

# Interagency Opportunities in Multi-Scale Modeling in Biomedical, Biological, and Behavioral Systems

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## Program Solicitation

NSF 04-607



### National Science Foundation

Directorate for Engineering

Division of Bioengineering and Environmental Systems

Division of Civil and Mechanical Systems

Division of Chemical and Transport Systems

Division of Design, Manufacture and Industrial Innovation

Division of Electrical and Communications Systems

Directorate for Computer and Information Science and Engineering

Division of Shared Cyberinfrastructure

Directorate for Mathematical and Physical Sciences

Division of Mathematical Sciences



### National Institutes of Health

National Institute of Biomedical Imaging and Bioengineering

National Cancer Institute

National Institute of Child Health and Human Development

National Institute on Drug Abuse

National Institute of Environmental Health Sciences

National Institute of General Medical Sciences

National Institute of Neurological Disorders and Stroke

National Library of Medicine



### National Aeronautics and Space Administration

Bioastronautics Research Division



### U.S. Dept. of Energy

Office of Science, Office of Biological and Environmental Research

Office of Science, Office of Advanced Scientific Computing Research

## Letter of Intent Due Date(s) (*required*):

September 22, 2004

## Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):

November 09, 2004

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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#### Program Title:

Interagency Opportunities in Multi-Scale Modeling in Biomedical, Biological, and Behavioral Systems

#### Synopsis of Program:

The intent of this solicitation is to provide an opportunity for an interagency granting activity to promote the development and dissemination of tools to enhance computational modeling of biological, biomedical and behavioral sciences at multiple scales ranging from the molecular to population. Multiple agencies are providing research funding in support of this solicitation.

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#### Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.070 --- Computer and Information Science and Engineering
- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences

#### Eligibility Information

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- **Organization Limit:** None Specified.
- **PI Eligibility Limit:** None Specified.
- **Limit on Number of Proposals:** None Specified.

#### Award Information

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- **Anticipated Type of Award:** Standard or Continuing Grant
- **Estimated Number of Awards:** 20
- **Anticipated Funding Amount:** \$15,000,000 total, subject to availability of funds and quality of proposals

#### Proposal Preparation and Submission Instructions

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##### A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Full Proposal Preparation Instructions:** This solicitation contains information that supplements the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

##### B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required.
- **Indirect Cost (F&A) Limitations:**

No limitation for NSF awards. Other participating agencies may have indirect cost limitations.

- **Other Budgetary Limitations:** Not Applicable.

#### C. Due Dates

- **Letters of Intent (*required*):**  
September 22, 2004
- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):  
November 09, 2004

#### Proposal Review Information

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- **Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

#### Award Administration Information

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- **Award Conditions:** Additional award conditions apply. Please see the full text of this solicitation for further information.
- **Reporting Requirements:** Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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## I. INTRODUCTION

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With recent advances in information technology—fast and inexpensive computer power, global networking infrastructure, and comprehensive databases--modeling and simulation are becoming increasingly important engineering tools. Major biology oriented modeling activities are now supported at most federal agencies under titles such as “Computational Biology,” “Bioinformatics,” “Quantitative Systems Biology,” “Biocomplexity,” “Modeling at the Nanoscale”, etc. For the most part, these efforts have focused at a single level/scale, e.g., genomic/proteomic, cellular, tissue, organ, organ system, whole body, behavior, and population. Less is being done to develop the tools, techniques, algorithms, and mathematical theory needed to integrate the continuum from the micro to the macro-scale in a seamless fashion. Multi-scale modeling encompasses concepts of space, time and state space. The different scales may be connected through parameters or coupling coefficients or by using novel numerical methods such as implicit solvers.

Systems engineering encourages a non-reductionist approach to model development, beginning with the simplest possible model. The modeling process itself brings about an understanding of the underlying structures, as components are modeled with mathematical and statistical concepts. The minimal model then grows in complexity, driven by new hypotheses that may not have been apparent from the phenomenological descriptions. The complexity is still minimalist, incorporating only the necessary components for enhancing the next level of model resolution. Multi-scale algorithms are expected to present unique problems for validation against data and observations. The constitutive model parameters may be measured directly or may be inferred during the validation process, however, the propagation of error through these parameters present significant challenges for the modeler. As well, the determination of conservation principles between scales requires a robust integration of theory with model design.

This solicitation describes a collaborative effort among the National Science Foundation (CISE, ENG, MPS), the National Institutes of Health (NIBIB, NICHD, NIDA, NIGMS, NINDS, NCI, NLM, NIEHS), the National Aeronautics and Space Administration and the U. S. Department of Energy (BER, ASCR).

The intent of this interagency solicitation is to encourage the integrative systems engineering approach to multi-scale modeling, combining theoretical and computational approaches to:

- 1) Formulate and validate novel computational and statistical methods and relationships for spanning multiple scales,
- 2) Discover and/or investigate intermediate levels of organization above and below the currently established level of modeling expertise,
- 3) Form novel collaborations among the research community focused on expanding the breadth of multi-scale modeling activities,
- 4) Produce models applicable to biological processes, diseases, environmental exposures and human behavior patterns that can be tangibly demonstrated to be of practical utility to the community at large for research or educational purposes,
- 5) Form a Consortium of Investigators for the purposes of information exchange, encouraging model intraoperability, model demonstration and evaluation, and discussion of critical issues pertaining to multi-scale modeling, and
- 6) Form a platform for open source software sharing.

This initiative builds upon discussions and outcomes from several workshops and working groups on modeling. In April 2003, the NIBIB organized a working group comprised of program staff from 9 NIH institutes and 3 NSF directorates. The Interagency Modeling and Analysis Group (IMAG) recognized that the modeling community is on the forefront of thinking across the biological continuum, rather than just focusing at one scale or level of resolution. In addition IMAG identified a strong desire among modelers to form multi-disciplinary partnerships across varied research communities. The group has continued to meet and has grown to the IMAG, representing 13 NIH components, 4 NSF directorates, NASA, 2 DOE components, 2 DOD components and USDA . Several extramural workshops have addressed these issues:

- NRC report on Dynamical Modeling of Complex Biomedical Systems (April 2001),
- Digital Human Project Unified Ontology Planning Meeting (NSF, July 2002, <http://www.fas.org/dh/conferences/paper.php> ),
- Data and Collaboratories in the Biomedical Research Community (NCRR, September 2002),
- BISTIC Roadmap Meeting (NIH, January 2003),
- Data Management for Cell and Molecular Biology (NLM-NSF-DOE, February 2003, <http://pueblo.lbl.gov/~olken/wdmbio> ),
- Model Systems for Neuroproteomics (NIDA, March 2003),
- Digital Human/Digital Astronaut Planning Meeting (August 2003),
- Information Processing in the Biological Organism (A Systems Biology Approach) (NSF, November 2003, <http://dimacs.rutgers.edu/Workshops/InfoProcess>),
- 1st BISTIC symposium (NIH, November 2003, <http://www.bisti.nih.gov/2003meeting/>),
- Workshop on Simulation Based Engineering Science (NSF, April 2004),
- A Workshop on Transport Processes in Biomedical Systems (NSF-NIBIB, May 2004, <http://www.psava.com/cts2004/intro.asp>).
- DOE Multiscale Mathematics Workshop (DOE, May 2004, <http://www-fp.mcs.anl.gov/multiscale-workshop> ).

## II. PROGRAM DESCRIPTION

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Multi-scale modeling deals with spanning scales from molecular to population and is expected to largely impact the understanding of biological processes and also further the predictive capability in biological, biomedical and environmental systems. This is a nascent research effort in biology; hence the modeling research that will be supported under this initiative must have an impact on systems at least on two levels of scale. **It is expected that:**

- 1) Proposals will include establishing new collaborations between computational and/or modeling experts who have traditionally focused their models on the same system, but at different scales; or collaborations between computational and/or modeling experts and experimentalists currently working on a single experimental scale but for whom a multi-scale approach would be an appropriate complement to their ongoing research,
- 2) New and novel theories and modeling approaches will be developed to bridge across scales, and
- 3) The development of the multi-scale model will bring about new understanding of a system that would not have otherwise been achieved without the model.

Examples are, but are not limited to:

- Multi-scale molecular function from electronic structure to kinetics
- From genotype to pathways to phenotype
- Reaction-diffusion systems to cell function
- Physiological and organ models that bridge scales from continuum macroscopic description to discrete molecular phenomena
- 3D multi-scale modeling of complexity in engineered tissues
- From genes to microbes to microbial communities
- Mesoscale methods to bridge conventional modeling and imaging techniques at microscales with those at macroscales

- Multiscale models that use small animal imaging techniques and data to infer large scale function in humans
- Multiscale models that explore the heterogeneity within time and length scales, across state-space in relation to predicting disease
- Methods for making the connection between continuum macroscale models (e.g., fluid) and discrete molecular phenomena (e.g., molecular behavior)
- Decision-making by combining real-time data with multi-scale modeling
- Machine-mediated health-care delivery
- Algorithmic tools for multi-scale modeling systems using optimization and simulation in time and space  
Mechanics and materials aspects on multi-scale modeling
- Pathways and networks for molecular interactions within and between cells and nanotools for measuring them
- Organ scale field and flow measurements coupled to injury and to molecular expression and activity (coupling of field effects to molecular effects)
- Simulation-based medicine modeled across multiple time and length scales for patient-specific treatment planning
- Transport of small molecules, macromolecules, viruses and cells across the vascular barrier, through the tissue, into interstitial cells and into the nucleus and into lymphatics
- More effective representation of the energetics of blood perfusion (for example, replacement of the Pennes equation for thermal analysis of biological tissue)
- Better links between cellular transport processes and macroscopic thermal transport for cryogenic preservation and cryotherapies
- Studies addressing the valuation of expected utility across behavioral, neural and economic models at various levels
- Model reduction and systems identification methods for uncertain multi-scale dynamical systems
- Multi-scale modeling of cell to cell communication and controls
- Multi-scale models that link integrated physiological, organ and tissue models to large-scale state changes induced by environmental perturbations

IMAG has agreed that the NSF format and review criteria as described in the NSF Grant Proposal Guide (GPG) and the multiple agency (NIH, NASA and DOE) review criteria as described in Section VI of this solicitation will be used. PIs are strongly advised to pay attention to the proposal instructions described in the GPG, particularly those that refer to page limitations. On the NSF Cover Sheet, please be sure to indicate that the proposal is responding to the NSF Program Solicitation number at the top of this solicitation. A multi-disciplinary panel will be reviewing these proposals, and is scheduled to meet in the winter of 2005. Based on the panel reviews, each participating agency will then decide which of the proposals they wish to support.

High priority will be given to projects that deal directly and explicitly with how to link multiple scales, as opposed to projects that deal with multiple scales separately. **Proposals will be returned without review if the three expectations described at the beginning of Section II. PROGRAM DESCRIPTION in this solicitation have not been explicitly addressed in the Project Summary of the proposal.**

Investigators are expected to develop methods of validation using appropriate models, e.g., cell cultures, animal models or comparison with human subjects data and images. Investigators are expected either to have access to computational resources, validation data and informatics expertise, or to propose focused data acquisition and database efforts. The Budget should request funds for appropriate infrastructure and software development, and should include funds for the PI to attend a post-award and annual Consortium meetings.



A programmatic goal is to promote open and interoperable software, and to have teams engage in concurrent software development efforts. The benefits of these practices are expected to include, but are not limited to, improved functionality by linking disparate but scientifically appropriate software, reduction of redundant software efforts, efficient software reuse, and improvement in quality of software by opening the development process to more scientists. Each investigator should include in the project description the software development practices they intend to use to achieve these goals. Proposers should also include a dissemination plan that describes in detail how software to be developed and data to be generated will be made available for incorporation into the work and the explorations of other members of the community, including interoperability of software components between the proposed project's software and others, and ability to merge data produced by the project with other workers' databases and datasets. The program is expected to promote these goals initially through the development of a knowledge base through which each investigator will contribute regular updates of their project. Investigators will be expected to interact with cognizant program officials in the creation of this knowledge base. The Consortium of Investigators and program officers will then be able to utilize this knowledge base to promote interaction between investigators. As the program matures, it is expected that mature software engineering practices will be developed that will enable concurrent development, interoperability, and the sharing of software. Investigators are expected to budget for and plan software repositories, and associated software engineering efforts.

There is no prescribed license format for software produced in this project. However IMAG does have goals for software dissemination, and reviewers will be instructed to evaluate the dissemination plan relative to the following goals: 1) The software must be freely available to researchers and educators in the non-commercial, non-profit sector, such as institutions of education, research institutes, and government laboratories. 2) The terms of software availability must permit the commercialization of enhanced or customized versions of the software, or incorporation of the software or pieces of it into other software packages. 3) The terms of software availability must include the ability of researchers outside the Consortium to modify the open source code and to share modifications with other colleagues as well as with the Consortium. A Consortium member must take responsibility for creating the original and subsequent "official" versions of a piece of software, and must provide a plan to manage the dissemination or adoption of improvements or customizations of that software by others. This plan must include a method to distribute other users' contributions such as extensions, compatible modules, or plug-ins. The proposal must include written statements signed by the officials of the proposing organizations responsible for intellectual property issues, to the effect that the organization supports and agrees to abide by the software dissemination plans put forth in the proposal (see Section V.A. "Full Proposal Instructions" in this solicitation).

We expect the work funded under this solicitation to form a scientific Frameworks community for concurrent software development and dissemination. This may involve development of community SourceForge repositories. Among other activities, a post award Consortium meeting will be a forum for planning and executing the Frameworks. This will apply, as appropriate, to software developed under the current solicitation, or even relevant software that has already been developed and deployed in the community.

### III. ELIGIBILITY INFORMATION

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The categories of proposers identified in the Grant Proposal Guide (GPG) are eligible to submit proposals under this solicitation. This includes academic institutions, non-profit and for-profit organizations, industrial organizations, and government (federal, state, and local) laboratories.

**Before submitting a proposal, investigators must discuss their idea for a proposal with a member(s) of the IMAG (see the list of Cognizant Program Officers from each Agency in this solicitation).**

### IV. AWARD INFORMATION

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The total estimated amount of funding available for inter-agency multi-scale modeling support is up to \$15,000,000. However, Agencies have no obligation to provide this amount of support if the quality of the proposals received does not justify such an expenditure, and/or sufficient funds are not available.



Award sizes are expected to range from \$100,000 to \$500,000 in total costs per year (including indirect costs), with durations up to 3 years. Most awards will be on the smaller end of this range. Estimated program budget, number of awards, and average award size and duration are subject to the availability of funds. Since the proposals will be submitted originally in the NSF format, they will not use the modular budget format currently used by the NIH. The maximum budgets of awards funded by the NIH will be \$250,000 per year in *direct* costs. The maximum budgets of awards funded by NSF will be \$375,000 per year in *total* costs. The maximum budgets of awards funded by NASA will be \$500,000 per year *total* cost. The maximum budget of awards funded by DOE will be \$500,000 per year in *total* costs.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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#### Letters of Intent (*required*):

Letters of intent must be submitted via fastlane ([www.fastlane.nsf.gov](http://www.fastlane.nsf.gov)). The letter of intent submission must include:

1. The names and institutions/organizations of PIs, Co-PIs, and maximum 5 senior personnel
2. The title of the proposal
3. A 2500-character synopsis (abstract) of the proposal
4. An initial request for primary and secondary assignments, i.e., NSF Division, NIH Institute, NASA or DOE
5. The name of the program officer(s) who has expressed an interest in the project (see Agency Contacts listed in this Solicitation).

Letters of intent will be used by the program to guide the selection of reviewers. PIs should not expect feedback on their letters of intent, beyond acknowledgment of their receipt.

#### Full Proposal Instructions:

Proposals submitted in response to this program announcement/solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF *Grant Proposal Guide* (GPG). The complete text of the GPG is available electronically on the NSF Website at: <http://www.nsf.gov/cgi-bin/getpub?gpg>. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

**Proposers are requested to indicate in the Project Summary which of the Participating Agencies or Departments have expressed an interest in their project.** Proposers are expected to prepare their proposals keeping in mind the budget limitations and review criteria specific to their agencies of interest (see Section VI. PROPOSAL REVIEW INFORMATION in this solicitation).

The proposal must include written statements signed by the officials of the proposing organizations responsible for intellectual property issues, to the effect that the organization supports and agrees to abide by the software dissemination plans put forth in the proposal (see Section II. PROGRAM DESCRIPTION in this solicitation). These should be submitted as supplementary documents in the FastLane proposal.

Proposers are reminded to identify the program announcement/solicitation number (04-607) in the program announcement/solicitation block on the proposal Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

### B. Budgetary Information

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#### Cost Sharing:

Cost sharing is not required in proposals submitted under this Program Solicitation.

### **Indirect Cost (F&A) Limitations:**

No limitation for NSF awards. Other participating agencies may have indirect cost limitations.

### **C. Due Dates**

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Proposals must be submitted by the following date(s):

#### **Letters of Intent (required):**

September 22, 2004

#### **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

November 09, 2004

### **D. FastLane Requirements**

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Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program announcement/solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this announcement/solicitation.

*Submission of Electronically Signed Cover Sheets.* The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the [Grant Proposal Guide](#) for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

## **VI. PROPOSAL REVIEW INFORMATION**

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### **A. NSF Proposal Review Process**

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Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements

Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which he/she is qualified to make judgments.

**What is the intellectual merit of the proposed activity?**

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

**What are the broader impacts of the proposed activity?**

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

NSF staff will give careful consideration to the following in making funding decisions:

***Integration of Research and Education***

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

***Integrating Diversity into NSF Programs, Projects, and Activities***

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

**Additional Review Criteria:**

**The NIH Review Process**

The goals of NIH-supported research are to advance our understanding of biological systems, improve the control of disease, and enhance health. In their evaluations of intellectual merit, reviewers will be asked to consider the

following criteria that are used by NIH:

*Significance*

Does this study address an important problem? If the aims of the application/proposal are achieved, how will scientific knowledge be advanced? What will be the effect of these studies on the concepts or methods that drive this field?

*Approach*

Are the conceptual framework, design, methods, and analyses adequately developed, well-integrated, and appropriate to the aims of the project? Does the applicant/proposer acknowledge potential problem areas and consider alternative tactics?

*Innovation*

Does the project employ novel concepts, approaches or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?

*Investigator*

Is the investigator appropriately trained and well suited to carry out this work? Is the work proposed appropriate to the experience level of the principal investigator and other researchers (if any)?

*Environment*

Does the scientific environment in which the work will be done contribute to the probability of success? Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements? Is there evidence of institutional support? (NOTE: Cost sharing is not required under this program solicitation. Any information in the application/proposal related to this criterion is not auditable.)

Where applicable, the following items will also be considered:

*Protection of human subjects from research risk*

The involvement of human subjects and protections from research risk relating to their participation in the proposed research will be assessed.

*Inclusion of women, minorities and children in research*

The adequacy of plans to include subjects from both genders, all racial and ethnic groups (and subgroups), and children as appropriate for the scientific goals of the research will be assessed. Plans for the recruitment and retention of subjects will also be evaluated.

*Care and use of vertebrate animals in research*

If vertebrate animals are to be used in the project, the five items described under Section f of the PHS 398 research grant application instructions (rev. 5/2001) will be assessed ([http://grants2.nih.gov/grants/funding/phs398/section\\_1.html#f\\_vertibrate\\_animals](http://grants2.nih.gov/grants/funding/phs398/section_1.html#f_vertibrate_animals)).

*Budget*

The reasonableness of the proposed budget and the requested period of support in relation to the proposed research.

**The DOE Review Process**

The goal of research supported by DOE's Office of Science is to deliver the remarkable discoveries and scientific tools that transform our understanding of energy and matter and advance the national, economic, and energy security of the United States.

The following criteria are used by DOE's Office of Science:

- (1) Scientific and/or technical merit or the educational benefits of the project;
- (2) Appropriateness of the proposed method or approach;
- (3) Competency of applicant's/proposer's personnel and adequacy of proposed resources;
- (4) Reasonableness and appropriateness of the proposed budget; and
- (5) Other appropriate factors, established and set forth by the Office of Science in a notice of availability or in a specific solicitation.

Also DOE shall consider, as part of the evaluation, other available advice or information as well as program policy factors such as ensuring an appropriate balance among the program areas listed in 605.5(b) of this part.

Selection of applications/proposals for award will be based upon the findings of the technical evaluations, the importance and relevance of the proposed application/proposal to the Office of Science's mission, and fund availability.

### **The NASA Review Process**

NASA will accept the NIH review criteria provided to reviewers and will use the reviews to make funding decisions based on the merit review and NASA program relevance.

### **Interagency Review Process**

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The review panels will be required to consider all of the criteria listed above for the participating agencies, including NSF, as well as the specific scientific guidelines detailed in this program solicitation.

For all proposals reviewed, a summary rating and accompanying narrative will be completed and signed by each reviewer. In all cases, reviews are treated as confidential documents. The Panel will also give each proposal a numerical score reflecting its relative scientific merit. If an Award, under this competition, is made by a participating Agency other than NSF, that Agency may disclose the entire composition of the Review Panel without revealing individual reviewers of a Proposal. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

Program officers from participating units will meet as soon as possible after proposals have been reviewed to formulate a set of funding recommendations consistent with the goals of the program. In doing so, the program officers will consider panel recommendations and other appropriate concerns such as program relevance and breadth of impact.

Those proposals selected for funding by NSF will be handled under the usual NSF processes. For those proposals that are selected for potential funding by participating NIH Institutes, the PI will be required to resubmit the original proposal and five copies on the PHS 398 application form directly to the Center for Scientific Review (<http://www.csr.nih.gov/>) at the NIH. Applications sent via the USPS EXPRESS or REGULAR MAIL should be sent to the following address:

Center for Scientific Review

National Institutes of Health

Suite 1040

6701 Rockledge Drive MSC 7710

Bethesda MD 20892-7710

The application must be received by CSR referral office on or before March 10, 2005. Each of these applications must be accompanied by a cover letter that associates the application with the IMAG program. An applicant will not be allowed to increase the proposed budget or change the scientific content of the application in the resubmission to the NIH. These NIH applications will be entered into the NIH IMPAC II system. The results of the review will be presented to the involved National Advisory Council for the second level of review. Subsequent to the Council review, NIH Institutes will make their funding determination and selected awards will be made. Subsequent grant administration procedures for NIH awardees will be in accordance with the policies of NIH.

For those proposals selected for funding by DOE, the PI will be required to submit a forms package (not the proposal) through DOE's Industry Interactive Procurement System (IIPS) that can be accessed on the Office of Science Grants and Contracts Web Site at <http://www.sc.doe.gov/grants/grants.html>. Applications packages should reference [Continuing Solicitation for all Office of Science Programs Notice DE-FG01-04ER04-01 --Published October 27, 2003](#). Application may be submitted at any time.

For those proposals selected for funding by NASA the PI will be required to resubmit the cover sheet on the NASA Research Announcement form. NASA will assist the applicant/proposer in this process.

## **B. Review Protocol and Associated Customer Service Standard**

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All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc and/or panel review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

## **VII. AWARD ADMINISTRATION INFORMATION**

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### **A. Notification of the Award**

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Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See section VI.A. for additional information on the review process.)



## B. Award Conditions

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An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1); \* or Federal Demonstration Partnership (FDP) Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

\*These documents may be accessed electronically on NSF's Website at [http://www.nsf.gov/home/grants/grants\\_gac.htm](http://www.nsf.gov/home/grants/grants_gac.htm). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

### Special Award Conditions:

If an award is made by a participating Agency other than NSF, the conditions of that award will be made available before the award.

## C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

For awards from participating Agencies other than NSF, reporting requirements will be provided before the award is activated. Progress reports from the PIs will be accessible to all cognizant program officers.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project reporting system, available through FastLane, for preparation and submission of annual and final project reports. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

## VIII. CONTACTS FOR ADDITIONAL INFORMATION

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General inquiries regarding this program should be made to:

- Semahat S. Demir, Program Director and **Solicitation Coordinator**, Directorate for Engineering, Division of Bioengineering & Environmental Systems, 565 S, telephone: (703) 292-7950, fax: (703) 292-9098, email:



[sdemir@nsf.gov](mailto:sdemir@nsf.gov)

- Ken P. Chong, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, 545 S, telephone: (703) 292-8360, fax: (703) 292-9053, email: [kchong@nsf.gov](mailto:kchong@nsf.gov)
- Michael Plesniak, Program Director, Directorate for Engineering, Division of Chemical & Transport Systems, 525 N, telephone: (703) 292-8371, email: [mplesnia@nsf.gov](mailto:mplesnia@nsf.gov)
- Suvrajeet Sen, Program Director, Directorate for Engineering, Division of Design, Manufacture, & Industrial Innovation, 550 S, telephone: (703) 292-7081, fax: (703) 292-9056, email: [ssen@nsf.gov](mailto:ssen@nsf.gov)
- Radhakishan Baheti, Program Director, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: [rbaheti@nsf.gov](mailto:rbaheti@nsf.gov)
- Paul J. Werbos, Program Director, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: [pwerbos@nsf.gov](mailto:pwerbos@nsf.gov)
- Vicki B. Booker, Program Director, Directorate for Computer and Information Science and Engineering, Division of Shared Cyberinfrastructure, 1122 N, telephone: (703) 292-4961, fax: (703) 292-9060, email: [vbooker@nsf.gov](mailto:vbooker@nsf.gov)
- Frederica Darema, Senior Science and Technology Advisor, Directorate for Computer & Information Science & Engineering, Division of Computer and Network Systems, 1122 N, telephone: (703) 292-8950, fax: (703) 292-9010, email: [fdarema@nsf.gov](mailto:fdarema@nsf.gov)
- Kenneth Whang, Program Director, Directorate for Computer & Information Science & Engineering, Division of Information and Intelligent Systems, 1125 S, telephone: (703) 292-5149, fax: (703) 292-9073, email: [kwhang@nsf.gov](mailto:kwhang@nsf.gov)
- Leland M. Jameson, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4883, fax: (703) 292-9032, email: [ljameson@nsf.gov](mailto:ljameson@nsf.gov)
- Thomas F. Russell, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4863, fax: (703) 292-9032, email: [trussell@nsf.gov](mailto:trussell@nsf.gov)
- Grace Peng (NIH, NIBIB), Program Director, Division of Discovery Science and Technology, National Institute of Biomedical Imaging and Bioengineering, telephone: (301) 451-4778, email: [penggr@mail.nih.gov](mailto:penggr@mail.nih.gov)
- David Balshaw (NIH, NIEHS), Program Administrator, Center for Risk and Integrated Sciences, Division of Extramural Research and Training, National Institute of Environmental Health Sciences, telephone: (919) 541-2448, email: [balshaw@niehs.nih.gov](mailto:balshaw@niehs.nih.gov)
- Milton Corn (NIH, NLM), Director, Division of Extramural Programs, National Library of Medicine, telephone: (301) 496-4621, email: [cornm@mail.nlm.nih.gov](mailto:cornm@mail.nlm.nih.gov)
- Dan Gallahan (NIH, NCI), Associate Director, Division of Cancer Biology, National Cancer Institute, telephone: (301) 435-5226, email: [gallahad@mail.nih.gov](mailto:gallahad@mail.nih.gov)
- Yuan Liu (NIH, NINDS), Director, Computational Neuroscience and Neuroinformatics Program, National Institute of Neurological Disorders and Stroke, telephone: (301) 496-1917, email: [liuyuan2@ninds.nih.gov](mailto:liuyuan2@ninds.nih.gov)
- Peter Lyster (NIH, NIGMS), Program Director, Center for Bioinformatics and Computational Biology, National Institute of General Medical Sciences, telephone: (301) 451-6446, email: [lysterp@mail.nih.gov](mailto:lysterp@mail.nih.gov)
- Lou Quatrano (NIH, NICHD), Program Director, Behavioral Sciences and Rehabilitation Engineering Technologies Program, National Center for Medical Rehabilitation Research, National Institute of Child Health and Human Development, telephone: (301) 402-4221, email: [quatrani@exchange.nih.gov](mailto:quatrani@exchange.nih.gov)
- Karen Skinner (NIH, NIDA), Deputy Director for Science and Technology Development, Division of Neuroscience and Behavioral Research, National Institute of Drug Abuse, telephone: (301) 443-1887, email: [skinner@nida.nih.gov](mailto:skinner@nida.nih.gov)
- John Whitmarsh (NIH, NIGMS), Assistant Director, Center for Bioinformatics and Computational Biology, National Institute of General Medical Sciences, telephone: (301) 451-6446, email: [whitmarj@nigms.nih.gov](mailto:whitmarj@nigms.nih.gov)
- Guy Fogleman (NASA), Director, Bioastronautics Research Division, Code UB, National Aeronautical and Space Administration, telephone: (202) 358-0220, email: [guy.fogleman@nasa.gov](mailto:guy.fogleman@nasa.gov)
- Bette Siegel (NASA), Enterprise Scientist, NASA Headquarters, Bioastronautics Research Division, 300 E Street, SW, Washington, DC, 20546, telephone: (202) 358-2245, email: [bette.siegel@nasa.gov](mailto:bette.siegel@nasa.gov)
- Gary Johnson (DOE), Program Manager, Office of Advanced Scientific Computing Research, Department of Energy, telephone: 301-903-4361, email: [garyj@er.doe.gov](mailto:garyj@er.doe.gov)
- David Thomassen (DOE), Program Coordinator, Office of Biological & Environmental Research, Office of Science, Department of Energy, telephone: 301-903-8521, email: [david.thomassen@science.doe.gov](mailto:david.thomassen@science.doe.gov)

For questions related to the use of FastLane, contact:

- Marcia Rawlings, Information Technology Specialist, Directorate for Engineering, Division of Bioengineering &

## IX. OTHER PROGRAMS OF INTEREST

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The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF *E-Bulletin*, which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's *Custom News Service* (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Other programs of interest from other IMAG agencies include:

The NIH BISTIC initiatives: <http://www.bisti.nih.gov>

Human Brain Project initiatives: <http://www.nimh.nih.gov/neuroinformatics/index.cfm>

Collaborative Research in Computational Neuroscience (NSF/NIH): <http://www.nsf.gov/pubs/2004/nsf04514/nsf04514.pdf>

The NIGMS MIDAS Initiative: <http://archive.nlm.nih.gov/proj/midas.php>

The Virtual Soldier (DARPA): <http://www.virtualsoldier.net>

Scientific Discovery through Advanced Computing (DOE): <http://www.osti.gov/scidac/>

Genomics:GTL (DOE): <http://www.doegenomestolife.org>

The Cooperative State Research, Education, and Extension Service (CSREES) (USDA): <http://www.csrees.usda.gov>

While all of the above have a significant modeling component, this program solicitation is the only computational initiative that is explicitly focused on multi-scale modeling.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded

from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF, although some programs may have special requirements that limit eligibility.

*Facilitation Awards for Scientists and Engineers with Disabilities (FASSED)* provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
  
- **For General Information** (NSF Information Center): (703) 292-5111
  
- **TDD (for the hearing-impaired):** (703) 292-5090
  
- **To Order Publications or Forms:**
  - Send an e-mail to: [pubs@nsf.gov](mailto:pubs@nsf.gov)
  - or telephone: (703) 292-7827
  
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays

a valid OMB control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

OMB control number: 3145-0058.

## **ABOUT THE NATIONAL INSTITUTES OF HEALTH**

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The National Institutes of Health (NIH) mission is to uncover new knowledge that will lead to better health for everyone. NIH works toward that mission by conducting research in its own laboratories; supporting the research of non-Federal scientists in universities, medical schools, hospitals, and research institutions throughout the country and abroad; helping in the training of research investigators; and fostering communication of medical information. The NIH institutes participating in this program contribute to NIH's mission through research efforts aimed at understanding, treating, and preventing disease states that involve or are related to the nervous system.

- NIBIB promotes fundamental discoveries, design and development, and translation and assessment of technological capabilities in biomedical imaging and bioengineering, enabled by relevant areas of information science, physics, chemistry, mathematics, materials science, and computer sciences.
- NINDS supports research on the healthy and diseased brain, spinal cord, peripheral nerves, and mechanisms underlying neurological and neuromuscular disorders.
- NIDA supported research is aimed at increasing the understanding of the causes and consequences of drug abuse and addiction. NIDA supports a broad research program in basic and clinical research, neuroscience, epidemiology, behavioral sciences and services research.
- NIEHS promotes research that will ultimately reduce the burden of human illness and dysfunction from environmental causes. Integral to this effort is an understanding of the interrelation between environmental factors, individual susceptibilities and age. The NIEHS achieves its mission through multidisciplinary biomedical research programs, prevention and intervention efforts, and communication strategies that encompass training, education, technology transfer, and community outreach.
- NLM collects, organizes, and makes available biomedical science information to investigators, educators, and practitioners and carries out programs designed to strengthen medical library services in the United States. Its electronic data bases, including MEDLINE and MEDLINEplus are used extensively throughout the world by both health professionals and the public.
- NIGMS supports basic biomedical research that is not targeted to specific diseases. NIGMS funds studies on genes, proteins, and cells, as well as on fundamental processes like communication within and between cells, how our bodies use energy, and how we respond to medicines. The results of this research increase our understanding of life and lay the foundation for advances in disease diagnosis, treatment, and prevention. NIGMS also supports research training programs that produce the next generation of biomedical scientists, and it has special programs to encourage underrepresented minorities to pursue biomedical research careers.
- NCI leads a national effort to eliminate the suffering and death due to cancer. Through basic and clinical biomedical research and training, NCI conducts and supports research that will lead to a future in which we can prevent cancer before it starts, identify cancers that do develop at the earliest stage, eliminate cancers through innovative treatment interventions, and biologically control those cancers that we cannot eliminate so they become manageable, chronic diseases.
- NICHD research on fertility, pregnancy, growth, development, and medical rehabilitation strives to ensure that every

child is born healthy and wanted and grows up free from disease and disability.

For the latest information about NIH programs, visit the NIH website at <http://www.nih.gov/>.

#### ABOUT THE National Aeronautics and Space Administration

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NASA's mission is to understand and protect our home planet, to explore the universe and search for life and to inspire the next generation of explorers as only NASA can. NASA has established a framework of six Strategic Enterprises to accomplish this mission. The enterprise that is involved in this research announcement is the Biological and Physical Research Enterprise (BPRE). Within the BPRE research is conducted to support a safe human presence in space.

For more information about BPRE see: <http://spaceresearch.nasa.gov/>

#### ABOUT THE US Department of Energy

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The Office of Science (<http://www.science.doe.gov/>) is the single largest supporter of basic research in the physical sciences in the United States, providing more than 40 percent of total funding for this vital area of national importance. It oversees - and is the principal federal funding agency of - the Nation's research programs in high-energy physics, nuclear physics, and fusion energy sciences.

The Office of Science manages fundamental research programs in basic energy sciences, biological and environmental sciences, and computational science. In addition, the Office of Science is the Federal Government's largest single funder of materials and chemical sciences, and it supports unique and vital parts of U.S. research in climate change, geophysics, genomics, life sciences, and science education.

BER ([http://www.sc.doe.gov/ober/ober\\_top.html](http://www.sc.doe.gov/ober/ober_top.html)) develops the knowledge needed to identify, understand, anticipate, and mitigate the long-term health and environmental consequences of energy production, development, and use. As the founder of the Human Genome Project, BER continues to play a major role in biotechnology research and also invests in basic research on global climate change and environmental remediation.

ASCR's (<http://www.sc.doe.gov/ascr/home.html>) mission is to discover, develop, and deploy the computational and networking tools that enable scientific researchers to analyze, model, simulate, and predict complex physical, chemical, and biological phenomena important to the DOE. This research is changing the ways in which modern science is conducted.

[nsf.gov](http://nsf.gov)

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