreach Metrics By Quarter

METRIC	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15
<b>STEM projects executed</b>	5	12	9	
<b>Total reach of STEM projects</b>	7,265	7,412	25,320	
<b>CASSIS outreach events</b>				
<b>Trade shows</b>	6	2	7	
<b>Print advertisements</b>	0	0	0	
<b>Total media impact</b>				
<b>You Tube posts</b>	2	2	12	
-Views (cumulative)	10,744	255,875	260,768 (4,893 new)	
<b>Twitter posts</b>	166	235	268	
-Followers (cumulative)	59,058	69,596	74,201	
<b>Facebook posts</b>	123	175	142	
-Likes (cumulative)	4,129	4,622	4,879	
<b>Website visitors</b>	49,254	49,715	66,705	
<b>News releases</b>	10	5	3	

<i>Media events</i>	9	3	7	
<i>News mentions (clips, blogs)</i>	1,379	733	953	
<i>Twitter mentions</i>	620	957	1,134	

## 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)			Crew time (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	538.3	59%	534	116	22%	229	216	15.33	94%
Inc 45/46	988	1140.8	115%	646	113.12	18%	297	296.12	125.5	100%
Inc 47/48	978	1003	103%	326	107.65	33%	356	358.67	59.55	101%

(Data through 6/30/15)

## Q3 FY15 PROJECT PIPELINE

### PROJECTS AWARDED IN Q2 FY15

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	LOCATION	PROJECT DESCRIPTION
Rodent Research-4 Validation Study	Dr. Melissa Kacena	Indiana University School of Medicine	Indianapolis, IN	Validation that mice can successfully undergo an orthopedic surgery (segmental bone defect) and be housed at high densities under conditions similar to that of spaceflight hardware. Validation that mice can successfully undergo an orthopedic surgery (segmental bone defect) and withstand the forces of gravity and vibration experienced during launch as well as the stresses associated with unloading.
Faraday Waves and Instability-Earth and Low G Experiments	Dr. Ranga Narayanan	University of Florida	Gainesville, FL	Study of the instability of an interface between two liquids with different densities under vibrational acceleration (Faraday Instability). This instability is an important way to induce mixing such as in microfluidic processing of pharmaceuticals, as well as a way to dislodge persistent drops or bubbles on surfaces.
The Universal Manufacture of Next Generation Electronics	Supriya Jaiswal	Astrieux	La Jolla, CA	Develop new smaller Extreme Ultraviolet (EUV) optics which will provide the foundation for optical systems used in solar radiation imaging, ground based telescopes, and satellites. These optics will enable illumination systems with higher resolution and more compact design. The long term exposure to the EUV radiation environment of space allows for accelerated degradation testing of these optical materials.
Cyclone Intensity Measurements from the International Space Station (CIMISS)	Dr. A.T. Stair	Visidyne, Inc.	Burlington, MA	Re-flight: Develop technology to measure maximum wind speeds within mature tropical cyclones from the ISS. This platform technology will have great interest for coastal regions at high risk for tropical cyclone landfalls.
Growth Rate Dispersion as a Predictive Indicator for Biological Crystal Samples Where Quality can be Improved with Microgravity Growth (LMM Biophysics 3)	Dr. Edward Snell	Hauptman Woodward Med. Research Institute	Buffalo, NY	Validate the hypothesis that growth rate dispersion could be an indicator of crystals whose quality could be improved in microgravity. Growth rate dispersion is a phenomenon encountered in crystallization where seemingly identical crystals, produced from the same conditions, grow at different rates. It is contended that large growth rate dispersion on the ground is indicative of a sample that should be improved by microgravity growth. Protein crystal growth (PCG) is a foundational element of R&D on ISS for drug discovery, drug formulation, drug delivery, and disease modeling.
The Effect of Macromolecular Transport on Microgravity Protein Crystallization (LMM Biophysics 1)	Dr. Lawrence (Larry) Delucas	University of Alabama at Birmingham	Birmingham, AL	Validate the hypothesis that the improved quality of microgravity-grown biological crystals is the result of two macromolecular characteristics that exist in a buoyancy-free, diffusion-dominated solution: 1) slower crystal growth rates, due to slower protein transport to the growing crystal surface, and 2) predilection of growing crystals to incorporate protein monomers versus higher protein aggregates due to differences in transport rates. Improved understanding of fluid dynamics and reaction kinetics in microgravity will improve mathematical models of PCG that will promote utilization of the ISS for drug discovery.

NDC-3: Chicagoland Boy Scouts and Explorers	Christie Capelety	Three Fires Council of Chicago	Hinsdale, IL	Student experiment titled The Impact of Gravity on Arabidopsis Seedlings and Undifferentiated Cells in Space.
NDC-3: Chicagoland Boy Scouts and Explorers	Norman McFarland	Three Fires Council of Chicago	Chicago, IL	Student experiment titled Effect of Radiation on Salmonella Bacteria.
NDC-3: Chicagoland Boy Scouts and Explorers	Dr. Sandra Rogers	Three Fires Council of Chicago	Whiting, IN	Student experiment titled The Impact of Infrared Spectrometer on Alzheimer's beta-amyloid Peptide.

## GROUND PROJECTS

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS UPDATE
Longitudinal Assessment of Intracranial Pressure During Prolonged Spaceflight	Dr. Clifford Dasco	Baylor College of Medicine	(b) (4)
Viral infection dynamics and inhibition by the Vecoy nanotechnology	Dr. Drew Cawthon	Lovelace Respiratory Research Institute	(b) (4)
Improving Astronaut Performance of National Lab Research Tasks	Dr. Jayfus Doswell	Juxtaporia, LLC	(b) (4)
Generation of Cardiomyocytes from Human iPS Cell-derived Cardiac Progenitors	Dr. Chunhui Xu	Emory University School of Medicine	(b) (4)
Generation of Mesendoderm Stem Cell Progenitors in the ISS-National Laboratory	Dr. Robert Schwartz	University of Houston	(b) (4)

<b>Examine Bone Tumor and Host Tissue Interactions Using Micro-Gravity Bioreactors</b>	Dr. Carl Gregory	Texas A&M Health Science Center	(b) (4)
<b>Microbead Fabrication using Rational Design Engineering</b>	Dr. Brian Plouffe	Quad Technologies	(b) (4)
<b>Optimizing Jammable Granular Assemblies in a Microgravity Environment</b>	Jason Hill	Benevolent Technologies for Health	
<b>Spacecraft-on-a-Chip Experiment Platform</b>	Dr. Mason Peck	Cornell University	
<b>HICO Identification of Harmful Algal Blooms</b>	Dr. Richard Becker	University of Toledo	
<b>Great Lakes Specific HICO Water Quality Algorithms</b>	Dr. Robert Shuchman	Michigan Technological University	
<b>Hyperspectral Mapping of Iron-bearing Minerals</b>	Dr. William H. Farrand	Space Science Institute	

Hyperspectral remote sensing of terrestrial ecosystem carbon fluxes	Fred Huemmrich	University of Maryland	HICO experienced a fatal malfunction shortly after the initiation of this project. (b) (4)
Impact of Increased Venous Pressure on Cerebral Blood Flow Velocity Morphology	Dr. Robert Hamilton	Neural Analytics	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)

## IN PREFLIGHT DEVELOPMENT

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PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	LAUNCH VEHICLE	LAUNCH DATE
Capillary-Driven Microfluidics in Space	Dr. Luc Gervais	1Drop Diagnostics	TBD	
Corrosion Inhibitor Exposed to the Extreme Environments in Space	Lauren Thompson	A-76 Technologies, LLC	TBD	
Materials Testing: The Evaluation of Gumstix Modules in Low Earth Orbit	Dr. Kathleen Morse	Advanced Materials Applications, LLC	SpX-8	9/2/15
Demonstration and TRL Raising of the Net Capture System on the ISS	Ron Dunklee	Astrium North America	TBD	
Use of Boron-Enhanced High-Density Polyethylene for Radiation Shielding — NDC Pilot	Angela Glidewell	Awty International School	TBD; lost during SpX-7 anomaly	
Carbon Dioxide Emissions of Yeast Cells in Microgravity Environment — NDC Pilot	Jessika Smith	Awty International School	TBD; lost during SpX-7 anomaly	
Electrolytic Gas Evolution under Microgravity	Larry Alberts	Cam Med LLC	TBD	
Controlled Dynamics Locker for Microgravity Experiments on ISS	Dr. Scott A. Green	Controlled Dynamics Inc.	TBD	
The Behavior of Slime Molds (Physarum) in Microgravity — NDC Pilot Program	Rev. Brian Reedy	Cristo Rey Jesuit College Preparatory of Houston	TBD	
NDC Pilot Program	Greg Adragna	Cristo Rey Jesuit College Preparatory of Houston	TBD	
The Effects of Microgravity and Light Wavelength on Plant Growth — NDC Pilot	Kathy Duquesnay	Duchesne Academy	TBD; lost during SpX-7 anomaly	
The Effects of Different Wavelengths of Light on Algae Oxygen Production in Microgravity — NDC Pilot	Susan Knizner	Duchesne Academy	TBD; lost during SpX-7 anomaly	

<b>Survivability of Variable Emissivity Devices for Thermal Control Applications</b>	Dr. Hulya Demiryont	Eclipse Energy Systems, Inc.	TBD
<b>Eli Lilly PCG</b>	Kristofer R. Gonzalez-DeWhitt	Eli Lilly and Company	SpX-8 9/2/15
<b>Eli Lilly – RR3 Myostatin</b>	Dr. Rosamund Smith	Eli Lilly and Company	SpX-8 9/2/15
<b>Eli Lilly – Dissolution of Hard to Wet Solids</b>	Dr. Richard Cope	Eli Lilly and Company	TBD
<b>Eli Lilly – Lyophilization</b>	Jeremy Hinds	Eli Lilly and Company	TBD
<b>Development and Deployment of Charge Injection Device Imagers</b>	Dr. Daniel Batcheldor	Florida Institute of Technology	TBD
<b>Materials Testing – Earth Abundant Textured Thin Film Photovoltaics</b>	Dr. Jud Ready	Georgia Institute of Technology	SpX-8 9/2/15
<b>Ultra-Portable Remote-Controlled Microfluidics Microscopy</b>	Dan O'Connell	HNu Photonics	SpX-12 8/24/16
<b>Microenvironment</b>	Dr. Benjamin Malphrus	Honeywell/Morehead State University	TBD
<b>Honeywell/Morehead-DM Payload Processor</b>	Dr. Aleksandar Ostrogorsky	Illinois Institute of Technology	TBD
<b>Detached Melt and Vapor Growth of InI in SUBSA Hardware</b>	Steve Altemus	Intuitive Machines	TBD
<b>Intuitive Machines-ISS Terrestrial Return Vehicle (TRV)</b>	Robert Carlson	JAMSS America, Inc. (JAI)	SpX-9 12/5/15
<b>GLASS AIS TransponderGlobal AIS on Space Station (GLASS)</b>	Dr. Kasthuri Venkateswaran	Jet Propulsion Laboratory/Caltech	SpX-9 12/5/15
<b>Molecules Produced in Microgravity from the Chernobyl Nuclear Accident</b>	Dr. Mary Kearns-Jonker	Loma Linda University	SpX-9 12/5/15
<b>Functional Effects of Spaceflight on Cardiovascular Stem Cells</b>	Dr. Alvar Saenz Otero	Massachusetts Institute of Technology Space Systems Laboratory	yearly
<b>Zero Robotics</b>	Dr. Abba Zubair	Mayo Clinic	SpX-10 2/13/16
<b>Application of Microgravity Expanded Stem Cells in Regenerative Medicine</b>	Dr. Jeff Strahan	Milliken	SpX-8 9/2/15
<b>Milliken/Vertical Burn</b>	Dr. Glaucio Souza	Nano3D Biosciences, Inc.	Orb-6 6/30/16
<b>Magnetic 3D Cell Culture for Biological Research in Microgravity</b>	Michael Johnson	Nanoracks, LLC	HTV5 8/16/15
<b>NanoRacks External Platform</b>	Talbot Jaeger	NovaWurks, Inc.	SpX-8 9/2/15
<b>Zero-G Characterization &amp; OnOrbit Assembly for Cellularized Satellite Tech</b>	Dr. Robert Applegate	Novopyxis	TBD
<b>Map the Penetration Profile of a Contact-Free Transdermal Drug Delivery System</b>	Dr. Alexei Churilov	Radiation Monitoring Devices, Inc.	TBD
<b>Crystal Growth of Cs2LiYCl6:Ce Scintillators in Microgravity</b>	Dr. Florence Gold	Rocky Mountain College	TBD; lost during SpX-7 anomaly
<b>HUNCH Chlorella/Billings Central Catholic High</b>			

<b>Project Meteor</b>	Michael Fortenberry	Southwest Research Institute	TBD; lost during SpX-7 anomaly
<b>Multilab: Research Server for the ISS</b>	Twyman Clements	Space Tango Corp.	SpX-9
<b>Intracellular Macromolecule Delivery and Cellular Biomechanics in Microgravity</b>	Harrison Bralower	SQZ Biotechnologies	TBD
<b>Effects of Microgravity on Stem Cell-Derived Heart Cells</b>	Dr. Joseph Wu	Stanford University	SpX-9
<b>Story Time from Space</b>	Patricia Tribe	T2 Science and Math Education Consultants	Orb-4
<b>MUSES Imaging Platform</b>	Bill Corley	Teledyne Brown Engineering	TBD
<b>Remote controlled nanochannel implant for tunable drug delivery</b>	Dr. Alessandro Grattoni	The Methodist Hospital Research Institute	TBD
<b>Decoupling Diffusive Transport Phenomena in Microgravity</b>	Dr. Alessandro Grattoni	The Methodist Hospital Research Institute	TBD; lost during SpX-7 anomaly
<b>Systemic Therapy of NELL-1 for Osteoporosis</b>	Dr. Chia Soo	UCLA	TBD
<b>Antibiotic Effectiveness in Space-2 (AES-2)</b>	Dr. David Klaus	University of Colorado Boulder	SpX-11
<b>Molecular Biology of Plant Development (Petri Plants) - follow-on flight</b>	Dr. Anna-Lisa Paul	University of Florida	TBD
<b>NIH-Osteo</b>	Dr. Bruce Hammer	University of Minnesota	SpX-9
			12/5/15

## CASIS-SPONSORED PROJECTS LOST IN THE SPX-7 LAUNCH ANOMALY

PROJECT NAME	PRINCIPAL INVESTIGATOR / PROJECT ORIGIN	DESCRIPTION
Project Meteor	Michael Fortenberry, Southwest Research Institute	This project's purpose is to launch a visible spectroscopy instrument for meteor observations. Project Meteor enables monitoring of meteor interaction with the Earth's atmosphere without the interference of ozone absorption. The resultant data would be the first measurement of meteor flux and would allow for remote monitoring of carbon-based compounds in the meteor. Investigation of meteor elemental composition is important to our understanding of the origin and evolution of planets in our solar system.
Microchannel Diffusion	Dr. Alessandro Grattoni, Houston Methodist Research Institute	This investigation's purpose is to examine the mechanisms of chemical transport across nanochannel membranes developed for the delivery of biologically active molecules and nanoparticles as drugs from implants inside the body. This study aims to examine fundamental transport phenomena in a microgravity environment to better understand how to fine tune drug delivery and dosage.
National Design Challenge (NDC)	7 STEM education payloads	Bell Middle School (Golden, CO) aims to evaluate if vermicomposting in a closed system has the same efficiency in microgravity as it does on Earth.  Chatfield Senior High School (Littleton, CO) hopes to establish the viability of algal hydrogen production in space. In specific, the students hope to show that if algae are removed from the gravitational influence of Earth, it will still produce hydrogen in a sulfur deprived environment.  Centaurus High School (Lafayette, CO) aims to study the Effects of Simulated Gravity on Bacterial Lag Phase in a Micro-Gravitational Environment.

		<p>Awty International School (Houston, TX) teacher Angela Glidewell's eighth-grade class aims to evaluate how cosmic radiation poses a serious threat to humans as they continue to inhabit the ISS. The goal is to investigate the feasibility of using Boron-enhanced high-density polyethylene material for shielding against galactic cosmic radiation and solar particle events.</p>
		<p>Awty International School teacher Jessika Smith's fifth-grade class is interested in determining whether yeast cells produce more carbon dioxide in microgravity than on Earth. Through this inquiry, the students hope to help engineers optimize life support systems for spacecraft and understand how yeast cells can be grown in space for medical research.</p>
		<p>Duchesne Academy (Houston, TX) teacher Kathy Duquesney's eighth-grade class aims to evaluate the effects of microgravity and light spectral quality (i.e., color of light) on plant growth in a CubeSat. This experiment is important for understanding how plants with high nutritional content can be grown on Earth in closed environments and on the ISS to support future long-duration spaceflight.</p>
SSEP	25 total student experiments	<p>Duchesne Academy teacher Susan Knizner's fourth-grade students will examine the effect of different wavelengths of light on algae oxygen production in microgravity.</p> <p>CASIS is a national sponsor for the Student Spaceflight Experiments Program (SSEP), in strategic partnership with NanoRacks, LLC. It is a STEM education initiative where students across the country have the ability to design and propose real experiments on the ISS. On SpaceX-7, SSEP was sending 25 total student experiments to the space station.</p>

## CURRENTLY IN ORBIT

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	RETURN VEHICLE	RETURN DATE	STATUS UPDATE
Story Time from Space	Patricia Tribe	T2 Science and Math Education Consultants	N/A	N/A	No on-orbit operations for this quarter.
Windows On Earth	Dan Barstow	T E R C	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.
NCESSE/SSEP (Student Spaceflight Experiments Program) - Odyssey	Dr. Jeff Goldstein	NCESSE/Tides Center	TBD; originally SpX-7	TBD	TBD: CASIS Education and SSEP partnership continues to progress with these payloads, postflight analysis pending.
Bone Densitometer	John Vellinger	Techshot, Inc.	-	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	TBD; originally SpX-7	TBD	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. Science operations expected to be completed FY15 Q4.
National Lab Project: AMS	Dr. Samuel Ting	-	-	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.

National Lab Projects: ISERV	-	-	N/A	N/A	The ISERV camera is currently in stowage on board the ISS awaiting required us response to humanitarian or disaster response.
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**IN POSTFLIGHT ANALYSIS**

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	STATUS UPDATE
Ants in Space, CSI-06	Stefanie Countryman	BioServe Space Technologies	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 <i>Frontiers in Ecology and Evolution</i> is described in the Metrics table "Contributions to scientific knowledge – results published in scientific journals" on page 14. (b) (4)
Antibiotic Effectiveness in Space-1 (AES-1)	Dr. David Klaus	University of Colorado Boulder	(b) (4)
PCG - Crystallization of Human Membrane Proteins in Microgravity	Dr. Stephen Aller	University of Alabama at Birmingham	PI received samples from SpX-4 in October 2014. (b) (4) (b) (4)
PCG - IPPase Crystal Growth in Microgravity	Dr. Joseph Ng	iXpressGenes, Inc.	April, Dr. Ng published a review article in an online journal, described in the Metrics table "Contributions to scientific knowledge – results published in scientific journals" on page 14, that references his CASIS-sponsored project. Two additional papers describing the X-ray and neutron diffraction results, respectively, are in preparation.

(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)
PCG-Crystallization of huntingtin Exon-1 Using Microgravity	Dr. Pamela Bjorkman			California Institute of Technology			
Protein Crystal Growth for Determination of Enzyme Mechanisms	Dr. Constance Schall			University of Toledo			
Cobra Puma Golf Microgravity Electrodeposition Experiment	Mike Yagley			Cobra Puma Golf			
Drug Development and Human Biology: Use of microgravity for drug development	Dr. Timothy Hammond			Veterans Administration Medical Center			
Kentucky Space/Exomedicine Lab - Flatworm	Dr. Mahendra Jain			Kentucky Space, LLC			
T-Cell Activation in Aging-1 and T-Cell Activation in Aging-2	Dr. Millie Hughes-Fulford			Northern California Institute for Research and Education (NCIRE)			
Merck PCG-1 and Merck PCG-2	Dr. Paul Reichert			Merck Pharmaceuticals			
Osteo-4	Dr. Paola Divieti Pajevic			Boston University			

(b) (4)	Novartis Rodent Research-1 and Novartis Rodent Research-2	Dr. David Glass	Novartis Institute for Biomedical Research
(b) (4)	Omega Hydrofuge Plant Growth Chamber - HUNCH Extreme Science - Lakewood	Matthew Brown	Lakewood High School, CO
(b) (4)	Zero Robotics	Dr. Alvar Saenz Otero	Massachusetts Institute of Technology Space Systems Laboratory

The experiment was flown and operated successfully onboard ISS. The student team's payload met its experimental objectives, with on-orbit successful plant growth for 12 days.

The SPHERES hardware on-board the ISS was utilized during Q2 FY15 to support the MIT-CASIS Zero Robotics High School competition. Both crew and hardware performed nominally in the execution of the high school finals.

### COMPLETED PROJECTS

PROJECT NAME	PRINCIPAL INVESTIGATOR	AFFILIATION	PROJECT TYPE	STATUS UPDATE
Molecular Biology of Plant Development (Petri Plants)	Dr. Anna-Lisa Paul	University of Florida	Flight	(b) (4)
Cyclone Intensity Measurements from the International Space Station (CIMISS)	Dr. A.T. Stair	Visidyne, Inc.	Flight	(b) (4)
Testing TiSi2 Nanonet Based Lithium Ion Batteries for Safety in Outer Space	Emily Fannon	EnerLeap	Ground	(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: <a href="http://hyspeedgeo.com/HICO/">http://hyspeedgeo.com/HICO/</a> . 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.
Utilize ISS Energy Systems Data for Microgrid Design and Operation	Nicholas Kurlas	Raja Systems	Ground	(b) (4)

(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)	(b) (4)
Reducing signal interruption from cosmic ray background in neutron detectors	Dr. Andrew Inglis	Silverside Detectors	Ground			
Effects of Simulated Microgravity on c-kit+ Cardiac Stem Cells	Dr. Joshua Hare	University of Miami	Ground			
Exploiting on-orbit crystal properties for medical and economic targets	Dr. Edward Snell	Hauptman-Woodward Medical Research Institute	Flight	This is a collaborative project with Protein BioSolutions (see below).		
Collaborative project-protein crystal growth to enable therapeutic discovery	Dr. Matthew Clifton	Beryllium Discovery Corp.	Flight			
Collaborative project-protein crystal growth to enable therapeutic discovery	Dr. Cory Gerdts	Protein Biosolutions	Flight	This is a collaborative project with Beryllium Discovery Corp. (see above). The payload returned on SpX-4.		
PCG - Crystallization of Medically Relevant Proteins Using Microgravity	Dr. Sergey Korolev	Saint Louis University	Flight			
Commercial space-borne hyperspectral harmful algal bloom (HAB) products	Dr. Ruhul Amin	United States Naval Research Laboratory	Ground	The team has submitted three journal papers, two of which have already been accepted. An additional short article has been accepted for the NRL 2015 Reviews.		
NCESSE/SSEP (Student Spaceflight Experiments Program) - Orion, Falcon, Mixture Tube, Yankee Clipper	Dr. Jeff Goldstein	NCESSE/Tides Center	Flight			

## CONFERENCES AND EVENTS IN Q3 FY15

DATE	EVENT TITLE	LOCATION	AUDIENCE	DESCRIPTION
April 7-8, 2015	Deep Space, Deep Ocean Conference	Houston, TX	Engineers, technologists, and executives from aerospace, oil and gas, and NASA.	Cross-industry collaboration event for the aerospace and energy industries, sponsored by Aramco and NASA JSC.
April 13-16, 2015	31st Space Symposium	Colorado Springs, CO	Space agencies; commercial space businesses; military, national security, and intelligence organizations; cyber security organizations; government agencies/organizations; think tanks; education institutions; space entrepreneurs; and media.	CASIS met with more than 20 key accounts to further develop the aerospace and technology development flight project areas. Attending companies typically develop testbed or TRL-raising projects, and work is currently underway to convert the project ideas into approved project proposals.
April 24, 2015	CASIS Academy Live event	NASA Kennedy Space Center, FL	28 students and 4 teachers from West Shore High School.	Mike Brieden from Intuitive Machines spoke about the Terrestrial Return Vehicle. Brieden talked about teamwork from the Shuttle days and how to find a niche, form a team, find funding, and follow your dreams. Engineering, navigation, fuel systems, and aerodynamics were just some of the topics he went into for his 1.5-hour talk. Students then participated in the "Living in Space" activity, and after lunch they explored Kennedy Space Center Visitors Center.
April 24, 2015	Dow Chemical	Cleveland, OH	Dow Chemical R&D scientists and leadership.	CASIS led a project-concept review session at NASA Glenn Research Center and is now working in conjunction with Implementation Partners and Dow scientists to fully define project scope.
April 27-30, 2015	Industrial Research Institute Annual Meeting	Seattle, WA	Industrial sector C-level executives and R&D leaders.	CASIS engaged with the leaders of the Industrial Research Institute to tap into consumer products, metals and alloys, and industrial applications companies. Growth in this sector is increasing faster than any other sector. Two new active key accounts include Ford and Westinghouse.
May 9, 2015	Zero Robotics webinar and training session	AMF Education Center, FL	Team leads participating in Florida, representing 240 anticipated Florida participants (160 students and 80 adults/teachers).	CASIS brought an Electrical Engineering Fellow volunteer who helped teachers complete their "hour of code" requirement. Each person who completed his or her hour of code received a certificate of completion from the MIT Zero Robotics program.
May 23-25, 2015	Destination Imagination Annual Conference	Knoxville, TN	1,468 teams from across the U.S. and around the world; approximately 19,000 students.	Destination Imagination is a multidisciplinary student competition that takes place at regional, state, country and global levels. Students compete across seven challenge areas ranging from technical, scientific, structural, fine arts, improvisational, and service learning. Students are encouraged to improve creative and critical thinking skills while the challenges reinforce team building and project management skills. The events involve 200,000 students annually.

May 24, 2015	NASA Dig Robotics Mining Competition	NASA Kennedy Space Center, FL	Teams of undergraduate and graduate students from 36 colleges and universities across the U.S.	CASIS observed, filmed, streamed on web, and talked to students and mentors, passing out 140 education collateral items to individuals and talking to teams from Alabama (the winners), Chicago, Oregon, Florida Tech, and 8 other schools. CASIS got 50 hits from video streaming in Q3.
June 2, 2015	Smucker's Science Survey	Cleveland, OH	Smucker's R&D scientists and leadership.	Smucker's met at their facility with CASIS and scientists from NASA Glenn Research Center to explore methods of measuring useful data for their materials of interest and develop initial project concepts. The team is now working to finalize experiment design.
June 25, 2015	Destination Station	Tarrytown, NY Manhattan, NY Kenilworth, NJ	Supported 3 major industry days as well as a legislative affairs day and a visit to the New York Stock Exchange (NYSE). The three major industry day locations were BASF (Tarrytown), Civic Hall (Manhattan), and Merck (Kenilworth), and of the events were attended by a variety of C-level executives, scientists, and other key executives and stakeholders. The audience for the NYSE event included approximately 1000 traders and other financial professionals as well as the TV audience watching the "closing bell" on CNBC and the NYSE channel.	<p>The first industry day took place at BASF, a Fortune 100 company ranked 75th of top worldwide corporate revenue and the biggest chemical manufacturer in the world. CASIS presented to 100 scientists onsite and broadcast a webinar (orchestrated by BASF) to more than 1000 employees throughout the company. Multiple project concepts are now being developed into proposals.</p> <p>The second location was Civic Hall / Silicon Alley, which is NYC's incubator and accelerator for top technology and life science companies. CASIS participated in a half-day seminar in downtown Manhattan and tapped into a variety of key stakeholder groups:</p> <ul style="list-style-type: none"> <li>• Discussed a sponsored program with the NYC Chief Technology Officer</li> <li>• Engaged Microsoft and discussed sponsored programs and STEM programming</li> <li>• Engaged GE on accelerator programs</li> <li>• Discussed an innovation platform with the Tribeca Disruptor Foundation</li> </ul> <p>The third industry day took place at Merck, where CASIS presented to more than 600 people at their New Jersey Headquarters site as part of a 2-hour plenary. The presentation was also broadcast to 3 other sites. CASIS has now signed a CDA and is working to convert more than a dozen project concepts into full proposals.</p>
June 9, 2015	Low Earth Orbit Commercialization Committee Meeting	NASA HQ, Washington, DC	NASA and CASIS leadership.	Discussed preliminary identification of LEO research areas and technology platforms with shared public-private benefit. Focused on identifying and selecting areas with significant revenue potential for future LEO human platforms utilizing broader community input (industry, academic, OGA) to make those selections.
June 15-18, 2015	Destination Station	Philadelphia, PA	R&D scientists and leadership.	CASIS supported the event via multiple presentations and by involving companies from the BIO Conference.

June 15-18, 2015	BIO International	Philadelphia, PA	BIO represents more than 1,100 biotechnology companies, academic institutions, state biotechnology centers, and related organizations across the United States and in more than 30 other nations.	CASIS met with 42 life science companies over the 4-day conference. From those meetings, at least 15 potential flight projects have been identified and are currently being developed into proposals. Ongoing follow-up is underway, with the intention of converting many more proposals.
June 26, 2015	CASIS Academy Live event	NASA Kennedy Space Center, FL	40 Youth, ages 8-14, from the Summer STEM Camp "Science Institute of Discovery Inc." from Gifford, Florida.	Retired Astronaut Winston Scott was a guest speaker, and a number of activities used WindowsonEarth.org imagery. The afternoon included an exploration of Kennedy Space Center Visitors Center.
Multiple dates	Local STEM Outreach	Multiple FL locations	Summer camps, Cub Scouts, and disadvantaged students.	In addition to CASIS Academy Live and other formal STEM education events, CASIS also presented to a variety of local groups in Florida.