

# Computing Education for the 21st Century (CE21)

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## PROGRAM SOLICITATION NSF 10-619



National Science Foundation

Directorate for Computer & Information Science & Engineering  
Division of Computing and Communication Foundations  
Division of Computer and Network Systems  
Division of Information & Intelligent Systems

Directorate for Education & Human Resources

Office of Cyberinfrastructure

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

April 27, 2011

Last Wednesday in April, Annually Thereafter

Type I and Type II proposals ONLY

Full Proposal Target Date(s):

February 22, 2011

Last Tuesday in February, Annually Thereafter

Planning proposals ONLY.

July 28, 2011

Last Thursday in July, Annually Thereafter

Planning proposals ONLY.

## IMPORTANT INFORMATION AND REVISION NOTES

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A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), [NSF 11-1](#), was issued on October 1, 2010 and is effective for proposals submitted, or due, on or after January 18, 2011. Please be advised that the guidelines contained in [NSF 11-1](#) apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 18, 2011, must also follow the guidelines contained in [NSF 11-1](#).

**Cost Sharing:** The PAPPG has been revised to implement the National Science Board's recommendations regarding cost sharing. Inclusion of voluntary committed cost sharing is prohibited. In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section of the proposal. The description should be narrative in nature and must not include any quantifiable financial information. Mandatory cost sharing will only be required when explicitly authorized by the NSF Director. See the PAPP Guide Part I: *Grant Proposal Guide (GPG) Chapter II.C.2.g(xi)* for further information about the implementation of these recommendations.

**Data Management Plan:** The PAPPG contains a clarification of NSF's long standing data policy. All proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>. See [Chapter II.C.2.j](#) of the GPG for further information about the implementation of this requirement.

**Postdoctoral Researcher Mentoring Plan:** As a reminder, each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See [Chapter II.C.2.j](#) of the GPG for further information about the implementation of this requirement.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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Program Title:

Computing Education for the 21st Century (CE21)

## Synopsis of Program:

The Computing Education for the 21st Century (CE21) program aims to build a computationally savvy 21st century workforce that positions the US to demonstrate a leadership role in the global economy. Innovations in computing and more broadly, information technology (IT), drive our economy, underlie many new advances in science and engineering, and contribute to our national security. Projected job growth in IT is very strong.

Despite these very positive indicators, student interest in computing has declined dramatically over the last decade. For example, the percentage of college freshmen indicating an intent to major in computing has declined overall by 70% in the last decade; for women, the decline was 80% (HERI, 2000-2009). Recent data show that student interest in computing majors has fallen behind projected job openings by a factor of five and a half (ACT, 2010).

The CE21 program seeks to reverse this troubling trend by engaging larger numbers of students, teachers, and educators in computing education and learning at earlier stages in the education pipeline. While interventions in primary education are within scope, the CE21 program focuses special attention on activities targeted at the middle and high school levels (i.e., secondary education) and in early undergraduate education.

The goals of the CE21 program are to:

- Increase the number and diversity of K-14 students and teachers who develop and practice computational competencies in a variety of contexts; and
- Increase the number and diversity of early postsecondary students who are engaged and have the background in computing necessary to successfully pursue degrees in computing-related and computationally-intensive fields of study.

The program seeks to increase computational competencies for *all* students, regardless of gender, race, ethnicity, disability status, or socioeconomic status, and regardless, too, of eventual career choices. By promoting and enhancing computing K-14 education, the CE21 program seeks to increase interest in computing as a field in its own right, and also to better prepare students for successful careers in other computing-intensive fields.

All CE21 projects are expected to:

- Contribute to the creation of a rich research base that informs our understanding of effective teaching and learning in computing; and
- Draw on partnerships among the computing and teaching and learning communities, institutions of learning, including primary, secondary and post-secondary institutions and organizations, and other stakeholders.

In addition, all CE21 projects must make contributions in one or more of the following areas:

- Design, develop and study the effectiveness of new instructional materials and interventions;
- Design, develop, and evaluate the impact of pre-service and in-service efforts and strategies that enhance K-14 teaching expertise in computing; and/or
- Implement and test promising computing education interventions at scale.

The CE21 program especially encourages proposals that align with, and promise to contribute to, the success of the NSF-initiated CS 10K Project. (See <http://www.computingportal.org/cs10k>) CS 10K aims to increase the effectiveness of computing education in high school through the introduction of an entirely new curriculum (based on a proposed, new Advanced Placement course) concomitant with the preparation of 10,000 high school teachers prepared to teach the new curriculum in 10,000 schools by 2015.

CE21 will fund three types of proposals.

- Type I proposals will contribute to the research base on the effective teaching and learning of computing, draw on partnerships of informed and committed stakeholders, and create and study the effectiveness of new instructional materials and interventions and/or strategies to develop K-14 teaching expertise. *Type I proposals typically describe smaller scale efficacy studies.*
- Type II proposals will contribute to the research base on the effective teaching and learning of computing, draw on partnerships of informed and committed stakeholders, and create and study the effectiveness of new instructional materials and interventions and strategies to develop K-14 teaching expertise. Type II proposals demonstrate implementations at scale, *where the interventions to be taken to scale have already proven effective in smaller-scale efficacy studies (studies that may or may not have been funded by NSF).*
- Planning proposals support the establishment of new partnerships and collaborations necessary to develop Type I or Type II proposals.

In the aggregate, CE21 awards will contribute to our understanding of how diverse student populations are engaged and retained in computing, learn its fundamental concepts, and develop computational competencies that position them to contribute to an increasingly computationally-enabled workforce.

## Cognizant Program Officer(s):

*Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.*

- Janice Cuny, Program Officer, CISE Directorate, 1175, telephone: (703) 292-8489, email: [jcuny@nsf.gov](mailto:jcuny@nsf.gov)
- Jeff Forbes, telephone: (703) 292-4291, email: [jforbes@nsf.gov](mailto:jforbes@nsf.gov)
- Jim Hamos, Program Officer, EHR Directorate, 835N, telephone: (703)-292-4687, email: [jhamos@nsf.gov](mailto:jhamos@nsf.gov)
- Mimi McClure, telephone: (703) 292-5197, email: [mmcclure@nsf.gov](mailto:mmcclure@nsf.gov)

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

- 47.070 --- Computer and Information Science and Engineering
- 47.076 --- Education and Human Resources
- 47.080 --- Office of Cyberinfrastructure

## Award Information

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Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 20 to 30 annually.

Anticipated Funding Amount: \$25,000,000 (pending availability of funds)

## Eligibility Information

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Organization Limit:

Proposals may only be submitted by the following:

- The lead organization for all Type II CE21 projects (only) must be an eligible institution of higher education, that is, a university or two- or four-year college (including community colleges) accredited in, and having a campus located in the U.S.

This organization limit applies to Type II CE21 proposals only. The categories of proposers eligible to submit Planning Grant and Type I proposals are identified in the [Grant Proposal Guide](#), Chapter I, Section E.

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 PI or Co-PI in **no more than two (2)** proposals submitted to a single deadline or target date in response to this solicitation, although an individual may participate in additional proposals as a Senior Personnel. **These eligibility conditions will be strictly enforced.** In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on the date and time of proposal submission. The first two proposals received will be accepted and the remainder will be returned without review. **No exceptions will be made.**

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- Letters of Intent: Not Applicable
- Preliminary Proposal Submission: Not Applicable
- 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: Inclusion of voluntary committed cost sharing is prohibited.
- Indirect Cost (F&A) Limitations: Not Applicable
- Other Budgetary Limitations: Not Applicable

### C. Due Dates

- Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
  - April 27, 2011
  - Last Wednesday in April, Annually Thereafter
  - Type I and Type II proposals ONLY
- Full Proposal Target Date(s):
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  - Planning proposals ONLY.

July 28, 2011

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Planning proposals ONLY.

## 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: 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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Computing has permeated and transformed our lives. As it becomes more important in all sectors of society, so does the preparation of a globally-competitive, 21st Century workforce poised to apply foundational computational concepts and methods, as well as computing technologies and tools, to a broad range of societal challenges and opportunities and in a wide range of professional contexts. Not surprisingly, the computing professions are among the fastest growing professions in the US economy.

Computing is playing a more prominent role not only in the general national workforce but also, more specifically, in the science and engineering workforce. State-of-the-art computing systems, tools, and services create a comprehensive cyberinfrastructure that is enabling advances in science and engineering research and education in ways that revolutionize who can participate, what they can do, and how they can do it. Sustaining this revolution requires the development of a science and engineering workforce with the computational competencies needed to design and deploy, as well as adopt and apply, these cyber-based tools and services over the long-term.

Despite the transformative importance of computational advances in all sectors of our knowledge-intensive economy, our Nation's youth have few opportunities to gain a foundational understanding of computing, to develop competencies in computational thinking, or to explore the role that computation may play in shaping and refining their career interests (CSTA, 2005; CSTA, 2009). Most of today's high schools do not offer any rigorous computing classes appropriate for college-bound students; few high school computing teachers have a formal background in computing; and little is being done to engage the majority of our students who show no interest in IT careers.

NSF has created the Computing Education for the 21st Century (CE21) program to affect the depth and scale of change that is necessary to integrate the teaching and learning of computing into the national education enterprise with the intent of engaging all students, regardless of their gender, race, ethnicity, disability status, socio-economic status, or long-term professional goals.

## II. PROGRAM DESCRIPTION

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### Vision and Goals

The motivating vision for the CE21 program is of a computationally savvy 21st Century workforce prepared to play a leadership role in the global innovation economy.

The program goals are to:

- Increase the number and diversity of K-14 students and teachers who develop and practice computational competencies in a variety of contexts; and
- Increase the number and diversity of early postsecondary students who are engaged and have the background in computing necessary to successfully pursue degrees in computing-related and computationally-intensive fields of study.

The goals of the CE21 program cannot be met without addressing underrepresentation. Currently almost 70% of our population - women, persons with disabilities, African Americans, Hispanics, Native Americans, Alaskan Natives, Native Hawaiians and indigenous people - have longstanding underrepresentation in computing. NSF is committed to ensuring the full participation of these individuals in computing and related career fields. Thus, all CE21 projects will be expected to address issues of underrepresentation in making their activities accessible to, and appropriate for, diverse student populations.

### Program Strategies

The program seeks to enhance the effectiveness of computing learning and teaching via five core strategies. All CE21 projects must contribute to both of the first two strategies, and to one or more of the remaining three strategies as described below.

All CE21 projects must:

- Contribute to the creation of a rich research base that informs our understanding of effective teaching and learning in computing. Projects supported will inform our understanding of how diverse populations of K-14 students become engaged and are retained in computing, learn core computing concepts, and develop computational competencies in computing in a variety of contexts; and
- Draw on partnerships among the computing and teaching and learning communities, institutions of learning, including primary, secondary and post-secondary institutions and organizations, and other stakeholders. Projects will be led by institutions of higher education and should engage, as appropriate, stakeholders in other relevant organizations, including K-12 schools, school districts, and state education systems as well as other types of organizations, including, but not limited to, informal education providers, industry and professional societies, and community groups. Project teams must include faculty members with expertise in the core computing disciplines and researchers in the education and/or learning disciplines; in most cases, it will also be necessary to include individuals with expertise in issues of underrepresentation.

In addition, all CE21 projects must make contributions in one or more of the following areas:

- Design, develop and study the effectiveness of new instructional materials and interventions. CE21 projects will design, develop, and evaluate new K-14 instructional materials and interventions that support the engagement, retention, and development of competencies in computing for diverse student populations in a variety of both formal and informal settings;
- Design, develop, and evaluate the impact of pre-service and in-service efforts and strategies that enhance K-14 teaching expertise in computing: CE21 projects will design, develop, and evaluate the impact of pre-service and in-service efforts and strategies that increase the computational expertise of K-14 teachers, with an initial emphasis on developing the teachers needed to teach rigorous computing courses in middle and high schools; and/or
- Implement and test promising interventions at scale (mandatory for CE21 Type II projects-see Project Type definitions below): Funded projects will take educational and learning interventions that have already been proven effective for diverse populations of K-14 students and their teachers in smaller scale efficacy studies, and will scale them for maximum impact.

While interventions in primary education are within scope, the CE21 program focuses special attention on activities targeted at the middle and high school levels (i.e., secondary education) and in early undergraduate education.

For example, the CE21 program encourages proposals that align with and promise to contribute to the success of the NSF-initiated CS 10K Project. (See <http://www.computingportal.org/cs10k>.) CS 10K aims to increase the effectiveness of computing education in high school through the introduction of an entirely new curriculum (based on a proposed, new Advanced Placement course) concomitant with the preparation of 10,000 high school teachers prepared to teach the new curriculum in 10,000 schools by 2015. (See <http://csprinciples.org/>.) The CS 10K project includes the development and piloting of curriculum, materials, assessments, pre-service training, in-service professional development, and ongoing support of high school computing teachers.

The CE21 program also seeks proposals that describe alternative models for delivering middle and high school curricula, such as (but not limited to) senior level high school courses (that meet state-wide math or science requirements), dual credit courses (to be taken simultaneously for secondary school and college credit), or online and distance learning activities.

In the aggregate, CE21 awards will contribute to our understanding of how diverse student populations become engaged in computing, learn its fundamental concepts, and develop computational competencies that position them to contribute to an increasingly computationally-enabled workforce.

### Project Types

Three types of CE21 proposals may be submitted:

- Type I proposals, in the aggregate, focus on activities that build the research base on the effective teaching and learning of computing, draw on partnerships of informed and committed stakeholders, and create and study the effectiveness of new instructional materials and interventions and/or strategies to develop K-14 teaching expertise in computing. Type I projects may conduct basic research on learning, or design, develop, test, validate, and refine materials, measurement tools, and methods for teaching and learning in specific contexts, and/or they may implement promising smaller-scale interventions in order to study their efficacy with particular groups. Type I projects will be funded at levels of up to \$1 million for up to three

years.

- Type II proposals, at the individual and at the aggregate level, focus on activities that study implementation and the sustained impact of computing teaching and learning interventions for diverse student populations, *where the interventions to be taken to scale have already proven effective in smaller-scale efficacy studies* (like those supported in Type I projects). Type II projects seek to understand how interventions proven effective at smaller scales might be implemented in varied contexts, the impact of such interventions at scale and over time, and the factors that influence effective implementation and sustainability, including organizational factors. In addition to involving faculty members with expertise in the core computing disciplines and education and/or learning researchers, Type II teams should also include administrators and other key stakeholders in the institutions and organizations in which interventions will be taken to scale. Type II projects must involve an adequate number of individuals, education settings or schools to provide for broadly generalizable results. PIs are encouraged to leverage existing organizational structures, including those provided by the CISE Alliances for Broadening Participation in Computing (BPC). Longitudinal studies of learner achievement are appropriate. Type II projects will be funded at levels of up to \$10 million for up to five years.
- Planning proposals seek to build the new partnerships and collaborations needed to design and develop Type I or Type II projects. They will be funded at levels up to \$200,000 for up to 18 months. PIs interested in submitting a planning grant should first contact a cognizant program officer.

## Designing a CE21 Project

The design of any CE21 project begins with the identification of an evidence-based hypothesis about how education in computing is best effected and improved through proposed innovation(s). A plan for developing and/or studying the impact of the suggested innovation(s) in learning and teaching is then developed. A compelling CE21 proposal will articulate clear goals and a plan of work that describes research, development, and implementation strategies appropriate for attaining its goals.

The Division for Research on Learning in Formal and Informal Settings (DRL) of the Directorate for Education and Human Resources (EHR) has developed a conceptual framework to help guide the design and development of projects focused on enhancing teaching and learning in science, technology, engineering, computing and mathematics. The framework incorporates five stages that together create a cycle for innovation and learning:

- Study and clarify phenomena of interest; frame issues; operationalize goals and constructs; develop and propose theory in teaching and learning; basic research on learning
- Design develop, test, validate, and refine materials, measurement tools, and methods, in specific contexts
- Implement innovations; study why interventions have the impacts they have, with particular groups
- Evaluate effectiveness; study complex phenomena, generalize
- Synthesize lines of work; identify new insights and questions to inform new research and development; set research and development agendas

Each part of the cycle informs advancement to the next.

CE21 efforts should be developed within this framework. For example, Type I projects that produce research findings, methods, and theoretical perspectives regarding the engagement of diverse populations of students in computing education would fall into the study, design, implement and/or evaluate stages.

Type II projects will always be based on the outcomes of an evaluate stage and will themselves include study, design, implement and/or evaluate stages. The proposing team need not include the developers of the innovation.

Design and evaluation are major components of any CE21 proposal. All projects should be designed in such a way that they will contribute evidence-based findings to our body of knowledge on teaching and learning of computing within diverse student and teacher populations. Research questions and the associated research design should be explicit and should link to the proposed work. The research and/or evaluation design for a project should be developed by investigators with relevant expertise and should be appropriate to the proposed activities and to the stages of the innovation and learning cycle.

Different methods of research and/or evaluation are appropriate. A Type I project might choose a design research strategy to develop and improve approaches through iterative pilot tests (Clements, 2007; Cobb et al., 2003; Lamberg and Middleton, 2009). Research questions and methods would then focus on systematic monitoring of teachers' and students' responses in order to inform the development process. Project evaluation activities would involve a small number of teachers and classrooms, and would document ways that evidence from pilot tests was used to refine the interventions. As another example, a Type II project in the evaluate stage might test its theory of action in a larger number of classrooms, schools, or sites using quasi-experimental or experimental research designs that allow causal inference. Results would provide evidence about what can be expected from the innovation when well-implemented, and would clarify which aspects of the implementation are crucial to obtaining desired outcomes in diverse student and teacher populations. Type I projects that study efficacy might use research designs with power analysis to determine the sample sizes required to have sufficient probability for detecting treatment effects. Such studies in education commonly employ multi-level modeling to describe both class- and student-level effects of innovations. They might also have a strong qualitative research component to illuminate how, why, and for whom the innovation works. Research designs for Type II projects might include experimental or quasi-experimental designs to determine whether broad implementation of the innovative curriculum, teaching method, assessment, or teacher preparation/ professional development strategy is warranted. Such studies should also provide insights into conditions and practices that will make that implementation successful.

## In Conclusion

The scope of the CE21 program is intentionally broad. It encompasses engagement and retention activities together with the teaching and learning of computational competencies in both disciplinary-based computer science classes as well as infused across the curriculum, in both formal and informal educational settings.

The sharing and dissemination of CE21 project outcomes will be accomplished in part through strategies proposed by each individual project, and, in part, through the coordinated efforts of CE21 PIs who will be required to participate in and provide data to enable program-wide evaluation. They will be required to keep the CE21 community apprised of their work by participating in PI/Community meetings and by maintaining an up-to-date website linked through the CE21 community portal.

The CE21 program seeks to build on promising practices, lessons learned, and research outcomes generated from the agency's ongoing investments in CISE Pathways to Revitalized Undergraduate Computing Education (CPATH), Broadening Participation in Computing (BPC), Discovery Research in K-12 Education (DRK-12), the Math and Science Partnerships (MSP), Cyberinfrastructure-TEAM (CI-TEAM), Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES), and Research and Evaluation on Education in Science and Engineering (REESE) projects.

The CISE community is encouraged to apply, as appropriate, to the related programs in the Education and Human Resources (EHR) Directorate. These include DRK-12, MSP, TUES, and REESE, but also Innovative Technology Experiences for Students and Teachers (ITEST), and Advanced Technological Education (ATE).

Principal Investigators with EHR awards that overlap significantly with CE21 content should contact the CE21 Program Officers about mechanisms (and possible support) for aligning their efforts with those of the CE21 community.

## References

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## III. AWARD INFORMATION

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Approximately \$25 million will be made available in FY11 and FY12 (combined) to support up to 30 awards. Type I projects will be funded at a level of up to \$1 million total for up to 3 years. Type II projects will be funded at a level of up to \$10 million total for up to 5 years. Planning Grants will be funded at a level of up to \$200,000 total for up to 18 months. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. Each annual round of competition is expected to have a similar amount of funding available for awards.

## IV. ELIGIBILITY INFORMATION

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### Organization Limit:

Proposals may only be submitted by the following:

- The lead organization for all Type II CE21 projects (only) must be an eligible institution of higher education, that is, a university or two- or four-year college (including community colleges) accredited in, and having a campus located in the U.S.

This organization limit applies to Type II CE21 proposals only. The categories of proposers eligible to submit Planning Grant and Type I proposals are identified in the [Grant Proposal Guide](#), Chapter I, Section E.

### 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 PI or Co-PI in **no more than two (2)** proposals submitted to a single deadline or target date in response to this solicitation, although an individual may participate in additional proposals as a Senior Personnel. **These eligibility conditions will be strictly enforced.** In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on the date and time of proposal submission. The first two proposals received will be accepted and the remainder will be returned without review. **No exceptions will be made.**

Additional Eligibility Info:

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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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 [nsfpubs@nsf.gov](mailto:nsfpubs@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 [nsfpubs@nsf.gov](mailto:nsfpubs@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.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

The following information SUPPLEMENTS (not replaces) the guidelines provided in the NSF Grant Proposal Guide (GPG) and NSF Grants.gov Application Guide.

Proposal Titles: Proposal titles must begin with the type of proposal being submitted:

- Type I
- Type II
- Planning grant

The proposal type should be followed with a colon then the title of the proposed project.

Project Summary: The project summary must clearly address in separate statements (within the one-page summary): (1) the Intellectual Merit of the proposed activity; and (2) the Broader Impacts resulting from the proposed activity. Proposals that do not separately address both of these NSF Merit Review Criteria within the one-page Project Summary will be returned without review.

Project Description: Standard page limits apply for Type I Projects. The body of the Project Description of a Type II Project must fit within the standard 15 page limit, but an additional one to five pages may be included for Results from Prior NSF support.

The Project Description for Type I and Type II CE21 proposals should include the following sections.

Project Goals and Outcomes. Clearly describe the goals and desired outcomes of the proposed work and how the project will contribute to our understanding of the teaching and learning of computing for diverse student populations. Provide a careful delineation of the core computing concepts and/or computational competencies to be developed and assessed. Define the scope and degree of impact, including the populations to be served as well as the duration and intensity of the interventions. Describe the research base on which the work builds; for Type II projects, this should include evidence of the efficacy of the interventions to be scaled. Discuss the sustainability of impact in terms of the infrastructure, institutional change, or artifacts that can be expected to last beyond the funding period.

Implementation Plan. Describe in detail the activities to be undertaken to realize the project goals and anticipated outcomes. Articulate a plan of work that describes the strategies you will use to realize the project goals and desired outcomes. Those strategies should be described in the context of the cycle of innovation and learning articulated earlier in this solicitation. Motivated by your understanding of the relevant issues of underrepresentation, describe your plan for addressing such issues. Highlight the potential for successfully aligning your work with other similar programs, projects and efforts (NSF-supported or otherwise). Describe your plans to disseminate the results of the project.

Evaluation Plan. Provide a rigorous research and/or evaluation plan designed to guide project progress and measure its impact;

the plan must include a description of the instruments/metrics that will be used. Please note that many, if not all, CE21 projects will involve human subjects and, therefore, will need Institutional Review Board (IRB) approval from the participating institutions before NSF can make relevant awards.

**Partnership Plan.** Describe how the participating organizations will work together to realize the project goals and provide evidence that all key stakeholders (including faculty and administrators) have participated in project planning and design. Describe the institutional and organizational commitment to realizing the project goals and outcomes. Provide evidence that the participating organizations have had experience in dealing with the non-academic components of K-12 education that are necessary to insure the success of underrepresented groups. Describe the organizational structures, mechanisms for communication, and responsibilities of all PIs, CoPIs, and Senior Personnel.

**Supplementary Documents.** All participating organizations should demonstrate their commitment to the proposed project by providing letters of commitment included as Supplementary Documents. If a proposal requests support for one or more postdocs, a postdoc mentoring plan must be included as a Supplementary Document.

## B. Budgetary Information

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Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

## C. Due Dates

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- Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
  - April 27, 2011
  - Last Wednesday in April, Annually Thereafter
  - Type I and Type II proposals ONLY
- Full Proposal Target Date(s):
  - February 22, 2011
  - Last Tuesday in February, Annually Thereafter
  - Planning proposals ONLY.
- July 28, 2011
- Last Thursday in July, Annually Thereafter
- Planning proposals ONLY.

## 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. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: [http://www07.grants.gov/applicants/app\\_help\\_reso.jsp](http://www07.grants.gov/applicants/app_help_reso.jsp). 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?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: <http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>.

Mentoring activities provided to postdoctoral researchers supported on the project, as described in a one-page supplementary document, will be evaluated under the Broader Impacts criterion.

### Additional Solicitation Specific Review Criteria

Reviewers will be asked to assess the extent to which the proposed work addresses issues of underrepresentation. For example, reviewers will be asked to respond to the following questions: Does the proposal provide evidence for an understanding of demographics and issues of underrepresentation for its target population? Are those issues of underrepresentation adequately addressed in the proposed work? Is the project likely to be successful for the diverse population that it is designed to serve? Will it contribute to our understanding of how to best engage and retain students from the underrepresented groups?

NSF staff also 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.

## 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, Internal NSF Review, or Site Visit Review.

Type I and Type II proposals will be reviewed primarily by panels with occasional supplemental ad hoc reviews when the program officer believes that the panel discussions could benefit from additional expertise relevant to the proposal. In addition, Type II proposals may be asked to participate in a site visit or reverse site visit review.

Planning proposals will be reviewed internally by NSF program officers with external, *ad hoc* reviews as necessary.

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 [nsfpubs@nsf.gov](mailto:nsfpubs@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, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report 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. The project outcomes report must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

Additional Reporting Requirements:

CE21 PIs will be required to participate in and provide data to a program-wide evaluation. They will be required to keep the CE21 community apprised of their work by participating in PI/Community meetings and by maintaining an up-to-date website linked through the CE21 community portal.

## VIII. AGENCY CONTACTS

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Please note that the program contact information is current at the time of publishing. See program website for any updates to the

points of contact.

General inquiries regarding this program should be made to:

- Janice Cuny, Program Officer, CISE Directorate, 1175, telephone: (703) 292-8489, email: [jcuny@nsf.gov](mailto:jcuny@nsf.gov)
- Jeff Forbes, telephone: (703) 292-4291, email: [jforbes@nsf.gov](mailto:jforbes@nsf.gov)
- Jim Hamos, Program Officer, EHR Directorate, 835N, telephone: (703)-292-4687, email: [jhamos@nsf.gov](mailto:jhamos@nsf.gov)
- Mimi McClure, telephone: (703) 292-5197, email: [mmcclure@nsf.gov](mailto:mmcclure@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).

## 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

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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 Arctic 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: [nsfpubs@nsf.gov](mailto:nsfpubs@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

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