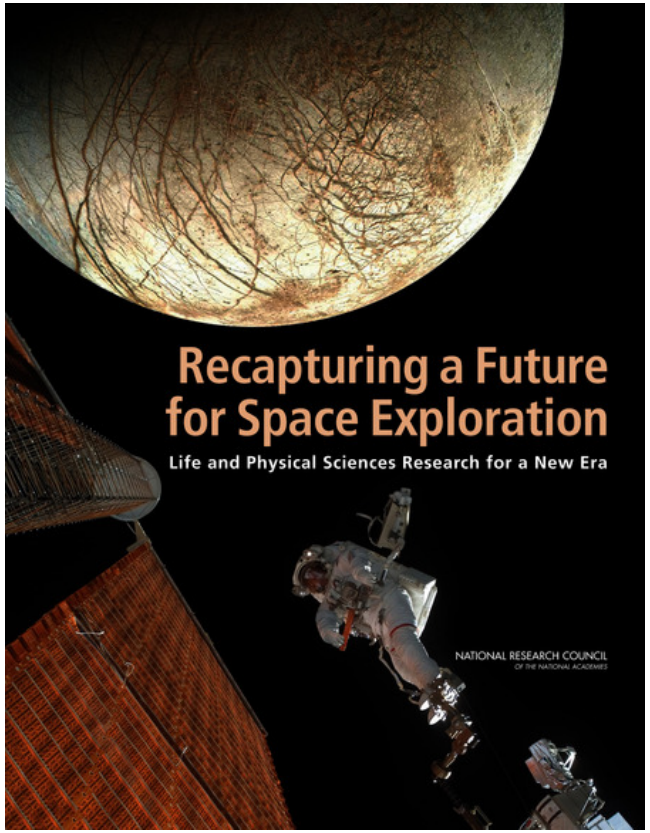
National Aeronautics and Space Administration

GeneLab Collaboration

Jonathan Galazka
GeneLab Science

October 28th, 2016

2011 NRC Decadal Survey



"*…**genomics, transcriptomics, proteomics, and metabolomics** offer an immense opportunity to understand the effects of spaceflight on biological systems…*"

"*…Such techniques generate considerable amounts of **data that can be mined and analyzed** for information by multiple researchers…*"

"*…The **creation of a formalized program** to promote the sharing and analysis of such data would greatly enhance the science derived from flight opportunities…*"

"*…Elements of such a program would include **guidelines on data sharing and community access, with a focus on rapid release** of these datasets while respecting the rights of the investigators conducting the experiments…*"

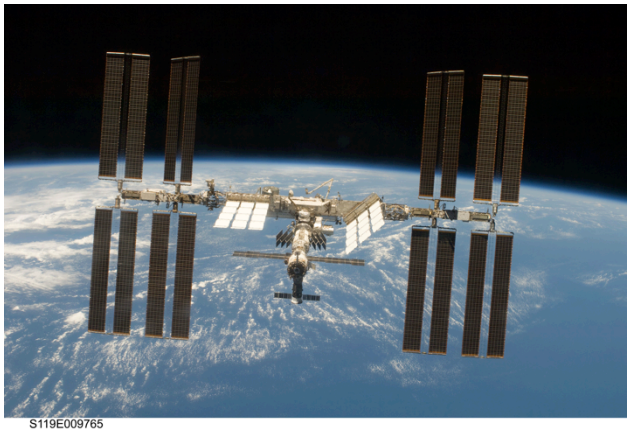
"*…**Larger-scale multiple investigator experiments**, with related science objectives, methods, and data products, would result in the **production of large datasets and would emphasize analysis over implementation**. Key aspects of such large-scale experiments would be **replicates and statistical strength**…*"

GeneLab
Open Science for Exploration

Maximizing Omics

Maximizing omics data

- Biological experiments are regularly delivered to ISS.
- GeneLab is authorized to collaborated with Space Biology PIs to increase the amount of omics data returned from these experiments.

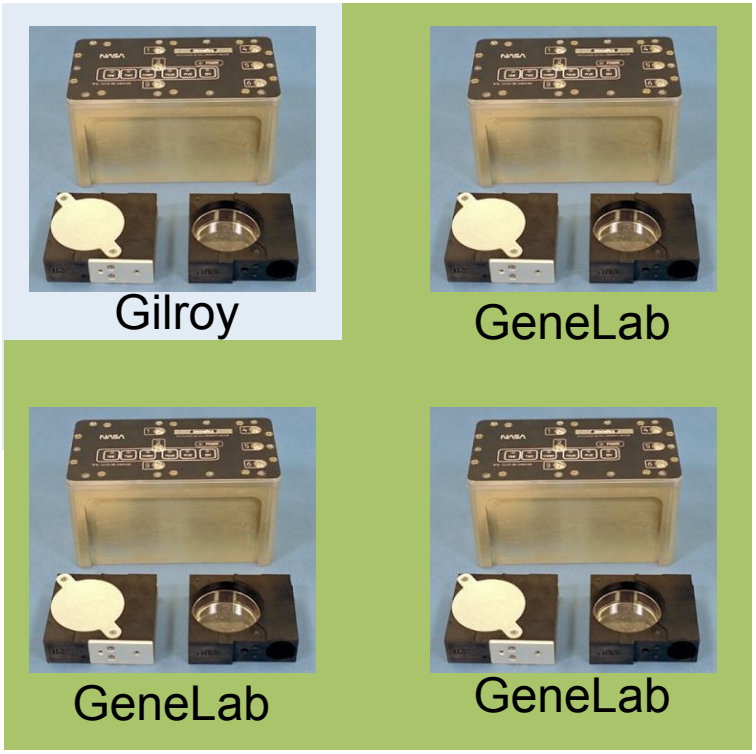


Flights Launch	**SpX-10** January 2017	**OA-7** February 2017	**SpX-11** March 2017	**SpX-12** June 2017	**SpX-13** September 2017	**SpX-14** January 2018
Payloads			**Fruit Fly Lab-02** (Bodmer)	**JRR-1** (SLPS+IMBP)	**Cell Science-01** (Validation)	**Rodent Research-7** (GL Good Health)
	Rodent Research-4 (ISS-NL)	**MT-2** (Jaing)	**Seedling Growth-3** (Kiss, Medina)	**Micro-12** (Hogan)	**Micro-11** (Tash)	**EMCS-2** (Wolverton)
			Rodent Research-5 (ISS-NL)	**GL-1** (Lewis Team)	**Rodent Research-6** (ISS-NL)	**FFL-03** (Govind)

Simon Gilroy: BRIC-19

Simon Gilroy

A. thaliana



- NNX13AM50G, BRIC: Plant Mechanical Signaling During Spaceflight
- The core study characterizes transcriptional patterns of *Arabidopsis thaliana* induced during germination and growth on the International Space Station.
- The GeneLab collaboration allows the comparative study of three additional ecotypes.

Col-0

Cvi-0

Ler-0

Ws-2

Sarah Wyatt: BRIC-20

Sarah Wyatt

A. thaliana

Wyatt

Wyatt

Wyatt

GeneLab

- Ground-to-microgravity comparative gene expression analysis of *A. thaliana* seedlings.
- The core project examined global gene expression and the composition of the soluble protein fraction.
- The GeneLab collaboration augmented the core investigation with a membrane protein data set.
- *"The GeneLab augmentation allowed us to examine membrane proteins and soluble proteins separately to determine which were differentially expressed between seedlings germinated in space compared to the ground, leading to the discovery of two integral membrane proteins that may provide insights into gravitropic signaling."* – Sarah Wyatt

Wyatt:

RNA sequencing
Soluble fraction proteomics

GeneLab:

Membrane fraction proteomics

Rodent Research-1

- Launch on SpaceX-4
- Validation mission for Rodent Habitat
- Carried 10 NASA mice on ISS for 38 days
- In 2015, some livers were dissected on orbit, others postflight from frozen carcasses. Other tissues were harvested and deposited to the LSDA (GLDS-47,48,49)
- In 2016, GeneLab requested 7 tissues from the LSDA and processed these to obtain additional omics datasets (data release Dec. 2016)
- Data set prioritization based upon relevance to known physiological changes and data gaps.
- GeneLab will not analyze or publish on data. For the community

10 mice for 38 days

2015

X livers dissected on orbit

X livers dissected on ground

Other tissues deposited to LSDA

2016

GeneLab requests 7 tissues

Processed for additional omics datasets

Collaboration Insertion Points

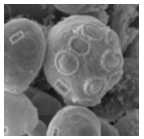
Microbial Observatory
(K. Venkateswaran)

BRIC-19
(S. Gilroy)

BRIC-20
(S. Wyatt)

Rodent Research-1
(CASIS)

Micro-4
(T. Hammond)



Development of experiment objectives

Payload mission definition & implementation

Experiment performed

Sample prep

Omics center processing

Data curation & release

Generic Flight Flow

Collaboration Process

Development of experiment objectives | Payload mission definition & implementation | Experiment performed | Sample prep | Omics center processing | Data curation & release

GL process involving Gap Maps and SWG

GL surveys and identifies active grants

GL and PI develop collaborative agreement

Review by ARC & KSC Space Biology for conflicts

Space Biology approves agreement

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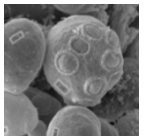

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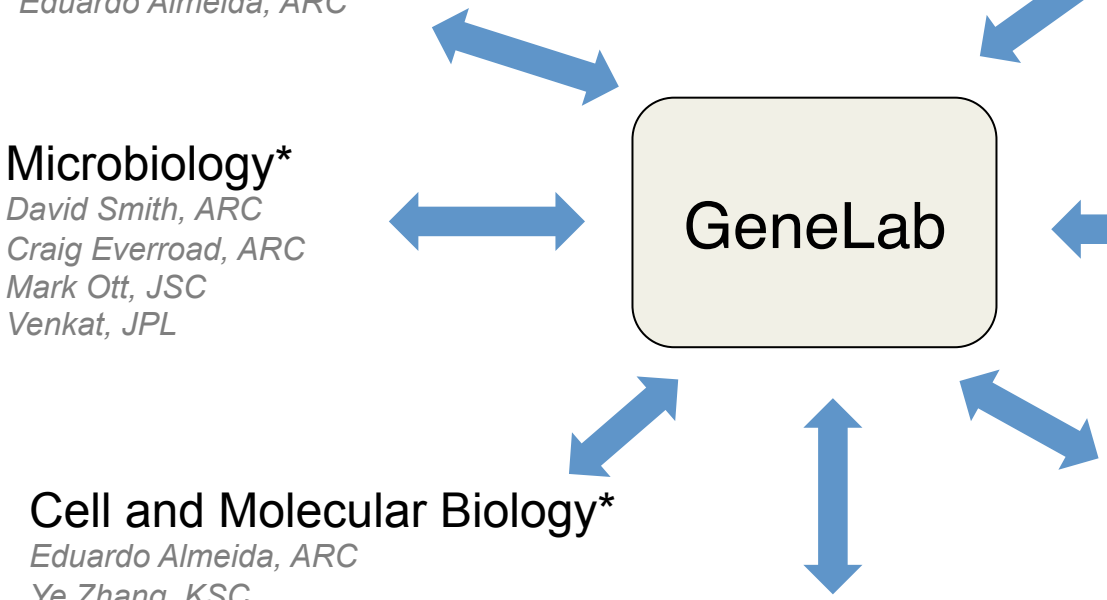
Science Working Group



Vertebrate and Invertebrate Animals*

Ruth Globus, ARC
Josh Allwood, ARC
April Ronca, ARC
Sharmila Bhattacharya, ARC
Eduardo Almeida, ARC

Developmental, Reproductive and Evolutionary Biology*

Sigrid Reinsch, ARC
Ruth Globus, ARC
April Ronca, ARC
Venkat, JPL
Lee Bebout, ARC
Mark Ditzler, ARC

Microbiology*

David Smith, ARC
Craig Everroad, ARC
Mark Ott, JSC
Venkat, JPL

Radiation Biology

Marianne Sowa, ARC
Honglu Wu, JSC

Cell and Molecular Biology*

Eduardo Almeida, ARC
Ye Zhang, KSC
Sigrid Reinsch, ARC
Jonathan Galazka, ARC
Ruth Globus, ARC

Plant Biology*

Howard Levine, KSC
Anna Lisa Paul, UFL

Systems Biology, Bioinformatics, Synthetic Biology

Viktor Stolc, ARC
Andrzej Pohorille, ARC
Lyn Rothschild, ARC
Stephanie Richards, ARC

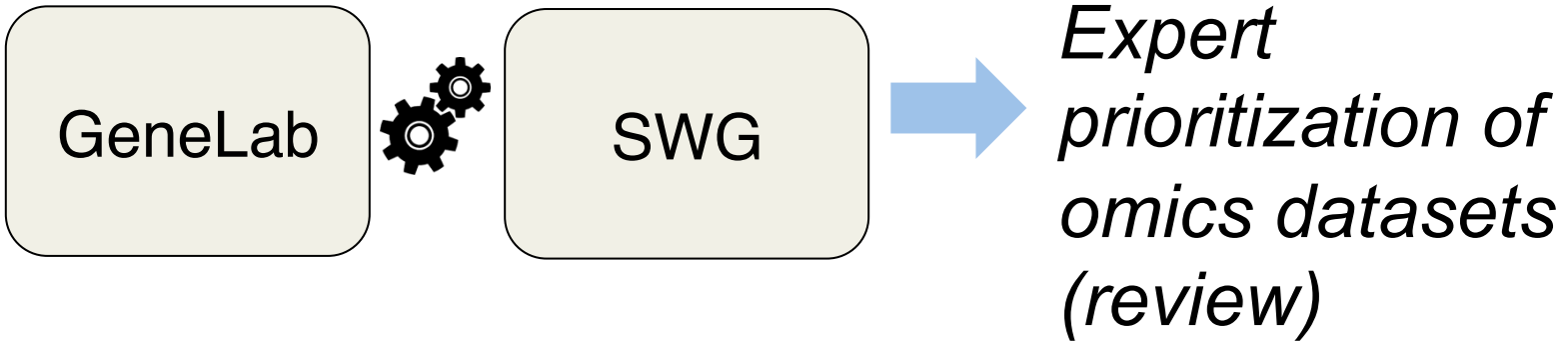
Gap Map

Rodent Gap Map

Minimum: Datasets in GLDS

Feature	Liver	Kidney	Eye	Gastroc-nemius	Soleus	Tibialis anterior	Extensor digitorum longus	Quad-riceps	Skin	Adrenal	Mam-mary	Thy-mus	Bone Marrow	Brain
mRNA	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5mc-DNA	X	X	X	X	X	X	X	X		X				
Protein	X	X		X		X		X		X				
miRNA	X	X		X		X		X						
5mc-RNA	X			X		X		X						

Ideal:



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Questions

Q. Who can collaborate with GeneLab?

A. NASA Space Biology PIs, GeneLab can be request samples from LSDA, NASA projects.

Questions

Q. How many collaborations will GeneLab participate in per year?

A. Funding is limited. Different analyses cost different amounts. We will participate with as many as possible and prioritize using community and programmatic input.

Questions

Q. I have a spaceflight mission through CASIS or Nanoracks or other commercial or international provider. Can I collaborate with GeneLab?

A. Current policy does not authorize this.

Questions

Q. Do PIs receive proprietary time on data produced through collaboration?

A. Current policy is no proprietary time for the GeneLab portion of any collaboration.

Questions

Q. Who performs sample processing?

A. Negotiable. GeneLab has a wet lab. Determination made based on available sample processing expertise and funding.

Questions

Q. What if I can spaceflight samples that may be useful to GeneLab?

A. Submit to LSDA

Questions

Q. Who can submit data to GeneLab?

A. Anyone, but curation process is time consuming. Datasets are prioritized based funding source, scientific relevance, evidence of peer review.

National Aeronautics and Space Administration

GeneLab Collaboration

Jonathan Galazka
GeneLab Science

October 28th, 2016

Agenda

- Big picture. Maximize science. ROI.
- Past examples of Collaborations
  - Sarah Wyatt
  - Simon Gilroy
- New process for Collaborations
  - Ability to transfer funds active SB grants for processing. GeneLab can perform some processing.
  - Use Gap maps and programmatic alignment to prioritize missions
  - Review active grants to avoid conflicts
  - Use SWG to vet science
  - Approval through SB (Kevin and David)
  - GeneLab proposes science after developing science with PI. Allows out of scope.
  - Limited funding
  - Must be authorized by Space Biology (easier if funded by Space Biology)
  - Apologies for slow response

Generic Questions

- What types of data does GeneLab hold?
- Can I work for GeneLab?
- Does GeneLab have internships?
- What is GeneLab?
- Does GeneLab publish papers?
- Does GeneLab accept data from platforms other than ISS?
- Can GeneLab accept data from ground experiments?
- Can GeneLab provide protected links to data sets to allow reviewers to access data during manuscript submission prior to public release of data?
- Why should I submit my data to GeneLab instead of other data repositories?