

Research Announcement

Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space

**A Research Announcement for the
Life Sciences Division**

**Letters of Intent: April 15, 1996
Proposals Due: May 15, 1996**

**NASA Research Announcement
Soliciting Proposals
for
Advanced Life Support and Environmental Technologies for Human
Exploration and Development of Space**

**NRA 96-OLMSA-01B
Issued: February 20, 1996
Letters of Intent: April 15, 1996
Proposals Due: May 15, 1996**

Life Sciences Division

**Office of Life and Microgravity Sciences and Applications
National Aeronautics and Space Administration
Washington, DC 20546-0001**

**NASA Research Announcement
Soliciting Proposals
for
Advanced Life Support and Environmental Technologies for Human
Exploration and Development of Space**

CONTENTS

	<u>Page No.</u>
Research Announcement: Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space	1
Appendix A: Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space	
I. Introduction	5
II. Proposal Types	5
III. Research Programs and Emphases	7
A. Space Human Factors Engineering	8
B. Advanced Life Support	11
C. Advanced Environmental Monitoring & Control	14
D. Data Analysis	17
IV. Flight Experiments	18
A. Small Payloads Experiments	19
B. Space Station Early Utilization	20
V. Proposal Evaluation and Awards Selection Process	25
A. Evaluation Factors	25
B. Evaluation Techniques	27

VI.	Program Management Information	28
A.	Type of Awards to be Made	28
B.	Eligibility	28
C.	Foreign Proposals	28
D.	Program Reporting	29
E.	Deadlines	30
F.	Proposal Schedule	31
VII.	Bibliography	32
Appendix B:	Instructions for Responding to NASA Research Announcements for Solicited Research Proposals	34
Appendix C:	Special Research Facilities	44
Appendix D:	Flight Experiment Accommodation	46
Appendix E:	Required Application Forms and Instructions for Proposal Preparation	53

NASA Research Announcement

Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA) solicits proposals to participate in research and development opportunities in Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space. This is a broad-based announcement that solicits proposals that support the opening of the space frontier by exploring, using and enabling the development of space and by expanding human experience in space. In consonance with NASA's strategic plan, research and technology development activities supported by the Life Sciences Division will aid in the exploration and settlement of the Solar System, support the achievement of routine space travel, and enrich life on Earth through people living and working in Space. The major means that the Life Sciences Division will employ in supporting these goals are: scientific research, engineering technology, the Space Shuttle, and the International Space Station. The specific programs that are included in this announcement are Space Human Factors Engineering, Advanced Life Support, Advanced Environmental Monitoring and Control, and Data Analysis. Proposals submitted in response to this Announcement may be for ground-based research investigations or for limited types of space-flight experiments designed for the Shuttle middeck or for the earliest phase of utilization of the International Space Station. Proposals may be for activities lasting up to four years and beginning in FY 1997; proposals to conduct ground-based research aimed at developing mature experiments designed for the later phases of space station utilization are particularly encouraged.

Subsequent Announcements similar to and based upon this Announcement will be updated and issued annually. Although this Announcement is broad-based, it is restricted to the science programs named above and described in detail in Appendix A. The potential proposer should read the program descriptions that are of interest with care and attempt to focus the proposal on the specific research emphases defined in this Announcement.

Participation in this Announcement is open to all individuals and all categories of domestic and foreign organizations, industry, educational institutions, other nonprofit organizations, NASA laboratories, and other government agencies. Proposals which will enhance or complement the scientific return from research currently being supported by the National Institutes of Health, the National Science Foundation, or other government agencies are encouraged. Because of the limitations of access to flight opportunities, it is expected that the majority of

proposals approved in response to this Announcement will be for ground-based research. A letter of intent to propose is requested by April 15, 1996. Proposals may be submitted at any time up to May 15, 1996. Proposals will be evaluated for overall scientific/technical value, relevance, implementation feasibility, and cost. A selection announcement will be made between October and November of 1996. Funding of selected proposals will begin sometime between October 1996 and September 1997.

Further details relevant to these programs are included in the enclosed appendices. Appendix A provides technical information applicable only to this Announcement in the general areas in which proposals are solicited and includes supplemental information to Appendix B. Appendix B contains the basic guidance needed for the preparation of solicited proposals in response to this Announcement. Appendix C describes special facilities available for use by proposers. Appendix D describes the experiment accommodations provided in the middeck of the Shuttle and on the International Space Station during the earliest utilization phase and the space flight equipment that will be available to support these opportunities. Appendix E contains forms for inclusion with proposals submitted in response to this NRA.

The following items apply only to this Announcement.

Solicitation Announcement Identifier:	NRA 96-OLMSA-01B
Number of Copies Requested:	Original + 20 copies
Letters of Intent Due:	April 15, 1996
Proposals Due:	May 15, 1996
Selecting Official:	Director Life Sciences Division Office of Life and Microgravity Sciences and Applications

Obtain Additional Information From: the appropriate Program Manager, as indicated in the table below, at the following address:
 UL/Life Sciences Division
 NASA Headquarters
 Washington, DC 20546-0001
 Telephone: (202) 358-2530
 Fax: (202) 358-4168

Program	Program Manager
Space Human Factors Engineering	June Ellison
Advanced Life Support	Maurice M. Averner, Ph.D.
Advanced Env. Monitoring & Control	Gregory K. Schmidt
Data Analysis	Ronald J. White, Ph.D.
Flight Experiments	Peter R. Ahlf

Proposals and Letters of Intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Information Dynamics, Inc.
 SUBJECT: NASA Life Sciences Technology Development Proposal
 300 D Street S.W.
 Suite 801
 Washington, DC 20024.

Special instructions apply to foreign (non-U.S.) proposals. In addition to sending the original (signed) proposal and twenty (20) copies to NASA through Information Dynamics, Inc., as directed above, **one (1) additional copy along with the Letter of Endorsement must** be forwarded to:

Ms. Ruth Rosario
 IH/Space Flight Division
 Ref: NRA 96-OLMSA-01B
 NASA Headquarters
 Washington, DC 20546-0001
 USA

Proposals and Letters of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above addresses between the hours of 8:00 AM and 4:30 PM.

The telephone number (202) 479-2609 may be used when required for reference by delivery services. Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or federal holidays.

Letters of intent (only) may also be submitted electronically via e-mail or World Wide Web to the following addresses:

E-mail: loi@gm.olmsa.hq.nasa.gov

World Wide Web: <http://peer1.idi.usra.edu>

Following receipt of a proposal by IDI, a postcard will be sent to the proposer confirming receipt of the proposal and notifying the proposer of any missing data (reference proposer checklist, Form I, Appendix E) that are required for the subsequent reviews.

The government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made and the receipt of proposals that the government determines are acceptable for award under this NRA. It is anticipated that approximately 25 awards averaging \$125,000 (total costs) each annually will be made, although the total annual cost may vary from \$15,000 to \$350,000. Your interest and cooperation in participating in this effort are appreciated.

Original Signed by

Harry C. Holloway, M.D.
Associate Administrator for
Life and Microgravity Sciences and Applications

**ADVANCED LIFE SUPPORT AND
ENVIRONMENTAL TECHNOLOGIES
FOR
HUMAN EXPLORATION AND DEVELOPMENT OF SPACE**

I. INTRODUCTION

The Life Sciences Division of the National Aeronautics and Space Administration (NASA) seeks proposals for Advanced Life Support and Environmental Technologies for Human Exploration and Development of Space. This Announcement and the companion Announcement “Research Opportunities in Space Life Sciences,” NRA 96-OLMSA-01A, which summarizes the Life Sciences Division’s research programs in Space Life Sciences, will be the two-part solicitation used to obtain scientific or technical proposals to be funded during Fiscal Year 1997, either for new research or for the continuation of research beyond the term specified in a previously funded proposal. Other Announcements calling for focused research or utilization of unique resources may be issued throughout the year. It should be noted, however, that unsolicited proposals for scientific or technical research that are submitted to the Division for evaluation will be held until the next annual review period if the proposed research is relevant to the programs described in this Announcement. Unsolicited proposals outside of the research and technology development emphases defined in this Announcement will, in most cases, be returned to the proposer. However, NASA reserves the right to act in the best interests of the federal government in the matter of proposal acceptance and evaluation.

This Appendix describes the types of proposals that are acceptable for submission in response to this Announcement, defines the technology development programs within the scope of this Announcement, and describes the current areas of technology development that proposals should address. In addition, this Appendix includes guidelines for preparing and submitting proposals and defines the administrative policies governing the program and grantees.

II. PROPOSAL TYPES

To be acceptable, each proposal submitted under this Announcement must be one of two types:

1. Ground-Based Research Investigation

It is expected that the majority of proposals submitted in response to this solicitation will fall into the category of standard technology development proposals, i.e., proposals to carry out a technical study in an Earth laboratory and having a clearly defined set of technical objectives. All proposals must be consistent with the program areas and emphases defined in this Announcement if they are to be considered for funding. Proposals to conduct ground-based research aimed at developing technologies for the later phases of International Space Station utilization (from 2001 onwards) and NASA's Human Exploration and Development of Space enterprise are particularly encouraged. Some proposals may require special NASA Earth-based facilities for their completion (see Appendix C for a description of special NASA facilities). If such a proposal is selected, NASA will seek to provide access to the required facilities for the investigator.

2. Space-Flight Experiment

Proposals are sought to carry out either of two special types of technology development and validation studies in space: (1) experiments, called Small Payloads Experiments, that can be implemented (primarily on the Shuttle middeck) without the use of major mission resources; and (2) experiments that can be implemented with the limited resources available on the International Space Station during the early assembly (construction) phase (1998-1999). Proposals to carry out space studies of either of these two types are severely constrained in both the resources (weight, power, crew time, etc.) and the flight hardware available (see Appendix D) for use. Proposals requiring resources beyond the capabilities defined in this Announcement should not be submitted at this time. Although it is recognized that flight proposals may, and often must, include ground-based research and technology development, flight investigations and technology validations must represent mature studies that are strongly anchored in previous ground studies and/or previous flight experiments.

Regardless of proposal type, every proposal should focus on at least one of the technology development programs defined in the next section, and should be relevant to the goals of the Human Exploration and Development of Space Strategic Plan cited in Section VII (Bibliography) of this Appendix.. A proposal may be multidisciplinary or interdisciplinary, involving combinations of these programs, but if this is the case, that fact should be stated clearly at the beginning of the proposal. Proposals should include a well-defined technical plan which can

be accomplished within four years or less. NASA has a strong commitment to the ethical treatment of human and animal research subjects. Assurance of compliance with applicable federal regulations regarding human subjects and/or animal care and use is required as part of the proposal submission process (see the “Special Matters” instructions in Appendix E). Potential applicants should note that review of a proposal will not be undertaken if the required information is not supplied. Applicants who meet the qualifications and wish to be considered for the “NASA Presidential Early Career Awards for Scientists and Engineers” should indicate this in their proposal (see the “Special Matters” instructions in Appendix E).

This Announcement solicits science and technical proposals that are highly innovative and, although based upon sound principles, may contain some risk of failure. Bold, novel approaches to solving technology needs are encouraged. At an appropriate point in the development of these technologies and after suitable evaluation, the appropriate NASA field center will become increasingly involved in the technology development, in order to ensure that requirements for future use are being addressed in the technology development effort. Finally, technologies advancing to a near flight-ready stage will be tested first in integrated ground-based systems and then in flight as appropriate to ensure their efficacy prior to becoming incorporated into flight experiments or flight systems.

Proposers are required to include a projection showing the timeframe for the anticipated use of their technology in flight systems in all proposals to this NRA. This requirement is not by any means meant to favor near-ready technologies over concept-level, high-risk technologies, but rather to stimulate creative, innovative ideas for incorporating new technologies into flight systems as early as possible. In fulfilling this requirement, proposers are encouraged to refer to Program Plans as available and to contact appropriate NASA field center personnel when possible.

III. RESEARCH PROGRAMS AND EMPHASES

The mission of the Human Exploration and Development of Space Enterprise (HEDS) is to open the space frontier by exploring, using, and enabling the development of Space. In using space, the Enterprise will develop the tools and skills to live and work there, to take advantage of its unique environment for conducting research in science and engineering, and to generate technology. In the long term, the goals of the Enterprise are to

- Understand and use nature's processes in space.

- Explore and settle the solar system.
- Achieve routine space travel.
- Enrich life on Earth through people living and working in space.

As related to NASA's Human Exploration and Development of Space Enterprise, the major goals of NASA's Life Sciences Division, located within the Office of Life and Microgravity Sciences and Applications, are to:

- Develop the scientific and technological foundations for a safe, productive human presence in space for extended periods and in preparation for exploration; and
- Apply this knowledge and technology to improve our nation's competitiveness, education, and the quality of life on Earth

To accomplish these goals, the Division supports research and technology development activities in three distinct but related programs: Advanced Life Support, Advanced Environmental Monitoring and Control, and Space Human Factors Engineering. This Announcement is concerned with these three programs only. The companion Announcement "Research Opportunities in Space Life Sciences" (NRA 96-OLMSA-01A) should be consulted for additional opportunities.

In the remainder of this section, the Advanced Life Support and Environmental Technologies programs supported by the Division are defined and their specific emphases for the 1997 fiscal year (October 1996 - September 1997) are specified. **It is important that the prospective investigator read the relevant section(s) carefully, as many of the programmatic emphases are different from those appearing in previous Division Announcements.**

A. SPACE HUMAN FACTORS ENGINEERING

Program Description

The Space Human Factors Engineering (SHFE) Program is designed to integrate knowledge about human capabilities and system engineering methodologies into spacecraft design, mission planning, and related ground operations. The Program also develops new processes and procedures, draws on human factors expertise in aeronautics to optimize crew training, automated systems design, proficiency and productivity, and uses relevant analog studies in simulators as

well as in extreme and isolated environments. Behavior and Performance is addressed in NRA 96-OLMSA-01A, "Research Opportunities in Space Life Sciences."

This Program supports both scientific and technical activities. Potential applicants should refer to Section V.A of this appendix, for definitions related to proposals for each of these activities. The primary focus of the Program is shifting from knowledge acquisition to knowledge application, a shift intended to extend the benefits of human factors research to space operations in accord with NASA's Strategic Plan, NASA's Enterprise for the Human Exploration and Development of Space, the Space Human Factors Program and Requirements Definition Plans (see bibliography).

The SHFE Program is organized around four major goals, each representing a distinct focus: **Expand knowledge** of human physical capabilities and limitations in space; **Develop cost-effective technologies** that support integrating the human and system elements of space flight; Ensure that mission planners **use human factors research results and technology developments to increase mission success and crew safety**; and **Make NASA technology available to the private sector** for Earth applications.

Program Emphasis for FY 1997

To be considered for funding in FY 1997, scientific proposals for fundamental research should be directed toward one or more of the following objectives:

- Identifying and defining SHFE functions that are critical to safety;
- Developing and applying realistic human-machine scenarios for use in overall system assessments;
- Determining SHFE habitability requirements for space flight;
- Developing and validating the design and performance requirements for equipment and procedures, operations, and environments in space and ground support from the human factors viewpoint;
- Developing and using ground-based models and analogs for studying space-related SHFE; and
- Identifying and evaluating SHFE technologies that have applications beyond the space program.

For FY 1997, technical proposals to undertake technology development should concentrate on the following areas.

1. Advanced Displays and Controls Development (AD&CD). The goal of this research area is to improve display and control techniques, both

computer-driven simulators (the "glass cockpit") and analogs. Specific needs are:

- Developing and evaluating new methods of presenting information to space and ground crews (such as multimedia and virtual environments) and of inputting commands (such as voice- or touch-activated screens).
- Approach for developing a hands-free display control that could present suit monitoring parameters, checklists, graphics, etc.

2. Human-machine Function Allocation. The increasing complexity of automation in human-machine systems raises many human factors issues. Specifically, requirements and guidelines for designing interfaces and modes of human-machine interaction, including, for example, the use of fuzzy logic and neural nets, as well as training approaches and procedures to guide the use of such systems. The emphasis in this NRA is on SHFE.
3. Interaction Among Intelligent Agents. Human interactions, with other humans and with intelligent machines, become increasingly important as missions become more diverse and longer in duration. Current knowledge in this area of human-factors analysis is very limited. Research is needed to understand the complexity of relationships among intelligent agents and information transfer. The emphasis in this NRA is on SHFE.
4. Intravehicular (IVA) and Extravehicular Activity (EVA). Input from biomechanical modeling, anthropometric and kinematic methodologies, psychophysics, physical and mental work capacity measurements, and unit and team task analysis can help to establish guidelines for tool design, workplace layout, human-machine interfaces, work protocol, posture maintenance, body control, and material handling limits for IVA and EVA. Major concerns include: human strength, stamina, range of motion, workload, and physical fatigue. Some specific EVA technology development needs are:
 - Technologies such as virtual reality integrating dynamics and force feedback into mass handling simulation and to facilitate EVA training (ground based or inflight). The inflight EVA training capability is needed for long-duration missions (e.g., Mars and extended space station missions) to counteract the potential loss of memory (due to intervening time and activities) for EVA tasks trained for before flight.
 - EVA Crewmember Model - a human-factors based model of EVA-suited crewmembers is needed to show the interaction

between the EVA crewmember and Shuttle or Station remote manipulators, and payloads. The model should emphasize suited human physical characteristics and performance capabilities, and their interactions with the remote manipulators. This includes predicting induced loads, effects of transferring hand-held payloads of varying size and mass, and safety issues.

5. Analog Studies. Earth-based testing and training facilities are critical to the design, development, and maintenance of space human-machine systems. Research in high-fidelity mockups and training simulators and in general environmental analogs are necessary for space missions. Analog studies should enhance human performance in operational procedures for both in-flight and ground-support personnel. The emphasis in this NRA is on SHFE.

B. ADVANCED LIFE SUPPORT

Program Description

The Advanced Life Support Program was initiated under the premise that NASA's goals would eventually include extended-duration missions with sizable crew requiring life support capabilities beyond the ability of currently available life support technology. With this in mind, the goal of the Advanced Life Support Program is to develop regenerative life support systems by combining biological, physical, and chemical processes capable of producing and recycling the food, air, and water needed to support long-term human missions in space in a safe and reliable manner. Fulfillment of this goal requires the application of engineering sciences to the design of technologies that support and control physical-chemical closed loop systems for clean air and potable water, and the additional application of life sciences to grow, harvest, and process crop plants for flight crew consumption. Thus, relevant subjects include, but are not limited to, air revitalization, water reclamation, waste management and contamination control, plant growth and food production, and systems control. Refer to the Advanced Life Support documents in the Bibliography (Section VII) for descriptions of currently available technologies and for requirements for advanced technologies.

Potential applicants should note that research proposed that would, as its primary objective, establish physiological norms for atmospheric gases, identify toxicants, or describe microbial populations (including their densities, pathogenicity, or products) that could be construed as pertinent to the establishment of space flight environmental standards for human health and should be submitted to NRA 96-OLMSA-01A, "Research Opportunities in Space Life Sciences" (Environmental

Health Program). Proposals that address the development of sensors to monitor environmental parameters should be submitted to the Advanced Environmental Monitoring and Control Program (see Section III.C).

Air Revitalization. New technologies for air regeneration for long duration space missions will cleanse the air, maintain levels of carbon dioxide and levels of airborne contaminants within acceptable limits, concentrations or standards, regenerate oxygen, capture and dispose of hazardous particulates, automatically monitor air quality, and provide early alert systems for excessive atmospheric contamination.

Efforts in system modeling, materials development, subsystem operational performance, and control responsiveness will be required to provide advanced systems which minimize support expendables and which maximize autonomous operations.

Water Reclamation. Space habitat water recycling systems are required to provide 4-8 people with safe, small, efficient, reliable recycling capability with built-in contamination monitoring to assure quality control, and which do not require significant amounts of expendables for pre- or post-treatment. Of particular interest are technologies directed at reducing the quantity and weight of present expendable water filters.

Waste Management and Contamination Control. The waste reclamation technologies will enable a totally integrated system that eliminates storage of noxious wastes and promotes crop plant growth. Technologies are required that process solid human wastes to stabilize them and allow non-noxious and non-hazardous storage.

Plant Growth and Food Production. A necessary function of any life support system is to supply appetizing and nutritionally adequate diets for the human crew. In theory, these diets could consist solely of vegetables, vegetables combined with animal proteins, or non-traditional foods. Plant combinations that will provide suitable diets for planetary life support systems must be selected based on harvestability, palatability, processing requirements, nutritional content, growth habitat, and power requirements. Biomass generated by crop plants will require processing to make it suitable for human consumption. Studies are now underway to define systems that will harvest, pre-process, and store plant biomass, and convert it into edible forms. Related research focuses on general food processing methods, and examines microbial, chemical, and enzymatic systems as candidate techniques for food conversion.

System Control. The success of life support systems developed for planetary surfaces is critically dependent upon the integration of the biological and non-biological processes and subsystems into a reliable and predictable overall system. To accomplish this, system monitoring, control strategies, and other technologies need to be developed and tested. Research in this area focuses on development of mathematical or laboratory models with particular attention to the application of engineering control theory and, especially for mathematical models, provision for model validation. It would be of advantage to the potential applicant to investigate opportunities for cooperative activity with NASA life support personnel through the Johnson Space Center. The appropriate contact person is:

Dr. Donald Henninger
Johnson Space Center
Mail Code EC3
Houston TX, 77058
fax: 713-483-5060
email: dhennin1@gp901.jsc.nasa.gov

Further information on this Program can be obtained from the documents: Advanced Life Support Program Plan (1992), Advanced Life Support Program Requirements (1996), Controlled Ecological Life Support Systems (CELSS) Program Plan (1992) listed in Section VI of this Appendix.

In addition to the above technologies directed at intravehicular activities, the Program also includes activities that address life support problems associated with advanced extravehicular activities (EVA). Specifically, further technology development is needed in the areas of thermal control systems, atmospheric monitoring and control, and integration of these subsystems. Research is needed in certain areas of portable life support system (PLSS) technology to develop simple, reliable, partially and fully regenerable subsystems that can be packaged into easily maintained micro-climate control systems comparable in size to the fully expendable system currently in use. System size and weight will be even more critical for Lunar and Mars missions during which surface gravity will be on the order of 1/6 g and 1/3 g. Many current PLSS technologies have prohibitive logistical support and maintenance requirements for use on such missions.

Program Emphasis for FY 1997

For FY 1997, the primary emphases of the Advanced Life Support Program will be in the areas of:

- Development of technologies for solid waste processing and food processing offering significant improvements over currently available

technologies in weight, power requirements, and associated consumables; and,

- System studies, with emphasis on mass closed system control and management.

Programmatic relevance for FY 1997 will be evaluated relative to these emphases.

C. ADVANCED ENVIRONMENTAL MONITORING AND CONTROL

Program Description

The Advanced Environmental Monitoring and Control Program develops advanced technologies which monitor the physical environments of both the human compartments and life support systems of current and future spacecraft, extravehicular systems and, wherever possible, ensures that these technologies find application in the commercial sector. The Advanced Environmental Monitoring and Control Program sponsors technology development activities that:

- Establish new areas of environmental monitoring technology development,
- Establish partnerships with industry, universities and other agencies to facilitate technology development and transfer, both into and out of NASA, and
- Promote technology transfer of NASA environmental monitoring technology to industry

Proposals that are selected will be funded through the phase of initial demonstration of feasibility and suitability for use in the ground-based or flight programs (the breadboard demonstration stage). Once a sufficient level of maturity is demonstrated, further development (e.g., packaging or brass boarding) becomes the responsibility of the benefiting ground-based or flight project.

Potential applicants should note that all proposals submitted to the Advanced Environmental Monitoring and Control Program should include a section that addresses how the proposed technological development may be integrated into current or future NASA technology development projects, and a section that discusses potential earth benefits of the proposed work, including but not limited to technology transfer to the commercial sector, potential benefits to medical sciences and technology, and potential general benefits to human welfare.

Program Emphasis for FY 1997

For FY 1997, the primary emphasis of the Advanced Environmental Monitoring and Control Program will be on environmental sensors. This includes the development of new technologies for air and water monitoring and microbial detection as well as the refinement and microminiaturization of currently available sensors. New proposals in this area will have the highest programmatic priority.

Proposals are also sought for development of technologies in the area of technologies designed to improve EVA garments.

The following additional information describes FY 1997 Advanced Environmental Monitoring and Control Program technology needs in more detail.

Sensor Technologies for Environmental Health. Sensors are needed in the areas of air and water monitoring as well as microbial detection. Ideally, integrated sensor systems should be lightweight, highly reliable, have a rapid response time, consume little power, require minimal to zero crew time or sample manipulation, be capable of self-calibration, data processing and fault diagnosis, require minimal space and consumables, be field-serviceable by replacement modules and be compatible with microgravity. Specific sensor technology needs:

1. Air Quality Monitors And Sensors. Among existing, commercially available technologies for toxic gas monitoring, the current response time of the instruments for sensing various toxic constituents in air is typically on the order of tens of seconds, their masses are on the order of pounds (including signal processing electronics, power supply, and display) and they require sampling and vacuum/inert gas purge. Technology development needs to be focused on significantly reducing the mass, volume, power and other overhead requirements of existing instruments, and potential improvements in these parameters should be specifically discussed in proposals.

Specific detection needs include target volatile organics, total hydrocarbons, formaldehyde, utility chemicals (presently ammonia and freon), benzene, metal aerosols, particulates, and inorganics (CO, CO₂, HF, HCl, HCN, and NO, or combinations of these). Proposals that target other atmospheric components that may be formed in the spacecraft environment are also welcome.

2. Water Quality Monitors And Sensors. NASA is interested in developing monitors which, in addition to meeting the generic requirements described above:

- Require zero or minimal chemical reagents, compressed gasses, vacuum, or chemical calibration standards;
- Produce negligible heat and hazardous chemical waste during operation;
- Identify and quantify target compounds such as halogenated organics, metals, inorganic cations and anions, and low molecular weight alcohols, organic acids and esters present in the low to mid µg/L range.

Also of interest is the development or refinement of other new ground based methods relevant to space flight, which will be used to expand the comprehensive database of chemical contaminants present in spacecraft waste water and the processed water produced by terrestrial based, prototype water processor testing and development.

3. Microbiology Monitors And Sensors. To maintain crew health, the rapid detection, identification and quantification of microorganisms will be needed. Particular attention must be paid to discerning differences between living and dead organisms. The major needs are:

- Rapid quantification of planktonic bacterial contaminants and potential coliform pathogens for rapid certification of water quality. This includes new methods for monitoring bacterial biofilm on internal surfaces of spacecraft water systems. Candidate technologies must have capabilities of detection of bacteria at very low levels (e.g., 10 to 100 CFU/100 ml for planktonic, aerobic bacteria).
- Detection and quantification of specific bacteria and fungal species for air quality (e.g., 500 CFU/m³ for bacteria; 100 CFU/m³ for fungi) and surface contamination (e.g., 40 CFU/cm² for bacteria; 10 CFU/cm² for fungi), and the detection and quantification of common airborne pathogens (e.g., legionella). Sensor technology must provide results rapidly to make important decisions directly affecting crew health, safety, and performance.
- Development of a miniaturized system for the detection of microbial populations on solid surfaces.

Technology to Improve Extra Vehicular Activity Garments. Astronauts involved in extended EVA activities require garments that provide optimal protection from the harsh environment of space while affording them maximal range of motion and dexterity for work outside the spacecraft. Technologies are solicited

to improve astronaut survivability following a puncture of a Thermal Micrometeoroid Garment (TMG) with its underlying bladder material.

D. DATA ANALYSIS

Program Description

The Data Analysis Program supports a range of activities that are focused on carrying out a thorough analysis of data gathered during space flight and its Earth analogs, including both studies that actually analyze existing data and studies that aim to develop new techniques that may be applied to biological data. **Extended data analysis** activities seek to examine, from a fresh perspective, data and samples that have already been collected during space flight or one of its analogs and subjected to primary analysis by the original principal investigator. Detailed new analyses of data extracted from the **Life Sciences Data Archive** or of specimens obtained from the **Biospecimen Sharing Program** are examples of extended data analysis tasks. In addition, proposals by a space flight experiment investigator to extend the scope of the postflight data analysis beyond that contained either in the original flight proposal or as negotiated during the flight experiment definition phase are appropriate extended data analysis activities.

The Program also supports the development of **special data analysis techniques** that promise to strengthen the analysis of data from space flight, such as mathematical modeling, computer simulation, artificial intelligence, or statistical methods. These high technology tasks generally require sophisticated computer manipulation of data in order to enhance the value of the data to the investigator.

Program Emphasis for FY 1997

For FY 1997, the primary emphasis of the Data Analysis Program will be on **extended data analysis** and new proposals in this area will have the highest programmatic priority. Secondary emphasis will be on the area of special data analysis techniques. Proposers should note that the information and data contained in the Life Sciences Data Archive (see information on the World Wide Web at <http://nssdc.gsfc.nasa.gov.life>) may be used as the basis for all or part of an extended or special data analysis proposal.

IV. FLIGHT EXPERIMENTS

Proposals for space-flight experiments may be submitted in response to this Announcement if they involve either of two special types of scientific studies:

1. Experiments, called **Small Payloads Experiments**, that can be implemented (primarily on the Shuttle middeck) without the use of major mission resources; or
2. Experiments that can be implemented with the limited resources available on the **International Space Station** during the early assembly (construction) phase (1998-1999).

Both of these experiment types are highly constrained in a number of ways (described below); *proposals requiring resources beyond the capabilities defined below should NOT be submitted in response to this Announcement.*

Potential applicants should recognize that, given the limited flight opportunities that are available at present, the flight experiments area is likely to be one of the most competitive arenas within the space life sciences for FY 1997. It is expected that successful flight experiment proposals will represent mature studies strongly anchored in previous or current ground and/or flight research. Ground-based research may, and often must, represent one component of a flight experiment proposal, but that research should be limited to activities that are essential for the final development of an experiment for flight and for the completion and publication of the scientific results of the experiment. In this case, only one (flight) proposal need be submitted. Preparatory ground research designed to define a mature space experiment should be proposed separately and in its own right as part of the ground-based program.

Note that all flight experiments must address one or more of the research programs and emphases defined in Section III above. Applicants proposing flight experiments must fill out the information required on Form E (Appendix E).

Finally, potential applicants should be aware that selection for flight is a multi-step process. Following the initial evaluation of flight proposals, a small group of investigators will receive a letter informing them that their experiment has been selected for definition. During the definition phase, NASA will interact with the applicant and determine whether the proposed experiment can actually be carried out on a space mission. At the end of this phase, NASA will select a smaller group of investigations to be developed for flight. **Normally, investigator funding does not begin until the initiation of the development phase.**

A. SMALL PAYLOADS EXPERIMENTS

Small payloads proposals submitted in response to this Announcement are restricted to experiments that can be accommodated in the middeck area of the Shuttle and that use existing flight hardware. The Shuttle middeck consists of "lockers" inside the Shuttle crew cabin that can house the specimens, hardware, and/or apparatus necessary for experiment completion. The experiments themselves are usually stand-alone studies that require limited crew training and involvement to execute. It is possible to take advantage of the location in the Shuttle middeck to obtain late preflight installation and early postflight retrieval of materials.

Hardware that will be available to support the small payload flight experiment opportunities with non-human subjects are as follows: Plant Growth Facility (PGF), Aquatic Research Facility (ARF), and Biological Research in Canisters (BRIC). Descriptions of these hardware items, as well as others that may be used to support experiments, are included in Appendix D. It is expected that small payload opportunities will also exist for the use of human (crew) subjects. Detailed descriptions of available hardware to support these experiments are also included in Appendix D. Note that the number of crew subjects available to support such studies will be limited due to both the late manifesting of middeck experiments and the limited amount of crew time historically available to support the middeck experiments. However, preflight and postflight studies of the crew are possible in a limited number of cases.

Investigators may propose to use one or more pieces of flight certified hardware to implement their experiment, or may propose to utilize their own currently existing flight hardware. Proposals for the development of experiment unique equipment to implement individual experiments are not encouraged. However, when exceptional circumstances justify the need for such equipment, such items should be proposed as new developments and the additional costs should be included in the proposal as specified in Appendix B.

Applicants should note that small payloads experiments should be proposed as if the actual flight of the experiment occurred in 1998 or 1999. Experiments that cannot be accomplished within this time period should not be proposed to this Announcement. With strong justification, applicants may request multiple flight opportunities; however, preference will be given to those proposals requesting only one flight to accomplish the proposed research.

Once selected, flight investigators and NASA must agree on the duration of the period (nominally one year) following receipt of specimens and data during which their investigation will be completed. At the end of this period,

investigators must provide a final report to NASA and should make the results of their experiments known to the scientific community through publication in appropriate peer reviewed journals. All suitable experimental and reduced data must be submitted to NASA in a form appropriate for archiving in the Space Life Sciences Data Archive, where it will be available to the scientific community.

B. SPACE STATION EARLY UTILIZATION

Research opportunities will exist during the construction phase of the International Space Station. These opportunities will include durations longer than the current Shuttle limit of approximately 16 days, but will be constrained in a variety of other ways. Research opportunities will be available during utilization flights when the Shuttle visits the Space Station, and during the time period between the utilization flights when the permanent onboard crew will act as experiment operators and, if necessary, as subjects. The duration of microgravity exposure during the 1998-99 time frame can, in theory, be indefinite with periodic disturbances every 30 days caused by the U.S. and Russian transportation vehicle docking activities. The primary opportunities to transport equipment, supplies, and samples will be on the utilization flights of Shuttle; however, modest capabilities for research related deliveries and sample return will be available on assembly flights that take place every 40-90 days. Two utilization flights are presently planned during 1998-99, one in February 1999 and one in July 1999.

Potential applicants should refer to Appendix D for a description of the accommodations available. During this period, space life sciences research is restricted to utilize a limited hardware set prior to delivery of the U.S. laboratory module in 1998, followed by the availability of early configurations of two facilities: the Biological Space Research Facility (BSRF) and the Human Research Facility (HRF). **Applicants should be aware of the fact that extravehicular activity (EVA) is scheduled for these flights;** this requires the atmospheric pressure in both the Shuttle and the Space Station to be reduced to 10.4 psi for 24 to 48 hours. Proposers should consider the potential impact of such reduced pressure on their investigations. In addition, it is expected that **crew availability for research operations will be limited** throughout 1998-99. Proposers who can submit experiments with few and/or simple inflight activities are likely to be more easily accommodated. Finally, it should be noted that the informed consent of human subjects must be obtained prior to carrying out any study in space and potential proposers should be aware that obtaining such informed consent will involve a uniform process regardless of country of origin of the proposer. The following is a draft of the consent form currently under development for the International Space Station. This is

provided for information purposes only and should not be submitted at this time as part of an application.

DRAFT
MULTINATIONAL SPACE STATION
HUMAN RESEARCH INFORMED CONSENT*

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following research study, test, or investigation:

NAME OF INVESTIGATION _____

MISSION TO WHICH ASSIGNED _____

PRINCIPAL INVESTIGATOR _____

RESPONSIBLE PROJECT SCIENTIST _____

I understand or acknowledge that:

- (a) This procedure is part of an investigation approved by participating agencies.
- (b) I am performing these duties as part of my employment with _____.
- (c) This research study has been reviewed and approved by the Multinational Review Board (MRB) which has also determined that the investigation involves _____ risk to the subject. (minimal or reasonable)
- (d) Definitions:
“Minimal risk” means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

“Reasonable risk” means that the probability and magnitude of harm or discomfort anticipated in the research are greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests, but that the risks of harm or discomfort are considered to be acceptable when weighed against the anticipated benefits and the importance of the knowledge to be gained from the research.
- (e) The research procedures were explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered to my satisfaction. A layman’s description was provided to me.**
- (f) I consider myself physically and mentally qualified to participate in the investigation.
- (g) I know that I can refuse to participate in the tests at any stage of their performance, and my refusal will be honored, except in those cases when, in the opinion of the responsible physician, termination of the tests could have detrimental consequences for my health and/or the health of the other subjects. However, understanding the significance of the investigations (tests), I will give every effort to perform the full scope of the program.
- (h) In the event of injury resulting from this study, I understand that I will receive medical attention and necessary treatment. I also understand that I will be compensated for any injuries to the

extent permitted under current _(TBD)_ and the provisions of the contract between _(TBD)_. My agreement to participate shall not be construed as a release of _(TBD)_ or any third party from any future liability which may arise from, or in connection with, the above procedures.

- (I) Consistent with statutory and Agency-approved routine uses under the _(TBD)_, the confidentiality of any data obtained as a result of my participation as a research subject in this study shall be maintained, so that no data may be linked with me as an individual. However, if a “life-threatening” abnormality is detected, the investigator will notify me and the _(TBD)_. Such information may be used to determine the need for care or medical follow-up, which, in certain circumstances, could affect my professional (flight) status.

Test Subject _____ Date _____

2. I, the undersigned, the Principal Investigator of the investigation designated above, certify that:

- (a) I have accurately described the procedure and related risk(s) to the test subject.
- (b) The test setup involves _____ risk to the test subject as determined by the MRB. (minimal or reasonable)
- (c) All equipment to be used has been inspected and certified for safe and proper operation.
- (d) The test subject is qualified to participate in my experiment protocol.
- (e) The test protocol has not been changed from that originally approved by the MRB.

Principal Investigator _____ Date _____

Concurrence:

Project Scientist _____ Date _____

Notes:

* This form is valid for the period including preflight, in-flight, and postflight data collection sessions for the mission. Before the first baseline data collection, the Principal Investigator will repeat the briefing concerning risks involved in the investigation. A signed, dated copy of this form with attachments must be forwarded to Chair, Multinational Review Board.

** A detailed description of the investigation will be attached to this consent form. The Principal Investigator is responsible for formulating this document, which should be in layman’s terms such that the subject clearly understands what procedures will be required and the risks associated therewith. The detailed description of the research procedures must specifically list the risks associated with the procedures to be employed, the possible adverse reactions of all medications to be administered, and the risks/hazards resulting from exposure to ionizing radiation. Further, the investigator must clearly specify all forms of subject behavior interdicted by the research protocol (exercise, diet, medications, etc.).

Pre-U.S. Laboratory Module

The International Space Station will have a permanent crew beginning in 1998, approximately six months prior to the assembly of the U.S. laboratory module and 10 months prior to the first utilization flight. During this time period, an extremely limited set of research equipment will be available. However, because of the presence of the crew and the expected availability of a small amount of crew time for research purposes, it is possible to carry out certain restricted kinds of investigations. Available equipment is described in Appendix D.

Biological Space Research Facility

During this early (construction) phase of the International Space Station, biological research with non-human specimens will be possible, focusing on opportunities in cell and molecular biology. NASA hardware, such as the Incubator, Cell Culture Unit (CCU), and the Standard Interface Glovebox (SIGB), will be available for experimentation. Additional hardware currently under development by the international partners may also be available for use, including: STATEX, the Aquatic Research Facility (ARF), and NIZEMI. More detailed hardware specifications can be found in either Appendix D, or from the Space Station Biological Research Project World Wide Web page (<http://pyroeis.arc.nasa.gov/>). Specimens which can be supported include: single-cell prokaryotic and eucaryotic organisms; various types of cell cultures; small aquatic animals and insects; and small plants.

Human Research Facility

There will also be opportunities for human research during these early utilization flights. These studies will utilize equipment that is located in the early elements of the Human Research Facility (HRF), a suite of generic life sciences laboratory equipment designed to support a multidisciplinary research program. See Appendix D for a description of the hardware items included in HRF Rack #1, which is currently scheduled for launch in 1999, and additional stowable hardware that does not use power. Applicants should propose to utilize that hardware in carrying out their investigations.

It is expected that competitive proposals will address issues of critical importance and will require the unique facilities or attributes of a space station (microgravity exposure in excess of 16 days) for their completion. As noted earlier, the experimental concept must have evolved from a clearly defined and rigorous program of successful ground-based or space-flight investigations.

Emphasis during this early utilization period will be on research that is operationally simple or, at least, relatively easy to perform, and that involves minimal crew training and minimal crew time during flight.

V. PROPOSAL EVALUATION AND AWARDS SELECTION PROCESS

The following information is specific to this NRA and **supersedes** the information contained in Appendix B (Instructions for Responding to NASA Research Announcements for Solicited Research Proposals), Sections 13 and 14.

A. EVALUATION FACTORS

The principal elements considered in the evaluation of proposals received in response to this NRA are: **overall scientific/technical value** of the proposed research; **relevance of the proposed activity to the research emphases** defined in this Announcement; and **cost**. In addition, space flight proposals and proposals to utilize special NASA ground-based facilities will be evaluated for the feasibility of actually implementing the proposed projects utilizing the requested flight hardware or ground facilities. The weight assigned to each of these elements is determined by the type of proposal being evaluated. For scientific proposals, overall scientific value will be given the greatest weight, followed by smaller weights for relevance and cost, in that order. For technical proposals, overall technical value and relevance will have approximately equal weight, followed by a smaller weight for cost.

For the purposes of this Announcement, scientific proposals should be differentiated from technical proposals by two characteristics: the underlying objective of the proposal and the method proposed for reaching that objective. Scientific proposals generally have, as their primary objective, the development of new knowledge through the scientific method (i.e., through the development and testing of a scientific hypothesis). Technical proposals, on the other hand, usually have the development of technologies or processes as their primary objective, and propose engineering methods, evaluations, and trade studies to reach their objective. It is the responsibility of each applicant to determine whether their submitted proposal is scientific or technical; NASA reserves the right to reclassify submissions prior to review.

For those proposals for which implementation feasibility is necessary to assess, it will be given a weight equal to that of overall scientific/technical value. Within each of these elements, the following factors are critical to the proposal evaluation and awards selection process:

1. Overall Scientific/Technical Value

- Clarity of the project's objectives;
- Feasibility of the approach and adequacy of the methods and procedures to carry out the proposed project;
- Innovation of the design;
- Originality of the proposed project;
- Likelihood that the proposed project will lead to new discoveries or fundamental advances within its field;
- Likelihood that the proposed project will lead to new technologies that contribute to NASA's mission or to the health and welfare of the American people;
- Familiarity of investigators with the relevant existing technology and published literature;
- Background and documented experience and skills of the investigators as an indication of their ability to accomplish the proposed activity;
- For flight investigations, documented adequacy of maturity of the proposed project (i.e., Is project scientifically/technically ready for flight or is further development required?);
- Availability of the investigators to devote adequate time and effort to the project;
- Adequacy of institutional resources, facilities, and equipment to support proposed project.
- Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.

2. Relevance

- Likelihood that accomplishing the proposed project will contribute meaningfully to progress in at least one of the emphases in this Announcement;
- Impact of the proposed project on programmatic progress in addressing one of the defined emphases of this Announcement.
- Potential that accomplishing the proposed project will significantly enhance the productivity and/or cost effectiveness of ground or space operations.

3. Implementation Feasibility (Not applicable to all proposals)

- Ability to implement the proposed project utilizing the flight and/or ground facilities available.

4. Cost
 - Appropriateness of the budget, including the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

B. EVALUATION TECHNIQUES

Upon receipt, proposals will be reviewed for compliance with the requirements of this Announcement. All compliant proposals, regardless of type, will undergo merit review by a panel of experts. The number of experts required will be determined by the response to this NRA and by the variety of disciplines represented in the proposals relevant to the research emphasis described in Section III of this Appendix. An engineering and technical review will be conducted by an appropriate engineering evaluation team for those proposals that require the determination of the feasibility of implementing the proposed projects utilizing available flight and/or ground facilities. Following these reviews, NASA program managers will prepare a selection plan for each program described in this Announcement. This plan will be based on: (1) the ratings and evaluations of the panels of experts according to the above criteria; and (2) the contribution of each proposal to the development of a sound scientific/technical research program having the appropriate balance of tasks required by the critical research issues confronting the program as determined by the Human Exploration and Development of Space Strategic Plan. This selection plan will be presented by the program managers to the Life Sciences Management Council, a group of senior NASA managers in the space life sciences. Following acceptance of the plan by the Council, selection for funding will be made by the Director of the Life Sciences Division.

VI. PROGRAM MANAGEMENT INFORMATION

A. TYPE OF AWARDS TO BE MADE

The award instrument will be appropriate to the submitting institution. NASA will fund the institution one year at a time. It is expected that such funding will continue for a total period of from one to four years, depending on the proposal requirement, the recommendation of the review panels, and the continuing programmatic contribution of the activity. The number of proposals selected for support will depend on the quality of the proposals received and the availability of funds. However, it is anticipated that approximately 25 awards averaging \$125,000 (total costs) annually will be made, although the total annual cost may vary from \$15,000 to \$350,000. The appropriate program managers of NASA's Life Sciences Division will have a primary role in oversight of these awards, and will be responsible for annually evaluating their progress and out-year plans.

B. ELIGIBILITY

All categories of institutions and scientists are eligible to submit proposals in response to this NRA. Multi-institutional consortium arrangements also are eligible: the applying entity may collaborate with universities, Federal Government laboratories, private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal.

The applying entity must have in place a documented base of ongoing high quality research in science and technology, or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this Announcement. Present or prior support by NASA of research and/or training in any institution or for any investigator is neither a prerequisite to submission of a proposal nor is it a competing factor in the selection process.

C. FOREIGN PROPOSALS

NASA will accept proposals from all countries in response to this Announcement. Proposals from non-U.S. entities should not include a cost plan. Non-U.S. proposals and U.S. proposals that include non-U.S. participation must be endorsed in writing by the respective government agency or funding/sponsoring institution in that country from which the non-U.S. participant is proposing. Such written endorsement should indicate that:

- (1) The proposal merits careful consideration by NASA; and,

- (2) If the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

In addition to sending the original (signed) proposal and twenty (20) copies to NASA through Information Dynamics, Inc., as directed in the next section, **one (1) additional copy along with the Letter of Endorsement must be forwarded to:**

**Ms. Ruth Rosario
IH/Space Flight Division
Ref: NRA 96-OLMSA-XX
NASA Headquarters
Washington, DC 20546-0001
USA**

All proposals must be typewritten in English. **All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S.** Non-U.S. proposals and U.S. proposals that include non-U.S. participation must follow all other guidelines and requirements described in this NRA. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating this Announcement. Copies of these letters will be sent to the sponsoring government agency.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Space Flight Division (Mail Code: IH) will arrange with the non-U.S. sponsoring agency for the proposed participation on a no exchange of funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging its respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

- (1) A letter of notification by NASA; and/or
- (2) An exchange of letters between NASA and the sponsoring governmental agency.

D. PROGRAM REPORTING

Applicants should note that investigators selected from proposals submitted in response to this Announcement will be expected to provide NASA with annual summary information about their projects. This information will consist primarily of an abstract, bibliographic list, copies of publications, and a statement of progress. This information will be made available to the scientific community and will be used to assess the strength of the Division's programs. Note that although this publication

will be made available to the general scientific community, it is not a substitute for traditional scientific reporting in journals and elsewhere.

Investigators selected to carry out space-flight experiments must also provide NASA with two special reports:

1. A “quick-look” report of preliminary flight results that is due one month after the space flight takes place;
2. A final report containing all data and information on the flight study due approximately one year after all required data is provided by NASA to the investigator. At this time, all of the data must also be provided to NASA for placement in the Life Sciences Data Archive; data in this archive will be made available to the scientific community.

Additional information may be required of investigators at the time of their annual funding renewal.

E. DEADLINES

To facilitate proposal processing, potential principal investigators are requested to confirm plans to submit a proposal responding to this Announcement by sending a **letter of intent to propose**, which is not binding, by 4:30 PM EDT, Monday, April 15, 1996. The letter of intent, which should be no more than two pages, should contain:

- The names, addresses, and telephone numbers of a single principal investigator and all co-investigators;
- A title descriptive of the research or technical proposal;
- A brief summary describing the proposed research, indicating clearly the research program(s) defined in this Announcement that are most relevant to the proposal;
- The major participating institutions; and
- Up to six (6) key words that best describe the research area of the pending proposal. Refer to Form B in Appendix E for a list of acceptable key words.

Letters of intent may be submitted through the U.S. Postal Service or commercial delivery services in the same manner as proposals, described below. In addition, letters of intent may be submitted electronically via e-mail or World Wide Web to the following addresses:

E-mail: loi@gm.olmsa.hq.nasa.gov

World Wide Web: <http://www.peer1.idi.usra.edu/>

An original signed proposal, plus twenty (20) complete copies of that proposal, must be received by 4:30 PM EDT, Wednesday, May 15, 1996.

Proposals and letters of intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Information Dynamics, Inc.
SUBJECT: NASA Life Sciences Technology Development
Proposal
300 D Street SW
Suite 801
Washington, DC 20024.

Proposals and Letters of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between the hours of 8:00 AM and 4:30 PM. The telephone number (202) 479-2609 may be used when required for reference by delivery services.

Note that Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or federal holidays.

F. PROPOSAL SCHEDULE

The following schedule is planned for the acquisition of investigations under this Announcement:

- Letter of Intent to Propose Due April 15, 1996
- Proposal Due May 15, 1996
- Selection Announcement October- November 1996
- Initial Funding Available October 1996 - September 1997

VII. BIBLIOGRAPHY

1. **NASA's Enterprise for the Human Exploration and Development of Space: The Strategic Plan.** 1996. Washington, DC: National Aeronautics and Space Administration. *
2. National Aeronautics and Space Administration, Life Sciences Division, Washington, DC 20546. Series of **Discipline Science/Technology Plans** produced by the programs of the Division.*
 - a. **Advanced Life Support Program Plan** (1992).
 - b. **Advanced Life Support Program Requirements** (1996).
 - c. **Controlled Ecological Life Support Systems (CELSS) Program Plan** (1992).
 - o. **Space Human Factors Program Plan**, Space Human Factors Program (1995).
 - p. **Space Human Factors Requirements Definition**, Space Human Factors Program (1996).
 - q. **Space Human Factors Discipline Science Plan**, Space Human Factors Program (1991).
3. National Aeronautics and Space Administration, Life Sciences Division, Washington, DC 20546. Cumulative bibliographies of publications resulting from research supported by the Division.*
 - a. **Space Human Factors Publications: 1980-1990.** 1991. K. J. Dickson (Ed.). NASA Contractor Report 4351. (*NTIS # N9120620 - \$22.00*)
 - b. **Publications of the NASA Controlled Ecological Life Support System (CELSS) Program: 1989-1992.** 1994. J.V. Powers (Ed.). NASA Contractor Report 4603. (*NTIS #N9430122 - \$17.50*)
3. **A Strategy for Space Biology and Medical Science for the 1980s and 1990s.** National Academy of Sciences. National Research Council. Committee on Space Biology and Medicine. Jay M. Goldberg, Committee Chairperson. 1987. Washington, DC: National Academy Press. (*NTIS #N8924024 - \$46.50*)
4. **Assessment of Programs in Space Biology and Medicine.** National Academy of Sciences. National Research Council. Committee on Space Biology and Medicine. 1991. Washington, DC: National Academy Press. (*NTIS #N9313327 - \$19.50*)

5. **Exploring the Living Universe: A Strategy for Space Life Sciences.** National Aeronautics and Space Administration Advisory Council. Life Sciences Strategic Planning Study Committee. Frederick C. Robbins, Committee Chairperson. 1988. Washington, DC: National Aeronautics and Space Administration.*
- 6.. **Space Biology and Medicine: Volume II, Life Support and Habitability.** F. M. Sulzman and A. M. Genin (Eds.). 1994. Washington, DC: American Institute of Aeronautics and Astronautics.
7. **Space Physiology and Medicine, 3rd ed.** A. Nicogossian, C. Huntoon, and S. Pool. (Eds.). 1994. Philadelphia, PA: Lea & Febiger.
8. **Strategic Considerations for Support of Humans in Space and Moon/Mars Exploration Missions.** National Aeronautics and Space Administration Advisory Council. Aerospace Medicine Advisory Council. 1992. Washington, DC: National Aeronautics and Space Administration.*

**Obtaining cited papers:*

Many of the documents may be ordered through your library or through the National Technical Information Service (NTIS). Documents available through NTIS are accompanied by their NTIS order number and price. To order a document through NTIS, call (703) 487-4650. If you are unable to locate a document through this means, please contact Information Dynamics, Inc. at (202) 488-5157.

APPENDIX B

**INSTRUCTIONS FOR RESPONDING TO
NASA RESEARCH ANNOUNCEMENTS
FOR SOLICITED RESEARCH PROPOSALS**

1. FOREWORD

a. NASA depends upon industry, educational institutions and other nonprofit organizations for most of its research efforts. While a number of mechanisms have been developed over the years to inform the research community of those areas in which NASA has special research interests, these instructions apply only to "NASA Research Announcements," a form of "broad agency announcement" described in 6.102(d)(2) and 35.016 of the Federal Acquisition Regulation (FAR). The "NASA Research Announcement (NRA)" permits competitive selection of research projects in accordance with statute while at the same time preserving the traditional concepts and understandings associated with NASA sponsorship of research.

b. These instructions are Appendix I to 18-70.203 of the NASA Federal Acquisition Regulation Supplement.

2. POLICY

a. NASA fosters and encourages the submission of research proposals relevant to agency mission requirements by solicitations, "NASA Research Announcements," which describe research areas of interest to NASA. Proposals received in response to an NRA will be used only for evaluation purposes.

b. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre award synopsis published for individual proposals.

c. A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to

be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

3. PURPOSE

These instructions are intended to supplement documents identified as "NASA Research Announcements." The NRAs contain programmatic information and certain "NRA-specific" requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

4. RELATIONSHIP TO AWARD

a. A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded on the basis of a proposal submitted in response to an NRA. NASA does not have separate "grant proposal" and "contract proposal" categories, so all proposals may be prepared in a similar fashion. NASA will determine the appropriate instrument.

b. Grants are generally used to fund basic research in educational and nonprofit institutions, while research in other private sector organizations is accomplished under contract. Additional information peculiar to the contractual process (certifications, cost and pricing data, facilities information, etc.) will be requested, as necessary, as the procurement progresses. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR Supplement (NHB 5100.4). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NHB 5800. 1).

5. CONFORMANCE TO GUIDANCE

a. NASA does not have any mandatory forms or formats for preparation of responses to NRAs; however, it is requested that proposals conform to the procedural and submission guidelines covered in these instructions. In particular, NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

b. In order to be considered responsive to the solicitation, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting

organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation. NASA reserves the right to reject any or all proposals received in response to an NRA when such action is considered in the best interest of the Government.

6. NRA-SPECIFIC ITEMS

- a. Several proposal submission items will appear in the NRA itself. These include: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information.
- b. Items included in these instructions may be supplemented by the NRA, as circumstances warrant. Examples are: technical points for special emphasis; additional evaluation factors; and proposal length.

7. PROPOSAL CONTENTS

- a. The following general information is needed in all proposals in order to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

b. Transmittal Letter or Prefatory Material

(1) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(2) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(3) Type of organization e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(4) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(5) Identification of any other organizations that are currently evaluating a proposal for the same efforts;

(6) Identification of the specific NRA, by number and title, to which the proposal is responding;

(7) Dollar amount requested of NASA, desired starting date, and duration of project;

(8) Date of submission; and

(9) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

c. Restriction on Use and Disclosure of Proposal Information

It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

d. Abstract

Include a concise (200-300 word, if not otherwise specified in the NRA) abstract describing the objective of the proposed effort and the method of approach.

e. Project Description

(1) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge in the field; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken and an adequate description of experimental methods and procedures. The project description should be prepared in a manner that addresses the evaluation factors in these instructions and any additional specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Note, however, that subcontracting significant portions of a research project is discouraged.

(2) When it is expected that the effort will require more than one year for completion, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should, of course, be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

f. Management Approach

For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and any necessary arrangements for ensuring a coordinated effort should be described. Aspects of any required intensive working relations with NASA field centers that are not logical inclusions elsewhere in the proposal should be described in this section.

g. Personnel

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other

personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

h. Facilities and Equipment

(1) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project.

(2) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for both research and non-research purposes should be explained.

i. Proposed Costs

(1) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all manpower data in terms of man-months or fractions of full-time.

(2) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases. (Standard Form 1411 may be used).

(3) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 18-31 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

j. Security

Proposals should not contain security classified material. However, if the proposed research requires access to or may generate security classified information, the submitter will be required to comply with applicable Government security regulations.

For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date .

k. Special Matters

(1) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(2) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

8. RENEWAL PROPOSALS

a. Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. It is not necessary that a renewal proposal repeat all of the information that was in the original proposal upon which the current support was based. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the proposal are expected to be covered during the period for which extended support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

b. NASA reserves the right to renew an effort either through amendment of an existing contract or by a new award.

9. LENGTH

Unless otherwise specified in the NRA, every effort should be made to keep proposals as brief as possible, concentrating on substantive material essential for a complete understanding of the project. Experience shows that few proposals need exceed 15-20 pages. Any necessary detailed information, such as reprints, should be included as attachments rather than in the main body of the proposal. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments: their availability may be mentioned in the proposal.

10. JOINT PROPOSALS

a. Some projects involve joint efforts among individuals in different organizations or mutual efforts of more than one organization. Where multiple organizations are involved, the proposal may be submitted by only one of them. In this event, it should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

b. Where a project of a cooperative nature with NASA is contemplated, the proposal should describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. However, the proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which purport to specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

11. LATE PROPOSALS

A proposal or modification thereto received after the date or dates specified in an NRA may still be considered if the selecting official deems it to offer NASA a significant technical advantage or cost reduction.

12. WITHDRAWAL

Proposals may be withdrawn by the proposer at any time. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

13. EVALUATION FACTORS

a. Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

b. Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

c. Evaluation of its intrinsic merit includes the consideration of the following factors, none of which is more important than any other:

(1) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(2) The offerors capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(3) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel who are critical in achieving the proposal objectives.

(4) Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.

d. Evaluation of the cost of a proposed effort includes the consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

14. EVALUATION TECHNIQUES

Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases, however, proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house where NASA has particular competence; others are evaluated by a combination of in-house people and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. Regardless of the technique, the final decisions are always made by a designated NASA selecting official. A proposal which is scientifically and programmatically meritorious, but which is not selected for

award during its initial review under the NRA may be included in subsequent reviews unless the proposer requests otherwise.

15. SELECTION FOR AWARD

a. When a proposal is not selected for award, and the proposer has indicated that the proposal is not to be held over for subsequent reviews, the proposer will be notified that the proposal was not selected for award. NASA will notify the proposer and explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

b. When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation with the submitter. Formal RFPs are not used to obtain additional information on a proposal selected under the NRA process. However, the contracting officer may request certain business data and may forward a model contract and other information which will be of use during the contract negotiation.

16. CANCELLATION OF NRA

NASA reserves the right to make no awards under this NRA and, in the absence of program funding or for any other reason, to cancel this NRA by having a notice published in the Commerce Business Daily. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation. Cancellation may be followed by issuance and synopsis of a revised NRA, since amendment of an NRA is normally not permitted.

SPECIAL RESEARCH FACILITIES

This Appendix provides a list of the special research facilities available to investigators for ground research at one of the NASA Field Centers or at other sites. Detailed descriptions of these research facilities can be found in the reference document entitled *Special Research Facilities for Space Life Sciences*. This document is available on the World Wide Web at the following address:

<http://peer1.idi.usra.edu/>

or it may be obtained by calling Information Dynamics, Inc. at
202-488-5157

and requesting a printed copy.

Potential applicants should contact persons identified in those facility description for additional technical information. The cost of using these facilities should be included in any proposal requiring them; such costs should be approved in advance by the contact persons listed there.

AMES RESEARCH CENTER

1. The Vestibular Research Facility (VRF)
 - Ground-based multi-axis centrifuge,
 - 12- Foot linear spring sled,
 - 30- Foot Sled, and
 - Portable linear sled.

2. Human Rated Hypergravity Facilities
 - 20-G Centrifuge,
 - Human-Carrying Rotation Device (HCRD), and
 - Human Powered Centrifuge.

3. Non-Human Hypergravity Facilities
 - 24-Foot Diameter Centrifuge,
 - 8-Foot Diameter Centrifuge, and
 - Hypergravity Facility for Cell Culture (HyFaCC).

4. The Biocomputation Center
- Zeiss 902 Transmission Electron Microscope
 - Workstations for computation, 3-D simulation, and visualization

JOHNSON SPACE CENTER

- The KC-135 "Zero-g" aircraft

BRANDEIS UNIVERSITY

- Slow Rotation Test Facility

GROUND-BASED ACCELERATOR FACILITIES

- Loma Linda University Medical Center (protons with energies between 70 and 250 MeV)
- Alternating Gradient Synchrotron (AGS) at Brookhaven National Laboratory (beams of iron and other heavy nuclei, with energies as low as 1 GeV/nucleon, up to 10 GeV/nucleon)

MICROGRAVITY USER SUPPORT CENTER, KÖLN, GERMANY

- Fast rotating clinostats;
- Cuvette clinostats;
- STATEX hardware;
- BIOLABOR double rack (DARA hardware);
- Low Rotating Centrifuge Microscope (NiZeMi lab model);
- Cultivation chambers for Biorack containers Type I and NiZeMi;
- Different centrifuges including large centrifuge;
- Large-scale Magnetic Resonance device (imaging, microscopy and spectroscopy);
- Tilting microscope;
- Data and image processing capabilities;
- Computer-based fluorescence microscopy (Zeiss Attofluor); and
- Laboratories and sophisticated workshops also for electronics.

FLIGHT EXPERIMENT ACCOMMODATION

This Appendix contains a technical description of the accommodation constraints imposed by the Shuttle middeck on Small Payloads Experiments and of the constraints of the International Space Station on Space Station Early Utilization Experiments. In addition, a list is provided of space-flight equipment that will be available on each platform during the time period covered by this Announcement. Detailed descriptions of the equipment listed below can be found in the reference document entitled *Flight Experiment Hardware for Space Life Sciences*. This document is available on the World Wide Web at the following address:

<http://peer1.idi.usra.edu/>

or it may be obtained by calling Information Dynamics, Inc. at
202-488-5157

and requesting a printed copy.

Applicants may propose to utilize the flight-certified hardware from these lists to implement their experiment or they may propose to utilize their other existing, available hardware. Applicants are not encouraged to propose the development of experiment unique equipment at this time.

I. SHUTTLE MIDDECK ACCOMMODATIONS

The middeck area in the Shuttle Orbiter cabin currently accommodates up to 42 standard middeck storage lockers. Normally, after the primary payloads and support equipment have been defined for a Shuttle flight, up to six middeck lockers remain available for Small Payloads Experiments and other middeck activities. A typical Small Payloads Experiment requires one or two lockers; however, other configurations (e.g., half of a locker) are possible.

A. VOLUME AND STRUCTURAL INTERFACE

A standard locker is 20.3 in deep, 17.3 in wide, and 10.0 in high, and provides two cubic feet of volume. Investigators may use the standard lockers to "stow" their experiments and related equipment or, if necessary, may fabricate similar containers with greater strength or rigidity. Experiments may also be mounted directly to adapter plates that occupy the same bulkhead space as one or two lockers.

B. WEIGHT

A standard middeck experiment is defined as not to exceed 54 pounds when stowed in a single locker. If the experiment is not stowed, and is mounted to adapter plates, the experiment maximum weight is based upon the experiment's center-of-gravity.

C. SAFETY

Because the middeck experiments are carried out inside the crew cabin, safety is of paramount importance. There are stringent requirements concerning flammability, odor, and offgassing of materials used in the Orbiter cabin. Surface touch temperatures of middeck equipment are not to exceed 113° F. Other limitations relate to sharp edges, center of gravity, volume, and protrusion into the cabin area. The specific requirements are established in Shuttle/Payload Interface Definition Document for Middeck Accommodations (refer to NASA document NSTS-21000-IDD-MDK).

D. POWER AND THERMAL (ENVIRONMENTAL)

In the middeck, the Orbiter can provide both 28V DC and 115V AC (although AC power is not available to experiments during ascent) to an experiment. Continuous power (power during Shuttle ascent and descent) may be provided to an experiment, but this resource is extremely limited. An experiment can also provide its own power supply (i.e., alkaline batteries). Maximum power normally available per middeck experiment is 130 watts. Experiments that have a DC power requirement greater than 130 watts will have to compete for a limited number of flight resources.

In the Shuttle middeck area, experiment equipment waste heat is dissipated to the cabin air by means of passive cooling, or forced air cooling (i.e., an experiment provides an air circulation fan). The heat load in a standard locker can be up to 60 watts.

Crew cabin ambient air is 65-80° F under normal operations, and cabin O₂ is 25.9% at 14.7±0.2 psia (cabin pressure). Sometimes, a flight may have extravehicular activity (EVA) procedures; as a result, cabin pressure is reduced to 10.2±0.5 psia, and cabin O₂ is 30.0% maximum. Extremely sensitive samples need to be identified as such so that their location can be considered during the flight definition.

E. ACCESS

Sometimes investigators have a requirement for access to their experiments as close as possible to launch. (For example, to load live specimen such as seedlings, sea urchins, or rodents.) The latest time to have access is up to 14 hours before a Shuttle launch. The critical late access window for a middeck experiment is between 24 and 14 hours before a launch. An experiment turnover occurs before late access installation into the Shuttle middeck. Experiments which can be installed in the middeck as early as possible (i.e., days before a launch) will have an easier time being placed on a mission. Also, if experiments have requirements to retrieve samples as soon as possible after landing, the earliest access is three hours after landing.

F. DATA ACQUISITION

There are no standard provisions for interfacing to the Shuttle data system for real-time data downlink. However, if a tape recorder or computer is needed, it may need to be provided by the user or, depending on the availability of support equipment, from the equipment inventory.

II. LIFE SCIENCES FLIGHT EQUIPMENT FOR SMALL PAYLOADS

The following items are available as flight-qualified hardware for use by applicants proposing Small Payloads Experiments. Since the development and acquisition of flight equipment is a continual process, prior to writing a proposal, potential applicants are advised to contact the Flight Experiments Program Manager (see page 3 of this Announcement) concerning the availability of other equipment not identified below, but required to carry out an investigation in space. **Note: items in this list marked by * may also be proposed to carry out experiments during all phases of early utilization of the International Space Station.**

- BIOLOGICAL RESEARCH IN CANISTERS (BRIC)*
- PLANT GROWTH FACILITY (PGF)
- GLOVEBAG KIT*
- HARVEST KIT
- FIXATIVE KIT*
- CELL CULTURE MODULE (CCM)
- AQUATIC RESEARCH FACILITY (ARF)
- FLIGHT SYRINGE UNIT
- AUTOGENIC FEEDBACK SYSTEM (AFS)*
- AUTOMATIC BLOOD PRESSURE SYSTEM (ABPS)

- ULTRASOUND LIMB PLETHYSMOGRAPH*
- VENOUS OCCLUSION CUFF AND CONTROLLER (VOCC)*
- ECHOCARDIOGRAPH
- INFLIGHT BLOOD COLLECTION SYSTEM (IBCS)
- HEMATOCRIT CENTRIFUGE*
- ORBITER CENTRIFUGE
- URINE MONITORING SYSTEM (UMS)*
- REFRIGERATOR/INCUBATOR MODULE (R/IM)
- TISSUE CULTURE INCUBATOR*
- LOWER BODY NEGATIVE PRESSURE DEVICE (LBNPD)
- ELECTROMYOGRAM (EMG) SIGNAL CONDITIONER*
- ELECTROCARDIOGRAPH SIGNAL CONDITIONER*
- ELECTRO-OCULOGRAPHIC (EOG) SIGNAL CONDITIONER*
- BICYCLE ERGOMETER

III. INTERNATIONAL SPACE STATION ACCOMMODATIONS

Since the both the International Space Station (ISS) and the experiment hardware systems are in development at the present time, some of the constraints defined here may change prior to actual experiment implementation; the constraints provided here are for planning purposes only. The ISS experiment hardware list provided in the next section of this Appendix (section IV) contains a brief technical summary of the known (or expected) equipment constraints associated with conducting research on the International Space Station during the early utilization period (1998-1999). During this period, most of the capability for life sciences research will be housed in the U.S. Laboratory module (US Lab), scheduled for launch in late 1998.

On-orbit resources, such as experiment power, thermal heat rejection, and crew time will be severely constrained in the early utilization time frame. Space Shuttle launch mass for payloads will also be extremely limited. Experiments employing simple, automated protocols designed for specific analyses after return to Earth and limited refrigeration/freezer use will be more likely to be accommodated than those employing complicated protocols. Results from these early operations should be used to develop a foundation for more complex scientific campaigns in the future.

Constraints also exist on the capability of transporting specimens to and from the Space Station. Two primary methods of transporting experiment

specimens and hardware are planned during the early utilization period. The first is transportation of hardware racks, passive (unpowered) experiments, and both passive and conditioned (refrigerated) storage in the Mini Pressurized Logistics Module (MPLM). For example, the incubators are planned to be transported in this carrier. However, access to the MPLM, once integrated into the Shuttle is limited. Frozen materials at -80°C that will be transported in the MPLM must be installed prior to 80 hours before the Shuttle launch. All other payload hardware systems must be transported unpowered.

The second transportation method available is in the Shuttle middeck. Sometimes access to the biological specimens prior to launch is required to be as late as possible to ensure specimen viability. Current planning allows for middeck late access, which must be completed before 14 hours prior to the Shuttle launch for CR/IMs or CCUs as discussed below.

Middeck access to returned samples from orbit is approximately three hours after landing. However, middeck space, as well as the late/early access capability, is limited, and experimenters are encouraged to investigate strategies that allow transport of specimens or media in a dormant or inactive state, and likewise, return preserved specimens in a stable condition. For materials returned within the -80°C freezer in the MPLM, access will be approximately five days following return for a nominal landing at KSC.

IV. SPACE STATION EXPERIMENT HARDWARE (EARLY UTILIZATION)

The following items are available as flight-qualified hardware for use by applicants proposing Space Station Early Utilization experiments. Since the development and acquisition of flight equipment is a continual process, prior to writing a proposal, potential applicants are advised to contact the Flight Experiments Program Manager (see page 3 of this Announcement) concerning the availability of other equipment not identified below, but required to carry out an investigation in space.

Four types of laboratory equipment will be available during the early utilization period of Space Station. First, a limited set of items will be available prior to the first Utilization Flight of the Shuttle (UF-1) (i.e., from May 1998 to February 1999). Beginning with UF-1, three other types of equipment will be available for research use. These types are: generic items, termed Laboratory Support Equipment (LSE), intended for use by a large number of experiments; items contained in the initial configuration of the

Biological Space Research Facility (BSRF); and items contained in the first set of equipment provided for the Human Research Facility (HRF).

A. EARLIEST UTILIZATION PHASE

The following hardware will be available from the initial time that the Space Station is permanently inhabited. Prior to the first Utilization Flight, currently planned for February 1999, this hardware is the only set of Space Station Hardware that will be available for scientific use. Applicants should note that certain items of equipment available for use on the Shuttle middeck may also be used on the International Space Station. These items, described in Section II of this Appendix, are marked by an * in that section; they may be proposed for use during any phase of Space Station activity.

- AEROBIC EXERCISE DEVICE (TREADMILL)
- AEROBIC EXERCISE DEVICE (ERGOMETER)
- RESISTIVE EXERCISE DEVICE (CONCENTRIC AND ECCENTRIC)

B. LABORATORY SUPPORT EQUIPMENT

- COMPOUND MICROSCOPE
- FREEZER (-80° C)
- REFRIGERATOR (4° C)
- CAMERA LOCKER
- FILM LOCKER
- STILL CAMERAS
- 35MM STILL CAMERAS AND ACCESSORIES

C. BIOLOGICAL SPACE RESEARCH FACILITY EQUIPMENT

The following items will be available in the initial outfitting of the Biological Space Research Facility (BSRF):

- COMMERCIAL REFRIGERATOR/INCUBATOR MODULE (CRIM)
- INCUBATOR
- STANDARD INTERFACE GLOVEBOX (SIGB)
- CELL CULTURE UNIT (CCU) (Not available until Utilization Flight 2 in late 1999)

D. HUMAN RESEARCH FACILITY EQUIPMENT

The following items are available at the initial outfitting of the Human Research Facility (HRF) and should be available from the first Utilization Flight, planned for February 1999.

- SAMPLE COLLECTION KITS
- INJECTION AND INFUSION SYSTEMS
- URINE COLLECTION SYSTEM
- HRF PORTABLE COMPUTER
- AMBULATORY DATA ACQUISITION SYSTEM
- PHYSIOLOGICAL SIGNAL CONDITIONER
- ULTRASOUND/DOPPLER FOR ECHOCARDIOGRAPHY, FLOW DETERMINATION, DEEP ORGAN AND MUSCLE/TENDON IMAGING
- BODY MASS MEASUREMENT DEVICE (SLMMD)
- CONCENTRIC, ECCENTRIC, AND ISOMETRIC STRENGTH MEASURING DEVICE
- GAS ANALYZER MASS SPECTROMETER (GASMAP)
- FOOT-GROUND INTERFACE (Flexible capacitors)
- HOLTER MONITOR
- CONTINUOUS BLOOD PRESSURE DEVICE
- PULSE OXIMETER
- LOWER BODY NEGATIVE PRESSURE DEVICE
- RESPIRATORY IMPEDANCE PLETHYSMOGRAPH (RIP)
- HAND-HELD ELECTRONIC LOGBOOK
- VIDEO SYSTEM
- HRF COMPUTER WORKSTATION
- RANGE OF MOTION SYSTEM (GONIOMETER)
- IMMUNIZATION KITS
- MANUAL BLOOD PRESSURE
- HAND GRIP DYNAMOMETER
- ACTIVITY MONITOR
- CENTRIFUGE

**REQUIRED APPLICATION FORMS AND INSTRUCTIONS FOR
PROPOSAL PREPARATION**

Instructions for Proposal Preparation

Form A	Solicited Proposal Application
Form B	Proposal Summary
Form C	Detailed Budget, First Year
Form D	Detailed Budget, Entire Project Period
Form E	Space-Flight Experiment Supplementary Application Information (Optional)
Form F	Certification Regarding Drug-free Workplace Requirements
Form G	Certification Regarding Debarment, Suspension, and Other Responsibility Matters
Form H	Certification Regarding Lobbying
Form I	Checklist for Proposers

INSTRUCTIONS FOR PROPOSAL PREPARATION

The information contained in these instructions is specific to this Announcement and supplements the general guidance provided in Appendix B.

All U.S. proposals should include one copy of each of the forms provided in this Appendix as part of the complete submission, with the exception of Form E that is submitted only with flight experiments. Non-U.S. proposals with no U.S. component are not required to submit Forms C, D, F, G, and H.

The proposal should include the following material, in this order:

- (1) Transmittal Letter;
- (2) Cover Page: Solicited Proposal Application (Form A);*
- (3) Proposal Summary (Form B);
- (4) Detailed Budget, 12 Month (Form C);
- (5) Detailed Budget, Entire Project Period (Form D);
- (6) Proposal Title Page, with Notice on Restriction on Use and Disclosure of Proposal Information, if any;
- (7) Project Description;
- (8) Space-Flight Experiment Supplementary Application Information (to be submitted with flight experiments only) (Form E);
- (9) Management Approach;
- (10) Personnel;
- (11) Facilities and Equipment;
- (12) Supporting Budgetary Information;
- (13) Special Matters (specific information on animal and/or human subjects protocol approval required, if applicable);*
- (14) Certification Regarding Drug-Free Workplace (Form F);*
- (15) Certification Regarding Debarment, Suspension, and Other Responsibility Matters (Form G);*
- (16) Certification Regarding Lobbying (Form H);*
- (17) Computer diskette (3.5 inch, Macintosh or PC format) containing an electronic copy of the principal investigator's name, address, telephone and Fax numbers, e-mail address, and the complete project title and abstract as provided on Form B;
- (18) Checklist for Proposers (Form I); and
- (29) Appendices, if any.

* One signed original required

Except for the Project Description Section, there is no specific page limitation on proposals submitted. However, every effort should be made to keep proposals as brief as possible. The name of the Principal Investigator should appear in the upper right hand corner of each page of the proposal, except on the Forms in this Appendix where special places are provided for this information. Note that the proposal must specify the period of performance for the work described; periods of performance may be for any duration up to four (4) years, but should be suitable for the project proposed.

TRANSMITTAL LETTER

The transmittal letter should contain, at least:

- (1) The legal name and address of the organization and specific division (or campus identification if part of a larger organization) that proposes to carry out the project;
- (2) A brief project title intelligible to a scientifically literate reader and suitable for use in the public press;
- (3) The name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
- (4) The identification of the specific NRA, by number and title, to which the proposal is responding; and
- (5) The signature of the responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization.

A copy of the Checklist for Proposers (Form I) should be attached to this letter. Only one copy of the transmittal letter is required; it should be attached to the single original signature version of the submitted proposal.

COVER PAGE: SOLICITED PROPOSAL APPLICATION (FORM A)

The information on Form A must be filled out completely and one original signature version of this form should be submitted with the transmittal letter above.

For Item (7) on this form, new means that a proposal for this project has not been submitted to NASA in 1994 or 1995, renewal means that this proposal is for the continuation of an already funded task beyond the term of the funded proposal, and revised means that this proposal represents a revision of a proposal submitted to NASA in 1994 or 1995, but not funded. A proposal previously submitted but not funded should be termed revised even if the original principal investigator has changed for 1996. Renewal

and revised applications should contain special material described in the Project Description section, below.

Note that items (9) and (10) on Form A require assurance of compliance with human subject and/or animal care provisions of NASA regulations (see Special Matters section, below). Applicants should be aware that review of a proposal will not be undertaken without prior assurance of compliance.

PROPOSAL SUMMARY (FORM B)

The information requested on this form is essential to the review of the proposal. It determines how the application will be evaluated and which program manager(s) will receive the final review materials for possible inclusion in one of the research programs of the Division. Applicants are requested to classify their proposals as either scientific or technical. Scientific proposals should be differentiated from technical proposals by two characteristics: the underlying objective of the proposal and the method proposed for reaching that objective. Scientific proposals generally have, as their primary objective, the development of new knowledge through the scientific method (i.e., through the development and testing of a scientific hypothesis). Technical proposals, on the other hand, usually have the development of technologies or processes as their primary objective, and propose engineering methods, evaluations, and trade studies to reach their objective.

DETAILED BUDGET, 12 MONTH (FORM C)

DETAILED BUDGET, ENTIRE PROJECT PERIOD (FORM D)

These forms are self-explanatory budget forms that must be submitted with each U.S. proposal, or with non-U.S. proposals that have a U.S. component for which NASA funding is sought.

Foreign proposals with no U.S. component should not submit these forms, but, as explained in Appendix A, should be endorsed in writing by the respective government agency or funding/sponsoring institution in that country from which the non-U.S. participant is proposing. This endorsement should indicate that:

- (1) The proposal merits careful consideration by NASA; and,
- (2) If the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

PROPOSAL TITLE PAGE, WITH NOTICE ON RESTRICTION ON USE AND DISCLOSURE OF PROPOSAL INFORMATION, IF ANY

The title page should contain the project title, name and address of the submitting institution, the name, address and telephone number of the Principal Investigator, and the names and institutions of any co-investigators. It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

PROJECT DESCRIPTION

The length of the Project Description Section of the proposal should not exceed 25 pages using regular (12 point) type. The proposal should contain sufficient detail to enable a reviewer to make informed judgments about the overall merit of the proposed research and about the probability that the investigators will be able to accomplish their stated objectives with the resources requested and with their own resources. In addition, the proposal should indicate clearly the relationship between the proposed

work and the research emphases defined in this Announcement. The project description should be consistent with the type of proposal that is being submitted (ground-based research investigation or space-flight experiment). If an investigator wishes to propose related studies of two different types (e.g., a ground-based research investigation and a related space-flight experiment), then two proposals should be submitted with their linkage described in each proposal.

Renewal applications (for competing renewal of currently funded activity) must include a progress report as an Appendix to the proposal, and should refer to this Appendix appropriately throughout the Project Description section.

Revised applications (revisions of 1994 or 1995 submissions) must include, as part of the Project Description section, an **Introduction** that contains responses to the criticisms in the previous critique. Applicants should highlight the changes they have made in their research plan by appropriate bracketing, indenting, or changing of typography. Clearly present any work done since the prior version was submitted. Note that revised applications that do not address the criticisms in the previous critique and/or include substantial revisions may be penalized in the review process.

SPACE-FLIGHT EXPERIMENT SUPPLEMENTARY APPLICATION INFORMATION (Optional, FORM E)

All applicants proposing space research should fill out Form E. The information on this form is essential for the evaluation of the feasibility of carrying out the proposed study. Before filling out this form, applicants read Appendix D carefully and make certain that they understand the accommodation constraints that are associated with flight experiments. In addition, applicants should utilize available equipment to implement the proposed experiment (as listed in Appendix D), or should provide a low-cost available alternative. Failure to do this may preclude implementation of the experiment.

MANAGEMENT APPROACH

Each proposal must specify a single principal investigator who is responsible for carrying out the proposed project and coordinating the work of other personnel involved in the project. In proposals that designate several senior professionals as key participants in the research project, the management approach section should define the roles and responsibilities of each participant, and note the proportion of each

individual's time to be devoted to the proposed research activity. The proposal should state clearly and unambiguously whether these key personnel have reviewed the proposal and endorsed their participation.

PERSONNEL

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator that includes his/her current position title, educational background, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

FACILITIES AND EQUIPMENT

Describe the available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project. Provide evidence that such facilities or equipment will be made available if the applicant is successful in obtaining funding. Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for both research and non-research purposes should be explained.

SUPPORTING BUDGETARY INFORMATION

This section should include the supporting information required by Forms C and D. In this NRA, the terms "cost" and "budget" are used synonymously. Sufficient proposal cost detail and supporting information will facilitate a speedy evaluation and award. Dollar amounts proposed with no explanation (e.g., Equipment: \$1,000, or Labor: \$6,000) may cause delays in evaluation and award. Generally, NASA will evaluate costs

as to reasonableness, allowability, and allocatability. The budgetary forms define the desired detail, but each category should be explained in the body of the proposal. Offerors should exercise prudent judgment in determining what to include in the proposal, as the amount of detail necessarily varies with the complexity of the proposal.

The following examples indicate the suggested manner to prepare a cost breakdown.

Direct Labor

Labor costs should be segregated by titles or disciplines with estimated hours and rates for each. Estimates should include a basis of estimate such as currently paid rates or outstanding offers to prospective employees. This format allows the Government to assess cost reasonableness by various means including comparison to similar skills at other organizations. Example:

	<u>Hours</u>	<u>Rate</u>	<u>Amount</u>
Principal Investigator	100	\$19.34	\$1,934
Co-Investigator	450	\$11.78	\$5,301
Clerical Support	<u>75</u>	<u>\$ 8.70</u>	<u>\$ 652</u>
Total	625		\$7,887

Indirect Costs

Indirect costs should be explained to an extent that will allow the Government to understand the basis for the estimate. Examples of prior year historical rates, current variances from those rates, or an explanation of other basis of estimates should be included. Where costs are based on allocation percentages or dollar rates, an explanation of rate and application base relationships should be given. For example, the base to which the General and Administrative (G&A) rate is applied could be explained as: application base equals total costs before G&A less subcontracts.

Other Costs

Each significant cost category should be detailed, explained, and substantiated such as travel. Past experience has indicated that up to six trips may be necessary for a flight experiment. (i.e., Crew

Familiarization (Johnson Space Center, JSC), pre-flight Science Verification Test (Kennedy Space Center, KSC), L-14 day Press Briefing (JSC), Mission Preparation/Operations (KSC), Post-Flight Ground Control (KSC), Post-Flight Results Symposium). Format should be as follows:

Travel Costs

<u>Destination</u>	<u>Duration</u>	<u>Airfare</u>	<u>Per Diem</u>	<u>Total</u>
Moffett Field, CA	3 days	\$500	\$300	\$800
Washington, DC.	1 day	\$500	\$100	\$600
Total				\$1,400

If the proposal is for competitive renewal of an ongoing research effort beyond the present period of approval, the proposal cost section should include an estimate of any significant amount of unspent or uncommitted funds remaining at the completion of the current period of performance.

The supporting budgetary information section of the proposal should include information concerning other current projects being conducted by the Principal Investigator and funded either by NASA or any other Government agency.

Provide the title of project, the sponsoring agency, the project period, the investigator's time commitment, and the value of the project. The following format is recommended:

Funding Organization	Title	Number	Total Project		
			Period	Total Effort	Direct Costs
NIH	Bone Mineralization	R01 NS 01234-06	12/89-11/94	30%	\$100,000
NSF	Osteosclerosis	DRF 7683-05	6/90-5/93	10%	\$20,000

SPECIAL MATTERS

The "Special Matters" section must contain a statement from the proposer's institution which states that the proposed work will meet all Federal and local human subject requirements and animal care and use requirements, if applicable. Note that no animal subjects may be utilized unless specific information justifying and describing their use is included in the proposal. Policies regarding the protection of human research subjects in NASA sponsored research are detailed in NASA Management Instruction (NMI)

7100.8B (Protection of Human Research Subjects), and animal care and use requirements are detailed in the NASA Code of Federal Regulations (CFR) 1232 (Care and Use of Animals in the Conduct of NASA Activities), both of which are available from the Life Sciences Division, Code UL, NASA Headquarters, Washington, DC 20546. Assurance of compliance with human subject and/or animal care provisions is required on Form A, to be submitted with each proposal. In addition, a letter signed by the chairperson of the Institutional Review Board (IRB) or institutional Animal Care and Use Committee (ACUC) or both, as appropriate, regarding approval of the experimental protocol, should be included with each copy of the proposal. All non-NASA proposals providing ACUC approval must also contain the institution's Public Health Assurance number. Applicants should note that this is a strong requirement: **Review of the proposal will not be undertaken until this information is supplied to NASA.**

NASA is a participating agency for the “Presidential Early Career Awards for Scientists and Engineers.” NASA will select its Awardees based on exceptionally meritorious proposals funded through the traditional grants process, including this NRA. Awardees must be U.S. citizens, nationals, or permanent residents who have received their highest degree within five years. Applicants should indicate in the Special Matters section that they are eligible and wish to be considered for the award. For additional information about the “NASA Presidential Early Career Awards for Scientists and Engineers” contact the Chief Scientist, NASA Headquarters, 300 E Street, S.W., Washington, D.C. 20546.

CERTIFICATION REGARDING DRUG-FREE WORKPLACE (FORM F); CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS (FORM G); and CERTIFICATION REGARDING LOBBYING (FORM H)

These three certifications are required of all U.S. applicants before a grant/contract can be awarded. They are not required of foreign proposals with no budget section.

COMPUTER DISKETTE (3.5 INCH, MACINTOSH OR PC FORMAT)
CONTAINING AN ELECTRONIC COPY OF THE PRINCIPAL
INVESTIGATOR'S NAME, ADDRESS, TELEPHONE AND FAX
NUMBERS, E-MAIL ADDRESS, AND THE COMPLETE PROJECT
TITLE AND ABSTRACT AS PROVIDED ON FORM B

Self-explanatory.

CHECKLIST FOR PROPOSERS (FORM I)

One copy of a completed version of this checklist should be attached to the transmittal letter.

APPENDICES, IF ANY

Renewal applications (for competing renewal of currently funded activity) must include an Appendix providing a Progress Report of the previously funded activity. That report should give the beginning and ending dates for the period covered since the project was last reviewed competitively and provide a list of all personnel who have worked on the project during this period (including dates of service and percentages of their appointments devoted to the project). The report should also summarize the previous project's original goals and specific objectives and provide a succinct account of published and unpublished results indicating progress toward their achievement. Changes in these objectives during the course of the project and a rationale for these changes should be presented. The importance of the findings should be summarized and discussed. Finally, a list should be provided of the titles and complete references to all publications, manuscripts submitted or accepted for publication, patents, invention reports, and other printed materials that have resulted from the project since it was last competitively reviewed.

Other Appendices may be appropriate for particular proposals.

FORM A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
 OFFICE OF LIFE & MICROGRAVITY SCIENCES & APPLICATIONS
 LIFE SCIENCES DIVISION

SOLICITED PROPOSAL APPLICATION
 PLEASE FOLLOW INSTRUCTIONS CAREFULLY

LEAVE BLANK

NUMBER

REVIEW GROUP

DATE RECEIVED

1. COMPLETE TITLE OF PROJECT

2. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR *(First, middle, and last name; degrees; position title)*

3. COMPLETE MAILING ADDRESS

*Internal Mail Code or Location
 Office or Organization Division
 Agency/Center, Company, or Institution
 Street or P.O. Box
 City, State, Zip Code*

4. TELEPHONE NUMBER
(area code, number, extension)

FAX NUMBER
 E-MAIL ADDRESS

5. CONGRESSIONAL DISTRICT

6. SOCIAL SECURITY #

7. IS THIS PROPOSAL NEW RENEWAL REVISED

8. HAS THIS PROPOSAL (OR SIMILAR REQUEST) BEEN SUBMITTED TO NASA OR ANY OTHER AGENCY?
 No Yes IF YES, SPECIFY AGENCY AND YEAR SUBMITTED:

9. HUMAN SUBJECTS

9a. No Yes

9b. EXEMPTION # OR IRB APPROVAL DATE _____

9c. Assurance of Compliance # _____

10. VERTEBRATE ANIMALS

10a. No Yes

10b. ACUC Approval Date _____

10c. PHS Animal Welfare Assurance # _____

11. DATES OF ENTIRE PROPOSED PROJECT PERIOD

From:
 Through:

12. COSTS REQUESTED FOR FIRST 12-MONTH BUDGET PERIOD

12a. Direct Costs \$
 12b. Total Costs \$

13. COSTS REQUESTED FOR ENTIRE PROPOSED PROJECT PERIOD

13a. Direct Costs \$
 13b. Total Costs \$

14. APPLICANT ORGANIZATION *(Organization Name)*

15. TYPE OF ORGANIZATION

Non Profit For Profit *(General)* For Profit *(Small Business)* Public, Specify: Federal State Local

16. ORGANIZATION OFFICIAL TO BE NOTIFIED IF AN AWARD IS MADE *(Name, title, address and telephone number)*

17. OFFICIAL SIGNING FOR APPLICANT ORGANIZATION *(Name, title, and telephone number)*

18. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSURANCE:
 I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if a grant is awarded as a result of this application. Willful provision of false information is a criminal offense (U.S. Code, Title 18, Section 1001).

SIGNATURE OF PERSON NAMED IN 2
(In ink "Per" signature not acceptable.)

DATE

19. CERTIFICATION AND ACCEPTANCE: I certify that the statements herein are true and complete to the best of my knowledge, and accept the obligation to comply with NASA terms and conditions if a grant is awarded as the result of this application. A willfully false certification is a criminal offense (U.S. Code, Title 18, Section 1001).

SIGNATURE OF PERSON NAMED IN 17
(In ink "Per" signature not acceptable.)

DATE

FORM B

PROPOSAL SUMMARY

Principal Investigator: _____

Co- Investigators: _____

Proposal Title: _____

Proposal Type:
SCIENTIFIC PROPOSAL _____ **OR** **TECHNICAL PROPOSAL** _____

_____ **GROUND-BASED RESEARCH**

OR

_____ **SPACE-FLIGHT EXPERIMENT**
_____ **SMALL PAYLOADS**
_____ **SPACE STATION EARLY UTILIZATION**

Program Applicability

{Place a single check in the "Primary Area" column next to the program that is most closely aligned with your proposal. Optional: Place a check in the "Secondary Area" column **if** your proposal has a dual-program emphasis}

	<u>Primary Area</u>	<u>Secondary Area</u>
SPACE HUMAN FACTORS	_____	_____
ADVANCED LIFE SUPPORT	_____	_____
ADVANCED ENV. MONITORING & CONTROL	_____	_____
DATA ANALYSIS	_____	_____

Abstract:

{Prepare a brief description of the application stating the broad, long-term objectives and specific aims of the proposed work, making reference to the relevance of this work to NASA's mission as described in the NRA. Describe concisely the research design and methods for achieving these objectives and aims. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from this application. Use separate page; limit to 300 words.}

Key Words:

{Assign numbers (1- highest relevance, 3-moderate relevance) to the areas that best describe your proposed research. Choose a maximum of three areas}

- | | | |
|---|--|-----------------------------|
| __ Neuroscience | __ Spacecraft Systems and Hardware | __ Developmental Physiology |
| __ Sensorimotor Integration | __ Space Suit Design | __ Genetics |
| __ Behavior | __ EVA/IVA Physiology | __ Cellular Genetics |
| __ Human Factors Studies | __ Radiation | __ Plant Genetics |
| __ Skeletal System | __ Advanced Life Support | __ Plant Development |
| __ Muscle Physiology | __ Fluid and Electrolyte Homeostasis | __ Plant Growth |
| __ Immunology | __ Regulatory Physiology | __ Plant Propagation |
| __ Cardiopulmonary Physiology | __ Cell Biology | __ Molecular Biology |
| __ Physico-Chemical Air/Food/Water Regeneration | __ Intra- and Inter-Cellular Communication | __ Reproductive Physiology |
| | | __ Other |

FORM C

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: _____

DETAILED BUDGET FOR 12-MONTH BUDGET PERIOD DIRECT COSTS ONLY		FROM	THROUGH		
Duplicate this form for each year of grant support requested		DOLLAR AMOUNT REQUESTS <i>(Omit cents)</i>			
PERSONNEL <i>(Applicant Organization Only)</i>		EFFORT ON PROJECT	SALARY	FRINGE BENEFITS	TOTALS
NAME	ROLE IN PROJECT				
	Principal Investigator				
SUBTOTALS →					
CONSULTANT COSTS					
EQUIPMENT <i>(Itemize, use additional sheet if needed)</i>					
SUPPLIES <i>(Itemize by category, use additional sheet if needed)</i>					
TRAVEL	DOMESTIC				
	FOREIGN				
OTHER EXPENSES <i>(Itemize by category, use additional sheet if needed)</i>					
TOTAL DIRECT COSTS FOR FIRST 12-MONTH BUDGET PERIOD <i>(Item 12a, Form A)</i>				\$	
INDIRECT COSTS FOR FIRST 12-MONTH BUDGET PERIOD				\$	
TOTAL COSTS FOR FIRST 12-MONTH BUDGET PERIOD <i>(Item 12b, Form A)</i>				\$	

FORM D

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: _____

BUDGET FOR ENTIRE PROJECT PERIOD DIRECT COSTS ONLY

BUDGET CATEGORY TOTALS		1st BUDGET PERIOD	ADDITIONAL YEARS OF SUPPORT REQUESTED		
			2nd	3rd	4th
PERSONNEL (Salary and Fringe Benefits) (Applicant organization only)					
CONSULTANT COSTS					
EQUIPMENT					
SUPPLIES					
TRAVEL	DOMESTIC				
	FOREIGN				
OTHER EXPENSES					
TOTAL DIRECT COSTS FOR EACH BUDGET PERIOD		\$	\$	\$	\$
TOTAL INDIRECT COSTS FOR EACH BUDGET PERIOD		\$	\$	\$	\$
TOTAL DIRECT + INDIRECT COSTS FOR EACH PERIOD		\$	\$	\$	\$
TOTAL DIRECT + INDIRECT COSTS FOR ENTIRE PROJECT					\$

JUSTIFICATION FOR UNUSUAL EXPENSES (Detail Justification in Cost Section of Proposal)

FORM E

SPACE-FLIGHT EXPERIMENT SUPPLEMENTARY APPLICATION FORM

The following form should be completed by all investigators proposing flight experiments. This form should be inserted into the Project Description section of the proposal. (Provide responses on additional sheets, as necessary.)

Principal Investigator _____

Proposal Title _____

Type of Flight Experiment: **Small Payloads** **Space Station Early Utilization**

- (1) List major hardware items required in this investigation. Hardware available is listed in Appendix D.
- (2) List any additional hardware required in this investigation. This includes any Experiment Unique Equipment (EUE) that needs to be developed.
- (3) Estimate number of middeck lockers needed to accommodate proposed experiment volume if not using hardware listed in Appendix D.
- (4) Estimate access time
 - a) Is late access needed and when?(i.e., do you need to load the experiment and/or species within a certain time period before a launch?)
 - b) Is early removal needed and when? (i.e., do you need to remove the experiment and/or species within a certain time period after landing? If so, please specify requirement.)
- (5) Identify potentially hazardous materials, including biowaste.
- (6) Are there any specific conditions requested (e.g., air composition, humidity, thermal, illumination, inflight observations)?
- (7) For Space Station experiments, estimate the maximum and minimum number of days of microgravity exposure required.
- (8) Estimate the total set of operations required to carry out the experiment in space (e.g., the number of sessions of crew activity and the time required for each session).
- (9) Estimate amount of time for crew participation with experiment before, during and after flight (e.g., data collection, crew training, etc.)

Responses (continue on additional sheets):

FORM F

CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS

This certification is required by the regulations implementing the Drug-Free Workplace Act of 1988, 34 CFR Part 85, Subpart F. The regulations, published in the January 31, 1989 Federal Register, require certification by grantees, prior to award, that they will maintain a drug-free workplace. The certification set out below is a material representation of fact upon which reliance will be placed when the agency determines to award the grant. False certification or violation of the certification shall be grounds for suspension of payments, suspension or termination of grants, or government-wide suspension or debarment (see 34 CFR Part 85, Sections 85.615 and 85.620).

I. GRANTEES OTHER THAN INDIVIDUALS

A. The grantee certifies that it will provide a drug-free workplace by:

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing a drug-free awareness program to inform employees about
 - (1) The dangers of drug abuse in the workplace;
 - (2) The grantees policy of maintaining a drug-free workplace;
 - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will
 - (1) Abide by the terms of the statement; and
 - (2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five days after such conviction;
- (e) Notifying the agency within ten days after receiving notice under subparagraph (d) (2) from an employee or otherwise receiving actual notice of such conviction;
- (f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d) (2), with respect to any employee who is so convicted
 - (1) Taking appropriate personnel action against such an employee, up to and including termination; or
 - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or Local health, Law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e), and (f).

B. The grantee shall insert in the space provided below the site(s) for the performance or work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

Check if there are workplaces on file that are not identified here.

II. GRANTEES WHO ARE INDIVIDUALS

The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance in conducting any activity with the grant.

Organization Name AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Principal Investigator Name Proposal Title

FORM G

**CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS**

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participants' responsibilities. The regulations were published as Part VII of the May 28, 1988 Federal Register (pages 19160-19211). Copies of the regulations may be obtained by contacting the U.S. Department of Education, Grants and Contracts Service, 400 Maryland Avenue, S.W. (Room 3633 GSA Regional Office Building No. 3), Washington, D.C. 20202-4725, telephone (202) 732-2505.

A. The applicant certifies that it and its principals:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three-year period preceding this application been convicted or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification; and
- (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lowered Tier Covered Transactions (Subgrants or Subcontracts)

- (a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.
- (b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Principal Investigator Name Proposal Title

FORM H

**CERTIFICATION REGARDING
LOBBYING**

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over \$100,000, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, an or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Organization Name

AO or NRA Number and name

Printed Name and Title of Authorized Representative

Signature

Date

Printed Principal Investigator Name

Proposal Title

FORM I

CHECKLIST FOR PROPOSERS

The following Checklist should be enclosed with the transmittal letter and annotated to indicate that the stated items have been included in the proposal package.

Principal Investigator/Program Director _____

<input type="checkbox"/> Form A: Solicited Proposal Application*	<input type="checkbox"/> Facilities and Equipment
<input type="checkbox"/> Form B: Proposal Summary	<input type="checkbox"/> Supporting Budgetary Information (include current support: list of other funded projects)
<input type="checkbox"/> Form C: Detailed 12 month Budget (First year of support)	<input type="checkbox"/> IRB or ACUC letter/ form regarding protocol approval, if applicable*
<input type="checkbox"/> Form D: Summary Budget Form	<input type="checkbox"/> Form F: Certification Regarding Drug-Free Workplace*
<input type="checkbox"/> Title Page	<input type="checkbox"/> Form G: Certification Regarding Debarment, Suspension, and Other Responsibility Matters*
<input type="checkbox"/> Project Description	<input type="checkbox"/> Form H: Certification Regarding Lobbying*
<input type="checkbox"/> Form E: Space-Flight Exp. Supplementary Information, if applicable	<input type="checkbox"/> Appendices, if any
<input type="checkbox"/> Management Approach	<input type="checkbox"/> 20 copies of all material listed above
<input type="checkbox"/> Personnel, Cvs; Biographical Summaries	<input type="checkbox"/> 3.5 inch computer diskette containing PI's name, address, complete project title and abstract

*One signed original form required.

Only one copy of the following materials needs to be submitted:

<input type="checkbox"/> Transmittal Letter
<input type="checkbox"/> Form I: This checklist indicates all items have been enclosed

NASA Research Announcement (NRA) Mailing List Update

This is the form to update information for the NASA Office of Life & Microgravity Sciences & Applications (OLMSA) NRA mailing list. Please fill out CONTACT INFORMATION completely. Check only those that apply in INSTITUTION TYPE and PROGRAM AREAS/DISCIPLINES. Fold the form, secure with tape (do not staple), and mail it back to the address on the reverse side. Proper postage must be applied.

Mailing list updates may also be submitted electronically via E-Mail or World Wide Web to the following addresses:

E-Mail: loi@hq.nasa.gov

World Wide Web: <http://peer1.idi.usra.edu/>

Check one:

- | | |
|---|---|
| <input type="checkbox"/> 1. Please add my name to the mailing list. | <input type="checkbox"/> 3. Please change my current listing (please attach mailing label). |
| <input type="checkbox"/> 2. Please remove my name from the mailing list (please attach mailing label). | <input type="checkbox"/> 4. Please leave my current listing unchanged (please attach mailing label). |

Contact Information

If your address has changed or your mailing label is incorrect, please provide COMPLETE contact information.

Prefix: (Mr., Mrs., Ms., Dr., Prof., etc.)	Suffix: (M.D., Ph.D., Jr., III, etc.)
Name, First:	Last:
Position Title:	
Mail Code, Loc:	
Office, Dept, Div:	
Org (Agency/Ctr, Univ):	
Street or PO Box:	
City:	State:
Zip Code:	Country:
Telephone No:	Fax No:
Internet/E-Mail:	

Institution Type

(check all that apply)

- | | | |
|--|---|---|
| <input type="checkbox"/> 1. College or University | <input type="checkbox"/> 4. NASA Center | <input type="checkbox"/> 7. Small Business |
| <input type="checkbox"/> 2. Minority College or University | <input type="checkbox"/> 5. Other Government Agency | <input type="checkbox"/> 8. Private Industry |
| <input type="checkbox"/> 3. Minority Business | <input type="checkbox"/> 6. Nonprofit Corporation | <input type="checkbox"/> 9. Foreign Addressee |

Program Areas/Disciplines

(check main area of interest)

- | | | |
|---|--|---|
| <input type="checkbox"/> 1. Life Sciences
<input type="checkbox"/> A. Advanced Life Support
<input type="checkbox"/> B. Advanced Technology Development
<input type="checkbox"/> C. Data Analysis
<input type="checkbox"/> D. Environmental Health | <input type="checkbox"/> E. Space Biology
<input type="checkbox"/> F. Space Human Factors
<input type="checkbox"/> G. Space Physiology & Countermeasures
<input type="checkbox"/> H. Space Radiation Health | <input type="checkbox"/> 2. Microgravity Sciences
<input type="checkbox"/> A. Biotechnology
<input type="checkbox"/> B. Combustion Science
<input type="checkbox"/> C. Fluid Physics
<input type="checkbox"/> D. Materials Science
<input type="checkbox"/> E. Microgravity Physics |
|---|--|---|

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