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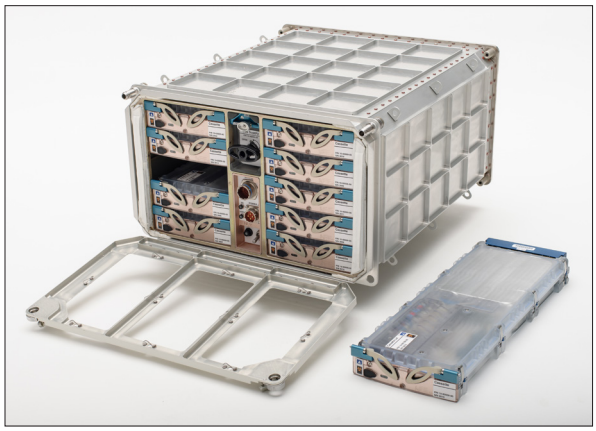
Bioculture System

Advancing cell, tissue, and microbiology spaceflight research aboard the International Space Station

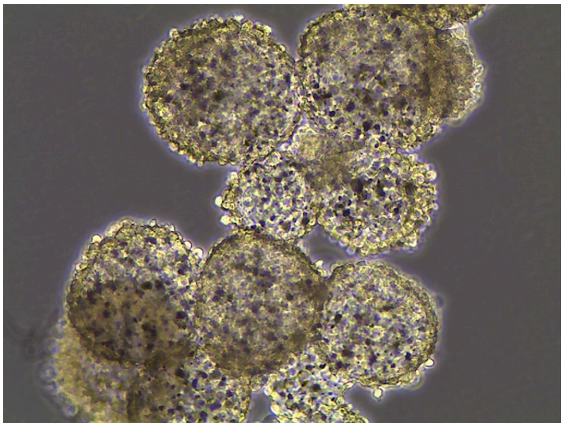
The Bioculture System is a cell biology research platform for the International Space Station that supports short- and long-duration studies involving the culture of living cells, microbes, and tissues in the unique microgravity environment of spaceflight.

Microgravity affects most organ systems of the body. Research conducted in space is essential for us to understand the biological consequences of these effects and to develop countermeasures—procedures, drugs or devices—to protect health. Gaining a deeper understanding of the mechanistic role of gravity in the regulation of biological systems is a high priority research goal for NASA. The Bioculture System supports this goal by broadening the scope of microgravity experiments available to scientists.



Bioculture System shown with one of the Cassettes removed. (Image credit: NASA / Dominic Hart)

Based upon the prior generation Cell Culture Module that flew on 21 space shuttle missions, the new system houses ten independent Cassettes, each of which may run for months aboard the station—far longer than the previous shuttle mission limit of two weeks.



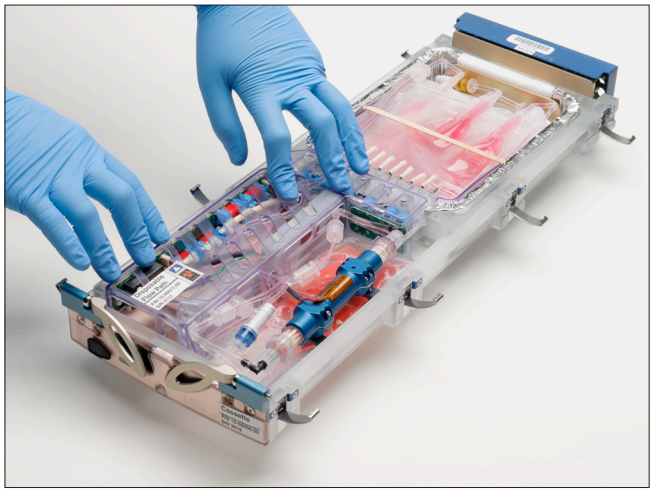
Mouse MLOY4 cells cultured onto GEM microcarrier beads. Similar cultures will be flown in the validation mission. (Image Credit: NASA / Natalya Dvorochkin)

Academic and commercial researchers may use the Bioculture System to study a wide range of biological processes in microgravity that are relevant to human health. These experiments can help us understand how gravity affects the physiology, biochemistry, genetics and gene expression of living cells, tissues and microbes. For example, cells and tissues cultured during spaceflight may be characterized using various “omics” techniques, used for drug discovery and countermeasure analyses, or used to study infectious disease processes. Other possible applications, which are not limited to these examples, include spaceflight studies of tissue engineering, regeneration, and wound healing.

Each Cassette contains a fluidics flow path and biochamber for perfusion-based

Bioculture System *aboard the International Space Station*

culturing and is divided into two independent temperature zones; an incubation zone for the biochamber, and an insulated cold zone for culture medium or other temperature-sensitive solutions and collected specimens. Temperature control is independent for each cassette and the gas supply is shared. A power and command module supplies power and data ports to each Cassette.



Interior view of an incubator Cassette. (Image credit: NASA / Dominic Hart)

Automated functions include 1) user-selected set point pre-programming of temperature settings, fluid flow rate, fluid circulation duration, fluid delivery modes, samplings volume and timeline, and injections volume and timeline and 2) gas supply delivery.

The system supports real-time experiment environment monitoring, hardware commanding, and manual crew operations—including change out of biochambers and fluid bags, sampling, and injections. Cultures may be initiated aboard the station from frozen or liquid stocks.

The system provides containment for biospecimens up to Biological Safety Level 2, and chemicals up to toxicological hazard level 2. The Cassettes will fit into the International Space Station Microgravity Sciences Glovebox for manual operations that require continuous containment or a sterile field.

The Bioculture System is being developed at Ames under the leadership of the Ames Research Center International Space Station Utilization Office and within the Space Biosciences Division. NASA and the Center for the Advancement of Science in Space (CASIS) are developing spaceflight research investigations that will use the Bioculture System.

This project is funded by the International Space Station Program at NASA's Johnson Space Center, Houston, and the Space Life and Physical Sciences Research and Applications Division within the Human Exploration and Operations Mission Director-ate at NASA Headquarters.

The first Bioculture System is scheduled to fly to the station aboard SpaceX-13 in 2017. Station crew will install the system in the U.S. Destiny module. Once installed, the system will be monitored and commanded by ground staff at NASA's Ames Research Center in Moffett Field, Calif.

For more information, visit:
www.nasa.gov/ames/research/space-biosciences

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www.nasa.gov/ames/research/space-biosciences/bioculture-system

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FS-2017-10-07-ARC