ISS NATIONAL LABORATORY®

# ISS National Laboratory Q4FY22 Report

Quarterly Report for the Fiscal Year 2022 Period July 1, 2022 – September 30, 2022

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# Q4FY22 Metrics

## ISS NATIONAL LAB UTILIZATION AND OPERATIONS TARGET METRICS

| TARGET METRIC | FY22 Q1 | FY22 Q2 | FY22 Q3 | FY22 Q4 | FY22 Total | FY22 Target | FY22 Stretch |
|---|---|---|---|---|---|---|---|
| FUNDAMENTAL SCIENCE | | | | | | | |
| 1) **Fundamental Science projects selected** | 0 | 4 | 0 | 11 | **15** | **10** | **13** |
| 2) **External funding supporting Fundamental Science users of the ISS National Lab** | 0 | $1M | 0 | $5.4M | **$6.4M** | **$5M** | **N/A** |
| **APPLIED RESEARCH & DEVELOPMENT** | | | | | | | |
| 3) **Applied Research & Development projects selected** | 0 | 4 | 3 | 2 | **9** | **8** | **N/A** |
| 4) **Ratio of external funding to CASIS funding (self-reported) supporting Applied Research & Development users of the ISS National Lab (cumulative)** | 0 | 1:1 | 1:1 | 1:1 | **1:1** | **1:1** | **2:1** |
| **TECHNOLOGY DEMONSTRATION** | | | | | | | |
| 5) **Technology Demonstration projects selected** | 7 | 0 | 2 | 5 | **14** | **12** | **13** |
| 6) **Ratio of external funding to CASIS funding (self-reported) supporting Technology Demonstration users of the ISS National Lab (cumulative)** | 6:1 | 6:1 | 6:1 | 5:1 | **5:1** | **3:1** | **5:1** |
| **EDUCATION & OUTREACH** | | | | | | | |
| 7) **Education & Outreach projects selected** | 0 | 0 | 0 | 7 | **7** | **7** | **9** |
| 8) **Total individuals participating in ISS National Lab Education & Outreach programs and projects (self-reported)** | 2,188,101 | 3,212,320[a] | 2,414,481 | 1,766,973 | **9,581,875** | **2M** | **4M** |
| 9) **Total individual users of ISS National Lab online education products (self-reported)** | 4,059,959 | 4,751,858 | 3,747,870 | 5,041,648 | **17,601,335** | **5M** | **8M** |
| **PROPOSAL MANAGEMENT** | | | | | | | |
| 10) **Time from solicitation close to selection/nonselection notification (cumulative)** | 72 days | 56 days | 58 days | 63 days | **63 days** | **≤75 days** | **N/A** |

## ISS NATIONAL LAB UTILIZATION AND OPERATIONS TRACKING METRICS

The following metrics have no target for FY22 but will be tracked internally and discussed in face-to-face meetings with NASA.

| TRACKING METRIC | FY22 Q1 | FY22 Q2 | FY22 Q3 | FY22 Q4 | FY22 Total |
|---|---|---|---|---|---|
| **1) Commercial Service Provider Facility Utilization payloads delivered** | 14 | 10 | 25 | 7 | **56** |
| (a) Percentage of Commercial Service Provider Facility Utilization payloads flown that meet the minimum research objectives | TBD[b] | TBD[b] | TBD[b] | TBD[b] | **TBD[b]** |
| (b) Percentage of Commercial Service Provider Facility Utilization payloads flown that meet the payload integration expectations | 29% | 0% | 24% | 29% | **19%** |
| **2) Education & Outreach payloads delivered** | 0 | 1 | 0 | 0 | **1** |
| **3) Fundamental Science payloads delivered** | 3 | 0 | 0 | 6 | **9** |
| (a) Percentage of Fundamental Science payloads flown that meet the minimum research objectives | TBD[b] | N/A[c] | N/A[c] | TBD[b] | **TBD[b]** |
| (b) Percentage of Fundamental Science payloads flown that meet the payload integration expectations | 33% | N/A[c] | N/A[c] | 0% | **11%** |
| **4) Applied Research & Development payloads delivered** | 0 | 0 | 0 | 2 | **2** |
| (a) Percentage of Applied Research & Development payloads flown that meet the payload integration expectations | N/A[c] | N/A[c] | N/A[c] | 0% | **0%** |
| **5) Technology Demonstration payloads delivered** | 1 | 5 | 0 | 2 | **8** |
| (a) Percentage of Technology Demonstration payloads flown that meet the minimum research objectives | TBD[b] | TBD[b] | N/A[c] | TBD[b] | **TBD[b]** |
| (b) Percentage of Technology Demonstration payloads flown that meet the payload integration expectations | 0% | 20% | N/A[c] | 100% | **38%** |
| **6) Total ISS National Lab-sponsored payloads delivered*** | 18 | 16 | 25 | 17 | **76** |
| **7) Total external funding committed** | $8,092,367[d] | $1,296,969 | $1,113,100 | $7,966,961 | **$18,469,397** |
| **8) Multiplier on CASIS grant funding committed (cumulative)** | 11:1[d] | 9:1 | 6:1 | 4:1 | **4:1** |

| | | | | | |
|---|---|---|---|---|---|
| **9) Funds raised post award and postflight by startup companies with ISS National Lab-sponsored flight projects** | | | | | |
| (a) Funds raised postflight | $554.3M | $52.8M | $40.6M[i] | $10.7M | **$658.4M** |
| (b) Funds raised post award | $580.5M | $61.5M | $40.0M[i] | $32.1M | **$714.0M** |
| **10) Users by new/returning** | | | | | |
| (a) ISS National Lab return users | 5 | 3 | 2 | 8 | **18** |
| (b) ISS National Lab new users | 3 | 5 | 3 | 17 | **28** |
| **11) Users by type** | | | | | |
| (a) Commercial | 8[e] | 2[f] | 2 | 6 | **18** |
| (b) Academic/nonprofit | 0[e] | 5[f] | 3 | 19 | **27** |
| (c) Government agency | 0 | 1 | 0 | 0 | **1** |
| **12) ISS National Lab concepts received** | 60[j] | 116 | 36 | 50 | **262** |
| **13) ISS National Lab proposals received** | 3 | 21 | 70 | 14 | **108** |
| (a) Total proposals with a rating of very good or excellent | 2 | 2[g] | 14[j] | 7 | **25** |
| (b) Proposals not selected with a rating of very good or excellent | 0 | 0 | 1 | 0 | **1** |
| **14) ISS National Lab projects selected** | 8 | 8 | 5 | 25 | **46** |
| **15) Active solicitations** | 3 | 2 | 0 | 1 | **6** |
| **16) Time from selection notification to agreement draft sent to principal investigator (cumulative)** | 51 days | 53 days | 48 days | 44 days | **44 days** |
| **17) New commercial facilities added** | 0 | 0 | 0 | 0 | **0** |
| **18) Commercial facilities (cumulative)** | 24 | 24 | 24 | 24 | **24** |
| **19) New Umbrella User Agreements executed** | 1 | 0 | 0 | 0 | **1** |
| **20) Percentage of Commercial Service Providers that have an active Umbrella User Agreement** | 96% | 96% | 93% | 100% | **100%** |
| **21) Crew time (actual vs. increment pair – 3 months allocation)** | 44% | | 97% | | **73%** |
| **(a) Ascent flight resources** | **Crew-3, SpX-24** | **NG-17** | **Crew-4** | **SpX-25** | |
| Upmass | 80% | 89%[h] | 148% | 134% | **102%** |
| Cold stowage | 21% | 51% | 0% | 82% | **43%** |
| Big bags | 88% | 67% | N/A | 75% | **75%** |

| | | | | | |
|---|---|---|---|---|---|
| Powered lockers | 100% | 0% | N/A[c] | 100% | **67%** |
| **(b) Facility resources (reported in Q2 and Q4)** | **Increment Basis** | | **Increment Basis** | | |
| Commercial facilities | 60% | | 50% | | **55%** |
| JEM airlock | 100% | | 100% | | **100%** |
| Life Sciences Glovebox | 50% | | 67% | | **59%** |
| Microgravity Science Glovebox | 50% | | 170% | | **110%** |
| **22) Number of payloads that did not turnover per the nominal delivery schedule** | 6 | 8 | 2 | 4 | **20** |
| Principal investigators | 0 | 0 | 0 | 1 | **1** |
| Implementation Partners | 6 | 8 | 2 | 2 | **18** |
| CASIS | 0 | 0 | 0 | 0 | **0** |
| NASA | 0 | 0 | 0 | 1 | **1** |
| **23) Number of reflight experiments flown** | 0 | 1 | 0 | 2 | **3** |
| Fundamental Science | 0 | 0 | 0 | 2 | **2** |
| Applied Research & Development | 0 | 0 | 0 | 0 | **0** |
| Technology Demonstration | 0 | 1 | 0 | 0 | **1** |
| Education and Outreach | 0 | 0 | 0 | 0 | **0** |
| Commercial Service Provider Utilization | 0 | 0 | 0 | 0 | **0** |
| **24) Number of payloads ready to fly that were left on the ground due to limited upmass** | 0 | 1 | 0 | 6 | **7** |
| **25) Number of payloads removed from the manifest after the freeze date because the principal investigator/payload could not make the flight** | 2 | 2 | 0 | 5 | **9** |

*Note: Resource data is projected/estimated based on payload requirements in the queue at the start of FY2022.*

*a. Story Time From Space did not submit Q2 numbers in time for the original Q2 report. This number has been updated with the additional data.*

*b. Pending further analysis.*

*c. Not applicable due to zero payloads flying.*

*d. An adjustment was made after Q1 reporting completed to account for Boeing's contribution to MassChallenge as an external funding source. As a result, the Q1 number in the FY22 Q2 report will differ from the Q1 number in the FY22 Q1 report.*

*e. Update from FY22 Q1 report.*

*f. Update: BioServe/U of CO was set to Commercial instead of Academic.*

*g. Update: Cured proposal (rated very good) received and re-rated in Q3 was added to Q2 count.*

*h. Update from FY22 Q2 report.*

*i. FY22 Q3 totals for funds raised post award and post flight have been adjusted to incorporate additional available funding data.*

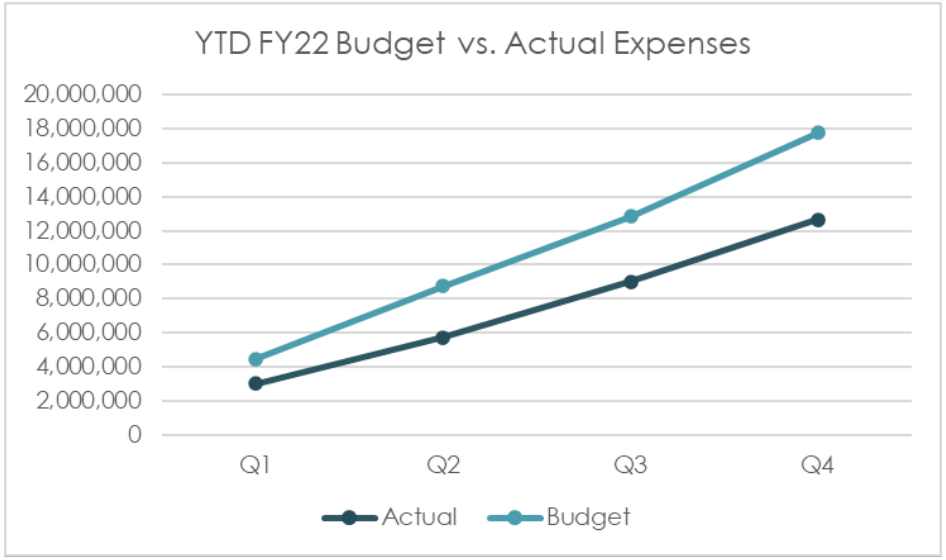
*j. Update from FY22 Q3 report.*

## FINANCIALS

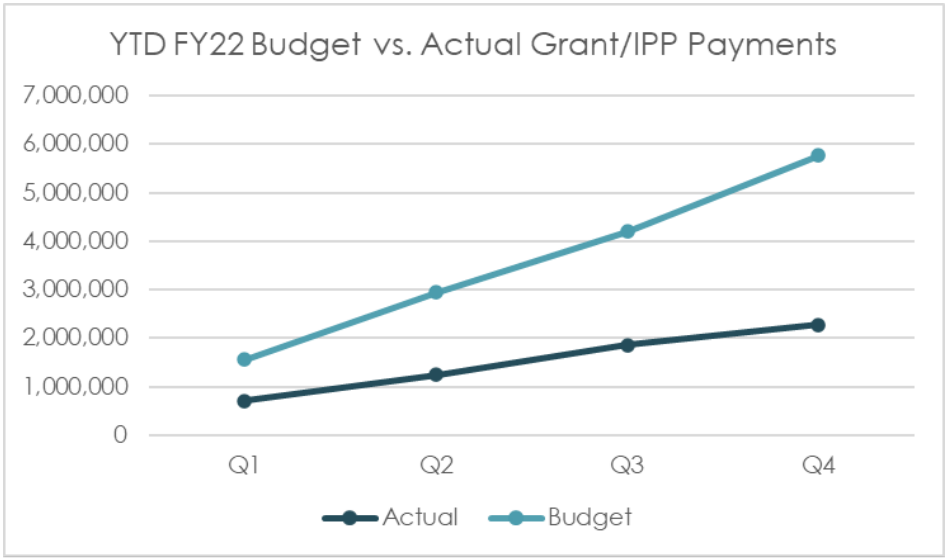
Business Status Report (unaudited)

| Expenses | Q4 Actuals | Q4 Budget | Variance | Actual YTD FY22 | Budget YTD FY22 | Variance YTD FY22 |
|---|---|---|---|---|---|---|
| Direct Labor | $1,913,528 | $2,044,912 | $(131,384) | $6,762,252 | $7,871,208 | $(1,108,956)[a] |
| Subcontracts | $363,975 | $205,886 | $158,089 | $1,223,755 | $1,126,499 | $97,256 |
| Other Direct | $805,858 | $778,477 | $27,381 | $1,737,175 | $1,975,792 | $(238,617)[b] |
| Travel | $72,204 | $235,015 | $(162,811) | $340,584 | $700,570 | $(359,986)[c] |
| Office Supplies and Equipment | $83,881 | $48,334 | $35,547 | $323,938 | $300,083 | $23,855 |
| Grants | $420,852 | $1,570,888 | $(1,150,036) | $2,278,742 | $5,770,803 | $(3,492,061)[d] |
| **Total Expenses** | **$3,660,298** | **$4,883,512** | **$(1,223,214)** | **$12,666,446** | **$17,744,955** | **$(5,078,509)** |

*a. Direct Labor: Headcount of 47 at 9/30/2022 vs a budgeted 56 positions.*
*b. Other Direct: Reduced number of trade show expenses.*
*c. Travel: Lower travel due to reduced headcount and less trade shows and some impact due to COVID variants.*
*d. Grants: Recipient milestone payments shifted based on awardees' actual spend rates and their ability to successfully deliver milestones on schedule as well as a delay in contracting new awards.*




IPP = Implementation Partner Payments




IPP = Implementation Partner Payments

Breakout of ISS National Lab Grants Payments

| | Q1FY22 | Q2FY22 | Q3FY22 | Q4FY22 | FY22 YTD Total |
|---|---|---|---|---|---|
| Academic | $156,577 | $173,093 | $58,422 | $155,740 | $543,832 |
| Commercial | $547,867 | $367,168 | $543,094 | $259,816 | $1,717,945 |
| Other Government Agency | - | - | $11,668 | - | $11,668 |
| **Total** | **$704,444** | **$540,261** | **$613,184** | **$415,556** | **$2,273,445** |

Total Value of Grants Awarded *(i.e., funds committed toward future projects)*

| | ACTUAL Q1 | ACTUAL Q2 | ACTUAL Q3 | ACTUAL Q4 | ACTUAL FY22 |
|---|---|---|---|---|---|
| Total value of grants awarded[a] | $723,157[b] | $296,620 | $779,726 | $3,248,352 | $5,047,855 |

*a. Grants include awards to projects and programs as well as modifications and extensions. The ability to award new grants will be dependent on availability of additional funding for the ISS National Lab.*

*b. An adjustment was made after Q1 reporting completed to account for Boeing's contribution to MassChallenge as an external funding source. As a result, the Q1 number in the FY22 Q2 report will differ from the Q1 number in the FY22 Q1 report.*

Breakout of Cooperative Agreement Funding

| | Q1FY22 | Q2FY22 | Q3FY22 | Q4FY22 | FY22 YTD Total |
|---|---|---|---|---|---|
| Direct | 49% | 60% | 55% | 67% | 58% |
| Indirect | 28% | 20% | 26% | 21% | 24% |
| Grants | 23% | 20% | 19% | 12% | 18% |

## IN-ORBIT ACTIVITIES

- SpaceX's 25th Commercial Resupply Services mission (SpaceX-25) delivered several ISS National Lab-sponsored payloads, including the following (complete details on the SpaceX-25 launch page):
  - Two investigations funded by the U.S. National Science Foundation: a City College of New York project testing eco-friendly ways to create foam and emulsion products and a project from Arizona State University and Rensselaer Polytechnic Institute studying protein aggregation to improve pharmaceutical manufacturing.
  - Two tissue chip investigations funded by the National Institutes of Health: a University of Florida project studying muscle loss and a University of California, San Francisco project studying immune system function in response to aging.
  - Two advanced materials investigations using Aegis Aerospace's MISSE Flight Facility: a Massachusetts Institute of Technology (MIT) project testing a new aerospace electronic textile and a Georgia Tech Research Institute project testing a way to visually assess the integrity of spacecraft materials.
  - A project from Procter and Gamble (P&G) evaluating the stain removal ingredients in the company's Tide to Go Pens and Tide to Go Wipes to help improve consumer products.
  - A student-led experiment through the Genes in Space™ program testing a new method to assess water quality in space that has applications for water quality testing in remote areas on Earth.

## R&D PROGRESS AND SUCCESSES

- A patent was granted to Hewlett Packard Enterprise for a novel electronic cooling system using limited power or coolant that stemmed from the company's Spaceborne Computer investigation.
- The ISS National Lab hosted two subject matter expert workshops at the 2022 ISS Research and Development Conference (ISSRDC): one on the broad area of in-space production applications and another focused on biomanufacturing in space.
- In Q4, 13 new peer-reviewed journal articles were published (view a complete list of peer-reviewed journal publications related to the ISS National Lab at www.issnationallab.org/publications).
  - Ali RH, Kashefi AK, Gorman AC, et al. Automated Identification of Astronauts on Board the International Space Station: A Case Study in Space Archaeology. Acta Astronaut. 2022;200:262-269.
  - Ariane Z, Adam G, Maupin KA, et al. Systemic Effects of BMP2 Treatment of Fractures on Non-Injured Skeletal Sites during Spaceflight. Front Endocrinol. 2022;13:910901.
  - Averesch NJH, Shunk GK, Kern C. Cultivation of the Dematiaceous Fungus Cladosporium sphaerospermum Aboard the International Space Station and Effects of Ionizing Radiation. Front Microbiol. 2022;13:877625.
  - Cordero RJ, Dragotakes Q, Friello PJ, et al. Melanin protects Cryptococcus neoformans from spaceflight effects. Environ Microbiol Rep. 2022;14(4):679-685.
  - Kim M, Waddell KA, Sunderland PB, et al. Spherical gas-fueled cool diffusion flames. Proc Combust Inst. 2022; In Press.
  - Landolina M., Yau A., Chen Y. Fabrication and Characterization of Layer-by-Layer Janus Base Nano-Matrix to Promote Cartilage Regeneration. J. Vis. Exp. 2022;(185).
  - Liang X, Kumar V, Ahmadi F, et al. Manipulation of droplets and bubbles for thermal applications. Droplet. 2022;1(1):1-11.
  - Loughney PA, Mujib SB, Pruyn TL, et al. Enhancing organosilicon polymer-derived ceramic properties. J Appl Phys. 2022;132(7):070901.
  - McCraney J, Kern V, Bostwick JB, et al. Oscillations of drops with mobile contact lines on the International Space Station: Elucidation of terrestrial inertial droplet spreading. Phys Rev Lett. 2022;129(8):084501.

- McCraney, J, Ludwicki JM, Bostwick J, et al. Coalescence-induced droplet spreading: experiments aboard the International Space Station. Phys Fluids. 2022; In Press.
- McMackin P, Adam J, Griffin S, et al. Amyloidogenesis via interfacial shear in a containerless biochemical reactor aboard the International Space Station. npj Microgravity. 2022;8(41):1-8.
- Rampoldi A, Forghani P, Li D, et al. Space microgravity improves proliferation of human iPSC-derived cardiomyocytes. Stem Cell Rep. 2022;17(10):2272-2285.
- Singh SKD, Lu K. Structural evolution and electrical conductivity of $Ti_3C_2$-SiOC ceramics. Mat Sci Eng B. 2022;285:115954.

## LEO ECONOMY

***Demand***

- In Q4, 25 projects were selected:
  - Two from the ISS National Lab Sustainability Challenge: Beyond Plastics funded by Estée Lauder:
    - A project from the Palo Alto Research Center to advance development of aerogel carbon capture sorbents and one from the National Renewable Energy Laboratory to advance a process to upcycle mixed plastic waste to bioplastics.
  - Three from NLRA 2022-5: Technology Advancement and Applied Research Leveraging the ISS National Lab:
    - A project from Johns Hopkins University Applied Physics Laboratory on technology for observation of Earth's ionosphere; one from Kall Morris Incorporated on technology to capture orbital debris; and another from the University of California, San Francisco on tissue engineering and tissue cryopreservation technology.
  - Seven from NLRA 2022-7: Leveraging the ISS National Lab to Enable Digital Engagement for K-12 and Higher Education, which sought applications for programs, products, and public-private partnerships focused on ISS National Lab-related educational objectives:
    - Projects from the Association of Space Explorers, the Institute of Competition Sciences, Magnitude.io, Carthage College, the University of Alabama, Oklahoma State University, and Amateur Radio on the International Space Station.
  - Two from NLRA 2-2022-6: In-Space Production Applications: Advanced Materials and Manufacturing:
    - A project by LambdaVision continuing to advance development of its artificial retina, and a project from Techshot (a Redwire Space company) continuing to advance a platform that enables molecular crystallization for pharmaceutical development.
  - Three from NSF/CASIS 2022 Collaboration on Tissue Engineering and Mechanobiology on the ISS to Benefit Life on Earth, which sought research projects in the field of biomedical engineering:
    - Projects from Tufts University; the University of California, Irvine; and the University of Alabama Birmingham.
  - Eight from NSF/CASIS 2022 Collaboration on Transport Phenomena Research on the ISS to Benefit Life on Earth, which sought projects on fluid dynamics, particulate and multiphase processes, combustion and fire systems, thermal transport processes, and nanoscale interactions (four of these projects are collaborations between two institutions):
    - Projects from the University of California, Santa Barbara; the University of California, Berkeley and Johns Hopkins University; Arizona State University and Texas State University; Portland State University; the University of Washington and Michigan Technological University; Leland Stanford Junior University and the University of California, Berkeley; the University of Notre Dame; and the University of South Carolina.

- Two solicitations opened in Q4: a technology development NLRA and the annual solicitation for the Technology in Space Prize in partnership with Boeing and the MassChallenge startup accelerator program.

***Supply***

- Majority owner and Chairman of the Board for Aegis Aerospace, Stephanie Murphy, was named an honoree for the 2022 Women Who Mean Business awards by the Houston Business Journal.
- The head of U.S. Space Systems at Airbus U.S. Space & Defense, Inc., Debra Facktor, was the keynote speaker for the Women's Breakfast event at ISSRDC 2022.
- Intuitive Machines announced its plans to become a publicly traded company through a merger with Inflection Point Acquisition Corp., a SPAC trading on the Nasdaq exchange.
- An MIT investigation that used Aegis Aerospace's MISSE Flight Facility won first place in the aerospace and defense category of the Tech Briefs Create the Future Design Contest for research on a new electronic textile to protect spacecraft.
- Nanoracks successfully tested the ability of Bishop Airlock to dispose of 172 pounds of waste from the ISS, representing the first open-close cycle of the commercial airlock.

***Investment***

- Continued volatility in the broader financial markets, including slowing venture capital investment activity during Q4, resulted in a modest pace of capital-raising activity by startups in the ISS National Lab ecosystem. Based on publicly available data, $11 million of private and public capital, including grant funding, was raised during Q4 by startups with a completed ISS National Lab flight project. To date, more than $1.8 billion of such startup funding has been raised post-ISS National Lab flight projects.
- The ISS National Lab Investor Network continues to expand, reaching 278 members in Q4. CASIS has facilitated more than 1,200 capital introductions between startups and investors in the ISS National Lab ecosystem.
- ISSRDC included an investor panel discussing the current state of capital access in the space industry and other topics, including opportunities and risks of in-space applications, services and infrastructure investing, and the government's role in supporting private capital engagement.
- The ISS National Lab hosted its seventh annual investor event, showcasing nine promising startups across remote sensing, materials processing, orbital logistics and services, data processing and computing, and R&D instrumentation sectors.

## EDUCATION OUTREACH AND ENGAGEMENT

- The ISS National Lab gained four new STEM education partner programs in Q4: the University of California, San Francisco; SETI; Beyond School Hours; and the National Center for Simulation.
- The Space Station Ambassador program continued to expand, with 86 new members in Q4.
- The ISS National Lab selected five recipients of the inaugural Expedition Space Lab funding opportunity and three recipients of the inaugural James A. Abrahamson Space Leader Fellowship.
- The Genes in Space™ program announced the 2022 competition winner: a North Carolina high school student whose experiment could lead to a better understanding of aging and cancer development.
- ISSRDC featured a STEM education panel discussion on how those inspired through STEM educational experiences inspire others and help foster innovation, and a keynote address from Deputy Secretary of Education Cindy Marten on equality and accessibility in STEM education.
- The ISS National Lab Education team participated in a session during the "Science is Cool Unconference," a virtual event for educators hosted by Space Station Explorers partner program PocketLab that drew more than 13,000 attendees.

## OUTREACH AND STAKEHOLDER ENGAGEMENT

- The 11th annual ISSRDC was held in Washington, D.C., with nearly 800 attendees. The conference featured several notable sessions, including a live downlink from the ISS with astronauts Kjell Lindgren and Jessica Watkins, and a panel discussion with ISS National Lab and NASA leadership on the next decade of space station science.
- The ISS National Lab User Advisory Committee (UAC) held a public meeting at ISSRDC in Washington, D.C. CASIS CEO Ray Lugo and all UAC subcommittee chairs presented updates since the last UAC meeting held in November 2021.
- ISS National Lab public relations outreach highlighting the ISS National Lab-sponsored AstroRad vest investigation launching on Artemis-1 led to pick-ups by outlets such as MarketWatch, Yahoo Finance, Associated Press, and MarketsInsider.
- ISS National Lab staff participated in several speaking engagements, including:
  - A panel session on Tissue Chips in Space at the Committee on Space Research (COSPAR) 2022 General Assembly; An invite-only roundtable on the future of in-space chemistry at the American Chemical Society's Fall 2022 meeting; A session on biomanufacturing in low Earth orbit at the Association of University Research Parks (AURP) 2022 International Conference.

## ADDITIONAL UPDATES

- NASA extended the cooperative agreement with the Center for the Advancement of Science in Space, Inc. to continue management of the ISS National Lab through 2027.
- Former NASA Chief Financial Officer David Radzanowski joined the CASIS board of directors.

# Full Project Pipeline Details

- Visit our project pipeline database for a complete list of ISS National Lab-sponsored projects and programs, including flight status.