

The GeneLab Buffet: A Bioinformatic MATRIX of MANGO and TOAST

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1. NASA Ames Research Center
2. Blue Marble Space Institute of Science
3. UW-Madison, Botany department



GeneLab Plant AWG



Special thanks to Dr Sigrind Reinsch

The usual suspects / regulars



Member

Colin P.S. Kruse		Colin
Richard Barker, Ph.D.		Richard
Sigrind Reinsch, Ph.D.		Sigrind
Sarah Wyatt, Ph.D.		Sarah
Chris (Scott) Wolverton, Ph.D.		Chris
Simon Gilroy, Ph.D.		Simon
John Kiss, Ph.D.		John
Javier Medina, Ph.D.		Javier
Alicia Villacampa Ph.D		Alicia
Pankaj Jaiswal, Ph.D.		Pankaj
Norman Lewis, Ph.D.		Norman
Kim Hixon	PhD	
Imara Perera, Ph.D.		Imara
Ivo Grosse, Ph.D.		Ivo
Raul Herranz, Ph.D.		Raul
Elliott Meyerowitz, Ph.D.		Elliott
Marie Dinh	Marie	
Christina M. Johnson, Ph.D		Christina
Josephine Pechous		Josephine
Aubrie Orourke, Ph.D.		Aubrie
Andrew Stauffer		Andrew
Hyun-seok Chang		Hyun-seok
Alex DongHyeon Seo		Alex
Aránzazu Manzano Pérez, Ph.D.		Aránzazu
Laurence Davin, Ph.D.		Laurence
Parul Gupta, Ph.D.		Parul
Sreeskandarajan Sutharzan, MS, PhD		Sreeskandarajan
Ming Wu, Ph.D.		Ming
Nicol Caplin, Ph.D.		Nicol
Vidya Manian, Ph.D.		Vidya
Wagner A. Vendrame		Wagner
Yen-Kai Chen		Yen-Kai
Carlos Martínez Martín, MSc		Carlos
Erik Hanschen, Ph.D.		Erik
Keywan Hassani-Pak, Ph.D.		Keywan
Carolina Livi, Ph.D.		Carolina
Angela Edwards		Angela
Lori Waters		
Marina Ribeiro Kaufmanner	Marina	Kaufmanner
Pia Sen		Pia
Elison Blancaflor, Ph.D.	Elison	Blancaflor
Sabrina Chin, Ph.D.	Sabrina	Chin
Joey Emhof		Joey
Camille Richman	Camille	Richman
Lovorka Degoricija	Lovorka	Degoricija
Jonathan Oribello	Jonathan	Oribello
Justin Elser		Justin
Emma Canaday	Emma	Canaday
A. Mark Settles	Mark	Settles

First Name

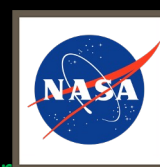
Last Name

Affiliation

Kruse	Los Alamos National Lab
Barker	University of Wisconsin, Madison
Reinsch	NASA Ames Research Center
Wyatt	Ohio University
Wolverton	Ohio Wesleyan University
Gilroy	University of Wisconsin Madison
Kiss	UNC Greensboro
Medina	Centro de Investigaciones Biológicas
Villacampa	Centro de Investigaciones Biológicas
Jaiswal	Oregon State University
Lewis	Pacific Northwest National Lab/Washington State University
Hixon	Pacific Northwest National Lab/Washington State University
Perera	North Carolina State University
Grosse	Martin Luther University Halle-Wittenberg
Herranz	Centro de Investigaciones Biológicas
Meyerowitz	California Institute of Technology
Dinh	NASA Ames Research Center
Johnson	NASA Kennedy Space Center
Pechous	Drake University/ NASA Kennedy Space Center Intern
Orourke	NASA Kennedy Space Center
Stauffer	Ohio University
Chang	University of Wisconsin, Madison
Seo	University of Wisconsin, Madison
Pérez	Centro de Investigaciones Biológicas
Davin	Pacific Northwest National Lab/Washington State University
Gupta	Oregon State University
Sutharzan	Cincinnati Children's Hospital Medical Center
Wu	Illumina
Caplin	European Space Agency
Manian	University of Puerto Rico, Mayagüez
Vendrame	University of Florida
Chen	University of Auckland
Martí	Eurofins Iproma (Castellón, Spain)
Hanschen	Los Alamos National Lab
Hassani-Pak	Rothamsted Research (KNET Miner)
Livi	Southern Oregon University
Edwards	Southern Oregon University
Lori	Waters
Kaufmanner	University of the West of England, Bristol, UK
Pia	Rutgers University
Blancaflor	NASA KSC
Chin	University of Wisconsin, Madison
Joey	Emhof
Richman	Penn State University
Degoricija	Hamama Microgreens
Oribello	KBR/NASA Ames Research Center
Justin	NASA Ames Research Center
Canaday	Elser
Settles	Oregon State University
	Ohio University
	NASA Ames Research Center



GeneLab Plants

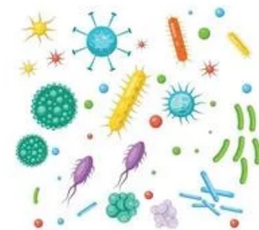


Lots of extra meta-data beyond the primary factor

Accession	Experiment Platform	Study Factor Type	Material Type
GLDS-7	Petri dish in Advanced Biological Research System (ABRS)	Space Flight, organism part	Roots, stems and shoots
GLDS-8	Magentic levitation	Gravitation, treatment	Cell culture
GLDS-16	Petri dish in Advanced Biological Research System (ABRS)	Gravitation, Space Flight, organism part	Roots and shoots
GLDS-17	BRIC-PDFU	Cosmic Radiation, Space Flight, organism part	Etiolated seedling
GLDS-22	Hydroponics and salts	genotype, timepoint, treatment	Roots
GLDS-37	BRIC-PDFU	ecotype, Space Flight	Etiolated seedling
GLDS-38	BRIC-PDFU	Preservation Biological, Space Flight	Etiolated seedling
GLDS-44	BRIC-PDFU	Cosmic Radiation, Space Flight, Genotype	whole organism
GLDS-45	Petri dish and 2D clinostat	age, timepoint, Weightlessness Simulation	Roots
GLDS-46	Petri dish and radiation source	Genotype, age, timepoint, Absorbed Radiation Dose, Ionizing Radiation, duration	Seedlings
GLDS-120	Petri dish on the ISS wall	Space Flight, ecotype, light	Roots
GLDS-121	BRIC-PDFU	Cosmic Radiation, Space Flight	Shoots of seedlings
GLDS-134	Petri dish and partial pressure	Atmospheric Pressure, Part	BTO:shoot
GLDS-136	Petri dish and partial pressure	Atmospheric Pressure	Roots
GLDS-144	Random positioning machine	Weightlessness Simulation, cell cycle phase	Cell culture
GLDS-147	BRIC-PDFU	Space Flight, genotype	hypocotyl cell culture
GLDS-193	Vegetable Production System (Veggie)	Space Flight, genotype, time	Roots
GLDS-205	BRIC-PDFU	Space Flight, Genotype	hypocotyl cell culture
GLDS-208	Petri dish in terrestrial lab	root	Roots
GLDS-210	Boron And Carbon Cosmic Rays in the Upper Stratosphere (BACCUS)	Cosmic Radiation, Genotype	Seeds
GLDS-213	ESA Simbox	Space Flight, Gravity Altered	callus cell culture
GLDS-217	Vegetable Production System (Veggie)	Space Flight, organism part	Root
GLDS-218	Vegetable Production System (Veggie)	Space Flight, organism part	Root
GLDS-219	Vegetable Production System (Veggie)	Space Flight, organism part	Root
GLDS-220	Vegetable Production System (Veggie)	Space Flight, organism part	Root
GLDS-223	European Modular Cultivation System (EMCS)	Cosmic Radiation, Space Flight, Genotype, organism part, Gravity Altered	Seedlings
GLDS-251	European Modular Cultivation System (EMCS)	Space Flight, Gravity Altered	Seedlings
GLDS-281	Vegetable Production System (Veggie)	age, Space Flight, Genotype	Seedlings
GLDS-282	Petri dish and anoxia	treatment	Seedlings
GLDS-296	Petri dish and radiation source	light, time, treatment, genotype	Seedlings
GLDS-320	Petri dish and radiation source	Genotype, Ionizing Radiation, Time of sample collection after treatment	Seedlings
GLDS-321	BRIC-PDFU	Cosmic Radiation, Space Flight, Genotype	Etiolated seedling
GLDS-329	Petri dish and radiation source	organism part, Genotype, Ionizing Radiation, time	root



MANGO is native graph interactive relational database for microbiomes



Qlik

BIN TIME SERIES



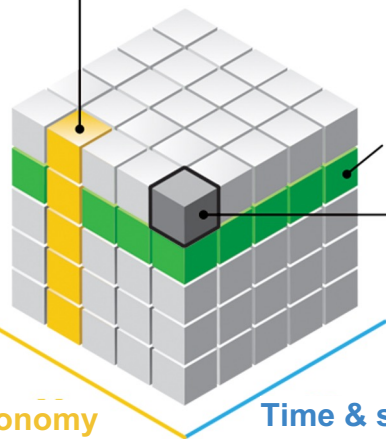
Evolved into European Bioinformatics "Super Study"
<https://www.ebi.ac.uk/metagenomics/super-studies/3>



NOW



THEN



Taxonomy

Time & space

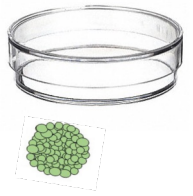
"Drill down into the data"



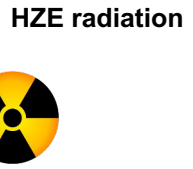
GeneLab Plant Analysis Working Group assessed all methods used to harvest RNA from flight

Space shuttle

Petri dish
Circular 60mm



Atmospheric chamber



International Space Station

BRIC



ISS wall



Square dish 10x10cm



VEGGIE



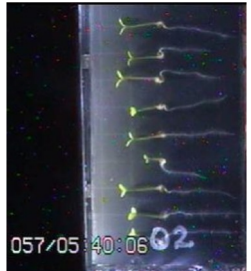
Petri dish & other science carriers such as pillows and ponds



EMCS

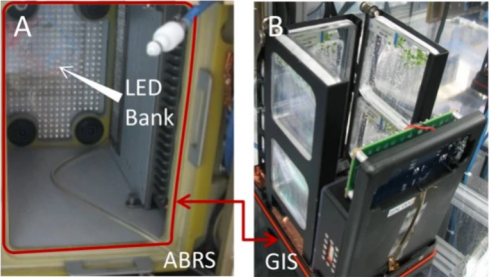


Custom cassette 1G & fractional G's
Centrifuge on orbit
Fractional G forces



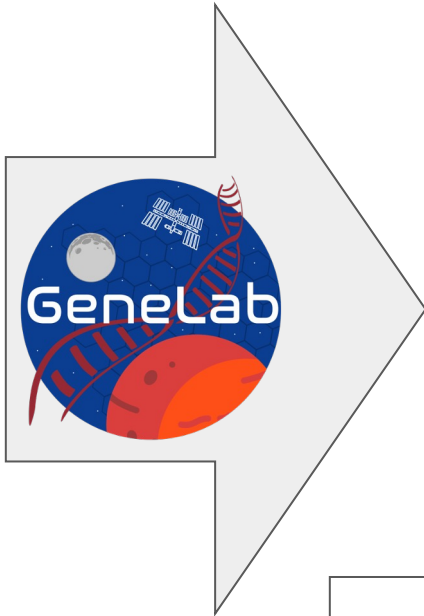
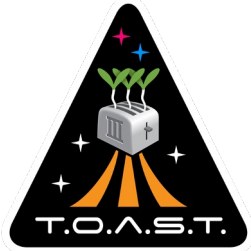
Shenzhou

Simbox 1G vs uG's
Centrifuge on orbit
Fractional G forces

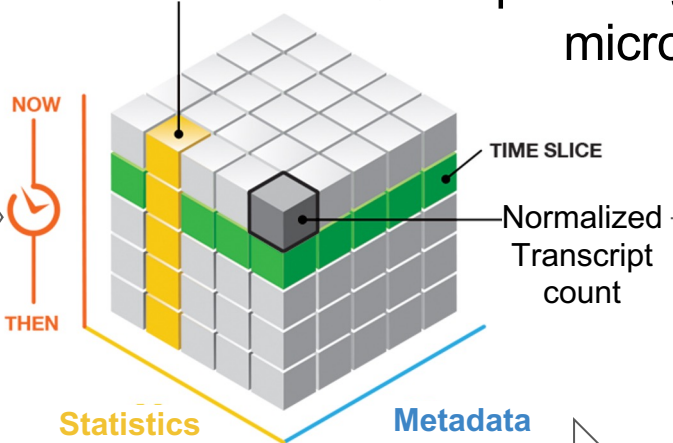




TOAST is native graph interactive relational database

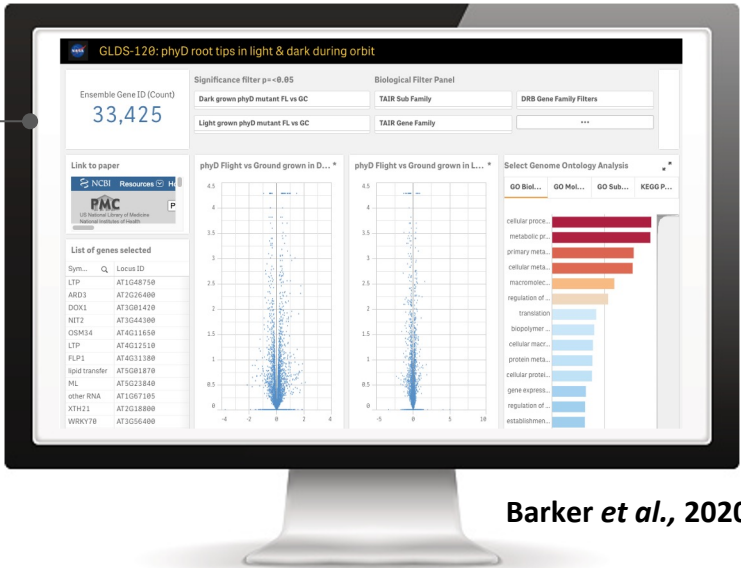


Qlik



Integrated multi-omics explorer providing access to space biology RNAseq, microarray, proteomic and epigenetic

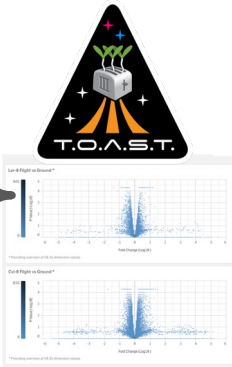
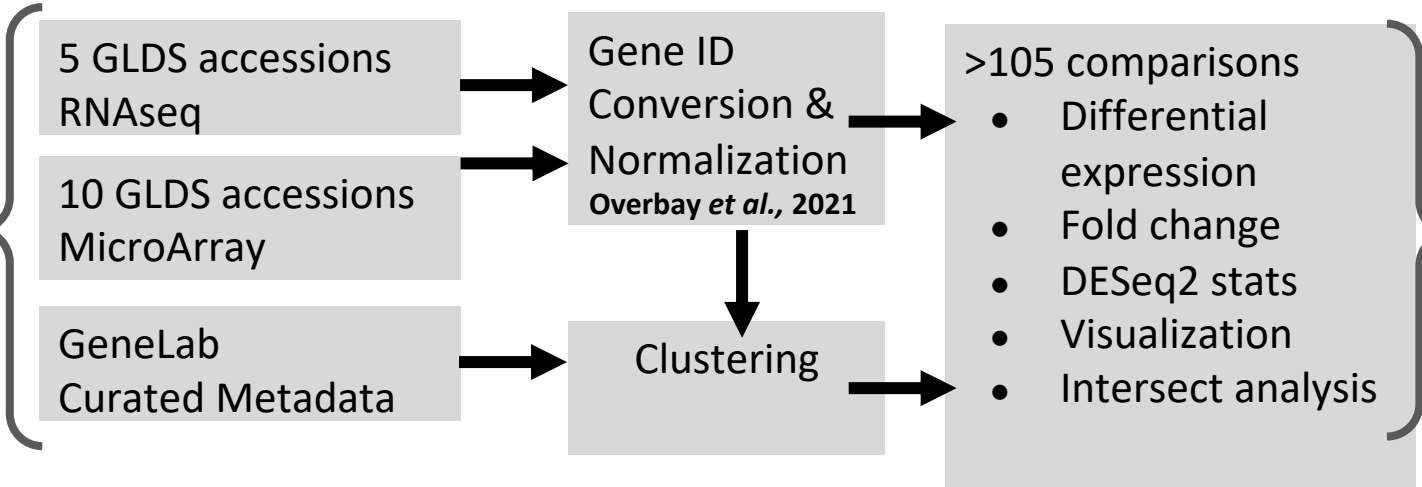
“Drill down into the data”



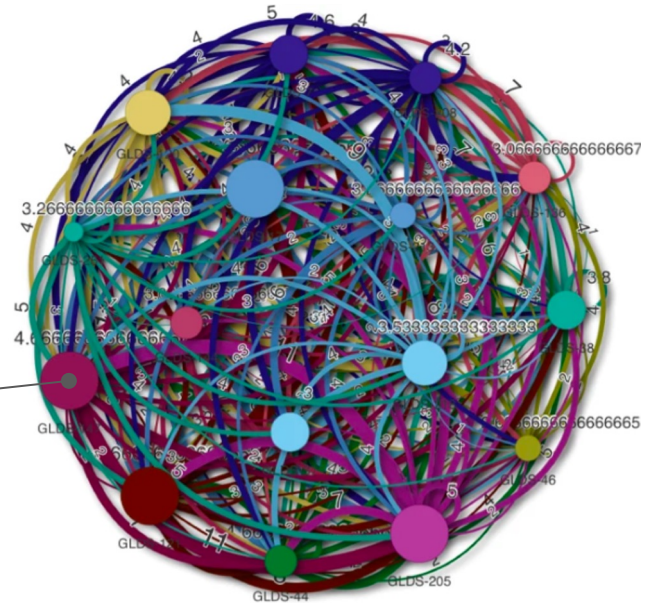
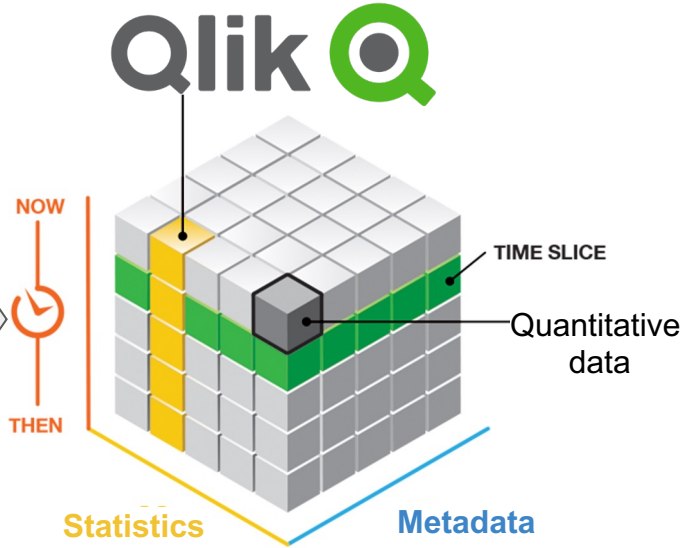
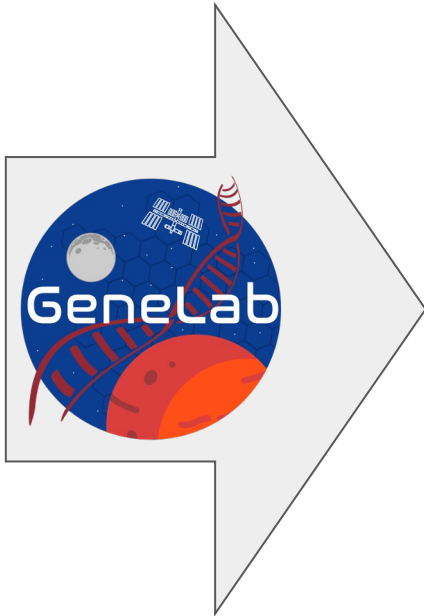
Barker et al., 2020



TOAST2 -> "The MATRIX"

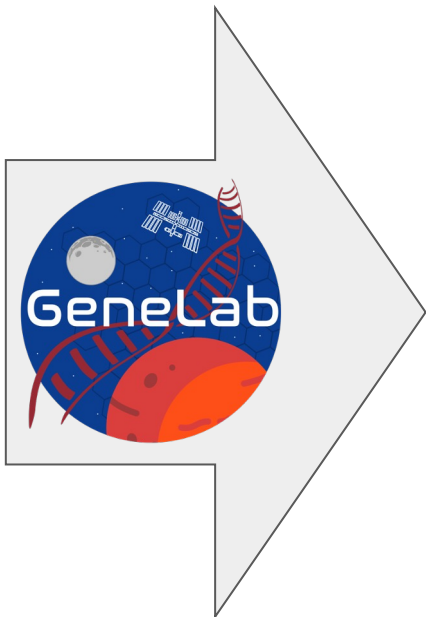


GeneLab Metadata adds weight to nodes and edges in Knowledge Graphs

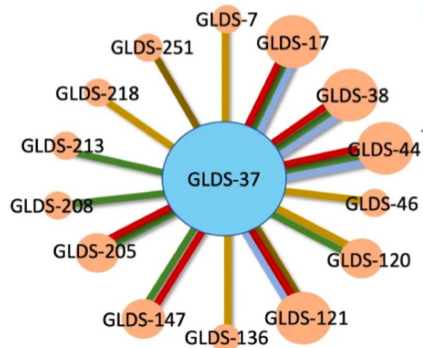
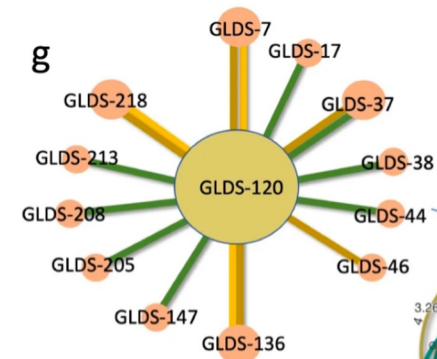


Many potential data types eg environmental metadata, microbiome, transcriptomics, proteomics, epigenetics, mutli-omics and phenomics

We can identify studies with increased connectivity

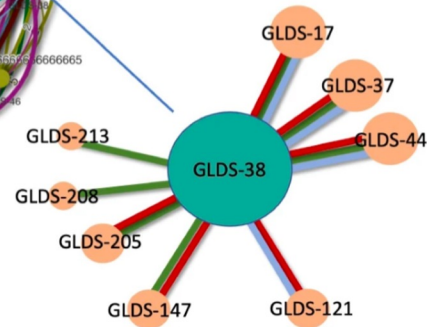
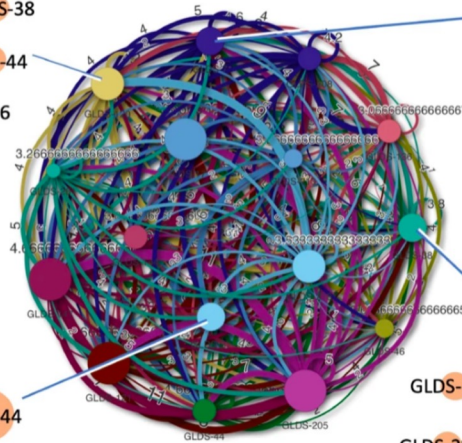
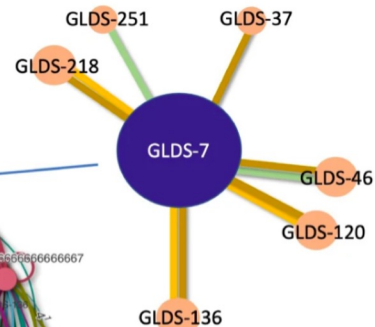


Light/Dark Node



Ecotype Node

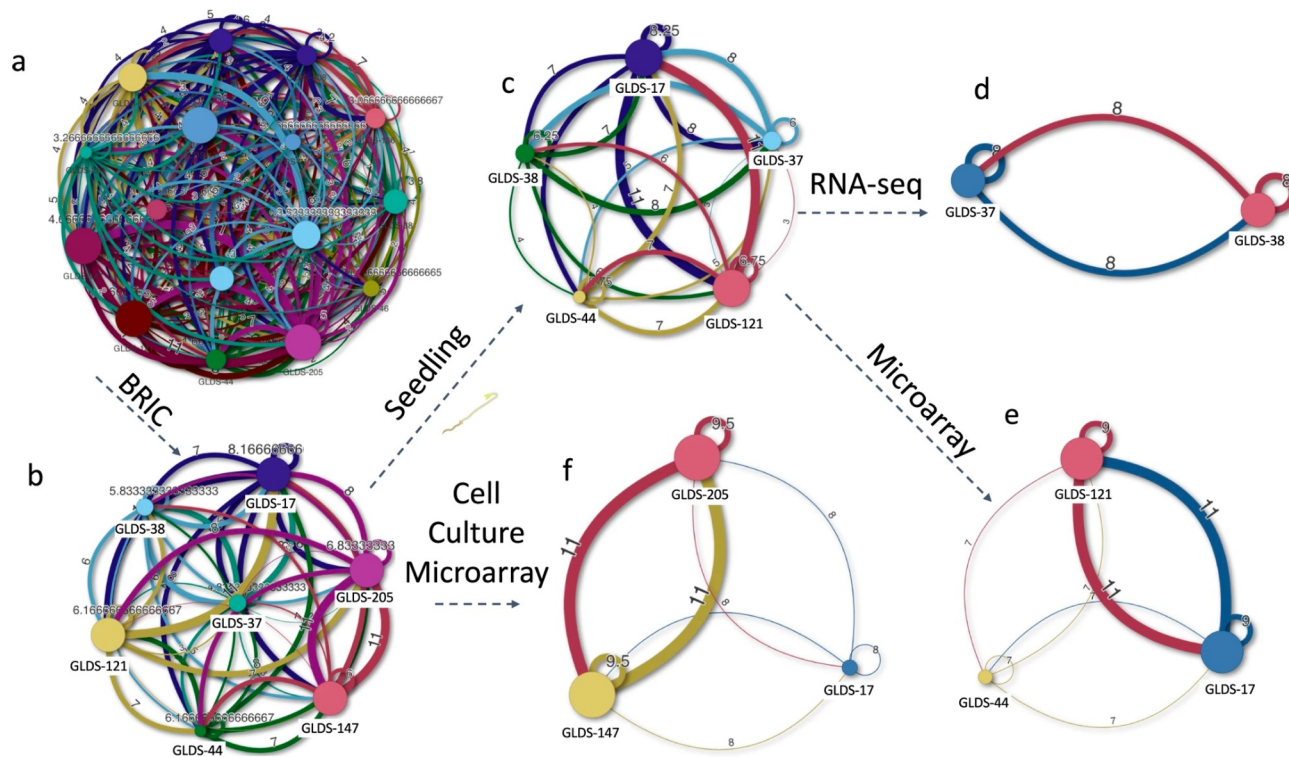
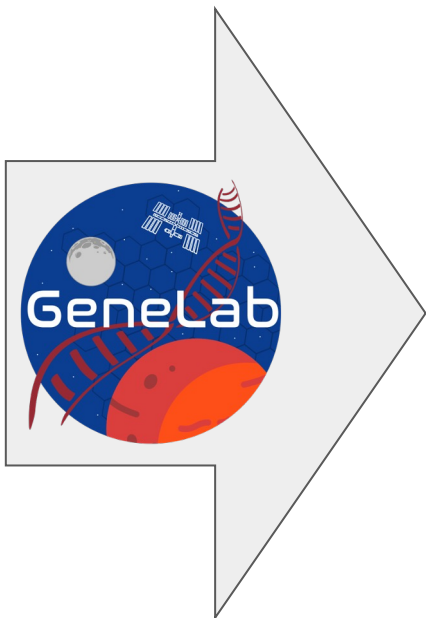
Multi-omics tissue node



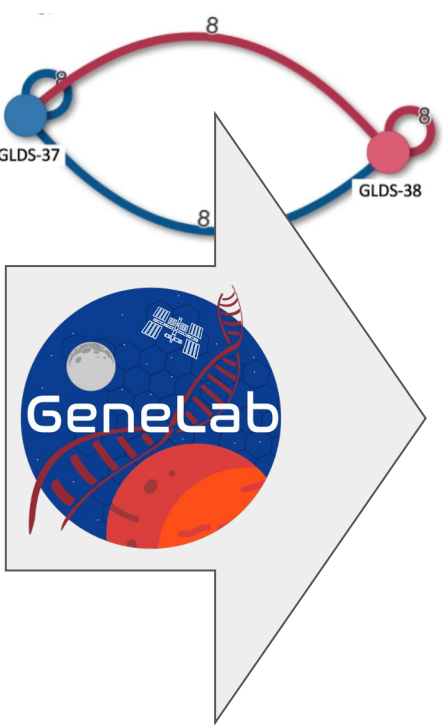
Preservation node

Barker, Kruse, Johnson *et al.*, (2023)

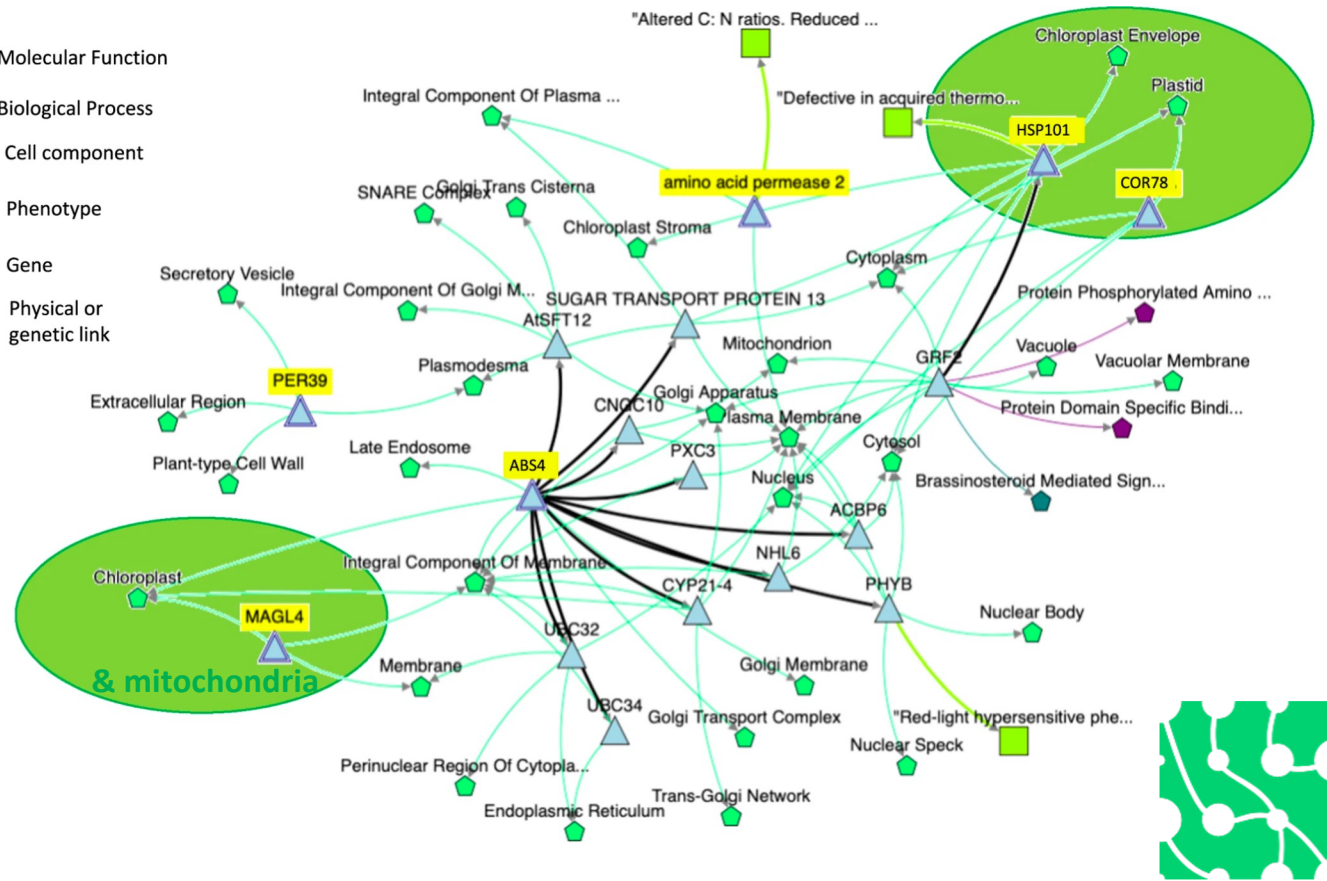
We can identify studies with increased similarity / “Edge score”



Gene involved in BRIC flight BRIC & RNAseq



- Molecular Function
- Biological Process
- Cell component
- Phenotype
- Gene
- Physical or genetic link



**Time lapse photography of Inspiration 4 launch
made of multiple telescope tracking shots, by the “MARS Scientific group”**



Is there a Lesson? “Artifacts associated with imaging system can make it hard to see true events the vehicle experienced during the launch / Mission”.

Questions?



Open Science for Life in Space

