ADDITIONAL PERFORMANCE INFORMATION

External Evaluations

At the programmatic level, NSF directorates, divisions, and programs use the recommendations of external experts in its decision-making. During FY 2009, seventeen external evaluations of NSF's existing programs and strategic investments were published and include the results of studies, reports, and workshops commissioned by various programmatic offices within the National Science Foundation. The list is organized alphabetically by the NSF Directorate/Office that commissioned the evaluation, with evaluations commissioned by more than one Directorate/Office listed first.

	Directorate for Engineering (ENG) Directorate for Geosciences (GEO) Directorate for Social, Behavioral and Economic Sciences (SBE)
Letter Report Assessing the WATERS Network Science Plan ***Committee on the Review of the Water and Environmental Research Systems (WATERS) Network; National Research Council***	**Scope:** Review and comment on the WATERS Network Science Plan **Findings:** The plan presents a compelling case for the need for new work in natural science, social science, and engineering, but the committee found the question of whether the project should be established within the MREFC framework to be less clearly answered by the Science Plan. **Recommendations:** Consider charging the WATERS team to bolster its case that a national network is required. Consider if an alternative mechanism to MREFC could be used. **Follow-Up Actions:** Currently under internal review at NSF. **Availability:** http://www.nap.edu/catalog.php?record_id=12707

	Directorate for Engineering (ENG) Directorate for Mathematical and Physical Sciences (MPS) Department of Energy (DOE) Air Force Office of Scientific Research (AFOSR) Defense Threat Reduction Agency (DFTA)
International Assessment of Research and Development in Catalysis by Nanostructured Materials ***World Technology Evaluation Center (WTEC)***	**Scope:** • The purpose of the study was to assess international research and development activities in the field of catalysis by nanostructured materials, in order to benchmark NSF's related programs and provide input to planning for the future of these programs. • The methodology included a preliminary bibliometric analysis, a workshop to review the U.S. state of the art, and site visits by a panel of U.S. experts to over 40 research labs and companies in Western Europe and Asia. **Findings:** • Bibliometric analysis showed a growing focus on this subject around the world. Western Europe leads in publications in this field, while U.S. output is relatively stagnant. Published papers originating in China are growing exponentially. • Based on site visits and laboratory tours in Europe and Asia, cooperation between universities and companies in catalysis R&D is more common in Europe and Asia than in the U.S., presumably because of a more favorable intellectual property environment outside of the United States. • In the area of catalyst synthesis, there is substantial activity to develop microporous materials with controlled mesoporosity and to prepare nanosized particles with preferentially exposed crystal planes. • Rapid growth of Asian manufacturing industries is helping to fuel a similarly rapid growth in Asian R&D on catalysis • Europe remains a dominant force in catalysis R&D, supported by an overall investment in catalysis research that appears to be higher than that in the U.S. **Follow-Up Actions:** The National Academy of Science drew upon this report in their evaluation of the catalysis program in Basic Energy Science at DOE: "Catalysis for Energy: Fundamental Science and Long-Term Impacts of the U.S. Department of Energy Basic Energy Science Catalysis Science Program." The report remains a benchmark reference indicating that fundamental U.S. research in catalysis is lagging behind that in Europe and Asia. **Availability:** http://wtec.org/catalysis/WTEC-CatalysisReport-6Feb2009-color-hi-res.pdf

	Directorate for Engineering (ENG) **Directorate for Mathematical and Physical Sciences (MPS)** **Department of Energy (DOE)** **National Institutes of Health (NIH)** **National Aeronautics and Space Administration (NASA)** **National Institutes of Standards and Technology (NIST)** **Department of Defense (DOD)**
International Assessment of Research and Development in Simulation-Based Engineering and Science ***World Technology Evaluation Center (WTEC)***	**Scope:** • The purpose of the study was to assess international research and development activities in the field of simulation-based engineering and science (SBE&S), in order to benchmark NSF's related programs and provide input to planning for the future of these programs. • The methodology included a preliminary bibliometric analysis, a workshop to review the U.S. state of the art, and site visits by a panel of U.S. experts to 59 research labs and companies in Western Europe and Asia involved in SBE&S research. **Findings:** • SBE&S activities abroad are strong, and compete with or lead the U.S. in some strategic areas. • Both here and abroad, SBE&S is changing the way disease is treated, the way surgery is performed and patients are rehabilitated, and the way we understand the brain. It is changing the way materials and components are designed, developed, and used in all industrial sectors. And it is aiding in the recovery of untapped oil, the discovery and utilization of new energy sources, and the way we design sustainable infrastructures. • There is excitement around the world about the opportunities that petascale computers will afford, but concern about the ability to program them. • There are immediate opportunities to strengthen U.S. capabilities in SBE&S through strategic investments in industry-driven partnerships with universities and national laboratories; new and sustained mechanisms for supporting R&D in SBE&S; and a new, modern approach to educating and training the next generation of researchers in high performance computing, modeling, and simulation. **Follow-Up Action:** Results from WTEC study are being used to conceptualize potential programs within CMMI as well as collaborations with other government agencies. These include potential efforts on integrated computational materials engineering, multi-scale mechanics, and simulation based engineering for manufacturing and design. **Availability:** **http://wtec.org/sbes/SBES-GlobalFinalReport.pdf**

	Directorate for Biological Sciences (BIO)
Exploring Science Needs for Predicting Organismal Responses to Rapid Directional Environmental Change ***Don Ort, University of Illinois - Urbana***	**Scope:** Integrative Organismal Systems (IOS) division support for study of organismal response to rapid environmental change. **Findings:** Rapid environmental change (REC) will cause • changes in phenology and mismatches in coevolved relationships • species distribution and boundaries will be impacted • species trophic interactions will be disrupted **Recommendations:** • Role of extreme events in organism adaptation and community collapse should be evaluated • Management strategies (conservation vs. human subsistence, refugial/inoculum populations, directed migration) should be evaluated • Determinants of population fitness at boundary extremes should be identified • IOS should consider targeting funding to address organismal response to rapid environmental change

	Directorate for Education and Human Resources (EHR)
Impact of Transformative Interdisciplinary Research and Graduate Education on Academic Institutions ***May 2008 Workshop Report*** ***Prepared by: Westat, Carol Van Hartesveldt, and Judith Giordan***	**Scope:** to define the progress of interdisciplinary research and graduate education and their impacts on academic institutions **Findings:** • **Research** o Disciplines have often benefited from borrowing and working with researchers from other disciplines o Many current disciplines have grown out of previous interdisciplinary research o Funding agency's role: must maintain support of advances by core disciplinary research while also supporting research which cuts across disciplines • **Faculty** o Interdisciplinary activities may cause tension and weakening of traditional disciplinary relationships o New faculty run the risk of alienation from a disciplinary unit as a result of interdisciplinary activity o Interdisciplinary work requires a broader knowledge base as well as being more difficult to assess/evaluate o A shift in traditional evaluation criteria (publication status, numbers of students supervised, etc.) may encourage increased faculty interest in interdisciplinary research. • **Graduate Education** o Interdisciplinary and emerging fields are perceived to have a wealth of new career opportunities, which will emphasize flexibility and adaptability o Current and future needs for scientifically trained professionals who are able to solve more complex problems and bridge the gaps between disciplines o Typically students attracted to interdisciplinary graduate work are more creative and more apt to take greater risks as well as being more highly motivated o Number of graduate students is directly impacted with the number of faculty involved in the same research o Interdisciplinary research can be an effective means to broaden participation • **Academic Institutions** o Disciplines are not fixed in time but continue to evolve, so administrative and structural evolution is also necessary; new interdisciplinary departments are naturally evolving from cluster hires or centers o Policies pertaining to faculty incentives and rewards including tenure and promotion are often implemented in primary departments o International interest has been sparked by interdisciplinary

collaboration: various models are being developed and instituted abroad to exploit benefits.

Recommendations:

- **Research**
  - Universities should-organize discussions about research around discovery and addressing social challenges rather than framing within a given discipline
  - Consult with and learn from industry to learn how to achieve teamwork
  - Develop short-term, intermediate-term, and long-term measures of success across internal and external effects
  - Remove disincentives and create incentives for faculty engaged in interdisciplinary research
- **Faculty**
  - To encourage interdisciplinary work, universities should-develop mechanisms for faculty with traditional disciplinary expertise to learn and embrace interdisciplinary collaborations
  - Develop paths to reduce tension between disciplinary and interdisciplinary interests in hiring
  - Address incompatibility between traditional hierarchical administrative structures in new interdisciplinary cross-cutting programs
  - Reward successful interdisciplinary initiatives
  - Hiring appointments and assignments—increased transparency in regard to
    - Policies for tenure, promotion and raises
    - Faculty workload assignments shared across units (via MOU?)
    - Valuation of work with appropriate rewards
- **Graduate Education**
  - Undergraduates should be better prepared with sufficient breadth to undertake interdisciplinary research in graduate school
  - Mechanisms should be developed to support teamwork in graduate education and thesis research
  - Develop specific outcomes for skill development in the broad topic of professional skills
  - Make funding mechanisms with in universities more portable and guarantee multi-year support, as well as ensuring a mix of experiences
  - Utilize and build on successful collaboration from the past and use as models for the future
- **Academic Institutions**
  - Institutions must be strategic in planning for investment in interdisciplinary research and education based on their strengths, sizes, and types
  - New elements of promotion and tenure guidelines need to be added to include recognition and reward for contributions to interdisciplinary research and education

	o Continue to base interdisciplinary graduate education solidly in disciplinary programs while allowing for new programs to develop/evolve o Forge links between majority and minority institutions **Follow-up Actions:** In the next regularly scheduled issuance of the IGERT public solicitation, this workshop report will be referenced as important guidance to both proposers and their institutions. **Availability:** http://www.nsf.gov/pubs/2009/nsf0933/igert_workshop08.pdf [Integrative Graduate Education and Research Traineeship (IGERT)]

	Directorate for Education and Human Resources (EHR)
Robert Noyce Teacher Scholarship Program Evaluation Highlights ***The University of Minnesota*** ***September 2009***	**Scope:** To evaluate the effectiveness of the Robert Noyce Teacher Scholarship Program, the University of Minnesota Noyce Program evaluation project team was funded in 2005. The University of Minnesota Noyce program evaluation project has four major components: 1. preparation of an extensive literature review pertaining to effects of incentive programs in recruiting and retaining STEM K-12 teachers, 2. thematic synthesis of the existing evaluation information through content analysis of project reports, 3. statistical querying of the existing monitoring data to produce quantitative models of the program, and 4. development and execution of an overall program evaluation plan through collaboration with existing projects. **Findings:** Between FY 2002 and FY 2008, 135 awards have been made. These awards are projected to produce approximately 4,900 new science and mathematics teachers for the Nation's high-need school districts. Initial analyses of evaluation survey data suggest that the NOYCE program is achieving its intended goals. Highlights from the University of Minnesota evaluation include: • Approximately 90% of the PIs reported that the Noyce funding had increased their ability to recruit students with STEM content degrees and those committed to working in high needs schools. • 22% of scholars surveyed who are teaching reported they are already in leadership positions in their schools or districts. • 37% of Noyce Scholarship and Stipend recipients identified themselves as minorities. This compares to 9-14% minorities in the national teacher workforce, depending on subject and grade range. • The average GPA for Noyce recipients throughout the course of the program is 3.36. **Recommendations:** Further studies suggested in the University of Minnesota evaluation include longitudinal studies of NOYCE scholars as their careers progress (the FY2009 solicitation invites proposals that include plans for such studies); investigations of NOYCE's effect on recruitment into teacher preparation programs; and comparative studies of different types of

	preparation program activities and experiences in terms of which are most related to students remaining in high-need settings. **Follow-Up Actions:** Currently, a contract is being negotiated to engage in the studies recommended by the University of Minnesota evaluation report. As well, selected projects have instituted longitudinal studies of NOYCE scholars (apart from the expected studies under the new study contract). **Availability:** **http://www.cehd.umn.edu/EdPsych/NOYCE**

	Directorate for Education and Human Resources (EHR)
Learning Science in Informal Environments: People, Places, and Pursuits ***The National Research Council Committee on Learning Science in Informal Environments***	**Scope:** The Committee on Learning Science in Informal Environments was established to examine the potential of nonschool settings for science learning. The committee, comprised of 14 experts in science, education, psychology, media, and informal education, conducted a broad review of the literatures that inform learning science in informal environments. Its charge specifically included assessing the evidence of science learning across settings, learner age groups, and over varied spans of time; identifying the qualities of learning experiences that are special to informal environments and those that are shared (e.g., with schools); and developing an agenda for research and development. The committee organized its analysis by looking at the places where science learning occurs as well as cross-cutting features of informal learning environments. The "places" include everyday experiences—like hunting, walking in the park, watching a sunrise—designed settings—such as visiting a science center, zoo, aquarium, botanical garden, planetarium—and programs—such as after-school science, or environmental monitoring through a local organization. Cross-cutting features that shape informal environments include the role of media as a context and tool for learning and the opportunities these environments provide for inclusion of culturally, socially, and linguistically diverse communities. **Findings:** The committee concludes that: • Everyday experiences can support science learning for virtually all people. Informal learning practices of all cultures can be conducive to learning systematic and reliable knowledge about the natural world. Across the life span, from infancy to late adulthood, individuals learn about the natural world and develop important skills for science learning. • Designed spaces—including museums, science centers, zoos, aquariums, and environmental centers—can also support science learning. Rich with real-world phenomena, these are places where people can pursue and develop science interests, engage in science inquiry, and reflect on their experiences through sense-making conversations. • Programs for science learning take place in schools and community-based and science-rich organizations and include sustained, self-organized activities of science enthusiasts. There is mounting evidence that structured, nonschool science programs can feed or stimulate the science-specific interests of adults and children, may positively influence academic achievement for students, and may expand participants' sense of future science career options.

	• Science media, in the form of radio, television, the Internet, and handheld devices, are pervasive and make science information increasingly available to people across venues for science learning. Science media are qualitatively shaping people's relationship with science and are new means of supporting science learning. Although the evidence is strong for the impact of educational television on science learning, substantially less evidence exists on the impact of other media—digital media, gaming, radio—on science learning. **Recommendations:** **Recommendation 1:** Exhibit and program designers should create informal environments for science learning according to the following principles. Informal environments should • be designed with specific learning goals in mind (e.g., the strands of science learning) • be interactive • provide multiple ways for learners to engage with concepts, practices, and phenomena within a particular setting • facilitate science learning across multiple settings • prompt and support participants to interpret their learning experiences in light of relevant prior knowledge, experiences, and interests • support and encourage learners to extend their learning over time **Recommendation 2:** From their inception, informal environments for science learning should be developed through community-educator partnerships and whenever possible should be rooted in scientific problems and ideas that are consequential for community members. **Recommendation 3:** Educational tools and materials should be developed through iterative processes involving learners, educators, designers, and experts in science, including the sciences of human learning and development. **Recommendation 4:** Front-line staff should actively integrate questions, everyday language, ideas, concerns, worldviews, and histories, both their own and those of diverse learners. To do so they will need support opportunities to develop cultural competence, and to learn with and about the groups they want to serve. **Follow-Up Actions:** The NSF Informal Science Education (ISE) program specifically references the NRC report, to wit: *The ISE program seeks to expand its portfolio of projects conducting research about informal STEM learning, in order to build the theoretical and empirical foundations for effective informal learning activities and to inform strategic investments in the future. Such research projects could pursue a variety of key questions. For example the National Research Council report Learning Science in Informal Environments: People, Places, and Pursuits (National Research Council, 2009) provides a current synthesis of research and indicates a number of fruitful and*

	important possible directions for continued research focus. Some topics include: What are the characteristics of informal learning experiences that have demonstrable impact on public STEM understanding and literacy? What are the features of existing learning environments, materials, programs, or techniques that affect learning? What are appropriate cognitive and affective outcomes of informal science education initiatives (e.g., motivation, engagement, scientific identity) and can valid and reliable measurement tools be developed for those outcomes? **Availability:** http://books.nap.edu/catalog.php?record_id=12190

	Directorate for Engineering (ENG)
Research Experiences for Undergraduates (REU) in the Directorate for Engineering (ENG): 2003-2006 Participant Survey ***SRI International***	**Scope:** ENG has two major award types for REUs—Site and Supplement awards. ENG wanted a comparison of REU Sites funded by the Division of Engineering Education and Centers ("EEC Sites"), REU Supplements funded by Engineering Research Centers ("ERC Supplements"), and REU Supplements funded by other divisions within ENG ("ENG Supplements"). In addition, ENG wanted the study to assess differences among respondent groups (undergraduates and faculty mentors) and, for undergraduates, differences by sex and race/ethnicity. **Findings:** Positive effects on students include: • Gains in o Awareness, confidence, skills, and understanding; o Increased interest in related careers; and ▪ Among the several racial/ethnic groups, Hispanics and African-Americans were the most likely to report these various positive effects. o Raised academic expectations ▪ Prior to their REU experience, nearly 75% of students did not expect to pursue a PhD; at the end of their experience the percentage of students who still did not expect to pursue a PhD decreased to 50% • Undergraduates who were motivated to participate in research because they wanted help with career decisions, had enthusiasm for research, or had prior personal contact with researchers showed the highest gains in awareness, confidence, skills, and understanding. • Those involved in a variety of research-related activities, who had adequate time with a research mentor, and who gained increasing independence over the course of the research also showed higher gains in these areas. **Follow-Up Action:** Results of the comparison have been factored into the Division Strategic Plan. **Availability:** **http://www.sri.com/policy/csted/reports/university/documents/REU%20ENG%202003-2006%20Participant%20Survey%20Exec%20Summary.pdf**

	Directorate for Engineering (ENG)
Evaluation of the Research Experiences for Teachers (RET) Program: 2001-2006 ***Executive Summary*** ***SRI International***	**Scope:** In 2003, NSF contracted with SRI International (SRI) to evaluate the ENG RET Program. The primary objective was to better understand how the Program experiences of ENG RET participants affected their teaching techniques, attitudes about teaching, and professional development activities. Outcomes and impacts beyond the teachers' own classrooms, such as knowledge transfer activities, formal partnerships formed between the RET Principal Investigator (PI) and the teacher's school system/district also were examined. The study did not assess the impacts of RET on students, other than through participants' reports of Program impacts on their students. **Findings:** RET participation increased almost all participants' • STEM knowledge base (98%) • Awareness of STEM research methods, issues and career opportunities (89%) • Motivation to find ways to improve student learning (94%) • Ability to convey the excitement of STEM to students (92%) • Opportunities for professional development (83%) RET Participants reported positive effects on the approximate ~7500 students (67% High School, 22% Middle School) impacted over the assessment period, including: • Increased awareness of STEM career options • More positive attitudes about STEM subjects in general • More interest in participating teacher's classes **Recommendations:** • Evaluate the impact of RET on students; discuss possibility of formal evaluation at Engineering Grantees Meeting and at the RET session at the NSTA Annual Meeting in New Orleans, March 2009 • Need more community college involvement • Target small colleges, HBCUs, MSIs • Establish RET sites in the West where there are currently few. (There are no RET sites in CA, OR, UT, NV.) • Increase program funding for ERC-RET funding—perhaps through supplements • Involve other NSF Directorates and other agencies in ENG RET solicitation (revision planned Spring 2009)

	Follow-Up Actions: Results of the evaluation have been factored into the Division Strategic Plan **Availability:** **http://www.sri.com/policy/csted/reports/university/documents/RET3_ExecSum_07.pdf**

	Directorate for Engineering (ENG)
Bioengineering and Bioinformatics Summer Institutes (BBSI) Program: Results of Surveys of 2003–2006 Student and Faculty Participants and Survey of 2002 Non-Awardees Executive Summary ***SRI International***	**Scope:** This study was conducted through site visits, phone interviews with principal investigators (PIs) and BBSI directors, and through surveys of former BBSI students, faculty participants, and PIs whose proposals were not awarded. SRI surveyed 444 students2 and 152 faculty members who participated in the BBSI Program between 2003 and 2006. Also surveyed were the 21 PIs who applied for BBSI grants in the 2002 competition but who were not awarded. **Findings:** • Program is meeting its goal of attracting students to biomedical engineering and bioinformatics; approximately 15 students are currently trained annually at each of the 13 Institutes. • Degree expectations of participating students raised following summer experiences; and for BBSI, more than 90% of student participants indicated that the program helped prepare them for graduate school. **Recommendations:** • Support the second year option in the BBSI; • The program should continue to support hands on research; • The BBSI Program should continue to accept graduate students. **Follow-Up Actions:** Results of the evaluation have been factored into program planning. **Availability:** **http://www.sri.com/policy/csted/reports/university/documents/BBSI%20Executive%20Summary.pdf**

	Directorate for Engineering (ENG)
Evaluation of NSF's Faculty Early Career Development (CAREER) Program ***Abt Associates Inc.***	**Scope:** This study was designed to learn how individuals in host departments and at the NSF perceive CAREER's value and purpose, as well as to assess the impact of CAREER on awardees. Among the respondents interviewed were a sample of CAREER awardees and a comparison group of scholars who had also received NSF funding as a Principal Investigator, but who had not received the CAREER award. In the course of our study, respondents provided substantial feedback about the CAREER program in general and other issues they thought were germane. **Findings:** • Regarding tenure, ENG CAREER awardees had received tenure at a rate that is significantly higher than the non-engineering CAREER awardees. • ENG CAREER awardees had a far greater leverage of their award with opportunities to form partnerships with industry than did non-engineering awardees. **Follow-Up Action:** EEC will support activities to more formally recognize ENG CAREER awardees and will factor the findings into Division planning for CAREER activities. **Availability:** **http://www.abtassociates.com/Page.cfm?PageID=40898**

	Directorate for Engineering (ENG)
Early Outcomes of the National Science Foundation's Grants Program on "How People Learn Engineering" (HPLE) ***IDA Science and Technology Policy Institute (STPI)***	**Scope:** To assure the efficient investment of public funds in the coming years, the NSF Engineering Education and Centers Division (EEC) of the Directorate for Engineering asked the IDA Science and Technology Policy Institute (STPI) to examine a sample of NSF grants programs in engineering education, while also developing a master plan for longer term support for research in engineering education. STPI launched a six-month study in April 2008 to provide the NSF's Engineering Education program with a systematic review of the outcomes and impacts of active grants in three engineering education program areas: How People Learn Engineering; Department Level Reform; and Innovations in Engineering Education, Curriculum, and Infrastructure. **Findings:** • Based on review of NSF documents and expert interviews, STPI found that the How People Learn Engineering (HPLE) program has been effective in supporting grants that treat the range of topics outlined in the program description. • Analysis of the data show that each Department Level Reform (DLR) team accomplished significant curriculum reforms to make the engineering program more relevant, hands-on, and team-based using an approach customized to the specific needs of their institution. DLR appears to be successful in encouraging engineering departments to undertake and implement curriculum reform that introduced emerging areas of technology and teaching methods. • For Innovations in Engineering Education, Curriculum, and Infrastructure, a common set of performance metrics is planned in FY10 and regular assessments consistent with foundation-wide procedures will be implemented. **Recommendations:** <u>HPLE:</u> • Publication and citation analyses would be useful to demonstrate that HPLE-supported grantees actively publish their results in peer-reviewed journals – and that their work is cited. • Longitudinal outcome assessments are needed to track the extent to which HPLE-based ideas have been embraced by the engineering education community in the U.S. and abroad.

	IEECI: Invest in formal and longer-range assessments of the outcomes and impacts of engineering education (IEECI) grants. **Follow-Up Actions:** Future assessment of the IEECI program will be guided by the results of the STPI report on "Strategies for Evaluating Engineering Education Research," including, but not limited to, the following questions: • To what extent do the program design and activities fit with the Division's strategic direction, and are they likely to lead to the outcomes outlined in the theory of change? • To what extent does the program fit and is recognized within the community • To what extent is some fraction of the research portfolio translational in nature – i.e. focuses on translating theoretical ideas into classroom interventions **Availability:** **http://nsf.gov/eng/eec/EEC_Public/STPI_evaluation_HPLE_final.pdf**

	Directorate for Geosciences (GEO)
NSF MARGINS Decadal Review Committee Report ***MARGINS Decadal Review Committee, Chair: Professor Anthony Watts, Oxford University, U.K.***	**Scope:** To review the MARGINS Program in its entirety and provide Comments and recommendations to Assistant Director for Geosciences on its major accomplishments, remaining scientific gaps and future research opportunities and structure of the Program. **Findings:** The review determined that the MARGINS Program has made significant progress with several scientific breakthroughs in marine geoscience: • New understanding of the updip limit of the seismogenic zone • Identification of pore pressure transients associated with seismicity • Detailed imaging of a 'megasplay' fault system from a 3D seismic data set acquired offshore the Kii Peninsula • Development of numerical models to predict the thermal structure and flow field in the slab and wedge during subduction. • Utilization of these models to examine the interconnectivity of hydrology, metamorphism, mantle wedge flow, and arc magmatism. • Improving understanding of many key processes within subduction systems, particularly with regard to mantle melting, volatile cycling, and material fluxes. • Measuring the volatile contents of arc magmas and volatile fluxes out of arcs and demonstrating the relationship of these to progressive dehydration reactions in subducted materials and experimentally based melting models for the mantle wedge. • Documentation of the influence of pre-rift magmatism on subsequent breakup processes. • Establishment of a correlation between mantle *P*-wave velocity structure and the degree of magmatism in a rift. • Determination that strain localization can occur before *or* after the onset of seafloor spreading. • Integration of modeling with observations, leading to the recognizing the importance of small melt fractions on mantle viscosity and the effect of rapid sedimentation on syn-rift and early post-rift magmatism. • Integration of different techniques in a concerted effort to study tectonic complexities in the Gulf of California. • Demonstration that anthropogenic changes in land-use at the Waipaoa River margin have caused a significant increase in sediment production that has led to a *rapid* shift in the locus of deposition from the shelf to upper slope. • Development and application of numerical models that predict the self organization of the Fly River delta distributary channels in

response to interaction of the measured fluvial and tidal regimes.

- Utilization of quantitative modeling that shows how sediment routing, involving both flood plain aggradation and/or incision, on the Fly and Strickland Rivers has responded to the rise in sea level since the Last Glacial Maxima (LGM).

Recommendations:

- That the NSF set up a new themed program, MARGINS-2010, to follow on from the existing MARGINS program.
- That the new program is not restricted to active margins, but also addresses passive margins in the context of understanding how these margins are formed.
- That the new program continues to build on the focus site concept, but is flexible such that old sites can be wound down and new ones brought in as the science dictates.
- That the new program builds on the strengths of MARGINS and incorporates its SEIZE and SubFac initiatives and a new initiative which we dub a Rifts, Sediments and Fluids initiative (RSF).
- That the S2S initiative is not a standalone entity within MARGINS-2010, but is integrated explicitly into the SubFac and RSF initiatives.
- That large-scale computer modeling, laboratory experimental studies and studies of margin analogues in the rock record continue to be important elements of MARGINS-2010.
- That MARGINS-2010 continue to work productively with other large-scale NSF facilities and programs such as EarthScope, OOI, IODP and the new R/V *Marcus G. Langseth*.
- That the new program highlights links with societal issues such as climate, sea-level and environmental change, geo-hazards and energy and resources.
- That a new committee, the Steering and Oversight Committee, be set up to manage MARGINS-2010 which is dominated by academics, but includes representatives of the industry and the state/national surveys.
- That the Distinguished Lecture Program is expanded to include a highly visible, videoed, Public and University Lecture Series which is held in international institutions, especially those who will be collaborating in MARGINS-2010 research.
- That the current 5-year review timescale of MARGINS be retained in MARGINS-2010.

Follow-Up Actions:

The MARGINS Steering Committee has been funded to hold a community-wide workshop in February 2010 to determine the future directions of MARGINS research. An initial "Science Plan" for the future is seen as an outcome of this workshop.

	Availability: http://www.nsf-margins.org/Review2009/index.html

	Directorate for Mathematical and Physical Sciences (MPS)
Interdisciplinary, Globally-Leading Polymer Science and Engineering Workshop ***External Organizing Committee headed by Prof. Christopher Ober (Cornell U.)***	**Scope:** Examined the current status of and prospects for polymer science and engineering with a view toward the next decade. This was not an evaluation of any NSF program or activity, but rather of the broad field of macromolecular science and engineering. It was co-sponsored by seven other federal agencies. **Findings:** The US polymer field is a global leader and is well positioned to grow across the frontier. There are special research/education opportunities in the following broad areas: • Polymer synthesis and new materials; • Polymer characterization, structure, and properties; • Complex polymeric systems; • Macromolecular processing and assembly; • Theory and simulations; • Meeting global competitiveness; and • Broadening participation. **Recommendations:** • Sustain and enhance the intellectual breadth and richness of the field. • Develop in concert the synthetic, analytical, theoretical, and processing capabilities for new polymers. • Aim towards achieving the ability to tailor-make polymers. • Develop real-time, high-throughput, non-destructive multi-scale polymer characterization techniques. • Accelerate research in technology-focused, enabling polymer materials. • Reduce the environmental impact of polymeric materials. • Maintain an emphasis on diversity. • Create and enhance outreach and education programs to prepare diverse future generations of globally leading polymer scientists. • Increase efforts to modernize the multidisciplinary curriculum in polymer science and engineering. **Follow-Up Actions:** This report is being used as a guide to help identify promising opportunities in funding research in polymer science, as well as promoting education and broadening participation in the field, in accordance with its recommendations.

	It has also received high visibility, *e.g.* by becoming the subject of a 7-page perspective in a premier international journal in polymer science (Macromolecules). **Availability:** http://www.nsf.gov/mps/dmr/NSF_Polymer_Workshop.pdf, http://people.ccmr.cornell.edu/~cober/NSFPolymerWorkshop/index.html

	Directorate for Mathematical and Physical Sciences (MPS)
Inspired by Biology: From Molecules to Materials to Machines. ***Committee on Biomolecular Materials and Processes (BMAP) convened by the National Research Council (NRC) of the National Academies***	**Scope:** The BMAP was charged with assessing current work and future promise at the intersection of biology and materials science. **Findings:** Practical design of biologically inspired materials has the potential to improve the well-being of people everywhere and our nation's economic competitiveness by addressing some of the most urgent national challenges. Biomolecular materials and processes may improve medical therapeutics, allow the creation of reliable sensors to detect biological and chemical threats, and facilitate the transition to energy independence. To realize these opportunities and fully harness the potential of biology to inform the development of materials and processes, further advances in fundamental physics, chemistry, and materials science will be required. Three closely related strategies for the creation of new materials and systems may help to realize the potential of biomolecular materials and processes: • *Biomimicry.* This strategy relies on first learning the mechanistic principle used by a living system to achieve a particular function. One then attempts to adapt that principle to achieve similar function in a synthetic material. One example is the encoding of information into building blocks when they are synthesized. One can also try to create materials that mimic whole cells in their response to external stimuli. Such materials could be used in devices for detecting hazardous biological and chemical agents. • *Bioinspiration.* Merely knowing that a task can be achieved by a living system can inspire scientists to develop a synthetic system that performs the same function, even if the synthetic system uses a scheme quite different from that employed by the biological system. Nature provides examples of systems whose exceptional properties and performance might be replicated for all sorts of applications. The adhesive gecko's foot, the self-cleaning lotus leaf, and the fracture-resistant mollusk shell have all fueled interest in smart biological materials. Yet attempts to create synthetic analogs have been largely unsuccessful, in part because our fundamental understanding of the biological systems is limited. • *Bioderivation.* This strategy involves using an existing biomaterial in concert with an artificial material to create a hybrid. A prominent example is the incorporation of biologically derived proteins into polymeric assemblies for targeted drug delivery.

Recommendations:

- Recommendation 1: The Department of Energy (DOE), the National Institutes of Health (NIH), the National Science Foundation (NSF), and other relevant departments and agencies should jointly sponsor programs of innovative research at the intersection of different disciplines. Initiatives of this type will provide incentives for universities to work across traditional departmental boundaries. The Office of Science and Technology Policy (OSTP) should take the lead in coordinating such programs.
- Recommendation 2: University physics, chemistry, biology, materials science, mathematics, and engineering departments and medical schools should jointly examine their curricula, identifying ways to prepare scientists and engineers for research at the intersection of the physical sciences, engineering, and the life sciences. The educational programs being created should be evaluated from a wide range of viewpoints, including input from leaders in industry and at the national laboratories.
- Recommendation 3: DOE, NIH, NSF, and other relevant departments and agencies should support the development of 1- or 2-week summer courses to train physical scientists and engineers in the tools and concepts of biology and medicine and, conversely, biologists in the tools and concepts of the physical sciences. Special attention should be given to finding ways of communicating fundamental physicochemical concepts to biologists using the mathematical knowledge common to the biology community. Such summer courses would help bridge the physical and life sciences communities, allowing them to exploit research opportunities at the intersection of the fields.
- Recommendation 4: DOE, NIH, NSF, and other relevant departments and agencies should collaborate to link fundamental research with commercial applications. While it is imperative to recognize and exploit the connections between fundamental advances and opportunities to transition them into practice, curiosity-driven fundamental research on outstanding unsolved questions should be encouraged, because it could lead to unforeseen technological advances.
- Recommendation 5: DOE should continue to evaluate the effectiveness of recently created facilities to provide access to midrange instrumentation and computational facilities for the advancement of interdisciplinary research in nanoscience and technology. Based on what is learned from this evaluation, analogous, but distinct, centers could be created to facilitate research in biomolecular materials and processes.

	Follow-Up Actions: The NSF Division of Materials Research (DMR) was among the sponsors of this NRC report. At about the time the BMAP committee was convened (Summer 2006) DMR instituted a new program in Biomaterials. The Biomaterials program receives, reviews, and funds proposals relating to the preparation and characterization of biomaterials, the structure-property relationships that confer utility on biomaterials, and the applications of biomaterials. The NRC report has been used to inform the choice of topics to be supported by the DMR Biomaterials program. **Availability:** http://www.nap.edu/catalog.php?record_id=12159

	Office of Cyberinfrastructure (OCI)
Workshop: Sustainable Software as Cyberinfrastructure ***Jennifer Schopf in conjunction with OCI Program Directors***	**Scope:** This was a discussion and a focused workshop to add depth and definition to the NSF efforts to encourage software development and to place it within the scope of cyberinfrastructure to expand and extend sustainability/usability. **Findings:** • Terms need to be defined and placed into perspective • What works (successful projects in place) need to be identified, highlighted and the lessons learned assessed/disseminated • Reporting needs to be more robust • There is a serious need for educating the community, a community culture change • There is a need for a coherent architecture • There is a need for effective "exit strategy" that will encourage support beyond NSF funding **Recommendations:** • Current "Vision Document" that remains dynamic through the process • Next steps workshops co-organized by NSF, ACCI, and other agencies • Develop programs from workshop results in targeted areas • Make use of the lessons learned from others (NASA) • Match needs to requirements in solicitations **Follow-Up Actions:** The next phases of workshops are being planned. Task forces are conducting investigations, continuing dialog, and researching options to meet the needs of the findings and plan for implementation of recommendations.

EHR Program Metrics

Division of Research on Learning (DRL)

Program	Description	National Goals	Metric	Metric
ISE	The Informal Science Education (ISE) program supports projects that promote lifelong learning of STEM by the public through voluntary, self-directed engagement in STEM-rich informal learning environments and experiences. It invests in projects that advance knowledge through research and evaluation about STEM learning in informal environments; design, implement, and study models, resources, and programs for STEM learning in informal environments; and/or expand the capacity of professionals engaged in the work of informal STEM education.	ACC Goal Improve practice and build professional and institutional capacity (ACC Goal #2 of Informal Education and Outreach)	Number of professionals who use ISE-funded resources to improve their knowledge and/or practice (Adaptation of ACC national metrics for professional audiences)	Percent of development-intensive projects in the ISE program that employ appropriate evaluation methods and that apply them with appropriate rigor. (Adaptation of NSF K-12 PART metric)

Program	Description	National Goals	Metric	Metric
ITEST	The Innovative Technology Experiences for Students and Teachers (ITEST) program responds to current concerns and projections about the growing demand for professionals and information technology workers in the U.S. and seeks solutions to help ensure the breadth and depth of the STEM workforce. ITEST supports research studies to address questions about how to find solutions. It also supports the development, implementation, testing, and scale-up of implementation models. ITEST projects may include students or teachers, kindergarten through high school age, and any area of the STEM workforce. Projects that explore cyberlearning, specifically learning with cyberinfrastructure tools such as networked computing and communications technologies in K-12 settings, are of special interest. ITEST is supported by H-1B VISA fees.	ACC Goal Increase student engagement, awareness, and interest in STEM (ACC Goal # 3 of K-12 Education and ACC Goal # 1 of Informal Education)	Percent of ITEST student participants that demonstrate an increase in interest in science technology, engineering and math (STEM) and STEM careers. (ACC K-12 National metric #4 under Engagement)	Percent of development-intensive projects in the ISE program that employ appropriate evaluation methods and that apply them with appropriate rigor. (Adaptation of NSF K-12 PART metric)

Program	Description	National Goals	Metric	Metric
DR-K12	The Discovery Research K-12 (DR K-12) program promotes significant advances in K-12 student and teacher learning of the STEM disciplines through research about, and development and implementation of, innovative resources, models, and technologies for use by students, teachers, and policy makers. Activities funded under this solicitation begin with a research question or hypothesis about K-12 STEM learning or teaching; develop, adapt, or study innovative resources, models, or technologies; and demonstrate if, how, for whom, and why their implementation affects learning.	ACC Goal Increase student learning of STEM skills (ACC Goal #1 of K-12 Education)	Minimum number of resources (instructional programs, models, or interventions) developed by the DR-K12 program whose effectiveness has been examined using rigorous methods (NSF K-12 PART 2008)	Percent of development-intensive projects in the DR-K12 program that employ appropriate methods to evaluate efficacy and that apply them rigorously. (NSF K-12 PART 2008)

Program	Description	National Goals	Metric	Metric
REESE	Research and Evaluation on Education in Science and Engineering (REESE) supports basic and applied research and evaluation that enhances STEM learning and teaching. It supports two types of research – synthesis studies and empirical proposals. Synthesis studies identify areas where the knowledge base in either evaluation or research is sufficiently robust to support strong scientific claims, or identify areas important to education research and practice; projects propose rigorous methods for synthesizing findings and drawing conclusions. Empirical proposals identify areas that have the potential for advancing discovery and innovation at the frontiers of STEM learning.	<u>Education Research Goal</u> Conduct high quality research on student STEM learning at all ages and in all settings.	Number of REESE research projects with an interdisciplinary character, intended to improve knowledge about student learning in STEM. (Adaptation of ACC K-12 Program Metric for Student Learning to suit research program)	Percent of projects in the REESE portfolio that employ appropriate STEM education research methods and that apply them with appropriate rigor. (Adaptation of NSF K-12 PART metric)

Division of Human Resource Development (HRD)

Program	Description	National Goals	Metric	Metric
HBCU-UP	This program provides awards to enhance the quality of undergraduate science, technology, engineering, and mathematics (STEM) education and research at Historically Black Colleges and Universities (HBCUs) as a means to broaden participation in the Nation's STEM workforce. Support is available for Implementation Projects (including Achieving Competitive Excellence), Planning Grants, Education Research Projects, and Targeted Infusion Projects.	ACC Goal Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	Number of new STEM curricula, courses, and infusion of technology, to enhance instruction in HBCU-UP programs (program-specific metric)	Number of students in HBCU-UP programs who engage in research experiences in an academic, industry, government, or nonprofit laboratory (Adaptation of ACC Undergraduate Program Collaborative Communities metric)

Program	Description	National Goals	Metric	Metric
LSAMP	Louis Stokes Alliances for Minority Participation (LSAMP) emphasizes development of broad-based regional and national alliances of academic institutions, school districts, state and local governments, and the private sector to increase the diversity and quality of the STEM workforce. Eligible LSAMP undergraduate students may receive continued support for up to two additional years of STEM graduate study through the Bridge to the Doctorate (BD) Activity.	ACC Goal Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education)	Number/percentage of STEM student enrollment and baccalaureate degree attainment in LSAMP programs (Adaptation of ACC national metric)	Number of students transitioning to LSAMP Bridge to Doctorate (BD) program (program-specific metric)

Program	Description	National Goals	Metric	Metric
TCUP	The Tribal Colleges and Universities Program (TCUP) provides awards to enhance the quality of science, technology, engineering and mathematics (STEM) instructional and outreach programs at Tribal Colleges and Universities, Alaskan Native-serving Institutions and Native Hawaiian-serving institutions. Support is available for the implementation of comprehensive institutional approaches to strengthen STEM teaching and learning in ways that improve access to, retention within, and graduation from STEM programs. Through this program, assistance is provided to eligible institutions in their efforts to bridge the digital divide and prepare students for careers in information technology, science, mathematics and engineering fields.	ACC Goals 1) Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education) 2) Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	Number of new STEM curricula, courses, and infusion of technology, to enhance instruction (program-specific metric)	Number of STEM graduates with AAS or BS degrees from tribal colleges with TCUP support (Adaptation of ACC national metric)

Program	Description	National Goals	Metric	Metric
GSE	The Research on Gender in Science and Engineering (GSE) program supports efforts to understand and address gender-based differences in science, technology, engineering, and mathematics (STEM) education and workforce participation through research, the diffusion of research-based innovations, and extension services in education that will lead to a larger and more diverse domestic science and engineering workforce. Typical projects will contribute to the knowledge base addressing gender-related differences in learning and in the educational experiences that affect student interest, performance, and choice of careers, and how pedagogical approaches and teaching styles, curriculum, student services, and institutional culture contribute to causing or closing gender gaps that persist in certain fields.	Education Research Goal Conduct high quality research on gender equity at all grade levels and in all settings	Number of efficacy studies in GSE program using rigorous research designs (Adaptation of NSF K-12 PART metric)	Number/percentage of GSE projects that demonstrate successful replication/extension projects (program-specific metric)

Program	Description	National Goals	Metric	Metric
RDE	The Research in Disabilities Education (RDE) program seeks to broaden the participation and achievement of people with disabilities in all fields of science, technology, engineering, and mathematics (STEM) education and associated professional careers. Particular emphasis is placed on contributing to the knowledge base by addressing disability-related differences in secondary and post-secondary STEM learning and in the educational, social and pre-professional experiences that influence student interest, academic performance, retention in STEM degree programs, STEM degree completion, and career choices. Projects also investigate effective practices for transitioning students with disabilities across critical academic junctures, retaining students in undergraduate and graduate STEM degree programs, and graduating students with STEM associate, baccalaureate and graduate degrees.	ACC Goal Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education) Education Research Goal Conduct high quality research on accessibility/ disability in STEM	Number/percentage of students with disabilities in RDE-funded sites who declare and complete a STEM major or program of study (Adaptation of ACC national metric)	Number/percentage of students with disabilities in RDE-funded sites who participate in STEM career development and research activities (program-specific metric)

Program	Description	National Goals	Metric	Metric
AGEP	Alliances For Graduate Education And The Professoriate (AGEP) furthers the graduate education of underrepresented STEM students through the doctorate level, preparing them for fulfilling opportunities and productive careers as STEM faculty and research professionals. AGEP also supports the transformation of institutional culture to attract and retain STEM doctoral students into the professoriate.	ACC Goal Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education)	Number/percentage of underrepresented grad/postdoc fellows at AGEP institutions who complete a STEM grad/postdoc program (Adaptation of ACC national metric)	Number of AGEP graduates who pursue careers in academia (program-specific metric)

Program	Description	National Goals	Metric	Metric
CREST	Centers of Research Excellence in Science and Technology (CREST) program makes resources available to enhance the research capabilities of minority-serving institutions through the establishment of centers that effectively integrate education and research. CREST promotes the development of new knowledge, enhancements of the research productivity of individual faculty, and an expanded presence of students historically underrepresented in STEM disciplines.	ACC Goal Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	1) Improvement in research quality and productivity 2) Number/percentage of underrepresented students receiving Ph.D. degrees in STEM (Adaptation of ACC national metric)	Number of STEM publications, presentations and patents from CREST sties (program-specific metric)
ADVANCE	The goal of the ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE) program is to develop systemic approaches to increase the representation and advancement of women in academic STEM careers, thereby contributing to the development of a more diverse science and engineering workforce.	Goal Promote institutional transformation	Career induction and retention rates and number/percentage of women faculty in STEM disciplines in ADVANCE sites (Adaptation of ACC national metric)	1) Number of ADVANCE-sponsored publications/tools regarding equity in STEM workforce 2) Number of faculty engaged in ADVANCE activities (program-specific metrics)

Division of Graduate Education (DGE)

Program	Description	National Goals	Metric	Metric
GRF	Graduate Research Fellowships (GRF) provide three years of support for graduate study leading to research-based master's or doctoral degrees and are intended for students who are in the early stages of their graduate study. The program invests in graduate education for a cadre of diverse individuals who demonstrate their potential to successfully complete graduate degree programs in disciplines relevant to the mission of the National Science Foundation.	Goal Build STEM workforce	1) Number and/or percentage of graduate fellowship recipients who complete a STEM graduate program 2) Number and/or percentage of program completers who are employed in a STEM or STEM-related field 3) Number of contributions to the research enterprise (ACC metrics)	

Program	Description	National Goals	Metric	Metric
IGERT	Integrative Graduate Education and Research Traineeship (IGERT) has been developed to meet the challenges of educating U.S. Ph.D. scientists and engineers who will pursue careers in research and education, with the interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills to become, in their own careers, leaders and creative agents for change. The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries. It is also intended to facilitate diversity in student participation and preparation, and to contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce.	Goal Build STEM workforce	1) Number and/or percentage of graduate traineeship recipients who complete a STEM graduate program 2) Number and/or percentage of program completers who are employed in a STEM or STEM-related field 3) Number of contributions to the research enterprise (ACC metrics)	

Program	Description	National Goals	Metric	Metric
GK-12	The Graduate Teaching Fellows in K-12 Education (GK-12) program provides funding for graduate students in NSF-supported STEM disciplines to bring their leading research practice and findings into K-12 learning settings. Through collaborations with other graduate fellows and faculty from STEM disciplines, teachers and students in K-12 environments, and community partners, graduate students can gain a deeper understanding of their own research and place it within a societal and global context. The GK-12 program provides an opportunity for graduate students to acquire value-added skills, such as communicating STEM subjects to technical and non-technical audiences, leadership, team building, and teaching while enriching STEM learning and instruction in K-12 settings.	Goal Build STEM workforce	1) Number and/or percentage of graduate fellowship recipients who complete a STEM graduate program 2) Number and/or percentage of program completers who are employed in a STEM or STEM-related field 3) Number of contributions to the research enterprise (ACC metrics)	
SMP	The Science Master's Program (SMP) program prepares U.S. master's students with a strong foundation in STEM science and/or engineering who are exceptionally well-prepared for careers in the corporate, non-profit and government sectors.	Goal Build STEM workforce	1) Number and/or percentage of science master's fellowship recipients who complete a STEM graduate program 2) Number and/or percentage of program completers who are employed in a STEM or STEM-related field (Adaptation of ACC national metrics)	

Division of Undergraduate Education (DUE)

Program	Description	National Goals	Metric	Metric
ATE	With an emphasis on two-year colleges, the Advanced Technological Education (ATE) program focuses on the education of technicians for the high-technology fields that drive our Nation's economy. The program involves partnerships between academic institutions and employers to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions; and other activities. A secondary goal is articulation between two-year and four-year programs for K-12 prospective teachers that focus on technological education. The program also invites proposals focusing on applied research relating to technician education.	ACC Goals 1) Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education) 2) Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	Number of students who earn degrees or certificates in technical fields in projects supported by ATE (Adaptation of ACC national metric)	1) Number of professionals who participate in professional development activities supported by ATE to update teaching and/or disciplinary/technical expertise 2) Number of ATE-supported courses that integrate the use of instruments, methods, and procedures that are commonly used in industry (ACC metric)

Program	Description	National Goals	Metric	Metric
CCLI	Course, Curriculum, and Laboratory Improvement (CCLI) seeks to improve the quality of STEM education for all undergraduate students. It especially welcomes proposals that have the potential to transform undergraduate STEM education for all students. The program supports efforts to create, adapt, and disseminate new learning materials and teaching strategies to reflect advances both in STEM disciplines and in what is known about teaching and learning. It funds projects that develop faculty expertise, implement educational innovations, assess learning and evaluate innovations, prepare K-12 teachers, or conduct research on STEM teaching and learning. It also supports projects that further the work of the program itself, for example, synthesis and dissemination of findings across the program.	ACC Goal Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	Number of STEM and non-STEM students who enroll in and complete CCLI-supported STEM courses created or improved by new materials or innovative pedagogies (Adaptation of ACC national metric)	1) Number of CCLI-supported STEM faculty who engage in the development and/or implementation of curricular materials, instructional strategies, assessment tools, educational research and/or faculty development to improve undergraduate STEM education 2) Number of CCLI-supported STEM courses that have integrated advances in the disciplines, pedagogy, assessment, and/or research on student learning (program-specific metrics)

Program	Description	National Goals	Metric	Metric
Climate Change	The Climate Change Education (CCE) program catalyzes activity at the national level in four strands of education: public understanding and engagement; resources for learning; local and national STEM education policy; and preparation of a climate science professional workforce. The program draws in scientists and engineers from all of the fields that NSF supports, and ensures especially the involvement of climate scientists, researchers in STEM education, K-12 teachers, and STEM faculty.	ACC Goals 1) Increase awareness, interest, engagement and understanding of STEM concepts and processes. (ACC Goal # 3 of K-12 Education and ACC Goal # 1 of Informal Education) 2) Encourage and support STEM professional collaborations, networks, etc. (ACC Goal #2 of Undergraduate Education)	Number of CCE projects that emphasize awareness, knowledge, understanding of STEM concepts, processes or careers (Adaptation of ACC national metric)	1) Number of CCE-supported STEM faculty who engage in the development and/or implementation of curricular materials, instructional strategies, assessment tools, education research and/or faculty development. (program-specific metric)

Program	Description	National Goals	Metric	Metric
PAEMST	The Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST) is the highest recognition that a kindergarten through 12th-grade mathematics or science teacher may receive for outstanding teaching in the United States. Teachers are recognized for their contributions to teaching and learning and their ability to help students make progress in mathematics and science. In addition to honoring individual achievement, the goal of the award program is to exemplify the highest standards of mathematics and science teaching. Awardees serve as models for their colleagues, inspiration to their communities, and leaders in the improvement of mathematics and science education.	ACC National Goal (adapted) Professional Audiences: Improve practice and build professional and institutional capacity.	Improved awareness, knowledge, and understanding of effective STEM teaching practices in PAEMST community (Adaptation of ACC Professional Audiences metric in Outreach)	Number of high quality finalists per year (program-specific metric)
PAESMEM	The Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring PAESMEM honors individuals and institutions that have enhanced the participation of underrepresented groups—such as women, minorities and people with disabilities—in science, mathematics and engineering education at all levels. All are highly regarded mentors and have pioneered innovative and resourceful programs to broaden opportunities in science, mathematics and engineering for underrepresented students at all levels.	ACC National Goal (adapted) Professional Audiences: Improve practice and build professional and institutional capacity.	Improved awareness, knowledge, and understanding of effective practices in enhancing participation of groups underrepresented in STEM. (Adaptation of ACC Professional Audiences metric in Outreach)	Number of nominations (individuals and/or organizations) that are recognized as national models for mentoring per year (program-specific metric)

Program	Description	National Goals	Metric	Metric
MSP	The Math and Science Partnership (MSP) program is a major research and development effort that supports innovative partnerships to improve K-12 student achievement in mathematics and science. MSP projects are expected to raise the achievement levels of all students and significantly reduce achievement gaps in the mathematics and science performance of diverse student populations.	ACC Goals 1) Increase student learning of STEM skills (ACC goal #1 for K-12 Education) 2) Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	For MSP (Math and Science Partnership Program) projects focused on mathematics, percentage of MSP schools meeting Adequate Yearly Progress (AYP) in mathematics. (NSF K-12 PART metric 2008)	1) Number of higher education STEM faculty, all higher education faculty and higher education administrators engaged in MSP projects 2) Number of teachers engaged in MSP professional development (program-specific metric) 3) Number of institutional awards supported by ARRA (ARRA) 4)Total number of unique teacher leaders/master teachers in mathematics and science (ARRA) 5)Number of unique teacher leaders/master teachers in mathematics and science, and teachers with post-baccalaureate credentials teaching in high-need districts by years of teaching (ARRA)

Program	Description	National Goals	Metric	Metric
NOYCE	The Robert Noyce Teacher Scholarship Program (NOYCE) program seeks to encourage talented science, technology, engineering, and mathematics majors and professionals to become K-12 mathematics and science teachers. The program provides funds to institutions of higher education to support scholarships, stipends, and academic programs for undergraduate STEM majors and post-baccalaureate students holding STEM degrees who commit to teaching in high-need K-12 school districts. A new component of the program supports STEM professionals who enroll as NSF Teaching Fellows in master's degree programs leading to teacher certification by providing academic courses, professional development, and salary supplements while they are fulfilling a four-year teaching commitment in a high need school district. This new component also supports the development of NSF Master Teaching Fellows by providing professional development and salary supplements for exemplary math and science teachers to become Master Teachers in high need school districts.	ACC Goal Improve teacher knowledge and recruit and retain teachers with STEM backgrounds (ACC Goal #2 for K-12 Education)	Number of STEM majors and STEM professionals preparing to become teachers and supported by Noyce (Adaptation of ACC national metric)	1) Number of Master Teachers supported by Noyce (program-specific metric) 2) Number and/or percentage of Noyce participants who are teaching in high-need school districts (program-specific metric) 3) Total number of unique pre-service teacher and teacher participants who received Noyce Program support. (ARRA) 4)Number of institutional awards supported by ARRA (ARRA)

Program	Description	National Goals	Metric	Metric
SfS	The Federal Cyber Service: Scholarship for Service (SfS) program seeks to increase the number of qualified students entering the fields of information assurance and computer security and to increase the capacity of the United States higher education enterprise to continue to produce professionals in these fields to meet the needs of our increasingly technological society.	ACC Goal Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education)	1) Number and/or percentage of students with SfS support who declare and complete a STEM major or program of study 2) Number and/or percentage of SfS STEM graduates who take a job in a STEM or STEM-related field (Adaptation of ACC national metrics)	1) Number and/or percentage of SfS supported professionals employed in information assurance (STEM) positions in the federal government upon graduation (program-specific metric) 2) Number and/or percentage of SfS supported professionals employed in information assurance positions in the federal government after fulfilling scholarship requirements (program-specific metric)

Program	Description	National Goals	Metric	Metric
S-STEM	Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) makes grants to institutions of higher education to support scholarships for academically talented, financially needy students, enabling them to enter the workforce following completion of an associate, baccalaureate, or graduate-level degree in science and engineering disciplines. Grantee institutions are responsible for selecting scholarship recipients, reporting demographic information about student scholars, and managing the S-STEM project at the institution.	ACC Goal Increase in graduates for STEM workforce (ACC Goal #1 of Undergraduate Education)	Number and/or percentage of S-STEM students who declare and complete a STEM major or program of study (Adaptation of ACC national metric)	Number and/or percentage of S-STEM graduates who take a job in a STEM or STEM-related field (Adaptation of ACC national metric)

Program	Description	National Goals	Metric	Metric
STEP	Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) seeks to increase the number of students (U.S. citizens or permanent residents) receiving associate or baccalaureate degrees in established or emerging fields within science, technology, engineering, and mathematics (STEM). Type 1 proposals are solicited that provide for full implementation efforts at academic institutions. Type 2 proposals are solicited that support educational research projects on associate or baccalaureate degree attainment in STEM.	ACC Goal Increase in number of graduates for STEM workforce (ACC Goal #1 of Undergraduate Education)	Number and/or percentage of students in STEP sites who declare and complete a STEM major or program of study (Adaptation of ACC national metric)	Number of students in STEP sites studying toward and completing undergraduate degrees in STEM in institutions receiving STEP funding (program-specific metric)
REU	The Research Experiences for Undergraduates (REU) program supports active research participation by undergraduate students in any of the areas of research supported by NSF. REU projects involve students in meaningful ways in ongoing research programs or in research projects specifically designed for the REU program.	ACC Goal Develop and advance institutional capacity (ACC Goal #3 of Undergraduate Education)	Number of REU students who engage in research experiences in an academic, industry, government, or nonprofit laboratory (Adaptation of ACC national metric)	