The Biological and Physical Research enterprise (BPR) has two organizing questions that can benefit from advanced sensors and devices: (1) How can we assure the survival of humans traveling far from Earth? and, (2) How does life respond to gravity and space environments? Proposals are sought in areas of nanotechnology, information technology, and biotechnology that are likely to help answer both questions. It is important for BPR to assure that its missions and experiments use new technologies, tools, models, and procedures that improve experiment integration and mission flight support. Proposals are also sought for payload technologies that will support planned human exploration missions to the Moon and Mars. BPR has the need to educate and inspire the next generation to take the journey. The objective is to improve science literacy by engaging the public in missions and discoveries associated with BPR. Proposals are sought for innovative methods for analysis, metrics development, audience assessment, and outreach product development.

Subtopics

**B5.01 Telescience and Flight Payload Operations**

Lead Center: MSFC

Participating Center(s): ARC

NASA has interest in the development of science and experiments that support strategic aspects of exploration, as well as to develop the technologies to extend humanity’s reach to the Moon, Mars, and beyond. Preparing for exploration and research will require the acceleration of the development of new technologies that will be imperative to future telescience and payload operations. It is important that the space missions and experiments for biological and physical research be managed using new tools, models, and procedures that improve telescience and flight payload operations. In addition, NASA wants to make available data and information associated with microgravity research investigations and results.

The ability for developers to access existing and new tools and collaborate in the design, simulation, modeling, building, and testing will be crucial to the success of NASA’s new initiative. New methods of computing, accessing...
disparate data spread over wide geographical areas will require new approaches to computing, data storage and communications.

There are many potential users for NASA services and data located throughout the U.S. There are three general types of users of these services and data. The first type is the principal investigator (PI)/payload developer (PD) who is responsible for the payload, experiment, and attendant science, and who commands the payload or experiment. The second type is the secondary investigator(s) who participates in analysis of the science and its control, but does not send commands. The third type is the educational user, from secondary school students up to graduate students. These users will receive either data processed by the PI or unprocessed data. Commercial investigations require the ability to receive, process, and display telemetry, view video from science sources, including the ISS, and interact with NASA concerning the science and operations. To conduct or be involved in general science activities, including the ISS science operations, a user will require various services from the Payload Operations Integration Center (POIC) located at the Marshall Space Flight Center near Huntsville, Alabama, or from other control centers located at various NASA facilities. These services are required to enable the experiment to be controlled using the inputs from various video sources, telemetry, and the crew. The input allows the experimenter to send to his/her payload or experiment commands to change various experiment operations. Before an experiment can get underway, an experimenter must participate in the payload planning process to schedule onboard services such as power, crew time, and cryogenics. This planning process is integral to the entire payload/carerrier operation and requires the PI/PD or his/her representatives to participate via voice or video teleconferencing. To enable a user to operate from his/her home base, whether located in a laboratory, office, or home; these services (commensurate to the level of operation) must be provided at the user's location at a reasonable cost. Costs include both the platform upon which these services will run, and the communications required to provide these services to the experimenter's location.

Proposals are sought for innovative ideas and efficiencies for systems to better effect communication and handling of data and information for scientific and commercial research on the International Space Station payloads and on manned exploration missions, and at the same time, for general use as applicable.

**B5.02 Flight Payload Logistics, Integration, Processing, and Crew Activities**

**Lead Center: MSFC**

In preparation for future human exploration, we must advance our ability to live and work safely in space, and at the same time, develop technologies to reach the Moon, Mars, and other planets. These new technologies will improve the Nation’s other space activities and may provide applications that could be used to address problems on Earth. The objective of this subtopic is to introduce new technology in the form of new tools, models, and procedures. It is important that the space missions and experiments for biological and physical research be managed using new tools, models, and procedures that improve flight payload integration and associated activities. Proposals are sought for more effective and efficient flight payload logistics, integration, processing, and crew activities. As experiment hardware is developed, concurrent planning for logistics, processing, and for both analytical and physical payload integration must take place. One objective is to minimize crew time required for experiment handling, transfer, installation, and operation through automation, procedural efficiencies, and other means. Some potential areas for payload improvements include, but are not limited to, the following:

- Acoustics, i.e., noise level reduction
• Power requirement reduction
• Electro Magnetic Interference/Electro Magnetic Compatibility (EMI/EMC) reduction
• Thermal control
• Materials usage
• Data control/handling
• Safety
• Test and checkout
• Systems integration
• Logistics
• Automation, robotics, and nanotechnology
• Training

B5.03 Development of Improved Outreach Planning and Implementation Products

Lead Center: MSFC

U.S. achievements in space have lead to the development of technologies that have widespread applications to address problems on Earth, as well as in space. In preparation for future human exploration of space, we must advance our ability to live and work safely in space and at the same time develop technologies to extend our reach to the Moon, Mars, and beyond. Outreach is a critical part of this process. This subtopic places emphasis on the effective implementation and analysis of outreach activities.

The Biological and Physical Research enterprise (BPR) seeks to use its research activities to encourage educational excellence and to improve scientific literacy from elementary school through the university level and beyond. The Enterprise delivers value to the American people by facilitating access to the experience and excitement of space research. NASA wants to provide access to information and data about microgravity research experiments and commercial investigations to schools, industry, and the general public.

Proposals are sought that provide a system, or systems, based on commercial solutions to develop outreach products for the improvement of education and public outreach planning and implementation. These systems should allow outreach participation in NASA programs, including the science and operational levels. Systems could provide for the general public and the educational community access to NASA and commercial science activities and operations through low-cost technologies, and outreach and education activities. The systems should be capable of facilitating secondary and college-level students’ access to, and the ability to participate in, science activities. Similarly, the systems should be able to accommodate institutions and organizations that promote the
use of science and technologies, e.g., museums and space camps. Examples of potential outreach activities include, but are not limited to the following:

- Exhibits and educational/informational material for conferences, workshops, and schools.
- Development and distribution of outreach brochures, newsletters to the general public, and student flight experiment programs.
- Adult Ambassador Program, e.g., advocacy speakers for community education and outreach events, alliance with Collegiate Alumni Learning Weekend Programs, development of a partnership with retirement organizations for the planning and implementation of a program with appropriate learning experiences, development and implementation of "learning laboratories" for science centers and museums, publication of articles in general interest periodicals, publication of articles and reports in scientific journals, multimedia outreach products, outreach Web sites, education briefs, fact sheets, and press releases.
- In addition to the development of new tools for planning and implementation, BPR seeks to evaluate the effectiveness of outreach activities. Systems are sought to assess and analyze the implementation and effectiveness of education and outreach activities and goals associated with BPR research. Assessment of available learning venues for varied age groups and priority order of attendance would be valuable in helping to formulate which venues and audiences to target.