

## GeneLab: Open Access Resource for Space Biology

### MISSION

Enabling space exploration through data-driven discovery

### VISION

- Design and deploy a unique repository housing high-throughput molecular data generated from spaceflight and spaceflight-relevant experiments (collectively called “omics” - transcriptomic, proteomic, epigenomic, metagenomic and metabolomics data)
- Partner with spaceflight-relevant projects through sample sharing or augmentation of experiment samples to expand omics analyses on precious spaceflight biological samples
- Make well-curated spaceflight omics data publically available as expediently as possible so that analyses of the data can lead to major advances in countermeasures that will drive human exploration of space as well as benefit life on Earth.

### STRATEGY

Long-duration human exploration of space faces major hurdles including risks to astronaut health as well as challenges in environmental control and life support. NASA initiated GeneLab, a multi-year, multi-phase project, on the premise that mining of omics data from spaceflight experiments offers an immense opportunity to understand the effects of spaceflight on biological systems, and that this can best be accomplished by ensuring open access to this data by as many researchers as possible.

GeneLab collects data from a variety of model organisms. These studies enable queries of how RNA, DNA and proteins, the building blocks of life, adapt and respond to the space environment. Because no single omics analysis can fully unravel the complexities of fundamental systems biology, investigators are designing experiments to provide multiple layers of omics information that can be studied in an integrated fashion to obtain a more complete understanding of how biological systems adapt to spaceflight, leading to translational research.

### GeneLab Data System

The GeneLab Data System (GLDS) is NASA's premier open-access omics data platform for biological experiments. GLDS houses standards-compliant, high-throughput sequencing and other omics data from spaceflight-relevant experiments. GLDS Version 1.0 went online in April 2015. Software updates and new data releases occur at least quarterly. As of October 2016, the GLDS contains 80 datasets and has search and download capabilities. Version 2.0 is slated for release in September 2017 and will have expanded, integrated search capabilities leveraging other public omics databases (NCBI GEO, PRIDE, MG-RAST). Future versions in this multi-phase project will provide a collaborative platform for omics data analysis.

(Continued on back page)





## GeneLab: Open Access Resource for Space Biology (continued)

Data from experiments worldwide, which explore the biological effects of the spaceflight environment on a wide variety of model organisms, are housed in GLDS including data from rodents, invertebrates, plants and microbes. Human datasets are currently limited to those with anonymized data (e.g., from cultured cell lines). The datasets include NASA-funded experiments as well as those funded by other international space agencies. GLDS ensures prompt release and open access to high-throughput genomics, transcriptomics, proteomics, and metabolomics data from spaceflight and ground-based simulations of microgravity, radiation, or other space environment factors. The data are meticulously curated to assure that accurate experimental and sample processing metadata are included with each dataset. GLDS uses an open repository with unrestricted access worldwide; dataset download volumes indicate strong interest of the scientific community in these data

### Partnerships

One of GeneLab's goals is to partner with as many spaceflight missions as possible to maximize the amount of omics data from every spaceflight with biology payloads. Currently GeneLab primarily partners with experiments funded through NASA's Space Life and Physical Sciences (SLPSRA) Division, and with the Center for Advancement of Science In Space (CASIS) on experiments with rodents. The purpose of the partnerships is multifold and can include sample sharing, enhanced omics analyses over the originally designed experiment, or simply data sharing. To date, GeneLab has partnered on multiple experiments including plants, rodents, and microbes. GeneLab optimized protocols in the rodent partnerships for maximum yield of RNA, DNA and protein from tissues harvested and preserved during the SpaceX-4 resupply mission to the International Space Station.

Analyses of GLDS data, which explore the network of molecular responses of terrestrial biology to the space environment, will contribute fundamental knowledge of how the space environment affects biological systems. These analyses will yield benefits both on Earth and for space exploration resulting from mitigation strategies to prevent negative effects observed during exposure to the spaceflight environment.

The GeneLab project team comprises computer scientists, biologists and bioinformaticians at NASA Ames Research Center. Science direction is provided by SLPSRA at NASA Headquarters. Project funding is provided jointly by SLPSRA and the International Space Station Research Integration Office at NASA Johnson Space Center.

For more information about GeneLab go to: <http://genelab.nasa.gov/>

For questions about GeneLab contact: [genelab-outreach@lists.nasa.gov](mailto:genelab-outreach@lists.nasa.gov)

