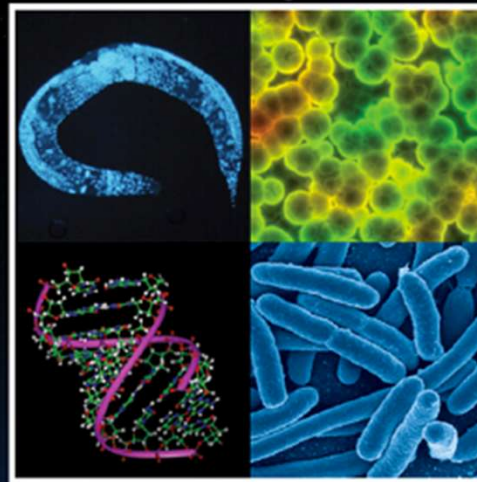


Open Science for Life in Space

National Aeronautics and
Space Administration

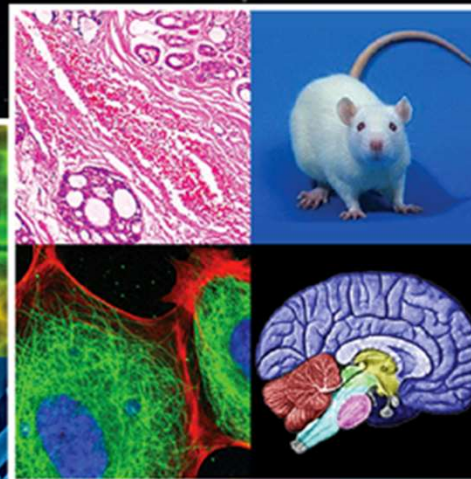


Biological Systems



- Model Organisms
- Cell and Microbial Biology
- Biomolecules

Human Health



- Mammalian Cells
- Model Organisms

Human Exploration



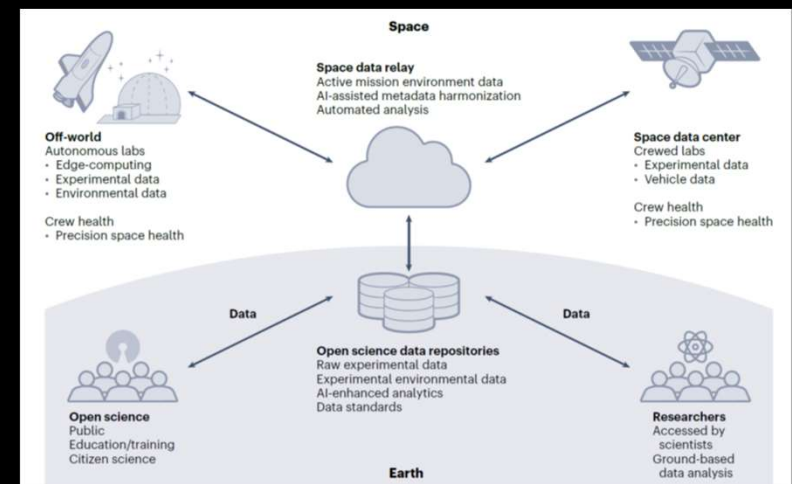
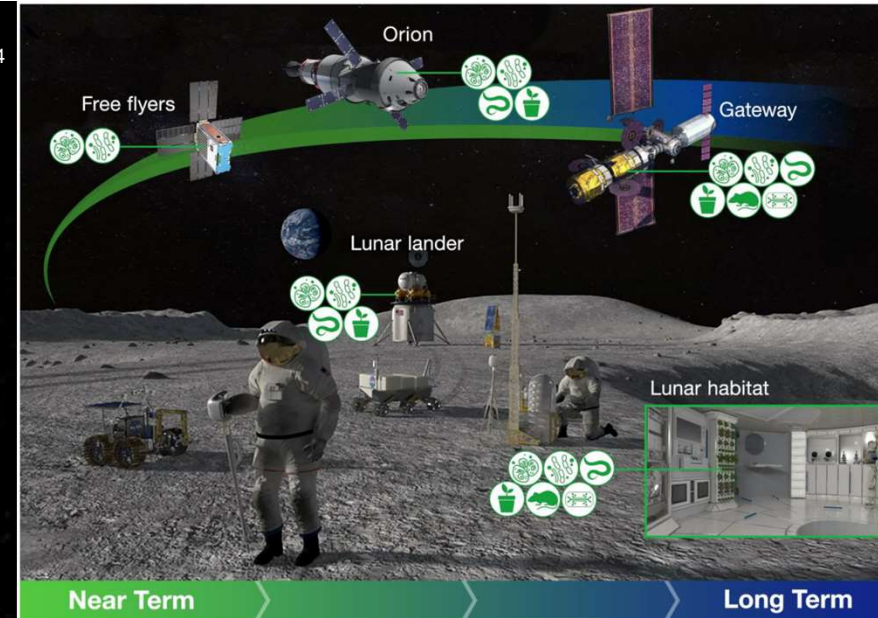
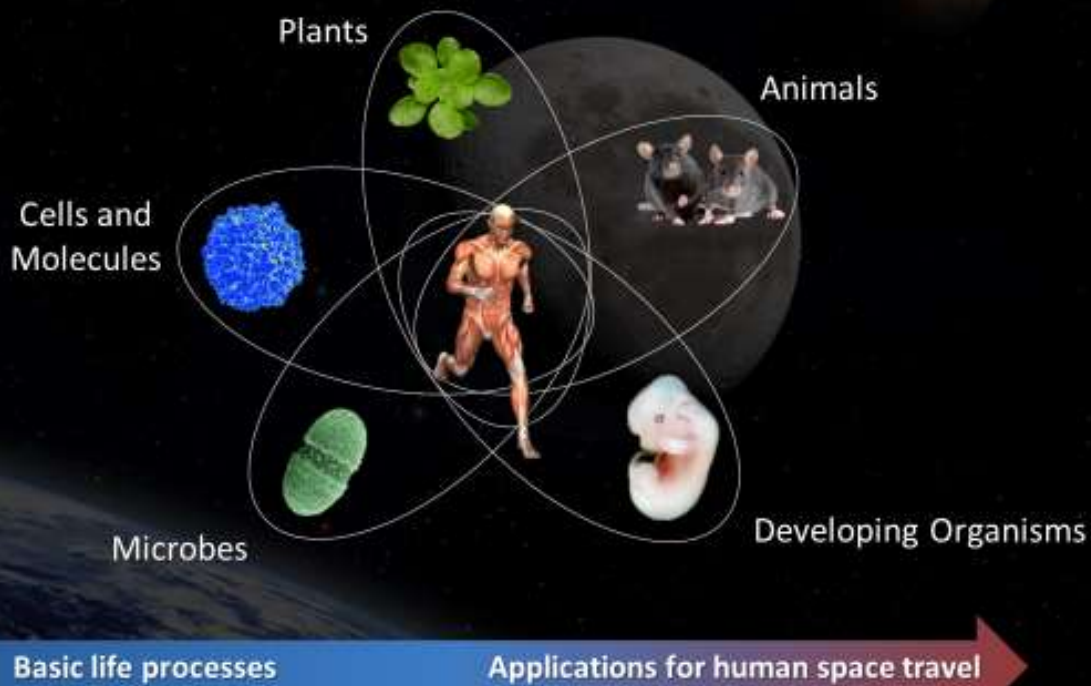
- Exploration Subsystems
- Bioregenerative Life Support

Sylvain V. Costes, Ph.D.

Open Sciences Data Repository Project Manager
Biological and Physical Sciences Division
Space Biosciences Research Branch Chief
arc-dl-osdr-data@mail.nasa.gov

Everroad et al., 2021
<https://ntrs.nasa.gov/citations/20210023324>

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



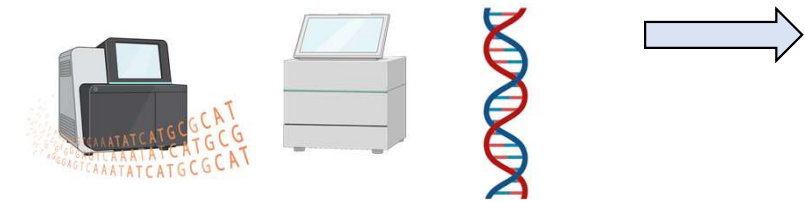
Sanders et al., 2023, "Biological Research and Self-Driving Labs in Deep Space Supported by Artificial Intelligence"

Formation of NASA's Open Science Data Repository

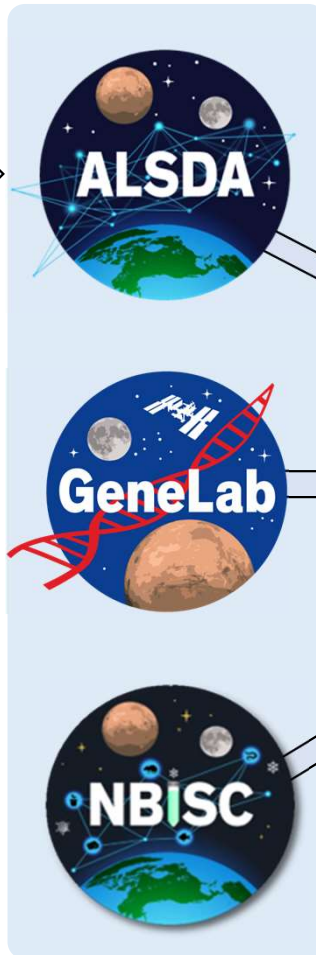
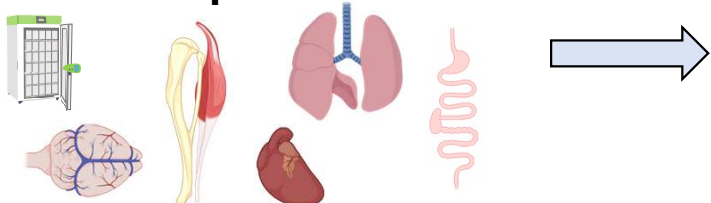
Physiological/Phenotypic/Imaging/ Environmental Telemetry Data



Molecular/Omics Data

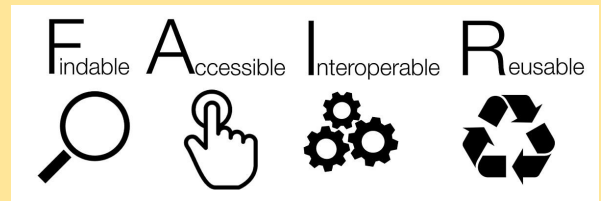


Biospecimens



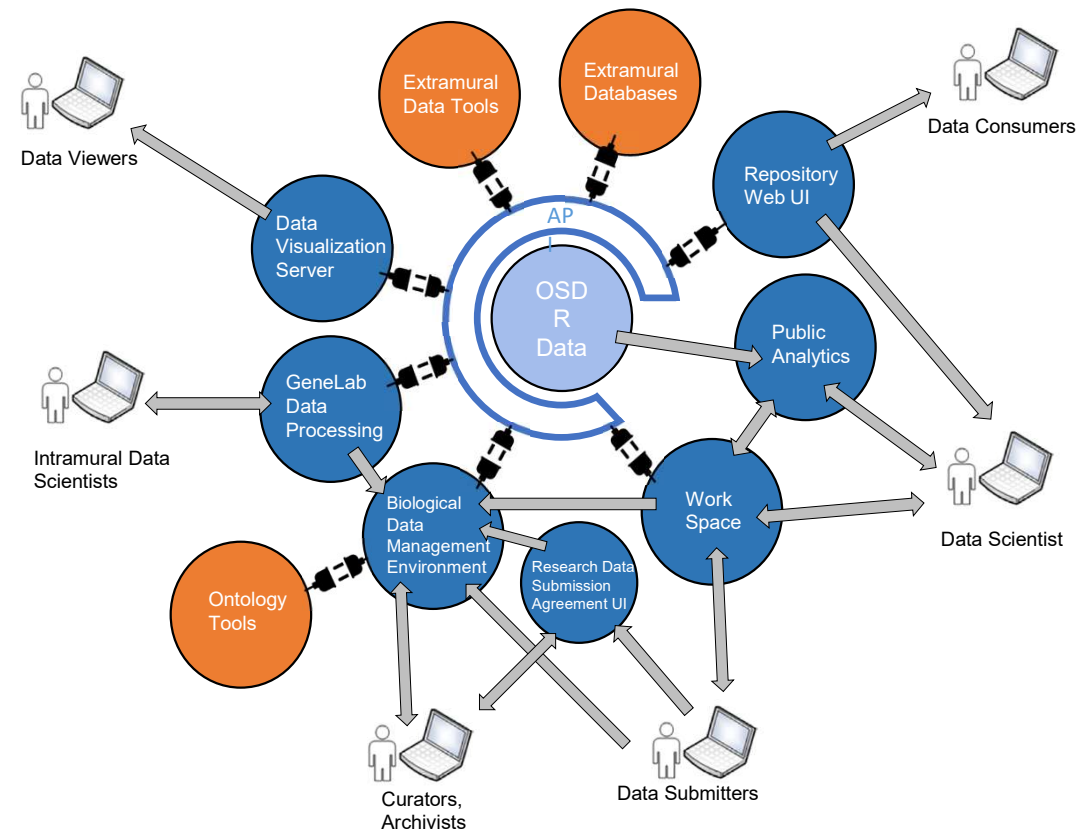
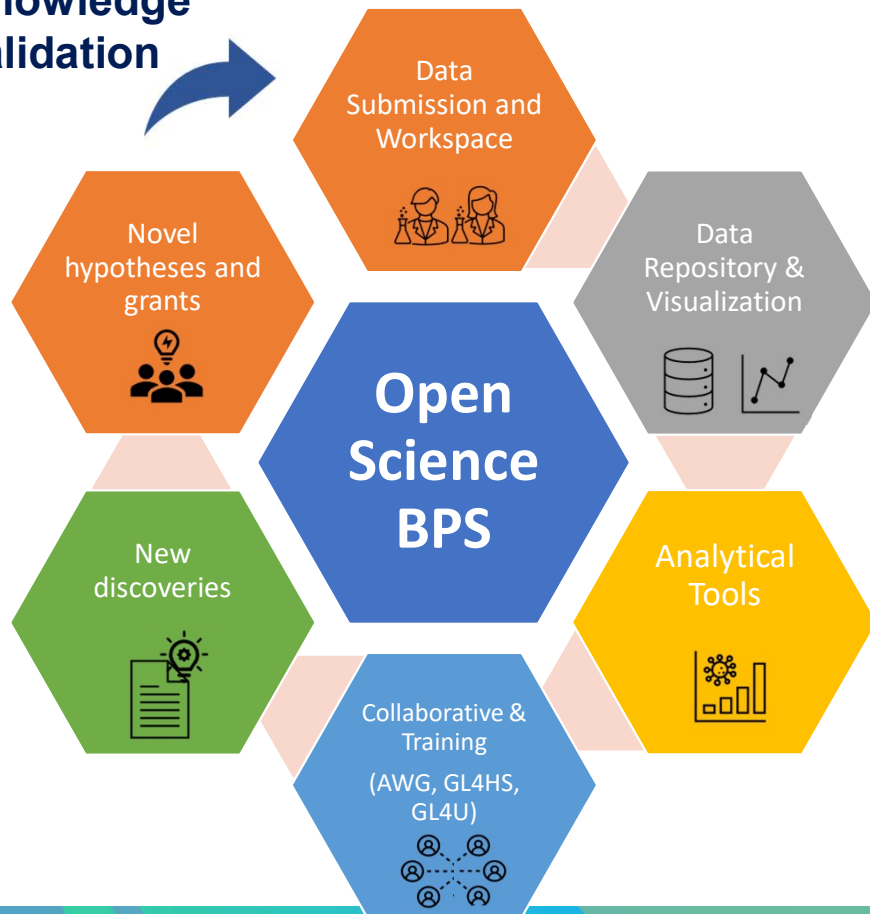
NASA Open Science Data Repository (OSDR) osdr.nasa.gov/bio

- Single Submission Portal (BDME)
- User Interface/Website Tool for RDSAs (Research Data Submission Agreements)
- Maximally Open Access with Necessary Controls for Sensitive Data
- Data Maximally FAIR



Accessibility, Inclusivity, Transparency, Reproducibility

Knowledge
validation



Centralizing information of different types of data

www.osdr.nasa.gov/bio



Open Science Projects

Open Science Projects primary goals aim to increase collaborative scientific data sharing, analysis and more rapid scientific advancement.

GeneLab

GeneLab, an open science multi-omics repository, covering transcriptomics, metagenomics, epigenomics, proteomics, and metabolomics. Studies comprise of data from model organisms including microbes, plants, fruit flies, rodents and humans.

Learn more GeneLab

BSP

The NASA Space Biology Biospecimen Sharing Program (BSP) collects biospecimens to maximize the scientific return from biological spaceflight and associated ground investigations and to encourage and broaden participation from the scientific community in space biology-related research.

Learn more about BSP

ALSDA

Ames Life Sciences Data Archive (ALSDA) collects, curates, and makes available space-relevant higher-order phenotypic datasets. Datasets that enable scientists to perform retrospective analysis across missions, experiments, life science disciplines, research subjects, and species.

Learn more about ALSDA

NBISC

NASA Biological Institutional Scientific Collection (NBISC) is a biorepository of non-human samples collected from NASA-funded spaceflight investigations and correlative ground studies. The purpose of NBISC is to receive, store, document, preserve, and make the collection available to the scientific community.

Learn more about NBISC



Search Filters

Data Source

- ☒ GeneLab
- ☐ NIH GEO
- ☐ EBI PRIDE
- ☐ ANL MG-IT
- ☐ ALSDA

GeneLab Search Filters

Project Type

- ☐ Ground
- ☐ Spaceflight
- ☐ Parabolic Flight Study

Assay Type

- ☐ Microarray
- ☐ RNA Sequencing (RNA-Seq)
- ☐ Single-Cell RNA Sequencing
- ☐ miRNA Sequencing (miRNA-Seq)
- ☐ Nucleotide Sequencing

Show more

COMMON ONLINE SEARCH

Data Repository Search

Search Datasets

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1 - 25 of 385

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GLDS-912

Transcriptional profiling of adrenal glands from mice flown on the RR-23 mission

Organisms	Factors	Assay Types	Release Date	Description
Mus musculus	Spaceflight Ionizing Radiation	transcription profiling	03-Aug-2022	The objective of the Rodent Research-23 missions (RR-23) was to better understand the effects of spaceflight on the eyes, specifically on the structure and function of the arteries, veins, and lymphat...

GLDS-911

Transcriptional profiling of mammary glands from mice flown on the RRRM-1 mission

Organisms	Factors	Assay Types	Release Date	Description
Mus musculus	Spaceflight Age Ionizing Radiation	transcription profiling	03-Aug-2022	In Rodent Research Reference Mission-1 (RRRM-1), also known as RR-8, forty female BALB/cAnTac mice were flown on the International Space Station. To assess differences in outcomes due to age, twenty ...

GLDS-910

The SOG1 transcriptional activator and the MYB3R family of repressors control a complex gene network in response to DNA damage in Arabidopsis [RNA-seq DREModel]

Organisms	Factors	Assay Types	Release Date	Description
Arabidopsis thaliana	Ionizing Radiation Time of Sample Collection After	transcription profiling	15-Nov-2018	To combat DNA damage, organisms mount a DNA damage response (DDR) that results in cell cycle regulation, DNA repair and, in severe cases, cell death.

Mission Telemetry Data

Ascent

Flight

Return

Ground Control

ENVIRONMENTAL DATA (common to both)

Relative Humidity, Temperature, CO2, O2, Airflows, Acceleration, Radiation, Acoustics, etc.

Multi-Hierarchical, Multi-Modal Data Mining Together, for Many Computational-Informatic Approaches Including AI/ML

Engaging with commercial entities: Inspiration 4 Mission and Human Data into OSDR

INSPIRATION

a SpaceX Inspiration4
Spaceflight Omic and Medical Data Release

SpaceX Inspiration4

Spaceflight Omic and Medical Data Release

Omic Data

Public (OSDR/GeneLab)

Controlled Access (OSDR/GeneLab, TrialX)

Clinical/Biomarker

Public (OSDR/ALSDA)

Pre-Flight

Flight

Post Flight

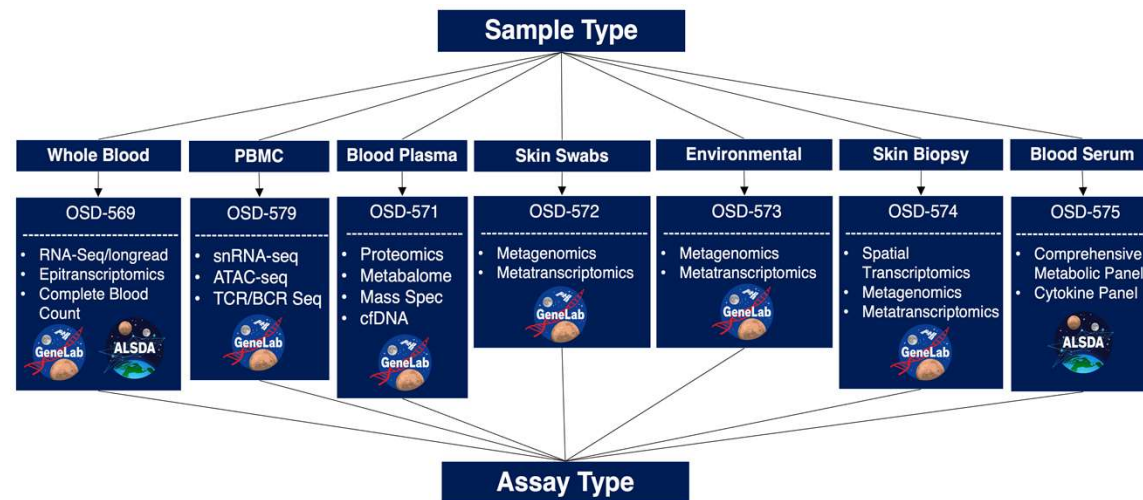
Recovery

Descriptive Profile

Comparative Profile Differentials

Processed Data

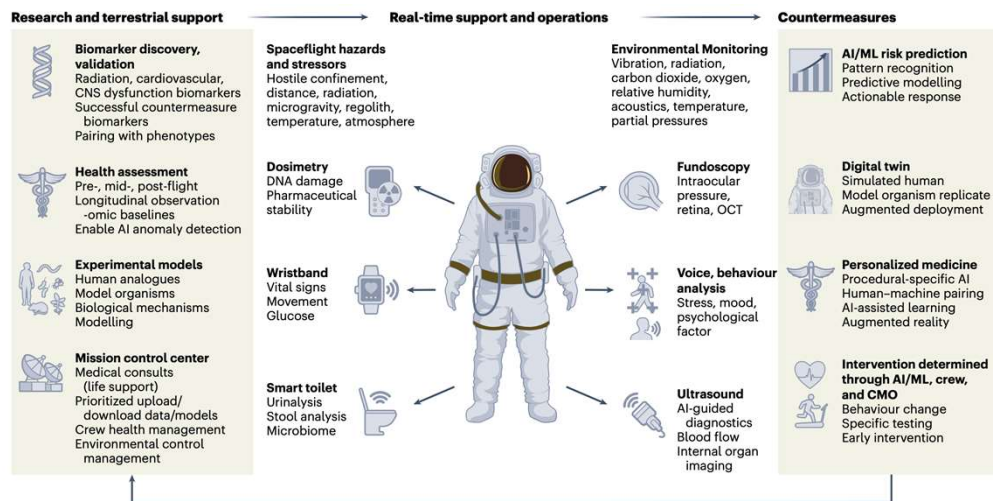
Samples	Assays	Raw Data	L-92	L-44	L-3	FD1	FD2	FD3	R+1	R+45	R+82	R+194				
Blood	Whole Genome Sequencing															
	Clonal Hematopoiesis															
	Complete Blood Count (CBC)															
	Direct RNA-seq															
	Cytokine/Chemokine Biomarker Panel													Expressed Genes, m ⁶ A Modifications		
	Cardiovascular Biomarker Panel													Biomarker Concentrations		
	Comprehensive Metabolic Panel													Biomarker Concentrations		
	Single-Nuclei RNA-seq													Expressed Genes		
	Single-Nuclei ATAC-seq													Accessible Chromatin		
	Single-Cell TCR-seq															
PBMCs	Single-Cell BCR-seq															
	Proteomics													Protein Abundance		
	Metabolomics													Metabolite Abundance		
	cDNA															
Plasma	Proteomics													Protein Abundance		
	Telomere qPCR															
Dried Blood Spot	Metagenome													Microbial Taxonomies & Functions		
	Metatranscriptome													Microbial Gene Expression		
Oral	Microbiome Swabs													Microbial Taxonomies & Functions		
	Metatranscriptome													Microbial Gene Expression		
Nasal	Microbiome Swabs													Microbial Taxonomies & Functions		
	Metatranscriptome													Microbial Gene Expression		
Skin	Spatially Resolved Transcriptomics													Expressed Genes		
	Metagenome													Microbial Taxonomies & Functions		
	Metatranscriptome													Microbial Gene Expression		



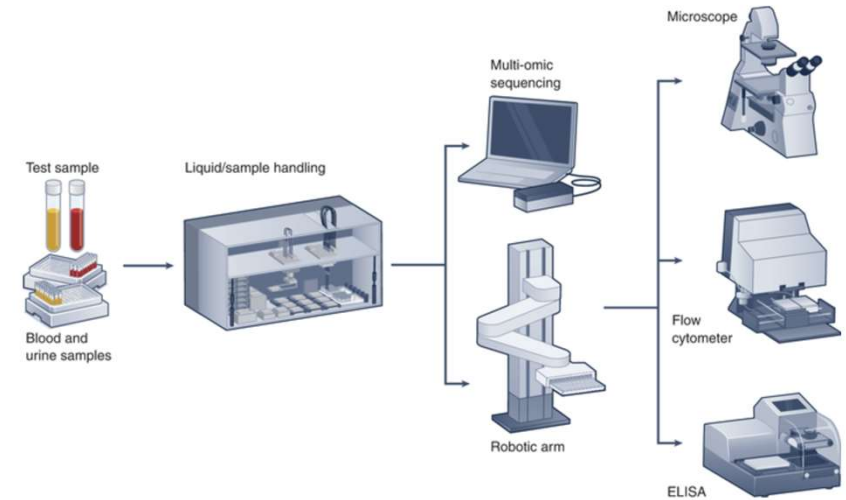
- Spring '23 Nature 'I4/JAXA/SB Package'
- Credit: Chris Mason's Lab; Overbey et al., 2023
- In Peer Review at *Nature*

- OSDR able to ingest and properly curate all data for reuse
- 3 New ALSDA Assay Metadata 'Configs'
 - Comprehensive Metabolic Panel (Spectrophotometry & Ion Selective Electrode)
 - Complete Blood Count (Hematology Analyzer)
 - Cytokine Panel (Multiplex)

Workshop on Decadal Vision for AI/ML in Space Life Sciences



- Scott et al., 2023, “Biomonitoring and Precision Health in Deep Space Supported by Artificial Intelligence”



- Sanders et al., 2023, “Biological Research and Self-Driving Labs in Deep Space Supported by Artificial Intelligence”

