Committee on Biological and Physical Sciences in Space (CBPSS)

Disclaimer: These slides are a personal assessment of issues discussed during recent Committee on Biological and Physical Sciences in Space meetings, and should not be cited or quoted - as the views expressed do not necessarily reflect those of Committee, the SSB, the ASEB or the Academies.

CBPSS Status

- Committee
- NASA reorganizations related to CBPSS
- Space Life and Physical Sciences Mid Term Assessment
- Mission architectures, destinations and impacts to CBPSS
- Next Decadal

CBPSS Status

- CBPSS
  - Round of transitions, including co chair rotation

Elizabeth R. Cantwell, Arizona State University (Co-Chair)
Robert J. Ferl, University of Florida (Co-Chair)
Kenneth M. Baldwin, University of California, Irvine
Marianne Bronner, California Institute of Technology
Steven Collicott, Purdue University
Vijay K. Dhir, University of California, Los Angeles
Mohammad Kassemi, Case Western Reserve University
Wayne Nicholson, University of Florida
James A. Pawelczyk, The Pennsylvania State University
Marylyn D. Ritchie, Geisinger Health System
Pol D. Spanos, Rice University
Krystyn J. Van Vliet, Massachusetts Institute of Technology
Peter W. Voorhees, Northwestern University
Erika Wagner, Blue Origin
Hai Wang, Stanford University
David Weitz, Harvard University

CBPSS Status

- CBPSS
  - Round of transitions, including co chair rotation
- CBPSS is associated with HEOMD
  - SLPSRA and other reorganization within human exploration
  - Discussions with SLPSRA on the outset of the reorgs
  - Still an open discussion at this point and include potentially splitting the portfolio
- Notion of primarily NASA providing the access to this science portfolio

CBPSS science and applications

- November 2017 discussions with science in the transition era
  - Four aerospace companies supporting NASA, in order to discuss their interests and concerns related to microgravity science research relevant to their exploration systems development
    - Sierra Nevada
    - Paragon Space Development
    - Southwest Research Institute
    - United Launch Alliance
  - spoke candidly about the critical importance of having access to NASA's microgravity knowledge base and discipline experts during their design and development of exploration systems
  - stressed that it was not possible for their organizations to develop internal programs to supply the kind of fundamental phenomenological understanding needed to inform systems design

CBPSS science and applications

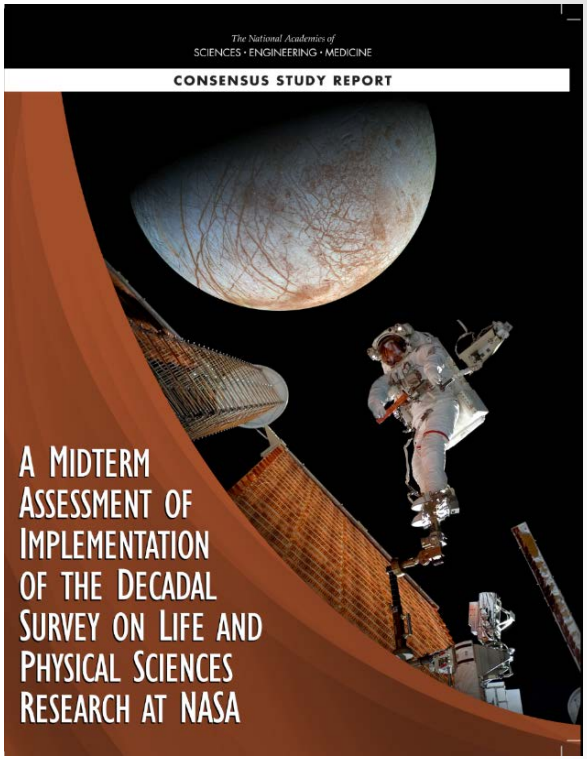
- November 2017 discussions with science in the transition era
  - Sam Scimemi, on planning for the ISS transition and Gateway
  - Open Question and challenges exist
  - Policy issues with respect to ISS utilization and NASA needs

- Suborbital platforms are flying payloads now, and ramping up for additional opportunities
  - Physical sciences payloads have flown
  - Biological payloads are in the early queue
  - Human tended opportunities now exist

CBPSS Science

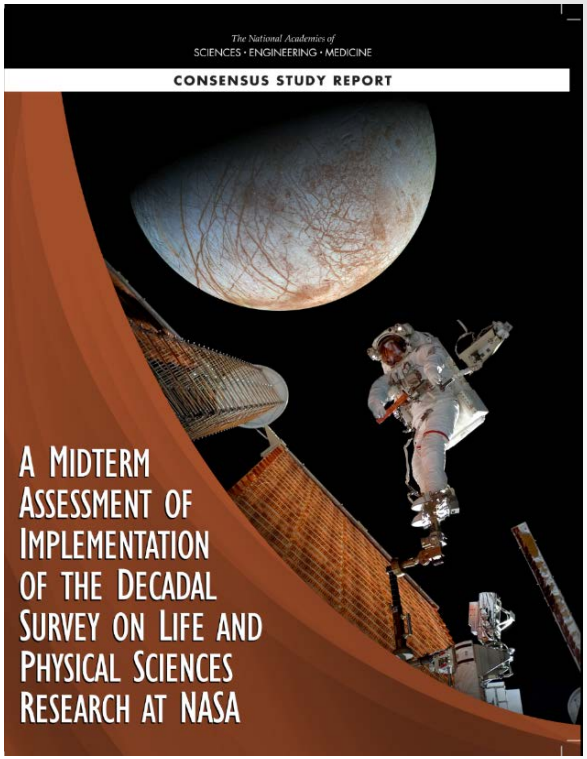
- ISS horizon and transition as the major policy impacting this area of science
  - Especially wrt what is not yet known about microgravity and its impacts on systems
  - Especially wrt the length of time that some experiments need to approach realistic Mars timelines
- Deep Space Gateway
  - Major science opportunity that is unfolding in real time especially wrt radiation and integrative science
  - But is limited in volume and capability
  - Brings into stark focus the time needed on ISS vs the opportunity for deep space
- Both major points are addressed in the Mid Term Assessment

Mid-Term Assessment



- Presented to NASA December 2017
- Briefings in February 2018 to OMB etc
- Letter of reply from SLPSRA
- Extraordinary timeliness
  - ISS Transition
  - Deep Space Exploration
    - Deep Space Gateway meeting
    - Integration of this decadal with others from SMD

Mid-Term Assessment



- Technology development impacts
  - Mapping technologies to provide solutions
  - Mapping especially to deep space
  - Radiation and combinations of effects
  - Every area provides impact for exploration
  - Example of life support
    - Draws upon science principles of microgravity and radiation effects
    - Biology on surfaces and in fluids, including humans and metals
    - Behaviors of fluids, cryogenics storage, humans
    - Systems interactions

SPACE SCIENCE WEEK

The National Academies of SCIENCES ENGINEERING MEDICINE

SPACE SCIENCE WEEK

SPRING 2017 MEETING OF THE COMMITTEE ON BIOLOGICAL AND PHYSICAL SCIENCES IN SPACE

March 28, 2018

NAS Building – 2101 Constitution Ave NW – Washington D.C

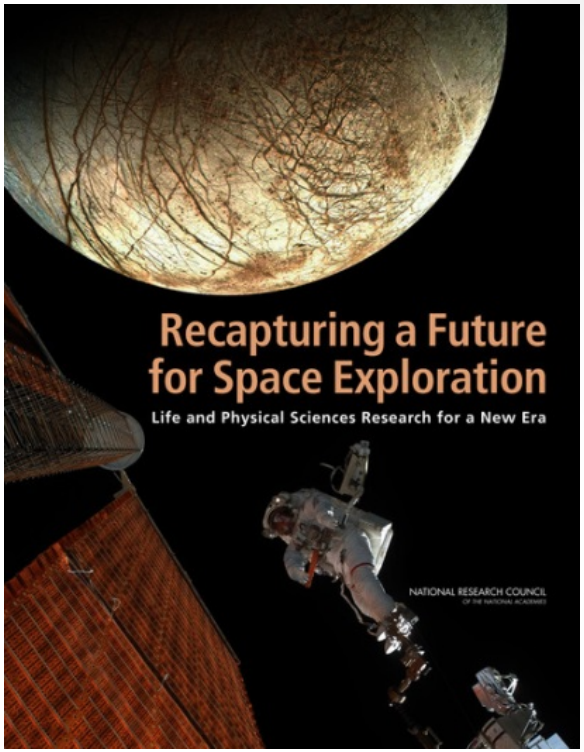
SYMPOSIUM AGENDA

Wednesday March 28, 2018		
COMMITTEE ON BIOLOGICAL AND PHYSICAL SCIENCES IN SPACE (CBPSS) – Room 125		
7:30 AM	*Registration Opens and Working Breakfast is Available in the Great Hall*	
OPEN SESSION		
Symposium[1]: Space Life and Physical Sciences Research Supporting Moon and Mars Missions		
9:00 AM	**Welcome and Introductions**	**Robert Ferl and Elizabeth Cantwell, Co-Chairs**
Session 1: Symposium: Human Health Is Pivotal for the Mission to Mars		
9:15 AM	**Integrated Resistance and Aerobic Exercise Training Protects Against Multi-System Deconditioning: Results from the NASA 70 Day Bed Rest Study**	**Jessica M. Scott, Principal Investigator, Memorial Sloan Kettering Cancer Center, New York City**
9:45 AM	**The Promise of Genomics and Epigenetics Studies in NASA Exercise Research**	**Shlomit Radom-Aizik, Associate Professor of Pediatrics and Director, UC Irvine Health Pediatric Exercise and Genomics Research Center (PERC), School of Medicine, University of California, Irvine**
10:15 AM	*Break Available Outside Room*	
10:30 AM	**The Role of Artificial Gravity for Maintaining Human Health on Both the Moon and Mars**	**Vincent Caiozzo, Professor, Department of Orthopedics and Physiology and Biophysics, University of California**
11:00 AM	***Exercise is Medicine* is Pivotal for Humans to Go to Mars and Return to Mother Earth**	**Scott Trappe, Professor of Exercise Sciences and Director of the Human Performance Laboratory, Ball State University**

Session 2: Physical Processes and Technology for Exploration		
1:30 PM	Plans and Design Challenges for Nuclear Thermal Propulsion Systems Supporting Deep Space Transportation	Ronald J. Litchford, Principal Technologist for Propulsion, Space Technology Mission Directorate, NASA
2:05 PM	Plans and Design Issues for Nuclear Power Systems Supporting Human Missions to Planetary Surfaces	Patrick Ray Mcclure, Kilopower Project Lead, Los Alamos National Laboratory
2:40 PM	*Break Available Outside Room*	
3:10 PM	Reduced Gravity and Environmental Issues in the Design and Operation of In-Situ Resource Utilization Systems for Human Missions	Gerald (Jerry) Sanders, Lead for ISRU System Capability Leadership Team, Human Exploration and Operations Mission Directorate, NASA
3:45 PM	ISRU Construction and Excavation of Regolith	Robert Mueller, Senior Technologist, Science and Technology Projects Division, NASA KSC

Next Decadal

- Discussions with community have begun
- ASGSR and others query to input
- CBPSS interactions and following that interest
- 2019 nominal for formal discussions on the process, in order to be out on time



Recap Issues for CBPSS

- The successful transition of microgravity research from ISS to a post-ISS era continues to be a central issue
- Questions include:
  - Timing and steps in the transition? Decadal and platforms
  - NASA reorganization directly influences this portfolio
  - Interest and creativity of the research community is very high, given the transitions occurring in exploration
  - ISS operations and policies increasingly critical
  - Deep space science opportunities are new areas
  - Opportunities to fly sub-orbital experiments growing rapidly
  - Monitoring the LEO ecosystem(s)
  - Maintaining health and diversity of microgravity disciplines