NASA Open Science Data Repository (OSDR) Enables Space Biomedical Research with Inspiration 4 and Model Organism Data, Standards, Pipelines, and Visualization Tools

Kris Peach, PhD
Curation Lead
Open Science Data Repository (OSDR)
Seabrook Solutions
kristen.peach@nasa.gov
she/her

BPS

Biological & Physical Sciences

National Aeronautics and Space Administration

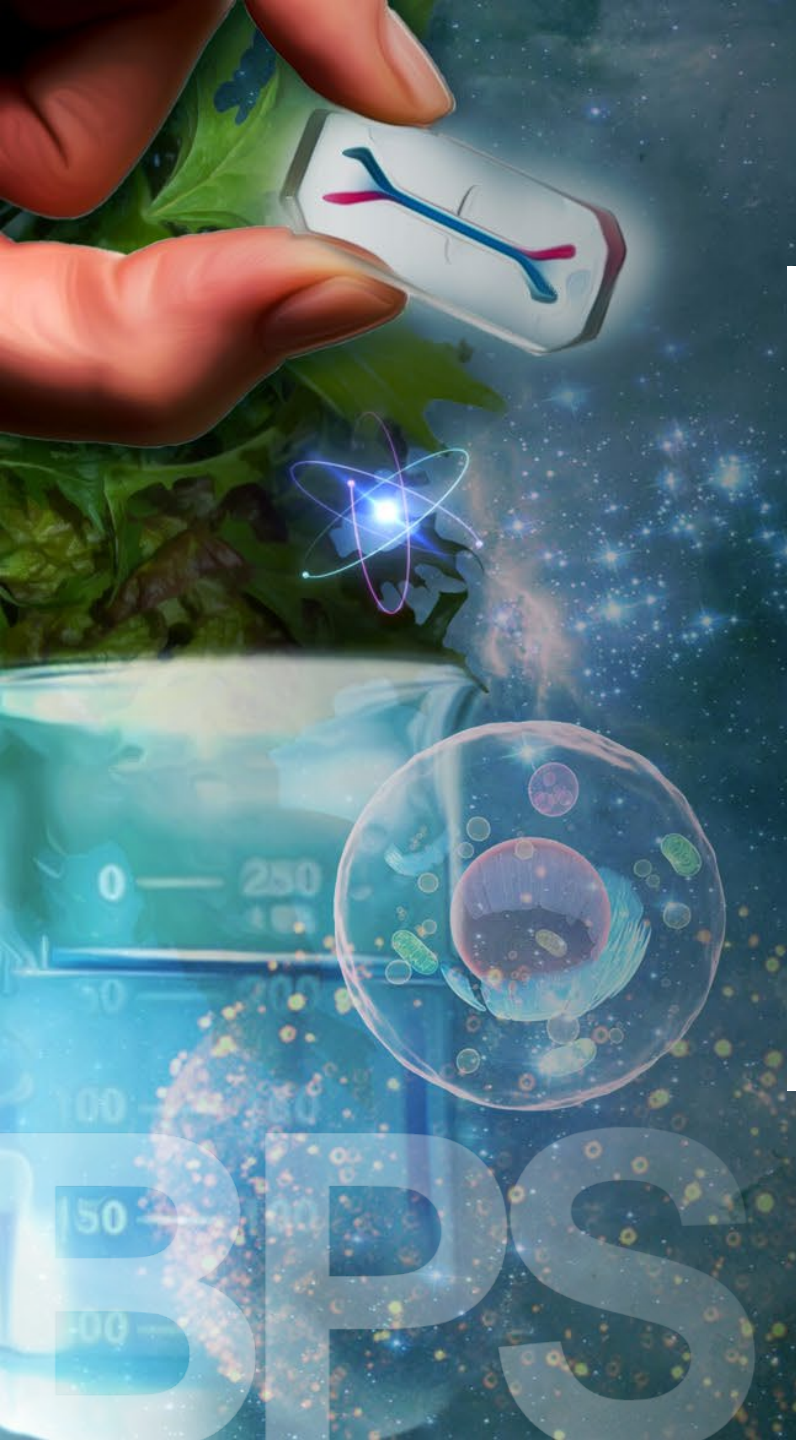
NASA

Agenda or Table of Contents

Intro to NASA's Open Science Data Repository

The Open Science Data Repository (OSDR) enables access to space-related data from experiments and missions that investigate biological responses of terrestrial life to spaceflight.

NEW OSDR Publication!



JOURNAL ARTICLE

NASA open science data repository: open science for life in space

Samrawit G Gebre, Ryan T Scott, Amanda M Saravia-Butler, Danielle K Lopez, Lauren M Sanders, Sylvain V Costes ✉

Author Notes

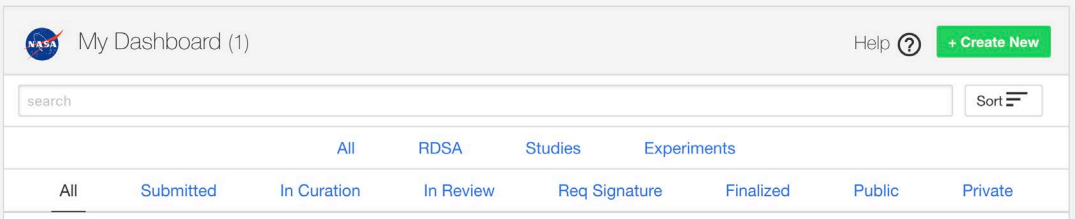
Nucleic Acids Research, gkae1116,

https://doi.org/10.1093/nar/gkae1116

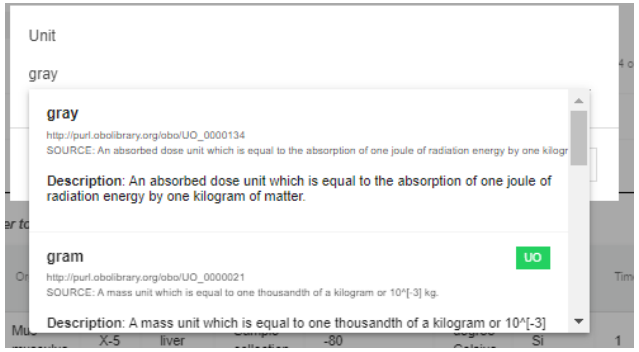
Published: 18 November 2024 **Article history** ▾

https://academic.oup.com/nar/advance-article/doi/10.1093/nar/gkae1116/7903386?login=true

Submission Portal Dashboard

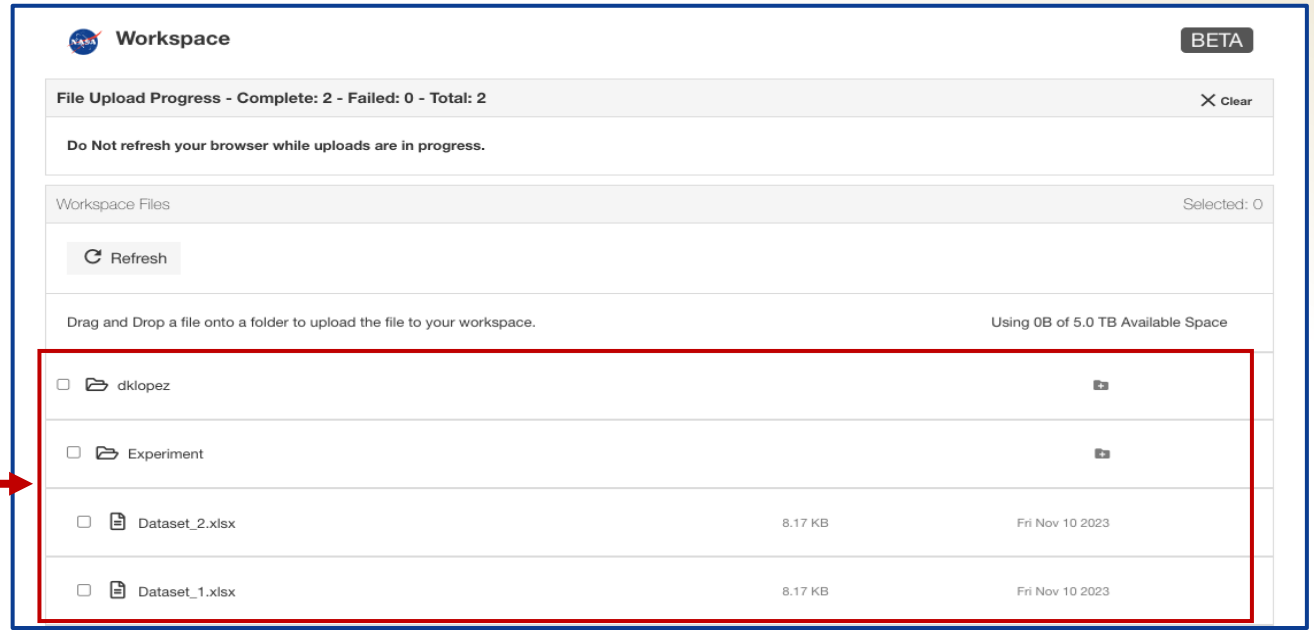


Sample Name	Protocol REF	Parameter Value - QA Instrument	Parameter Value - QA Assay	Parameter Value - QA Score	Unit	Extract Name	Protocol REF
Sample1	Nucleic Acid Extraction	BioAnalyzer	NanoChip	8	RIN	Extract 1	Library Construction
Sample2	Nucleic Acid Extraction	BioAnalyzer	NanoChip	9	RIN	Extract 2	Library Construction
Sample3	Nucleic Acid Extraction	BioAnalyzer	NanoChip	9.1	RIN	Extract 3	Library Construction

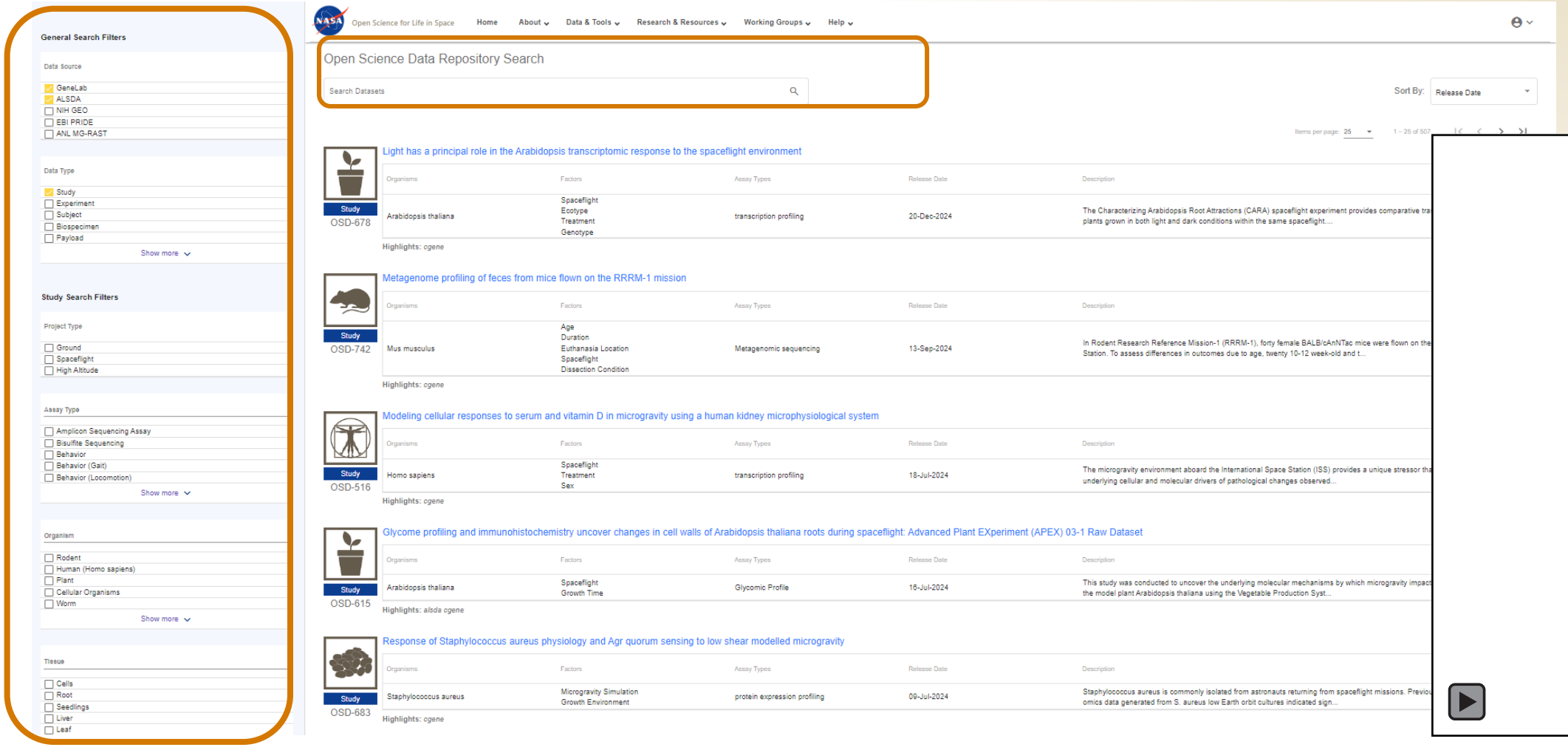


- Self-service submission portal.
- Allows efficient input of sample and assay level metadata alongside data files.
- Controlled vocabulary and ontologies
- Tailored to specialized needs of spaceflight samples.
- Used for both omics (GeneLab) and non-omics (ALSDA) data submissions.
- Private link for sharing with reviewers and collaborators.

PI 'Private' Workspace



Data Repository



COMING SOON

522
Studies

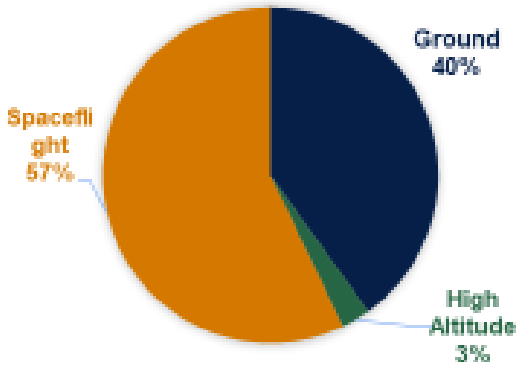
973
Datasets

45
Species

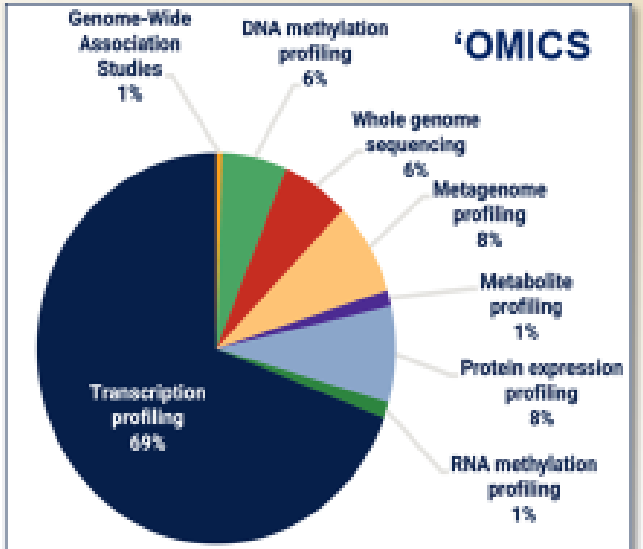
>80
Assays

>210TB
Data

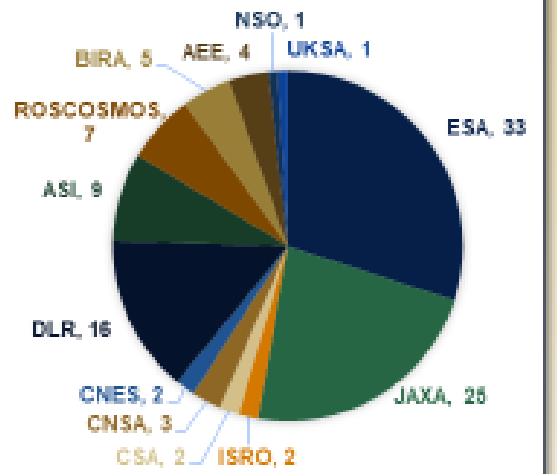
STUDY TYPE



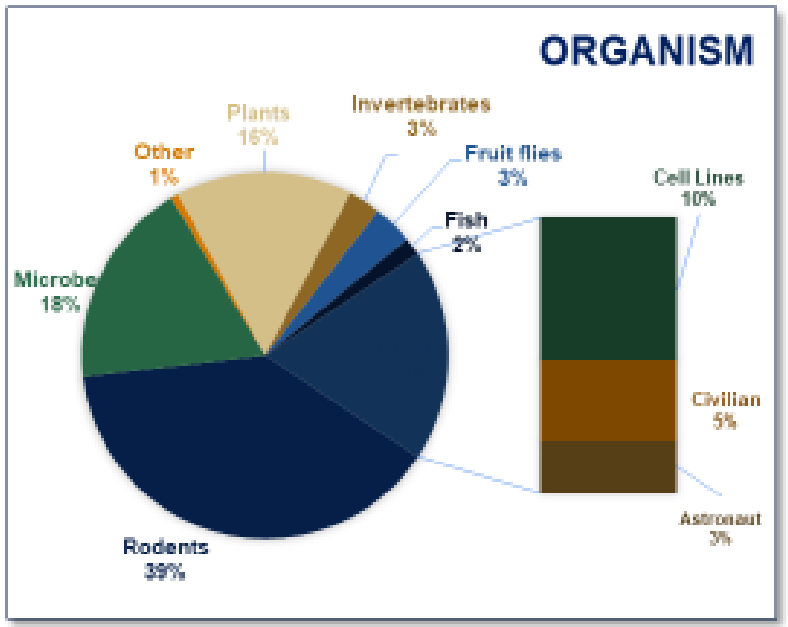
'OMICS



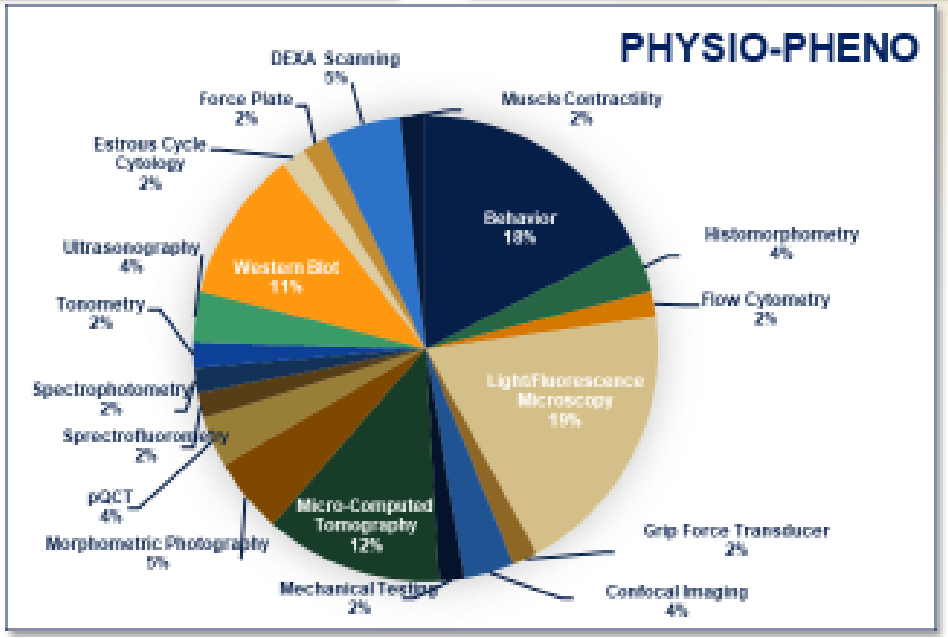
INTERNATIONAL STUDIES



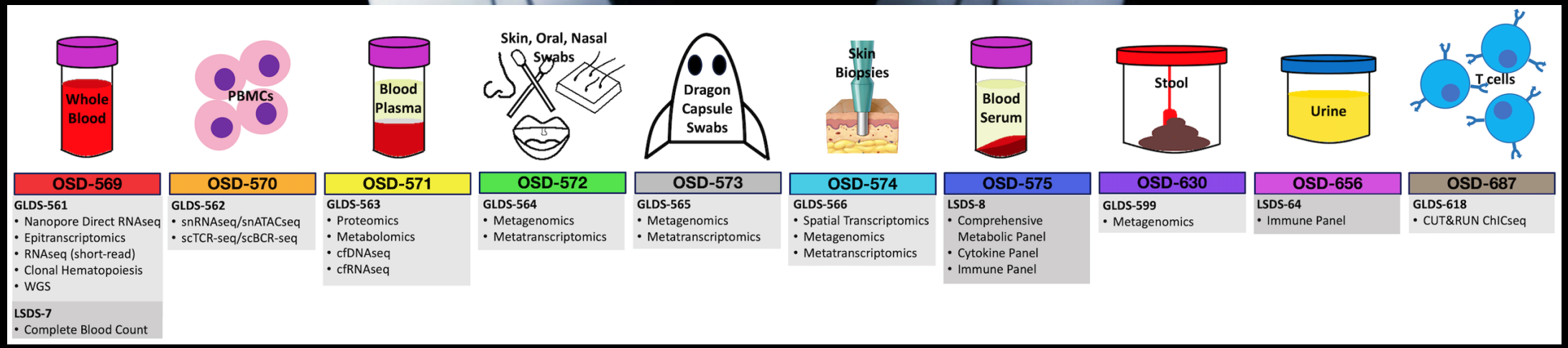
ORGANISM



PHYSIO-PHENO



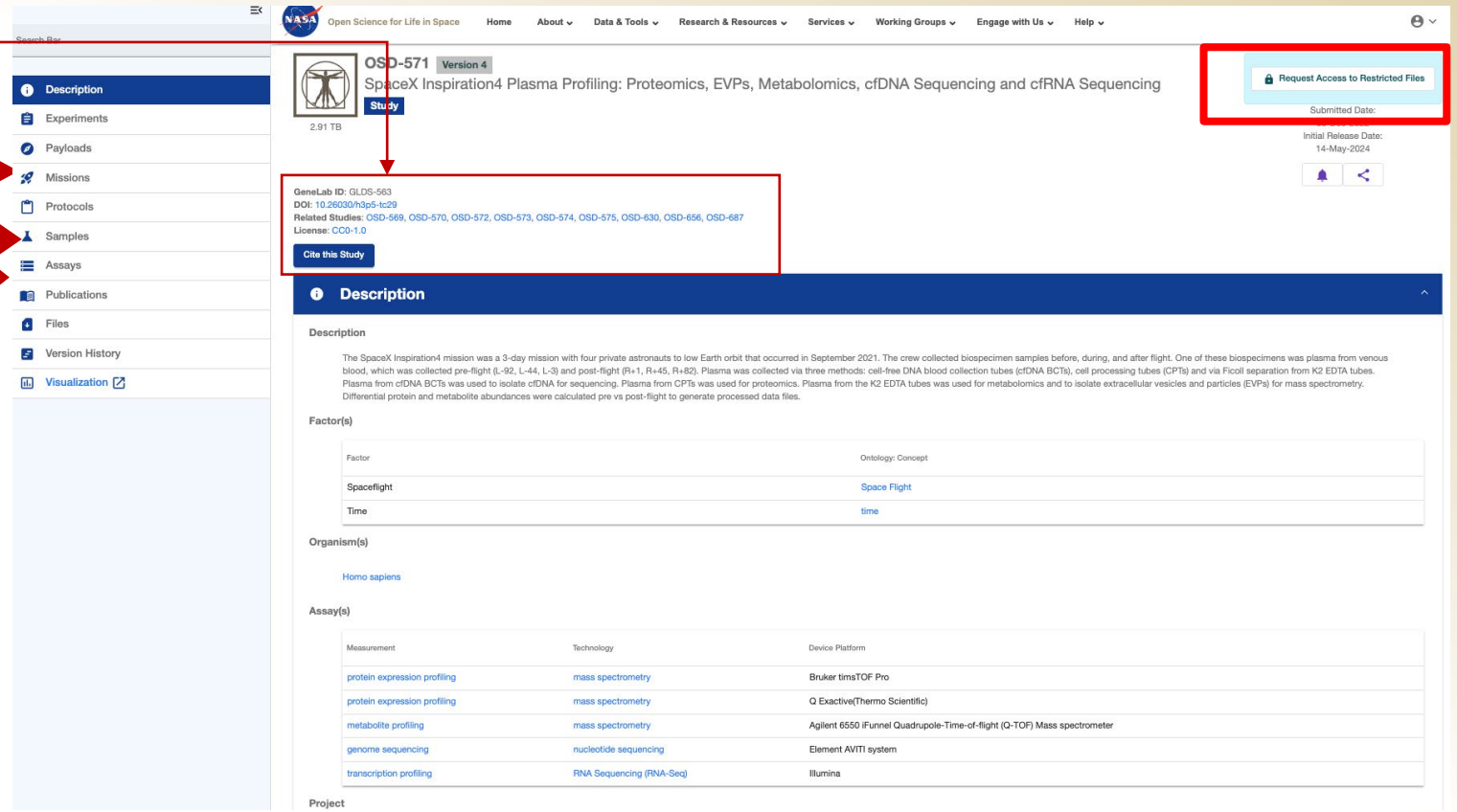
Weil Cornell Medicine



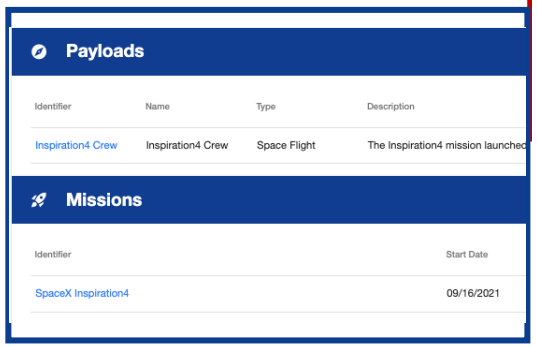
Nature Portfolio - SOMA'
I4 Image Credit: Chris Mason's Lab;
Overbey et al., 2024

Studies

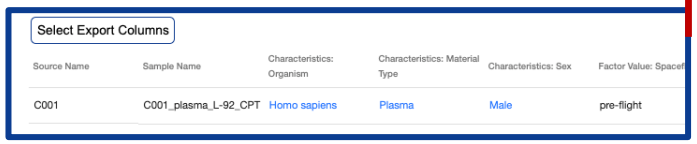
DOIs, citation, license



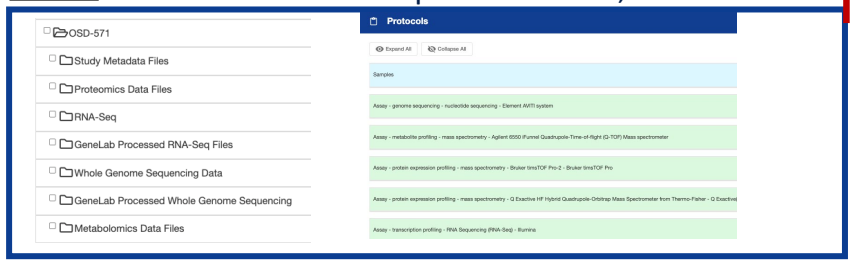
Mission and Payload Details



Detailed Sample Metadata



Raw and Processed Experiment Data, Methods

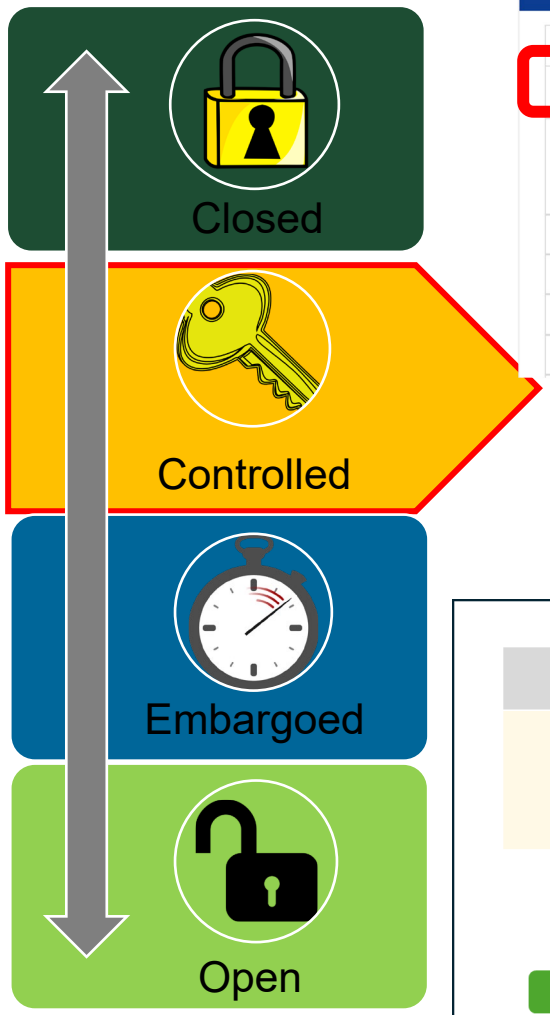


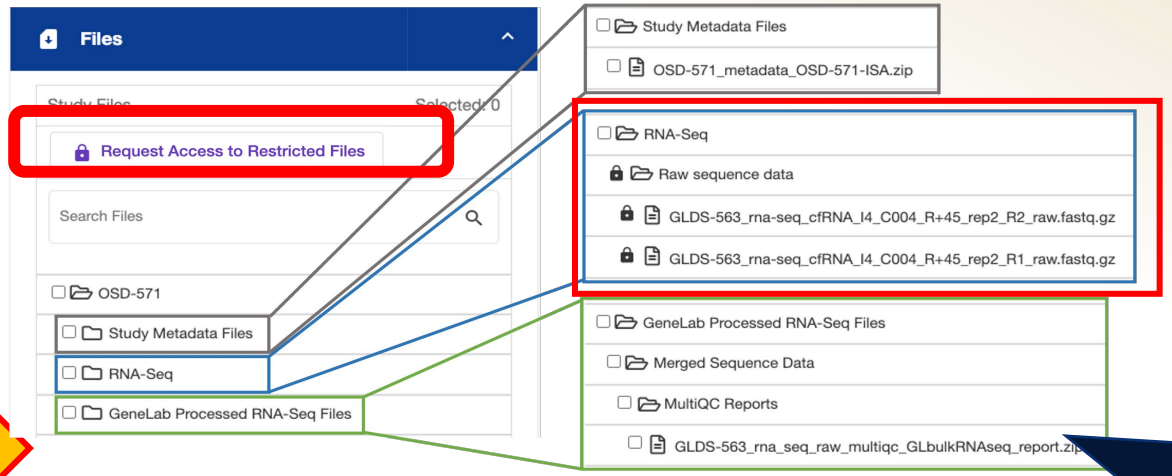
Publication Information

CONTRIBUTE | DISCOVER | LEARN | EXPLORE

Controlled Access Data

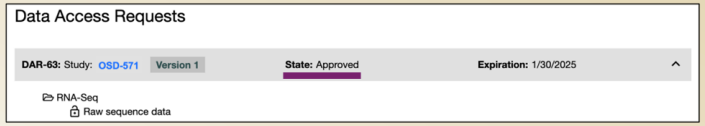
The Continuum

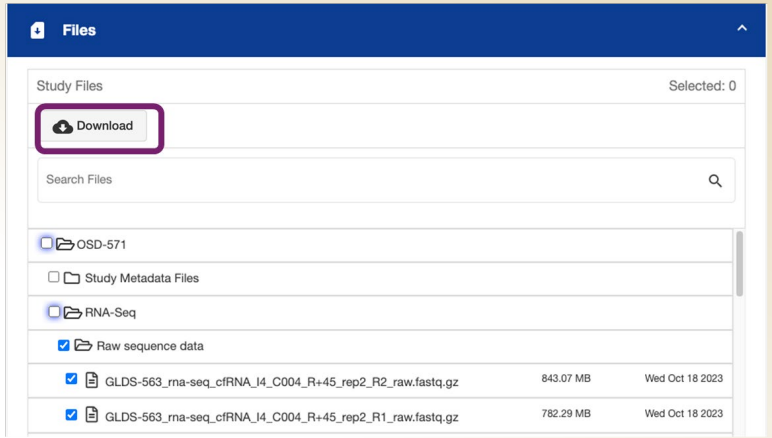




If Approved

Data Access Info Available On DAR Portal



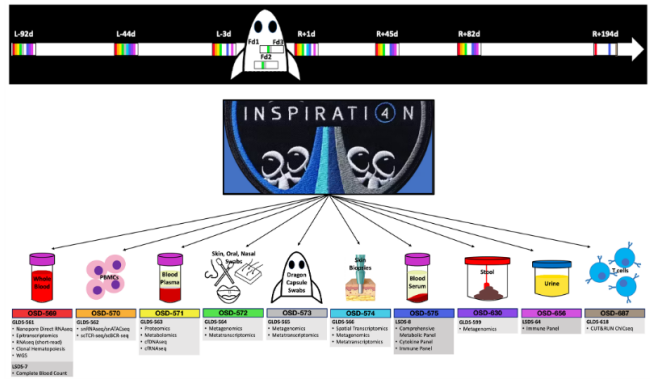


Access Request Process for Private Data

1	2	3	4	5	6	7	8
Identify the Dataset	Submit Request	Verify Affiliation	Review by OSDR	Review by Committee	Data Access	Progress Report	Close Out
Request Button clicked in OSD dataset	OSDR Data Request Package sent w/ Data Use Agreement	OSDR Follow-Up with your institution	Data Access Committee review with Specific Stakeholders (OSDR, PIs, etc)		Approved / Denied Secure Access	Annual update	Access removed at end of access period, upon participant request, or if conditions of Data Use Agreement are violated

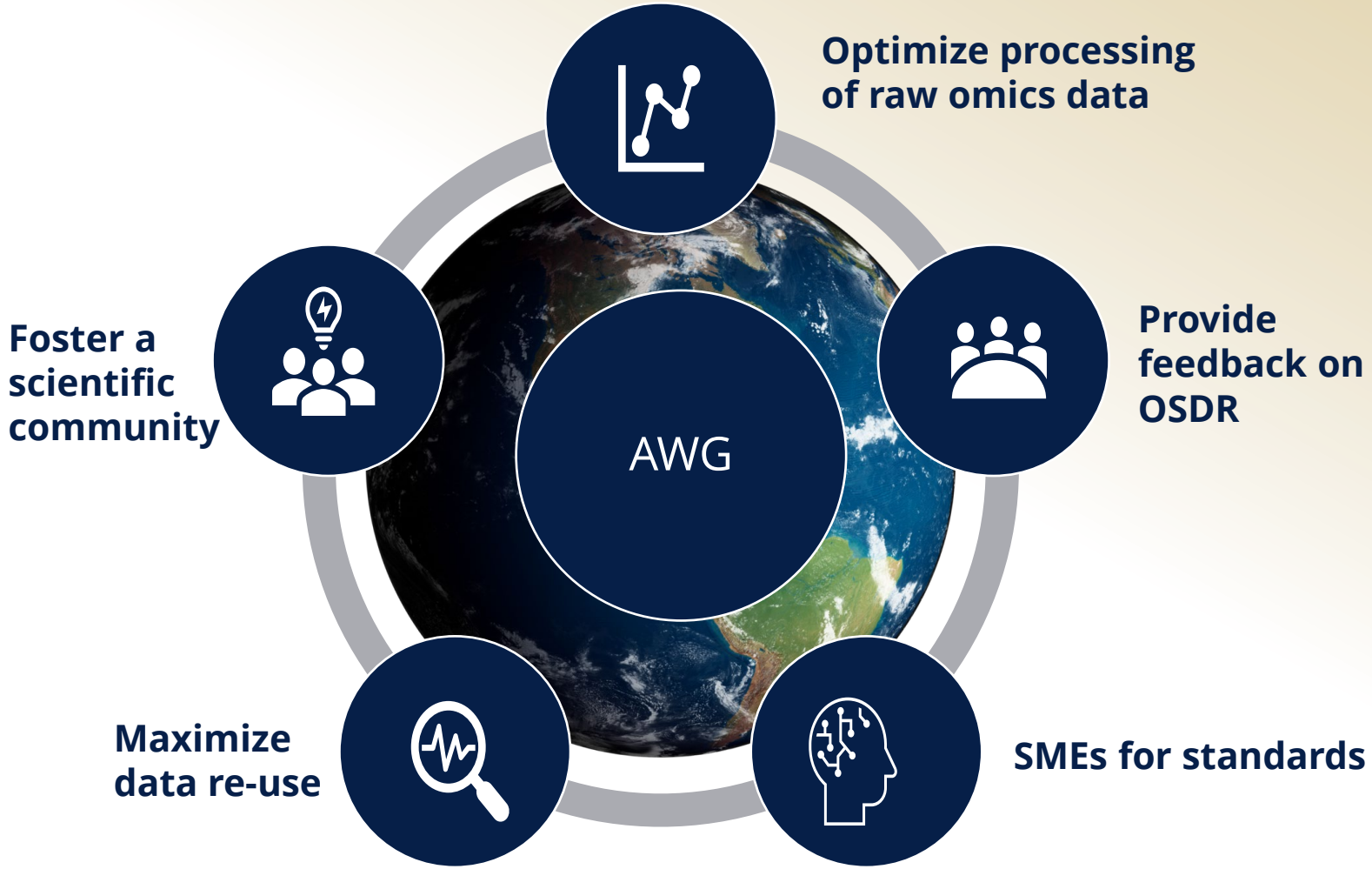
Process inspired by NIH's Database of Genotypes and Phenotypes (dbGaP)

Present your discoveries at the human AWG!



Community Engagement - AWGs

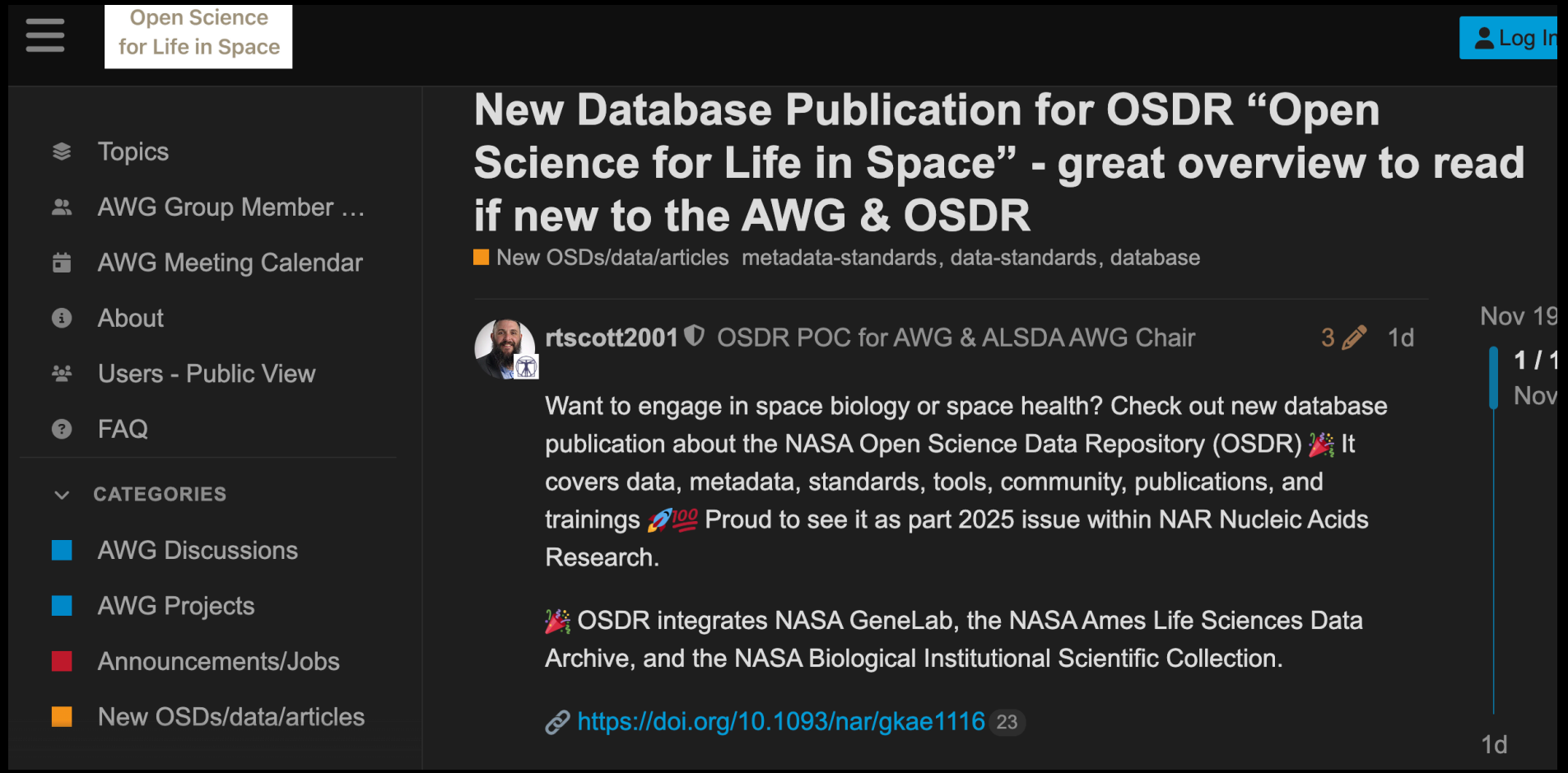
- Launched in 2018, we currently have 9 groups: Animal, Microbes, Multi-Omics, Plants, ALSDA, AI/ML, Female Reproduction, RadLab and Human AWG.
- We host yearly workshops, virtual symposiums and events
- Overall, we have had over 1000 members, with 800 current active members.
- AWG Forum space for transparent and open communication



NEW OSDR AWG Forum space

493 New AWG Members in 2024 (January-October)

853 current members as of Oct 25th



AWGs Accelerate Data Mining & Publications

Cell Press 2020 – the Biology of spaceflight

- A coordinated package of 29 scientific papers published in five *Cell Press* journals
- 9 papers utilize data or resources in GeneLab

Nature Portfolio Collection 2024: Space Omics and Medical Atlas

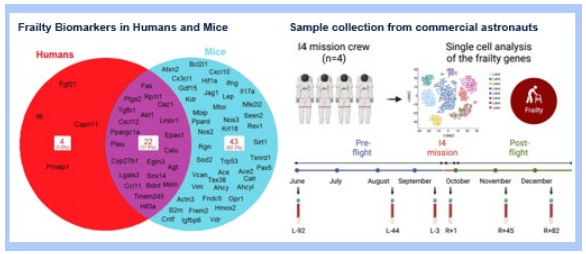
- **44 publications** across **25 countries** and **100 institutions**
- **111 AWG Members** participated in the Nature Press Package across **43 publications**
- **13 OSDR Members** participated in the Nature Press Package across **17publications**
- **Global Reach** with 650 news articles, >1,300 posts with 7M+views on X, and over 100,000 accesses across all publications

AWGs have published over 30 publications utilizing data in OSDR

https://osdr.nasa.gov/bio/data/publications.html

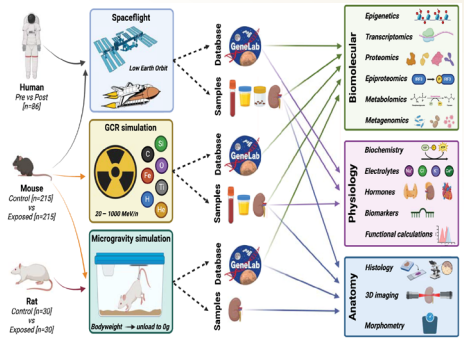
Recent Science Findings

Collaborative AWG Publications



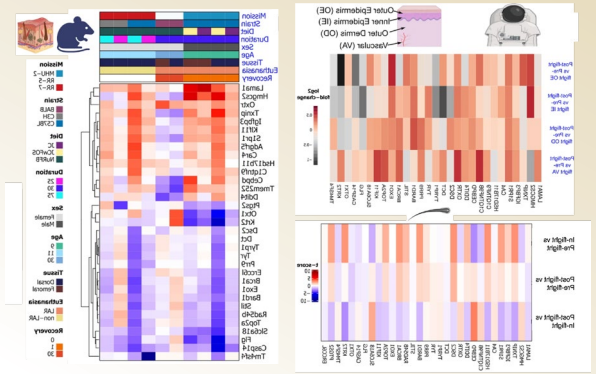
Aging and Fragility Biomarkers are Altered by Spaceflight

Camera, A.,... Karouia, F., …Beheshti A. Aging and putative frailty biomarkers are altered by spaceflight. *Sci Rep* 14, 13098 (2024). https://doi.org/10.1038/s41598-024-57948-5



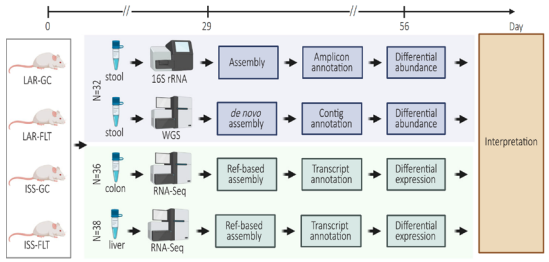
Cosmic Kidney Disease: A study into spaceflight-induced renal dysfunction

Siew, K., Nestler, K.A., Nelson, … C., Boyko, V., Degoricija, L., Gebre, S., Polo, S.L., Scott, R.T., Saravia-Butler, A.M., Sanders, L.M., Costes, S.V., Almeida, E.A.C., Galazka., J.M... et al. Walsh, S.B. Cosmic Kidney Disease: The Effects of Spaceflight and Galactic Cosmic Radiation on Renal Structure and Function. Nat Communications 15, 4568 (June 2024). https://doi.org/10.1038/s41467-024-49212-1



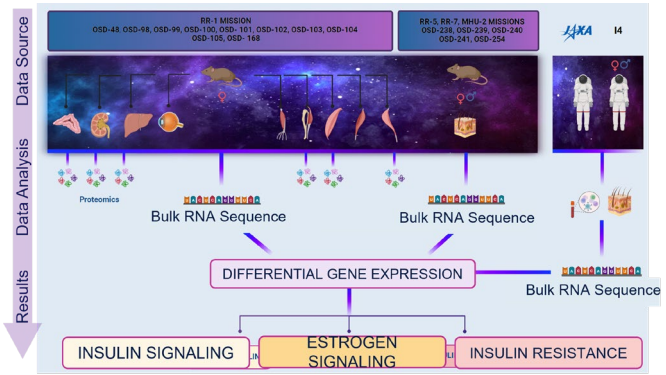
Spaceflight Induces Molecular Alterations in Skin

Cope, H., Elsborg, J., ... Parthasrathy, H., Unadkat, H., Chatrathi, M., Claudio, J., Reinsch, S., ... Beheshti, A. Transcriptomics analysis reveals molecular alterations underpinning spaceflight dermatology. *Nature: Communications Medicine 4*, 106 (2024). https://doi.org/10.1038/s43856-024-00532-9



Multi-Omics Analysis Reveals Impact of Spaceflight Stress on Mice Gut Microbiome and Physiology

Gonzalez, E., Lee, M.D, ... Karouia, F., Barker, R., Galazka, J., Brereton, N.J.B. Spaceflight alters host-gut microbiota interactions. npj Biofilms Microbiomes 10, 71 (2024). https://doi.org/10.1038/s41522-024-00545-1



Spaceflight induces changes in gene expression profiles linked to insulin and estrogen

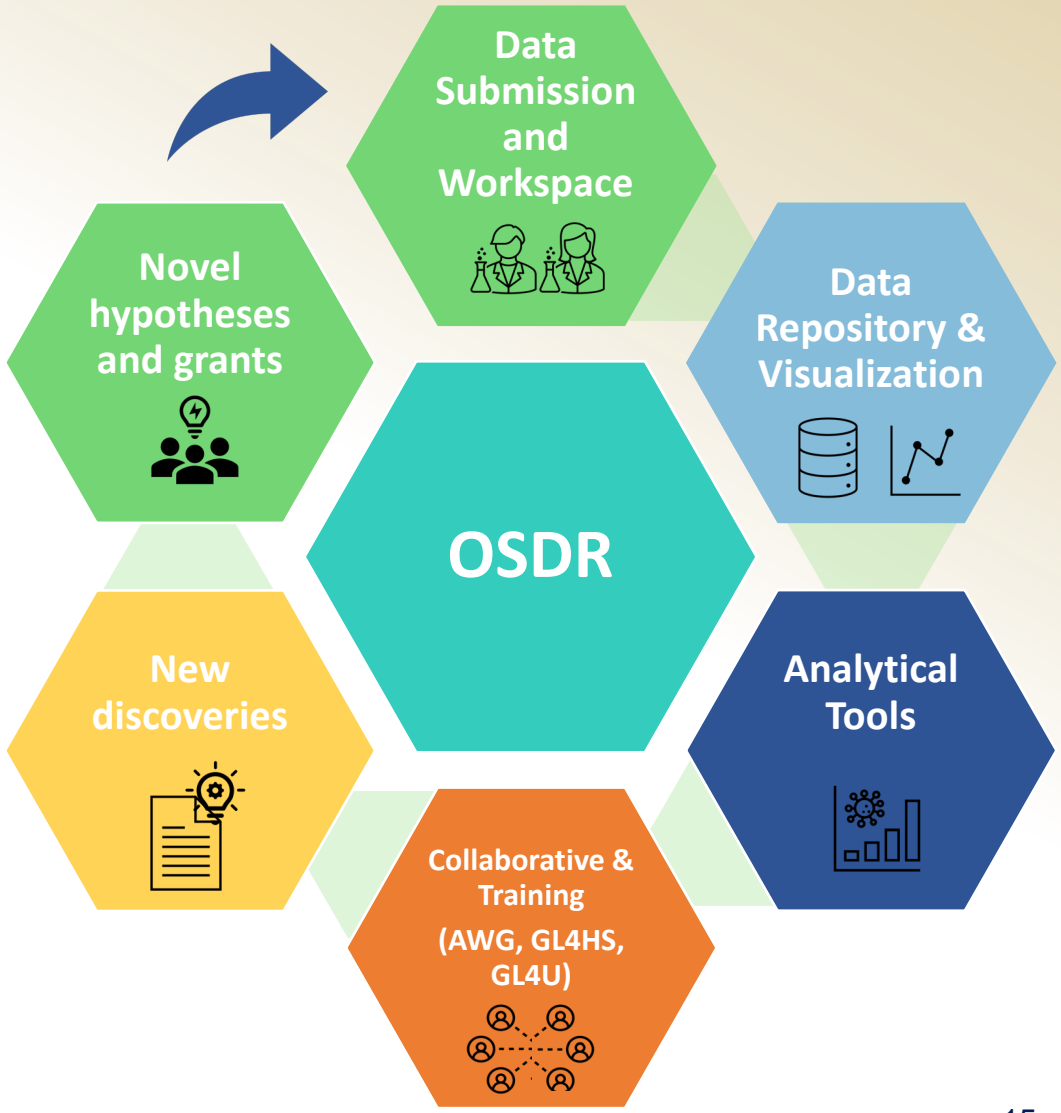
Mathyk, B.A., Tabetah, M., Karim, R.... Beheshti, A. (2024). Spaceflight induces changes in gene expression profiles linked to insulin and estrogen. *Nature: Commun Biol* 7, 692. https://doi.org/10.1038/s42003-023-05213-2

BIOLOGICAL OPEN SCIENCE ECOSYSTEM

Join us today!

- **FAIR Data Portal**: Self-service submission portal with standard metadata templates, private workspace, and sharing capabilities.
- **Open Data Repositories**: Diverse datasets (microbes to humans) with visualization for discovery.
- **Bioinformatics Tools**: User-friendly analysis tools for students, scientists, and researchers.
- **Global Impact**: 600+ members, training programs, and **research enabled by data reuse.**

Open access data enables discovery of new hypotheses and new ideas for grant proposal. Data from those new research experiments are generated and deposited back into OSDR.



THANK YOU!

OSDR Team

- $ GeneLab funded by BPS
- $ ALSDA and NBISC funded by BPS and HRP




San-huei Lai Polo
Alec Vallota Eastman
Rachel Gilbert
Skylar D'Angiolillo

SCIENTIFIC COMMUNITY

OPEN SCIENCE

DATA REPOSITORY

GENELAB OMICS + **ALSDA** PHENOTYPIC