# Computing Education for the 21st Century (CE21)

## PROGRAM SOLICITATION
## NSF 12-527

## REPLACES DOCUMENT(S):
## 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 09, 2012

April 02, 2013

First Tuesday in April, Annually Thereafter

## IMPORTANT INFORMATION AND REVISION NOTES

This solicitation replaces NSF 10-619 and includes the following major revisions:

The solicitation requests proposals in three tracks-educational research, CS 10K, and broadening participation-that replace the original categorization of Type I, Type II, and Planning Grants.

Broadening Participation is no longer a separate Merit Review Criteria. Only the two standard NSF Merit Review Criteria apply. All proposals, though, should be informed by best practices and current literature on broadening participation.

The maximum award is now $600,000 total over 3 years or $1,000,000 total over three years, depending on the track.

The Organizational Restrictions have changed. Universities and colleges, nonprofits focused on educational or research activities, state education offices, and local school districts are eligible to apply.

**Important Reminders**

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.

**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

### General Information

**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 robust computing research community, a computationally competent 21st century workforce, and a computationally empowered citizenry. In this undertaking, there are three interrelated challenges: the significant underproduction of degrees needed for the computing and computing-related workforce, the longstanding underrepresentation of many segments of our population, and the lack of a presence of computing in K-12.

Innovation in information technology (IT) has driven economic growth, underlies many of our recent scientific advances, and ensures our national security; it is not surprising then that predicted IT job growth is very strong. Yet students are not majoring in computing in sufficient numbers. This shortfall is exacerbated by the longstanding underrepresentation of women, persons with disabilities, African Americans, Hispanics, Native Americans and indigenous peoples in computing. We cannot meet workforce demands without their participation and we cannot, in an increasingly competitive world economy, afford to cede the talents and creativity of so many. To ensure their participation, and the full participation of all students, we must provide better opportunities to study computing in K-12. We must start with a better understanding of how students learn computing. Unlike many of the other STEM (science, technology, engineering, and mathematics) disciplines, computing has not developed a robust research base on the teaching and learning of its fundamental concepts and skills. That research base must be built and it must be used in providing all students with rigorous academic curricula that cover computational concepts and skills, and the breadth of application and potential of computing. Providing access to rigorous, academic computing in K-12 will require an unprecedented effort to develop curriculum and materials and to prepare teachers.

CE21 thus supports efforts in three tracks:

***Computing Education Research*** (CER) proposals will aim to develop a research base for computing education. Projects may conduct basic research on the teaching and learning of computational competencies; they may design, develop, test, validate, and refine materials, measurement tools, and methods for teaching in specific contexts; and/or they may implement promising small-scale interventions in order to study their efficacy with particular groups. Efforts can focus on computational thinking as taught in computing courses or infused across the curriculum, they can target students or their teachers in informal or formal educational settings, or they can address any level within the K-16 pipeline, from elementary school through high school and college.

***CS 10K*** proposals will aim to develop the knowledge base and partnerships needed to catalyze the CS 10K Project. The CS 10K Project aims to have rigorous, academic curricula incorporated into computing courses in 10,000 high schools, taught by 10,000 well-trained teachers. CS 10K proposals can address a wide range of needed activities, including the development of course materials, pedagogy, and methods courses, as well as professional development and ongoing support for teachers, approaches to scaling, best practices for increasing the participation of students from underrepresented groups, and strategies for building K-12, university, and community partnerships.

***Broadening Participation*** (BP) proposals will aim to develop and assess novel interventions that contribute to our knowledge base on the effective teaching and learning of computing for students from the underrepresented groups: women, persons with disabilities, African Americans, Hispanics, Native Americans and indigenous peoples. Proposed interventions should be designed to engage and retain students from these groups and, at the same time, to increase their knowledge of computational thinking concepts and skills. Proposers are encouraged to leverage the resources provided by the existing BPC-A Alliances and to develop interventions that, if proven successful, could be implemented within a BPC-A Alliance. For additional information on the Alliances, see http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503593&org=NSF.

In aggregate, CE21 projects 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 empowered 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 Director, CISE Directorate, 1105, telephone: (703) 292-8900, email: jcuny@nsf.gov

- Jeff Forbes, Program Director, CISE Directorate, 1175, telephone: (703) 292-4291, email: jforbes@nsf.gov

- James E. Hamos, Program Director, EHR Directorate, 835, telephone: (703) 292-4687, email: jhamos@nsf.gov

- Mimi McClure, Associate Program Director, Office of Cyberinfrastructure, 1160, telephone: (703) 292-5197, email: 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

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

**Estimated Number of Awards:** 13 to 20 annually.

**Anticipated Funding Amount:** $13,000,000 per year (pending the availability of funds and the quality of proposals)

## Eligibility Information

**Organization Limit:**

Proposals may only be submitted by the following:

- 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.
- 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.
- State and Local Governments: State educational offices or organizations and local school districts.

**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 Senior Personnel. These eligibility conditions will be strictly enforced. In the event that an individual exceeds this limit, only the first two proposals received from that PI (or CoPI) will be accepted and the remainder will be returned without review. No exceptions will be made.

## Proposal Preparation and Submission Instructions

**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.
    - 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)

**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 09, 2012

    April 02, 2013

    First Tuesday in April, Annually Thereafter

## Proposal Review Information Criteria

**Merit Review Criteria:** National Science Board approved criteria apply.

## Award Administration Information

**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

Computing has permeated and transformed our lives. As computing becomes more important in all sectors of society, so does the preparation of a globally-competitive, 21st Century workforce poised to apply its foundational concepts, methods, and tools to a broad range of societal challenges and opportunities. There are three interrelated challenges in building and sustaining this workforce: underproduction, underrepresentation, and lack of a presence of computing in K-12.

Innovation in information technology (IT) has driven economic growth, underlies many of our recent scientific advances, and ensures our national security. IT job growth is predicted to be very strong. Yet students are not majoring in computing in sufficient numbers: current Bureau of Labor Statistics predictions and National Center for Educational Statistics data show that U.S. universities and colleges are producing only about 60% of the computing-related degrees that U.S. industry will need over the next decade. This shortfall is exacerbated by the longstanding underrepresentation of women, persons with disabilities, African Americans, Hispanics, Native Americans and indigenous peoples in computing. Together these groups make up almost 70% of our population. We cannot meet workforce demands without their participation, and we cannot, in an increasingly competitive world economy, afford to cede the talents and creativity of so many. To ensure their participation, as well as the full participation of *all* students, the computing community must address the lack of presence of computing in K-12. We must start with a better understanding of how students learn computing. Unlike many of the other STEM disciplines, computing has not developed a rich research base on the teaching and learning of its fundamental concepts and skills. That research base must be built and it must be used in the development of curriculum, materials, and teacher preparation in order to ensure that all students have the opportunity to learn computational concepts and skills, and to see the breadth of applications and potential of computing.

The CE21 program, thus, aims to integrate efforts that advance the field in addressing the interrelated issues of underproduction, underrepresentation, and the lack of a K-12 presence.

CE21 supports efforts on three tracks:

- *Computing Education Research* (CER) proposals aim to develop an educational research base for computing;
- *CS 10K* proposals aim to develop the knowledge base needed to catalyze the CS 10K effort to have rigorous, academic curricula incorporated into computing courses in 10,000 high schools, taught by 10,000 well-trained teachers; and
- *Broadening Participation* (BP) proposals aim to develop and assess small-scale interventions to engage and retain students from the underrepresented groups.

In aggregate, CE21 projects 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-empowered workforce.

# II. PROGRAM DESCRIPTION

**Vision**

The motivating vision for the CE21 program is of a robust computing research community, a computationally competent 21st Century workforce prepared to play a leadership role in the global innovation economy, and a computationally empowered citizenry. The program aims to increase the number and diversity of students who develop and practice computational competencies and are engaged and have the background in computing necessary to successfully pursue degree programs in computing-related and computationally-intensive fields of study

**Strategies**

To achieve these goals, CE21 will fund proposals on three distinct tracks.

**Track 1: Computing Education Research (CER).** CER proposals will contribute to the creation of a rich resource base that informs the computing community's understanding of effective teaching and learning in computing. Projects may, for example, conduct basic research on the teaching and learning of computational competencies; and/or they may design, develop, test, validate, and refine materials, measurement tools, and methods for teaching in specific contexts; and/or they may implement promising small-scale interventions in order to study the efficacy of those interventions with particular groups. Efforts may focus on computational concepts and skills as infused across the curriculum or as taught in computing courses, within informal or formal educational settings, and at the elementary, middle school, high school or college levels. Proposals must include a strong research component and the proposing team must include sufficient expertise in educational research. While the primary focus of a successful CER proposal will be education research, projects should be informed by the best practices and current literature on broadening participation.

CER research projects must contribute evidence-based findings to the body of knowledge on teaching and learning of computing within diverse student and teacher populations. The design of such a project necessarily begins with the identification of an evidence-based hypothesis about how computing is taught or learned. The proposal should then articulate a detailed research plan that describes the approach and methodology that will be used in testing that hypothesis. The research questions and design should be explicit and they should be clearly linked to the proposed work. A range of research and/or evaluation methods might be appropriate. A project might, for example, choose a research strategy of developing and improving approaches through iterative pilot tests. Research questions and methods would then focus on the systematic monitoring of teachers' and students' responses needed to inform the development process. Project evaluation activities might involve a small number of teachers and classrooms, and might document ways that evidence from pilot tests was used to refine the interventions. As another example, a project 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 then could provide evidence about what can be expected from the innovation when well-implemented, and could identify aspects of the implementation crucial to obtaining the desired outcomes. 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 other 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, and under what conditions it would be successful. All research data collected for a CER project should be disaggregated by gender, ethnicity, and disability status where appropriate.

**Track 2: CS 10K.** Projects from this track will develop the knowledge base needed to catalyze the CS 10K Project. The CS 10K Project aims to have rigorous, academic curricula incorporated into computing courses in 10,000 high schools, taught by 10,000 well-trained teachers. It is centered on CS Principles, an entirely new, proposed Advanced Placement (AP) course (Cuny, 2011), but also includes efforts to develop and deploy other introductory courses in high schools. CS 10K is not primarily a curriculum development program, instead it focuses on efforts that could lead to the widescale deployment of the CS Principles and other introductory level courses, with a particular emphasis on teacher preparation. Proposals can address a wide range of related activities: the development of course materials, models for online and remote delivery, pedagogy, teacher professional development and ongoing support, approaches to scaling, strategies for engaging and retaining students from the underrepresented groups, and strategies for building the needed partnerships. Proposers of CS 10K proposals are encouraged to draw on partnerships among the computing community, the teaching and learning community, institutions of learning, including primary, secondary and post-secondary institutions and organizations, and other stakeholders. Proposers are encouraged to include university researchers as partners. All proposed CS 10K efforts should be informed by the current literature on educational research, as well as the best practices and current literature on broadening participation. Successful proposals will likely address a narrow set of strategies that are well evaluated.

All CS 10K proposals must have detailed plans for evaluation that include student/teacher learning outcomes. Metrics and methodologies should be included and data should be disaggregated by gender, ethnicity, and disability status as appropriate. The evaluation should be designed and performed by an independent evaluator, though the data collection and other routine evaluation tasks may be carried out by other members of the project team. In most cases, the independent evaluator will be from outside the proposing institution, or at least from a different organizational unit than the PIs and CoPIs. The evaluator should receive sufficient funding to guarantee full participation. For further information on evaluation, proposers may want to consult the 2002 User Friendly handbook for Project Evaluation (http://www.nsf.gov/pubs/2002/nsf02057/start.htm) and other resources.

**Track 3: Broadening Participation (BP).** Proposals from the BP track will develop and assess small-scale interventions that contribute to our knowledge of effective teaching and learning of computing for students from the underrepresented groups: women, persons with disabilities, African Americans, Hispanics, Native Americans and indigenous peoples. Proposed interventions should be designed to enhance engagement and retention of students from the underrepresented groups at the elementary, secondary, undergraduate, or graduate levels and, at the same time, to increase their knowledge of computing, and/or computational skills. The interventions and evaluations should be designed to contribute evidence-based findings to our body of knowledge on teaching diverse student populations. It will not be sufficient, for example, to merely situate the work in schools with a high minority enrollment, or to include a member of an underrepresented group on the project team, or to propose interventions that appeal to "all students." While these are all potentially strong aspects of any proposal, successful BP proposals will likely also describe the demographics of their target audience, demonstrate knowledge of the relevant literature on underrepresentation and awareness of best practices and related efforts, have a concrete plan for improving representation, and have clear metrics and methodologies for documenting outcomes.

All BP proposals must have a detailed evaluation plan that includes assessments of student/teacher (and possibly faculty) learning outcomes and attitudinal changes disaggregated by gender, ethnicity, and disability status as appropriate. The evaluation should be designed and performed by an independent evaluator, though data collection and routine tasks can be carried out by other members of the project team. In most cases, the independent evaluator will be from outside the proposing institution, or at least from a different organizational unit than the PIs and CoPIs. The evaluator should receive sufficient funding to guarantee full participation. For further information on evaluation, proposers may want to consult the 2002 User Friendly Handbook for Project Evaluation (http://www.nsf.gov/pubs/2002/nsf02057/start.htm) and other resources.

BP proposers are also encouraged to leverage the resources provided by the existing BPC-A Alliances (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503593) and to develop interventions that, if proven successful, could be implemented within a BPC-A Alliance. All proposed efforts should be informed by the current literature on educational research.

**In Conclusion**

The scope of the CE21 program is intentionally broad. It encompasses educational research, engagement and retention activities, and 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, and aimed at students, as well as their teachers. Most CE21 proposals will need Institutional Review Board (IRB) approval from the participating institutions before an award can be made. 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. CE21 PIs 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 a 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 Directorate for Education and Human Resources (EHR). These include DRK-12, MSP, TUES, and REESE, but also Innovative Technology Experiences for Students and Teachers (ITEST), and Advanced Technological Education (ATE).

**References**

- Cuny, J. (2011) Transforming Computer Science Education in High Schools, *IEEE Computer*, June 2011 107-109.

## III. AWARD INFORMATION

We expect that $13 million will be made available in FY 2012 to support 13-20 awards. CER and BP projects will be funded at a level of up to $600,000 total over 3 years. CS 10K projects will be funded at a level of up to $1,000,000 total over 3 years. Estimated program budget, number of awards, and average award size/duration are subject to the availability of funds and the quality of the proposals. Each annual round of competition is expected to have a similar amount of funding available for awards.

## IV. ELIGIBILITY INFORMATION

**Organization Limit:**

Proposals may only be submitted by the following:

- 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.
- 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.
- State and Local Governments: State educational offices or organizations and local school districts.

**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 Senior Personnel. These eligibility conditions will be strictly enforced. In the event that an individual exceeds this limit, only the first two proposals received from that PI (or CoPI) will be accepted and the remainder will be returned without review. No exceptions will be made.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

## A. Proposal Preparation Instructions

**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. 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. 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). 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.

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:

- CER
- CS 10K
- BP

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 CER and BP projects. The body of the Project Description of a CS 10K project proposal 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 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. 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. Highlight the potential for successfully aligning the work with other similar programs, projects and efforts (NSF-supported or otherwise). Describe the 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. 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** (Required for CS 10K proposals only). 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. Describe the organizational structures, mechanisms for communication, and responsibilities of all PIs, CoPIs, and Senior Personnel.
>
> **Supplementary Documents.** The only documents that can appear as Supplementary Documents are the following:
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> - Letters of support that document the commitment of participating organizations unless otherwise covered in the Project Description.
> - A postdoctoral mentoring plan if the proposal requests support for one or more postdocs.
> - A Data Management Plan (required).
>
> No other Supplementary Documents are permitted.

## B. Budgetary Information

**Cost Sharing:** Inclusion of voluntary committed cost sharing is prohibited

## C. Due Dates

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

    April 09, 2012

    April 02, 2013

    First Tuesday in April, Annually Thereafter

## D. FastLane/Grants.gov Requirements

- **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. 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. 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. 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

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

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.

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

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

## A. Notification of the Award

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

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. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from 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.

## C. Reporting Requirements

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

*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 Director, CISE Directorate, 1105, telephone: (703) 292-8900, email: jcuny@nsf.gov

- Jeff Forbes, Program Director, CISE Directorate, 1175, telephone: (703) 292-4291, email: jforbes@nsf.gov

- James E. Hamos, Program Director, EHR Directorate, 835, telephone: (703) 292-4687, email: jhamos@nsf.gov

- Mimi McClure, Associate Program Director, Office of Cyberinfrastructure, 1160, telephone: (703) 292-5197, email: 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.

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.

## IX. OTHER INFORMATION

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 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**                 (703) 292-5111
  (NSF Information Center)**:**

- **TDD (for the hearing-impaired):**    (703) 292-5090

- **To Order Publications or Forms:**

      Send an e-mail to:                        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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The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (800) 281-8749

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