



Research Aboard the International Space Station

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Space Life and Physical Sciences



- **NASA's Space Life and Physical Sciences Research and Applications Division (SLPS) has been formulated to execute high quality, high value research and application activities in the areas of:**
 - Space Biology
 - Physical Sciences
 - Human Research
- **These programs conduct fundamental and applied research to advance basic knowledge and to support human exploration in the environment of space.**
- **Division serves as the Agency liaison with the ISS National Laboratory management organization, the Center for the Advancement of Science in Space (CASIS).**

Selection of CASIS to Manage the ISS National Laboratory

NASA released a Cooperative Agreement Notice (CAN) on February 14, 2011 for a non-profit entity “to develop the capability to implement research and development projects utilizing the ISS National Laboratory.” The objectives stated in the CAN included:

- *Identify the unique capabilities of the ISS that provide breakthrough opportunities for non-NASA uses*
- *Identify and prioritize the most promising research pathways*
- *Increase the utilization of the ISS and facilitate matching of research pathways with funding sources*

CASIS was awarded a Cooperative Agreement on August 31, 2011. The Agreement has a planned value of \$15M/year, with a period of performance ending in September 2020.



CASIS Startup Activities

- CASIS began with an interim Board of Directors.
- In 2012, the Interim Chief Scientist, Timothy Yeatman, MD, working with an interim Science Advisory Board, reviewed published results from life sciences research on the ISS and identified initial CASIS research priorities in protein crystal growth and non-embryonic stem cell culture.
- The current CASIS Board was appointed in November 2012. Under Florida state law, it is self-perpetuating – the board is responsible for selecting its successors.
 - Dr. France Córdoba, Chair
 - Dr. Bess Dawson-Hughes, M.D.
 - Dr. Lewis Duncan
 - Dr. Leroy M. Hood, MD
 - Dr. Andrei Ruckenstein
 - Dr. Gordana Vunjak-Novakovic
 - Dr. Howard Zucker

Board of Directors:

The Board continued weekly special meetings throughout the quarter and also conducted its quarterly meeting on June 3, near Johnson Space Center (JSC) in Houston, Texas. The quarterly meeting included attendance by management of the ISS Program Office. In addition, CASIS and NASA leadership conducted a networking meeting with members of the Baylor College of Medicine to discuss a partnership approach to high-throughput omics research on ISS. The next in-person meeting is scheduled for October 27-28 in Washington, DC.

Highlights of the major activities performed by the Board during Q3 include:

- Final interviews and down-select of candidates for the Executive Director position. A final candidate selection is expected to be made near the beginning of Q4 in July.
- Approved and released the CASIS Strategic Plan. The plan formalizes the organization's vision, mission, challenges, strategic goals and objectives for innovation, new capabilities, outreach and operational strategies. It was submitted to NASA for comment.
- The Board Science Committee held a collaborative call with panel experts titled, "Technologies Using the ISS as a Platform", and will continue research on other options and technology-based projects.
- Approved release of the RFP providing an opportunity for Stem Cell Research on ISS.
- Approved additional staff member positions in business development, contracts, and communication, along with a need to align proportional staffing with the goals of the organization.
- Approved response to the Office of the Inspector General draft report regarding ISS utilization.

Business Development:

- Major activities focused on the deployment of a business and partnership ecosystem in Houston, Texas. The ecosystem model enables access to academic institutions, research specific organizations, philanthropic entities, and industry partners localized due to the region's targeted economy and market concentration that have the potential to benefit from use of the International Space Station (ISS) U.S. National Laboratory in areas of research.
- Targeted development activities included leveraging the existing strong ties to the space program, the Houston medical research center, and the oil and natural gas industry to generate business opportunities.
- The Business Development (BD) team continued its work with the Boeing Company to discuss a CASIS/Boeing partnership focused on establishing a Texas innovation accelerator opportunity along with a funded solicitation that would be sponsored by the State of Texas budgeted Emerging Technology Funds. The concept is similar to the MassChallenge model.

Business Development:

- CASIS partnered with Novartis Pharmaceuticals to participate in and provide proof of concept verification science on the initial rodent habitat flight on SpaceX-4. In conjunction with NASA, CASIS operations personnel have coordinated the validation plans for the hardware and crew time to include dissection and appropriate preservation of tissues for valuable muscle wasting research demonstration by the pharmaceutical company. Additional planning is in work for a multi-flight plan for cancer research using the rodent model as well as possible wound healing research in partnership with the DoD.

Operations: CASIS supported the planning, and management of two events to be conducted during the 2013 AAS International Space Station Research and Development Conference in Denver – the Implementation Partner Tradeshow and the New Users’ Workshop.

Payload Development and Integration Updates: The payload development and integration activities for projects scheduled to launch during Increment 37/38 (Sept. 2013 – March 2014) continue on schedule. Newpayload development and integration activities have been initiated for the following new projects:

- Project “Gumstix”, PI Kathleen Morse, Advanced Materials LLC
- Project “Photovoltaic Cell”, PI Jud Ready, Georgia Tech
- Project “NanoMaterials”, PI Alessandro Grattoni, Methodist Hospital Research Institute
- Project “CASID HDPCG-2”, PI Constance Schall, University of Toledo

HEO NAC Subcommittee on Life and Physical Sciences



NASA Advisory Council recommended formation of a research subcommittee of the HEO Committee in March, 2012

Research Subcommittee is chaired by Dr. David Longnecker, MD, of the American Association of Medical Colleges. Members are:

Robert Altenkirch, University of Alabama in Huntsville

Kathy Banks, Texas A&M University

Jeff Hoffman, Massachusetts Institute of Technology

Terri Lomax, North Carolina State University

Stein Sture, University of Colorado

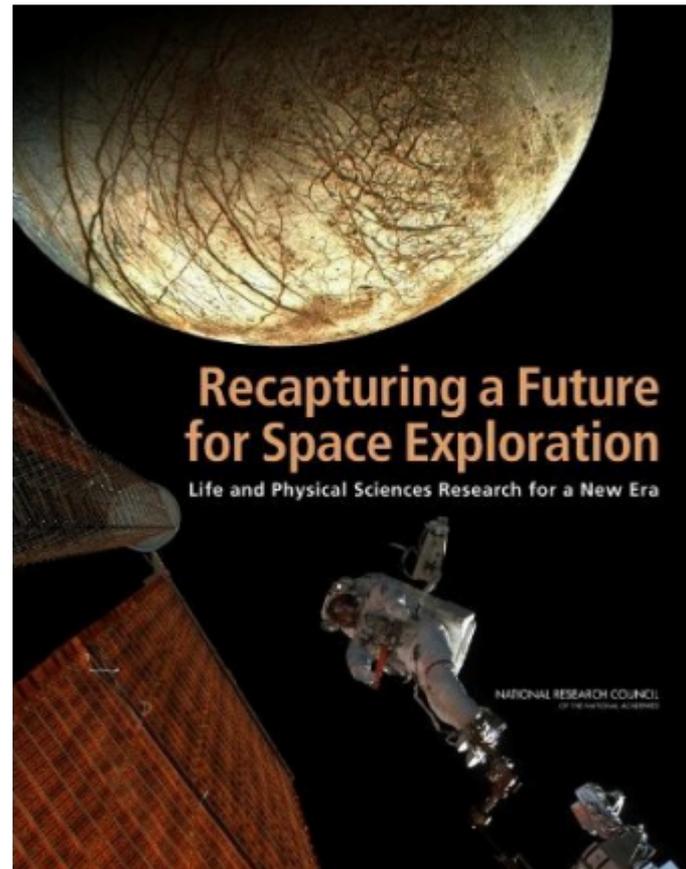
Kathy Thornton, University of Virginia

First meeting of the Research Subcommittee was held in April, 2013, in conjunction with the Spring meeting of the HEO Committee.

Next meeting will be held on July 31, 2013. The subcommittee will review the relationships between research and technology and between human research and space biology in HEO. Main focus now on implementation of new science management strategies based on an “open source science” approach.

Response to the Decadal Survey: Perspectives and Approaches for Going Forward

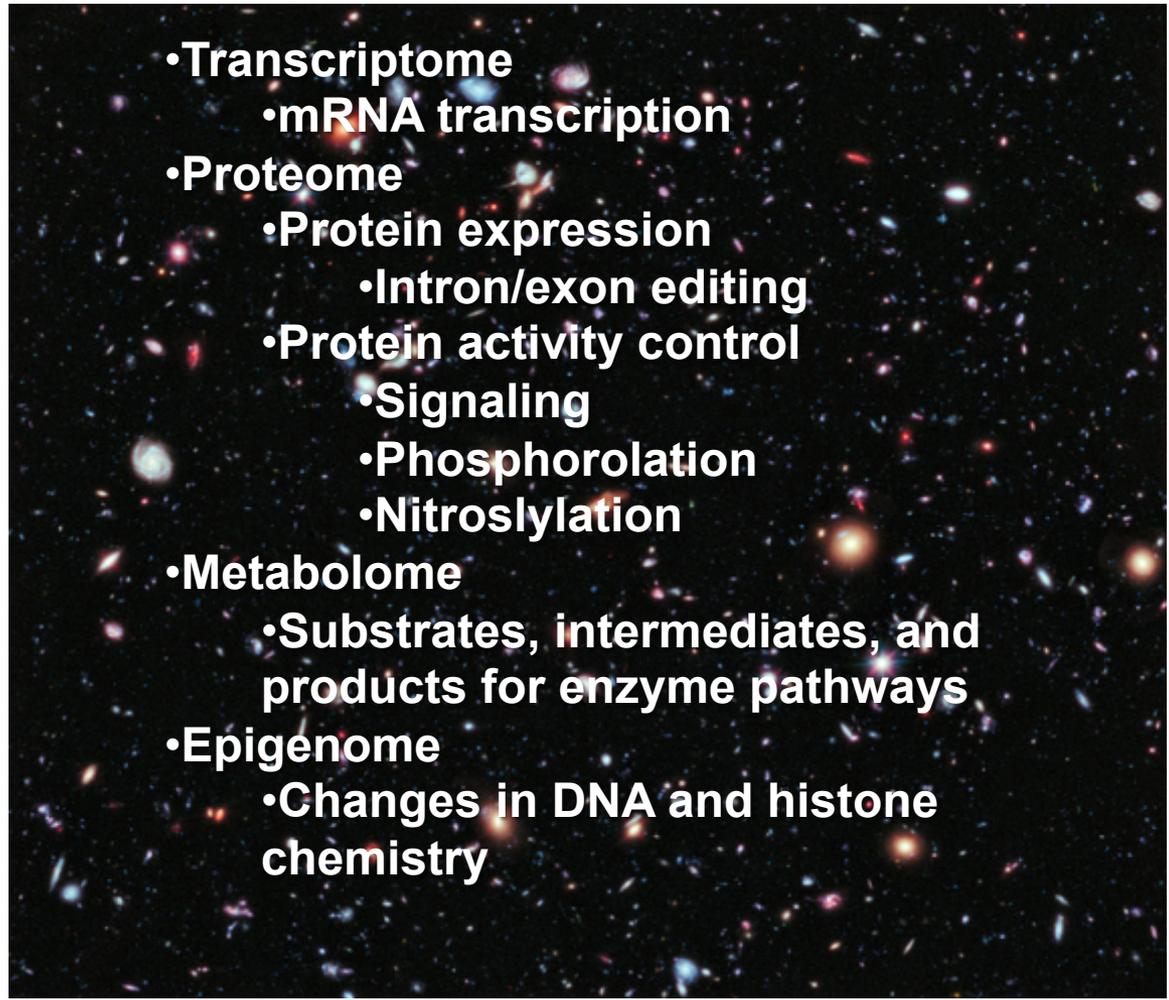
- **NASA Advisory Committee Subcommittee on Life and Physical Sciences Research.**
- **Coordination with Human Research Program to assure overlap in animal models research.**
- **Reorganized International Space Life Sciences Working Group and Joint Working Group for increased international partner collaboration.**
- **Results from evaluation of decadal recommendations adapted into NRAs and new programs.**





The Expressome as the “Telescope for Life Sciences”

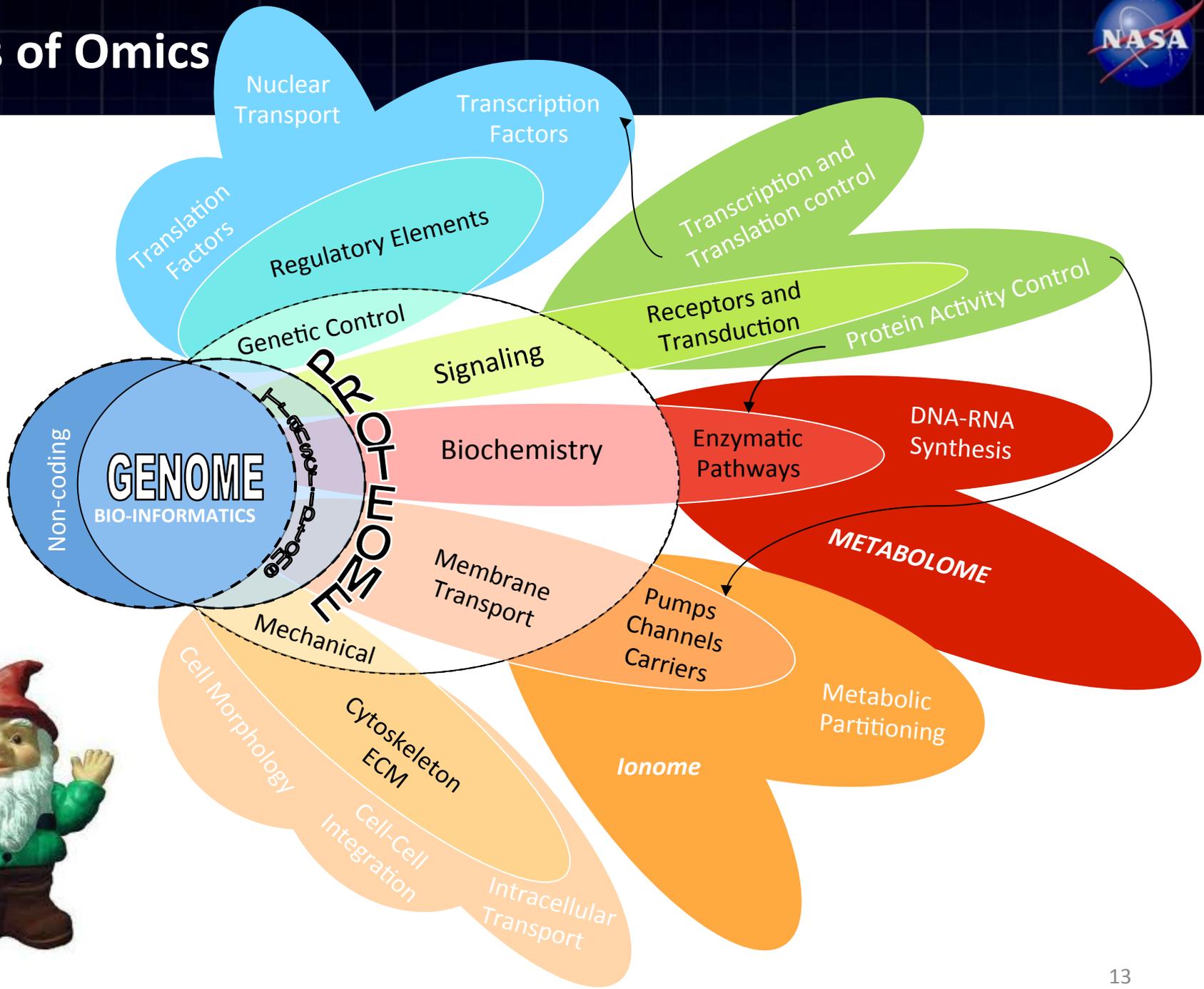
High Content Screening: A Platform for High Density/High Throughput Life Science Utilization of ISS



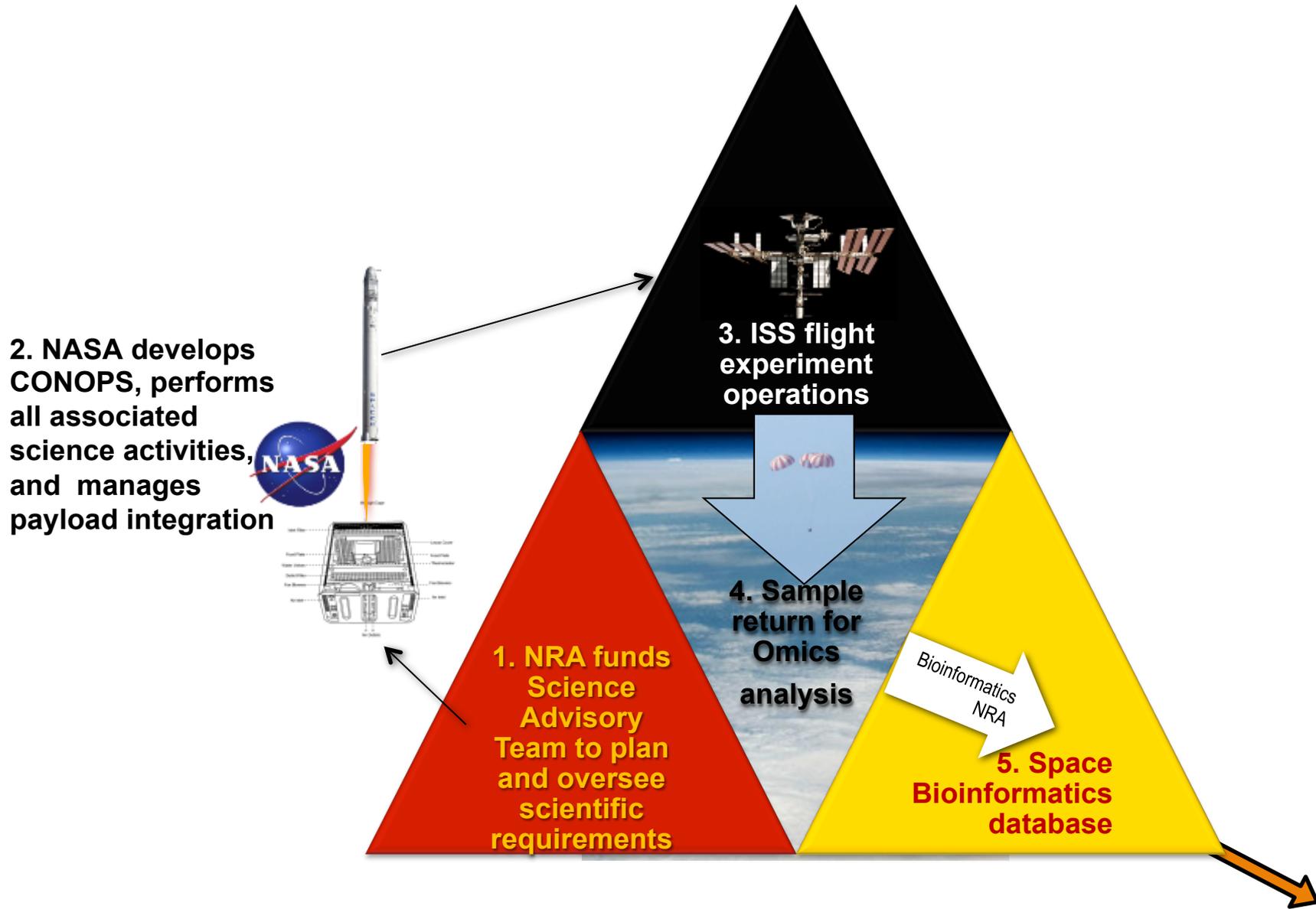
- **Transcriptome**
 - mRNA transcription
- **Proteome**
 - Protein expression
 - Intron/exon editing
 - Protein activity control
 - Signaling
 - Phosphorolation
 - Nitrosylation
- **Metabolome**
 - Substrates, intermediates, and products for enzyme pathways
- **Epigenome**
 - Changes in DNA and histone chemistry

$$\begin{array}{r} \text{Transcriptome} \\ \text{Proteome} \\ \text{Metabolome} \\ + \text{Epigenome} \\ \hline = \text{Expressome} \end{array}$$

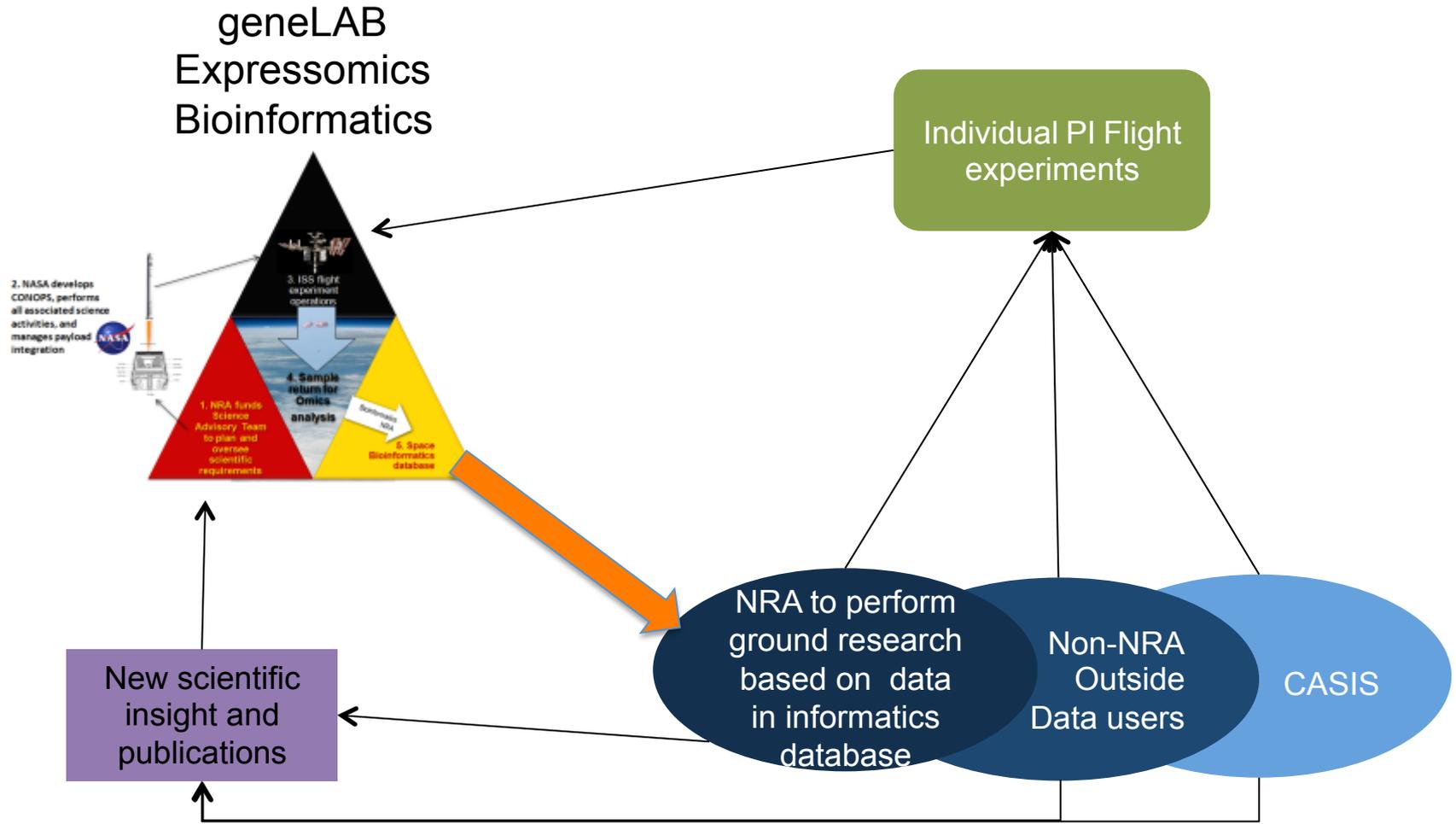
Omics of Omics



geneLAB Science Campaign



geneLAB Supports Multi-Investigator Utilization Open Source Science for ISS Utilization



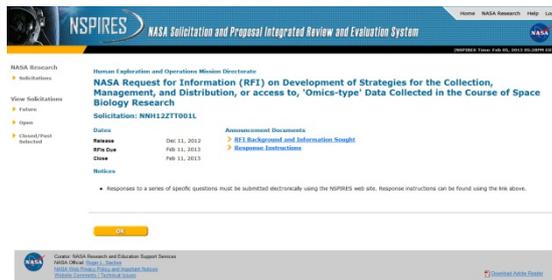


geneLAB Campaign Progress

To move forward with the definition of the geneLAB campaign two efforts have been undertaken:

1. NASA Request for Information (RFI) December 11, 2012:

“Development of Strategies for the Collection, Management, and Distribution, or access to, 'Omics-type' Data Collected in the Course of Space Biology Research”
(NNH12ZTT001L)



2. geneLAB Workshop held at NASA Ames Research Center on January 22, 2013.





geneLAB Next Steps

- ➔ Define an implementation plan for geneLAB
- ➔ Form the Science Definition Team
- ➔ Gain participation from the international partners and other US government agencies
- ➔ Determine how future NRAs and ILSRAs will encompass geneLAB
- ➔ Define the data standards and acquire the data services that are needed to support geneLAB





Questions?

