

Spaceflight Biospecimen and Data Sharing in Support of Science Discovery and Exploration

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For decades, NASA and international partners have conducted biological experiments in space to understand effects of spaceflight and address potential hazards. To enable spaceflight back to the Moon, and then to Mars and beyond, it is imperative to further understand basic science and health risks associated with spaceflight, along with developing countermeasures. The sending of experiments and organisms into space is a costly endeavor. To maximize scientific return, sharing with the scientific community both space-flown biospecimens and data from completed experiments is essential. New fundamental, applied, and bioinformatic science insights can be gained from specimen and data sharing efforts. Data reuse enables spaceflight health risk modeling, analyzing adverse outcomes across spaceflight hazards, and deep space autonomous support for the flight medical officer.

Space-flown biospecimens not required by mission Principal Investigators are regularly archived and made available for scientific request. The largest biorepository of these samples are found within NASA's Institutional Scientific Collection at Ames Research Center (ISC-ARC), which stores over 32,000 specimens mostly from Shuttle and International Space Station (ISS) missions, but also some ground-based analog samples. The Ames Life Sciences Data Archive manages the ISC-ARC. Tissues are predominantly from mice and rats, though samples are also available from bacteria and quail. Only a handful of other similar collections exist worldwide. Rodent biospecimens exposed to simulated space radiation at Brookhaven National Laboratory are archived under the purview of NASA HRP Space Radiation Element. Microbial collection and analyses from 20 years of routine environmental monitoring of air, surfaces, and water systems of the ISS were performed to ensure a safe environment for astronauts. Samples from the ISC-ARC, space radiation and microbial collections are searchable and requestable through the NASA Life Sciences Data Archive (LSDA). Decades of planetary protection microbial isolates derived from spacecraft bioburden are archived in JPL's microbial collection. Rodent biospecimens from spaceflight investigations conducted by the Japan Aerospace Exploration Agency (JAXA) are archived and available at the JAXA Biorepository at Tsukuba Space Center. The Russian Institute of Biomedical Problems also has a collection of animal, microbial, cellular, and fungi available for research from ground analog experiments.

Several data repositories exist for scientists to utilize. The LSDA is the primary NASA source of life sciences research data and information. It contains decades of spaceflight and ground-analog research involving human, microbial, cellular, plant, and animal subjects. Data is collected from NASA-funded investigations through the Human Research Program and the Space Biology Program. The NASA Lifetime Surveillance of Astronaut Health collects and grants access to clinical and occupational health monitoring data from astronauts, with a list and description of data collected available for request through the LSDA. NASA GeneLab at ARC collects genomic, transcriptomic, proteomic, and metabolomic data from any species. It is a repository and platform for collaborative open-science bioinformatic approaches. JAXA is establishing an 'omics-based repository in collaboration with the Tohoku Medical Megabank (ToMMo), called the JAXA-ToMMo Integrated Biobank for Space Life Science. Overall, the sharing of these biospecimen and data resources can assist researchers worldwide in understanding spaceflight effects on biology, along with enabling next generation data science applications for space exploration platforms.

Websites: <https://lsda.jsc.nasa.gov/> ; <https://www.nasa.gov/ames/research/space-biosciences/isc-bsp> ; <https://www.nasa.gov/ames/research/space-biosciences/alsda>