



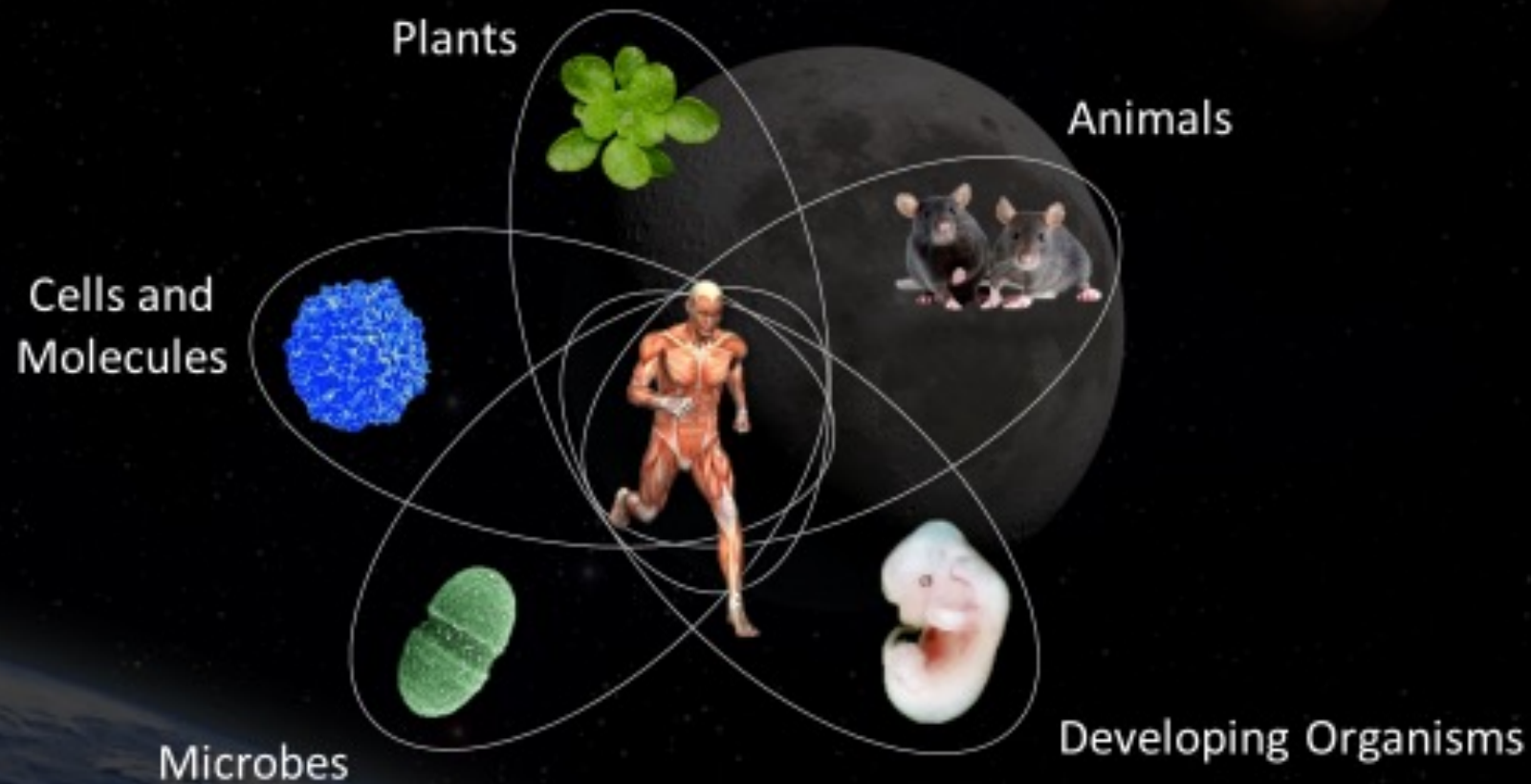
Biological and Physical Sciences

GeneLab: Enabling discovery through Open Science

Jonathan Galazka
GeneLab Project Scientist
NASA Ames Research Center



To pursue safe and successful space exploration
Space Biology investigates five elements:

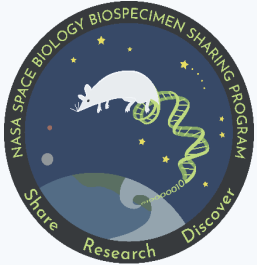


Basic life processes

Applications for human space travel

NASA Biological Open Science Resources

Biospecimen Sharing Program (BSP)



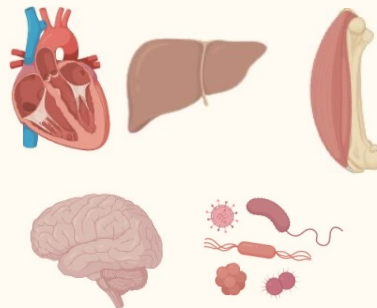
- *Dissects and preserves* rodent tissues from Flight and Ground investigations
- *Coordinates* internal tissue sharing



NASA Biological Institutional Scientific Collection (NBISC)



- *Collection* of non-human specimens and space microbial culture



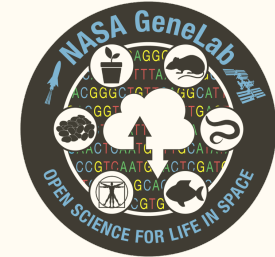
Ames Life Sciences Data Archive (ALSDA)



- *Collects and curates* mission, project and imaging data



GeneLab (GL)



- *Collects and curates* omics data



GeneLab

GeneLab Open Science for Life in Space

Home About Data & Tools Research & Resources Working Groups Help

Keywords

REGISTER NOW for the GeneLab AWG Symposium on June 30th from 10 AM to 2:30 PM PT.

Welcome to NASA GeneLab - the first comprehensive space-related omics database; users can upload, download, share, store, and analyze spaceflight and spaceflight-relevant data from experiments using model organisms.

Data Repository Search and upload spaceflight datasets

Analyze Data Perform large-scale analysis of biological omics data

Environmental Data Radiation data collected during experiments conducted in space

Collaborative Workspace Share, organize and store files

Submit Data Have space-relevant data to submit to GeneLab?

Visualize Data Interact with GeneLab processed data

LATEST NEWS

AWG Symposium 2022

ANALYSIS WORKING GROUP SYMPOSIUM 2022

JUNE 30, 2022, 10 AM - 2:30 PM PT

Leveraging Advances in Modern Science to Revitalize Low-Dose Radiation Research in the United States

AWG member spotlight—Congratulations Dr. Parul Gupta!

AWG charter gets a facelift!

GeneLab Analysis Working Group (AWG)

TRANSCRIPTOMICS

GLDS-402: SOG1 activator and MYB3R repressors regulate a complex DNA damage network in Arabidopsis.

GLDS-457: Expression profiles in multiple tissues of WT and H2G- knockout mouse under space flight

GLDS-432: Expression profiling reveals transcriptional regulation by Fbw7/mTOR pathway in radiation.

GENOMICS (including metagenomics, epigenomics)

GLDS-406: The SOG1 transcriptional activator and the MYB3R family of repressors control a complex gene

GLDS-467: Fungal Diversity associated with space-craft assembly facility (SAF)

GLDS-460: Microbiome profiling of feces from mice flown on the RR-10 mission

PROTEOMICS / METABOLOMICS

GLDS-380: Effects of low dose space radiation exposures on the splenic metabolome

GLDS-482: Transcriptional profiling, protein expression profiling, and phosphoprotein profiling of kidneys from

GLDS-359: Proteome profiling of the exhaled breath condensate after long-term spaceflights

PROCESSED

GLDS-401: Alternative splicing regulates the physiological adaptation of the mouse hind limb postural and phasic

GLDS-379: Transcriptional profiling of livers from mice flown on Rodent Research Reference Mission-1 (RRRM-1)

GLDS-314: Adaptive response of Arabidopsis seedlings in microgravity and Mars reduced gravity environment is

www.genelab.nasa.gov

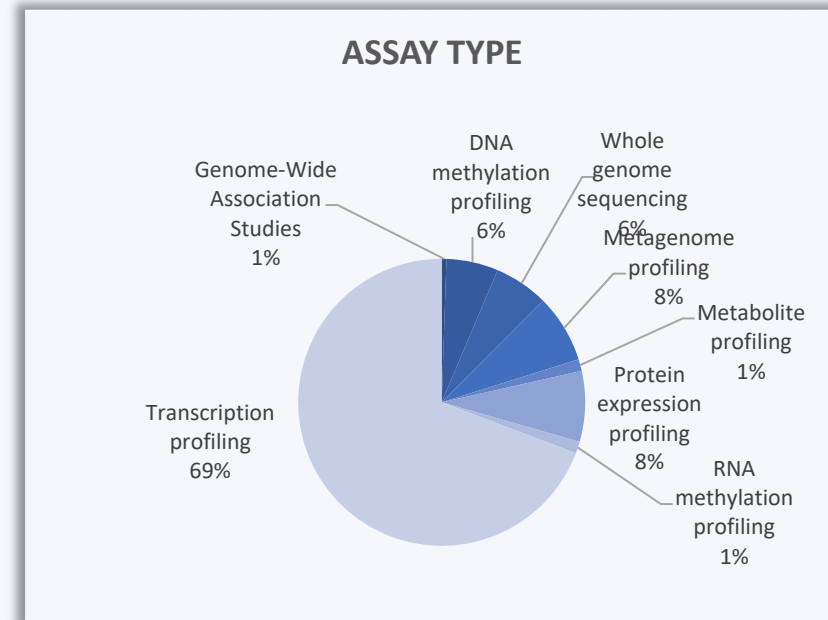
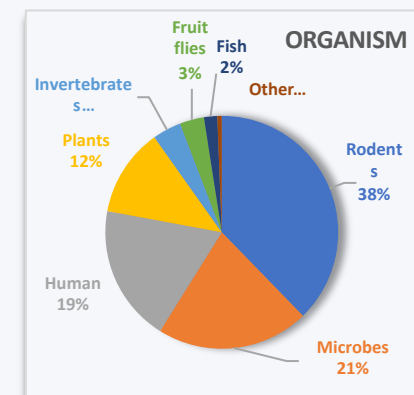
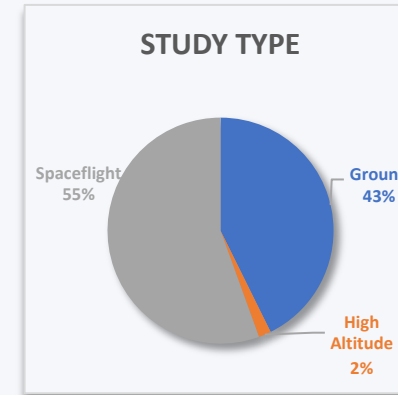
378
Studies

429
Datasets

45
Species

>10
Assays

>130 TB
Data



DISCOVER

Search Data

All

GeneLab

NIH GEO

EBI PRIDE

ANL MG-RAST

Search Filters (GeneLab Only)

Project Type

Factors

Organisms

Assay Type

Clear

Ground

Spaceflight

Parabolic Flight Study

bions

Acinetobacter pittii

Acinetobacter pittii

Acinetobacter radiresistens

Arabidopsis thaliana

Arabidopsis thaliana

Arnicola proteolyticus

Aspergillus fumigatus

Aspergillus nidulans

Aspergillus niger

Aspergillus niger

Aspergillus terreus

Page 1 of 14 (Total Studies: 339) Next >

Studies Per Page: 25

GLDS-436

Arabidopsis thaliana

Spaceflight

transcription profiling

01-Apr-2021

The increasing availability of flights on suborbital rockets creates new avenues for the study of spaceflight effects on biological systems, in particular the transitions between hypergravity and micr...

GLDS-434

Arabidopsis thaliana

Altered Gravity Time

transcription profiling

01-Apr-2021

The increasing availability of flights on suborbital rockets creates new avenues for the study of spaceflight effects on biological systems, in particular the transitions between hypergravity and micr...

EXPLORE

GeneLab Visualization

+ Add Visualization

GLDS-4

Title: Microarray Analysis of Space-flown Murine Thymus Tissue

Organism(s): Mus musculus

Number of Genes: 20217

Number of Samples: 7

Group Selection

Group 1: Ground Control

Group 2: Space Flight

Update

GLDS-4 PCA

GLDS-4 Volcano

GLDS-4 DGE

Copy CSV Excel PDF Print

Maximum p-value:

Search:

Symbol	LOG2FC	PVAL	ADJP
0610009822Rik	0.15407506639823598	0.375179028040943	0.7101000817246831
0610009118Rik	-0.0314533496186336	0.800050635558309	0.9247611817918641

CONTRIBUTE

Status

In Curation

Release Date

26-Nov-2021

Validation

Failed

Recent Study

NASA GeneLab: interfaces for the exploration of space omics data.

Samraavit Gebre, Daniel C Berrios, Jonathan Galazka, Kirill Grigorev, Sylvain V Costes

+ Add person

The mission of NASA's GeneLab database (https://genelab.nasa.gov) is to collect, curate, and provide access to the genomic, transcriptomic, proteomic and metabolomic (so-called 'omics') data from biospecimens flown in space or exposed to simulated space stressors, maximizing their utilization. This large collection of data enables the exploration of molecular network responses to space environments using a systems biology approach. We review here the various components of the GeneLab platform, including the new data repository web interface, and the GeneLab Online Data Entry (GEODE) web portal, which will support the expansion of the database in the future to include companion non-omics assay data. We discuss our design for GEODE, particularly how it promotes investigators providing more accurate metadata, reducing the curation effort required of GeneLab staff. We also introduce here a new GeneLab Application Programming Interface (API) specifically designed to support tools for the visualization of processed omics data. We review the outreach efforts by GeneLab to utilize the spaceflight data in the repository to generate novel discoveries and develop new hypotheses, including spearheading data analysis working groups, and a high school student training program. All these efforts are aimed ultimately at supporting precision risk management for human space exploration.

PUBLICATIONS

+ Add Publication

NASA GeneLab: interfaces for the exploration of space omics data.

Berrios DC, Galazka J, Grigorev K, Gebre S, Costes SV.

Edit

Description

Samples

Assays

Protocols

Files

Related Studies

Study Validations

Study Design Descriptor

+ Add

Growth Condition Design

ANALYZE

GeneLab

Open Science for Life in Space

Analyze Data

Workflow

Visualize

Shared Data

Admin

Help

User

Using 29.1 GB

Tools

search tools

from tastq tiles

Volcano Plot create a volcano plot

Annotate DESeq2/DEXSeq output tables Append annotation from GTF to differential expression tool outputs

edgeR Perform differential expression of count data

annotateMyIDs annotate a generic set of identifiers

htseq-count - Count aligned reads in a BAM file that overlap features in a GFF file

featureCounts Measure gene expression in RNA-Seq experiments from SAM or BAM files.

htseq-count - Count aligned reads in a BAM file that overlap features in a GFF file (Galaxy Version 0.9.1+galaxy1)

Favorite

Options

Aligned SAM/BAM File

No sam or bam dataset available.

GFF File

No gff dataset available.

Mode

Union

Mode to handle reads overlapping more than one feature. (--mode)

Stranded

Yes

Specify whether the data is from a strand-specific assay. **Be sure to choose the correct value** (see help for more information). (--stranded)

History

search datasets

New

7 shown, 2 deleted

780.32 MB

9: Mus_musculus.GRCm38.dna.primary_assembly.fa.gz

6: fgsea on data 2 and data 1: Plots

5: fgsea on data 2 and data 1: Ranked category list

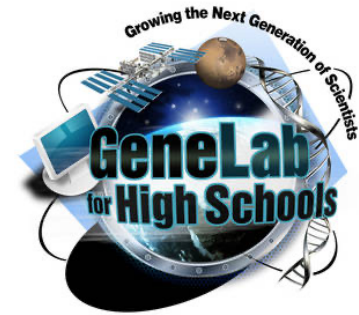
4: fgsea on data 2 and data 1: Plots

5

Opportunities for Students & Educators

GeneLab for High Schools (GL4HS): A four-week intensive training summer program for rising high school juniors and seniors to learn bioinformatics and computational biology methods and techniques to analyze space omics data.

Learn more and apply at: <https://www.nasa.gov/ames/genelab-for-high-schools>



GeneLab for Colleges/Universities (GL4U):

For educators and students to learn how analyze omics data using GeneLab standard pipelines and space-relevant data

Access to course materials: <https://github.com/nasa/GeneLab-Training/tree/main/GL4U>



SLSTP: Provides undergraduate students entering their junior or senior years, and entering graduate students, with professional experience in space life science disciplines including:

Applications open! <https://www.nasa.gov/ames/research/space-life-sciences-training-program>



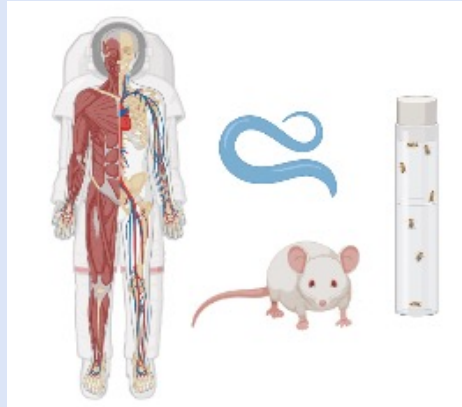
Connecting the world through science

- *Kicked-off on January 25th, 2018*
- *150+ scientists from multiple space agencies, international institutions, and industry.*
- *Scientists meet monthly with each group to analyze data in the GeneLab repository.*
- Published over 10 collaborative peer-reviewed papers
- **Join the breakout sessions today to learn more and sign up!**

ANIMAL

68 members

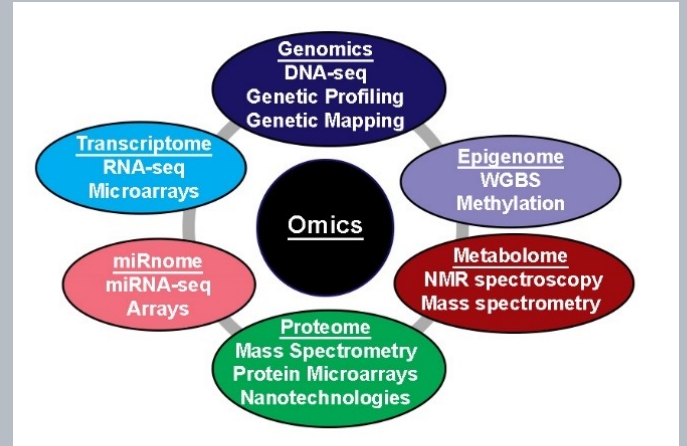
Facilitates the use of omics in understanding basic mechanisms by which animals and constituent tissues and cells adapt to the spaceflight environment.



MULTI-OMICS

181 members

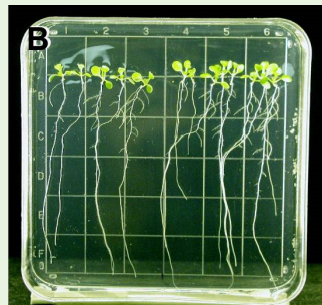
Interactions between the different omics to provide a better understanding of the systemic response.



PLANTS

58 members

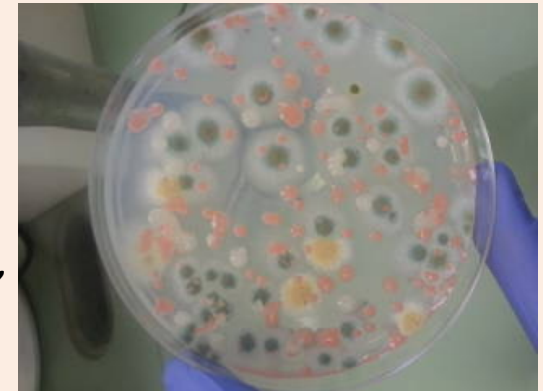
*Share and discuss the latest developments in **AstroBotany** – the discipline of botany concerned with interactions between plant biology and space environment.*



MICROBES

50 members

Focuses on analyzing microbial datasets within GeneLab that includes gene-expression, proteomic, metabolomic and environmental metagenomic datasets.



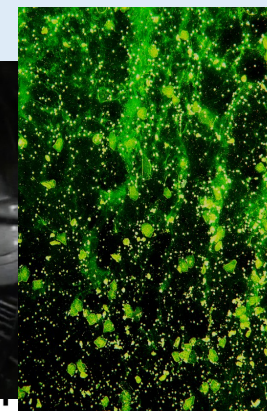
Ames Life Sciences Data Archive (ALSDA) and its AWG

ALSDA

- Data from Human Research Program and Space Biology
- Phenotypic-Physiological-Behavioral-Level Data
- Federated with GeneLab (Omics-Level Data)

AWG: ~150 members

- Recruiting members to support data standards and novel methods to analyze cross mission and platform data
- Establish standards for various assays' metadata
- Provide feedback on database and tools



Microgravity induces proteomic changes involved in endoplasmic reticulum stress and mitochondrial protection

Received: 01 June 2016
Accepted: 05 September 2016

ORIGINAL ARTICLE

JBM

TRT	Mouse #	BV/TV (%)	Mean	SD	SE	CV (%)	CV (1/mm ³)	M
CTL	2	21.24					221.19	
CTL	11	22.60					230.26	
CTL	16	23.39					227.63	
CTL	18	23.08					278.20	
CTL	20	21.32					209.89	
CTL	30	22.52					248.13	
CTL	40	21.62					225.86	
CTL	50	21.82					235.42	
CTL	59	22.00					231.38	
CTL	62	20.52	22.01	0.89	0.28	4	241.18	23
HLU	9	19.75					212.04	
HLU	14	19.84					264.40	
HLU	17	15.70					223.30	
HLU	34	17.76					219.51	
HLU	51	21.63					238.95	
HLU	51	21.63					229.40	
HLU	51	21.63					263.83	
HLU	51	21.63					266.46	
HLU	51	21.63					252.28	
HLU	51	21.63					265.08	24

Inner Ear Vestibular Signals Regulate Bone Remodeling via the Sympathetic Nervous System

Guillaume Vignaux,¹ Jean-Denis Ndoni,²
¹Department of Medicine, Vanderbilt University School of Medicine, Nashville, TN
²Department of Orthopaedic Surgery & Rehabilitation, Vanderbilt Center for Bone Biology, Nashville, TN

TbTh. (02/02/16)	LSM	Std. Error	N
4 HU,Loaded,Vehicle	0.058349	0.001322	0.0037402
8 HU,Loaded,Zolendronate	0.059839	0.001399	0.0039582
3 HU,No Compress,Vehicle	0.04973	0.001322	0.003740
7 HU,No Compress,Zolendronate	0.0549	0.001399	0.003958
2 NA,Loaded,Vehicle	0.058587	0.001616	0.004275
6 NA,Loaded,Zolendronate	0.062817	0.001275	0.003606
1 NA,No Compress,Vehicle	0.052693	0.001616	0.004275
5 NA,No Compress,Zolendronate	0.056735	0.001275	0.003606

TbN. (02/02/16)	LSM	Std. Error	N
4 HU,Loaded,Vehicle	2.6581136	0.15513024	0.438774
8 HU,Loaded,Zolendronate	3.51881173	0.16461955	0.465614
3 HU,No Compress,Vehicle	2.18411235	0.15513024	0.438774
7 HU,No Compress,Zolendronate	3.37023673	0.16461955	0.465614
2 NA,Loaded,Vehicle	3.09758836	0.18195737	0.48141395
6 NA,Loaded,Zolendronate	3.8183936	0.15339879	0.4338773
1 NA,No Compress,Vehicle	2.69824693	0.18195737	0.48141395
5 NA,No Compress,Zolendronate	3.7565211	0.15339879	0.4338773



Analysis Working Groups

Charter

Purpose

- The purpose of the GeneLab Analysis Working Groups (AWGs) is to optimize the processing of raw omics data from the GeneLab repository in order to maximize the gain of new knowledge from such complex datasets. The AWDs will also assess and improve the effectiveness of the GeneLab Data System (GLDS) through intensive utilization of the analytics to be deployed therein.

Organization and Function

- The AWDs aspire to scientific excellence, and participation in **AWGs is strictly on a volunteer basis**. The primary activity of each AWD is to establish analytical processes to generate higher order data from data housed in the GLDS with relevance to one or more specific application areas. For example, a mammalian AWD would analyze all data relevant to mammalian systems (human, mouse, rat, etc.). The GeneLab AWDs aspire to yield:
 - *Canonical data analysis pipelines*
 - *Processed (“higher-order”) space biology data.*
 - *Critiques of the GLDS.*
 - *Scientific communication of available analyses and interpretations.*

Precisely how each AWD reaches these goals will be determined by the AWDs themselves, but, in general, AWDs should hold frequent in-person or virtual meetings to organize work and review progress. The schedule for delivering the above products is set by the Chair in consultation with GeneLab and the other AWD participants.

Analysis Working Groups

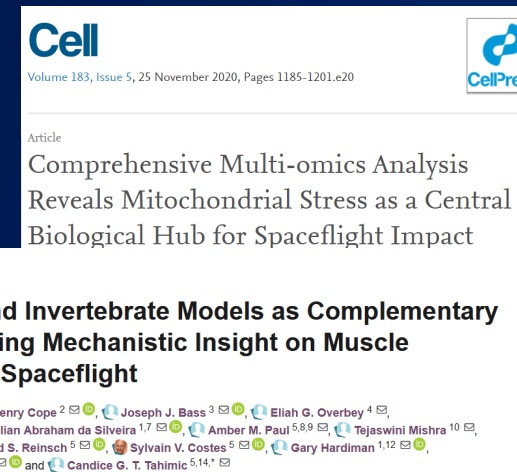
Charter

Expectations for AWG Participation

- Participation in GeneLab AWGs is open to all investigators (academic, government, private sector); however, participants must be willing to:
 - Contribute significantly to the goals of the AWG.
 - Take part in group activities including periodic teleconferences. Participants are expected to actively contribute to the group goals (see above).
 - Share AWG products with other AWG participants via the collaborative workspace provided by the GLDS.

Benefits of AWG Participation

- By participating within a GeneLab AWG, investigators will join a group of scientific excellence and may co-author a landmark paper. They will help set data and analysis standards for the community, and may develop relationships that could lead to additional collaborations.



10:40 – 11:40 am PT: GeneLab Grant Recipients



Sushma Naithani, PhD
Oregon State University
10:40 - 11:00 am



Sarah Wyatt, PhD
Ohio University
11:00 - 11:20 am



Pankaj Jaiswal, PhD
Oregon State University
11:20 - 11:40 am

10:10 – 10:40 am PT: Keynote Speaker



Kathleen "Kate" Rubins, PhD
NASA Astronaut
10:10 - 10:40 am



Nathaniel Szewczyk, PhD
Ohio University
11:40 - 11:50 am



Braden Tierney, PhD
Weill Cornell Medicine
11:50 am- 12:00 pm



Afshin Beheshti, PhD
NASA ARC Broad Institute
12:00 - 12:10 pm



Colin Kruse, PhD
Lawrence Livermore National Labs
12:10 - 12:20 pm



Ryan Scott, MS
NASA ARC
12:20 - 12:30 pm

11:40 – 12:30 pm PT: AWG Status Updates

12:30 – 12:50 pm PT:

Break

12:50 – 1:15 pm PT: AWG Early Career Lightning Science Talks



Henry Cope
University of Nottingham

12:50 - 12:55 pm



Jaden Hastings, PhD
Weill Cornell
Medicine

12:55 – 1:00 pm



Rebecca Finch, MS
Staffordshire
University

1:00 - 1:05 pm



Emma Canaday
Ohio University

1:05 - 1:10 pm

1:15 – 2:30 pm PT: AWG Science Talks



Richard Barker, PhD
University of Wisconsin -
Madison

1:15 - 1:30 pm



Nicholas Brereton, PhD
University of Montreal

1:30 - 1:45 pm



Jean Calleja Agius,
PhD
University of Malta

1:45 – 2:00 pm



Erik Antonsen, PhD
Baylor College of Medicine

2:00 – 2:15 pm



Masafumi Muratani,
PhD
University of Tsukuba

2:15 - 2:30 pm