Beyond FAIR: Engagement, Data Usability, and Open Community Productivity through NASA OSDR

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Amentum | Science Lead
NASA Open Science Data Repository
OSDR Liaison for all AWG Members

Danielle Lopez (KBR)
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Lauren Sanders (NASA Ames)
Samrawit Gebre (NASA Ames)
Sylvain Costes (NASA Ames)

BPS
Biological & Physical Sciences

ryan.t.scott@nasa.gov – HRP-IWS25 – Jan 30, 2025

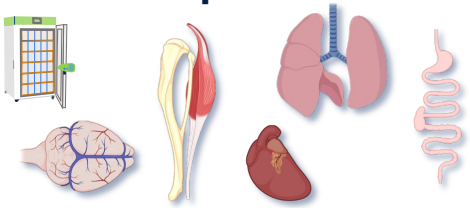
Data for Space Biological, Health, Telemetry Analytics

Physiological/Phenotypic/Imaging/ Environmental Telemetry Data

Tabular, text, imaging, telemetry, video, code

Molecular/Omics Data

Biospecimens



ALSDA

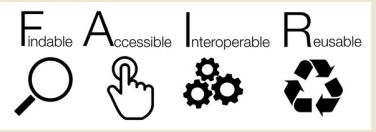
GeneLab

NBISC

NASA Open Science Data Repository (OSDR)

www.nasa.gov/osdr/

- **Single Submission & Curation Portal**
- **Workspace for Submitter Labs/Collaborators**
- **File Transfer Manager App**
- **Research Data Submission Agreement GUI**
- ***Maximally* Open Access**
- **Controlled Data Access Request System**
- **Data Maximally FAIR**



- **Environmental Data Application & RadLab**
- **Multi-Study Viz tool for Users (Omics)**

(Gebre et al 2024, PMID: 39558178)

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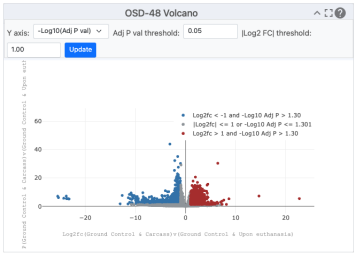
A Buffet of OSDR Space Bioscience Data

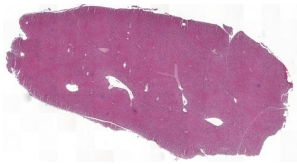
OSD-48 Version 13

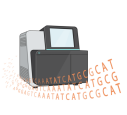
Rodent Research-1 (RR1) NASA Validation Flight: Mouse liver transcriptomic, proteomic, epigenomic and histology data

552.72 GB

Study





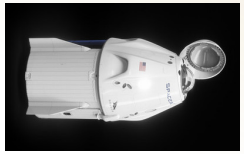


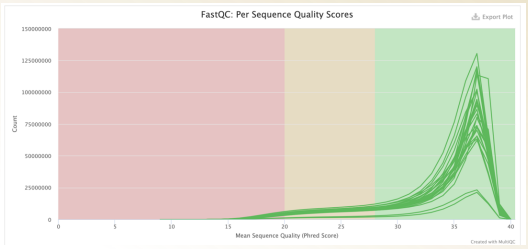
OSD-569 Version 2

Whole Blood Measurements from the SpaceX Inspiration4 Mission (RNA-seq, epitranscriptome, WGS, clonal hematopoiesis, CBC)

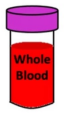
6.51 TB

Study





Sample Name	absolute_basophils	absolute_eosinophils
C001_whole-blc	49	161
C001_whole-blc	50	204
C001_whole-blc	70	259
C001_whole-blc	50	170
C001_whole-blc	49	221
C001_whole-blc	59	127
C001_whole-blc	69	181
C002_whole-blc	29	151
C002_whole-blc	32	211
C002_whole-blc	33	280
C002_whole-blc	39	160
C002_whole-blc	19	166
C002_whole-blc	51	211
C002_whole-blc	32	90
C003_whole-blc	49	88
C003_whole-blc	47	130
C003_whole-blc	125	614
C003_whole-blc	28	140
C003_whole-blc	59	207
C003_whole-blc	62	117

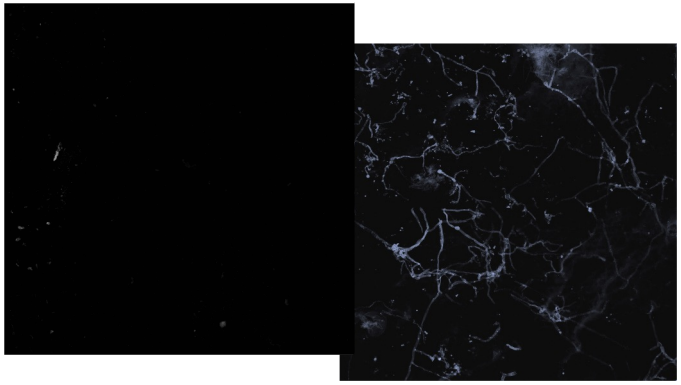


OSD-628 Version 2

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

5.29 GB

Study

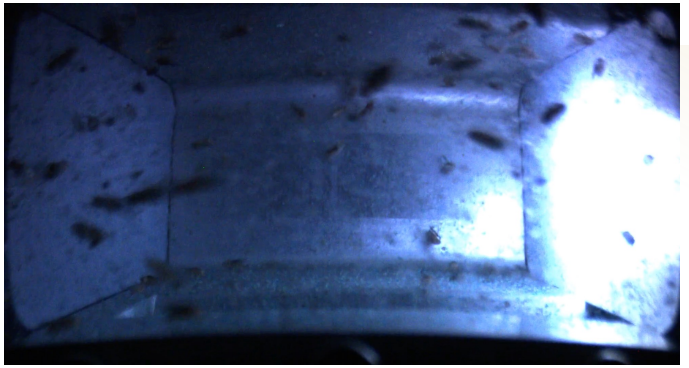


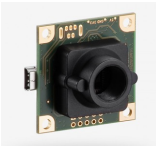
OSD-595 Version 1

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

17.29 GB

Study





(NIAID Visual & Medical Arts. 2024, Confocal Microscope. NIAID NIH BIOART)

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(Sanders et al., 2024, PMID: 38744887; Aegis electronic group; IDS Imaging UI-1461LE-C-HQ USB 2.0 Rolling Shutter Board Level Camera; SpaceX / Inspiration4, via Wikipedia)

NASA Open Science Data Repository

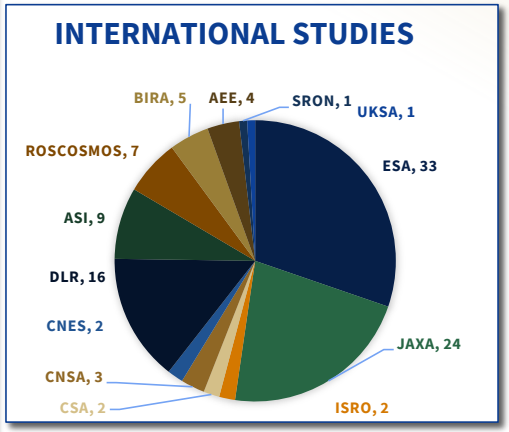
530 Studies

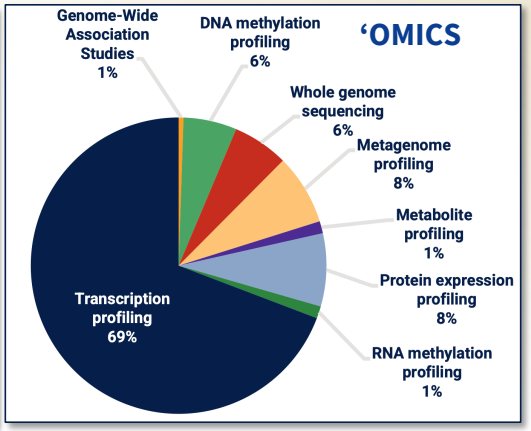
973 Datasets

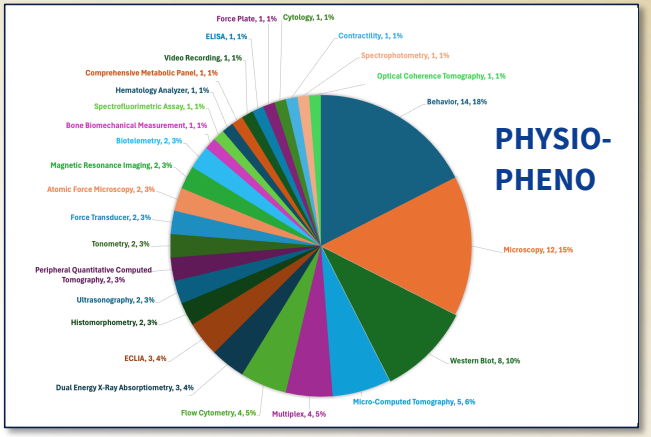
45 Species

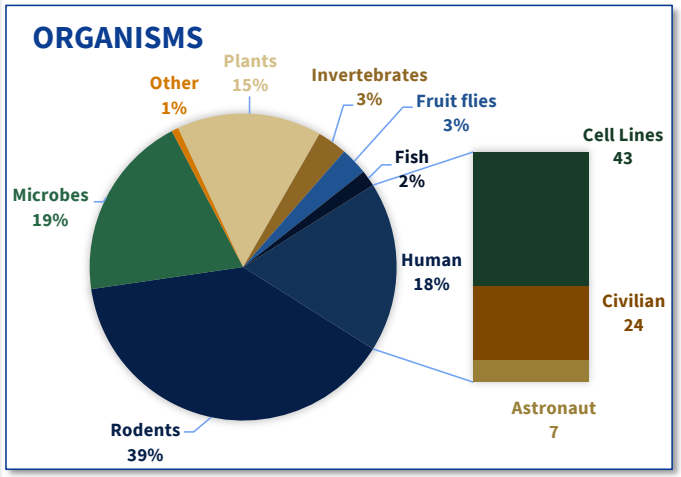
>80 Assays

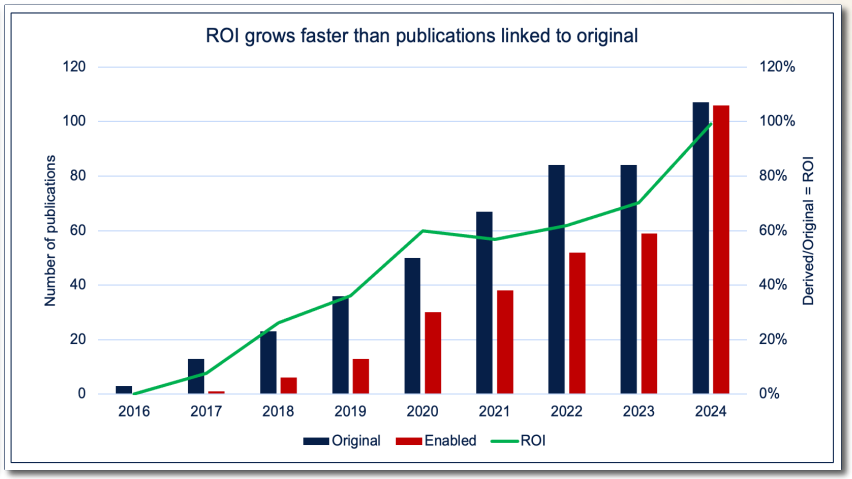
>210TB Data











107 Original Publications Have Data Submitted to OSDR

106 Publications Enabled by OSDR Data Mining

160 Datasets Used in Enabled Publications

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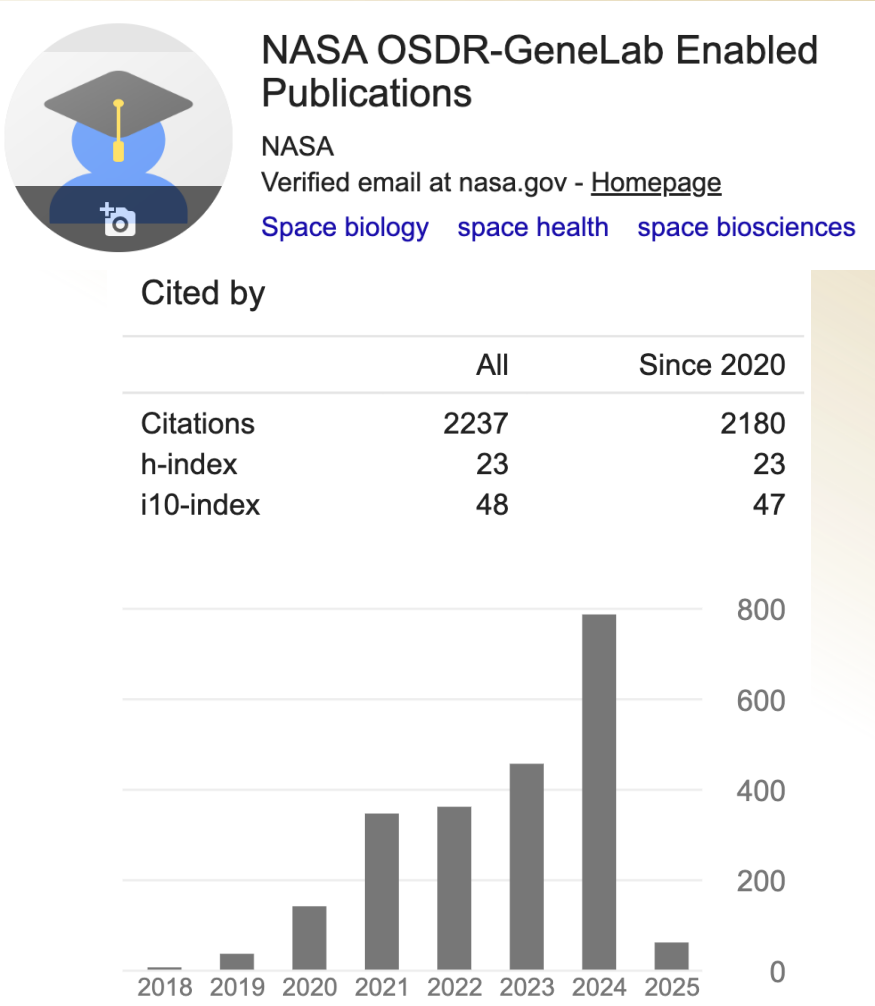
(Gebre et al 2024, PMID: 39558178)

Usage Metrics of OSDR

2024 OSDR/GeneLab Enabled:

51 scientific peer-reviewed articles, pre-prints, student theses

- 2023: 19 peer-reviewed scientific articles
- 2022: 20 peer-reviewed scientific articles
- 2021: 14 peer-reviewed scientific articles
- 2020: 16 peer-reviewed scientific articles
- 2019: 7 peer-reviewed scientific articles
- 2018: 5 peer-reviewed scientific articles
- 2017: 1 peer-reviewed scientific articles



FAIR Standards for Ingestion/Reuse – and FAIR-EST

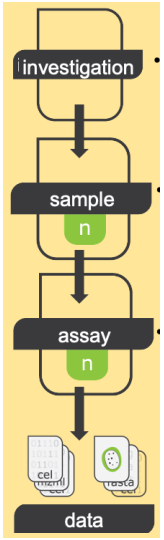
OSDR/GeneLab is maximally FAIR

108 **Assay Metadata Configs Created/Live**

~235 **SMEs/AWG Members Contributed**

~18 **Assay metadata configs in Progress**

~22 **Assay Metadata Configs on Radar/TBD**



Breakout meetings with SMEs, or asynchronous feedback

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

github.com/nasa/GeneLab_Data_Processing

github.com/nasa/OSDR_Data_Curation

Many dozens of Templates for data submissions for PIs

(Gebre et al 2024, PMID: 39558178)

E = Engagement, S = Social, T = Trust

Table 5. Engagement metrics.

Table 6. Social connections metrics.

Type	
Reflecting the social context	
Creating new social connections	

Table 7. Trust metrics.

Type	Metric	ID	Values	Description
Content	Authentication	TC1	y/n	A system is assessed as possessing the feature (y) if it includes an authentication mechanism for users.
	Gate keeping	TC2	y/n	A system is assessed as possessing the feature (y) if it provides a review functionality during submission by data stewards or other permitted organizational users.
	Review feature	TC3	y/n	A system is assessed as possessing the feature (y) if it includes a functionality for writing reviews on specific research artefacts.
Content support	Indicator	TCS1	n/s/a	A system is assessed as possessing the feature (s) if it records usage statistics and (a) if it provides advanced research indicators like h-Index or AltMetrics.
	Long-term preservation	TCS2	date	Date at which the first available artefact was deposited on the platform.
System	Open Source software and libraries	TS1	y/n	A system is assessed as possessing the feature (y) if the underlying system is open source.
	Uptake	TS2	h/m/l	A system is assessed as having high uptake (h) if it is used by a thousands of active users each month, medium uptake (m) with hundreds of active users, and low uptake (l) with lower numbers of active users.
Regulations	System backup	TG1	y/n	A system is assessed as possessing the feature (y) if it includes automated backups in a constant time interval.
	Right of information	TG2	y/n	A system is assessed as possessing the feature (y) if it provides a function to get all data about one user.
	Data deletion	TG3	y/n	A system is assessed as possessing the feature (y) if it provides a function to delete all data about one user.
	Agreement per data management process	TG4	y/n	A system is assessed as possessing the feature (y) if it allows the user to opt-in, agreeing to single personal data management processes individually.
	Portable and secure data exchange format	TG5	y/n	A system is assessed as possessing the feature (y) if it provides all personal data in an open standard format (e.g. HTML, TXT, PDF).
	Protection against data leaks	TG6	y/n	A system is assessed as possessing the feature (y) if it includes security tests for personal data.

(d'Aquin et al., 2023, https://doi.org/10.1162/dint_a_00159)

Open Science OSDR Analysis Working Group: 966 Members Worldwide

ANIMAL
310 members

MULTI-OMICS
498 members

MICROBIAL
301 members

Human
(BioMedical, Clinical)
111 members

RadLab
55 members

PLANTS
235 members

AI/ML
425 members

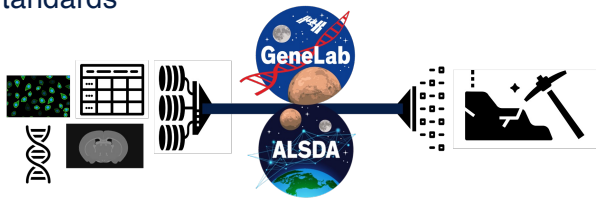
ALSDA
(Physiological/ Imaging)
267 members

Female Repro
108 members

Feedback on Ingress/Egress Standards

Ingestion, Curation, Processing Standards

Standards to Enable Reuse/Data Mining



(Gebre et al 2024, PMID: 39558178)

Collaborate on Data Mining & Investigations

Nature Portfolio Package 2024

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

List of 106 publications enabled by OSDR
https://osdr.nasa.gov/bio/data/publications.html

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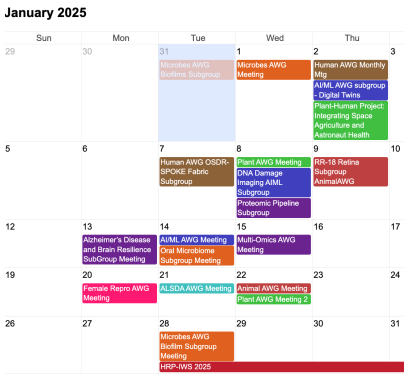
Kudos to the AWG Community – awg.osdr.space

awg.osdr.space/about



Our Admins

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OSDR POC for AWG …

lauren.sanders
Lauren Sanders
AIML AWG

gebresg
Sam Gebre
OSDR Project Manager

PCastano
Paola Castano
PlantAWG

danielle.lopez91
Danielle Lopez
ALSDAawg

kirill
Kirill Grigorev
RadLabWG

Our Moderators

jessicadurbano
Jessica D'Urbano
MultiOmicsAWG; ALS…

svcostes
Sylvain Costes
RadLabWG

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Seerat Maqsood
FemaleReproAWG

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ALSDAawg

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Begum Mathyk
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Dr Richard Barker
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Masafumi Muratani
AnimalAWG

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Charlotte Nelson
HUMANawg

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Jaume Puig
Microbes AWG

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Borja Barbero
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Tejaswini Mishra
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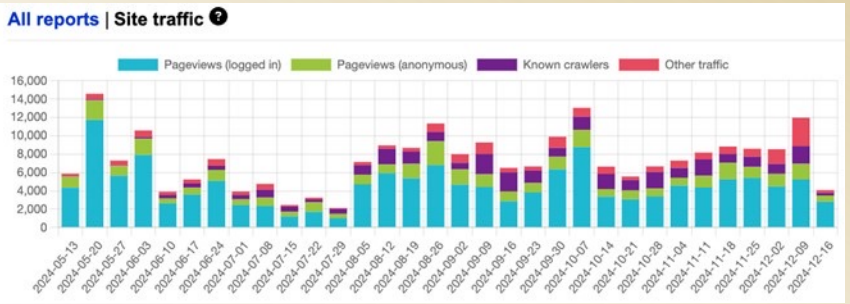
AfshinBeheshti
Afshin Beheshti
MultiOmicsAWG

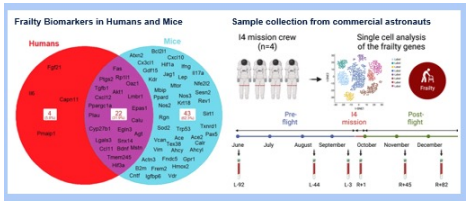
Dr.Overbey
Eliah Overbey
HumanAWG



- 22.0k views last 30 days
- 811 of 966 AWGers in the Forum
- ~200 AWGers ‘active’ per week
- ~500 AWGers visit per week
- ~200 send/reply in Chat per week

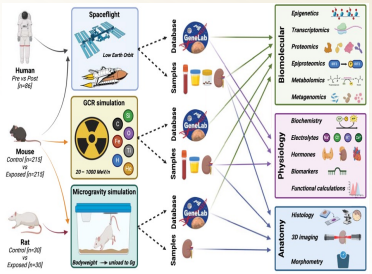
To Join the AWG

Collaborative AWG Findings – 16 publications in 2024



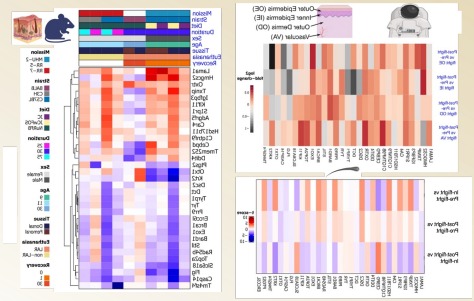
Aging and Fragility Biomarkers are Altered by Spaceflight

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



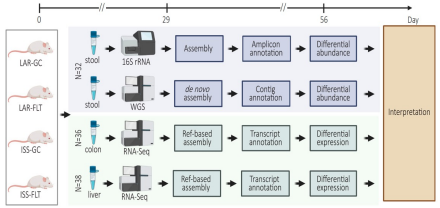
Cosmic Kidney Disease: A study into spaceflight-induced renal dysfunction

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



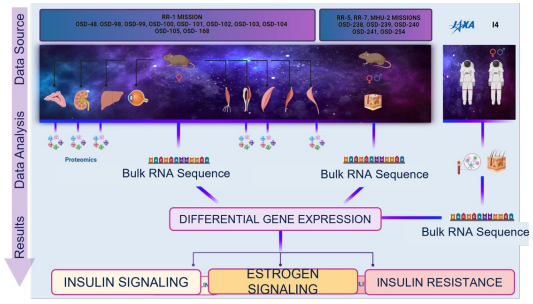
Spaceflight Induces Molecular Alterations in Skin

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

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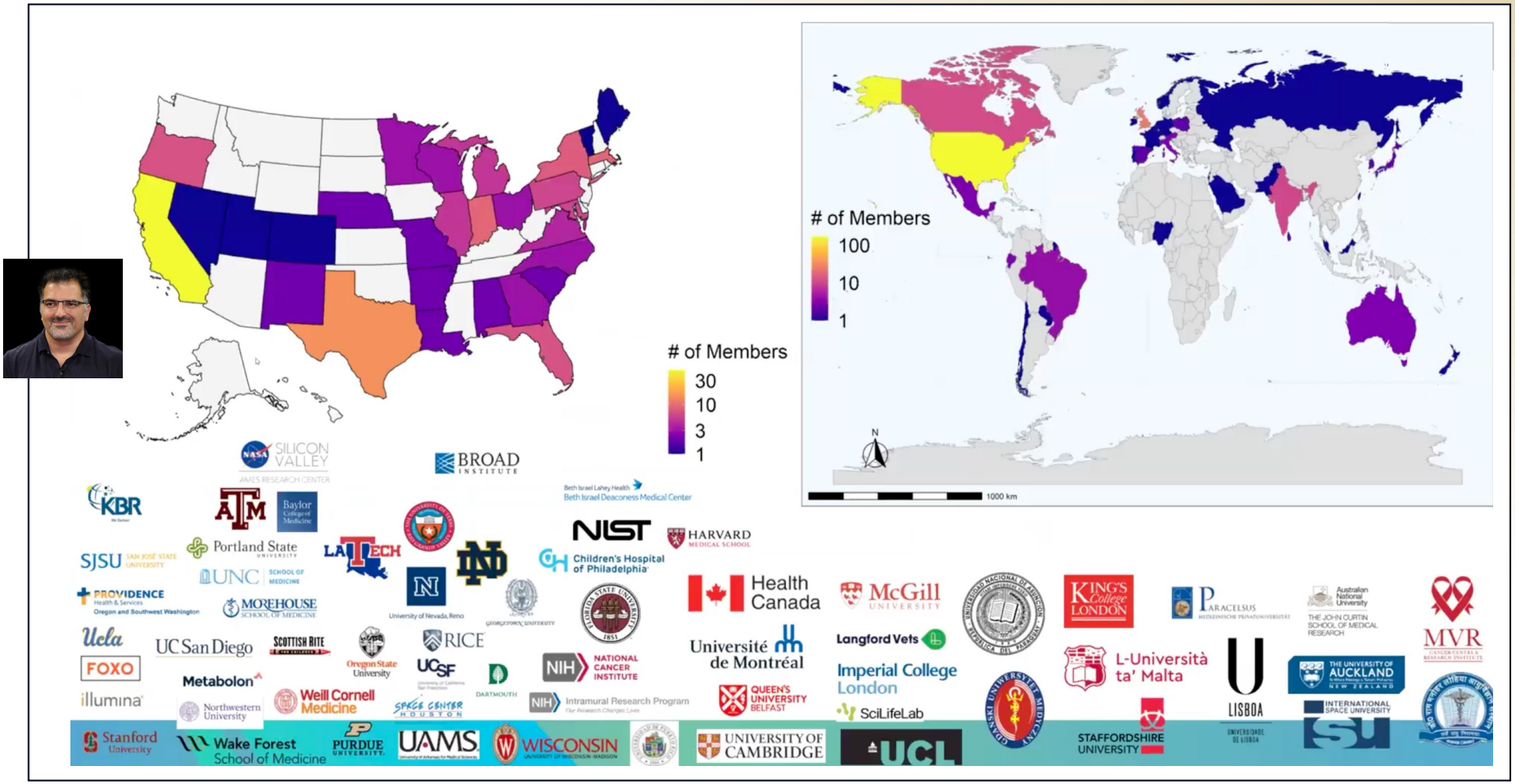
Multi-Omics AWG = 498 Members

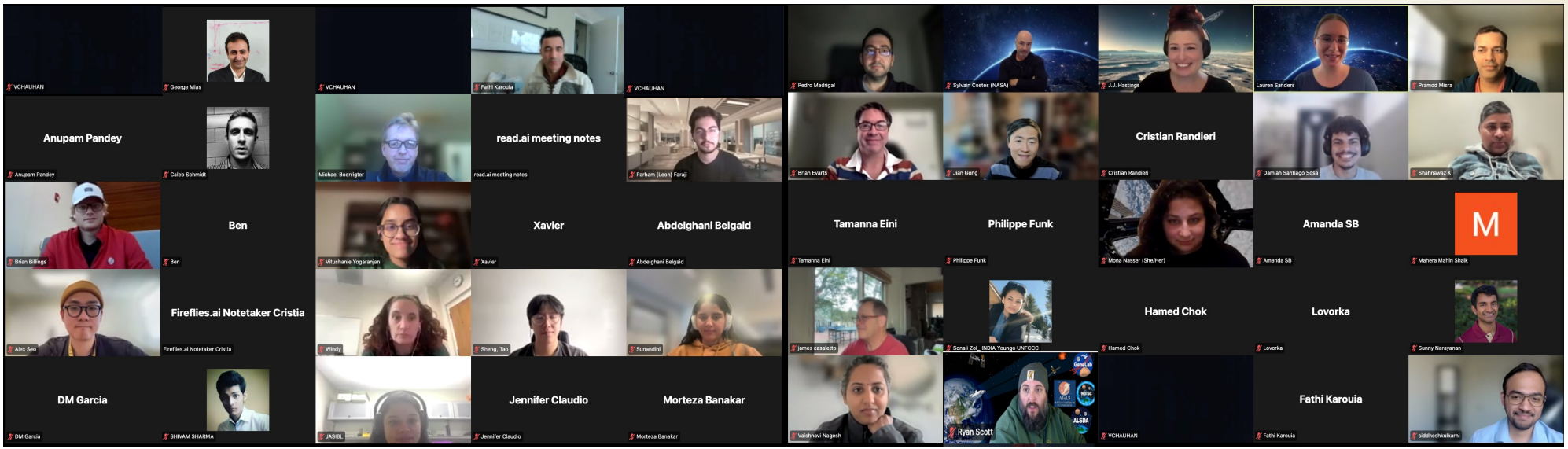


(Credit: Afshin Beheshti, Multi-Omics AWG Lead)

AI/ML AWG = 425 Members

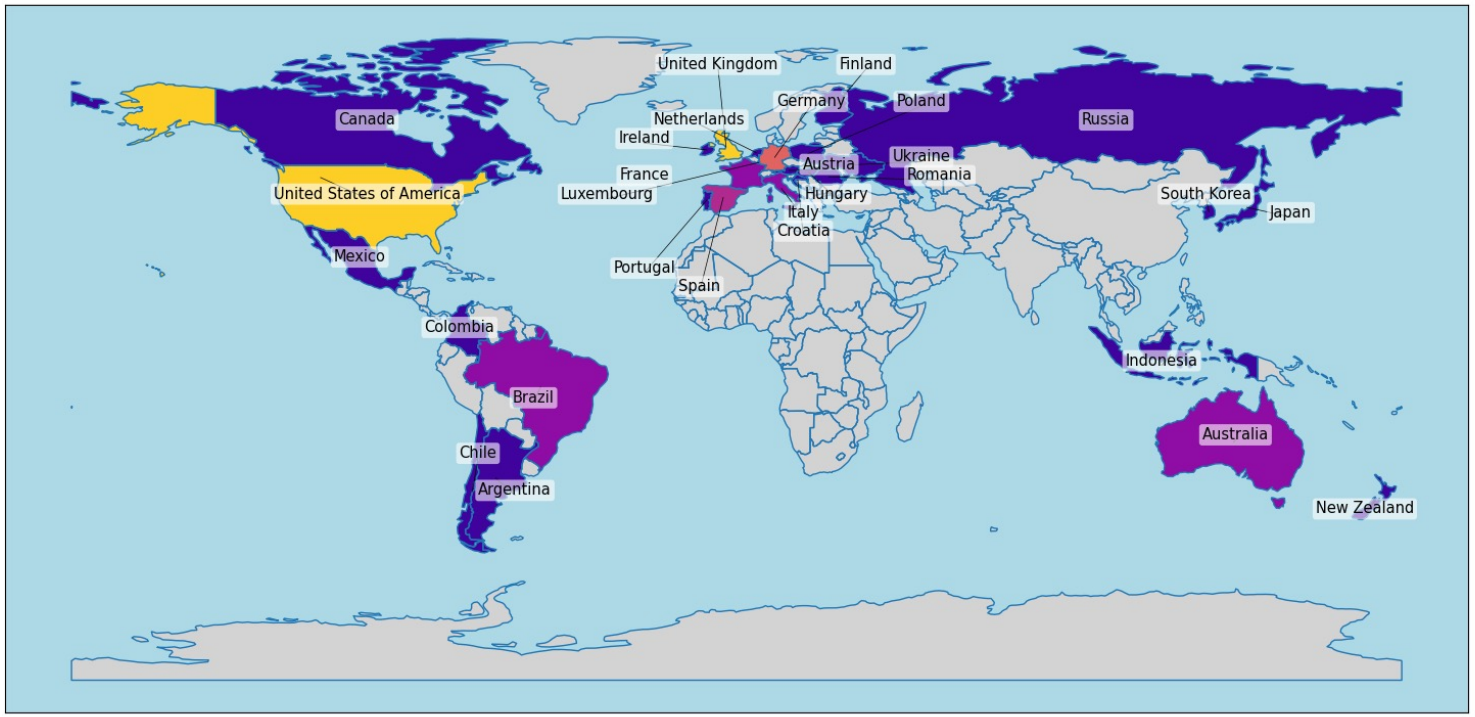
Sub-Group Updates:

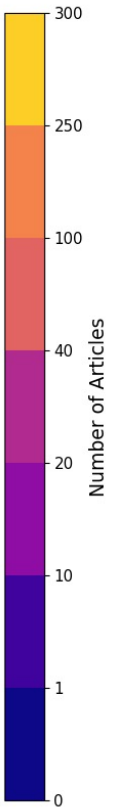
DNA Damage, Blood, Imaging/ML *Brian Evarts*	Digital Twin Retina *Jian Gong*	Causal Inference *Pramod Misra*	AI-Readiness *Pedro Madrigal*	Anomaly Detection, Environmental Telemetry *Michael Boerrigter*	AI-driven AOP's *Vinita Chauhan*



(Credit: Lauren Sanders, J.J. Hastings and Damian Santiago-Sosa; AI/ML AWG)

News Articles by Country





United States	250	United Kingdom	256	France	12	Spain	20
Brazil	11	Portugal	2	Indonesia	3	Chile	4
Finland	1	Poland	7	Romania	2	Argentina	3
Luxembourg	1	Russia	3	Germany	41	Italy	13
Australia	12	Canada	1	Colombia	1	Croatia	1
Ireland	3	Mexico	3	Hungary	1	Ukraine	2
Austria	1	Netherlands	1	Japan	2	New Zealand	1
South Korea	3						

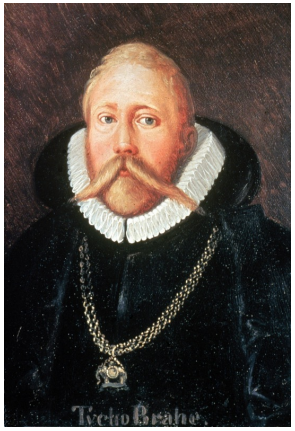
627 Articles covering all 45 articles; Scraping the Altmetric tracking data (via Nature; as of Jul 1, 2024)

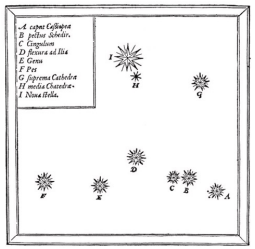
15 of 45 articles enabled or drive by the AWGs

116 AWG Members authored across 45 publications

Tycho Brahe Era of Space Biology, Space Health, Space Medicine

Data Collection, Curation, Annotation





Data Collection, Curation, Annotation

1971 (200,000 structures)

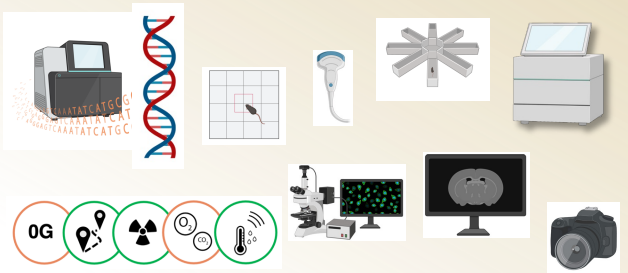
2002 (41,455 entries)

2002 (500 million sequences)

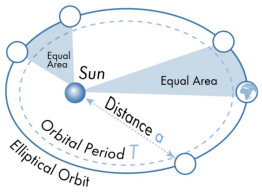
Data Collection, Curation, Annotation

NASA Open Science Data Repository (OSDR)

www.nasa.gov/osdr/

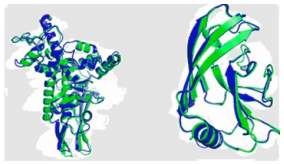


Knowledge and Insight Extraction



(Tycho Brahe, 1573 De Nova Stella, https://en.wikipedia.org/wiki/Tycho_Brahe; Eduard Ender, 1855, Portrait of Tycho Brahe; Johannes Kepler used by permission by Ele Willoughby, www.minouette.etsy.com)

Knowledge and Insight Extraction



ryan.t.scott@nasa.gov – HRP-IWS25 – Jan 30, 2025

Knowledge and Insight Extraction

-Basic-Fundamental Science

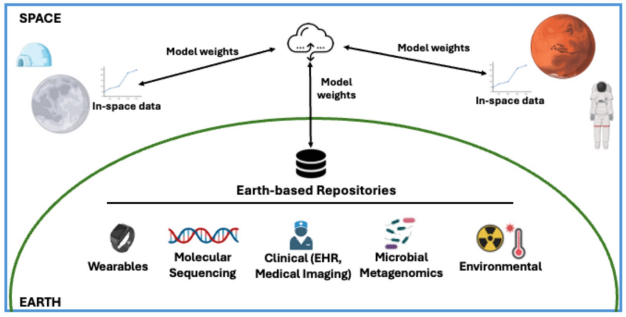
-Applied Science and Countermeasures

-Operational Support, Mission Planning

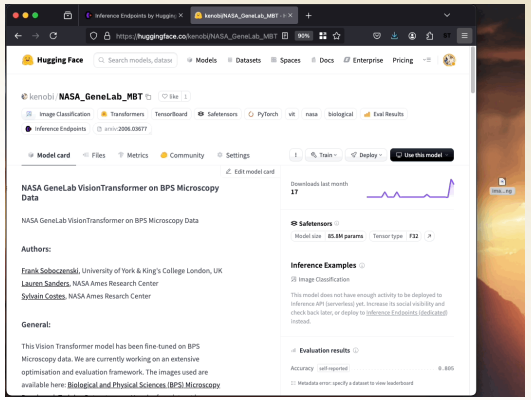
(Nobel Illustration used by permission: © Niklas Elmehed for Nobel Prize Outreach; Icons from Noun Project)

AI/ML for Space Biology, Space Health, Space Medicine

Deployed a Federated Biomedical Machine Learning Model Between Earth and the ISS

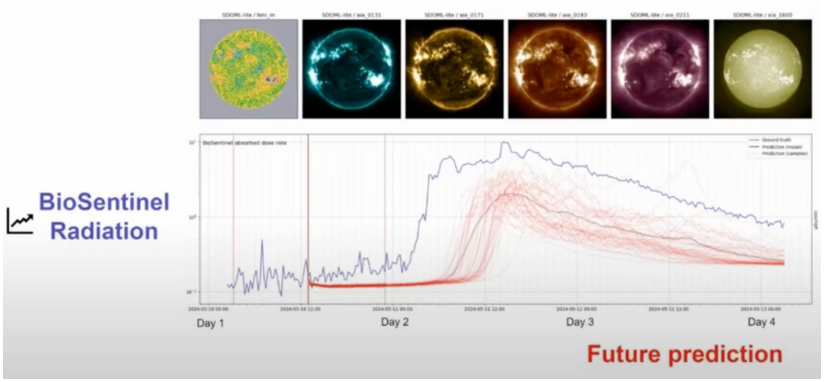


Training a Model to Detect Radiation DNA Damage



https://huggingface.co/kenobi/NASA_GeneLab_MBT

Forecasting Radiation Exposure For Human Space Flight

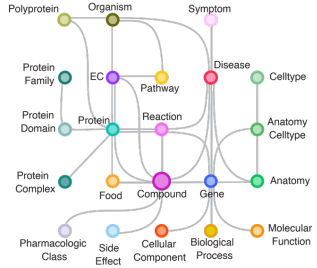


Knowledge Graph and Algorithms to Detect Pre-Clinical Space Impacts to Health

(Casaletto et al., 2025, bioRxiv preprint https://doi.org/10.1101/2025.01.14.633017
Massara, E., Song, X., Gurav, R., Sinclair, K., FDL 2024 Showcase, Heliophysics and Biology Collaboration, Trillium Tech, https://www.youtube.com/watch?v=VYe9wpx8PXQ
OSDR RadLab: https://visualization.osdr.nasa.gov/radlab/gui/overview/)

(Nelson et al., 2021, https://doi.org/10.3390/life11010042

New Analysis Tool – The Power of Quality & Structured Data



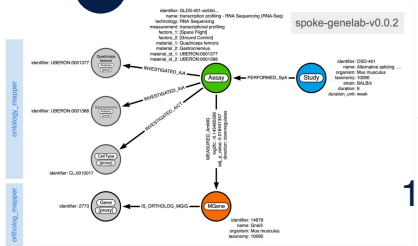
SPOKE KG

43 million nodes | 33 types

184 million edges | 116 types

>60 foundational databases

OSDR-SPOKE Data Fabric



OSDR KG

105,930 nodes | 7 types

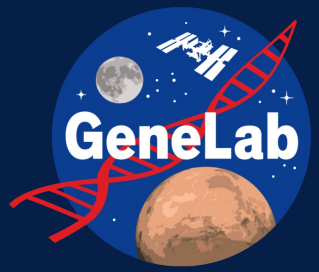
1,268,911 edges | 6 types

OSDR-SPOKE Viz Portal

Instant spaceflight health insight analysis for:

46 Studies & 569 Assays

NASA Open Science Data Repository



Stakeholders-Management

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

AI for Life in Space
- Walter Alvarado
- James Casaletto
- Lauren Sanders
- Sylvain Costes

Collaborators

All “Open Science for Life in Space” AWG Members

NASA Center for Climate Simulation; Science Managed Compute Environment
- Aaron Skolnik
- Andre Avelino Paniagua
- Ellen Salmon
- Daniel Duffy

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