BIOLOGICAL DATA FOR DEEP SPACE MISSION SUPPORT

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Increased biomedical risks and challenges associated with deep space missions (cis-Lunar, Mars transit, Mars surface) require new knowledge discovery and development of novel ecosystem and biomedical support capabilities. This paradigm shift supporting distant and long-duration missions requires biological data to be findable, accessible, interoperable, reusable (FAIR), and maximally open-access (i.e., there is a data governance continuum from closed to mediated to embargoed to open). The NASA "Open Science Data Repositories" (OSDR) aims to meet scientific, technical, and operational spaceflight needs, and offers the ability to upload, download, search, share, analyze, and visualize data across physiological, behavioral, 'omics, and environmental monitoring telemetry datasets. OSDR includes NASA GeneLab, NASA Ames Life Sciences Data Archive (ALSDA), and NASA Biological Institutional Scientific Collection (NBISC).

In the past year, ALSDA has undergone a transformation in its data collection, curation, and architecture methods. Standardizing non-genomic (phenotypic) datasets was, and will continue to be, a challenge because of their diverse nature (e.g., molecular, cellular, tissue, whole organism, behavior; micro-computed tomography, intraocular pressure, fluorescence microscopy, western blot, ultrasonography; tabular, images, video). This year ALSDA, alongside GeneLab, introduced the Biological Data Management Environment (BDME) with the purpose to accept submission of data from space relevant experiments including spaceflight, radiation, simulated gravity, gravitropism, isolation and confinement, hostile closed environments and/or distance from Earth. In addition to bringing together omics, phenotypic, physiological, bioimaging, and behavioral data into one repository. By integrating with GeneLab a multi-project submission portal aims to reduce the burden on PIs submitting data and enabling the discovery of both omics and phenotypic data.

The purpose of ALSDA is to collect, curate, and make all non-human space-relevant biological data maximally findable, accessible, interoperable, and reusable (FAIR). These scope of ALSDA data collected and submitted by PIs include study design metadata, subject metadata, assay metadata (parameters), raw and processed assay data, assay imagery/video, and subject-experienced mission data telemetry (radiation, temperature, humidity, acoustics, vibrations, etc.). In 2021, a community of researchers rallied to form the ALSDA Analysis Working Group (AWG) and provided scientific consensus on dataset sample and assay metadata. The community and excitement around the ALSDA/OSDR system has already led to several data reuse studies, demonstrating value using machine learning (ML), knowledge graphs, and meta-analysis approaches.