

Open Science for Life in Space:

The NASA Open Science Data Repository

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October 29, 2024 (Pacific Time) Hybrid Meeting
Exchange of Experience 2024 #GBI_EoE2024



Biological & Physical Sciences

National Aeronautics and
Space Administration

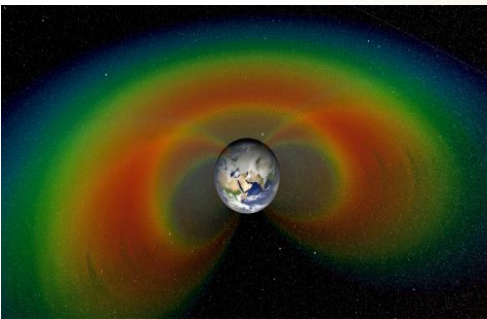


Biologically Relevant Environmental Factors Encountered in Spaceflight

Microgravity/Reduced Gravity



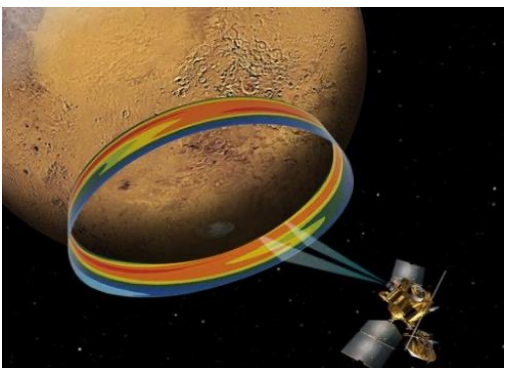
Ionizing Radiation



Altered Day/Night Cycles:
Circadian Rhythm Changes



Altered Temperature
and Atmosphere



Isolation



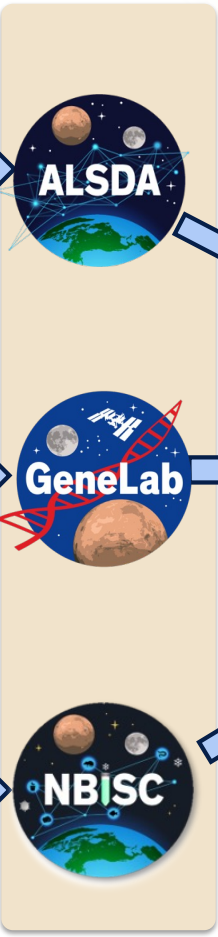
- Elevated CO2
- Reduced atmospheric pressure and elevated volumetric fraction of oxygen

COMBINATION OF
MULTIPLE STRESSORS



Data for Biological, Health, Telemetry Analytics

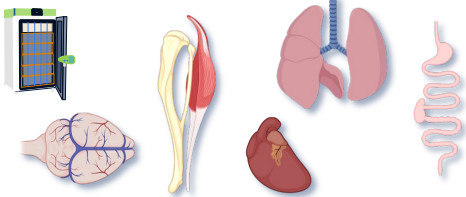
Physiological/Phenotypic/Imaging/ Environmental Telemetry Data



Molecular/Omics Data

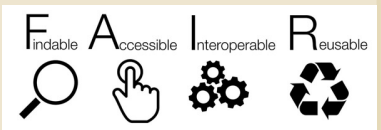


Biospecimens



NASA Open Science Data Repository (OSDR)
osdr.nasa.gov/bio

- Tutorials for all OSDR aspects
- Single Submission & Curation Portal
- File Transfer Manager App
- Workspace for Submitter Labs/Collaborators
- *Maximally* Open Access
- Data Maximally FAIR
- Environmental Data Application & RadLab
- Multi-Study Viz tool for Users (Omics)
- Knowledge graph tool (soon – SPOKE/UCSF)



513

Studies

969

Datasets

45

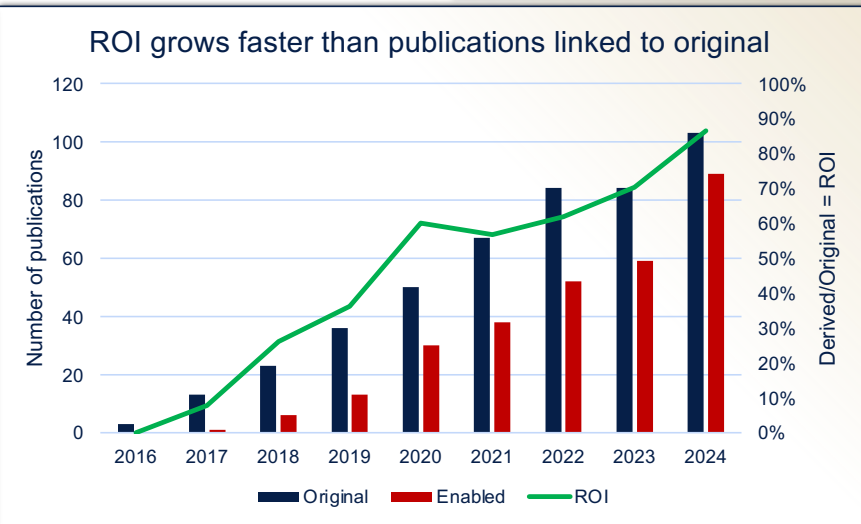
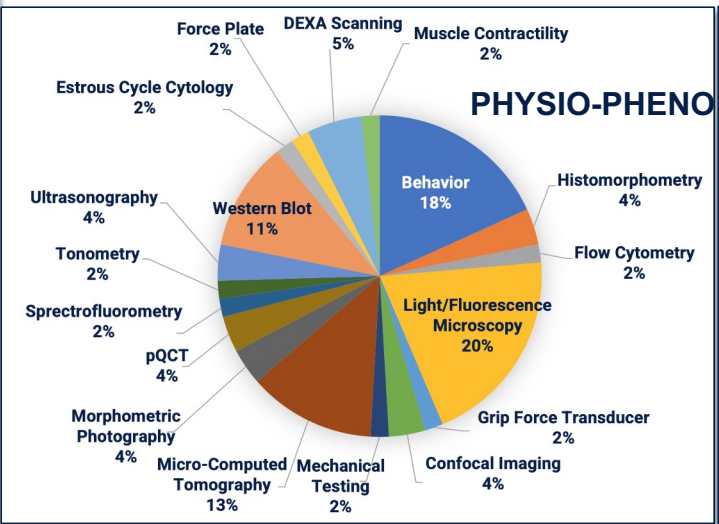
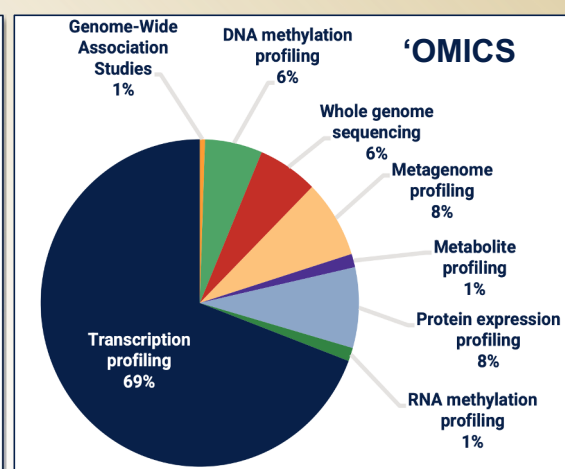
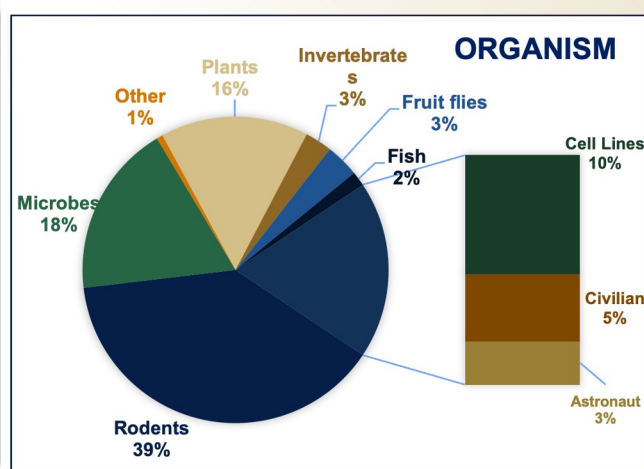
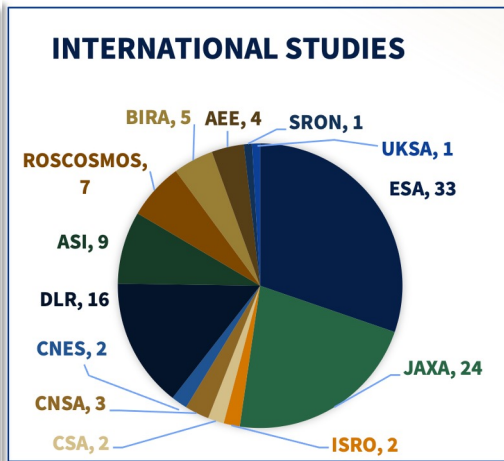
Species

>65

Assays

>160TB

Data



93

Enabled Publications linked to OSDR

103

Original Publications linked to OSDR

150+

Datasets used in enabled publications

<p>ANIMAL</p> <p>135 members</p>	<p>MULTI-OMICS</p> <p>355 members</p>	<p>MICROBIAL</p> <p>137 members</p>	<p>HUMAN</p> <p>(BioMedical, Clinical)</p> <p>30 members</p>	<p>RadLab</p> <p>30 members</p>
<p>PLANTS</p> <p>127 members</p>	<p>AI/ML</p> <p>149 members</p>	<p>ALSDA</p> <p>(Physiological/ Imaging)</p> <p>287 members</p>	<p>Female Repro</p> <p>67 members</p>	

Feedback on Ingress/Egress Standards

Ingestion, Curation, Processing Standards

Standards to Enable Reuse/Data Mining

The diagram illustrates a workflow where data from GeneLab and ALSDA is processed through standards to enable reuse and data mining. On the left, icons represent data ingestion (microscopy, spreadsheets, DNA, brain). In the center, GeneLab and ALSDA logos are shown with a DNA helix and a globe. On the right, icons represent standards and data mining (microscope, data points, microscope).

ryan.t.scott@nasa.gov – Exchange of Experience2024

Collaborate on Data Mining/Publications

Nature Portfolio Package 2024
<https://www.nature.com/collections/ebdbcahdgc>

Cell Press Package 2020
<https://www.cell.com/c/the-biology-of-spaceflight>

List of 90 publications enabled by OSDR
<https://osdr.nasa.gov/bio/data/publications.html>

Two QR codes are provided for more information. To the right are covers for Nature Portfolio (Space Omics) and Cell Press (The Biology of Spaceflight).

#GBI_EoE2024

October 30, 2024

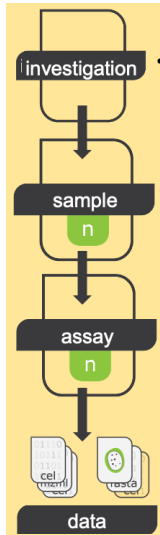
Assay Metadata Standards

106 Assay Metadata Configs Created/Live

~225 SMEs/AWG Members Contributed

15 Assay metadata configs in Progress

20 Assay Metadata Configs on Radar/TBD



Breakout meetings with SMEs, or asynchronous feedback via open file sharing

Using GitHub and Google Doc – for shared documentation development and version control

Many dozens of Templates for data submissions for PIs

Community, Engagement, and Social Interaction

Our Moderators

dr.richard.barker Dr Richard Barker PlantAWG	fumimuratani Masafumi Muratani AnimalAWG
paula6 Amber M. Paul AnimalAWG	jaume.puig Jaume Puig MicrobesAWG
jessicadurbano Jessica D'Urbano ALSDAwg; Multi-Omicsawg	daniela.bezdan Daniela_Bezdan MicrobesAWG
abegum Begum Mathyk FemaleReproAWG	AfshinBeheshti Afshin Beheshti MultiOmicsAWG
Dr.Overbey Eliah Overbey Executive co-chair of the Human AWG. Assistant profess...	ss.damianj Damián J. AIMLAv...
busracetinkayaun Busra Cetinkaya Un FemaleReproAWG	

“Forum-Space”

Awg.osdr.space

650 members joined

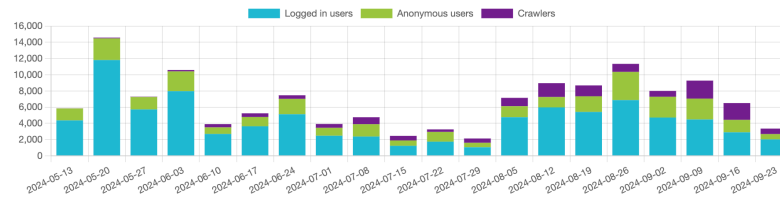
-50-100 login/day

Transparency

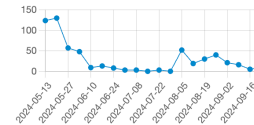
Engagement for Projects

Open Science
for Life in Space

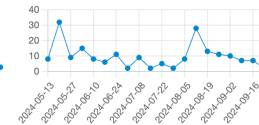
Consolidated Pageviews



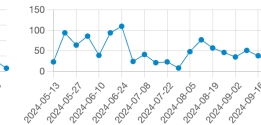
Signups



Topics



Posts



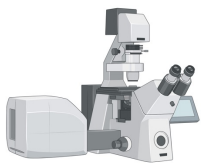
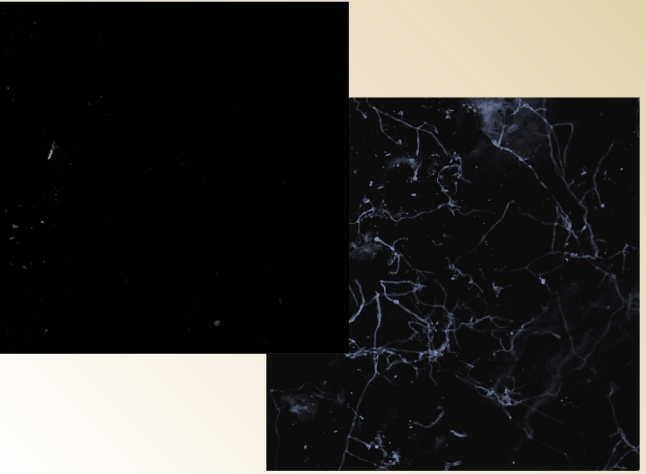
Join Here



Study
OSD-628

Characterization of Biofilm Formation, Growth, and Gene Expression on Different Materials and Environmental Conditions in Microgravity (Morphology of *Penicillium rubens* biofilms)

Organisms	Factors	Assay Types	Release Date	Description
<i>Penicillium rubens</i>	Spaceflight Growth Environment Time	Molecular Cellular Imaging	12-Sep-2023	Microorganisms' natural ability to live as organized multicellular communities – also known as biofilms – provides them with unique survival advantages. For instance, biofilms are protected against en...



Protocols

Samples

Assay: Molecular Cellular Imaging - Confocal - Nikon SIM-A1 Laser-scanning Confocal Microscope

Source Name	Sample Name	Characteristics: Organism	Characteristics: Strain	Characteristics: Growth	Characteristics: Material Type	Characteristics: Material	Factor Value: Spaceflight	Factor Value: Growth Environment
A1	A1	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Carbon Fiber	Space Flight	Carbon Fiber
A2	A2	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Space Flight	Space Flight	Carbon Fiber
A3	A3	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Space Flight	Space Flight	Quartz
A4	A4	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Space Flight	Space Flight	SiO2/Si
A5	A5	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Space Flight	Space Flight	Quartz
A6	A6	<i>Penicillium rubens</i>	ATCC 26899	Wet Type	Cells	Space Flight	Space Flight	Silicone

Assays

Assay Name: Molecular Cellular Imaging - Confocal

Technology Type: Confocal

Technology Platform: Nikon SIM-A1 Laser-scanning Confocal Microscope

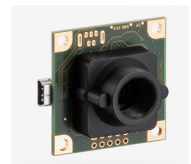
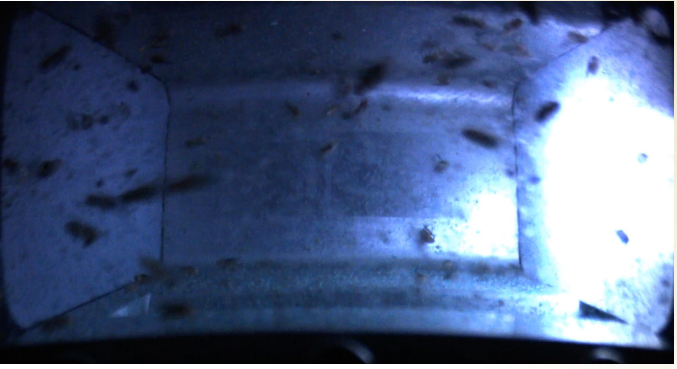
Sample Name	Protocol ID	Parameter Value: Dimension (µm)	Parameter Value: Number of Z-Sections Per Image	Parameter Value: Resolution (µm/Frame)	Parameter Value: Frame Rate (Frames/Sec)	Parameter Value: Frame Size (µm)	Parameter Value: Frame Rate (FPS)	Parameter Value: Frame Size (FPS)	Parameter Value: Frame Size (FPS)
A1	Image File Dimensions	975x675	30	1	2 comp/s 12bit	0.02 micron pixel	640x and 1280x		
A2	Image File Dimensions	975x675	30	1	2 comp/s 12bit	0.02 micron pixel	640x and 1280x		



Study
OSD-595

Artificial gravity partially protects space-induced neurological deficits in *Drosophila melanogaster*

Organisms	Factors	Assay Types	Release Date	Description
<i>Drosophila melanogaster</i>	Altered Gravity Spaceflight	Behavior	25-May-2023	Spaceflight poses risks to the central nervous system (CNS), and understanding neurological responses is important for future missions. We report CNS changes in <i>Drosophila</i> aboard the International Spa...



Protocols

Samples

Assay: Behavior - Video Recording - Multi-use Variable Gravity Drosophila hardware (J-1491LE camera)

Source Name	Sample Name	Characteristics: Organism	Characteristics: Strain	Characteristics: Strain	Characteristics: Strain	Characteristics: Material Type	Factor Value: Spaceflight
Module 1	Module 1	<i>Drosophila melanogaster</i>	Bloomington Stock Center	W1118	Wild Type	Whole Organism	Space Flight
Module 2	Module 2	<i>Drosophila melanogaster</i>	Bloomington Stock Center	W1118	Wild Type	Whole Organism	Space Flight
Module 3	Module 3	<i>Drosophila melanogaster</i>	Bloomington Stock Center	W1118	Wild Type	Whole Organism	Space Flight
Module 4	Module 4	<i>Drosophila melanogaster</i>	Bloomington Stock Center	W1118	Wild Type	Whole Organism	Space Flight
Module 5	Module 5	<i>Drosophila melanogaster</i>	Bloomington Stock Center	W1118	Wild Type	Whole Organism	Space Flight

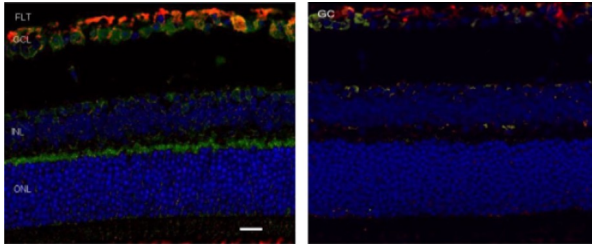
Assays

Assay Name: Behavior - Video Recording

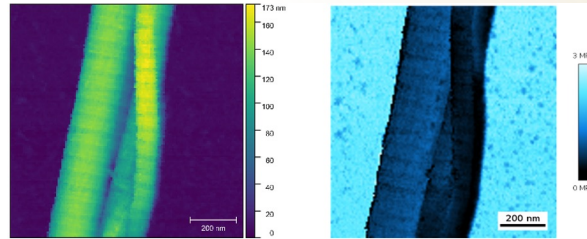
Technology Type: Video Recording

Technology Platform: Multi-use Variable Gravity Drosophila hardware (J-1491LE camera)

Source Name	Protocol ID	Parameter Value: Frame Rate (FPS)	Parameter Value: Frame Size (µm)	Parameter Value: Frame Size (FPS)	Parameter Value: Frame Size (FPS)
Module 1	Behavior in Flight Video	10 FPS	10 FPS	10 FPS	10 FPS
Module 2	Behavior in Flight Video	10 FPS	10 FPS	10 FPS	10 FPS
Module 3	Behavior in Flight Video	10 FPS	10 FPS	10 FPS	10 FPS
Module 4	Behavior in Flight Video	10 FPS	10 FPS	10 FPS	10 FPS
Module 5	Behavior in Flight Video	10 FPS	10 FPS	10 FPS	10 FPS



Mouse Retinas; RR-9
Immunostaining
(OSD-568, 557)



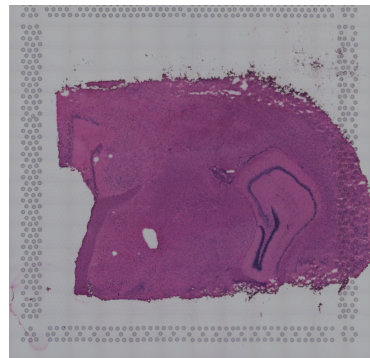
Mouse Tendon; RR-1
Atomic Force Microscopy
(OSD-702, 718)



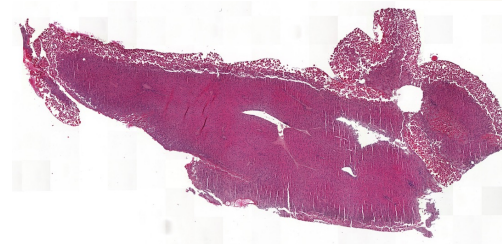
Mice behavior, ISS/RR1
(OS-830)



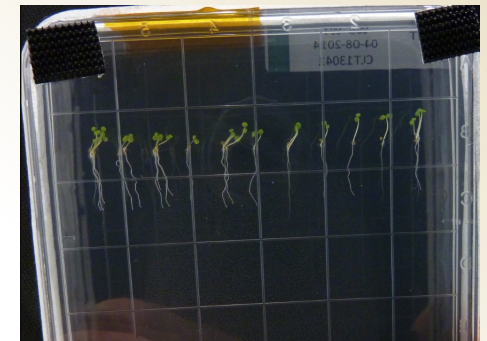
Arabidopsis; Lunar Regolith,
Apollo 11, 12, 17
(OSD-476)



Mouse Brain; RR-3
Spatial Transcriptomics
(OSD-352)


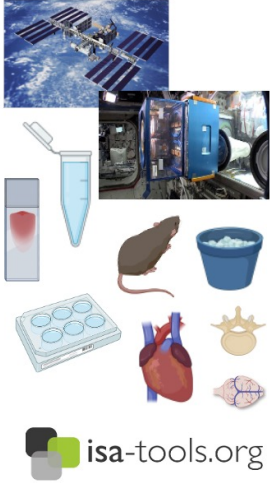
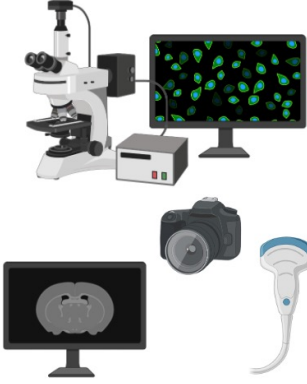
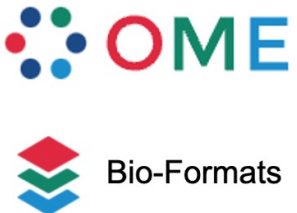
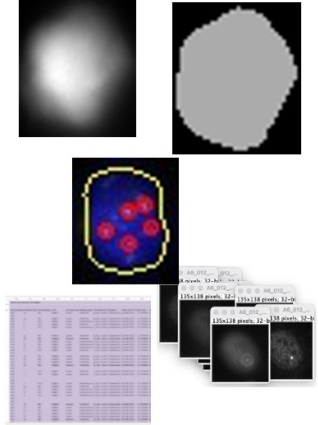


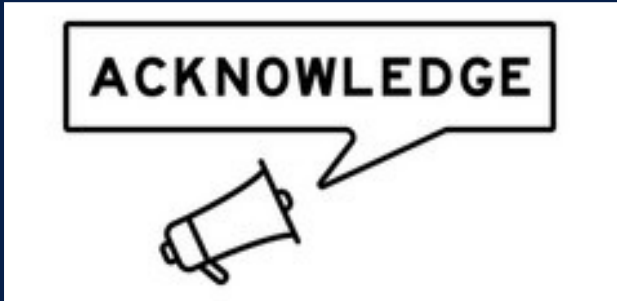
Mouse Liver; RR-1
Spatial Transcriptomics
(OSD-47)



Arabidopsis; CARA & BRIC
on International Space Station
(OSD-120, 121)

(Credit: Anna-Lisa Paul, Rob Ferl <https://doi.org/10.1371/journal.pone.0180186>; Xiao Wen Vivien Mao <https://doi.org/10.1038/s41598-019-44696-0>; Ronca et al 2019 <https://doi.org/10.1038/s41598-019-40789-y> ; Mice Aboard ISS <https://www.youtube.com/watch?v=q7lgj3aZ8dU>)

	Investigation & Sample Metadata	Assay/Modality Metadata	Diverse File Formats	Raw, Processed, Results, and Analysis
<p>Essential metadata for methods/materials to support quantification, reuse, reproducibility</p> <p>Ensure data and metadata are maximally:</p> <ol style="list-style-type: none"> 1. Open-Access 2. Findable 3. Accessible 4. Interoperable 5. Reusable 	 <p>Investigation Sample Assay</p>	 <p>Assay metadata parameters, based on domain norms. Ontology selection for interoperability</p>	 <p>162 formats. OME-TIFF format; NGFF. Pixels, openness, utility, export, multiple images, pyramid (multiple resolutions)</p>	 <p>Raw, processed, and image results accessible through API</p>



NASA Open Science Data Repository

Samrawit Gebre – Project Manager
Danielle Lopez – Deputy Project Manager
Lauren Sanders – Project Scientist
Amanda Saravia-Bulter – GeneLab Science Lead
Ryan Scott – ALSDA Science Lead



ryan.t.scott@nasa.gov – Exchange of Experience2024
#GBI_EoE2024 October 30, 2024

Stakeholders-Management

NASA Space Biology Program
NASA Biological & Physical Sciences Division
NASA Science Mission Directorate
NASA Human Research Program
NASA Postdoctoral Program

Collaborators

All Open Science AWG Members