

# Cyber-Enabled Discovery and Innovation (CDI)

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## PROGRAM SOLICITATION

NSF 08-604

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### REPLACES DOCUMENT(S):

NSF 07-603

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#### National Science Foundation

Directorate for Biological Sciences

Directorate for Computer & Information Science & Engineering

Directorate for Education & Human Resources

Directorate for Engineering

Directorate for Geosciences

Directorate for Mathematical & Physical Sciences

Directorate for Social, Behavioral & Economic Sciences

Office of Cyberinfrastructure

Office of International Science and Engineering

Office of Polar Programs

Office of Integrative Activities

#### Preliminary Proposal Due Date(s) (required):

November 08, 2008 - December 08, 2008

Type I Preliminary Proposal Submission Deadline (5 PM Proposer's time)

November 09, 2008 - December 09, 2008

Type II Preliminary Proposal Submission Deadline (5 PM Proposer's time)

#### Full Proposal Submission Window Date(s):

By invitation only, based on review of preliminary proposal - see instructions.

April 20, 2009 - May 20, 2009

Type I and Type II Full Proposal Deadline (5 PM Proposer's time)

## REVISION NOTES

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- Letter of Intent is no longer required or accepted
- Preliminary and full proposal deadlines were revised
- The description of the theme "Designing, Building, and Understanding Virtual Organizations" has been revised.
- Changes in preliminary and full proposal preparation instructions, under single copy documents
- PIs are required to send by e-mail two Excel files: one file with list of PIs, Co-PIs, and other senior personnel and their conflicts of interest (Col), and another file indicating primary and other relevant CDI themes, and keywords relevant to the proposal; both Excel files are to use templates made available through NSF CDI web site; keywords should be selected from the CDI keyword list provided on <http://www.nsf.gov/crssprgm/cdi/> or of the PI's own choosing; the Excel files are to be e-mailed to [cdi@nsf.gov](mailto:cdi@nsf.gov).
- PIs are to include a PDF file of the Col information as a single-copy document in the preliminary or full proposal itself.

## SUMMARY OF PROGRAM REQUIREMENTS

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## General Information

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### Program Title:

Cyber-Enabled Discovery and Innovation (CDI)

### Synopsis of Program:

Cyber-Enabled Discovery and Innovation (CDI) is NSF's bold five-year initiative to create *revolutionary* science and engineering research outcomes made possible by innovations and advances in computational thinking. Computational thinking is defined comprehensively to encompass computational concepts, methods, models, algorithms, and tools. Applied in challenging science and engineering research and education contexts, computational thinking promises a profound impact on the Nation's ability to generate and apply new knowledge. Collectively, CDI research outcomes are expected to produce paradigm shifts in our understanding of a wide range of science and engineering phenomena and socio-technical innovations that create new wealth and enhance the national quality of life.

CDI seeks ambitious, transformative, multidisciplinary research proposals within or across the following three thematic areas:

- **From Data to Knowledge:** *enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data;*
- **Understanding Complexity in Natural, Built, and Social Systems:** *deriving fundamental insights on systems comprising multiple interacting elements; and*
- **Building Virtual Organizations:** *enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries.*

With an emphasis on bold multidisciplinary activities that, through computational thinking, promise radical, paradigm-changing research findings, CDI promotes transformative research within NSF. Accordingly, investigators are encouraged to come together in the development of far-reaching, high-risk science and engineering research and education agendas that capitalize on innovations in, and/or innovative use of, computational thinking. Research and education efforts around the world are beginning to address various aspects of the CDI themes, and CDI projects are expected to build upon productive intellectual partnerships involving investigators from academe, industry and/or other types of organizations, including international entities, that advance CDI objectives within the rapidly evolving global context.

Congruent with the three thematic areas, CDI projects will enable transformative discovery to identify patterns and structures in massive datasets; exploit computation as a means of achieving deeper understanding in the natural and social sciences and engineering; abstract, model, simulate and predict complex stochastic or chaotic systems; explore and model nature's interactions, connections, complex relations, and interdependencies, scaling from sub-particles to galactic, from subcellular to biosphere, and from the individual to the societal; train future generations of scientists and engineers to enhance and use cyber resources; and facilitate creative, cyber-enabled boundary-crossing collaborations, including those with industrial and international dimensions, to advance the frontiers of science and engineering and broaden participation in STEM fields.

Two types of CDI awards will be supported as a result of the FY 2009 CDI competition:

- Type I awards will require efforts up to a level roughly comparable to: summer support for two investigators with complementary expertise; two graduate students; and their collective research needs (e.g. materials, supplies, travel) for three years.
- Type II awards will require larger (than Type I) efforts up to a level roughly comparable to: summer support for three investigators with complementary expertise; three graduate students; one or two senior personnel (including post-doctoral researchers and staff); and their collective research needs (e.g. materials, supplies, travel) for four years. The integrative contributions of the Type II team should clearly be greater than the sum of the contributions of each individual member of the team.

In subsequent years, subject to availability of funds, funding opportunities will be provided for three classes of awards, Types I and II as defined above, and Type III as defined below:

- Type III awards will require the engagement of larger (than Type II) multidisciplinary teams, roughly comparable to multiple senior investigators with complementary expertise, multiple graduate students, several senior personnel, and their collective research needs (e.g. materials, supplies, travel) for up to five years. As for Type II awards, the integrative contributions of the Type III team should be clearly greater than the sum of the contributions of each individual member of the team.

### Cognizant Program Officer(s):

- Mary Lou Maher, CISE/IIS, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)
- Eduardo Misawa, ENG/CMMI, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)
- Thomas Russell, MPS/DMS, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.078 --- Office of Polar Programs
- 47.079 --- Office of International Science and Engineering
- 47.080 --- Office of Cyberinfrastructure

## Award Information

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**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 30 - In FY 2009, the number of Type I and Type II awards will be determined based on the results of separate review processes. There will be no Type III awards in FY 2009. In FY 2010 and beyond, subject to availability of funds, awards of Type I, II and III will be made based on the results of separate review processes.

**Anticipated Funding Amount:** \$26,000,000 - Pending availability of funds, a minimum of \$26,000,000 will be available in FY 2009 for proposals submitted in response to this solicitation.

## Eligibility Information

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### Organization Limit:

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

### PI Limit:

None Specified

### Limit on Number of Proposals per Organization:

None Specified

### Limit on Number of Proposals per PI: 2

An individual may participate as Principal Investigator, co-Principal Investigator or other Senior Personnel in at most two preliminary proposals and full proposals in each annual competition. Any individual whose biographical sketch is provided as part of the proposed activity will be considered Senior Personnel in the activity, with or without financial support from the project. If a person appears on more than two preliminary or full proposals, all preliminary or full proposals in which that individual is participating will be returned without review.

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at:  
[http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg).
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at:  
[http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide))

### B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required under this solicitation.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

### C. Due Dates

- **Preliminary Proposal Due Date(s) (required):**
  - November 08, 2008 - December 08, 2008  
Type I Preliminary Proposal Submission Deadline (5 PM Proposer's time)
  - November 09, 2008 - December 09, 2008  
Type II Preliminary Proposal Submission Deadline (5 PM Proposer's time)
- **Full Proposal Submission Window Date(s):**

By invitation only, based on review of preliminary proposal - see instructions.

April 20, 2009 - May 20, 2009

Type I and Type II Full Proposal Deadline (5 PM Proposer's time)

## Proposal Review Information Criteria

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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:** Standard NSF award conditions apply.

**Reporting Requirements:** Standard NSF reporting requirements apply.

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## I. INTRODUCTION

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Our everyday lives have been transformed by the impact of computation and communication. This impact can be observed in the national economy where information technology has contributed in significant and numerous ways to growth in productivity, and to a plethora of new products and services. For example, advances in computing have led to improvements in healthcare diagnoses, access and delivery, in education where learning is increasingly mediated by information technologies, and in science and engineering where the conduct of research is being revolutionized by an increasingly pervasive and sophisticated cyberinfrastructure. There has also been an impact at a conceptual level. Applying computing to problem-solving has led to, and continues to engender, the development of new ways of conceptualizing, analyzing and solving problems, particularly problems related to complex systems where more traditional research tools afford only limited progress.

Motivated by compelling research challenges across the science and engineering frontier, NSF has been making investments in computational science and engineering research, education, and infrastructure for many years. The potential of an increasingly powerful and functionally-complete cyberinfrastructure to advance science and engineering discovery and learning recently culminated in the creation and initial implementation of the agency's *Cyberinfrastructure Vision for 21<sup>st</sup> Century Discovery*.

Recognizing that contemporary advances in computational capabilities – most notably algorithms, architectures, data storage, languages, manipulation and visualization, networking, processing power, software systems, and a growing community of experienced computational scientists and engineers – place us on the threshold of a transformation in our understanding of the world around us, NSF has formulated a bold new initiative called Cyber-Enabled Discovery and Innovation (CDI). All NSF directorates and programmatic offices are participating.

## II. PROGRAM DESCRIPTION

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The Cyber-Enabled Discovery and Innovation (CDI) initiative has been designed to yield *revolutionary* science and engineering research outcomes made possible by innovations and advances in computational thinking. Computational thinking is defined comprehensively to encompass computational concepts, methods, models, algorithms, and tools. Applied in challenging and compelling science and engineering research and education contexts, computational thinking promises a profound impact on the Nation's ability to generate and apply new knowledge. In addition, the challenge of applying computational thinking to very difficult problems in science and engineering will stimulate further advances in computational thinking.

Collectively, CDI research outcomes will produce paradigm shifts in our understanding of a wide range of science and engineering phenomena and socio-technical innovations that create new wealth and enhance the national quality of life. CDI investigators are expected to generate groundbreaking multidisciplinary research and education outcomes across biological sciences, computer and information sciences, education, engineering, geosciences, mathematical sciences, physical sciences, and social, behavioral, and economic sciences. The development and creative use of computational thinking to enable discovery and innovation on all fronts of science and engineering is likely to stimulate advances that collectively accelerate development of an increasingly powerful cyberinfrastructure.

With an emphasis on bold, multidisciplinary activities that, through computational thinking, promise radical, paradigm-changing science and engineering outcomes, CDI promotes transformative research within NSF. Accordingly, investigators are encouraged to come together in the development of far-reaching, high-risk research and education agendas that capitalize on innovations in, and/or innovative use of, computational thinking to create new knowledge and societal impact far beyond today's capabilities. Research and education efforts around the world are beginning to address various aspects of the CDI themes, and CDI projects are expected to build upon productive intellectual partnerships involving investigators from academe, industry and/or other types of organizations, including international entities, that advance CDI objectives within the rapidly evolving global context.

A **competitive** CDI proposal will:

- Describe an ambitious research and/or education agenda that, through computational thinking, promises paradigm-shifting advances in more than one field of science or engineering;
- Provide a compelling rationale for how innovations in, and/or innovative use of, computational thinking will yield the desired project outcomes; and,
- Draw on productive intellectual partnerships that capitalize upon knowledge and expertise synergies in multiple fields or sub-fields of science or engineering, and/or in multiple types of organizations, including academic, for-profit, and not-for-profit entities, both foreign and domestic.

***Projects that make use of existing computational concepts, methods, models, algorithms, and tools to significantly advance only one field of science or engineering should be submitted to an appropriate NSF program in that field instead of to CDI.***

Motivated by transformative science and engineering research opportunities, CDI seeks bold research and education proposals within or across the following three thematic areas:

- **From Data to Knowledge:** *enhancing human cognition and generating new knowledge from a wealth of digital data*

An abundance of digital data promises a profound impact in both the quality and rate of discovery and innovation in science and engineering, as well as in other societal contexts. Worldwide, researchers are producing, accessing, analyzing, integrating and storing massive amounts of digital data daily, through observation, experimentation and simulation, as well as through the creation of collections of digital representations of tangible artifacts and specimens. Modern experimental and observational instruments generate and collect large sets of data of varying types (numerical, video, audio, textual, multi-modal, multi-level, multi-resolution) at increasing speeds. Often, the data users are not the data producers, and they thus face challenges in harnessing data in unforeseen and unplanned ways. In many science or engineering applications, for example, in mesoscale weather prediction or critical infrastructure protection applications, the ability to gather, organize, analyze, model, and visualize large, multi-scale, heterogeneous data sets in rapid fashion is often crucial.

New methods are required that create knowledge and understanding from an abundance of digital data across the science and engineering frontier, and that accelerate the transformation of knowledge into new products and services that stimulate economic growth as well as other societal benefits. Driven by compelling science and engineering research and education opportunities, new efforts to support the complex tasks of data analysis and discovery must be explored.

The massive scale and often dynamic nature of science and engineering data dictate that relevant computational technologies be fast, flexible, and capable of operating at multiple levels of abstraction. Data of different types often must be synthesized into a single model that permits an emphasis on data meaning rather than on the forms in which the data were originally represented. Models may dynamically incorporate information via data assimilation and machine learning. Alternative models may be compared in exploratory data analysis. A key component of developing or parameterizing a model is often an inverse problem: deducing system properties and structures, parameter values, or underlying principles from data. Inverse problems are commonly non-unique or in some way ill-posed, so that the data may not determine a unique model, and selection of the best model may require careful optimization. Ultimately, the value of a model depends on the major challenge of validation against "ground truth"; feedbacks between mathematical, computational, and application-domain analyses, each influencing the next step in the others, are vital to real-world insight.

Analysis of large data sets, both real-time and offline, demands scalable algorithms whose computational complexity grows as slowly as possible with the scale of the data. Research may require the development of novel algorithms that, for example, can discern and exploit parametric, geometric, and topological properties of data, as well as the development of novel data mining and dimension reduction methodologies that can expose the knowledge underlying science and engineering data. Some of the important ways of extracting information from data include data aggregation and annotation, pattern recognition, perturbation and sensitivity analysis, real-time manipulation, filtering and estimation, spectral graph analysis, statistical analysis, and stochastic simulation. New visualization methods can enhance human cognition, allowing scientists, engineers, researchers, educators, and students to detect and comprehend previously indiscernible abstract concepts, patterns, and important exceptions amidst vast data. Approaches informed by knowledge of human cognition and perception can amplify individuals' capability to perceive, understand, synthesize and reason about complex and often dynamic data. In some science and engineering domains, innovative technologies may also need to address the data confidentiality, privacy, security, provenance, and regulatory issues that often impact the use of data.

Ambitious CDI projects in this area will allow investigators to confirm the expected and reveal the unexpected in

multiple science or engineering domains. Under this theme, CDI seeks proposals for multidisciplinary efforts focused on the development and evaluation of new approaches to data mining, data federation, knowledge extraction and knowledge representation, and visualization in demanding scientific and engineering applications. New approaches in computational thinking applied in the context of From Data to Knowledge will support collaboration and teamwork, often among people of diverse backgrounds and levels and areas of expertise. Projects should promise to communicate the results of research findings in ways that both deepen and broaden their impact in a wide variety of application domains.

- **Understanding Complexity in Natural, Built, and Social Systems:** *deriving fundamental insights on systems comprising multiple interacting elements*

Identifying general principles and laws that characterize complexity and capture the essence of complex systems is one of the major challenges of 21<sup>st</sup> century science and engineering. Complex systems are more than just complicated; they display distinct characteristics not encountered in "simple" systems, such as multi-scale interactions, emergent behavior, pattern formation, and self-organization, and they are often inherently stochastic or operate in unpredictable settings. Nonlinear couplings and feedbacks across multiple processes and scales typify these systems. They are not amenable to reductionism; finding constructs that persist through the dynamics is fundamental, and involves a major role for innovative computational experimentation. As well as advancing science and engineering, the understanding of complexity will enable the design, synthesis, and control of novel complex engineered systems. Furthermore, it will facilitate intervention in and analysis of complex natural and social systems. This theme therefore promotes the exploration and modeling of natural interactions, connections, complex relations, and interdependencies, scaling from sub-particles to galaxies, from subcellular to biosphere, and from the individual to the societal, across time, in order to understand, mimic, synthesize, and exploit complex systems.

The functionalities offered by computational thinking allow "experiments" to take place entirely in cyberspace. In many situations, simulation through computation is the only feasible approach to a systematic investigation of realistic complex scientific phenomena, or is essential to the scientific basis for and design of "traditional" experiments. Key challenges include accuracy and resolution, efficiency, perturbation analysis, uncertainty, stochasticity, validation against "ground truth", long-term dynamics, and predictive modeling. Simulations and computational experiments in mainstream and informal education can engage students and the public in the excitement of scientific and engineering discovery.

Much of the understanding of complexity will come from mathematical and statistical modeling and analysis, based on both theoretical and empirical studies. Mimicking and synthesizing systems will exploit a wide variety of techniques. Complexity often requires advances in numerical methods for differential, algebraic, and discrete systems. Other approaches include agent-based modeling, neural networks, and dynamically interactive human-in-the-loop calculations. An important consideration for large systems is that scalable methods and tools be available in the working environments of scientists, engineers, and STEM educational researchers.

- **Building Virtual Organizations:** *enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries*

Virtual Organizations (VO) can facilitate the conduct of cutting-edge, transformative research and learning within and across all fields of science and engineering. As complex, networked socio-technical systems supported by cyberinfrastructure, VO's promise to connect people and resources across institutional and geographic boundaries, to foster dynamic configurations of instruments, data streams, facilities, and researchers and to enable new approaches to scientific inquiry and education through remote access to experimental tools, observational instruments, simulation systems, and globally dispersed individuals. Because they extend beyond traditional "brick and mortar" research institutions, they allow for more flexible boundaries, memberships, and lifecycles and for scientific inquiry to be performed at a scale and a distance never before possible. Achieving such radical scalability and seamless integration and interoperability will require the application of computational thinking to all levels of VO design, implementation, and maintenance.

For example, how can researchers who remain rooted in their home institutions and disciplines establish common ground for successful VO's that satisfy everyone's preferences and practices? How can heterogeneous data of different forms and types be most effectively transferred and integrated? How can information systems become easily interoperable and accessible any place, any time? How can organizational and regulatory structures be aligned with their virtual ones? How can cultural differences be resolved? Myriad other concerns must be addressed in order to design, build, and advance effective VO's for science and engineering. As distributed, dynamic, and computationally-enhanced modes of operation and organization, VO's will need to overcome traditional boundaries in unprecedented ways and not only expand but diversify the research and educational opportunities and experiences available to researchers, students, and citizens. As such, VO's should also be explored as a primary vehicle for enhancing innovation and broadening participation in not just research but also exciting inquiry-based STEM education.

Understanding how to model and leverage these socio-technical systems to generate and accelerate transformative research within and across different science and engineering necessarily requires the bringing together of domain scientists with expertise in, for example, network science, artificial intelligence and machine learning, game theory, workflow and value chain analysis, statistical physics, software/hardware design, information privacy and security, participatory and social computing, operations research, and organizational studies. Accordingly, CDI investigators of different disciplinary perspectives should collaborate on the design, development, and implementation of VO's to test and verify proposed theories and models of distributed learning and discovery with specific problems, populations and purposes.

Successful projects in the Virtual Organizations theme should seek to produce paradigm-shifting research in the targeted areas as well as advance the understanding of virtual organizations as new modalities of science, engineering, and education. The outcomes should be transformative not only for the science and engineering disciplines being supported by the VO but also create more generalized systematic knowledge and principled understanding of the intertwined human behaviors and technological conditions that enable effective VO's.

All three themes are inter-related. Realistic modeling and accurate, efficient solution of models are becoming possible for ever more complex phenomena, which defy understanding by other means. Such models and increasingly sophisticated scientific observations are described in terms of data of unprecedented scale, from which insight must be extracted through more ingenious techniques than before. Attacking these problems also requires larger organizations, often both geographically dispersed and intellectually diverse; empowerment of such groups is central to this transformation. Accordingly, proposals in one theme, or that cross two or more of the three themes, are encouraged.

In order to realize the full potential of cyber-enabled discovery and innovation, CDI will contribute to the preparation of a workforce

trained in computational thinking, with broad participation that ensures inclusion of students and faculty from historically underrepresented populations, minority-serving institutions, and institutions serving students with disabilities. Effective multi-sector or international collaborations will involve true intellectual partnerships in which successful outcomes depend on the unique contributions of all partners. They also engage junior researchers and students in the collaboration, taking advantage of cyber environments to prepare a well-grounded and globally-engaged workforce.

For additional information about CDI, including frequently asked questions, see <http://www.nsf.gov/crssprgm/cdi>. Examples of motivating science and/or engineering research and education opportunities can also be found there. This list is provided for the purposes of illustration only; it is neither exhaustive, nor indicative of preference regarding research areas.

### III. AWARD INFORMATION

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Two types of CDI awards will be supported in the FY2009 competition of CDI:

- Type I awards require efforts up to a level roughly comparable to: summer support for two investigators with complementary expertise; two graduate students; and their collective research needs (e.g. materials, supplies, travel) for three years.
- Type II awards require larger (than Type I) efforts up to a level roughly comparable to: summer support for three investigators with complementary expertise; three graduate students; one or two senior personnel (including post-doctoral researchers and staff); and their collective research needs (e.g. materials, supplies, travel) for four years. The integrative contributions of the Type II team should clearly be greater than the sum of the contributions of each member of the team.

In subsequent years (FY2010 and beyond), subject to availability of funds, funding opportunities will be provided for three classes of projects, Types I and II as defined above, and Type III as defined below:

- Type III awards require the engagement of larger (than Type II) multidisciplinary teams, roughly comparable to multiple senior investigators with complementary expertise, multiple graduate students, several senior personnel, and their collective research needs (e.g. materials, supplies, travel) for up to five years. As for Type II awards, the integrative contributions of the Type III team should be clearly greater than the sum of the contributions of each member of the team.

In FY 2009, the number of Type I and Type II awards will be determined based on the results of separate review processes; there will be no Type III awards. In FY 2010 and beyond, subject to availability of funds, awards of Type I, II and III will be made based on the results of separate review processes.

### IV. ELIGIBILITY INFORMATION

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#### Organization Limit:

Proposals may only be submitted by the following:

- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.

#### PI Limit:

None Specified

#### Limit on Number of Proposals per Organization:

None Specified

#### Limit on Number of Proposals per PI: 2

An individual may participate as Principal Investigator, co-Principal Investigator or other Senior Personnel in at most two preliminary proposals and full proposals in each annual competition. Any individual whose biographical sketch is provided as part of the proposed activity will be considered Senior Personnel in the activity, with or without financial support from the project. If a person appears on more than two preliminary or full proposals, all preliminary or full proposals in which that individual is participating will be returned without review.

### V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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#### A. Proposal Preparation Instructions

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**Preliminary Proposals (required):** Preliminary proposals are required and must be submitted via the NSF FastLane system, even if full proposals will be submitted via Grants.gov.

Preliminary proposals must be submitted via FastLane and must adhere to the font type and size, as well as margin and spacing



requirements, specified for full proposals in NSF's Grant Proposal Guide.

### Preliminary Proposal Preparation Instructions

**Cover Sheet:** Select the CDI program solicitation number from the Program Announcement/Solicitation pull down menu. Go to the Unit Selection Lists section. In the "Divisions" selection box, you will see the Office of Integrative Activities (OIA). Go straight to the "Programs" selection box, and select the relevant CDI Type (Type I or II). The Type you choose will be added to the "Current List of selected NSF Units". Then click "Go Back", click "Go" button next to "Remainder of the Cover Sheet" to get to that section. Provide a short informative title for the proposed CDI project. To assist NSF staff in sorting preliminary proposals for review, for the FY 2009 competition, preliminary proposal titles should begin with "CDI-Type I:" or "CDI-Type II:". FastLane allows one PI and at most four Co-PIs to be designated for each proposal. Check the box indicated for preliminary proposal. If your project involves international partners, check the international activities box and list the countries involved. If needed, additional lead personnel should be designated as non co-PI, Senior Personnel on the Budget form.

- A. **Project Summary (1-page limit):** At the top of this page enter the title of the CDI project, beginning with "CDI-Type I:" or "CDI-Type II:", the name of the PI and the lead institution, and the primary and other relevant CDI themes. Provide a summary description of the CDI project, including its transformative research and education goals, and the innovations in, and/or innovative use of, computational thinking being proposed. In separate statements, provide a succinct summary of the intellectual merit and broader impacts of the proposed project. ***Preliminary proposals that do not address the intellectual merit and broader impacts of the proposed project in separate statements will be returned without review.***
- B. **Table of Contents:** For all proposals submitted, a Table of Contents is automatically generated and cannot be edited.
- C. **Project Description (6-page limit):** The project description contains the following items.
1. **List of Participants (1-page limit):** Include each individual's last name, first name and department/institution/organization affiliation. The list of PI, Co-PIs and other Senior Personnel should include individuals who would be supported via sub-awards. The list of Key Collaborators should also include individuals who would not receive salary support from the NSF grant, such as industrial or international partners.
  2. **Description (exclusive of list of participants, must not exceed 5 pages):** Describe the scope of the project, including:
    - the research and/or education agenda that promises paradigm-shifting advances in more than one field of science or engineering;
    - a compelling rationale for how innovations in, and/or innovative use of, computational thinking will yield the desired project outcomes; and,
    - a description of the intellectual partnership on which the project is based.
- D. **References Cited (1-page limit):** Cite references relevant to the research and education plan.
- E. **Biographical Sketches:** Prepare the standard 2-page biographical sketches in accordance with NSF's Grant Proposal Guide. In choosing what to include, emphasize information that will be helpful for understanding the strengths, qualifications, and specific impact each individual brings to the proposed CDI project.

Current and pending support information is not required for preliminary proposals.

- F. **Budget (3-page limit):** The estimated total project budget and budget justification should be included. The budget should be entered in FastLane as if the duration of the project were one year. FastLane will generate forms for Year 1 and Cumulative. The figures on these two pages will be identical, and should correspond to cumulatives. The third page is the budget justification. The only required information on the forms and in the justification is the total estimated project budget. Additional detail may be provided voluntarily, within the 3-page limit.
- G. **Single copy documents:** ***Preliminary proposals that do not provide the following information will be returned without review.***

Provide the following information in the "List of Personnel, Collaborators and Affiliates" both in the preliminary proposal PDF file and in an Excel spreadsheet file (CSV format) following the template available in the CDI's website, as instructed below in item (1) of subsection "Electronic Documents".

**Project Personnel.** List all PIs, Co-PIs, and other Senior Personnel in the project. A corresponding biographical sketch should be provided in E. above for all individuals included on this list. For each person, provide the last name, first name, and institution/organization.

**Collaborators/Individuals with Conflicts of Interest.** Provide a list, in an alphabetized table, of the full names and institutional affiliations of all persons with potential conflicts of interest as specified in NSF's Grant Proposal Guide. For each PI, Co-PI and other Senior Personnel, include all co-authors/editors and collaborators (within the past 48 months), all graduate advisors and advisees, and any other individuals or institutions with which the investigator has financial ties (please specify type). In addition, list all subawardees who would receive funds through the CDI award.

#### Electronic Documents:

In addition, the proposers must send the following two documents via email immediately after submission of their proposal. After receipt of the proposal number from FastLane or Grants.gov, send an email to [cdi@nsf.gov](mailto:cdi@nsf.gov). The subject heading of the email should note the proposal number and the lead institution. Attach the following documents prepared on templates that will be available at <http://www.nsf.gov/crssprgm/cdi/>:

(1) "List of Personnel, Collaborators and Affiliates": An Excel spreadsheet containing two lists: one lists the last names, first names and institutional affiliations of all PIs, Co-PIs, and other senior personnel; the second one lists the full names and institutional affiliations of all people having conflicts of interest with any PIs, Co-PIs, and other senior personnel. This list will be used by NSF to check for conflicts of interest in assembling the review community; the information must be provided according to the template provided and must be saved using the CSV format. The filename should be the proposal number followed by the three characters "coi" (for example, for a proposal number 0912345, this file name will be 0912345coi.csv where the extension csv will be automatically added by Excel when saving the file using the csv format).



(2) "List of Themes and Keywords": An Excel spreadsheet listing the themes and keywords relevant for the proposal. This list identifies the primary and other relevant **CDI themes** and up to **3 keywords** selected from the CDI keyword list (or of the PI's own choosing) that best describe the major areas of the multidisciplinary research and education being proposed. This information will be used internally to NSF to facilitate the review process and not to exclude areas not explicitly represented in the CDI keyword list.

- **Themes:** "From Data to Knowledge," "Understanding Complexity" and "Virtual Organizations."
- **Keywords:** The CDI keyword list is available on <http://www.nsf.gov/crssprgm/cdi/>

The information must be prepared according to the template provided and must be saved using the CSV format. The filename should be the proposal number followed by the three characters "kyw" (for example, for a proposal number 0912345, this file name will be 0912345kyw.csv where the extension csv will be automatically added by Excel when saving the file using the csv format).

The templates are available at: <http://www.nsf.gov/crssprgm/cdi/>

Remember to e-mail these two Excel documents to [cdi@nsf.gov](mailto:cdi@nsf.gov); do not use FastLane or Grants.gov.

NOTE: Preliminary proposals that fail to provide these electronic documents with proper information and according to the required format will be returned without review.

No other items or appendices are to be included. Information pertaining to "Current and Pending Support", and "Facilities, Equipment and Other Resources" is not required for preliminary proposals and should not be included. ***Preliminary proposals containing items other than those required above will not be reviewed or considered for NSF funding.***

Following merit review of preliminary proposals, a smaller number of proposers will be invited to submit full proposals. ***Full proposals will be accepted only if invited by NSF. Unsolicited full proposals will be returned without review.***

**Full Proposal Preparation Instructions:** Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program 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/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=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 reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: ([http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.

#### **Additional Full Proposal Preparation Instructions:**

***Note that no change in CDI award Type will be permitted between preliminary proposal and full proposal submission. Any deviations from the research team cited in the preliminary proposal, deviations from the scope of the preliminary proposal, or deviations from the preliminary proposal budget by more than 10%, must be approved by NSF prior to full proposal submission.***

#### **Cover Sheet:**

- FastLane Users: Select the CDI program solicitation number from the Program Announcement/Solicitation pull down menu. Go to the Unit Selection Lists section. In the "Divisions" selection box, you will see the Office of Integrative Activities (OIA). Go straight to the "Programs" selection box, and select the relevant CDI Type (Type I or II). The Type you choose will be added to the "Current List of selected NSF Units". Then click "Go Back", click "Go" button next to "Remainder of the Cover Sheet" to get to that section.
- Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. Grants.gov users should refer to Section VI.1.2. of the NSF Grants.gov Application Guide for specific instructions on how to designate the NSF Unit of Consideration.

Provide a short informative title for the proposed CDI project. To assist NSF staff in sorting full proposals for review, for the FY 2009 competition, full proposal titles should begin with "CDI-Type I:" or "CDI-Type II:". The system allows one PI and at most four Co-PIs to be designated for each proposal. If your project involves international partners, check the international activities box and list the countries involved. If needed, additional lead personnel should be designated as non co-PI, Senior Personnel on the Budget form.

**Project Summary (1-page limit):** At the top of this page enter the title of the CDI project, beginning with "CDI-Type I:" or "CDI-Type II:", the name of the PI and the lead institution, and the primary and other relevant CDI themes. Provide a summary description of the CDI project, including its transformative research and education goals, and the innovations in, and/or innovative use of, computational thinking being proposed. In separate statements, provide a succinct summary of the intellectual merit and broader

impacts of the proposed project. **Full proposals that do not address the intellectual merit and broader impacts of the proposed project in separate statements will be returned without review.**

**Coordination Plan (3-page limit, in addition to the usual 15-page limit for project description):** Each proposal must contain a coordination plan, which includes 1) the specific roles of the PI, co-PIs, other senior personnel and paid consultants at all institutions involved, 2) how the project will be managed across institutions and disciplines, 3) identification of the specific coordination mechanisms that will enable cross-institution and/or cross-discipline scientific integration (e.g., yearly workshops, graduate student exchange, project meetings at conferences, use of the grid for videoconferences, software repositories, etc.), and 4) pointers to the budget line items that support these coordination mechanisms.

**Exclusive of the coordination plan, the project description must be no longer than 15 pages.**

**Single copy documents: Full proposals that do not provide the following information will be returned without review.**

Provide the following information in the "List of Personnel, Collaborators and Affiliates" both in the full proposal PDF file and in an Excel spreadsheet file (CSV format), as instructed below in item (1) of subsection "Electronic Documents".

**Project Personnel.** List all Senior Personnel in the project. A corresponding biographical sketch should be provided in E. above for all individuals included on this list. For each person, provide the last name, first name, and institution/organization.

**Collaborators/Individuals with Conflicts of Interest.** Provide a list, in an alphabetized table, of the full names and institutional affiliations of all persons with potential conflicts of interest as specified in NSF's Grant Proposal Guide. For each PI, Co-PI and other Senior Personnel, include all co-authors/editors and collaborators (within the past 48 months), all graduate advisors and advisees, and any other individuals or institutions with which the investigator has financial ties (please specify type). In addition, list all subawardees who would receive funds through the CDI award.

#### **Electronic Documents:**

In addition, the proposers must send the following two documents via email immediately after submission of their proposal. After receipt of the proposal number from FastLane or Grants.gov, send an email to [cdi@nsf.gov](mailto:cdi@nsf.gov). The subject heading of the email should note the proposal number and the lead institution. Attach the following documents prepared on templates that will be available at <http://www.nsf.gov/crssprgm/cdi/>

(1) "List of Personnel, Collaborators and Affiliates": An Excel spreadsheet containing two lists: one lists the last names, first names and institutional affiliations of all PIs, Co-PIs, and other senior personnel; the second one lists the full names and institutional affiliations of all people having conflicts of interest with any PIs, Co-PIs, and other senior personnel. This list will be used by NSF to check for conflicts of interest in assembling the review community; the information must be provided according to the template provided and must be saved using the CSV format. The filename should be the proposal number followed by the three characters "coi" (for example, for a proposal number 0912345, this file name will be 0912345coi.csv where the extension csv will be automatically added by Excel when saving the file using the csv format).

(2) "List of Themes and Keywords": An Excel spreadsheet listing the themes and keywords relevant for the proposal. This list identifies the primary and other relevant **CDI themes** and up to **3 keywords** selected from the CDI keyword list (or of the PI's own choosing) that best describe the major areas of the multidisciplinary research and education being proposed. This information will be used internally to NSF to facilitate the review process and not to exclude areas not explicitly represented in the CDI keyword list.

- **Themes:** "From Data to Knowledge," "Understanding Complexity" and "Virtual Organizations."
- **Keywords:** The CDI keyword list is available on <http://www.nsf.gov/crssprgm/cdi/>

The information must be prepared according to the template provided and must be saved using the CSV format. The filename should be the proposal number followed by the three characters "kyw" (for example, for a proposal number 0912345, this file name will be 0912345kyw.csv where the extension csv will be automatically added by Excel when saving the file using the csv format).

The templates are available at: <http://www.nsf.gov/crssprgm/cdi/>

Remember to e-mail these two Excel documents to [cdi@nsf.gov](mailto:cdi@nsf.gov); do not use FastLane or Grants.gov.

NOTE: Full proposals that fail to provide these electronic documents with proper information and according to the required format will be returned without review.

No other items or appendices are to be included. **Full proposals containing items other than those required above will not be reviewed or considered for NSF funding.**

## **B. Budgetary Information**

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**Cost Sharing:** Cost sharing is not required under this solicitation.

## **C. Due Dates**

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- **Preliminary Proposal Due Date(s) (required):**

November 08, 2008 - December 08, 2008

Type I Preliminary Proposal Submission Deadline (5 PM Proposer's time)

November 09, 2008 - December 09, 2008

Type II Preliminary Proposal Submission Deadline (5 PM Proposer's time)

- **Full Proposal Submission Window Date(s):**

By invitation only, based on review of preliminary proposal - see instructions.

April 20, 2009 - May 20, 2009

Type I and Type II Full Proposal Deadline (5 PM Proposer's time)

## D. FastLane/Grants.gov Requirements

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- **For Proposals Submitted Via FastLane:**

Detailed technical instructions regarding the technical aspects of 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 solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

**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. Further instructions regarding this process are available on the FastLane Website at: <https://www.fastlane.nsf.gov/fastlane.jsp>.

- **For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: <http://www.grants.gov/CustomerSupport>. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: [support@grants.gov](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

## VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

### A. NSF Merit Review Criteria

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All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. 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 the reviewer is qualified to make judgements.

**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, original, or potentially transformative 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:**

In responding to the standard NSF review criteria, reviewers will be asked to place emphasis on the following CDI objectives:

- The proposal should define a bold multidisciplinary research agenda that, through computational thinking, promises paradigm-shifting outcomes in more than one field of science and engineering. **Projects that make straightforward use of existing computational concepts, methods, models, algorithms and tools to significantly advance only one discipline should be submitted to an appropriate program in that field instead of to CDI.**
- The proposal should provide a clear and compelling rationale that describes how innovations in, and/or innovative use of, computational thinking will lead to the desired project outcomes.
- The proposal should draw on productive intellectual partnerships that capitalize upon knowledge and expertise synergies in multiple fields or sub-fields in science or engineering and/or in multiple types of organizations.

Reviewers will also be asked to provide an evaluation of whether the proposed project has the potential for extraordinary outcomes, such as, revolutionizing entire disciplines, creating entirely new fields, or disrupting accepted theories and perspectives as a result of taking a fresh, multi-disciplinary approach. Special emphasis will be placed on proposals that promise to enhance competitiveness, innovation, or safety and security in the United States.

## **B. Review and Selection Process**

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Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review 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.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's 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 Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

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 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.B. 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 (GC-1); \* or Research Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

\*These documents may be accessed electronically on NSF's Website at [http://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). 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 and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

## C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report.

Failure to provide the required annual or final project reports will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. 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. Such reports provide information on activities and findings, project participants (individual and organizational) 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. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete.

## VIII. AGENCY CONTACTS

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General inquiries regarding this program should be made to:

- Mary Lou Maher, CISE/IIS, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)
- Eduardo Misawa, ENG/CMMI, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)
- Thomas Russell, MPS/DMS, telephone: (703) 292-8080, email: [cdi@nsf.gov](mailto:cdi@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@nsf.gov).

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: [support@grants.gov](mailto:support@grants.gov).

Drs. Maher, Misawa and Russell are being assisted by a multidisciplinary team of Program Officers drawn from throughout NSF. CDI team members include: Kile Baker (GEO/ATM), Charles Bouldin (MPS/DMR), Maria Burka (ENG/CBET), Arlene de Strulle (EHR/DRL), Anne Emig (OD/OISE), Anne-Francoise Lamblin (BIO/DBI), D. Terence Langendoen (SBE/BCS), Anita La Salle (CISE/CCF), Dan Lubin (OD/OPP), Peter McCartney (BIO/DBI), Barbara Olds (EHR/OAD), Abani Patra (OD/OCI), Wayne Patterson (OD/OISE), Diana Rhoten (OD/OCI), Sirin Tekinay (CISE/CCF), Rita Teutonico (SBE/OAD), William Wiseman (OD/OPP) and Eva Zanzerkia (GEO/EAR).

## IX. OTHER INFORMATION

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The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the [NSF web site](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.



## ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities* provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

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

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; and 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 proposer 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 or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; 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," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). 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 Office of Management and Budget (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 the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton  
Reports Clearance Officer  
Division of Administrative Services  
National Science Foundation  
Arlington, VA 22230

