# Hearts, airlocks, and asteroids: New research flies on 21st SpaceX cargo mission

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Technicians work on the Nanoracks Bishop Airlock inside the Space Station Processing Facility at NASA's Kennedy Space Center in Florida on Sept. 29, 2020, preparing the facility for its flight to the International Space Station. The first commercially funded airlock for the space station provides payload hosting, robotics testing, satellite deployment, and more. Credit: NASA/KSC

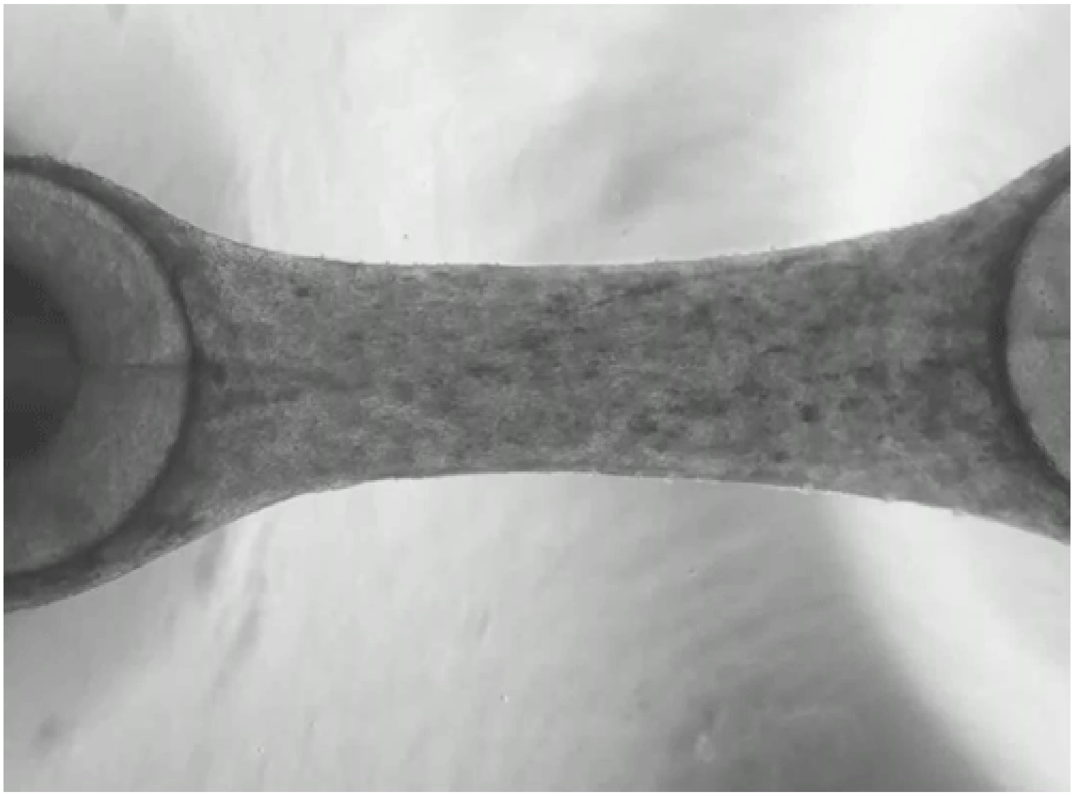
The 21st SpaceX cargo resupply mission that launches from NASA's Kennedy Space Center in Florida carries a variety of critical research and technology demonstrations to the International Space Station.

The mission represents the first on an upgraded version of the company's Dragon cargo spacecraft designed to carry more science payloads to and from the space station.

Highlights of the payloads on this mission include:

## Microbial meteorite miners

A mixture of meteorite samples and microbes are headed to the space station. Certain microbes form layers on the surface of rock that can release metals and minerals, a process known as biomining. A previous investigation from ESA (European Space Agency), BioRock, examined how microgravity affects the processes involved in biomining. ESA follows up on that work with BioAsteroid, which examines biofilm formation and biomining of asteroid or meteorite material in microgravity. Researchers are seeking a better understanding of the basic physical processes that control these mixtures, such as gravity, convection, and mixing. Microbe-rock interactions have many potential uses in space exploration and off-Earth settlement. Microbes could break down rocks into soils for plant growth, for example, or extract elements useful for life support systems and production of medicines.



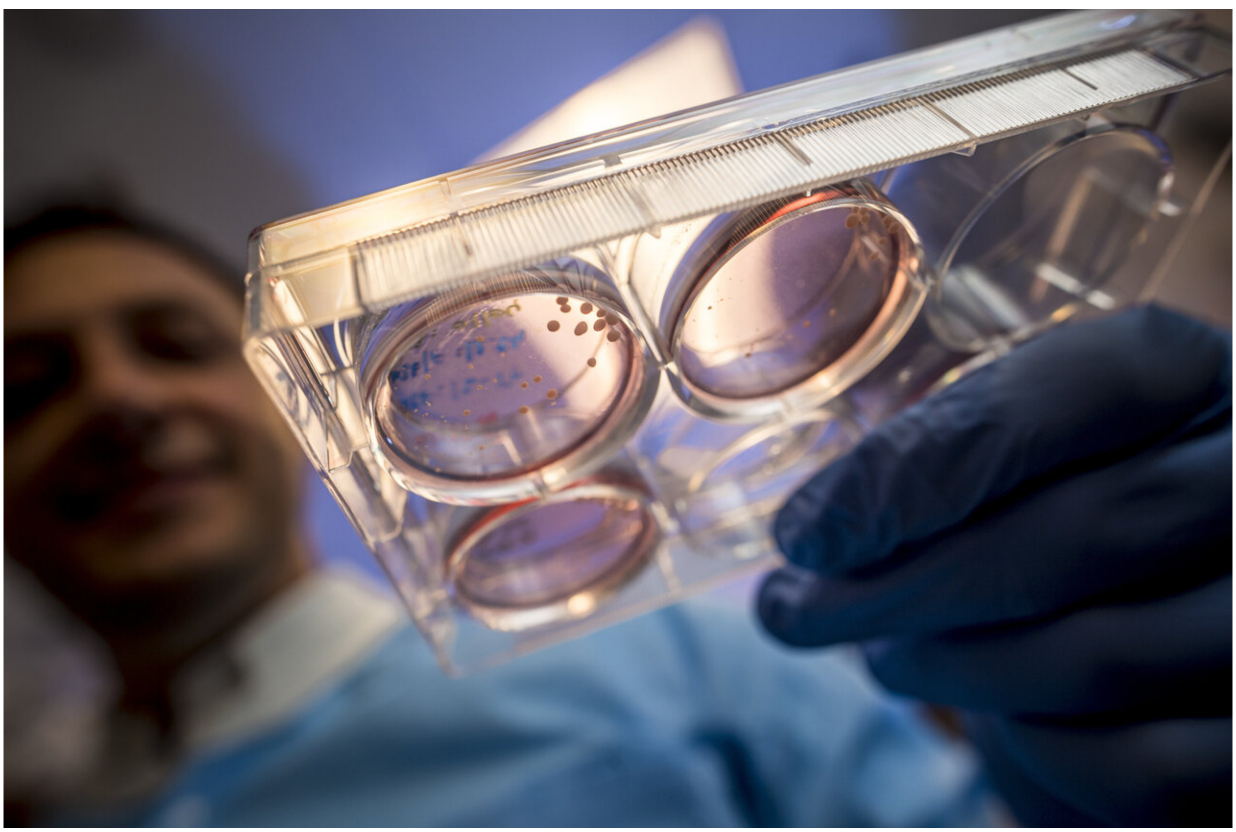
3D engineered heart tissue beats within a tissue chip. Engineered heart tissues will be used in the Cardinal Heart investigation to model pathological processes involved in heart failure. What researchers learn may contribute to discovery of novel therapeutic targets for clinical application. Credit: Stanford/BioServe

## Examining changes in hearts using tissue chips

Microgravity causes changes in the workload and shape of the human heart, and it is still unknown if these changes could become permanent if a person lived more than a year in space. If that were to happen, it is possible it may take the returning astronaut many months to readjust to Earth's gravity. Cardinal Heart studies how changes in gravity affect cardiovascular cells at the cellular and tissue level. The investigation uses 3-D engineered heart tissues (EHTs), a type of tissue chip. Results could provide new understanding of heart problems on Earth, help identify new treatments, and support development of screening measures to predict cardiovascular risk prior to spaceflight.

## Counting white blood cells in space

HemoCue tests the ability of a commercially available device to provide quick and accurate counts of total and differentiated white blood cells in microgravity. Doctors commonly use the total number of white blood cells and counts of the five different types of white blood cells to diagnose illnesses and monitor a variety of health conditions on Earth. Verification of an autonomous capability for blood analysis on the space station is an important step toward meeting the health care needs of crew members on future missions.



Brain organoids being prepared to fly to the space station for the Space Tango-Human Brain Organoids investigation. Credit: UC San Diego/Erik Jepsen

**Building with brazing**

SUBSA-BRAINS examines differences in capillary flow, interface reactions, and bubble formation during the solidification of brazing alloys in microgravity. Brazing is a type of soldering used to bond together similar materials, such as an aluminum alloy to aluminum, or dissimilar ones such as aluminum alloy to ceramics, at high temperatures. The technology could serve as a tool for constructing human habitats and vehicles on future space missions as well as for repairing damage caused by micrometeoroids or space debris.

## A new and improved door to space

Launching in the trunk of the Dragon capsule, the Nanoracks Bishop Airlock is a commercial platform that can support a variety of scientific work on the space station. Its capabilities include deployment of free-flying payloads such as CubeSats and externally-mounted payloads, housing of small external payloads, jettisoning trash, and recovering external Orbital Replacement Units (ORUs). ORUs are modular components of the station that can be replaced when needed, such as pumps and other hardware. Roughly five times larger than the airlock on the Japanese Experiment Module (JEM) already in use on the station, the Bishop Airlock allows robotic movement of more and larger packages to the exterior of the space station, including hardware to support spacewalks. It also provides capabilities such as power and Ethernet required for internal and external payloads.

**Your brain on microgravity**

The Effect of Microgravity on Human Brain Organoids observes the response of brain organoids to microgravity. Small living masses of cells that interact and grow, organoids can survive for months, providing a model for understanding how cells and tissues adapt to environmental changes. Organoids grown from neurons or nerve cells exhibit normal processes such as responding to stimuli and stress. Therefore, organoids can be used to look at how microgravity affects survival, metabolism, and features of brain cells, including rudimentary cognitive function.

Provided by NASA