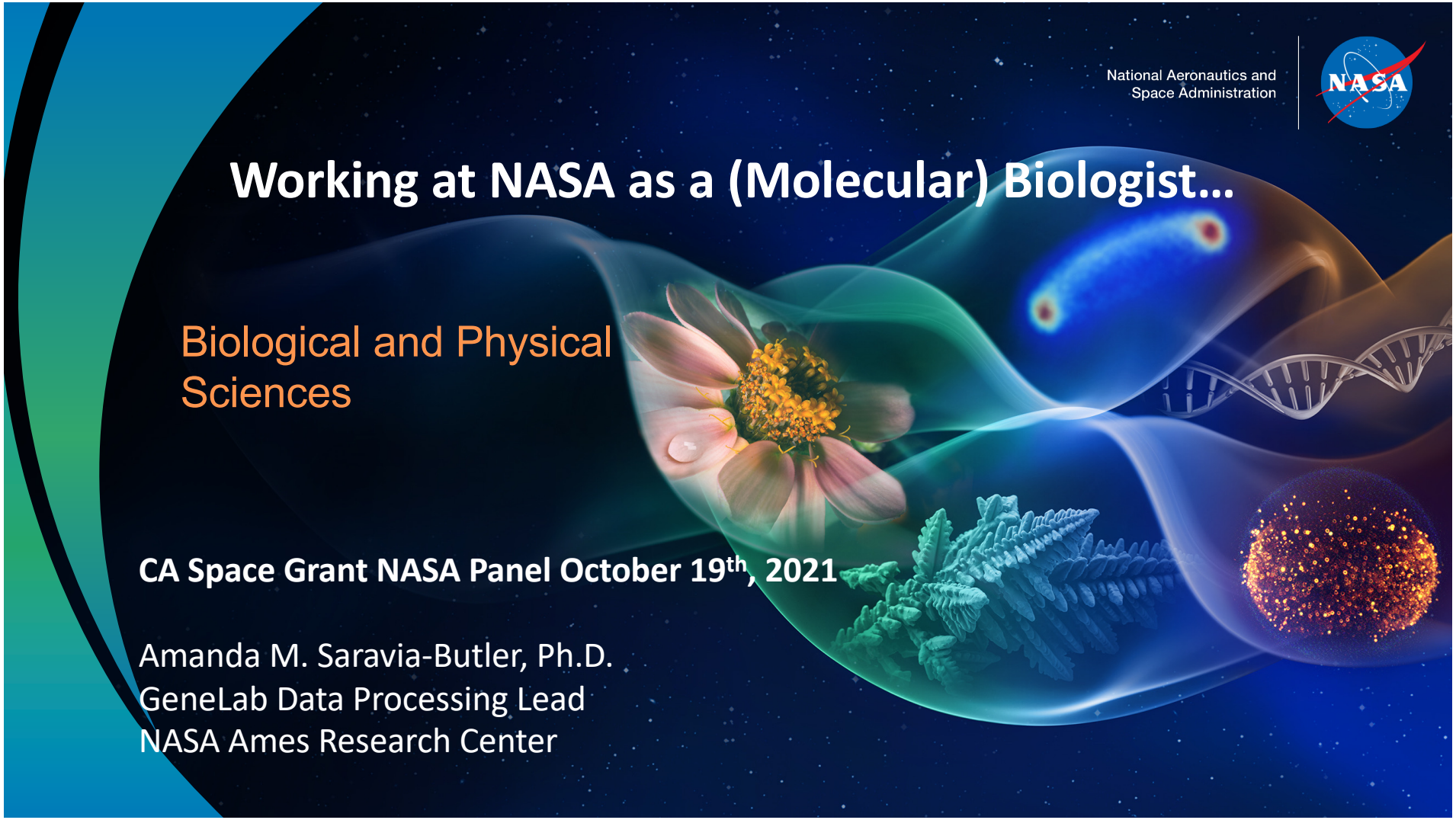
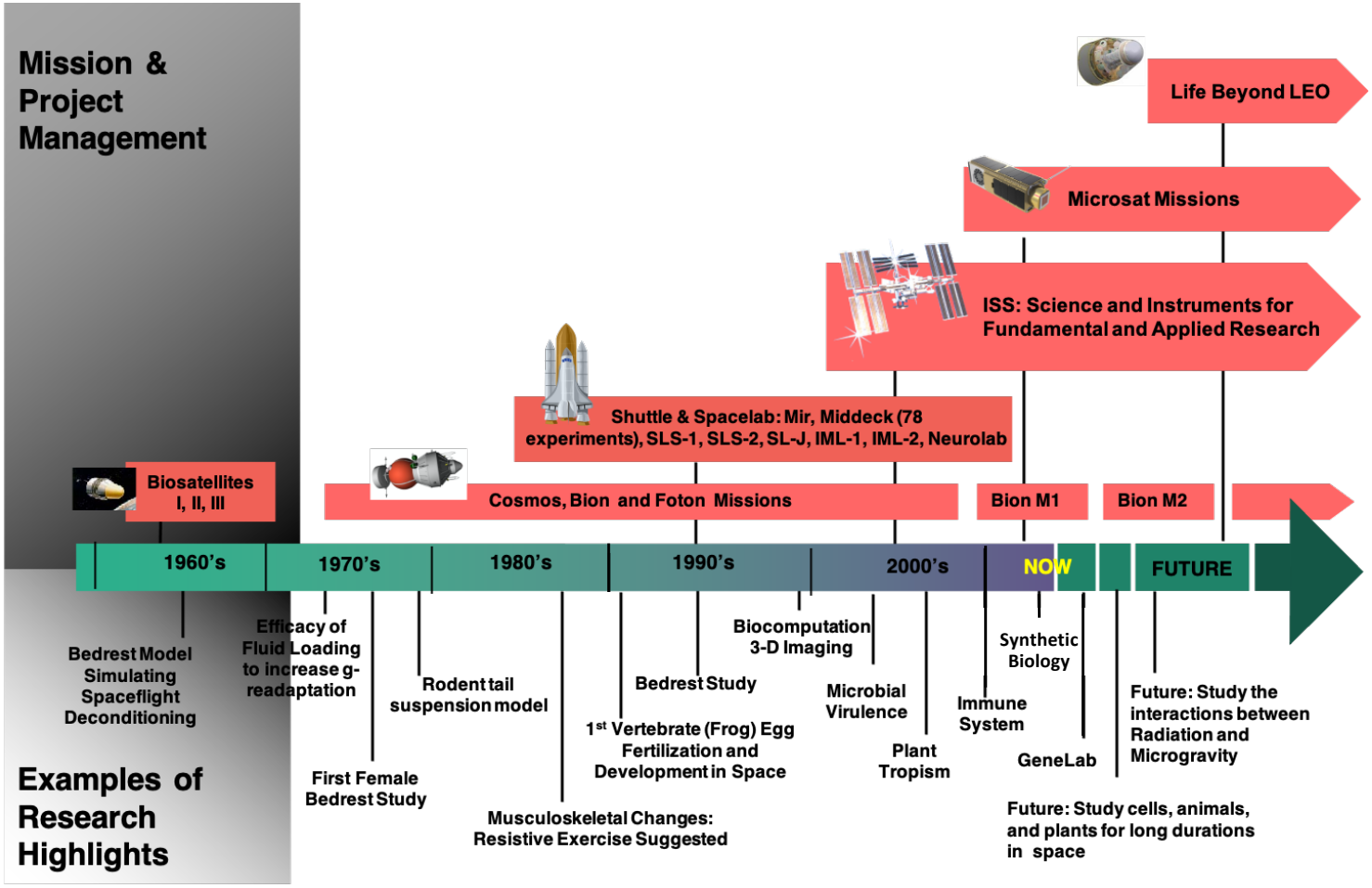

National Aeronautics and
Space Administration
NASA
Working at NASA as a (Molecular) Biologist…
Biological and Physical
Sciences
CA Space Grant NASA Panel October 19th, 2021
Amanda M. Saravia-Butler, Ph.D.
GeneLab Data Processing Lead
NASA Ames Research Center

5+ Decades of NASA Life Sciences Research



Exposure to Spaceflight Changes our Physiological Systems

The Musculoskeletal System

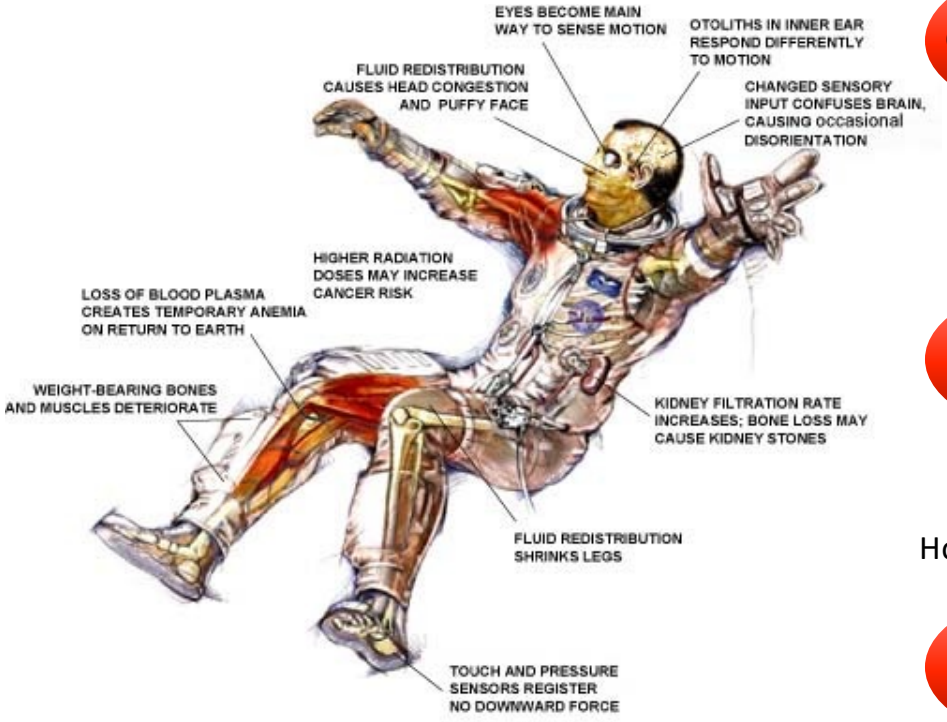
Osteoporosis
Osteoarthritis
Muscle atrophy

The Cardiovascular System

CVD
Atherosclerosis
Anemia

The Lymphatics

Lymphatic pump disorders



The Central Nervous System

Memory loss
Retinal edema

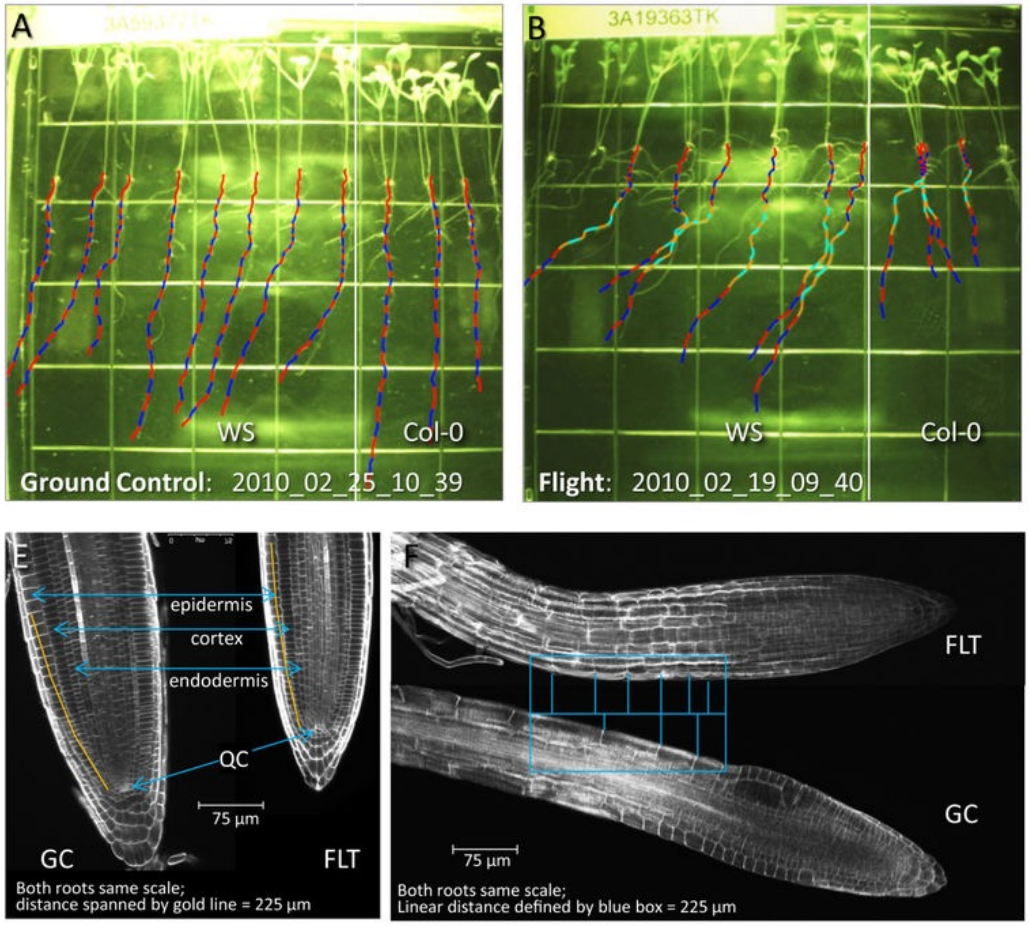
The Reproductive System

Sperm motility
Infertility
Hormonal imbalances

The Digestive System

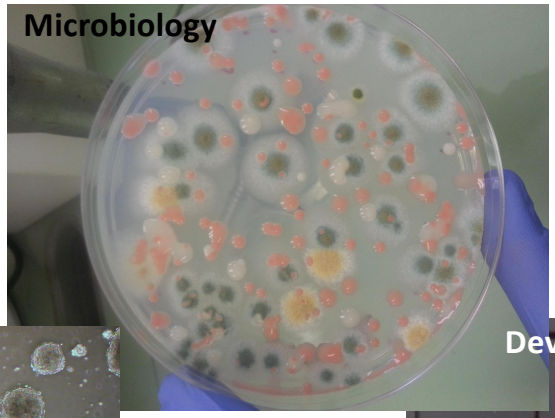
Liver fibrosis
NAFLD
IBS
Microbiome

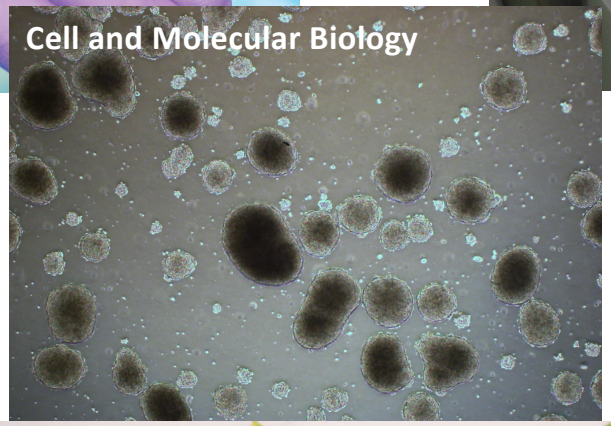
Exposure to Spaceflight Changes Plant Physiology Too



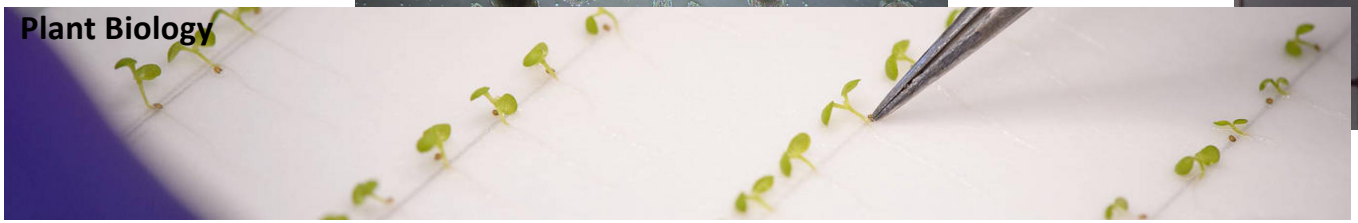
Space Biology Program







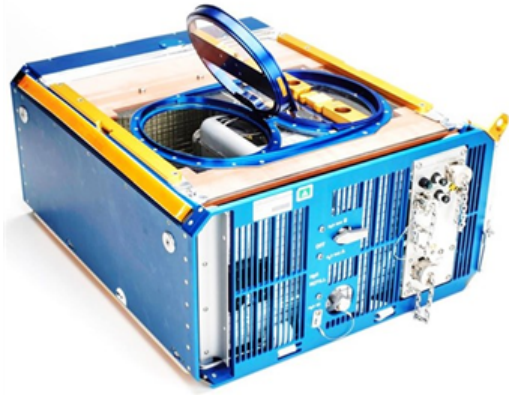




https://science.nasa.gov/biological-physical/programs/space-biology

Mission Scientist on the Rodent Research Project

RR Habitat



Animal Access Unit (AAU)

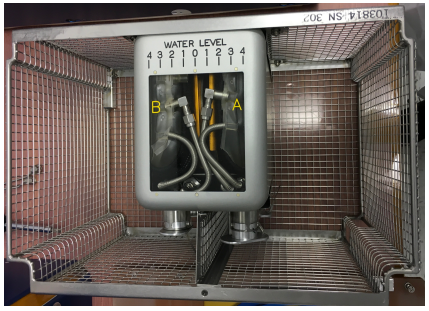


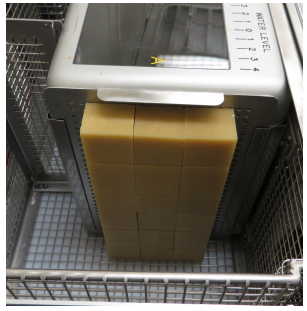
SpaceX Dragon

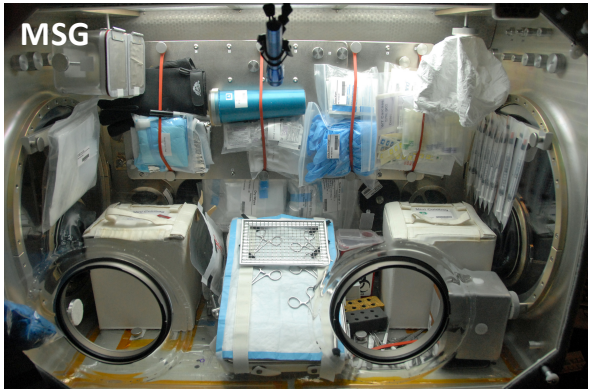


EXPRESS Rack 4: U.S. Laboratory





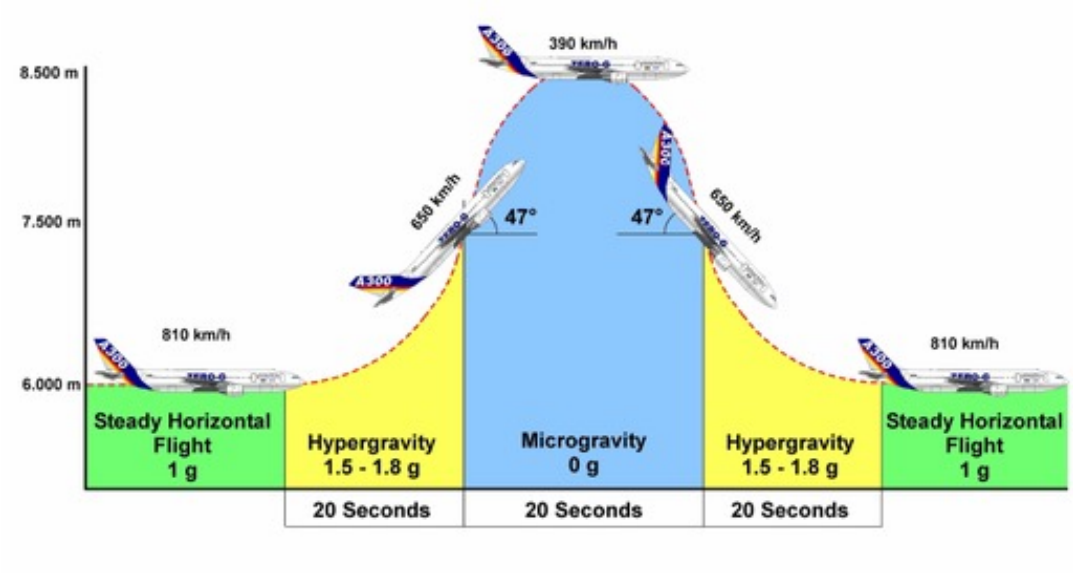




https://www.nasa.gov/mission_pages/station/research/experiments/explorer/Investigation.html?#id=598

Space is Hard!

Parabolic Flight aka the Vomit Comet



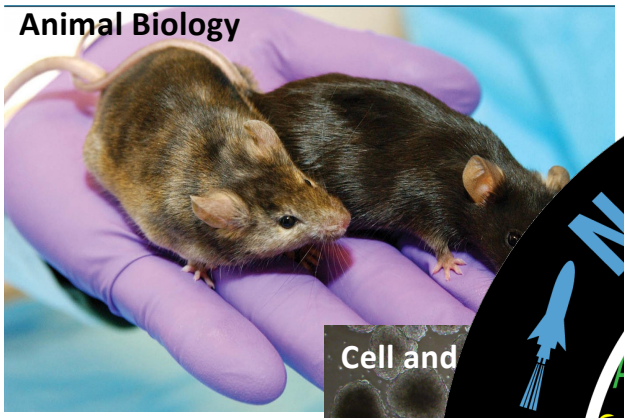


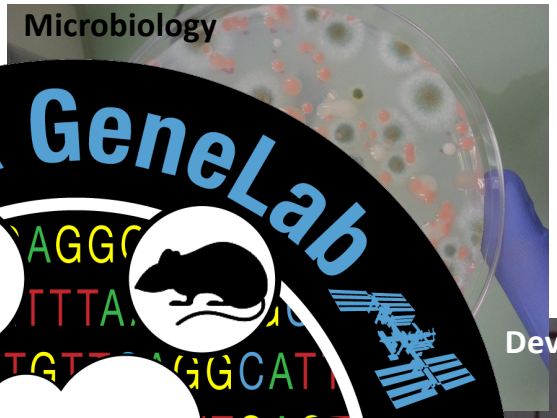
Space is Hard!

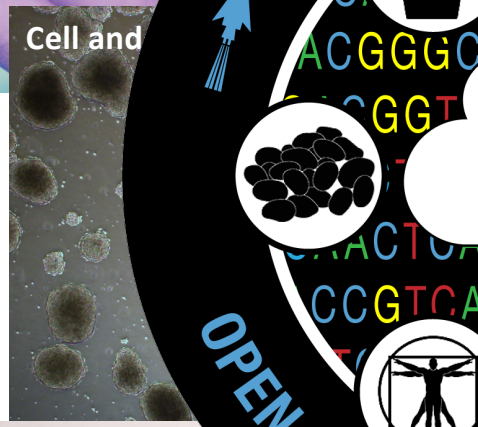


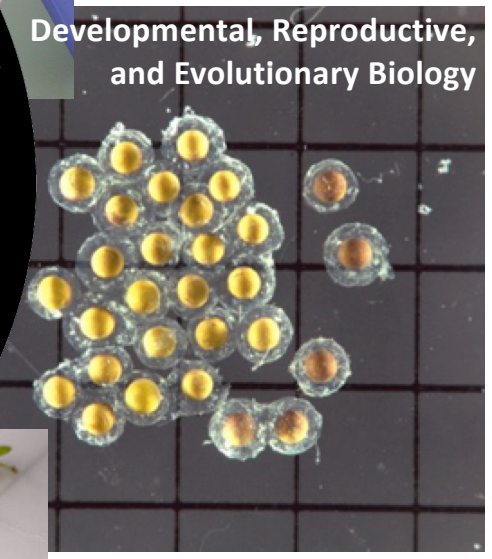
Dr. Andrew Feinberg

Space Biology Program









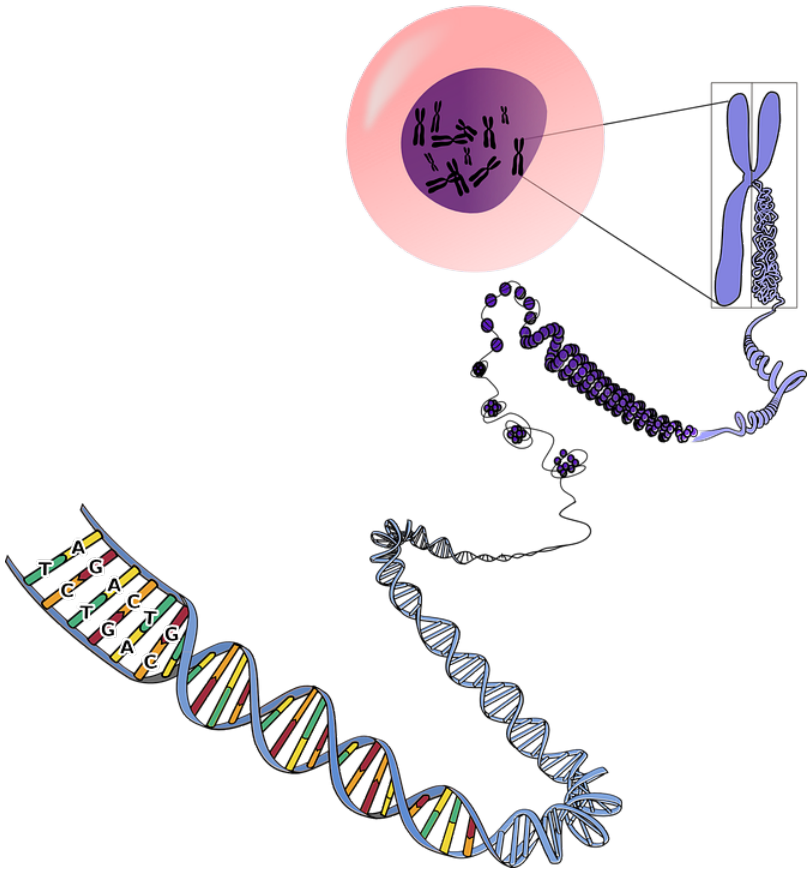


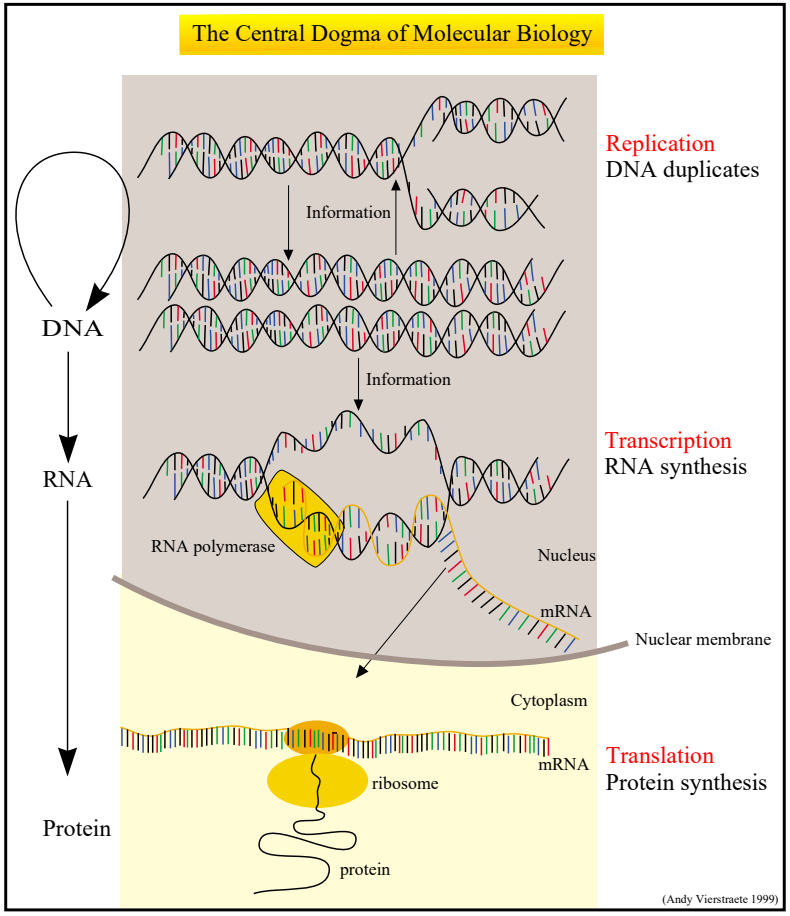
NASA GeneLab

OPEN SCIENCE FOR LIFE IN SPACE

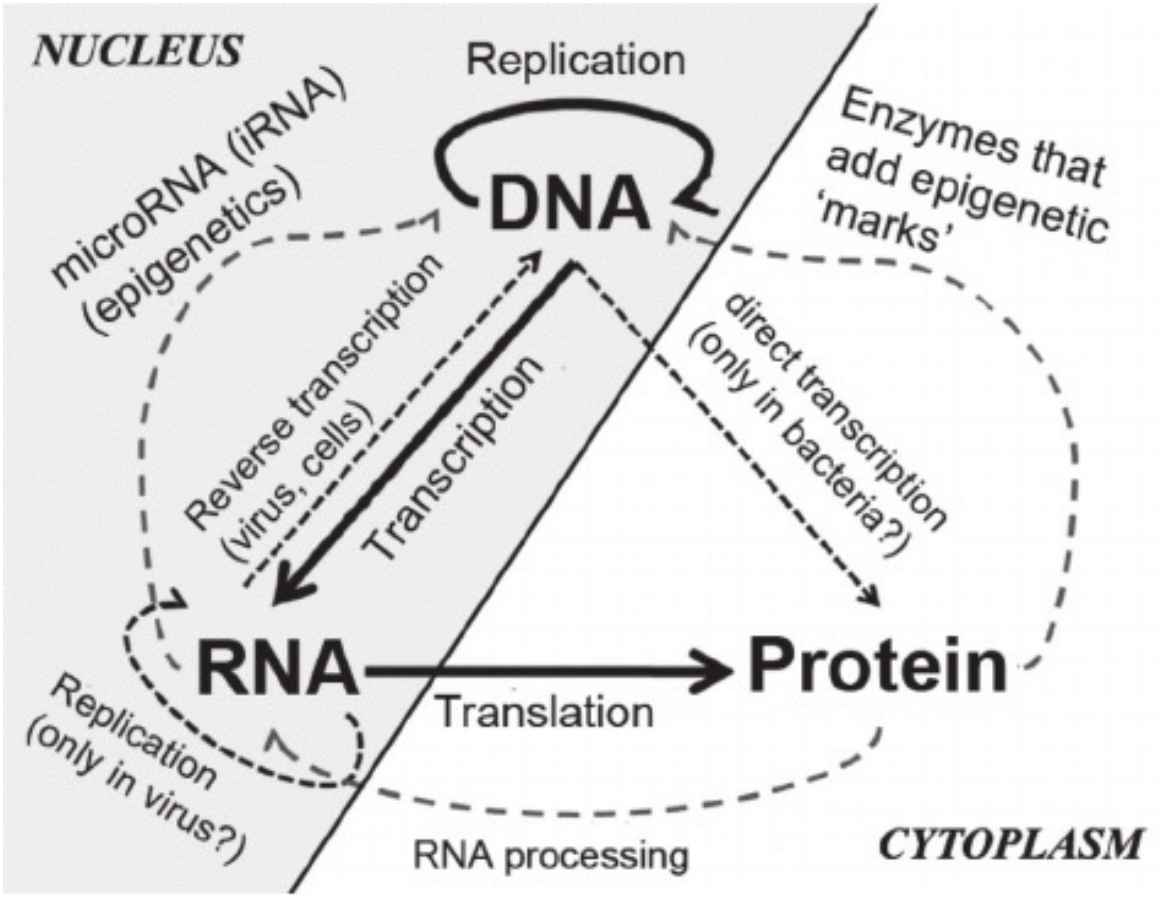
https://science.nasa.gov/biological-physical/programs/space-biology

What are ‘omics?



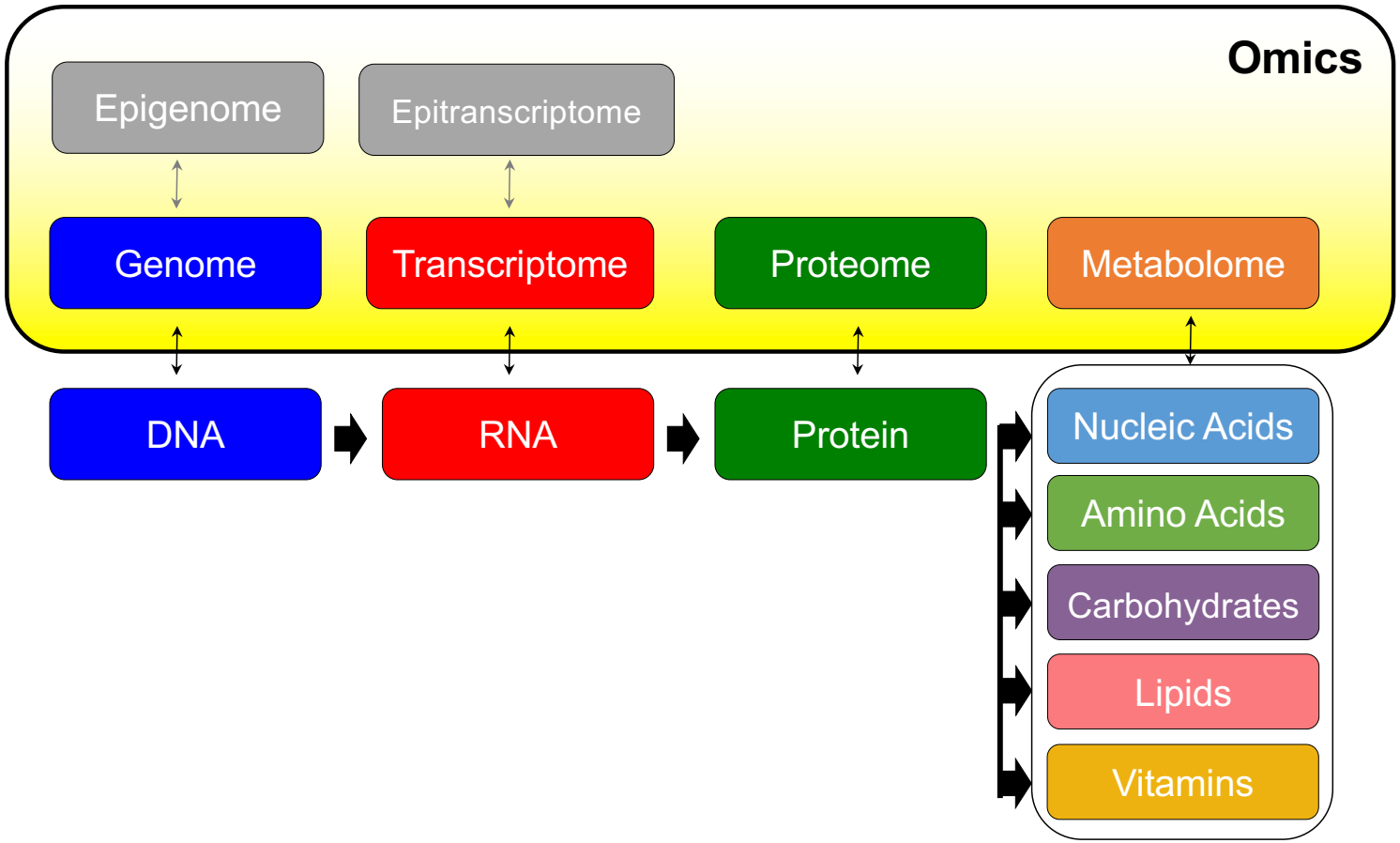


Beyond the Central Dogma



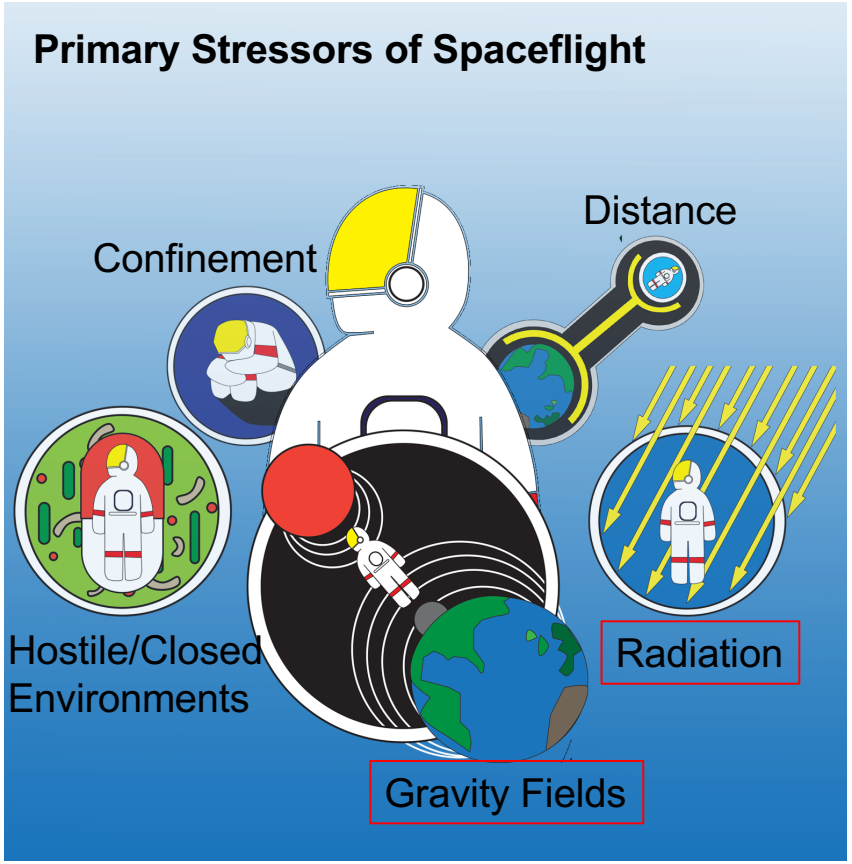
Gonzalez-Pardo and Alvarez, 2013

What are ‘omics?



Why is studying omics important for spaceflight?

- What, when, and where genes are expressed allow for cell type diversity and enable living organisms to respond and adapt to surroundings
- Gene expression is primarily regulated by environmental factors both micro (cell's micro-environment) and macro (organism's external stimuli or stressors)
- Spaceflight alters the transcriptional patterns and molecular signaling networks within our cells, which in turn causes physiological changes
- Understanding such changes will enable development of mitigation strategies to better withstand the rigors of long-duration spaceflight



GeneLab: Open Science for Life in Space (https://genelab.nasa.gov)

Open Science for Life in Space

Home | About | Data & Tools | Research & Resources | Working Groups | Help

Keywords



Welcome to NASA GeneLab - the first comprehensive space-related omics database; users can upload, download, share, store, and analyze spaceflight and spaceflight-relevant data from experiments using model organisms.

Data Repository
Search and upload spaceflight datasets

Analyze Data
Perform large-scale analysis of biological omics data

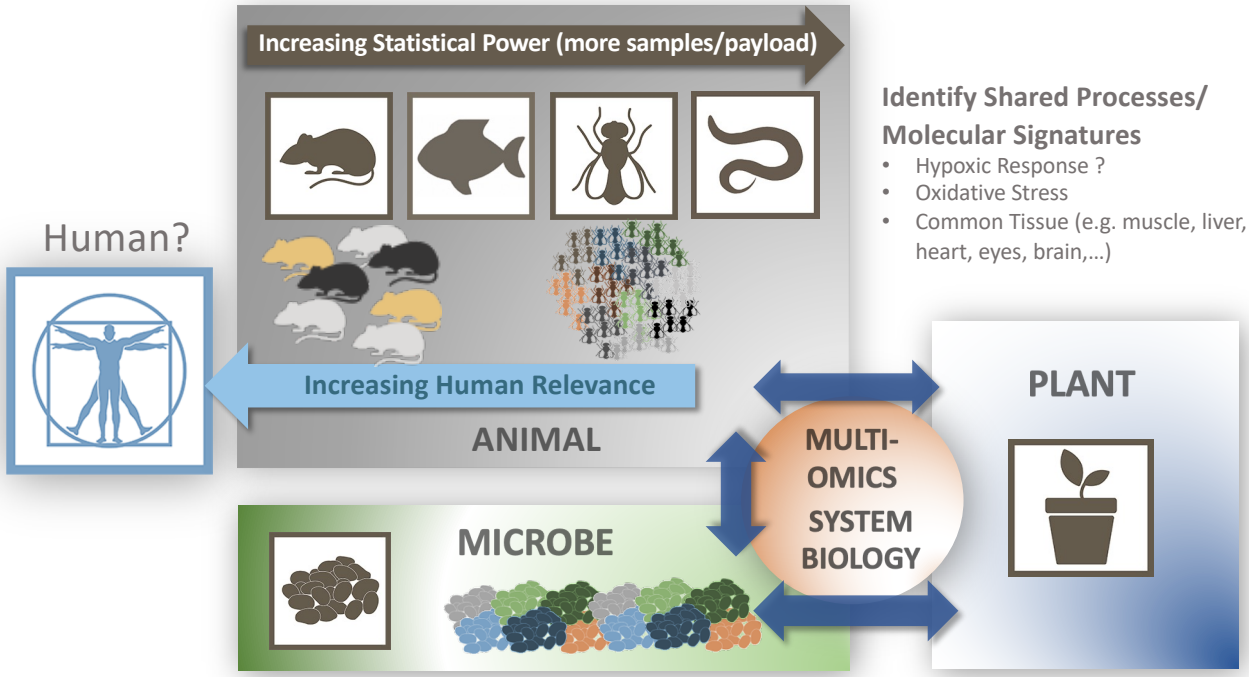
Environmental Data
Radiation data collected during experiments conducted in space

Collaborative Workspace
Share, organize and store files

Submit Data
Have space-relevant data to submit to GeneLab?

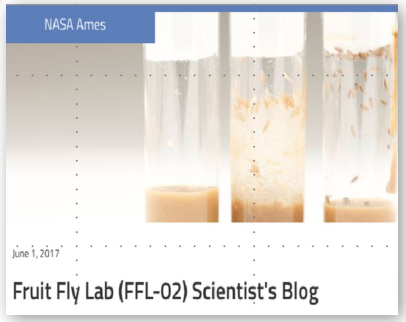
Visualize Data
Interact with GeneLab processed data

GeneLab ecosystem: Maximizing knowledge by bringing experiments together



Identify Shared Processes/ Molecular Signatures

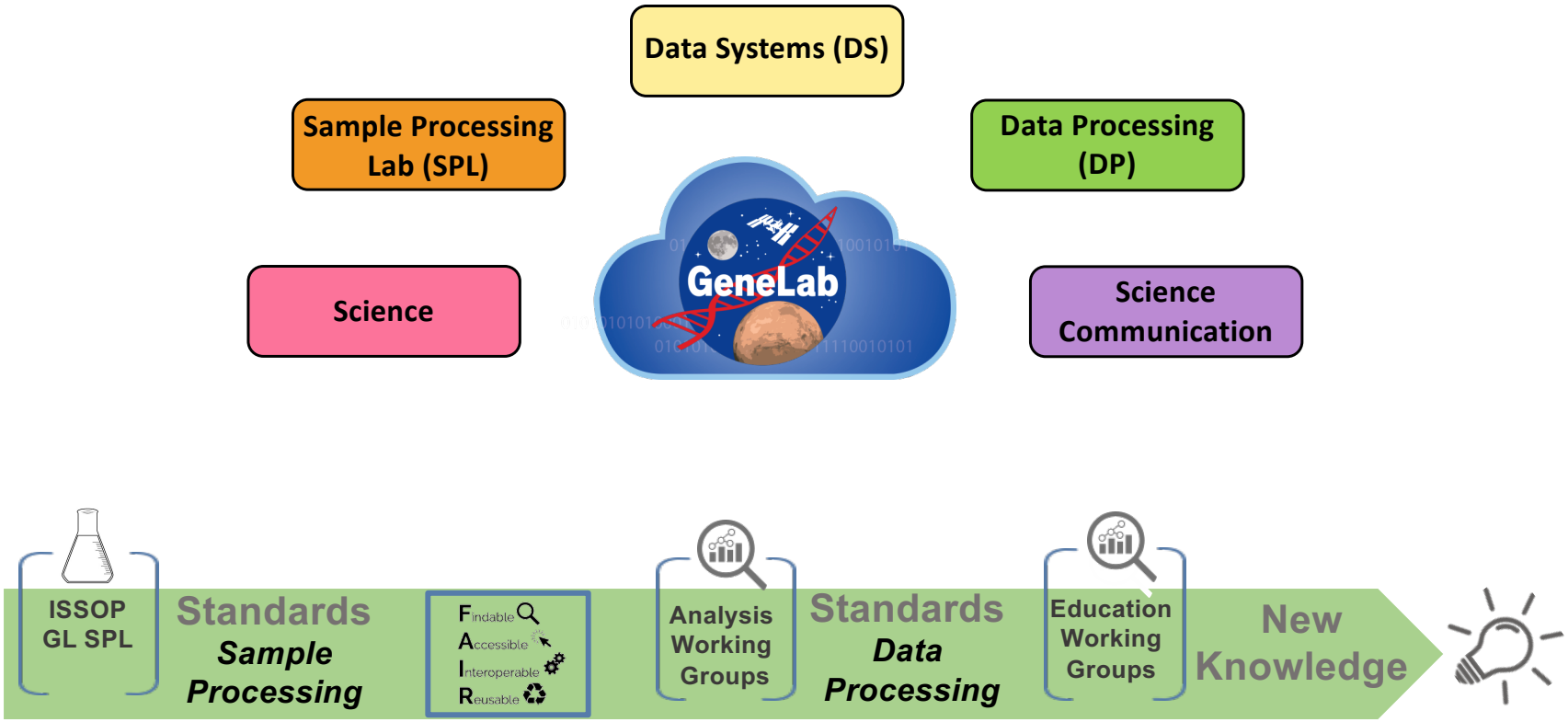
- Hypoxic Response ?
- Oxidative Stress
- Common Tissue (e.g. muscle, liver, heart, eyes, brain,…)



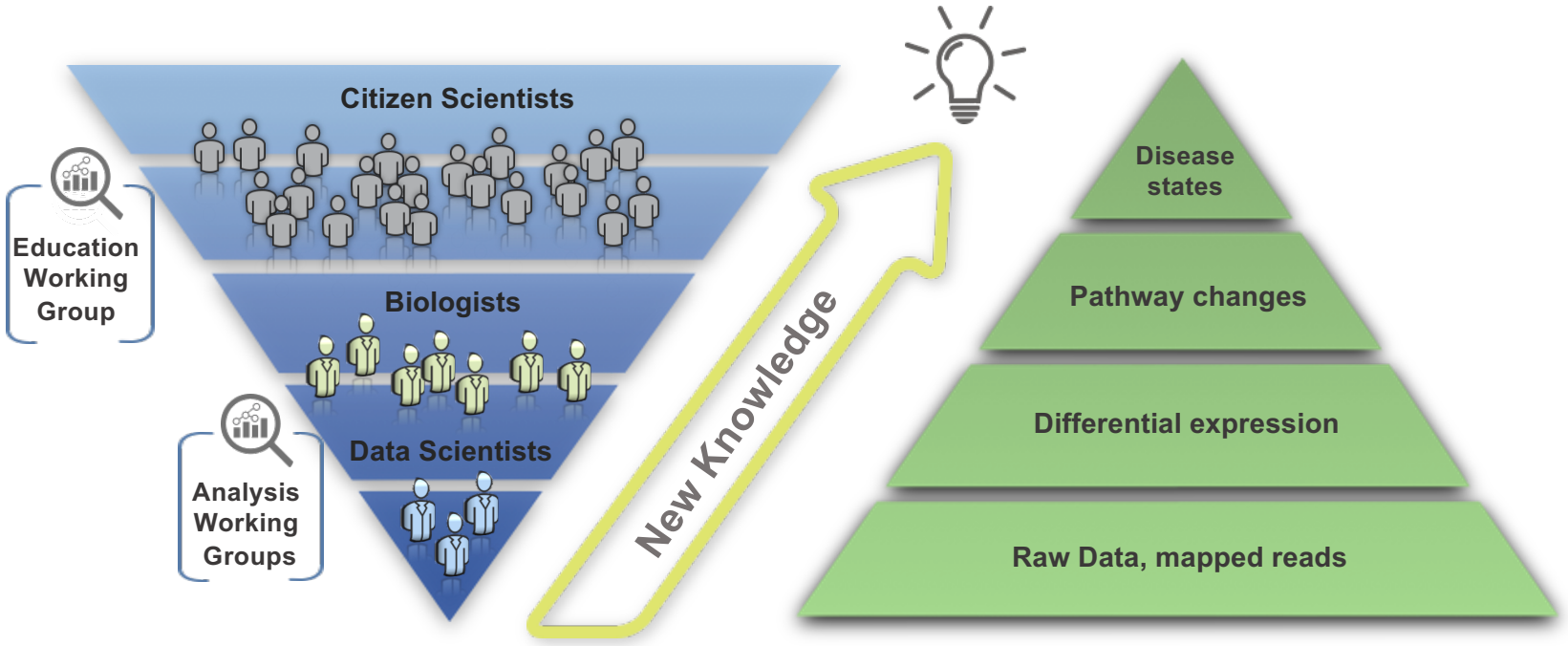
For Spaceflight

- High "n" number – statistically significant data
- Genetically identical animals
- Low resource requirements
- Short life cycle - multiple generations
- Measure response of a whole multicellular animal
- **Flies used as a model for humans for innate immunity, circadian rhythm, oxidative stress, neurobehavior, development, genetics, GWAS, "omics" studies etc**

GeneLab Teams



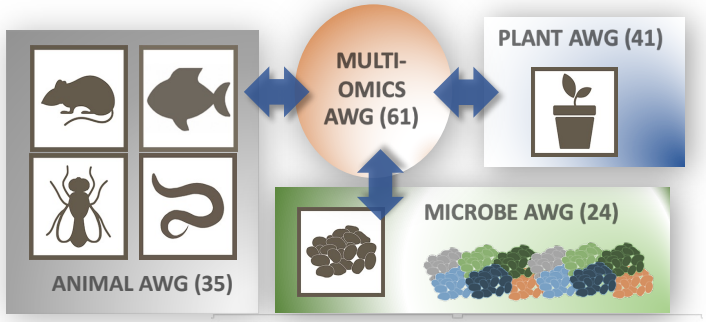
GeneLab Data Democratization



GeneLab – Get Involved!

GeneLab Analysis Working Groups (AWGs) *consist of* ***130+ scientists*** *from multiple space agencies, international institutions, and industry. Scientists meet monthly with each group to analyze data in the GeneLab repository. Majority of members are non-NASA PI's – many have applied for NASA funding following AWG interactions.*

https://genelab.nasa.gov/awg/join



AWG Members represent:

- 48 US Universities
- 4 NASA Centers
- 4 Other Government-funded Organizations
- 3 Institutes or Private Industry
- 3 International Universities

Educational Working Group (EWG) *consists of educators and scientists spanning across high school and college, focusing on developing content to learn about spaceflight OMICS, promoting the use of GeneLab's database via the repository, and the visualization and analytical portals.*

GeneLab for High Schools (GL4HS)

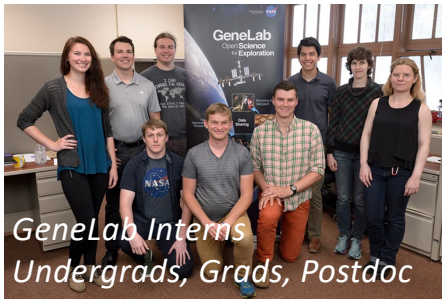
GeneLab for College/University (GL4U – Pilot with SJSU)

SJSU SAN JOSÉ STATE UNIVERSITY

GeneLab included in Bioinformatics curriculum of degree granting university



GL4HS (Tutorial + Tools)





NASA Opportunities



Outreach / NASA Internship Opportunities – College+

Young Scientist Program

Blue Marble Space Institute of Science

- Opportunities for students and eligible early career scientists to participate in basic research, learn about effective science communication, and develop critical thinking skills in ethics, policy, and more
- **The NASA/BMSIS Young Scientist Program in Space Biosciences:** For post-bachelors and pre-doctoral students (at Mountain View, CA)
- **The BMSIS Young Scientist Program:** For undergraduate students and those who have completed undergraduate studies but have not yet enrolled in graduate school (primarily virtual)
- **Learn more and apply at:** https://www.bmsis.org/ysp/



Learn more and apply at: https://www.nasa.gov/ames/research/space-life-sciences-training-program

SLSTP: Provides undergraduate students entering their junior or senior years, and entering graduate students, with professional experience in space life science disciplines including:

- The effects of spaceflight on living systems
- The development and operation of specialized research facilities to support investigations in microgravity, partial gravity, and hypergravity
- Research and development of advanced biotechnologies that enable NASA's exploration of distant destinations

NASA STEM Engagement

Discover more NASA Internship opportunities and apply at: https://intern.nasa.gov/

GeneLab for Colleges/Universities (GL4U):

- For educators and students to learn how analyze omics data using GeneLab standard pipelines and space-relevant data

https://github.com/nasa/GeneLab-Training/tree/main/GL4U

Questions?

