NASA SBIR 2004 Phase I Solicitation

B2.02 Biological Instrumentation

Lead Center: ARC

Participating Center(s): JPL

The Fundamental Biology (FB) Program is the Agency lead for biological research and biological instrumentation and technology development, and focuses on research designed to develop our understanding of the role of gravity in the evolution, development, and function of biological processes. Increasingly, the research thrusts are directed at incorporating the most advanced technologies from the fields of cell and molecular biology, genomics, and biotechnology, to provide researchers with the most up-to-date methods to conduct their biological research. For these requirements, the capability to perform autonomous, in situ acquisition, and preparation and analysis of samples to determine the presence and composition of biological components is a highly desired objective. As the size of flight payloads becomes increasingly smaller, and information technologies permit smarter and more independent payload and device control and management, the realization of completely autonomous in situ biological laboratories (ISBL) on spacecraft platforms and planetary surfaces will become more desirable.

Biological and biomolecular, microbiological, and genomic research is enabling unprecedented insight into the structure and function of cells, organisms, and subcellular components and elements, and a window into the inner workings and machinations of living things. Techniques and technologies, which have evolved from the microelectronics and biological revolutions, have permitted the emergence of a new class of instruments and devices. Many devices, techniques, and products are now available or emerging, which allow measurement, imaging, analysis, and interpretation of the biological composition at the molecular level, and which permit determination of DNA/RNA and other analytes of interest. Advances in information systems and technologies, and bioinformatics, provide the capability to understand, simulate, and interpret the large amounts of complex data being made available from these biological-physical hybrid systems. These synergistic relationships are facilitating the development of revolutionary technologies in many areas.

Biological instrumentation technologies to support FB objectives are grouped into the solicited categories below.

**Biological Sample Management and Handling:**

- Technologies for remote, automated biosample and biospecimen collection, handling, preservation/fixation, and processing; and
• Modular, embeddable systems and subsystems capable of supporting a variety of tissue, liquid, and/or cellular specimens, from a wide range of biological subjects, including cells, nematodes, plants, fish, avians, mice, rats, and humans.

**In situ Measurement and Control:**

• Technology development for sensors, signal processors, biotelemetry systems, sample management and handling systems, and other instruments and platforms for real-time monitoring and characterization of biological and physiological phenomena.

**Genomics Technologies:**

• Technologies to enhance and augment research in genomics, proteomics, cell and molecular biology, including molecular and nanotechnologies, cDNA arrays, gene array technologies, and cell culture and related habitat systems.

**Bio-Imaging Systems:**

• Advanced, real-time capabilities for visualization, imaging, and optical characterization of biological systems. Technologies include multidimensional fluorescent microscopy, spectroscopy systems, and multi- and hyperspectral imaging.

**Biological Information Processing**

• Capability for automated acquisition, processing, analysis, communication, and archival and retrieval of biological data, and interface and transfer to advanced bioinformatics and biocomputation systems.

**Integrated Biological Research Systems and Subsystems**

• Integrated, experiment- and subject-specific biolaboratory modules and systems, providing complete flight prototype capability to support the above five categories.