Report on Collaborative Life Sciences Data Technical Exchange Meeting held at Ames Research Center January 14-15, 2016

Executive Summary

January 14-15 Code TI and Code SC / Life Sciences Data Archive and ISOC team sponsored a cross center and program "Collaborative Life Science Data” Technical Exchange Meeting (TEM):

The TEM Focus was on the following:

To discuss multi-program and multi-center collaboration approach on architecture standard interfaces, tissue sharing and biobanking standards in support of the NPD 7100.1A and following NPR on Curation of Scientific Collections.    This launch of the 1st TEM was to foster discussion on gaps, challenges, lessons learned, and strategy for a collaborative vision between the Human Research Program (HRP), Space Biology Program (SLPS), and International Space Station Program (ISSP) projects that maintain human research and biosciences data and curate scientific collections (biospecimens from on-orbit operations and ground control operations).

Attendance and Presenters were:

- JSC Life Sciences Data Archive (LSDA)

- GeneLab (GL)

- Space Radiation Lab

- KSC Plant & Microbe Project

- KSC Life Sciences Data Archive

- JSC Code SF5 Architecture and Strategy Working Group (ASWG), supporting the following:

MEME – Mission Extended Medical Enterprise (electronic medical records)

SISL – System Integration and Support Laboratory (lab/research machines)

TSC – Telescience Center (HRP ISS-Medical Projects element)

LSDA – Life Sciences Data Archive

- Lifetime Surveillance of Astronaut Health (LSAH)

- WestPrime (HQ-CIO)

- Exploration Medical Capability (ExMC)

- Space Bio Rodent Research (RR)

 -Translational Research Tissue Sharing Project (HHC TSP)

- Life Sciences Translational Research (HHC)

- Ames Life Sciences Data Archive (ALSDA)

- International Space Station Science Operations Center (ISOC)

- Human Research Program (ARC Representation)

- Space Biosciences Division (ARC Representation)

Data Management:  The meeting between the Centers surfaced agreement on the need for a common web port that would provide search to necessary linkages to data repositories and analytic and decision tools for cross center data and biospecimen sharing.  Also discussed were the potential benefits in both cost and simplification for users of having a common interface across the Centers e.g., data dictionaries (metadata syncing), and application Interfaces for real-time and near real-time access of data for principal investigators, other researchers, science management and/or the public; and to move away from legacy IT systems and software.   The goal is to eventually facilitate the use of analytic and decision tools that support translational research benefiting human exploration.

Curation of Scientific Collections:  This section of the meeting focused on discussion on Tissue Sharing Program needs and identification of a standard for Institutional and project tissue sharing across agency, with external partners, and international partners.

The JSC Code SF5 Architecture and Strategy Working Group (ASWG) that manages MEME, SISL and TSC were impressed by the ARC Joint LSDA and ISOC progress in use of their Collaborative Life Sciences Repository (Cloud). The CLSR enables near-real time and real time access to TLM and video, which significantly reduces cost of operations from 8-16 hours a day of operations resource hours to 2-4 operations hours a day, which increases research investigation turnaround time, and crew training time. The ASWG plans on working with the ARC LSDA and ISOC team in leveraging off the necessary automation application and Cloud applications to model similar architecture for the TSC and support the HRP ISSMP program.

Actions Agreed To by members in this TEM:

1) Development of a white paper which addresses goals, plans, gaps, stakeholders, schedule, challenges. Hope to submit for the PPBE cycle.

2) Continue these meetings as a series (to further discussion on collaboration and completion of the white paper)

3) Send out draft of NPR 7100.XXX - scientific collections.

Report

**A.  TEM Rationale and Vision**

Looking for a multi-program and multi-center agreement on architecture standard data interfaces and tissue sharing (Biobanking): Collaboration between the Human Research Program (HRP), Space Biology Program (SLPs), and International Space Station Program (ISSP)

Common architecture of applications and interfaces across the Centers, including data dictionaries (metadata syncing), and application Interfaces for real-time and near real-time access of data for principal investigators (PIs) and the public; and to move away from legacy IT systems and software.

Facilitate the use of information technology and bioinformatics analysis and decision tools for data collected from Translational Research to benefit human exploration.

Support the White House Policy on Open Science - “Increasing Access to Results of Federally Funded Scientific Research”

**B.  Project/Program Reports**

 Following is a list of presentations given at the TEM with a top level summary of each:

1. **GeneLab: Mike Skidmore**

- Description:

* At its core, the GeneLab concept is focused on omics data and is based on an Open Science ideal.
	+ 5 functional areas:
		- Payloads and partnerships
		- Science
		- Long-term data collaboration, storage, dissemination, and analysis
		- Science communications
		- Software development
* Omics data is derived from modern analytical techniques such as those employed in genomics (DNA), transcriptomics (RNA), proteomics (proteins), and metabolomics (metabolic products).
* Open Science, as defined by Wikipedia (https://en.wikipedia.org/wiki/Open\_science) is “the movement to make scientific research, data, and dissemination accessible to all levels of an inquiring society, amateur or professional. It encompasses practices such as publishing open research, campaigning for open access, encouraging scientists to practice open notebook science, and generally making it easier to publish and communicate scientific knowledge.”
* So, in the service of the Open Science ideal, GeneLab provides a continually evolving set of omics related services that will facilitate that ideal.
* The mission of GeneLab is to maximize the utilization of the valuable biological research resources aboard the ISS by collecting genomic, transcriptomic, proteomic, and metabolomics data (known as “omics”) to enable exploration of the molecular network responses of terrestrial biology to the space environment, and to make all the data available to a worldwide network of researchers in an open-access database.
* The multi-year GeneLab project is both a **science collaboration** initiative to *maximize the omics data collected from spaceflight and from ground simulations of microgravity and radiation experiments*; as well as a **data system** effort to establish a *public bioinformatics repository and collaborative analysis space* for these data.

- GeneLab: Challenges and Next Steps

**Data System**

* Link to Public Databases via federated standards.
* Beta GeneLab Phase II -informatics system

**Data System**

* Integrated Platform across model organisms
* Build Community via collaborative science analysis & modeling

**Data System**

* Website and platform sustaining activities
* Continuous improvement

- GeneLab: Q&A Items (only major points that influence collaboration)

Q: What about data analysis tools?

A: (Mike) Using X-Gene software development tool but will take time to implement. K-base is a recommended NIH tool but takes a major effort.

Policy issues regarding the Twins study have not been formulated

Would like to have a truly collaborative platform where PIs cand post data and have access to the tools to do additional analysis.

Genelab funded by both ISS and SLSP

1. **Life Sciences Data Archive (LSDA): DeeDee Thomas & Peggy Delaney**

-Description:

The LSDA is a collection of NASA’s life sciences research data and information, consisting of human, animal, microbe, and plant studies conducted from 1958 to present. The LSDA has archive offices at ARC and JSC and the KSC office has recently been reestablished.

The ARC office has primary responsibility for the preservation of plant, microbe and animal research information and data, and has the added responsibility of maintaining the Biospecimen Sharing Facility.

The JSC office has primary responsibility for the preservation of human research information and data. The JSC office also has the additional responsibility of maintaining the central databases, the public website, and associated data management infrastructure.

The LSDA is also a NASA JSC Institutional Review Board (IRB) approved repository. The purpose of the LSDA Repository (LSDA-R) is to enable the distribution of archived human research data and information beyond the purpose for which the data was originally collected.

The LSDA-R and the Lifetime Surveillance of Astronaut Health Repository (LSAH-R) house the evidence base for the Human Health and Performance Directorate (HH&P).

Collectively, the repositories provide reusable data to researchers and establish permanence of NASA’s research and medical data collections.

The LSDA-R also encompasses the Biospecimen Sharing Program (BSP), managed at ARC, which provides the scientific community with access to NASA's inventory of non-human biological materials from organisms that have either flown in space or have been included in related ground control studies.

- Life Sciences Data Archive: Challenges and Next Steps

* + Data privacy in the age of Omics and subject consent
	+ Curation and use of human biospecimens
	+ Location of human Omics data archive and the increased storage capacity requirements
	+ Search capabilities and data analytics capabilities

- Life Sciences Data Archive: Q&A Items (only major points that influence collaboration)

Q: What about collecting human genomics data?

A: Policy is being discussed but not developed yet. Consultants are involved.

Q: What about genomic data requests? Are they being referred to GeneLab?

A: No, not being referred at this point. There have been JSC & HQ TEMs looking at this issue but no decision yet.

1. **ARC Life Sciences Data Archive (ALSDA): Alison French**

-Description:

The ALSDA is a node of the NASA Space Life Sciences Data Archive and is responsible for capturing, curating and distributing Ames-managed life science research.

Current holdings include:

* + Experiments dating back to the Gemini program
	+ More than 700 experiments
	+ Full experiment descriptions, plus some supporting data for those experiments
	+ Searchable publications list
	+ Images and Video (historic project) ~3000 each
	+ Many documents including final reports, safety reports, science requirements, project reports
	+ Substantial engineering documents and hardware drawings (supported by the Ames Engineering Release Center (ERC))
	+ ~ 15,000 biospecimens
	+ Some raw downlink and ground control data streams and much more coming in with research coming from ISS (vs Shuttle where most missions were unique)
	+ Rodent Research 1 – Nearly curated and soon to be available via LSDA.JSC.NASA.GOV
	+ Rodent Research 2 – Being curated but mostly private sector so not so much of it online

- ALSDA: Gaps & Challenges

* ALSDA is currently working on finding suitable housing for non-digital holdings and space is scarce at Ames.
* Will need to develop link(s) to support GeneLab.
* Working on resolving long-term storage for commercial experiment data.

- ALSDA: Q&A Items (only major points that influence collaboration)

 None

1. **International Space Station Science Operations Center (ISOC): Helen Stewart**

-Description:

The ISOC is a subset of the MMOC and is located in Building 245.

Managed by Helen Stewart and staffed by: Anthony Chan, Sue Blumenberg, Brian Yu, Cameron Milne, and Cedric Priscal. Science Ops: Nancy Rustemeyer

* The ISOC has responsibility for:
	+ Commanding the habitat & capturing ARC data from ISS
	+ Transforming the data for science and engineering use
	+ Hosting live data access
	+ Delivering raw and processed data sets to the archive

- ISOC: Challenges and Next Steps

* Reduce payload operator fatigue in ISOC e.g., for ARC ISOC SF Payload Operations
* Move majority of Engineering and Science operations into the CLSR (enabling operators to work from anywhere during after-hour events)
* Reduce ISOC IT Support after hours
* System monitoring automation processes
* Enhanced exception monitoring and automation of payload archiving for trending data for higher precision science return
* Improve science return turnaround time and science PI fatigue

- ISOC: Q&A Items (only major points that influence collaboration)

None

1. **Collaborative Life Sciences Repository (CLSR): Helen Stewart**

-Description:

The CLSR is significant new (FY15) infrastructure to NASA space life sciences provided by WestPrime, and their broker, Infozen.

The ISOC team, working with the archive and science ops, implemented a file sharing cloud instance as a means for collecting large live data streams (terabytes per mission) and hosting those video and data files until operational needs are met.

Deployed a 1 Terabyte EC2 Linux instance type c3.xlarge with elastic S3 buckets for storage.

Cloud is Amazon .gov service that provides ITAR/Pii level security.

The ISOC implemented file management software FileCloud which provides:

* IT Security Interconnection Agreements meeting FISMA
* Single Sign-On (SSO) - SAML 2.0 solution which utilizes Launchpad authentication.
* Near Real time video collection (onboard and GC) and distribution to Science for daily review via a web interface.

- CLSR: Challenges and Next Steps

* Will continue build-out of this relatively new service
* Explore bio-informatics and decision tools to incorporate contingent on science and payload project needs

- CLSR: Q&A Items (only major points that influence collaboration)

None

1. **KSC Life Sciences Data Archive: Stephanie Richards**

-Description:

* KSC payloads are predominantly focused on plant and unicellular organism research.
* Primarily the projects managed by KSC provide a greater foundation in elucidating adaptive responses of these organisms when subjected to microgravity and spaceflight conditions.
* Hardware portfolio:
	+ Biotube
	+ Biological Research In Canisters (BRIC) Series
		- -60
		- -100
		- -100VC
		- -Opti
		- -Petri Dish Fixation Unit (PDFU)
	+ FASTRACK
	+ Kennedy Space Center Fixation Tube (KFT)
	+ Vegetable Production Unit (VEGGIE)
	+ ***Under development***
		- Advanced Plant Habitat (APH), expected completion 2016
		- BRIC-Light Emitting Diode (LED), expected completion 2016
		- Multispectral Fluorescent Imager, expected completion 2017

Note: the presentation from KSC includes an inventory of KSC life science related capabilities & resources and a list of recently completed KSC payloads.

- KSC Life Sciences: Challenges and Next Steps

* KSC payloads have predominantly shifted from microarray analysis to sequencing analysis (storage equivalent = Gb to Tb of data).
* Type of data for submission into GeneLab:
	+ RNA Sequencing
		- Whole transcriptome (total RNA)
		- Transcriptome (mRNA)
	+ DNA Sequencing
		- Epigenome
		- Microbiome
	+ Proteome
	+ Metabolome
* Additional data for incorporation into the LSDA:
	+ Images
* Nutritional composition
* There are plans to upload data to GeneLab.

- KSC Life Sciences: Q&A Items (only major points that influence collaboration)

Q: Will KSC provide hardware and experiment descriptions?

A: Need to work on this, especially hardware info.

Q: Where are the Omics data analysis done?

A: Some done by KSC PIs either at KSC or in PI university labs.

Q: Do those labs have certification processes in place?
A: Some of the labs are Good Clinical Laboratory Practice (GCLP) certified.

Q: (Some PIs request Omics data but can't analyze it. Make sure expertise is there.

Q: What does ‘make more data available’ really mean?

A: For example, expertise required to interpret data, which might not be readily understood in raw formats. And using parameter standardization would make comparisons between data sets possible.

Q: How deep do the processing standards go?

A: Determined by the payload success criteria and QC metrics that are determined by the science team and PI and dependent on the type of organism and hypothesis.

Q: What about the data management plans for the proposals, like sampling, processing, detailed lists of data to be captured?

A: The experiment design in the proposals talk about this and it’s reviewed by the science team as part of the proposal analysis. Typically, it’s pretty solid and worked out before the readiness review.

Q: What percent of the KSC plant experiments are NASA funded vs commercial?
A: At this point it’s all NASA funded.

Omics Standards – institutions are required to follow established standards.

1. **Life Sciences Translational Research: Richard Mains**

-Description:

* 2010 Decadal Survey has driven the need to establish the Translational Research effort within HEOMD.
	+ AG Workshop (2014)
	+ Translational Research Roadmap (2014)
	+ ASGSR Translational Research Panel (2015)
	+ ARC Translational Research Report (1965-2011) (TBD)
	+ Cell and Animal Research 4-year task (?)
* NASA is increasingly seeing the value of translational researchthat *captures basic biological knowledge and facilitates its potential application to medical operations for safer human space exploration*.
* New Omics-based knowledge, the availability of model organisms and epigenetic sciences allows basic research results to be more readily applied to human challenges.
* The space biology cell and animal research areas are the highest priority translational research knowledge generators. But, Space Biology has many other areas that contribute to human space exploration such as; plant research (food production), microbial research (disease mitigation), reproduction/development (future human settlements), and radiation exposure (mitigate pathology risks). So, these broader translational benefits that are not necessarily direct physiological countermeasures need to be included as part of the rationale for increased collaboration.

- Translational Research: Challenges and Next Steps

* “Open Science” with increased researcher teaming and data sharing is driving collaboration by NASA IT-related systems (GeneLab, LSDA, Biobanks, etc.).
* Translational research needs are increasing within NASA life and physical sciences and is part of the evolving SLPS Strategic Plan.
* “The challenges are many, the gaps are many, but the collaboration has begun.” (in reference to this meeting)

- Translational Research: Q&A Items (only major points that influence collaboration)

None

1. **WestPrime/Infozen: Ravi Raghava**

- Description:

WestPrime is a NASA contract to manage the nasa.gov domain as well as provide cloud services to NASA. “WestPrime is a secure, high-performance, multi-tenant environment that is hosted in Amazon’s public and private cloud facilities.”

30-day trial boxes are free

All security functions offloaded from the customer. Security compliance as a service.

1. **Lifetime Surveillance of Astronaut Health (LSAH): Mary Van Baalen**

-Description:

The primary aim of the LSAH is “to investigate and describe the incidence of acute and chronic morbidity and mortality of astronauts and to determine whether the unique occupational exposures encountered by astronauts are associated with increased risks of morbidity or mortality.”

Combining Omics data with medical data

- LSAH: Challenges and Next Steps

* Key Issues –
	+ Data privacy in the age of Omics and subject consent
	+ Curation and use of human biospecimens
	+ Location of human Omics data archive and the increased storage capacity requirements
	+ Search capabilities and data analytics capabilities
	+ Manual nature of combining Omics data with medical testing data
* Questions –
	+ What is NASA’s plan for housing the volume Omics data?
	+ What analytics tools are GeneLab researchers using? Who has access to these data and tools?
	+ Is dbGaP being considered a possible storage site for human spaceflight Omics data?
	+ Potential interfaces with other archives?
* Desired Take Away from this TEM
	+ Learn who the Data Systems players are and their goals
	+ Understanding of the scope of GeneLab
	+ Development of a strategic plan for integration of repositories
	+ Sharing of Lessons Learned
	+ Format of Omics data for archive and searching purposes
* Future Plans
	+ Continued improvements to data accessibility
	+ Supporting studies funded under the new HRP Translational Research Institute
	+ International Data Sharing

- LSAH: Q&A Items (only major points that influence collaboration)

None

1. **Radiation Research: Honglu Wu**

-Description:

The NASA Space Radiation Laboratory, or NSRL, commissioned Oct. 14, 2003, at the Department of Energy's Brookhaven National Laboratory in Upton, N.Y. The laboratory, built in cooperation between NASA and the Department of Energy, or DOE, is one of the few facilities that can simulate the harsh space radiation environment.

"Scientists will use this facility as a research tool to protect today's crews on the International Space Station and to enable the next generation of explorers to safely go beyond Earth's protected neighborhood," said Guy Fogleman, director of NASA's Office of Biological and Physical Research's Bioastronautics Research Division.

Space radiation database is under construction.

Started communications with Genelab and identified datasets to be submitted to Genelab.

- Radiation Research: Gaps & Challenges

Information be to extracted from omics data

* Pathways or networks that are unique in cellular responses to high-LET radiation
* Differences of cellular responses to radiation exposure between low and high doses, and between low and high dose rates
* Correlation between the changes at the molecular level and functional changes in response to radiation exposure
* Differences of cellular responses to radiation exposure between cultured cells or animals of different genetic backgrounds
* Biomarkers of radiation risks
* Risk prediction by integrating with currently used epidemiological data-based models
* Countermeasures that can be developed by targeting genes.
* A Space Radiation Program Element Experiment Database is under construction. The Ionizing Radiation Expressome pilot project extracts omics data from several public databases, with the aim to close the radiation gaps.
* - Radiation Research: Q&A Items (only major points that influence collaboration)

HRP has identified several HRP Space Radiation data sets to be submitted to GeneLab.

1. **Architecture Systems Working Group (ASWG): Andrew Carnell**

-Description

* SF5 – Information Architecture Branch
	+ Stood up ~2 years ago
	+ Consolidate all HHP IT support
	+ Infrastructure & SW development
* Enterprise architect
	+ Holistic view of branch goals, processes and systems
	+ Transform from “best effort” service to defined services at best cost/value
	+ Currently documenting HHP enterprise (Casewise tool)
	+ Branch is defining strategic goals and objectives
	+ Need to define future, “to-be” state
* Major systems
	+ MEME – Mission Extended Medical Enterprise (electronic medical records)
	+ SISL – System Integration and Support Laboratory (lab/research machines)
	+ TSC – Telescience Center (HRP ISS-Mission Programs element)
	+ LSDA

Documenting HHP Enterprise using Casewise tool to know what we have and how it’s organized.

Starting a series of meetings next week to define strategic goals and objectives. Need to find the right balance between custom software and COTS. Some systems are stitched together using COTS with custom software, but some are almost entirely custom built.

- ASWG: Challenges and Next Steps

* Key issues
	+ Clarifying requirements for HHP “customers”
	+ Improving transparency and support to customers
	+ Integrating support across all Centers
* Questions
	+ Integration of Ames and GeneLab?
	+ Cloud storage and computing at Ames?
	+ Plans for accommodating omics (storage and analytics)?
* Desired take away from this TEM
	+ Personal contacts
	+ Better understand current Ames/GeneLab architecture and future roadmap
* Future plans
	+ Increase use of cloud services
	+ Tiered storage
	+ Capture HERA (Human Exploration Research Analog) data with CLSR-like service.
	+ Build out analytics platform
	+ Engage HRP leadership and 6 HRP elements on future requirements
	+ There are three major focuses (1) Internal process improvements, (2) Data storage, and (3) Analytics platform

- ASWG: Q&A Items (only major points that influence collaboration)

Q: Do any of these systems include real-time access to operations?

A: MEME and TSC have real-time data components.

Q: Make use of centralized data storage or federated/distributed systems?
A: Unlikely that analytics pulling data from one location is realistic so federated data centers more likely. And GeneLab is looking at this issue.

Q: Any work being done using analytics to look at experiment metadata?

A: Langley has done some work in content analytics using about 1,000 radiation articles, looking at correlations and strengths.

Q: GeneLab using any analytics tools?
A:

Richard asked about the the effort of pulling toetgher the translational studies book – can analytics be applied to this? Yes, Langley has done a mining on 1000s of articles on space radiation – need to have the tool to do the concept analytics.

Do we (NASA) provide the tools or do we leave it up to the end users to obtain the tools? (dmt – didn’t catch the response).

1. **ExMC-Ames Bioinformatics: Tony Lindsey**

-Description

 “To minimize mission medical risk through medical system development and integration into the overall mission and vehicle design.”

The Exploration medical system supports healthy crew to enable completion of mission objectives. Concerned with adverse health prevention not just catastrophic events.

ALSDA/Genelab concept – it was recommended that you look at the requirements individually, then holistically. This may reveal different approaches.

- ExMC-Ames Bioinformatics: Challenges and Next Steps

* A comprehensive medical system to support the crew in Exploration Missions targeting autonomy.
* In order to do this, ExMC will need integration with vehicle systems – single point solutions are not desirable for Exploration Missions.
* *Networked Exploration Medical Information Support and Integration System*
	+ *Provide for centralized medical care*
	+ *Enhance available knowledge base*
	+ *Provide for electronic training needs*
	+ *Monitor supplies for crew*
	+ *Monitor crew as needed*
	+ *Streamline communication with ground flight surgeons*
	+ *Decrease likelihood of medical errors*

- ExMC-Ames Bioinformatics: Q&A Items (only major points that influence collaboration)

Q: What about the data architecture?

A: Tony talked about capturing data and the EMR, including ultrasound images, patient portals. Their multi-layer architecture includes analytics and data storage. Tianna pointed out that we are working with Agency partners, developing layers which have some level of metadata, a transformation layer and an analytics layer. The ExMC will be used in the HERA campaign starting January 17

1. **ALSDA/ GeneLab data systems architecture concepts to date**
* This was a discussion about how GeneLab could use the ALSDA RDMS to enter experiment summary information and then migrate the records to the GL database and to the LSDA public website.
* How would KSC enter information? Probably through the DevTool.
* Need to consider a data requestor in that many times the response requires input from several different systems and this situation is bound to occur with GeneLab coming online.
* Should ExMC enter information into the RDMS like GL? Maybe but are there experiments in the same sense for ExMC? Needs further investigation.

DAY 2 – Friday January 15, 2016

This day’s presentations represent a selection of topics on the subject of biospecimen management, use and sharing by projects/programs that were presented on Day 1 of this TEM. Below is a listing and top level summary.

**14. Introduction to Tissue Sharing: Helen Stewart, Alison French**

* NASA Policy Directive (NPD) and NASA Procedural Requirement (NPR)
* Difference between institutional scientific collection and project collection
* Biospecimen Sharing Program (BSP)
	+ The NASA Ames Research Center BSP was developed to ensure that valuable tissue samples from rare and complex spaceflight experiments, and not part of primary investigations, would be made available to the scientific community for analysis.
	+ Maximize overall scientific return from the specimens flown
	+ Encourage broader participation of the research community
* Requesting Biospecimens – (screen shots of lsda.jsc.nasa.gov where the request form can be found).
* Biospecimen Support Facility (BSF) – Description of the BSF.
* Tissue Sharing & the LSDA: Q&A Items (only major points that influence collaboration)
* Q: What about growth of the BSF content?
* A There will be 2 rodent flights/yr so more biospecimen storage will be needed.
* Q: Will there be a BSP NRA?
* A: Yes, there will be one developed.
* Q: Based on the impressive summary of value produced by the BSP, perhaps there should be summary of the research publications that have resulted, also.
* A: Good idea. ALSDA already has the publications.
* Q: PIs donate unused tissues since they belong to NASA. That should be true for commercially-driven research by BioServe and CASIS too.
* A: Some commercial customers save tissues to their own facilities and eventually make full use of them. NASA didn't get those.
* Q: What about human biosamples?
* A: Human biosamples are not part of the current LSDA Strategic Plan.
* A: Many human samples went through a culling at JSC a decade ago. Were mainly for medical use and so were not available for research. But there is now a plan for human biosamples collection for research purposes, but no samples have been candidates for release yet. End of 2017 is target for release according to Kathleen McMonigal/NASA MD is contact point.

**15. Biospecimen Culling: Jon Rask, Kaushik Chakravarty**

Goals:

1. Increase available space for future samples in the BSF.
2. Identify candidate biospecimens for RNA integrity analysis.
3. Identify biospecimens that should be discarded.
4. Further characterize select biospecimens in the BSF.
5. Perform extraction and purification of RNA from selected biospecimens.
6. Collect RNA integrity data from the select biospecimens.
7. Determine if tissues frozen at -70˚C are viable for omics analyses and the GeneLab data repository.
8. Prepare a NASA white paper and/or a manuscript.
9. Provide disposition recommendations for biospecimens in the culling list.
10. Support and guide NASA policy on best practices for curation of biological collections (NPD 7100.xx Scientific Collections Directive), addressing stowage duration and temperature, sample testing cycle and frequency.

**16. GeneLab Sample Sharing: Oana Marcu**

Q: Is there a GeneLab sample that results from tissue processing that is not yet digital data (numbers or images)?

A: (Yes there are tissue extracts that have been treated with specific solutions to prepare them for analysis of Omics-related data (DNA, RNA, etc.). These extracts are generally water-based and can be stored for certain periods and used for additional analyses, if warranted. Thus GeneLab could have tissue, extracts and digital data, all potentially sharable with additional PIs.

Q: Are there plans for human biospecimens and genomics?
A: There are strategic plans but not tactical plans.

**17. Rodent Research Tissue Sharing: Shungshin Choi**

Objectives of the Rodent Research Tissue Sharing Plan

To maximize science return from NASA ISS Rodent Research missions

* ensure that valuable tissue samples, not used by primary investigators, could be made available and distributed to the scientific community
* encourage broader participation from the research community (increase the number of investigators and investigations by providing opportunities for scientists to have access to spaceflight tissues)

Q&A RR Tissue Sharing

Q: It is not commonly known but a complex BSP was conducted with Rodent Tissues to validate ability to capture valid biosamples. Some were distributed to GeneLab and some to the Russian IBMP.

**18. Human Health and Countermeasures Tissue Sharing Program: April Ronca**

Description: A 3 yr. project using rodents with tail suspension to simulate spaceflight unloading with translation potential to HRP who funds the study. Concept was to bring the BSP down to Earth to magnify the results by including many more researchers in the studies at lower cost. The concept of using hyper-g was also proposed but has not yet been done. Study based at C. Fuller's facility at UC Davis and has significant support from ARC staff for biosamples capture and preservation. A vast number of biosamples are being captured at various durations from 7 days to 90 days and with full-recovery data too.

Q: (Mains), is there a plan to do a Gravity Continuum Study comparing simulated spaceflight (low-g) with hyper-gravity (high-g)? That could provide predictive data for variable-g research with rodents.

A: Not yet been planned but would be a good idea.

**19. Space Radiation Research Tissue Sharing: Honglu Wu**

Rationale for Radiation Research Tissue Sharing:

* To maximize science return from HPR Space Radiation Program Element (SRPE) funded projects.
* Exercise phased approach from encouraging and facilitating tissue sharing among SRPE funded PIs in Phase 1 to making tissue sharing madidatory in the future.

There is a web site for PI collaboration; The NASA Space Radiation Tissue Sharing Forum. <https://spaceradiation.jsc.nasa.gov/research/>

**C. Wrap-up remarks (Helen Stewart)**

* There was broad consensus that it is highly useful to share knowledge about these collections.
* There seems to be consensus in using an experiment based approach to collections.
* Cooperation needed in specimen descriptions
* Cooperation would be useful in tissue sharing.
* Where will we be in 5-10 years?

Q&A for Wrap Up

There are questions regarding ownership of biospecimens (should be NASA for funded projects) and what happens to them when funding is suspended and/or PI’s retire?

Q: Radiation tissues captured could be valuable for Human Radiation Research Element (HRP). They could go to the LSDA (Steve Davison is HRP Program Exec.)

A: Not yet planned.

Q: HRP sharing cost of TSP with Space Biology (Ronca TSP above) for ground tissues. How can we build an archival path to LSDA tissue capture for Radiation Ground Data BSP?

A: Jenks will do a trip report for the JSC HRP Science Management Panel and Stewart wants a white paper from the TEM as output.

Q: CASIS wants Tissue Sharing from ISSNL but doesn't want to duplicate any existing resources. Good option for collaboration?

A: We need to define commonalities between research projects for metadata, data to expand researcher access and use. This is a new strong vision unparalleled in NASA (see PSI RFI just out).

Attendee List

|  |  |  |
| --- | --- | --- |
| Online | JSC/Jessica Baker |  |
| F2F | ARC/Daniel Berrios | IT Architecture |
| F2F | ARC/Sue Blumenberg | Rodent Research Operations and Documentation |
| F2F | ARC/April Gage | ALSDA Archivist |
| Online | JSC/Andy Carnell | Information Systems Architect |
| F2F | ARC/Kaushik Chakravarty | GeneLab Lead Senior Scientist for Omics Preparation Lab |
| F2F | ARC/Anthony Chan | Rodent Research Lead Software Engineer |
| F2F | ARC/Rick Chen | GeneLab Ground Science Team |
| F2F | ARC/Sungshin Y. Choi | Rodent Research BSP Lead |
| Online | JSC/Abul Chowdhury | LSDA Lead Programmer |
| F2F | JSC/Margaret “Peggy” Delaney | LSDA Lead Archivist |
| F2F | ARC/Sandy Dueck | GeneLab Science Communication Lead |
| F2F | ARC/Paul Espinosa | ARC HHC POC and Manager |
| F2F | ARC/Homer Fogle | GeneLab Bioinformatician/Computational Biologist |
| F2F | ARC/Miriam “Molly” Freed | Engineering Release Center Configuration Management |
| F2F | ARC/Alison French | ALSDA Contractor Lead |
| F2F | JSC/Ken Jenks | LSDA IT Civil Servant Lead |
| Online | JSC/Kathy Johnson-Throop | Branch Chief, Information Systems Architecture |
| F2F | ARC/San-Huei “San” Lai | GeneLab Ground Science Team |
| F2F | ARC/Dorothy Leung | ALSDA Archivist |
| F2F | ARC/Laura Lewis | ARC HHC Biospecimen Sharing Program Lead |
| F2F | ARC/Tony Lindsey | Technical Lead for ExMC |
| F2F | ARC/Daniel Lupez |  |
| F2F | ARC/Chris Maese | ARC HRP Project Manager & SC Deputy Div Chief |
| F2F | ARC/Richard Mains | Translational Research Subject Matter Expert |
| F2F | ARC/Oana Marcu | GeneLab Lead Scientist |
| F2F | ARC/Chris Middour | ExMC Software Architect |
| Online | HQ/Ravi Raghava | InfoZen WESTPrime Enterprise Cloud Architect |
| F2F | ARC/Jon Rask | Biospecimen and Culling Lab Scientist |
| F2F | ARC/Sigrid Reinsch | GeneLab Project Scientist  |
| F2F | KSC/Stephanie Richards | Project Science Coordinator |
| Online | JSC/Jeanie Riggs |  |
| F2F | ARC/April Ronca | ARC HHC Science Lead |
| Online | JSC/Caroline Schaefer | LSAH Statistical Data Analyst |
| Online | JSC/Jessica Shafer | LSAH Epidemiologist |
| F2F | ARC/Tianna Shaw | ExMC Team Member |
| F2F | ARC/Mike Skidmore | GeneLab Project Manager |
| F2F | ARC/Helen Stewart | Ames LSDA Civil Servant Lead, also coordinates some ISS payload operations |
| F2F | ARC/Olga Stotzky | GeneLab Deputy Project Manager |
| F2F | ARC/Sid Sun | ARC Division Chief |
| F2F | JSC/Diedre “DeeDee” Thomas | LSDA Contractor Lead |
| F2F | ARC/David Thompson | Payload Ground Systems Cell Science Lead and ExMC Data Architecture |
| Online | ARC/Peter Tran |  |
| Online | JSC/Mary Van Baalen | LSAH/LSDA Civil Servant Lead; Evidence Base Working Group (EBWG) Chair |
| F2F | ARC/Shawn Wolfe | ExMC Data Scientist |
| F2F | ARC/Alan Wood | ALSDA Information Management Lead |
| F2F | JSC/Honglu Wu | HRP Space Radiation Element support, JSC Biophysics Laboratory Manager |
| F2F | ARC/Brian Yu | Rodent Research Engineering/Software |