CASIS-sponsored research heads to space station aboard SpaceX-3

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This crew image shows samples from the Advanced Plant Experiments on Orbit - Transgenic Arabidopsis Gene Expression System (APEX-TAGES) study during Expedition 23, similar to the Characterizing *Arabidopsis* Root Attractions (CARA) investigation that will fly during SpaceX-3. Credit: NASA

Riding a dragon is a fantasy many have and few fulfil, but if you're interested in sending research to the International Space Station, the Center for the Advancement of Science in Space (CASIS) can help bring those dreams to life. To clarify, this "dragon" is actually a spacecraft carrying cargo and supplies to the orbiting laboratory and the "ride" is for the research proposed by investigators. This simply adds the magic of discovery to the journey, as knowledge expands with each result from microgravity experimentation aboard the space station.

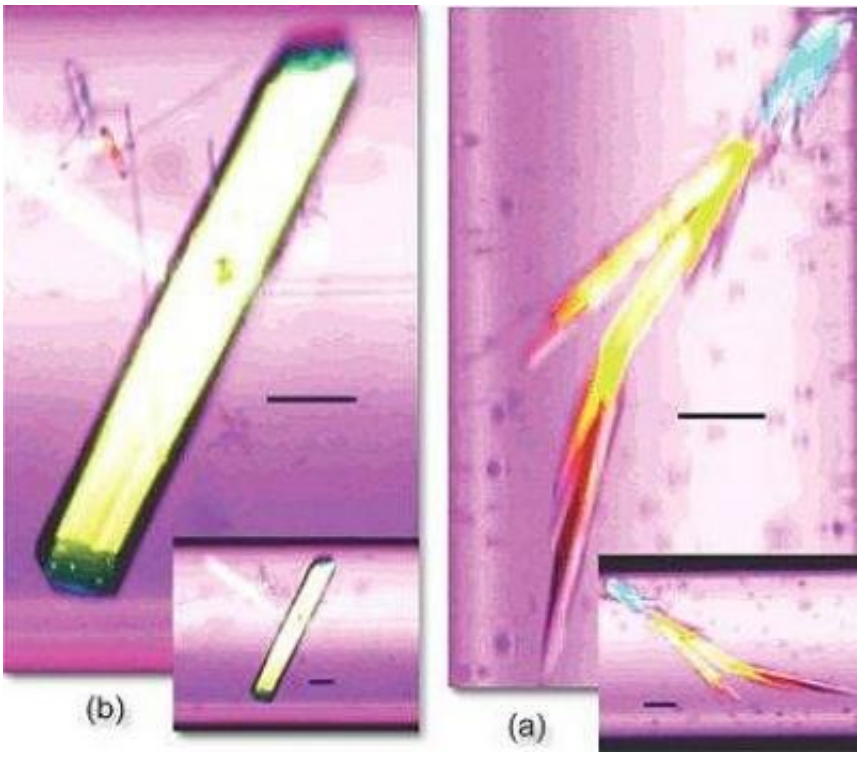
Advancing Research Knowledge 1 (ARK 1) is the first increment marking a series of research payloads being sent to the space station under the CASIS umbrella. The nonprofit manages the U.S. national laboratory aboard the space station to maximize use of the in-orbit research facility. Through a formal solicitation process as well as an unsolicited proposal process, CASIS has pathways whereby new and existing users within academia, industry and other governmental agencies can access the space station for research and technology development for the benefit of life on Earth.

"The role of CASIS is to bring the possibility of conducting related research aboard humanity's greatest technical platform to reality. While the task of CASIS is challenging, the possible success stories have the potential to greatly improve how we live our lives here on Earth," said CASIS Chief Operating Officer, Duane Ratliff.

CASIS works to facilitate and promote innovative research on the station, which is made possible through a strong relationship with NASA and flight providers like Orbital Sciences Corporation and SpaceX. Since its inception in 2011, CASIS has partnered with a network of over 30 flight certified hardware and integration providers or implementation partners, providing the resources needed to transport their research to space.

In January, the first CASIS-sponsored payloads were sent to the space station via Orbital' Cygnus vehicle. The launch marked a historic moment for CASIS, a first glimpse at the actualization of the organization's mission—maximizing utilization of the U.S. national laboratory portion of the space station. These first investigations demonstrate the diverse portfolio of station research CASIS has begun to broker with focuses ranging from education to biology and even fluid physics.

SpaceX is scheduled to launch its Dragon vehicle in late-March, carrying additional CASIS-sponsored research to the space station that complete the ARK 1 studies. The investigations rounding out ARK 1 aboard the Dragon capsule include research into protein crystal growth, which may lead to drug development through protein mapping, and plant biology. The more perfectly grown crystals, made possible in the microgravity environment, assist researchers with mapping and understanding the protein structures.



This is an example of how crystals in a microgravity environment (b) can grow bigger and stronger than those grown on Earth (a). Six separate protein crystal growth studies are slated to launch on SpaceX-3 with the intent on creating a baseline for future experimentation in the research discipline. Credit: Dr. Yoshihiro Urade, Osaka Bioscience Institute

For instance, there is the Crystalline Monoclonal Antibody (Merck PCG) study, which focuses on the protein crystal growth of a human monoclonal antibody currently undergoing clinical trials for treatment of an immunological disease. High-quality crystalline suspensions of the antibodies in microgravity will aid in not only structure determination but also pharmaceutical applications, such as drug delivery and purification/storage of the therapeutic substance.

Next there is the IPPASE Crystal Growth in Microgravity (CASIS PCG GCF-1) investigation, which examines the inorganic pyrophosphatase, or IPPASE, enzyme that is involved in a variety of cell functions. By mapping the crystal growth, researchers may learn more about the enzyme's nature by analyzing detailed structural features.

There are several other investigations heading to the station that are pertinent to human health. The Crystallization of Medically Relevant Proteins Using Microgravity (CASIS PCG GCF-2a) study will focus on producing improved protein crystals of two proteins with multiple functions within cells. The results could assist in the development of various medical interventions. This may include benefits from anticoagulant therapies to drug treatments for cardiovascular disease, diabetes, muscular dystrophy and Parkinson's disease.

The Exploiting On-Orbit Crystal Properties for Structural Studies of

Medically and Economically Important Targets (CASIS PCG GCF-2b) investigation centers on four proteins associated with human disease. These proteins crystallize on Earth but not with sufficient quality and uniformity to determine their structures. The larger, better-organized crystals grown in the microgravity environment of the space station for these specific proteins may impact drug development for Parkinson's disease, bovine spongiform encephalopathy, ethylmalonic aciduri and cutaneous squamous cell carcinoma.

The Crystallization of Huntington Exon 1 Using Microgravity (CASIS PCG HDPCG-1) investigation will examine the protein responsible for Huntington's disease. The structure of this protein remains unknown. Procuring a high-resolution mapping of this protein may have significant scientific and medical impact in understanding the structural basis for neural toxicity and developing treatments for Huntington's disease and other related disorders, such as spinocerebellar ataxia.

The Advancing Membrane Protein Crystallization by Using Microgravity (CASIS PCG HDPCG-2) investigation will study the structure of human membrane proteins. The resulting knowledge may accelerate the commercialization of next-generation drugs to treat AIDS-related dementia, high-cholesterol and a several other diseases and disorders.

The seventh CASIS-sponsored research study heading to the space station is the Molecular Biology of Plant Development in the Space Flight Environment (Characterizing Arabidopsis Root Attractions (CARA)) investigation. This investigation looks to identify the genes involved in plant root morphology and adaptive physiology—in other words, how a root knows which direction to grow when gravity is absent.

These payloads continue to reflect the diversity within the CASIS research and development portfolio and show what's possible for space

station investigations. Research aboard the orbiting laboratory ranges from science, technology, engineering and mathematics education and human research to life, physical and Earth sciences to technology demonstrations. Maintaining a robust and diverse flow of investigations is a critical component to ensuring the space station national laboratory remains accessible to all types of inquiry. As a non-profit, CASIS's goal is to expand beyond a small set of researchers to include all potential investigators whose research has the potential for Earth benefit.

With the conclusion of ARK 1, attention turns to the next research suite of ARK 2. No earlier than May 6, Orbital will launch its second resupply mission to the space station, carrying with it a variety of investigations from the ARK 2 suite. ARK 2 will begin a new chapter in research, creating the capability of enhancing life on Earth: from education payloads to new hardware designed to take advantage of the outside of the station for materials research. Even rodent research investigations are planned for future payloads, to coincide with commercial investigation and drug development.

CASIS's role in ensuring the full use of this national laboratory is far from a fantasy, but has the potential to fulfil the dreams of those with microgravity research aspirations. Taking these dreams to reality—and to space—may in turn change the lives of many of us here on Earth through the advances developed from research results.

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