Open Science for Life in Space:

The NASA Open Science Data Repository

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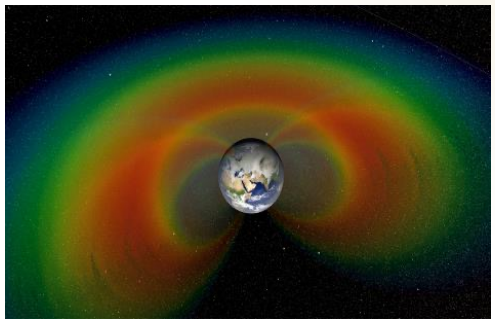
October 29, 2024 (Pacific Time) Hybrid Meeting
Exchange of Experience 2024 #GBI_EoE2024

BPS
Biological & **P**hysical **S**ciences

Biologically Relevant Environmental Factors Encountered in Spaceflight

Microgravity/Reduced Gravity

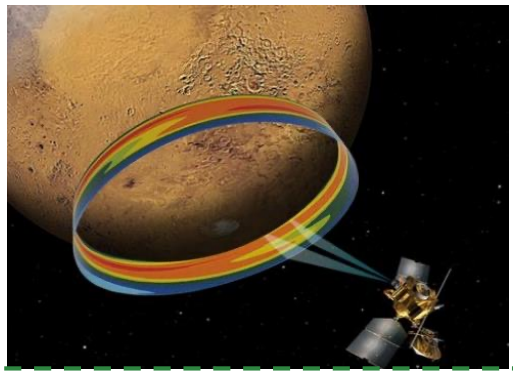
Ionizing Radiation



Altered Day/Night Cycles:
Circadian Rhythm Changes

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

Altered Temperature and Atmosphere



Isolation

COMBINATION OF MULTIPLE STRESSORS

Afshinnekoo et al. 2020

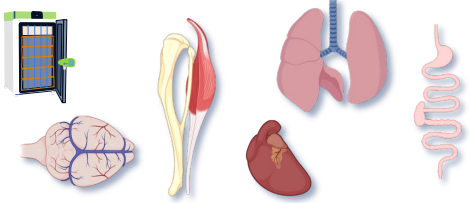
Data for Biological, Health, Telemetry Analytics

Physiological/Phenotypic/Imaging/ Environmental Telemetry Data

Tabular, text, imaging, telemetry, video, code

Molecular/Omics Data

Biospecimens



ALSDA

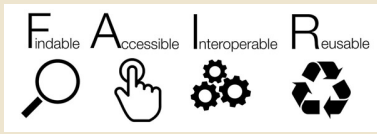
GeneLab

NBISC

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)

NASA OSDR – By The Numbers

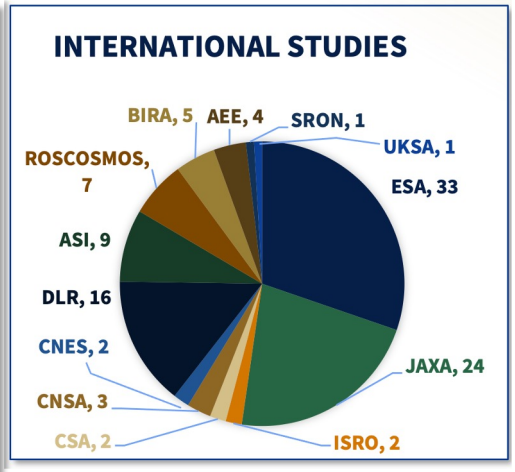
513 Studies

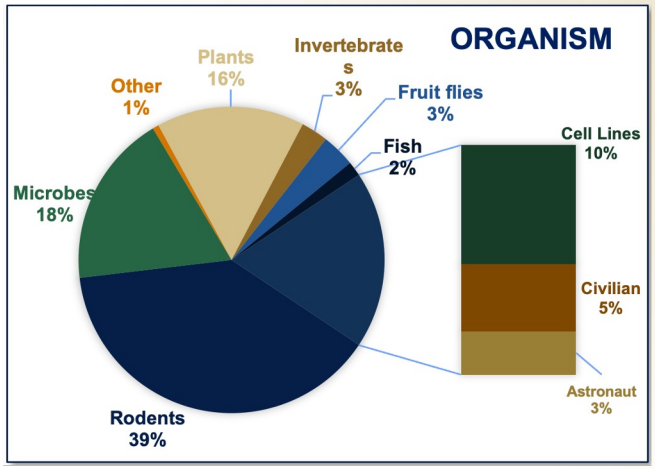
969 Datasets

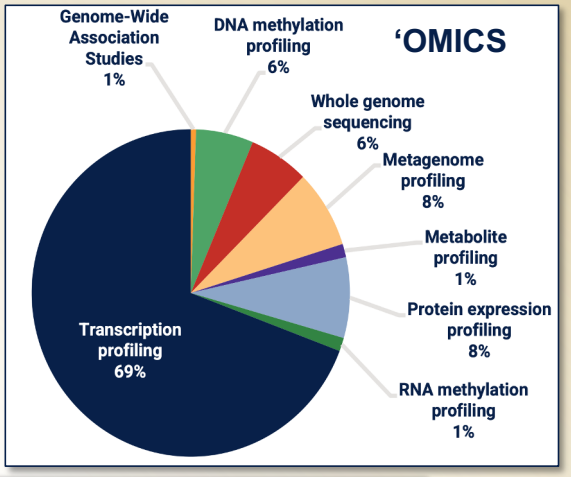
45 Species

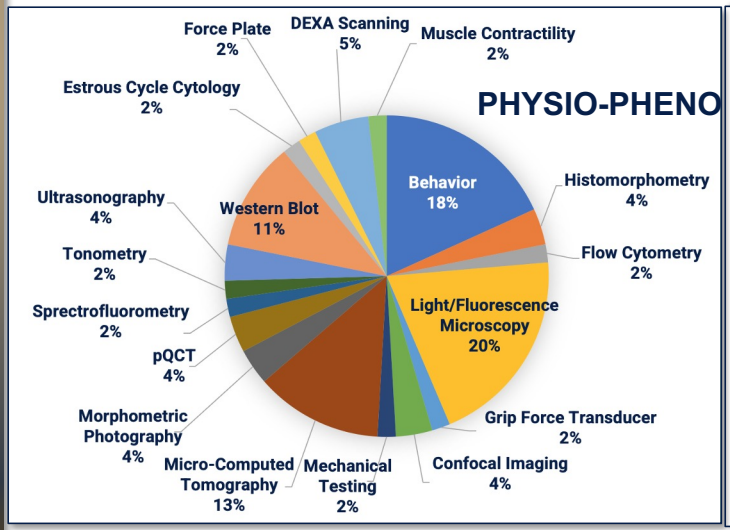
>65 Assays

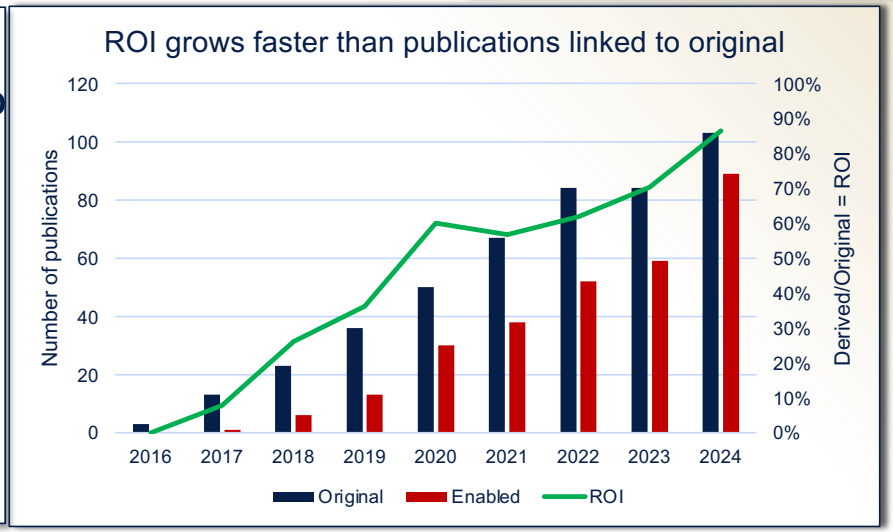
>160TB Data











93 Enabled Publications linked to OSDR

103 Original Publications linked to OSDR

150+ Datasets used in enabled publications

Open Science OSDR Analysis Working Group: ~800 Members Worldwide

ANIMAL
135 members

MULTI-OMICS
355 members

MICROBIAL
137 members

HUMAN
(BioMedical, Clinical)
30 members

RadLab
30 members

PLANTS
127 members

AI/ML
149 members

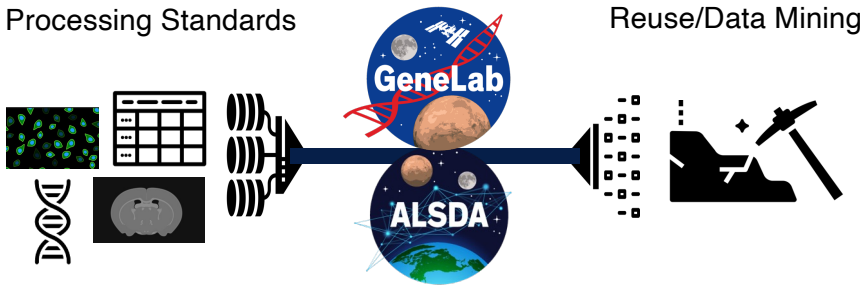
ALSDA
(Physiological/ Imaging)
287 members

Female Repro
67 members

Feedback on Ingress/Egress Standards

Ingestion, Curation, Processing Standards

Standards to Enable Reuse/Data Mining



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

Standards for Ingestion/Reuse – and FAIR-EST

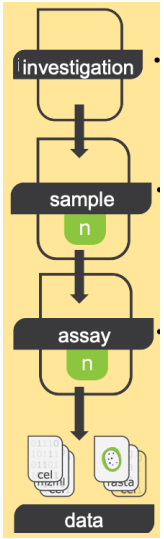
Assay Metadata Standards

106 Assay Metadata Configs Created/Live

~225 SMEs/AWG Members Contributed

15 Assay metadata configs in Progress

20 Assay Metadata Configs on Radar/TBD

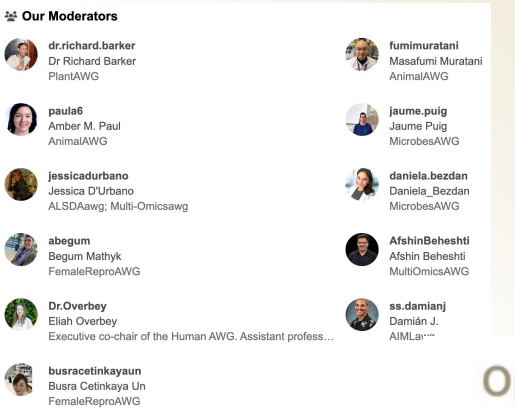


Breakout meetings with SMEs, or asynchronous feedback via open file sharing

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

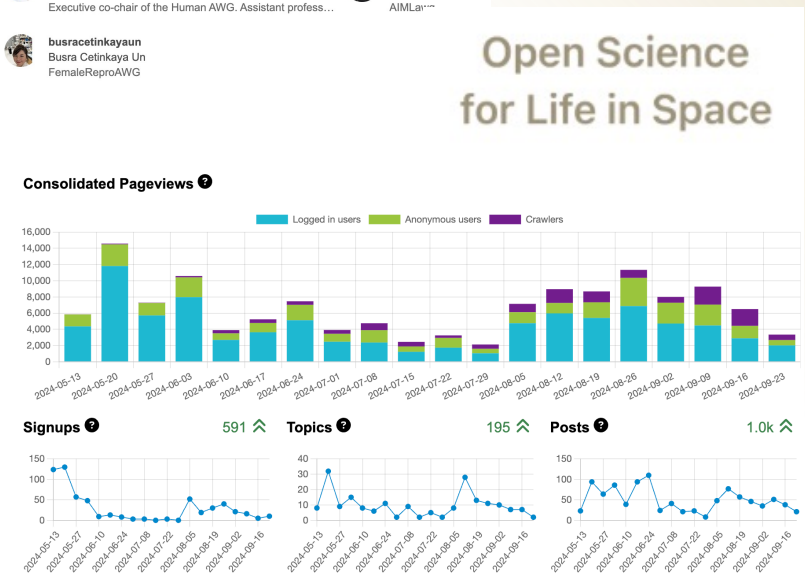
Many dozens of Templates for data submissions for PIs

Community, Engagement, and Social Interaction



"Forum-Space"

Awg.osdr.space
650 members joined
-50-100 login/day
Transparency
Engagement for Projects



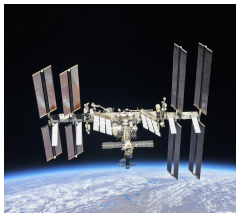
Join Here

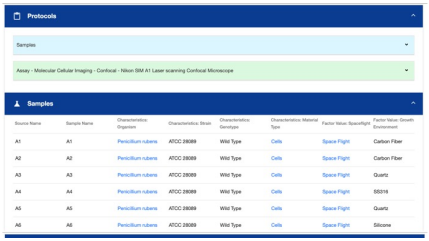
Imaging and Video in OSDR

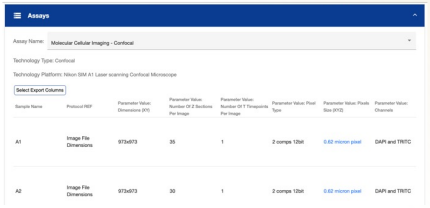
Study
OSD-628

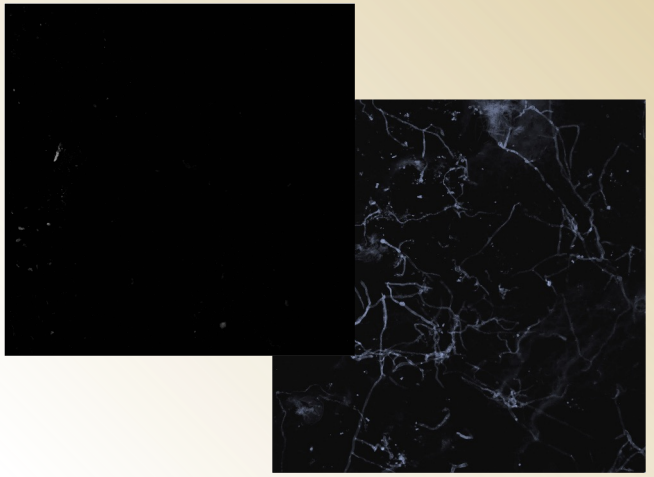
Characterization of Biofilm Formation, Growth, and Gene Expression on Different Materials and Environmental Conditions in Microgravity (Morphology of Penicillium rubens biofilms)

Organisms	Factors	Assay Types	Release Date	Description
Penicillium rubens	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...





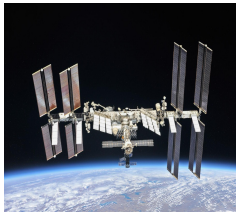


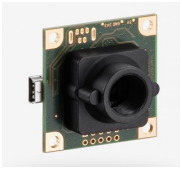


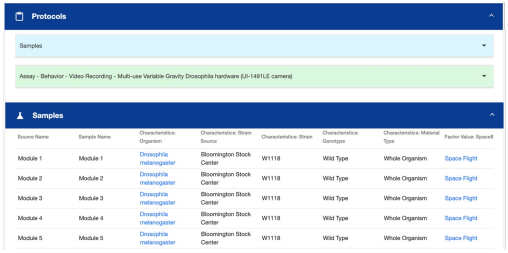
Study
OSD-595

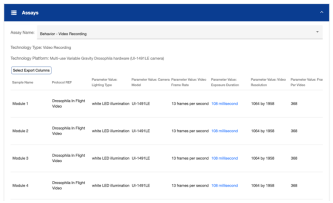
Artificial gravity partially protects space-induced neurological deficits in Drosophila melanogaster

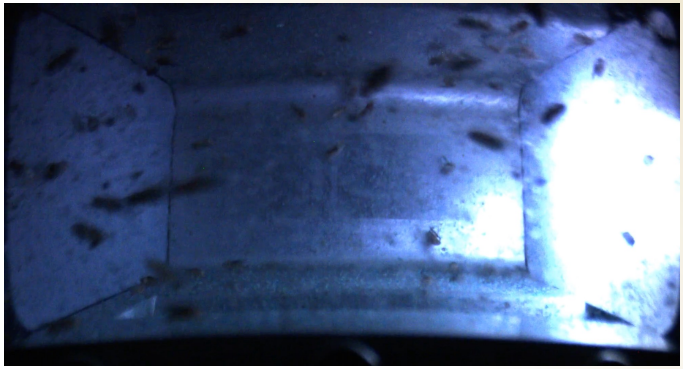
Organisms	Factors	Assay Types	Release Date	Description
Drosophila melanogaster	Altered Gravity Spaceflight	Behavior	25-May-2023	Spaceflight poses risks to the central nervous system (CNS), and understanding neurological responses is important for future missions. We report CNS changes in Drosophila aboard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



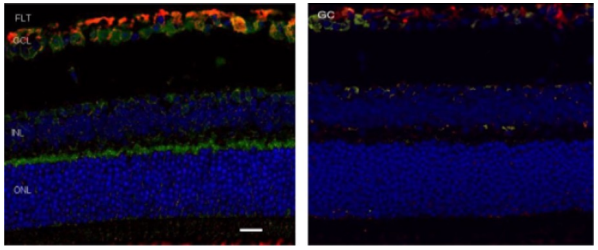




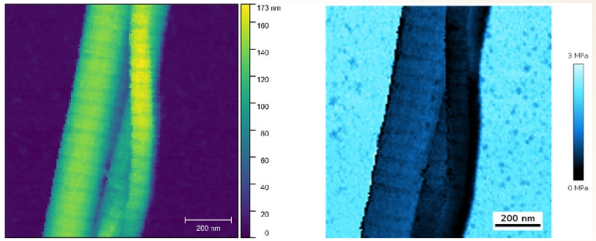




Imaging and Video in OSDR



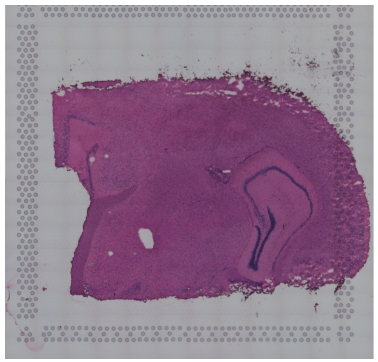
Mouse Retinas; RR-9
Immunostaining
(OSD-568, 557)



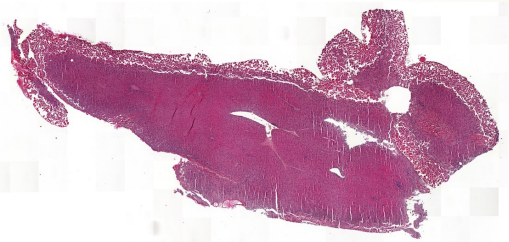
Mouse Tendon; RR-1
Atomic Force Microscopy
(OSD-702, 718)

Mice behavior, ISS/RR1
(OS-830)

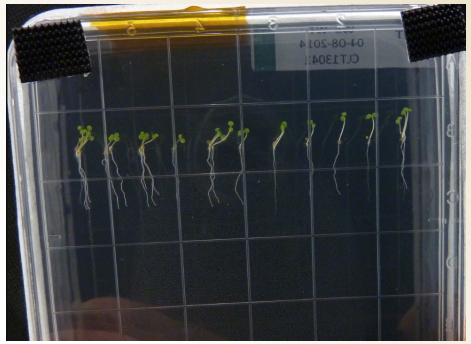
Arabidopsis; Lunar Regolith,
Apollo 11, 12, 17
(OSD-476)



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



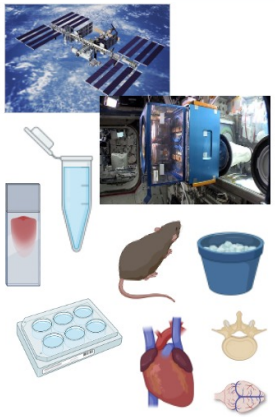
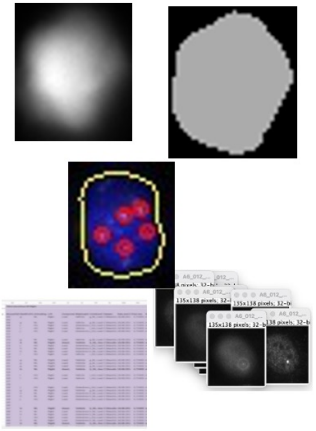
Mouse Liver; RR-1
Spatial Transcriptomics
(OSD-47)

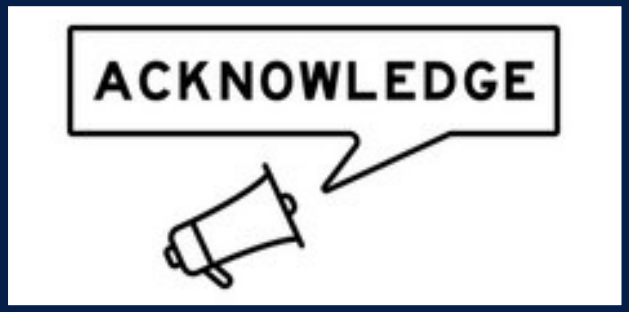


Arabidopsis; CARA & BRIC
on International Space Station
(OSD-120, 121)

(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)

Features and Future OSDR Bioimaging

ALSDA	Investigation & Sample Metadata	Assay/Modality Metadata	Diverse File Formats	Raw, Processed, Results, and Analysis
Essential metadata for methods/materials to support quantification, reuse, reproducibility Ensure data and metadata are maximally: 1. Open-Access 2. Findable 3. Accessible 4. Interoperable 5. Reusable	 isa-tools.org Investigation Sample Assay	 Assay metadata parameters, based on domain norms. Ontology selection for interoperability	OME Bio-Formats 162 formats. OME-TIFF format; NGFF. Pixels, openness, utility, export, multiple images, pyramid (multiple resolutions)	 Raw, processed, and image results accessible though API



NASA Open Science Data Repository

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Amanda Saravia-Bulter – GeneLab Science Lead
Ryan Scott – ALSDA Science Lead

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

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