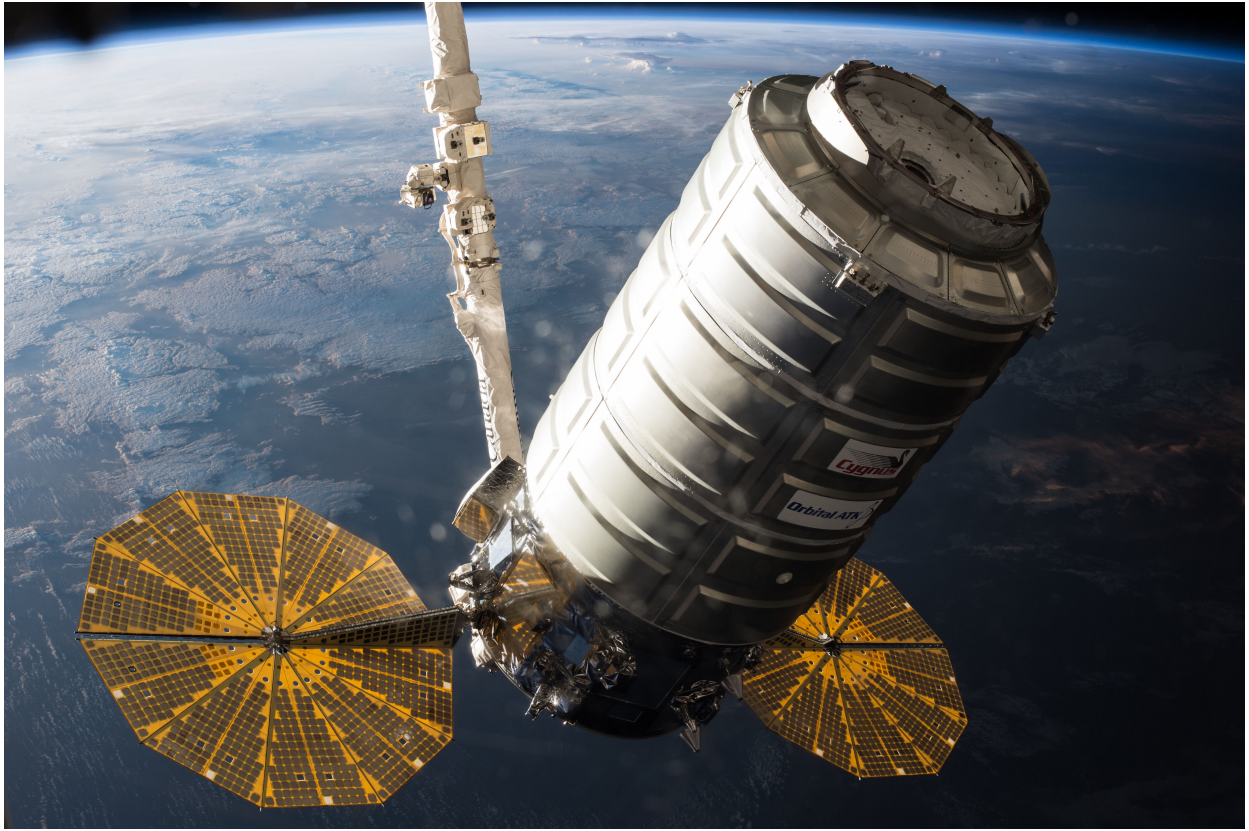
LATEST DELIVERY OF SCIENCE TO THE ISS



ISS
U.S. NATIONAL LABORATORY

NASA CASIS

POWERED THROUGH PARTNERSHIP

WWW.ISS-CASIS.ORG

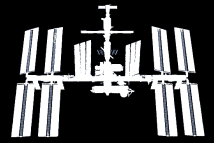
31March 2016

THE ISS NATIONAL LAB
NASA ADVISORY COUNCIL BRIEFING

Gregory H. Johnson, Executive Director
gjohnson@iss-casis.org

THE COOPERATIVE AGREEMENT

CASIS™



IMPROVE LIFE ON

1.2 CASIS Purpose

1.2.1 CASIS Mission

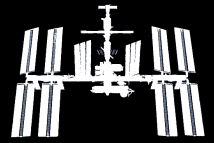
CASIS will be responsible for maximizing the value of the ISS to the nation by developing and managing a diversified R&D portfolio based on U.S. national needs for basic and applied research and by using the ISS as a venue for Science, Technology, Engineering and Mathematics (STEM) educational activities.

1.2.2 CASIS Goals

- Stimulate, develop and manage the U.S. national uses of the ISS by other U.S. government agencies, academic institutions and private firms.
- Develop tools and techniques to communicate the value of uses of the ISS National Laboratory ("ISS NL") and increase the return on the U.S. investment in the ISS.

THE COOPERATIVE AGREEMENT

CASIS™



IMPROVE LIFE ON

2.1 CASIS Responsibilities

2.1.1 Stimulate Interest and Use of the ISS National Laboratory
CASIS will stimulate interest in and use of the ISS NL as a platform for basic and applied research for other U.S. government agencies, academic institutions, and private firms.

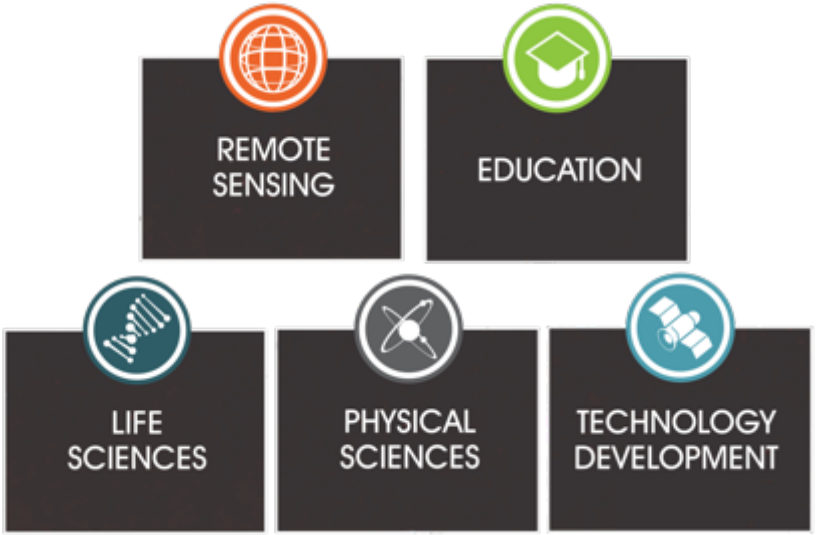
2.1.2 Develop the ISS National Laboratory
CASIS will determine the research objectives that provide the most value to the nation across the breadth of research disciplines and across the range of basic to applied research.

2.1.3 Manage the ISS National Laboratory
CASIS will prioritize the entire NL research portfolio of technology demonstrations, basic, and applied research using a fair, transparent, and impartial selection process that maximizes value of the ISS investment made by the Nation.

THE ISS U.S. NATIONAL LAB

The ISS U.S. National Lab provides opportunity for research and discovery targeted to definitive impacts on Earth.

The opportunities on the ISSNL are wide-ranging:



ISS
U.S. NATIONAL LABORATORY

NASA CASIS
POWERED THROUGH PARTNERSHIP

IMPROVE LIFE ON

CASIS MISSION

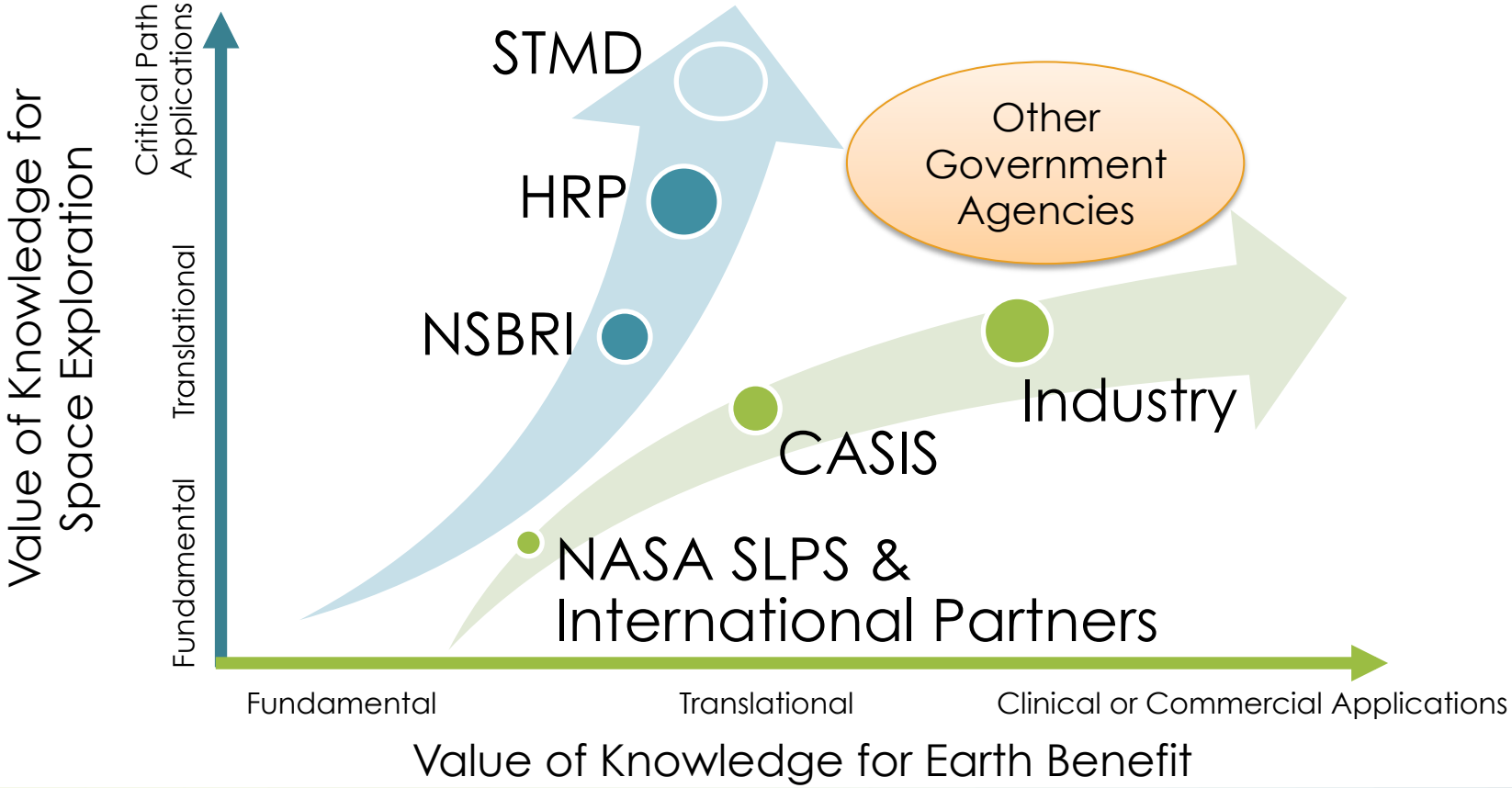
Established as a nongovernment, nonprofit organization in 2011 to:

- *Develop and manage a diverse R&D portfolio on the ISSNL*
- *Stimulate and manage the use of ISSNL by other government agencies, academic institutions, and commercial entities*
- *Communicate the value of the ISSNL, including STEM education, to diverse research communities*

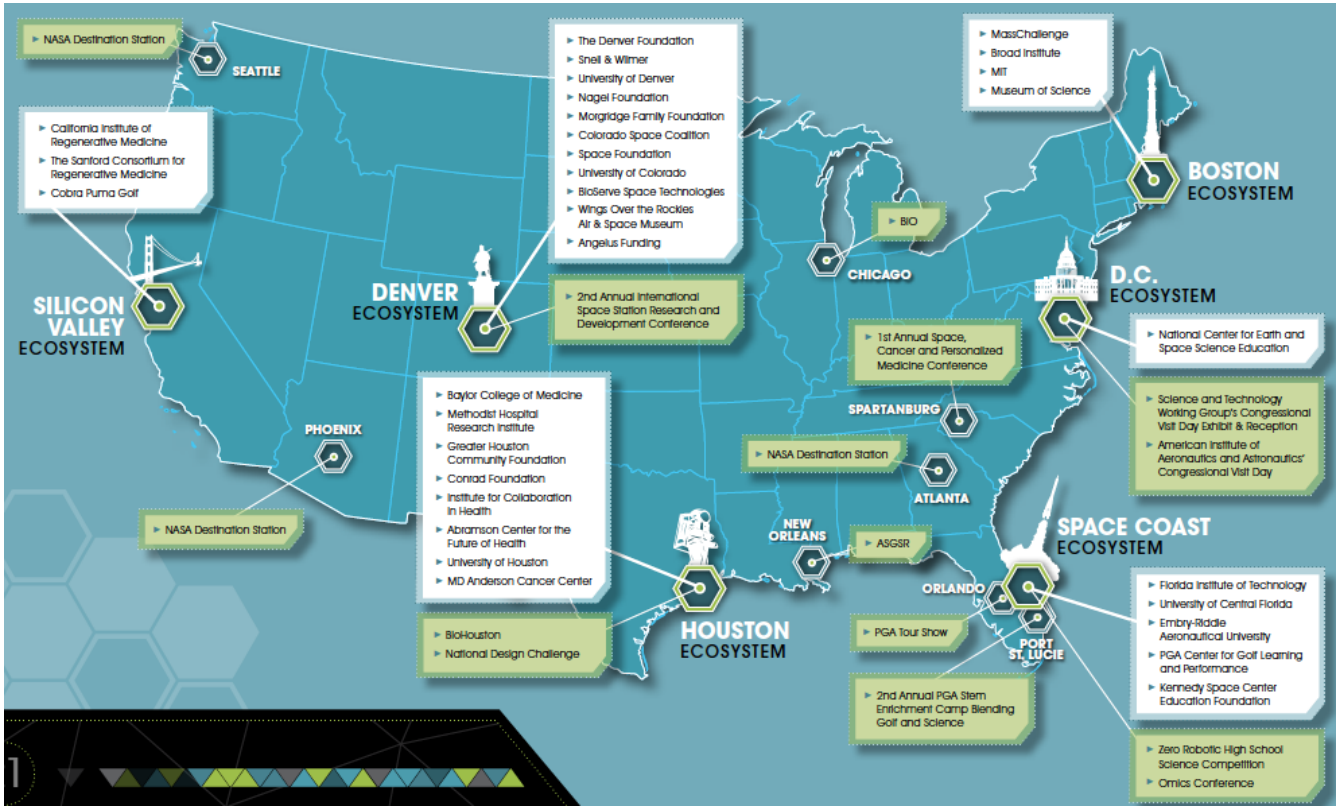
NASA provides:

- *Transportation (commercial resupply services) and on-orbit logistics*
- *At least 50% resource allocation (USOS facilities, hardware, and crew time)*
- *$15M annual funding from NASA HEOMD*

R&D OBJECTIVES OF ISS NATIONAL LAB STAKEHOLDERS



WE BEGAN BY DEVELOPING GEOGRAPHIC ECOSYSTEMS



AND MAPPING INITIATIVES TO EARTH BENEFIT

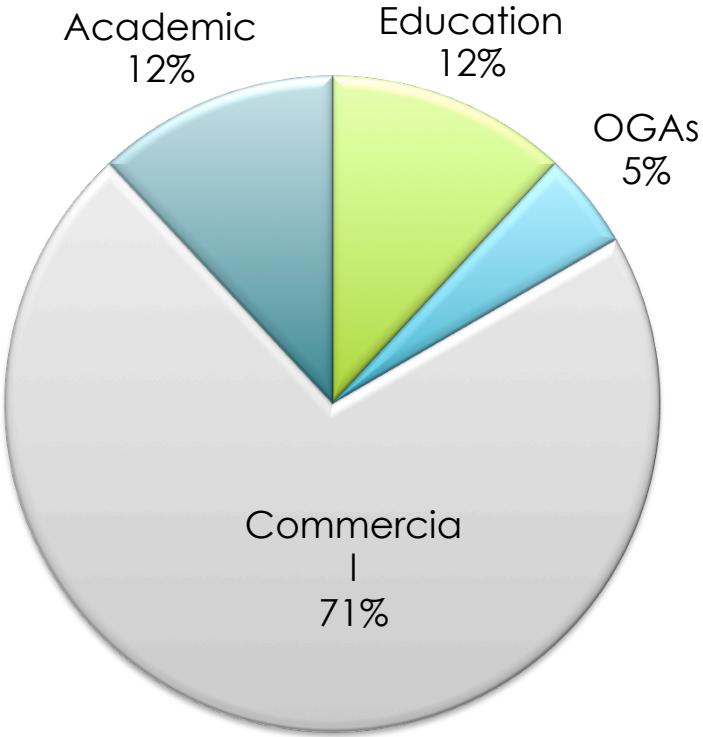
STRATEGIC INITIATIVES

	LIFESCIENCES	PHYSICALSCIENCES	REMOTESENSING	TECHNOLOGY DEVELOPMENT
ECONOMIC IMPACT	Increased Revenue, Job Creation, New Companies, New Markets			
INNOVATION IMPACT	New IP (Patents, Products and Services) and High Impact Science Publications			
STEM IMPACT	Reach, Impact and Diversity			
SOCIETAL IMPACT	• Improved clinical outcomes and lives saved by drug discovery / delivery • New formulations of drugs with better efficacy, shelf life, and stability, and fewer side effects	• Improved flame retardant and semiconductor materials • Improved alloys for engine technologies to reduce emissions • Advanced additive manufacturing	• Disaster mitigation • Optimizing resource management for exploration (e.g., water, energy) and operation (e.g., remote detection of oil and gas leaks) • Better data products from remote sensing	• STEM awareness • Improved data return and communication access to ISS and LEO • TRL advancement for small satellite systems and low power, fault tolerant computers • Virtual / Enhanced Reality technologies

CUSTOMER FOCUSED APPROACH

EVOLVING ISS NATIONAL LAB

- **Commercial engagement** – 71% of FY15 CASIS-sponsored research projects represent commercial companies
- **Robust portfolio** – CASIS has evaluated more than 200 proposals since inception
  - Awarded more than $20M in seed money to ~100 projects
- **Sponsored program model** – Leveraged the financial resources of other outlets with our ability to manifest ISS National Lab flight opportunities
  - NSF – $1.8 million investment a significant step to larger scale funding partnerships
  - NIH – in discussion with the National Center for Advancing Translational Sciences (NCATS)
- **Network building** – Developing/managing partnerships across targeted geographic ecosystems
  - *e.g.,* MassChallenge in Boston, Houston Angel Network in Houston, Space Angels Network in SoCal, Lux Capital in CA



*OGAs – other government agencies

CASIS

WWW.ISS-CASIS.ORG

PIPELINE AND LEO COMMERCIALIZATION

Michael S. Roberts, Ph.D., Deputy Chief Scientist
mroberts@iss-casis.org

CASIS COMMERCIAL SUCCESS: WHO WE ENGAGE

Life Sciences

ACCELERATED DISEASE MODELS: MUSCLE / BONE / WOUND HEALING

Lilly
NOVARTIS
ONCOLINX

DRUG DELIVERY SYSTEMS

Lilly
HOUSTON Methodist LEADING MEDICINE

POINT OF CARE DIAGNOSTICS AND ON CHIP TECHNOLOGIES

NANOBIOSYM Where little things make a big difference
SQZBIOTECH TM
CAMMED
Zaiput Flow Technologies Groundbreaking Innovations in Flow Chemistry
NOVOPYXIS
1DropDiagnostics

DRUG DISCOVERY & DEVELOPMENT (PROTEIN CRYSTALLIZATION)

Lilly
MERCK Be well
iXpressGenes
TATE & LYLE

MICROGRAVITY ENABLED NOVEL MATERIALS

Astrileux
A2M Advanced Materials, Inc.

Physical Sciences

INDUSTRIAL MATERIALS / CONSUMER PRODUCTS

nemak
COBRA PUMA GOLF
Ras Labs We bring motion to life
Milliken
P&G

ADDITIVE MANUFACTURING

DSI DEEP SPACE INDUSTRIES
MADE IN SPACE

Remote Sensing Tech Development

EARTH OBSERVATION

VISIDYNE
gumstix dream, design, deliver
Honeywell

TECH DEMO

Space Tango
ASTRIUM
NovaWurks
Intuitive MACHINES

AND ON THE HORIZON…

Life Sciences

- MedImmune
- The Scripps Research Institute
- Baylor College of Medicine
- Synthetic Genomics
- Salk Institute for Biological Studies
- AstraZeneca
- Merck
- The University of Texas MD Anderson Cancer Center
- Novartis
- Sanofi
- Houston Methodist Leading Medicine

Physical Sciences

- Goodyear
- Cargill
- General Mills
- BASF We create chemistry
- Unilever
- valspar
- Target
- Mars
- GE imagination at work
- Delta
- NALCO Champion An Ecolab Company

Remote Sensing

- Vision Engineering Solutions
- JAMSS America Inc. JAI
- Ursa Space Systems A Geospatial Services Company
- Project Ultra

Technology Development

- Microsoft
- Google
- oculus

PROMOTING LEO ECOSYSTEM DEVELOPMENT

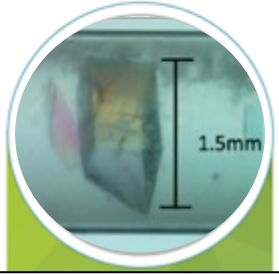
Enabling "demand side" interest alongside NASA, commercial service providers, and other providers of orbital and sub-orbital services

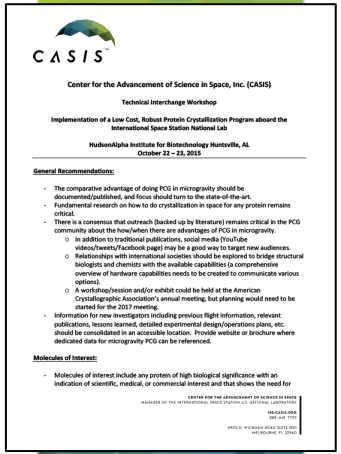
- The CASIS mission is to maximize the value of the ISS to the nation by developing and managing a diversified R&D portfolio based on U.S. national needs for basic and applied research.
  - *CASIS is thus in a position to stimulate demand that could attract business players to invest in building space-based platforms, privately invested infrastructure, and R&D.*
- CASIS is not in this alone, and looks to NASA, other agencies and businesses such as SpaceX, Orbital ATK, Bigelow Aerospace, Nanoracks, and others to help create demand.
  - *Each plays a unique role in promoting LEO ecosystem development.*
  - *Businesses are especially anxious to create demand and show that their investments will create revenue.*

FOCUS AREA: PROTEIN CRYSTALLIZATION

- Why this area?
  - *Significant amount of prior research*
  - *Most traction with industry—already working with Merck and Eli Lilly*
  - *Farther along the "research pathway"*

- Demand will be stimulated by
  - *Offering multi-mission commitments to R&D community, including opportunities to partner with OGA's (e.g., DOE)*





CASIS

Center for the Advancement of Science in Space, Inc. (CASIS)

Technical Interchange Workshop

Implementation of a Low Cost, Robust Protein Crystallization Program aboard the International Space Station National Lab

HudsonAlpha Institute for Biotechnology Huntsville, AL
October 22 – 23, 2015

General Recommendations:

- The comparative advantage of doing PCG in microgravity should be documented/published, and focus should turn to the state-of-the-art.
- Fundamental research on how to do crystallization in space for any protein remains critical.
- There is a consensus that outreach (backed up by literature) remains critical in the PCG community about the how/when there are advantages of PCG in microgravity.
  - In addition to traditional publications, social media (YouTube videos/tweets/Facebook page) may be a good way to target new audiences.
  - Relationships with international societies should be explored to bridge structural biologists and chemists with the available capabilities (a comprehensive overview of hardware capabilities needs to be created to communicate various options).
  - A workshop/session and/or exhibit could be held at the American Crystallographic Association's annual meeting, but planning would need to be started for the 2017 meeting.
- Information for new investigators including previous flight information, relevant publications, lessons learned, detailed experimental design/operations plans, etc. should be consolidated in an accessible location. Provide website or brochure where dedicated data for microgravity PCG can be referenced.

Molecules of Interest:

- Molecules of interest include any protein of high biological significance with an indication of scientific, medical, or commercial interest and that shows the need for

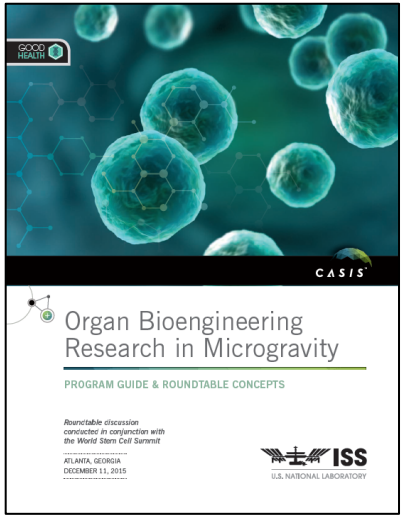
CENTER FOR THE ADVANCEMENT OF SCIENCE IN SPACE
MANAGER OF THE INTERNATIONAL SPACE STATION U.S. NATIONAL LABORATORY
ISS-CASIS.ORG
SMS-AR-7509
4950 W. NICKLAUS ROAD SUITE 500
MELBOURNE, FL 32901

Image courtesy of Dr. Joe Ng

FOCUS AREA: ORGAN/TISSUE BIOENGINEERING

- Why this area?
  - *Value in LEO environment to stem cell research and the organization of cell/tissue structures.*
  - *To date, the demand is mostly among smaller players, but has great potential for larger business.*

- Demand will be stimulated by:
  - *Leveraging ongoing parallel efforts toward the goal of organ bioengineering, including academia, industry, not-for-profit institutes, and OGAs including NIH, DoD, HHS, NIST, NSF, and OSTP.*
  - *3D Microphysiological Systems for Organs-On-Chips Research Challenge, with $1M in CASIS funding*
  - *Vascularization Challenge in collaboration with the Methuselah Foundation, with $500K+ in NASA STMD funding*



FOCUS AREA: ON-ORBIT PRODUCTION

- Why this area?
  - *Superior optical fibers produced in parabolic flights; potential value in manufacturing exotic fibers*
  - *Additive manufacturing in LEO has been demonstrated*
  - *Process to "heal" silicon carbide wafers in LEO*

- Demand will be stimulated by
  - *Partnering with industry through business plan competitions and challenges*
    - *Competitions for the most relevant technologies to solve key industry problems*
  - *Incremental funding to help more proof-of-concept flights for companies that could then attract external capital investment*
  - *Development of new consortia or carve niche within existing collaborations*

ISS
U.S. NATIONAL LABORATORY

NASA CASIS
POWERED THROUGH PARTNERSHIP

SPACE

now closer than you think.

Explore the New Era of Science in Space for Life on Earth.

The International Space Station U.S. National Laboratory is a functioning research laboratory with the tools and facilities you need to translate your ground experiments into flight-ready payloads. Research in space is already advancing research and development (R&D) on the ground that will define tomorrow's world. Join us in this new frontier of discovery, and give your research a competitive edge.

ISS NATIONAL LAB: ***WWW.SPACESTATIONRESEARCH.COM***
CASIS: ***WWW.ISS-CASIS.ORG***