Summary of Proceedings:

FAST-TRACK ACTION COMMITTEE ON THE UTILIZATION OF THE INTERNATIONAL SPACE STATION (ISS) AS A NATIONAL LABORATORY

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Committee on Science

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COMMITTEE ON SCIENCE

About the National Science and Technology Council

The National Science and Technology Council (NSTC) is the principal means by which the Executive Branch coordinates science and technology policy across the diverse entities that make up the Federal research and development enterprise. A primary objective of the NSTC is establishing clear national goals for Federal science and technology investments. The NSTC prepares research and development strategies that are coordinated across Federal agencies to form investment packages aimed at accomplishing multiple national goals. The work of the NSTC is organized under five committees: Environment, Natural Resources and Sustainability; Homeland and National Security; Science, Technology, Engineering, and Math (STEM) Education; Science; and Technology. Each of these committees oversees subcommittees and working groups focused on different aspects of science and technology. More information is available at http://www.whitehouse.gov/ostp/nstc.

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976. OSTP's responsibilities include advising the President in policy formulation and budget development on questions in which science and technology are important elements; articulating the President's science and technology policy and programs; and fostering strong partnerships among Federal, state, and local governments, and the scientific communities in industry and academia. The Director of OSTP also serves as Assistant to the President for Science and Technology and manages the NSTC. More information is available at http://www.whitehouse.gov/ostp.

About the Committee on Science

The purpose of the Committee on Science (CoS) is to advise and assist the NSTC, under Executive Order 12881, to increase the overall effectiveness and productivity of federally supported efforts that develop new knowledge in the sciences, mathematics, and engineering (not including those areas primarily related to the environment and natural resources). The CoS addresses significant national and international policy, program, and budget matters that cut across agency boundaries and provides a formal mechanism for interagency science-policy development, coordination, and information exchange.

About the Life Sciences Subcommittee

The Life Sciences Subcommittee (LSSC) contributes to the activities of the Committee on Science (CoS) of the National Science and Technology Council (NSTC). The purpose of the LSSC is to advise and assist the CoS and the NSTC on Federal policies, procedures, and plans in the life sciences. As such, and to the extent permitted by law, the LSSC defines and coordinates Federal efforts in the life sciences, identifies emerging opportunities, stimulates international cooperation, and fosters the development of life sciences. The LSSC also explores ways in which the Federal government can increase the overall effectiveness and productivity of its investments

in life sciences research and development, especially with regard to interagency and interdisciplinary efforts targeting grand challenges related to food, health, energy, and the environment. The LSSC comprises representatives from 15 Federal agencies.

About the Fast Track Action Committee on the Utilization of the International Space Station as a National Laboratory

The Fast Track Action Committee (FTAC) on "The Utilization of the International Space Station (ISS) as a National Laboratory" was formed in March 2012 under the auspices of the Life Sciences Subcommittee (LSSC) of the National Science and Technology Council (NSTC). It completed its work in August 2012. The FTAC comprised representatives from six Federal agencies. Its role was to address a range of issues and needs associated with developing a more coordinated Federal research agenda for the ISS National Laboratory, including identification of common life sciences research interests across Federal departments and agencies.

Introduction

The Fast Track Action Committee (FTAC) on "The Utilization of the International Space Station (ISS) as a National Laboratory" was formed in March 2012 under the auspices of the Life Sciences Subcommittee (LSSC) of the National Science and Technology Council (NSTC). It completed its work in August 2012. The LSSC comprised representatives from 15 Federal agencies. Its role was to conduct activities that foster and enhance communication and collaboration related to life sciences research across the Federal agencies. This document summarizes the proceedings of the FTAC between March and August of 2012.

In 2005, the National Aeronautics and Space Administration (NASA) Authorization Act designated a portion of the U.S. segment of the ISS as a National Laboratory, and in 2011 NASA awarded a cooperative agreement to the independent, non-profit Center for the Advancement of Science in Space (CASIS) to manage research and development activities on the ISS National Laboratory (ISS-NL). CASIS has the mission of maximizing use of the ISS-NL resource, and serves as the primary entry point for support, coordination, and selection of research projects utilizing the ISS-NL, including those proposed by commercial entities as well as those supporting the missions of other (non-NASA) agencies.[1]

At the time of the FTAC's deliberations, the structure and operations procedures for CASIS were still under development and the FTAC did not directly address the impact of CASIS on Federal agencies or mechanisms for that engagement. The focus for the FTAC was on identifying ISS-NL research activities and capabilities that serve the needs of multiple Federal agencies. The resulting information is expected to be useful in fashioning future NASA and CASIS priorities, solicitation topics, and review criteria. Note that while the ISS-NL supports a wide variety of research, the charge to the FTAC under the LSSC concentrated on biological and biomedical research (Appendix A - FTAC Charter).

In order to address a range of issues and needs associated with developing a more coordinated Federal life sciences research agenda for this unique laboratory, the FTAC was charged with:

- Identifying the potential areas of life sciences research and experimentation in the unique microgravity environment provided by the ISS-NL that would most benefit the Nation.
- Identifying microgravity research of common interest across Federal departments and agencies.
- Improving the use of existing government interagency coordination mechanisms that facilitate microgravity research by non-NASA Federal agencies as a complement to the activities led by CASIS.
- As appropriate, establishing long-term, outcome-oriented goals for ISS-NL Federal research.

The intent was to identify the agencies' areas of interest in life sciences research that could take advantage of the microgravity environment, and to identify mechanisms for coordination across

[1] www.iss-casis.org

agencies and with the ISS-NL management. In this regard, the efforts of the FTAC-ISS complement and facilitate CASIS's mission to maximize the utilization of the ISS-NL, which includes responsibility for selecting and managing research projects.

The FTAC included representatives from the Department of Energy, NASA, National Institutes of Health, National Institute of Standards and Technology, National Science Foundation, and United States Department of Agriculture (National Institute of Food and Agriculture, and Agricultural Research Service). To support the FTAC's charge, NASA briefed the FTAC on the ISS and its life sciences research facilities and capabilities, and presented overviews of the NASA biological and medical research programs. Additionally, representatives from the six participating FTAC agencies gave presentations on their agencies' missions and life sciences research goals, past research efforts in the domain of space and life sciences, and life science research interests that could be pursued utilizing the ISS-NL. Participants identified common research interests and discussed how the shared areas relate to long-term goals and societal benefits. Additionally, members considered interagency communication and collaboration strategies, and ways in which agencies might educate non-Federal scientists and those from other agencies about the ISS-NL. This report summarizes the deliberations of the FTAC.

Agency Life Sciences Research Interests

This section addresses the following two elements from the FTAC Charter:

- Identifying the potential areas of life sciences research and experimentation in the unique microgravity environment provided by the ISS-NL that would most benefit the Nation.
- Identifying microgravity research of common interest across Federal departments and agencies.

The ISS-NL provides access to the unique environment of space. The most salient characteristic of the ISS low-Earth orbit environment is microgravity. The lack of gravity can be exploited to study the role that this physical force—all-pervasive on Earth—may play in the regulation, control, and activity of living systems. Experiments in the microgravity environment can also provide novel insights into biological processes that may be masked by the gravitational environment. The breadth of areas that can be better understood through microgravity research was highlighted in a recent report by the National Research Council (NRC), *Recapturing a Future for Space Exploration: Life and Physical Sciences Research for a New Era.*[2] The NRC report provides a comprehensive assessment of high-priority areas for life and physical sciences research on the ISS. These are detailed within seven broad categories: Plant and Microbial Biology; Behavior and Mental Health; Animal and Human Biology; Cross-cutting Issues for Humans in the Space Environment; Fundamental Physical Sciences in Space; Applied Physical Sciences in Space; and Translation to Space Exploration Systems. Several of the ISS research interests of the FTAC participating agencies align with specific recommendations in the NRC report. That report also addresses administrative and policy issues surrounding the science and

[2] National Research Council (NRC), *Recapturing a Future for Space Exploration: Life and Physical Sciences Research for a New Era,* National Academies Press, 2011.

engineering program, listing as one of eight overarching metrics: "The extent to which the results of the research can be synergistic with other [non-NASA] agencies' needs." It notes specifically that "Research productivity and efficiency will be enhanced if the historical collaborations of NASA with other sponsoring agencies, such as the National Institutes of Health, are sustained, strengthened, and expanded to include other agencies."

The FTAC identified the following overarching themes as representing the leading areas of life sciences research of interest to multiple agencies and enabled by the ISS-NL that could most benefit the Nation:

- Understanding the fundamental forces, forms, and functions of living systems across scales of time and size, from molecules, to cells, to organisms, to the environment
- Understanding disease processes in animals and plants that can be modeled or studied in the space environment that will contribute to improved human health and welfare
- Contributing to the growth of the bio-economy through advances in bio-energy, biomaterials, biotechnology and bio-pharmaceutics

The unique character of the ISS expands opportunities in these areas by removing effects such as gravity-driven convection, shear, and turbulence; allowing access to extremes of environment (including temperature and vacuum); and offering the versatility (not available in unattended space platforms) to adjust, tune, adapt, modify and install instruments to expand or add capabilities in onboard synthesis or measurement as well as observational tools. Examples of some specific kinds of work that fall within the above themes include examining the effects of microgravity and the space environment on gene mutation and expression, alterations in cellular structure and processes, and physiological systems and processes in living organisms from microbes to plants, animals or humans. Outcomes could lead to better toxicology tests, advances in tissue engineering and synthetic biology, and new treatments for various diseases. Beyond experiments that take advantage of the microgravity environment, ISS-enabled research could include remote sensing observations and analysis of environmental processes using hyperspectral analysis for agricultural applications and disease control, and the study of the ISS radiation environment to validate ground-based radiation models.

FTAC members affirmed that access to ISS-NL resources should be based on scientific merit, which includes the importance of the questions being asked and the rigor of the methods to be employed to answer them, guided by implementation feasibility.

The following sections describe the missions of the participating FTAC agencies and provide detailed information about each agency's specific life sciences research interests that could utilize the ISS-NL.

Department of Energy

The mission of the Department of Energy (DOE) is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. It has established four goals in order to achieve its mission:

- Catalyze the timely, material, and efficient transformation of the nation's energy system and secure U.S. leadership in clean energy technologies.
- Maintain a vibrant U.S. effort in science and engineering as a cornerstone of our economic prosperity with clear leadership in strategic areas.
- Enhance nuclear security through defense, nonproliferation, and environmental efforts.
- Establish an operational and adaptable framework that combines the best wisdom of all Department stakeholders to maximize mission success.

From a science perspective, the DOE addresses these goals through its Office of Science, which focuses (in its life sciences programs) on the development of biofuels from lignocellulosic biomass and understanding the role of biological processes in environmental systems. In the past, DOE and NASA have jointly funded ground-based life science research in a variety of areas including cellular biology, genomics, and radiation effects on physiological systems. The DOE has identified the following specific topics as potential ISS-NL research areas:

- Mixed field radiation effects
- Biofilm research and/or altered gene expression patterns for plants and microbes
- Remote sensing and analysis of environmental processes
- Structural analysis of unique biomolecules and complex cellular components in a microgravity environment
- On board "omics" analysis such as high-performance mass spectrometric instrumentation that is sufficiently compact and otherwise adapted to the space station environment and experimental requirements

National Institutes of Health

The National Institutes of Health (NIH), within the Department of Health and Human Services, seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability. NIH has a long history of involvement in space medical and biological research, spanning the early days of the space program, through the Shuttle era, and on the ISS. In 1994, NIH and NASA established the NASA/NIH Center for Tissue Culture, where intramural and extramural scientists work on various projects related to the effects of microgravity and modeled microgravity for the study of the physiology and pathophysiology of human cells and tissues. Although the Center was originally designed to promote the transfer of NASA bioreactor technology to scientists at NIH, its role quickly expanded as discoveries were made about gravity's influence on basic biological mechanisms underlying normal and pathological cell physiology and metabolism. The NASA/NIH Center was instrumental in developing new paradigms for onboard training of astronaut/scientists for experimental protocols, "lab meeting" type discussions between ground and crew to follow up on protocols, and progressive updating of experimental protocols after each procedure. In addition, the first ISS cell culture experiments on the human immune system were completed and published.

In 2000, in anticipation of a fully functional laboratory aboard the ISS, NIH began soliciting applications from its extramural research community for additional ground-based research on basic, applied, and clinical biomedical and behavioral problems that are relevant to human space

flight or that could use the space environment as a laboratory[3]. Through this solicitation, NIH stated its interest in supporting research on spatial orientation and sensory-motor processes, the nervous system, behavioral and psychological processes, the musculoskeletal system, pulmonary and cardiovascular functions, sleep and biological rhythms, immunology, pharmacodynamics/pharmacokinetics, hemodynamics, and response to injury. Ten NIH Institutes and Centers agreed to consider applications under this announcement.

After Congress established the U.S. portion of the ISS as a National Laboratory, NIH and NASA entered into a Memorandum of Understanding (MOU) for cooperation in space-related health research[4]. As part of NIH's commitment to "publicize, to the intramural and extramural communities, the availability of the ISS as a research environment that can accommodate a variety of experimental approaches and can address a vast range of research questions," NIH requested applications related to the missions of nine Institutes[5].

Unlike the applications funded under the earlier solicitation, the grants funded in fiscal years 2010, 2011, and 2012 are for research conducted on the ISS. Although NIH is evaluating the outcomes of the ongoing grants before it decides whether to specifically solicit additional applications for biomedical research on the ISS, investigators continue to be eligible to submit proposals for research that would use the ISS-NL through NIH's Funding Opportunity Announcements for investigator-initiated research, as long as the proposed research relates directly to the NIH mission[6]. Topics need not be limited to the suggestions mentioned in the solicitations described above.

National Institute of Standards and Technology

The National Institute of Standards and Technology (NIST) is part of the U.S. Department of Commerce and serves as the US national metrology institute. Its mission is to promote innovation and industrial competitiveness, advance measurement science, and create standards and technology that help the economic security of the nation and improve the quality of life. The Material Measurement Laboratory (MML) is the part of NIST focused on measurements in the chemical, biological, and material sciences. MML's biomedical and health program contains the majority of NIST's life science projects, many of which are dedicated to reducing US health care costs and improving medical decision making by the introduction of innovative technologies and advanced measurement methods.

NIST has a long history of space-related research and partnership with both NASA and NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), including a large amount of work from the 1950's to the 1980's. More recent efforts include microgravity and spacecraft fire safety research in the 1990's, work by NIST Astronaut Greg Linteris (STS-83 and STS-94 in 1997), design and delivery of radiometers and calibrations for NASA's Earth Observing System satellites, the Solar Ultraviolet Magnetograph Investigation (SUMI, launched

[3] http://grants.nih.gov/grants/guide/pa-files/PA-00-088.html
[4] http://www.niams.nih.gov/News_and_Events/NIH_NASA_Activities/nih_nasa_mou.asp
[5] http://grants.nih.gov/grants/guide/pa-files/PAR-09-120.html
[6] http://grants.nih.gov/grants/guide/parent_announcements.htm#more

July 2010), and partnership on the Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission.

Although NIST does not have a formalized extramural funding program, as the Nation's metrology institute NIST can contribute to a wide array of ISS-based research topics by providing necessary measurement expertise as well as standard reference materials and methods, through collaborations with other Federal agency partners. Establishment of collaborative mechanisms such as the existing NSF-NIST MOU[7] can facilitate effective interaction and collaboration between NIST and other agency partners or grantees.

National Science Foundation

The mission of the National Science Foundation (NSF) is *"to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."* The NSF is the only Federal agency whose mission includes support for all fields of fundamental science and engineering, except for medical sciences, and it is tasked with keeping the United States at the leading edge of discovery.

The number of research areas and questions in which NSF investigators could make use of ISS resources is broad. A few examples are listed below:

- Microbial evolution
- Mechano-signal transduction
- Cell imaging: cell-to-cell variability
- Biology of stress/adaptation
- Neural systems
- Cell/tissue engineering – synthetic biology

A number of existing NSF award mechanisms could be applicable to ISS research including Early-concept Grants for Exploratory Research (EAGER), Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE), and supplements to active research grants in order to follow up on novel or unexpected research findings or opportunities not envisioned in the original project proposal. The BioMaPS (Research at the Interface of the Biological, Mathematical, Physical Sciences, and Engineering) initiative is considering including language describing capabilities potentially available via the ISS-NL in future BioMaPS announcements. BioMaPS is a multi-NSF Directorate activity to discover new knowledge at the intersections of the biological, mathematical and physical sciences and engineering by supporting collaborative proposals from interdisciplinary research teams. In addition, NSF principal investigators with current BioMaPS grants would be eligible for supplements to their existing awards in order to use ISS resources as part of their ongoing research.

[7] http://www.nsf.gov/pubs/2011/nsf11077/nsf11077.jsp

United States Department of Agriculture

National Institute of Food and Agriculture

The National Institute of Food and Agriculture (NIFA) provides national leadership and administers Federal funding to support its research, education, and extension programs through partnership with the broad agricultural and food community (e.g., universities and colleges, commodity groups, states, individuals) to advance its mission in support of the strategic goals of the United States Department of Agriculture:

- Assist rural communities to create prosperity so they are self-sustaining, repopulating, and economically thriving
- Ensure our national forests and private working lands are conserved, restored, and made more resilient to climate change, while enhancing our water resources
- Help America promote agricultural production and biotechnology exports as the Nation works to increase food security
- Ensure that all Americans have access to safe, nutritious and balanced food

Over the past decade NIFA has funded a number of ground-based, space-related research projects having to do with gravity's effects on plant systems, and plant related life support and food processing technologies. NIFA identified a number of potential areas of interest for research in the ISS-NL:

- Food science (e.g., sensory/acceptability, food shelf life and radiation, nutritional countermeasures, food safety/sanitization, food packaging and preservation technologies)
- Plant science and entomology (e.g., microbes/pathogens/pests, sensing and response mechanisms of plant roots, gene expression, stress factors on plants, impact of environmental and climate change on physiology, nitrogen use efficiency, carbon sequestration in controlled environments)
- Precision, geospatial and remote sensor technologies for use in the food and agricultural domain (the effects of environmental stresses, crop growth, invasive species)
- Animal science (reproduction, animal health and diseases, waste management under sustainability consideration, new mechanisms of producing animal proteins, and organismal physiomics under microgravity)

Agricultural Research Service

The mission of the Agricultural Research Service (ARS) is to conduct research to develop and transfer solutions to agricultural problems of high national priority and provide information access, and dissemination, to:

- Ensure high-quality, safe food, and other agricultural products
- Assess the nutritional needs of Americans
- Sustain a competitive agricultural economy
- Enhance the natural resource base and the environment, and

- Provide economic opportunities for rural citizens, communities, and society as a whole.

To achieve these goals ARS funds research projects in four areas:

- Nutrition, food safety, and quality
- Animal production and protection
- Natural Resources and sustainable agricultural systems
- Crop production and protection

Potential areas of life science ISS research include:

- 3D *in vitro* models of animal organs (examples - test animal stem cell-derived organoid formation and function in microgravity).
- Hyperspectral remote imaging and analysis.
    - The hyperspectral remote sensing device proposed by NASA for the ISS could be used by agricultural scientists for instrument prototype and algorithm testing and faster imaging and analysis for multiple agricultural assessments (i.e., crop growth, forage land quality, irrigation methods, soil erosion, farm related pollution sources)
- Plant gene expression alteration and gene mutation analysis.
    - functional genomic studies in commercially important plants to improve disease resistance, environmental stress resistance, structural attributes, nutritional content
- Human nutrition countermeasures of microgravity-induced detrimental changes to the human body.
    - Access to the space environment on the ISS provides a biological model that scientists within the USDA's Human Nutrition Research Program can use to test the effects of bioactive food components on bone and muscle atrophy, immune function, and aging
- Crop Production/Protection.
    - Proposed crop production and protection experiments offer the opportunity to assess (phenotype) plant populations and mutant sets under a low-gravity environment. There is much interest in altering the architecture of crop plants to facilitate automated harvesting and reduce the need for water and fertilizer inputs. These proposed experiments might identify unique genes that can be exploited for new production methods including greenhouse tunnels, urban architecture, etc.

Communication, coordination, and collaboration

This section addresses the following element from the FTAC Charter:

- Improving the use of existing government interagency coordination mechanisms that facilitate microgravity research by non-NASA Federal agencies as a complement to the activities led by CASIS.

NASA ISS management and CASIS coordinate and manage the utilization of the ISS-NL to maximize the scientific research output of this valuable national resource. The FTAC discussed mechanisms to encourage and foster communication, coordination, and collaboration among the non-NASA Federal agencies as well as between the agencies and NASA and CASIS, and to use the ISS-NL, consistent with the agencies' missions, interests, priorities, and resources. The recommended approach would be to extend the dialogue begun under the FTAC within a continuing discussion group organized by the appropriate NASA organization(s) and including CASIS as well as all non-NASA Federal agencies with interests in life sciences research at the ISS-NL.

The FTAC also discussed other potential mechanisms for collaborating and exchanging information. For example, Federal agencies that support life-sciences research participate in a variety of multi-agency committees that could provide fora for exchanging information about ISS-NL research and encouraging their scientific communities to explore ISS-NL resources in specific research areas. These include the National Nanotechnology Initiative (NNI), the Multi-Agency Tissue Engineering Science (MATES) Interagency Working Group, and the Federal Working Group on Bone Diseases. Representatives of the agencies could also use these meetings to discuss the potential for outreach to scientific organizations and communities to make better known the opportunities for microgravity research.

Mechanisms for interagency collaboration

A number of the FTAC participating agencies have supported and conducted life sciences research in space on the Space Shuttle or the ISS. In general these efforts have been carried out through one-on-one agreements between the agency and NASA. An example of an MOU to encourage research on the International Space Station is available at: http://www.niams.nih.gov/News_and_Events/NIH_NASA_Activities/nih_nasa_mou.asp. Cross-agency collaborations to engage in space-based research have been much less frequent. However, precedent for large, multi-agency missions exists: Shuttle mission STS-90 (Neurolab)[8] is one example of a life-sciences research effort that could be used as a model for other trans-agency activity (other agencies participated via individual MOUs with NASA, but the effort involved multiple agencies).

Effective engagement among the agencies to discuss proposed research plans is critical to developing potential collaborations. Many of the FTAC agencies have Memoranda of Understanding (MOU) with each other. These existing MOUs could be amended to include possible engagement in joint ISS research collaborative efforts, or new multi-lateral MOUs could be established specifically for ISS collaboration.

Collaborations across the agencies can include activities such as joint planning for research solicitations or joint implementation of selected research proposals. Consistent with agencies' priorities and budgets, and their research communities' needs, joint funding opportunity announcements can be issued by collaborating agencies. Such solicitations could range from a general call for proposals that utilize the ISS life sciences research capabilities to targeted

[8] Neurolab Spacelab Mission: Neuroscience Research in Space, Results From the STS-90, Neurolab Spacelab Mission, 2000.

requests for proposals that address specific common research interests of the collaborating agencies. Individual agencies other than NASA have issued ISS-specific solicitations previously: an example of an NIH Funding Opportunity Announcement that solicited applications for NIH-mission-relevant research proposals that would use ISS-NL resources is available at http://grants.nih.gov/grants/guide/pa-files/PAR-09-120.html.

A key component of any joint solicitation would be agreement between the participating agencies on the mechanism for scientific peer review. Additionally, coordination with NASA and CASIS will be necessary to provide a technical feasibility evaluation of candidate studies.

Engaging the scientific community

While some federally funded investigators have been engaged in space life sciences research for years, many more are unfamiliar with the opportunities that the ISS-NL may offer in their areas of interest. The ISS provides a unique environment in which to answer important scientific questions, but there are special requirements and constraints that investigators need to be familiar with when designing an experiment. Providing information to non-NASA research communities about the capabilities of the ISS-NL and familiarizing them with the properties and research potential of the microgravity environment by NASA and CASIS will be necessary to stimulate their interest and potential engagement in life sciences research in space.

Many of the Federal agencies that support life-sciences research primarily fund ideas that originate from the investigators who will be conducting the experiments relevant to the agency's mission (i.e., "investigator-initiated" research). Engaging these researchers directly via webinars, with opportunities for interaction in real time, could help to disseminate background information about the research capabilities of the ISS and the kinds of research it can support. Conducting 'Wiki' interactions, where a researcher with a potential idea for an ISS study could get technical and feasibility feedback from appropriate technical experts, would facilitate research planning and enhance the efficiency of implementing ISS studies.

Summary and Findings

Clearly there is a wide range of life sciences activity that can effectively utilize the unique capabilities of the ISS and that directly relates to the varied missions of Federal agencies. Review of proposals and allocation of ISS resources should recognize and take consideration of these agency priorities, for the benefit of the Nation.

Three broad themes in life sciences research enabled by the ISS-NL, spanning various agencies, were identified:

- Understanding the fundamental forces, forms and functions of living systems across scales of time and size, from molecules, to cells, to organisms, to the environment
- Understanding disease processes in animals and plants that can be modeled or studied in the space environment that will contribute to improved human health and welfare
- Contributing to the growth of the bio-economy through advances in bio-energy, biomaterials, biotechnology and bio-pharmaceutics

Specific activities in microgravity research, or other uniquely ISS-enabled research, of common interest across Federal departments and agencies include:

- Capabilities for monitoring and investigating gene mutation and expression, for microbes, plants, and animals (NSF and USDA), and humans (NIH and NASA)
- Development, deployment, and utilization of a versatile hyperspectral remote sensing device on the ISS to enable or facilitate: monitoring of crop growth, soil erosion, and related phenomena (USDA); albedo, ice, and related measurements (NIST & NOAA); and environmental processes, particularly relating to biofuels (DOE and NSF)

While these do not necessarily constitute the highest individual agency or interagency priorities or represent specific commitments of resources, they serve as illustrative examples of ISS research areas and capabilities that are of substantial interest to multiple Federal agencies.

An ongoing discussion to facilitate the planning and implementation of non-NASA life sciences research projects proposing to use the ISS-NL, as well as outreach to the research community, would be of value. This might be accomplished by leveraging participation in existing interagency efforts in a variety of related areas, and by having NASA regularly convene stakeholders from other agencies to discuss evolving opportunities and priorities.

Appendix A

CHARTER
of
the
FAST-TRACK ACTION COMMITTEE ON THE UTILIZATION OF THE INTERNATIONAL SPACE STATION (ISS) AS A NATIONAL LABORATORY
SUBCOMMITTEE ON LIFE SCIENCES
COMMITTEE ON
SCIENCE
NATIONAL SCIENCE AND TECHNOLOGY
COUNCIL

A. Official Designation

The Fast-Track Action Committee on the Utilization of the International Space Station as a National Laboratory (FTAC-ISS) is hereby established by action of the National Science and Technology Council (NSTC), Committee on Science (CoS), Life Sciences Subcommittee (LSSC).

B. Purpose and Scope

The NASA Authorization Act of 2005 designated the U.S segment of the International Space Station (ISS) as a National Laboratory, and the operational life of the ISS was extended through 2020 by the NASA Authorization Act of 2010 and international partner agreements. Pursuant to the 2010 Act, the independent, non-profit Center for Advancement of Science in Space (CASIS) was awarded a Cooperative Agreement by NASA in 2011 to manage research and development activities on the ISS National Laboratory (ISS-NL). The purpose of the FTAC-ISS is to help identify opportunities to expand on existing Federal utilization of the ISS-NL and to facilitate research collaborations among departments and agencies.

A major capability of the ISS is the capacity to support a broad scope of biological and medical research. Available facilities and resources support molecular, cellular, and physiological studies using a variety of plant and animal models, as well as human medical research. The FTAC-ISS will identify common research interests across Federal departments and agencies in order to enhance collaboration within the U.S. Government and leverage a more integrated approach informed by cross-agency expertise. The FTAC-ISS will address a range of issues and needs associated with developing a more coordinated Federal

research agenda for this unique laboratory. In this regard, the efforts of the FTAC-ISS will complement and facilitate CASIS's mission to manage and prioritize research efforts for the ISS-NL.

To achieve its goals, the FTAC-ISS will:

1. Identify the potential areas of life sciences research and experimentation in the unique microgravity environment provided by the ISS-NL that would most benefit the Nation.
2. Identify microgravity research of common interest across Federal departments and agencies.
3. Improve the use of existing government interagency coordination mechanisms that facilitate microgravity research by non-NASA Federal agencies as a complement to the activities led by CASIS.
4. As appropriate, establish long-term, outcome-oriented goals for ISS-NL Federal research.

These efforts will result in a list of integrated, cross-cutting agency life sciences research priorities of national interest that could take advantage of the microgravity environment—a list that will be provided to the LSSC. The FTAC-ISS will identify mechanisms for coordination with the ISS-NL management in order to incorporate these projects into the planned research portfolio, subject to available funding and to the extent feasible in light of other ISS-NL priorities. In addition, the FTAC-ISS may produce other work products (e.g., reports, joint requests for proposals, schedules) that support its stated purpose.

C. Functions

The functions of the FTAC-ISS are to:

1. Identify life sciences research areas of agency and/or interagency interest, and opportunities for collaborations among them.
2. Identify opportunities to increase use of the ISS-NL and facilitate better interagency alignment in terms of collaborations for flight and supporting ground-based research. As possible, review existing MOUs, existing grants, and current plans of non-NASA agencies for ISS.
3. Report the activities and progress of the FTAC-ISS, and make recommendations to the LSSC for appropriate forwarding to NASA by the Director of the Office of Science and Technology Policy.

D. Membership

The following NSTC departments and agencies are represented on the FTAC-ISS:

Department of Agriculture;
Department of Commerce;
Department of Defense;
Department of Energy;

Department of Health and Human Services;
Department of the Interior;
Department of State;
Department of Veterans Affairs;
National Aeronautics and Space Administration (Co-chair); and
National Science Foundation.

The following organizations in the Executive Office of the President shall also be represented on the FTAC-ISS:

Office of Management and Budget, and
Office of Science and Technology Policy (Co-chair).

Cooperating departments and agencies shall include other such Executive organizations, departments, and agencies as the Co-chairs may, from time to time, designate.

E. Termination Date

This charter shall terminate 120 days from the date of inception, unless renewed by the Co-chairs of the LSSC.

F. Determination

I hereby determine that the establishment of the Fast-Track Action Committee on the Utilization of the International Space Station as a National Laboratory is in the public interest in connection with the performance of duties imposed on the Executive Branch by law, and that such duties can best be performed through the advice and counsel of such a group.

for

3/15/12

Kathy Hudson
Co-chair of Subcommittee on Life Sciences, and
Deputy Director for Science, Outreach, and Policy
National Institutes of Health
Department of Health and Human Services

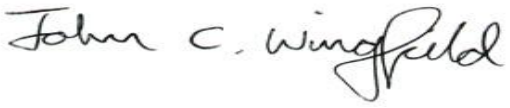
Date

Chavonda Jacobs-Young

3/14/12

Chavonda Jacobs-Young
Co-chair of Subcommittee on Life Sciences, and
Acting Director of the National Institute of Food and Agriculture
Department of Agriculture

Date



03/14/2012

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Co-chair of Subcommittee on Life Sciences,
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Sharlene Weatherwax
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Department of Energy

Date

Appendix B

FAST-TRACK ACTION COMMITTEE ON THE UTILIZATION OF THE INTERNATIONAL SPACE STATION (ISS) AS A NATIONAL LABORATORY
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