Description of document:	A copy of each response to a Question for the Record (QFR) provided to Congress by the National Science Foundation (NSF), 2012-2015
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Source of document:	National Science Foundation Attn: FOIA Officer 2415 Eisenhower Avenue Alexandria, Virginia 22314 Fax: (703) 292-9041 Email: foia@nsf.gov

NATIONAL SCIENCE FOUNDATION
2415 Eisenhower Avenue
Alexandria, Virginia 22314

OFFICE OF THE
GENERAL COUNSEL

February 12, 2018

Case #14-219F

This is the final response regarding your June 15, 2014 FOIA request for "a copy of each response to a Question for the Record provided to Congress by the National Science Foundation." You asked that we provide "records created since January 1, 2009," however you stated that "if this will produce voluminous records, please limit the request to records created since January 1, 2012."

A search was conducted and due to the volume of records located, we are enclosing records from 2011 – FY 2015 per your instructions. The records are being released to you in their entirety. Your right of administrative appeal is set forth in Section 612.9 of the NSF FOIA regulation (copy enclosed). Your appeal must be postmarked or electronically transmitted within 10 days of the date of the response to your request.

If you need any further assistance or would like to discuss any aspect of your request, please do not hesitate to contact our FOIA Public Liaison at 703-292-8060. Additionally, you may contact the Office of Government Information Services (OGIS) which was created to offer mediation services to resolve disputes between FOIA requesters and Federal agencies as a non-exclusive alternative to litigation. Using OGIS services does not affect your right to pursue litigation. If you are requesting access to your own records (which is considered a Privacy Act request), you should know that OGIS does not have the authority to handle requests made under the Privacy Act of 1974. You may contact OGIS in any of the following ways:

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College Park, MD 20740-6001

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Sincerely,

Sandra Evans
FOIA/Privacy Act Officer

Enclosures

The Honorable Susan M. Collins
Full Appropriations Hearing on Innovation in the FY 2015 Budget Request
Questions for the Record

(*Director Cordova*) Director Cordova, the Experimental Program to Stimulate Competitive Research (EPSCoR), which is administered by NASA, the Department of Energy, and your organization, the National Science Foundation, has played a critical role in helping to advance our nation's research infrastructure and integrated STEM workforce development efforts.

In my state, EPSCoR is housed at the University of Maine at Orono, but the funding has facilitated collaboration among institutions statewide and has enabled colleges, universities, and researchers to forge partnerships with private, non-profit, and governmental sectors.

NSF EPSCoR grants have been particularly beneficial to Maine. For example, in 2006, Maine ESPCoR received NSF seed funding to initiate a Forest Bioproducts Research Institute with the goal of creating and commercializing wood bioproducts while maintaining forest health. Before long, industry recognized the great R&D work that the FBRI was conducting and forged a technology transfer partnership—resulting in major private capital investments and the establishment of a full-fledged research institute and technology center. The FBRI has brought over $3.5 million in new capital equipment to Maine and produced 11 patents. Perhaps more important, however, than the development of new technologies is the development of a STEM-ready workforce.

The public-private partnerships between the FBRI and industry have supported more than 100 graduate, undergraduate, and high school research internships, and integrated more than 5,000 students into its STEM outreach activities.

What role do you see EPSCoR playing in helping states to develop self-sustaining academic research enterprises that not only produce new technologies but also prepare students for employment in STEM fields?

The Honorable Frank R. Wolf
Chairman, Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on Federal Investments in Neuroscience
Witness: Dr. John Wingfield

1. NSF has decided to support The BRAIN initiative primarily through existing programs that can be used to address neuroscience research rather than creating something new just for BRAIN awards. What is the rationale behind this strategy? How will you control the direction of the initiative if its implementation is spread out across many different NSF programs?

NSF's key strength regarding The BRAIN Initiative is that it currently funds neuroscience research and technology development relevant to The BRAIN Initiative through successful programs across a very wide range of science and engineering discipline areas. As NSF has written in our recent budget requests, a central challenge is to integrate the approaches, skills, knowledge and results from across these disciplines to accelerate progress on understanding the brain. In essence, a new transdisciplinary research community must be developed. NSF is fortunate to have many existing funding mechanisms to draw on immediately to promote this integration and workforce development at the investigator level, including Research Coordination Networks, research centers, workshop support, as well as domestic and international training opportunities.. In FY 2015 and over the longer term, as this transdisciplinarity and integration develops, opportunities may arise to create specific, targeted opportunities related to The BRAIN Initiative as appropriate.

In order to drive the above cross-disciplinary integration in the science community, NSF has taken steps to enhance the Foundation's own internal coordination. Beginning in FY 2012, NSF established several internal bodies to coordinate the Cognitive Science and Neuroscience cross-cutting activities, including The BRAIN Initiative. This coordination has been outlined most recently in our FY 2015 Budget Request, and includes NSF's engagement in interagency neuroscience activities. A high-level Steering Committee on Understanding the Brain is staffed with a senior representative from each participating directorate and reports regularly to NSF senior management. The Steering Committee oversees two working groups, one devoted to The BRAIN Initiative and the other to the additional research areas pertaining to cognitive science and neuroscience. These working groups are staffed by cognizant program officers representing each participating directorate, and are charged with identifying priorities, appropriate funding approaches, and mechanisms. For instance, The BRAIN Initiative Working Group developed the set of NSF-specific research foci for The BRAIN Initiative that were reviewed by the Steering Committee, approved by NSF senior management, and posted on the new NSF website "Understanding the Brain", www.nsf.gov/brain. Finally, NSF's representatives on the NSTC Interagency Working Group on Neuroscience (IWGN) are members of either the NSF Steering Committee (including one of the IWGN Co-Chairs and the IWGN Executive Secretary) or one of the two above working groups.

2. How comprehensive is the cognitive science and neuroscience crosscutting theme in NSF's budget? Are there any significant cognitive science or neuroscience activities at NSF that are not included in this theme and, if so, why? What is the relationship between the BRAIN initiative budget line item and the cognitive science and neuroscience budget theme?

The Cognitive Science and Neuroscience cross-cutting theme is broad and comprehensive, with participation of five science and engineering directorates. There are no relevant scientific areas that are specifically excluded from this broad activity. Thematic areas and goals are defined and discussed in the Cognitive Science and Neuroscience narrative in the NSF-Wide Initiatives section of the NSF FY 2015 Budget Request.

New requested funds for The BRAIN Initiative activities fall within the Cognitive Science and Neuroscience umbrella: in FY 2015, NSF is requesting $29 million for new Cognitive Science and Neuroscience activities, $20 million of which will be devoted to activities related to The Brain Initiative.

In keeping with the technological emphasis of The BRAIN Initiative as announced by the President, the NSF's thematic activities for The BRAIN Initiative are mainly concentrated on development of enabling technologies, experimental and computational methods, models, and comparative and integrative approaches for accelerating the detailed study of the brains of humans and other organisms. A Dear Colleague Letter issued in March 2014 to solicit research ideas to enable innovative neurotechnologies to reveal the functional and emergent properties of neural circuits underlying behavior and cognition elicited almost 600 responses. The majority of these were cross-disciplinary, multi-investigator, and NSF specific.

The Honorable John Carter
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on Federal Investments in Neuroscience
Witness: Dr. John Wingfield

1. How can we ensure that federal investments in biomedical research along with large scale brain mapping yield not just new data but lead to actual treatments?

2. What are the interagency cooperation and coordination policies of the BRAIN initiative? What efforts are being made to provide transparency on how taxpayer dollars are being spent?

Since these questions were directed to both NSF and OSTP, the OSTP response includes the pertinent input from NSF.

The Honorable Mario Diaz-Balart
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on Federal Investments in Neuroscience
Witness: Dr. John Wingfield

1. Dr. Wingfield, as you move forward with investments in neuroscience research, how are you planning on engaging research institutions that work with diverse populations so that your research outcomes can be more complete and more reflective of the country as a whole?

NSF does its utmost to ensure that all types of institutions — from major research universities to community colleges — are represented as far as possible. NSF is committed to developing a diverse STEM workforce by increasing access for currently underrepresented groups to STEM education and careers through our investments in research and education.. For instance, the recent Science and Technology Center that NSF funded, "Brains, Minds, and Machines", has three Minority-serving Institutions associated with it.

United States House of Representatives
Subcommittee on Coast Guard and Maritime Transportation
Hearing on Implementing U.S. Policy in the Arctic
July 23, 2014
National Science Foundation Responses to Questions for the Record

John Garamendi and Rick Larsen

Antarctic Breakout Needs

The National Science Foundation (NSF) has relied on an assortment of icebreakers to conduct the annual break-out to resupply research stations on the Antarctic continent. Nevertheless, you seem to imply in your written statement that you prefer to have the Coast Guard provide this capability.

- *Why? Do you feel institutionally bound to utilize an asset from another Federal agency before looking elsewhere?*
- *Are there features on the Coast Guard icebreakers that better address the needs of NSF?*
- *What have been the disadvantages to NSF in having to contract out with foreign governments or private contractors to acquire icebreaking services?*

Historically, the U.S. Coast Guard has provided heavy icebreaker services on a cost reimbursable basis as stipulated in Presidential Memorandum 6646 governing the U.S. Antarctic Program: "*To ensure that the United States has the necessary flexibility and operational reach in the area, the Departments of Defense and Transportation shall continue to provide, on a reimbursable basis, the logistic support requested by the National Science Foundation and to develop, in collaboration with the Foundation, logistic arrangements and cost structure required for effective and responsive program support at minimum cost.*"

Between 2005 and 2013, there were several years when the USCG's polar icebreakers were unable to conduct the mission on their own. NSF then leased foreign vessels to break the channel through McMurdo Sound, either alone or with a USCG vessel on standby. In 2012, when the Swedish government decided that the icebreaker ODEN would not be available to complete the Antarctic break-in mission, NSF found alternative arrangements. Regardless of the arrangement, mission requirements have always been met. Ideally, the critical resupply of the U.S. national program would be under U.S. control and be cost effective.

In 2014, the refurbished USCGC POLAR STAR completed the break in mission on its own and is expected to do so for the next 6 to 9 years, although ice conditions or maintenance problems could require additional assets.

Icebreakers as Research Platforms

The Coast Guard has expressed concern that one of the principal factors driving up the cost of building a new heavy icebreaker are the mission requirements of other Federal agencies, including the requirements of NSF, that add to the complexity and cost of a new vessel.

- *What specific features does NSF need in an icebreaker other than to have the vessel break ice to reach remote, inaccessible area? Are icebreakers suitable platforms for science research?*

- *Does NSF really need the services of a heavy icebreaker just for the resupply of its Antarctic stations? Are the other two vessels that NSF charters, the NATHANIEL B. PALMER and the LAWRENCE M. GOULD sufficient to address NSF's research needs?*

NSF has been clear that any new USCG vessel should be optimized for heavy icebreaking and not for supporting science. The design for any such vessel should also ensure efficient, economical, and reliable operations and would not, for example, have a requirement to ballast with fuel that must be taken from McMurdo Station's fuel farm in order to conduct icebreaking activities.

In the Arctic, NSF funded-research projects require the services of ice-capable research vessels. NSF draws services from a network of potential vessel providers. These include the U.S. Coast Guard (USCG), which provides medium icebreaking capability and ship-based research support through the USCGC HEALY. Additionally, vessels are scheduled through the University-National Oceanographic Laboratory System (UNOLS), including the new NSF light icebreaking research vessel SIKULIAQ that is scheduled to commence operations in 2015 out of Seward, AK. Services likewise are drawn through the Coast Guards of other countries, charters of foreign vessels, and arrangements with international partners.

In the Antarctic, research needs are being met predominantly via the light icebreaking research vessel PALMER and the ice-reinforced GOULD (both leased by NSF's Antarctic Support Contractor). Both ships are outfitted with state of the art equipment and technical support for science. The GOULD also serves to resupply and move personnel for Palmer Station that is only accessible by sea and can only accommodate a shallow draft vessel at the pier. Additional research support is provided via UNOLS vessels and foreign vessels of international partners through a variety of arrangements. Note that neither PALMER nor GOULD alone or in concert is sufficiently ice-capable to conduct the break-in of the channel necessary for resupplying McMurdo station. The break-in of the channel requires a significantly more powerful icebreaker.

NSF has a long history of supporting science at sea on board NSF-owned research vessels outfitted with the latest oceanographic instrument and equipment. NSF also funds scientific endeavors onboard vessels of opportunity (VOP), as described below.

Observations from VOP are particularly important in under sampled regions such as the Arctic and Southern Oceans. Polar Programs at NSF is highly experienced with and remains committed to partnering with our sister agencies and international partners to achieve observations of opportunity. We would welcome the opportunity to continue to join forces with the USCG to ensure appropriate and quality observations are made from their vessels in polar regions within the constraints of their primary mission drivers.

Science aboard VOPs tends to have limited impact on the day-to-day operations and does not interfere with the overall design of the vessels. In many cases, data collection can occur through small, non-intrusive sensors and data loggers mounted on vessel masts or bridge decks. Some scientific systems can be fully contained in portable, modular containers mounted on vessel decks. In other cases, non-recoverable instruments can be hand-deployed off a ship's stern, in some cases without even requiring the vessel to slow down. Examples of science that is performed aboard vessels of opportunity include:

- Automated collecting and transmitting real-time atmospheric and weather data to include in global weather monitoring and forecasting (http://samos.coaps.fsu.edu/html/mission.php);

- Automated atmospheric O_2/CO_2 measurements that can also be relayed in real time (http://www.pmel.noaa.gov/co2/story/Volunteer+Observing+Ships+%28VOS%29)
- Launch of floats for climate variability studies throughout the world's oceans (http://www.argo.ucsd.edu/);
- Launch of expendable temperature and conductivity probes (XBT/XCTD), and other disposable sampling equipment;
- Launch of gliders and other autonomous vehicles;
- Marine mammal and/or bird observations;
- Scientific diving to collect marine fauna and perform under-ice studies;

Depending on the equipment already installed, some VOPs are able to support more moderately complex scientific efforts. For vessels equipped with cranes, technical personnel can be deployed aboard the vessel to perform mooring or autonomous vehicle recoveries and/or turn-arounds. In addition, vessels equipped with helicopters and/or small boats can further assist science by deploying scientific personnel to ice camps or remote field locations.

The National Science Foundation has continued to work closely with other ship-operating US Government agencies to identify and maximize the types of science that can be performed from a wide range of vessel types. Most recently, NSF contributed to the 2013 OPNAV document, *Arctic Science Accommodation Mission (SAM): Surface Ships*, which identified mission package components for Navy Arctic S&T Modules that could be easily deployed aboard Naval vessels of opportunity.

United States House of Representatives
Subcommittee on Coast Guard and Maritime Transportation
Hearing on Implementing U.S. Policy in the Arctic
July 23, 2014
National Science Foundation Responses to Questions for the Record

Duncan Hunter

Shipping / Icebreakers

Icebreakers are essential equipment as it relates to the execution of a variety of Arctic activities, including the maintenance of US domestic security. Their growing importance is demonstrated by the investment programs undertaken by other Arctic nations; Russia has a fleet of eight service-ready nuclear powered icebreakers, with a ninth under construction. China owns the world's largest non-nuclear icebreaker and has just launched a second. Canada has committed $38 billion to build additional vessels[1]. In contrast, the US has only two polar-class icebreakers, with a third chartered from the private sector.

Do you believe that we have sufficient capability? Do you have a view on why we aren't we investing as much as other nations in what is an increasingly important area?

The National Science Foundation's (NSF) primary mission is to fund basic scientific research. In the Polar Regions, NSF's need for icebreaker capabilities is thus determined by the demand for scientific research and its related support. To date, NSF has been able to meet the demand for polar scientific research and its related support using available icebreaker capabilities.

In the Arctic, NSF funded-research projects require the services of ice-capable research vessels. NSF draws services from a network of potential vessel providers. These include the U.S. Coast Guard (USCG), which provides medium icebreaking capability and ship-based research support through the USCGC HEALY. Additionally, vessels are scheduled through the University-National Oceanographic Laboratory System (UNOLS), including the new NSF ice-capable research vessel SIKULIAQ that is scheduled to commence operations in 2015 out of Seward, AK. Services likewise are drawn through the Coast Guards of other countries, charters of foreign vessels, and arrangements with international partners.

Icebreaking is needed for both research and logistics in the Antarctic. Currently, research needs are being met predominantly via the light icebreaking research vessel NATHANIEL B. PALMER and the ice-reinforced LAURENCE M. GOULD (both leased by NSF's Antarctic Support Contractor). Additional research support is provided via UNOLS vessels and foreign vessels of international partners through a variety of arrangements.

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[1] Alaska House of Representatives *'Arctic Planning & Infrastructure Investment study'*

On the Antarctic continent, success of NSF-funded scientific research depends fundamentally on the annual resupply system. Resupply of Palmer Station is completed with the ice-reinforced LAURENCE M. GOULD. Resupply of McMurdo and South Pole Stations requires significantly more powerful icebreaker services capable of cutting a channel through sea ice in McMurdo Sound, thus allowing a fuel tanker and the cargo vessel to deliver vital fuel and materials. Historically, the USCG has provided heavy icebreaker services on a cost reimbursable basis as stipulated in Presidential Memorandum 6646 (*To ensure that the United States has the necessary flexibility and operational reach in the area, the Departments of Defense and Transportation shall continue to provide, on a reimbursable basis, the logistic support requested by the National Science Foundation and to develop, in collaboration with the Foundation, logistic arrangements and cost structure required for effective and responsive program support at minimum cost.*). NSF requires these more powerful icebreaker services for only about 2-4 weeks annually (exclusive of the time required for transit which is about 30 days each way under current arrangements). Between 2005 and 2013, ice conditions in Antarctica and the condition of the USCG's polar icebreakers made it necessary for NSF to lease foreign vessels to break the channel through McMurdo Sound, either alone or with a USCG vessel. In 2014, the refurbished USCGC POLAR STAR completed the break in mission on its own and can be expected to do so for the next 6 to 9 years.

To address potential uncertainty in the availability of U.S. icebreaker assets, NSF has developed practices for securing back-up icebreaker services. These practices are now part of a comprehensive and continuous contingency planning process. Information on worldwide icebreakers, including their Operational, Cost and Policy considerations, is kept up-to-date. NSF will continue for the foreseeable future to preserve a range of options for obtaining cost-effective and reliable polar icebreaking services and ship-based research support.

General

Over 100 years of established science has been conducted in the Arctic, much of it funded by the energy industry. If we do not encourage oil and gas development in the Arctic, who do we expect will support the research and development necessary to spur future economic development? Should we expect those costs to be borne by the taxpayer instead?

In the Arctic, NSF's primary mission is to fund basic scientific research. NSF principally promotes understanding of the Arctic's physical, biological, geological, chemical, social and cultural processes; the interactions of oceanic, terrestrial, atmospheric, biological, social, cultural, and economic systems; and the connections that define the Arctic. Additionally, NSF's polar programs support projects that contribute to the development of the next generation of researchers and scientific literacy for all ages through education, outreach, and broadening participation in science, technology, engineering, and mathematics.

NSF Support for Lifelines in the National Earthquake Hazards Reduction Program

The *National Earthquake Hazards Reduction Program (NEHRP) Strategic Plan for Fiscal Years 2009-2013* (Reference 1) supports earthquake mitigation of critical infrastructure lifelines through the Plan's following strategic priorities and goals/objectives:

- One of the nine Strategic Priorities: "Develop guidelines for earthquake-resilient lifeline components and systems."
- Goal A, Objective 2: Advance understanding of earthquake effects on the built environment: "NEHRP will support basic research to advance scientific and engineering knowledge of earthquake effects on the built environment. This research will contribute to developing cost-effective design methodologies and technologies for mitigating these effects on soils, lifelines, existing structures, and new construction."
- Goal B, Objective 8: Develop tools to improve the seismic performance of critical infrastructure: "NEHRP will use the results of basic research in earthquake-resistant design and construction to develop technologies and measures suitable for system-wide mitigation in new and existing infrastructure lifelines... and critical facilities (e.g., facilities critical to public health, business continuity, or key economic or governmental functions)."

The NEHRP Strategic Plan defines critical infrastructure lifelines using the Department of Homeland Security's *National Infrastructure Protection Plan*, 2006. This critical infrastructure includes communications, energy, transportation and water and wastewater systems.

NSF supports research on earthquake effects on lifelines through special program solicitations, core research programs, and the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) lifelines facility at Cornell University supported during FY 2005 – FY 2014 as under the NEES operations umbrella award CMMI-0927178 to Purdue University. The attached spreadsheet shows NSF awards made through these funding opportunities.

Special Solicitations

As FY 2013 and FY 2015 activities, NSF supported program solicitations 12-610 and 14-581, Interdisciplinary Research in Hazards and Disasters (Hazards SEES)., a joint activity among the Directorates for Geosciences, Computer and Information Science and Engineering (CISE), Engineering (ENG), Mathematical and Physical Sciences, and Social, Behavioral and Economic Sciences (SBE). Below is a synopsis of this solicitation:

> The overarching goal of Hazards SEES is to catalyze well-integrated interdisciplinary research efforts in hazards-related science and engineering in order to improve the understanding of natural hazards and technological hazards linked to natural phenomena, mitigate their effects, and to better prepare for, respond to, and recover from disasters. The goal is to effectively prevent hazards from becoming disasters. Hazards SEES aims to make investments in strongly interdisciplinary research that will reduce the impact of such hazards, enhance the safety of society, and contribute to sustainability. The Hazards SEES program is a multi-directorate program that seeks to: (1) advance understanding of the fundamental processes associated with specific natural hazards and technological hazards linked to natural phenomena, and their interactions; (2) better understand the causes, interdependences, impacts and cumulative

effects of these hazards on individuals, the natural and built environment, and society as a whole; and (3) improve capabilities for forecasting or predicting hazards, mitigating their effects, and enhancing the capacity to respond to and recover from resultant disasters.

Hazards SEES seeks research projects that will productively cross the boundaries of the atmospheric and geospace, earth, and ocean sciences; computer and information science; cyberinfrastructure; engineering; mathematics and statistics; and social, economic, and behavioral sciences. Successful proposals will integrate across these multiple disciplines to promote research that advances new paradigms that contribute to creating a society resilient to hazards. Hazards SEES intends to transform hazards and disaster research by fostering the development of interdisciplinary research that allows for appropriately targeted data collection, integration, and management; modeling (including predictive models for real-time decision making); visualization and simulation; data analytics and data-driven discovery; real-time sensing; cross-cutting knowledge development; and synthesis of applicable models and theory. Proposals must demonstrate the inclusion of the appropriate expertise to address the research questions, hypotheses, and problems being posed. Hazards SEES research projects should be designed around one or more locations, identifiable hazards, and/or themes. Furthermore, Hazards SEES research should train the next generation of scientists for interdisciplinary hazards and disaster research.

As an FY 2014 activity, NSF supported program solicitation NSF 14-524, Resilient Interdependent Infrastructure Processes and Systems (RIPS) through the Directorates for CISE, ENG, and SBE. The anticipated funding amount is $15,000,000 and up to 20 awards will be made. Awards will be made by end of FY 2014. Below is a synopsis of this solicitation:

"Critical infrastructures are the mainstay of our nation's economy, security and health. These infrastructures are interdependent. For example, the electrical power system depends on the delivery of fuels to power generating stations through transportation services, the production of those fuels depends in turn on the use of electrical power, and those fuels are needed by the transportation services.

The goals of the **Resilient Interdependent Infrastructure Processes and Systems** (RIPS) solicitation are (1) to foster an interdisciplinary research community that discovers new knowledge for the design and operation of infrastructures as processes and services (2) to enhance the understanding and design of interdependent critical infrastructure systems (ICIs) and processes that provide essential goods and services despite disruptions and failures from any cause, natural, technological, or malicious, and (3) to create the knowledge for innovation in ICIs to advance society with new goods and services. The objectives of this solicitation are:

- Create theoretical frameworks and multidisciplinary computational models of interdependent infrastructure systems, processes and services, capable of analytical prediction of complex behaviors, in response to system and policy changes.
- Synthesize new approaches to increase resilience, interoperations, performance, and readiness in ICIs.
- Understand organizational, social, psychological, legal, political and economic obstacles to improving ICI's, and identifying strategies for overcoming those obstacles.

The RIPS solicitation seeks proposals with transformative ideas that will ensure ICIs services are effective, efficient, dependable, adaptable, resilient, safe, and secure. Successful proposals are expected to study multiple infrastructures focusing on them as interdependent systems that deliver services, enabling a new interdisciplinary paradigm in infrastructure research...Projects supported under this solicitation may undertake the

collection of new data or use existing curated data depending on the category of award, and must recognize that a primary objective is integrative predictive modeling that can use the data to validate the models and which can be integrated into decision making."

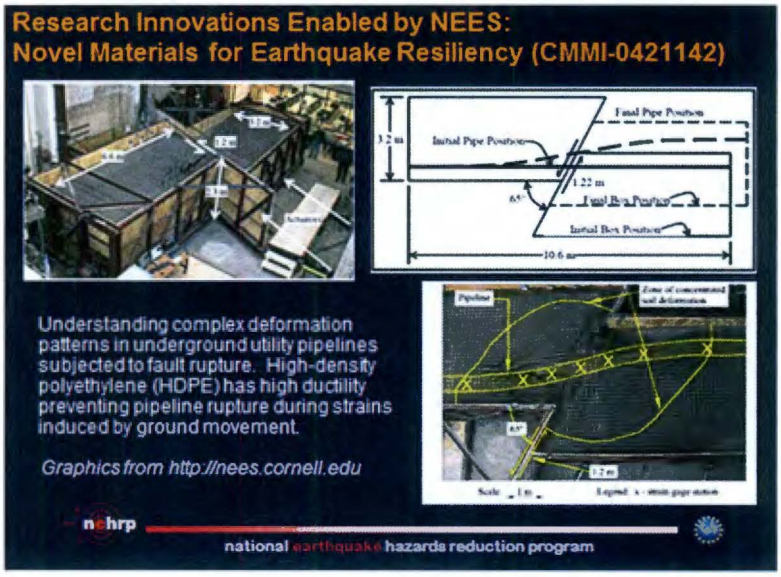
NSF Core Research Programs

Research on earthquake mitigation for lifelines has been supported from the following core research programs in the ENG Directorate, Division of Civil, Mechanical, and Manufacturing Innovation:

- Geotechnical Engineering (GTE)
- Hazard Mitigation and Structural Engineering (HMSE)
- George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Research (NEESR)
- Infrastructure Management and Extreme Events (IMEE)

NEES Lifelines Facility at Cornell University

Located in Cornell University's Department of Civil Engineering, this facility has enabled large-scale testing to study the effects of large differential ground deformation on buried pipeline and conduit performance. The slide below show a test at the Cornell lifelines facility investigating the seismic capacity of high-density polyethylene (HDPE) pipelines.



References:

Strategic Plan for the National Earthquake Hazards Reduction Program, Fiscal Years 2009-2013, October 2008, http://www.nehrp.gov/pdf/strategic_plan_2008.pdf

Department of Homeland Security, *National Infrastructure Protection Plan*, 2006. http://www.chemicalsecurity.com/index/NationalStrategy/NationalInfrastructureProtectionPlan(2006).pdf. Note: The most recent version is dated 2013.

1. Question for the Record -- From the Honorable Mo Brooks: Your testimony touches on the way investments in cybersecurity research are tied to investments in cybersecurity education and workforce development. Why is this important? Are there real-world implications if federal investments shift from education and workforce development in this field?

If these investments were to shift or stop, the pipeline of cybersecurity scientists, engineers and professionals would be slowed. With insufficient cybersecurity experts, the US would no longer be competitive in the science and engineering of cybersecurity and in the development of new cybersecurity technologies and start-ups.

For example, the Scholarship for Service (SFS) program at NSF provides direct evidence that investments in cybersecurity education can have a profound impact on the Nation and its ability to secure cyberspace. To date, SFS has admitted 1400 students; 1100 of the graduates have been successfully placed in the Federal government, including at the National Security Agency, Department of Homeland Security, Central Intelligence Agency, and the Department of Justice.

The Advanced Technology Education (ATE) program focuses on the education of technicians in high technology fields. The ATE center-scale track is funding three cybersecurity education centers. Each center has myriad partners, including a dozen or more community colleges and universities; each center has enrolled over 1500 students since its inception. Both SFS and ATE reach every region of the country and significantly increase the pool of cybersecurity professionals available for jobs in the U.S.

Our investment in fundamental, unclassified, long-term research in cybersecurity has an educational component as well. NSF-funded research projects are the training grounds for the graduate students who will turn into the next generation of advanced cyber security professionals. NSF principal investigators (who are usually university faculty) recruit graduate students to work with them side by side to make discoveries. This day by day faculty-student research training is the basic way we ensure a continuing supply of innovators. Trustworthy Computing currently has about 500 ongoing projects; most of them have at least one graduate student. These NSF principal investigators also recruit undergraduates to work in their labs through supplements to their grants in the Research Experiences for Undergraduates (REU) program. Finally, NSF's most prestigious program that supports junior faculty – the CAREER program – explicitly addresses the integration of research and education to ensure that young faculty learn early in their careers the critical connection between fundamental research and science and engineeering education.

2. Question for the Record -- From the Honorable David Wu: In Rear Admiral Brown's testimony, he notes that no single agency controls cyberspace and the success of our cybersecurity mission relies on effective communication and critical partnerships across the government. However, the Administration's legislative proposal released on May 12th recommends consolidating a significant amount of cybersecurity related activities at DHS, arguably making DHS the de facto lead on cybersecurity activities in the Federal government. If this structure is enacted, how can we ensure that it will not reduce incentives for other agencies to be actively engaged on cybersecurity, believing that DHS has it covered?

The model proposed in the legislation reflects established partnerships with Department of Homeland Security (DHS) on broad cybersecurity operational matters and those involving FISMA legislative and

policy requirements. In addition, NSF interacts with DHS and other agencies to share cybersecurity "best practices" and "lessons learned" through the government-wide Chief Information Security Officer forum and routinely leverages DHS expertise to address an increasingly dynamic threat environment. DHS conducts independent benchmarking and qualitative reviews of Federal agency cybersecurity programs as part of the FISMA review process. NSF has participated in these assessments for the last two years, and has used the results to make continued improvements to our cybersecurity program.

Such a framework clearly defines the structure of the authorities and responsibilities of the partners. In this case, subsection 3553 assigns DHS a leadership role in setting overall policy and providing guidance and requirements. Subsection 3554 assigns specific responsibilities to agencies, including: assessing risk; determining appropriate levels of security; implementing policies and procedures; actively monitoring effectiveness; and sharing cybersecurity information. Thus, the proposal envisions DHS and the agencies working together towards better cybersecurity operations across the federal government.

NSF frequently works in partnership with other agencies. Another example -- focused on cybersecurity education -- is the National Initiative for Cybersecurity Education (NICE), which is led by NIST with the participation of the Departments of Homeland Security, Defense, Labor, and Education, the Office of Personnel Management, the National Science Foundation, the Director of National Intelligence, and other Federal agencies.

NSF remains the lead agency, however, for long-term, foundational research in cybersecurity. In FY 2011, NSF will invest up to $129.4 million in cybersecurity research, including $55 million in the cross-cutting Trustworthy Computing program. Its projects range from security at the microscopic level, detecting whether a silicon chip contains a malicious circuit, to the macroscopic, determining strategies for securing the next generation electrical power grid. These investments are critical to an effective national strategy of achieving a "trustworthy" cyberspace.

3. Question for the Record – From the Honorable Randy Neugebauer: What aspects of the current federal system of research and development in the United States allow us to stay ahead of the curve in predicting and responding to future cybersecurity threats? What must be improved?

A major reason that cybersecurity is such a challenging problem is that attacks and defenses co-evolve. Every day, we learn about more sophisticated and dangerous attacks: systems that were secure yesterday are no longer secure. To respond to this continued escalation, we have created a healthy and vibrant U.S. cybersecurity R&D ecosystem that – with effective nurturing – has kept us at the frontier of innovation and deployment.

This ecosystem is driven by fundamental research. It is important to note that many of our cybersecurity technologies deployed today capitalize on fundamental research and discoveries made years, even decades, ago. Fundamental problems that are being addressed now are often difficult to solve but may bear fruit that will give us dramatic new advantages against cyberthreats. For example, *doubly homomorphic encryption* is a technique that will allow us to secure computers at the same level we can currently secure networks: even physical access to a computer would not allow useful information to be stolen. While this approach was first proposed back in 1978, recent NSF-funded research has led to its implementation in limited ways. With continued work by our brightest researchers, we could soon see a fully practical approach that will be adopted by industry.

NSF's cybersecurity research efforts are focused on building systems whose trustworthiness derives from first principles. To do that, we are formulating and developing a comprehensive research portfolio around a view of systems that are deemed *trustworthy*, i.e., systems that people can depend on day after day and year after year to operate correctly and safely. Such systems include transportation systems (avionics, metro, automobile systems), medical devices (medical implants, robotic surgery operated remotely that can be used to save lives in remote areas and on battlefields), and the rapidly developing smart power grid. Included in this notion of trustworthiness are a number of critical concepts: *reliability* (does it do the right thing?); *security* (how vulnerable is it to attack?); *privacy* (does it protect a person's information?); and *usability* (can a human easily use it?). Such research needs to be game-changing and forward-looking.

Of course, one program in one agency cannot solve the challenges of cybersecurity alone, and so part of the research ecosystem is the rich exchange of ideas, goals, and results. This exchange is across disciplines, across governmental agencies, between industrial partners and research institutions, and across nations; it has fueled new ideas, approaches, and results.

Exchanges between academia and industry bring fundamental results into practice. NSF-funded principal investigators, working with industry partners and mission agencies, continually seed translation of knowledge into new technologies and more effective practice. NSF-funded research activities have led to the formation of start-up companies in the IT sector that are bringing innovative solutions and technologies to the marketplace, both helping to protect cyberspace and fueling job growth. Other NSF-funded research activities have led to current industries directly adopting results to harden existing IT infrastructure. By promoting a healthy connection between academia and industry, NSF further enhances its research portfolio in trustworthy computing with foundational concepts and new ideas that are directly relevant to the commercial sector.

For example, the NSF Team for Research in Ubiquitous Security Technology (TRUST) Science and Technology Center combines 6 universities with 16 industrial partners, and has produced new knowledge ranging from how to protect automobile control systems from attack to revealing flaws in methods used by websites to guard against attacks by programs impersonating people. Such partnerships need to be encouraged.

The trend toward increasingly cyber-enabled systems, i.e., the integration of computation, communication, and control into physical systems, offers new challenges. Healthcare, education, and finance are already at risk of attack, and physical infrastructure – manufacturing, energy production, and transportation – will be next. An effective national strategy to secure cyberspace must include investments in these areas of research, which will allow our society to continue to benefit from a robust, secure, dependable cyber infrastructure that supports all application sectors, including those on which our lives depend. NSF will continue to make significant investments in support of a secure cyberinfrastrucrue.

Cybersecurity researchers need access to operational data in order to develop and validate their new theories, approaches, and technologies. For many reasons, such data have been hard to obtain. One excellent example of a long-term effort to provide such data is the PREDICT archive, developed by the Department of Homeland Security.

More broadly, as we become ever more cross-disciplinary, cross-agency and international, the coordination costs of supporting the R&D enterprise increase. Partnerships are a critical component,

but they also require considerable investments of time. We need to develop tools and approaches to become more efficient and effective. For example, new technologies need to be employed that allow for more effective remote collaboration such as virtual presence, as well as for research portfolio and gap analysis.

UNITED STATES SENATE
COMMITTEE ON APPROPRIATIONS
Hearing on
Driving Innovation through Federal Investments
April 29, 2014
Dr. France Córdova, Director, National Science Foundation

Questions for the Record Submitted by Sen. Tom Udall

NRAO AND RADIO ASTRONOMY IN NEW MEXICO

Question 1: Dr. Cordova, NSF plays a key role in supporting astronomy and STEM education activities at National Radio Astronomy Observatory (NRAO) facilities in Socorro, New Mexico. NRAO enables research into the birthplaces of stars and planets, super-massive black holes, gravitational waves, chemical precursors of life, and the remnant heat of the Big Bang. How is the NSF leveraging federal investments in NRAO and other scientific facilities to foster innovation?

Answer: Investments in these facilities foster innovation, first and foremost, by providing tools for frontier scientific inquiry by thousands of U.S. scientists each year. Working at the frontier provides training opportunities for young students, postdocs, and early-career faculty to develop their scientific and technical careers, renewing the capabilities of young STEM professionals in the U.S. Over the longer term, technical advances in areas such as low-noise radio receivers, advanced data-analysis and big data techniques (such as the extraction of signals from noisy data sets), and application of adaptive optics are likely to lead to innovative uses of such technologies in the broader society.

NSF INVESTMENTS IN INTERNATIONAL RADIO ASTRONOMY FACILITIES

Question 2: The Federal government is investing in ground-breaking international facilities such as the Atacama Large Millimeter/submillimeter Array in Chile. How is NSF ensuring that these investments leverage and contribute to our critical domestic science facilities?

Answer: The U.S. science community that employs the Atacama Large Millimeter/ submillimeter Array (ALMA) for observations is conducting its research through the work of hundreds of investigators located at institutions within the United States; the actual location of the Observatory is critical for these scientists to acquire the best data to achieve the goals of their scientific investigations, but their research is largely conducted at their home institutions in the United States. A number of the ALMA technologies are common with those of the Karl J. Jansky Very Large Array (VLA) in New Mexico, so shared scientific and technical personnel simultaneously contribute to the success of both VLA and ALMA.

NSF RADIO ASTRONOMY AND SOLAR OBSERVATORIES ROLE IN PROMOTING STEM EDUCATION

Question 3: Dr. Cordova, we share a keen interest in attracting young American students to STEM fields and encouraging greater participation in STEM career fields. Given that astronomy is a field that often sparks a lifelong interest in science, how is NSF using federal research facilities such as those of the NRAO in Socorro, New Mexico and the

National Solar Observatory (NSO) near Alamogordo, New Mexico to help foster a new generation of young scientists?

Answer: The National Radio Astronomy Observatory (NRAO) and the National Solar Observatory (NSO) support observation by a large number of students, often in conjunction with their advisors at their home institutions; the tools at the national facilities provide these students with forefront data that are not available through any other observatories. For decades, these national facilities also have hosted independently funded NSF Research Experiences for Undergraduates (REU) programs. NSO partners in an award via NSF's Partnerships in Astronomy and Astrophysics Research and Education (PAARE) program; PAARE seeks to enhance training of individuals from institutions that focus on the teaching of under-represented groups. Finally, both of the mentioned NRAO and NSO sites have active visitor centers that support both formal and informal science education programs.

IMPACT OF BUDGET CUTS AND BUDGET UNCERTAINTY ON AMERICAN SCIENTIFIC CAPABILITIES

Question 4: Could you describe how recent budget cuts, budget uncertainty, and the recent government shutdown have impacted American researchers and scientific facilities, such as the NRAO and NSO observatories in New Mexico? How does this impact the retention of core US scientific capabilities?

Answer: Budget uncertainty and constraints are a challenge to all American researchers and scientific facilities. Budgets are always limited, of course, and this limits the number of facilities that can support researchers and necessitates difficult choices within the portfolio of existing and future facilities. Development and construction of new scientific facilities at the forefront of the field is an outstanding way to attract talented young Americans into astronomy, thus ensuring the retention of core US scientific capabilities. For example, development of the Atacama Large Millimeter/submillimeter Array (ALMA) and the Daniel K. Inouye Solar Telescope (DKIST) are crucial to the retention of US leadership in radio astronomy and solar physics, respectively. Development and implementation of the Large Synoptic Survey Telescope (LSST) will provide an avenue for leadership in the scientific uses and exploration of "Big Data," in a way that has not been possible with any previous astronomical facility.

SPECTRUM SHARING AND RADIO ASTRONOMY

Question 5: How is NSF working with the Department of Commerce, the Federal Communications Commission and others to ensure that efforts to increase commercial access to radio spectrum for mobile broadband and other uses do not prevent the ability of radio astronomers to continue to make observations from NRAO facilities?

Answer: NSF is actively working with these agencies, generally through the National Telecommunications and Information Administration (NTIA), in order to satisfy the spectrum requirements of radio astronomy while also enabling societal use of the radio spectrum. Examples of current items in which NSF is engaged include the re-distribution of Channel 37 and television "white space" spectrum as well as the spectrum allocations for automobile radars.

LEVERAGING COMMERCIAL SPACEFLIGHT INVESTMENTS TO PROMOTE SCIENTIFIC RESEARCH AND STEM ACTIVITIES

Question 6: New Mexico is home to some exciting research and STEM activities that take advantage of suborbital space launches. Test flights have already begun at Spaceport America for commercial reusable suborbital vehicles that could dramatically increase access to microgravity environments for scientific research. I have heard from scientists from New Mexico and across the country who eagerly anticipate doing more experiments at lower cost in microgravity and space environments thanks to America's burgeoning commercial spaceflight industry. This includes research relevant to numerous fields as well as studying the upper parts of Earth's atmosphere itself. These upper parts of the Earth's atmosphere are currently so inaccessible--and so little understood--that scientists sometimes refer to it as the "ignorosphere." What plans does NSF have to support scientific research that takes advantage of access to suborbital space to advance the frontiers of science and technology? How can NSF encourage more researchers to take advantage of such opportunities as they become more widely available through commercial suborbital spaceflights?

Answer: NSF's Division of Atmospheric and Geospace Sciences (AGS) in the Directorate for Geosciences supports research on the lower thermosphere and mesosphere; regions sometimes referred to as the "ignorosphere." Presently, observations of this region of near Earth space are provided by high power radars and lidars, as well as NASA rocket-based experiments. AGS has also supported research using Cube-Sats, which are small low-cost observational satellites, typically with a volume of 1 liter (10 cm cube) and that are launched as secondary payloads on existing missions. When the cost and availability of suborbital vehicles is established, NSF expects to entertain proposals that use these additional tools for upper atmospheric studies.

The aeronomy community is well aware of this emerging opportunity to access suborbital space. To catalyze research interest, NSF cosponsored a workshop: "The End of the Ignorosphere: An Aeronomy Researcher's Conference on Commercial Suborbital Access to Space" in April 2013. In addition, this research community's largest annual workshop, which was attended by more than 300 scientists, featured a presentation on this opportunity last year in June.

NATIONAL SOLAR OBSERVATORY SITE IN NEW MEXICO

New Mexico is home to the National Solar Observatory's Richard B. Dunn Solar Telescope (DST). Located on Sacramento Peak near Alamogordo, this telescope has revealed many intricacies of the surface features of the Sun. DST has also served as a test bed for adaptive optics technologies and the next generation of solar instrumentation. Yet my understanding is that the National Science Foundation is developing a plan to potentially close this facility by the time the new Daniel K. Inouye Solar Telescope (DKIST) in Hawaii becomes operational. I have serious concerns about a potentially costly closure of DST given the value of continuing to operate this telescope facility for scientific research and training purposes, even after the newer DKIST facility becomes operational.

Question 7: Will you assure me that NSF will keep me apprised of any plans regarding the future of the National Solar Observatory's Richard B. Dunn Solar Telescope? Before NSF decides to divest from or close DST, will you seek to find suitable entities willing and able to continue operating the facility?

Answer: As mentioned in a previous response, the Daniel K. Inouye Solar Telescope (DKIST) is a critical component in retaining the core capabilities and leadership of the American solar physics community. The Richard B. Dunn Solar Telescope (DST) test-bed activities in adaptive optics and solar instrumentation have been aimed specifically at the development and implementation of DKIST, so one of the primary test-bed functions will be concluded upon the completion of DKIST construction. NSF and the personnel of the National Solar Observatory are actively seeking entities that are interested in the continuation of operations at Sacramento Peak.

NSF will keep the committee apprised of its plans for the future of the telescopes it currently supports.

BEHAVIORAL AND SOCIAL SCIENCES FUNDING

Question 8: Many challenges facing society ranging from pollution to violence are often related to human behavior. Given the importance of studying human behavior, what implications do you see for the proposed cuts to NSF funding for the behavioral and social sciences?

Answer: The proposed reductions to NSF's research funding for the social, behavioral, and economic (SBE) sciences will seriously affect the near- and long-term research agenda.

In 2013, the directorate sponsored a two-day workshop on "Youth Violence: What We Need to Know." This two-day workshop brought together researchers from sociology, anthropology, psychology, communications, computer science, information systems, and public policy to identify much of the existing scientific evidence regarding the precursors and causes of violence perpetrated by children and adolescents and underscored the need for additional study to enhance our understanding of the dynamics of, contributors to, and impact of violent ideology and violent acts. Just this April, U.S. Representative Ed Royce (R-CA), Chairman of the House Foreign Affairs Committee, held a hearing to examine how the education of women in countries prone to violent extremism can create economic opportunities and help counter the spread of radicalism. In his opening statement and drawing on examples in Pakistan, Chairman Royce noted the importance of the SBE sciences and their global reach:

> Studies have shown that women tend to invest more in their children than men, which is why increases in female income improve child survival rates some twenty times more than increases in male income. Women who can read also stand to benefit from the pamphlets distributed in public awareness campaigns, and have been shown to better understand radio broadcasts designed to keep them informed.[1]

Such studies, which examine deep relationships among gender and family dynamics, education, employment, political participation, and the roles of media and communications, are precisely the type of long term, interdisciplinary research that are at risk.

SBE's contributions to public health and safety, education, innovation, and the economy are well documented. Consider just a handful:

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[1] http://foreignaffairs.house.gov/press-release/chairman-royce-convene-hearing-women-s-education-promoting-development-countering

- In 2012, Alvin Roth shared the Nobel Prize in Economic Sciences with Lloyd S. Shapely "for the theory of stable allocations and the practice of market design," which has had applications that range from matching compatible organ donors and recipients to matching medical students to residencies. NSF/SBE has supported his research since the late 1970s.
- Through the National Center for Geographic Information and Analysis at the University of California-Santa Barbara, NSF-funded researchers have developed transformative GIS technologies, embedded in large systems and handheld devices. NSF/SBE has supported this work since the late 1980s.
- Working with state, county, and city planners, SBE-funded researchers are modelling ways to allocate scarce water resources, implement new mosquito control systems, and decipher the social networks that both enable disease to spread and encourage vaccination programs.
- SBE-supported researchers provided the Federal Communications Commission (FCC) with its current system for apportioning the airwaves via a fruitful practical application of game theory and experimental economics. Since their inception in 1994, FCC "spectrum auctions" have netted over $60 billion in revenue for the federal government and have been emulated in several other countries.
- NSF-funded investigators are examining the development of political protests in the Ukraine and elsewhere, focusing on ways that social media allows for "leaderless" protests. These findings have been reported in several outlets including CNN, Voice of America, and Huffington Post.

These examples, which provide clear value to the Nation, are based on research sustained over decades, but it is the innovation pipeline to the future that is most threatened. Early results in the psychological sciences suggest ways that experiences as a child, whether learning to speak another language or to play a musical instrument, affect cognitive capacity much later in life, which has profound implications for an aging population. Much more research is needed to establish robust connections and relevant recommendations for structuring work, retirement, and long term care for the elderly. Fundamental research in neuroscience extends to developmental issues, illness, and traumatic injury, and thus has broad implications for the disabled, many of whom are returning veterans. Global migration -- from poor countries to wealthy, from south to north, and from societies dominated by the young to those that are aging – threatens to overwhelm social organizations, distort labor markets, and destabilize political structures. Fluctuations in population combined with global climate change and its impacts on habitat, agriculture, trade and finance require more — not less — SBE analysis to tease out causality and identify points where interventions might be effective.

Responding to the nexus of aging, disability, retirement, and long term care or modeling population, environment, and behavior defies reduction to a single discipline and draws on research in a broad range of disciplines from neuroscience and psychology to economics, spatial sciences, and anthropology. Cutting funding for long term research in the SBE sciences now compromises the future.

SUPPORT FOR HISPANIC SERVING INSTITUTIONS

Question 9: The America Competes Act authorized the NSF "to establish a new program to award grants on a competitive, merit-reviewed basis to Hispanic Serving Institutions (HSIs) to enhance the quality of undergraduate STEM education at such institutions, and to increase the retention and graduation rates of students pursuing associate's or

baccalaureate degrees in STEM." My understanding is that NSF did not submit a proposal to create such a program and has even expressed its intent to never fund this initiative. Why is it so difficult for the NSF to create an initiative focused on HSIs within its Directorate for Education and Human Resources?

Answer: In FY 2013, NSF funds awarded to Hispanic-Serving Institutions (HSIs) totaled $155.65 million through 332 awards. NSF support to HSIs continues to be strong and exceeds the combined total of $104.52 million for Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs). While there are about 105 HBCUs and 30-35 TCUs, in 2010-2013 there were 370 HSIs (defined as institutions with 25 percent or more total undergraduate Hispanic full-time equivalent student enrollment), with an additional 277 "emerging HSIs" (defined as institutions with 15-24 percent undergraduate full-time equivalent Hispanic enrollment). These 370 institutions of higher education are very heterogeneous, including small community colleges, four-year primarily undergraduate institutions, and large research-intensive universities, all with different missions. The range of available STEM programs within these diverse institutions is quite wide. Crafting a single program, comparable to NSF's dedicated programs for HBCUs and TCUs, which has the potential for national scale and serves such a variety of institutions presents a logistical, programmatic, and financial challenge, particularly as the numbers of HSIs are increasing rapidly.

Questions for the Record Submitted by the Honorable Susan M. Collins

THE EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH (EPSCOR)

Director Cordova, the Experimental Program to Stimulate Competitive Research (EPSCoR), which is administered by NASA, the Department of Energy, and your organization, the National Science Foundation, has played a critical role in helping to advance our nation's research infrastructure and integrated STEM workforce development efforts.

In my state, EPSCoR is housed at the University of Maine at Orono, but the funding has facilitated collaboration among institutions statewide and has enabled colleges, universities, and researchers to forge partnerships with private, non-profit, and governmental sectors.

NSF EPSCoR grants have been particularly beneficial to Maine. For example, in 2006, Maine EPSCoR received NSF seed funding to initiate a Forest Bioproducts Research Institute with the goal of creating and commercializing wood bioproducts while maintaining forest health. Before long, industry recognized the great R&D work that the FBRI was conducting and forged a technology transfer partnership—resulting in major private capital investments and the establishment of a full-fledged research institute and technology center. The FBRI has brought over $3.5 million in new capital equipment to Maine and produced 11 patents. Perhaps more important, however, than the development of new technologies is the development of a STEM-ready workforce.

The public-private partnerships between the FBRI and industry have supported more than 100 graduate, undergraduate, and high school research internships, and integrated more than 5,000 students into its STEM outreach activities.

Question 1: What role do you see EPSCoR playing in helping states to develop self-sustaining academic research enterprises that not only produce new technologies but also prepare students for employment in STEM fields?

Answer: EPSCoR stimulates research that is fully competitive in the disciplinary and multidisciplinary research programs of the National Science Foundation. Specific EPSCoR objectives are: (1) to catalyze key research themes that empower knowledge generation, dissemination, and application; (2) to activate effective jurisdictional and regional collaborations that advance scientific research, promote innovation, and benefit society; (3) to broaden participation in science, engineering, and education by institutions, organizations, and people within EPSCoR jurisdictions; and (4) to use EPSCoR for development, implementation, and evaluation of future programmatic experiments that inform programmatic enhancement and new initiatives.

For FY 2013, NSF EPSCoR's Research Infrastructure Improvement (RII) Track-1 awards supported 1,535 faculty members who produced 679 publications based on research funded primarily through their RII Track-1 projects. Primary support is defined as research that is directly funded by EPSCoR. These researchers also produced 1,254 publications that were partially funded by EPSCoR. Partial support is defined as use of equipment or facilities that are funded by EPSCoR. Moreover, RII Track-1 researchers leveraged their EPSCoR support and were awarded 654 grants for a total of $259.5 million in FY 2013. Funding sources include

NSF, other federal agencies, foundations, and state agencies. Also, 12 patents were awarded based on RII discoveries and 55 patents are pending.

Moreover, with regard to workforce development, student engagement is an important part of EPSCoR RII Track-1 projects. In FY 2013, for example, these projects supported 1,383 graduate and 1,955 undergraduate students, of which 43 percent were female, 15 percent underrepresented minorities, and 1 percent disabled. A total of 305 graduate students completed degrees (41 percent female, 11 percent underrepresented minorities and one person with a disability). In addition, 825 undergraduate students graduated (30 percent female, 12 percent underrepresented minorities, and two persons with disabilities).

An example of how these investments prepare students for employment is South Dakota, where research, education, and economic development partnerships involving 200 different companies have created 773 industry and university internships for students; 32 percent of which have resulted in full-time job offers for the interns.

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Appropriations
Subcommittee on Commerce, Justice, Science, and Related Agencies
Hearing on
National Science Foundation FY 15 Budget Request
March 27, 2014
Dr. Cora Marrett, Acting Director, National Science Foundation
Questions for the Record Submitted by
Frank R. Wolf

Education and Human Resources (EHR) Programs

Question 1. NSF's recent budget requests have placed a lot of emphasis on graduate-level fellowship programs, with much smaller increases requested for traineeships. Why has NSF chosen to focus its resources in this way? How do you respond to critics who believe that fellowship and traineeship opportunities need to be better balanced with one another in your budget?

Answer: NSF recognizes the importance of appropriately balancing its investments in graduate education. As is noted in the FY 2015 Request, the agency is addressing this through the development of a five year strategic plan for its investments in graduate students and graduate education. This plan builds on four related efforts: 1) the recommendations of the National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education (Co-STEM) 5-Year Strategic Plan[1] 2) on-going interagency discussions about leveraging assets; 3) recent national reports on graduate education[2,3,4,5] and 4) NSF-wide efforts to ensure that its many forms of investment in graduate education form a coherent agency strategy. A key driver of this effort is the recognition that graduate training in STEM must continue to evolve in order to provide a supply of scientists and engineers who not only meet the needs of the emerging STEM enterprise, but who have the knowledge, skills, and preparation to advance it, both within and outside of academia.

Question 2. In fiscal year 2014, NSF unsuccessfully proposed to consolidate 3 of its undergraduate STEM programs into a new initiative called Catalyzing Advances in Undergraduate STEM Education (CAUSE). Now the fiscal year 2015 request consolidates those same 3 programs into a new initiative called Improving Undergraduate STEM Education (IUSE). What is the difference between last year's CAUSE initiative and this year's IUSE proposal?

Answer: As a part of continuing efforts to stimulate innovations in undergraduate education, in FY 2014 NSF merged three undergraduate STEM education programs – Transforming

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[1] National Science and Technology Council, Committee on STEM Education (2013) *Federal Science, Technology, Engineering and Mathematics (STEM) 5-Year Strategic Plan* www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf.
[2] Council of Graduate Schools (2012) *Pathways through Graduate School and Into Careers*, http://pathwaysreport.org/rsc/pdf/19089_PathwaysRept_Links.pdf
[3] National Institutes of Health (2012) *Biomedical Research Workforce Working Group Report*, http://acd.od.nih.gov/biomedical_research_wgreport.pdf
[4] American Chemical Society (2012) *Advancing Graduate Education in the Chemical Sciences*, www.acs.org/content/dam/acsorg/about/governance/acs-commission-on-graduate-education-summary-report.pdf
[5] National Research Council (2012) *Research Universities and the Future of America*, www.federalrelations.wisc.edu/docs/FutureofAmericaU.pdf

Undergraduate Education in STEM (TUES), STEM Talent Enhancement Program (STEP), and Widening Implementation and Dissemination of Evidence-based Reforms (WIDER) – into an umbrella program description, Improving Undergraduate STEM Education (IUSE). IUSE, an NSF program, provides grantees with greater flexibility to integrate multiple approaches to increase attraction to STEM; to increase persistence and retention in STEM of all students; to improve the quality of the undergraduate STEM learning experience; and to prepare both a quality STEM workforce and a STEM literate citizenry. Over the past year, NSF has made considerable progress toward a stronger, more cohesive infrastructure for delivering undergraduate STEM education programs. IUSE provides a core that in fiscal year 2015 will lead to greater effectiveness, efficiency, and impact. The coherency of IUSE supports the development of common metrics and evaluation to measure the impact of NSF awards on undergraduate education.

In the fiscal year 2014 budget, NSF's request to integrate undergraduate STEM programs was presented in a broader cross-government context of Catalyzing Advances in Undergraduate STEM Education (CAUSE). In this broader context, undergraduate programs across federal agencies were proposed for reorganization. Respecting the request of Congress, this cross-government reorganization did not occur as originally proposed. NSF has continued with internal efforts, however, notably the integration of these three undergraduate programs at NSF through the IUSE program description.

Question 3. NSF's budget requests imply that the agency thinks the CyberCorps: Scholarships for Service program has too much money. Are there significant differences in the annual funding rates for this program versus other major NSF programs or the agency-wide average? Are there significant differences in NSF's ability to efficiently obligate funding for CyberCorps versus other major NSF programs?

Answer: The budget requests for the CyberCorps: Scholarships for Service (SFS) program have been in keeping with an assessment of the growth of the field and the capacity of the training community so that highly meritorious programs could be identified and funded.

NSF has been asked by Congress to enhance funds available for the program by an additional $20.0 million in each of fiscal years 2012, 2013, and 2014. As a result, the additional projects funded have expanded the original SFS mandate, which called for maintaining 300 students on SFS scholarships, to the 470 that the program currently supports. It is expected that already-funded projects will increase this number to 600 students during the next few academic years. At the same time, the number of universities offering SFS scholarships increased from 35 in 2011 to 54 in 2014. In FY 2011, the funding rate for the SFS program rose to levels significantly higher than the NSF average (35 percent for SFS vs 22 percent for NSF overall); however, the SFS institutional capacity is now at the point that the SFS funding rate is anticipated to be closer to the NSF average (in FY 2013 the SFS funding rate was 25 percent versus 22 percent for NSF overall).

In keeping with the enhanced capacity that has been developed in the field, the FY2015 NSF budget request for the SFS is $25.0 million. An additional $20.0 million is provided through the Administration's Opportunity, Growth, and Security Initiative (OGSI). In FY 2014, $45.0 million is allocated for SFS.

Number of Awards and Funding Rate

Question 4. The budget request projects that 11,400 awards will be made in fiscal year 2015, an increase of 100 awards over the fiscal year 2014 projection. How is this possible when the request for Research and Related Activities is a decrease and the increase proposed for Education and Human Resources is primarily needed to pay for higher Graduate Research Fellowship stipends?

Answer: In FY 2015 NSF estimates making 11,400 awards, a one percent increase over the 11,300 awards estimated for FY 2014. This increase is due to a combination of additional education grants and a small increase to the percentage of continuing grants in FY 2015. NSF can shift the balance of standard versus continuing awards to increase the overall number of new awards made in a given year in order to mitigate impact to funding rate under scenarios of increasing proposal pressure and/or decreasing funding. Keep in mind, however, that because continuing grants require out-year commitments, they encumber future funding that could otherwise be used to make new awards. Repeatedly increasing the share of continuing grants over a number of years would increase the total 'mortgage' owed and could actually have a detrimental effect on future funding rates if high mortgage levels prevent a sufficient number of new awards from being made.

Question 5. The projected agency-wide funding rate for fiscal year 2015 is 22%, the same as fiscal year 2014. In your opinion, what is a healthy agency-wide funding rate that would indicate sufficient budgetary resources available to all programs?

Answer: Since NSF issues awards based on the availability of funds there is no target or 'healthy' funding rate. The funding rate is determined by a number of factors in addition to the budgetary resources available, such as the number of proposals submitted, the quality of proposals, the size of awards, and the balance between standard awards and continuing awards.

Question 6. Last year, you indicated that NSF was seeking to address the unusually low funding rate in the Engineering Directorate, but the budget request does not appear to do anything to improve it. How does the budget request address the problem of low funding rates in Engineering?

Answer: In a climate of constrained budgets, addressing this issue is quite challenging. Each of the Foundation's research directorates plays an important role in national and emerging priorities worthy of support. The FY 2015 budget request recognizes the importance of balancing these issues. The Directorate for Engineering (ENG) continues to seek innovative ways of addressing this issue, including making some changes in business processes, which has helped increase funding rates. Two engineering research divisions have gone from two annual proposal submission windows to a single submission window and all divisions have revised the focus of their program descriptions. As a result of these changes, the directorate has seen a decrease of over 10 percent in the total number of research proposals received since FY 2010. In addition, ENG achieved a funding rate of 18 percent in FY 2014, equivalent to three other Research & Related Activities directorates. This is an increase of one percentage point over FY 2012 and 3 percentage points over FY 2010 and FY 2011. We will continue to pay close attention to this issue in future fiscal years.

NSF Inflation Factor

Question 7. At the hearing, NSF indicated that it does not calculate or track a research-specific inflation factor similar to NIH's Biomedical Research and Development Price Index. In the absence of an NSF-specific inflation estimate, what was the general inflation factor assumed for fiscal year 2015 in the President's budget request? How does this inflation factor compare to the 1.2% increase requested for NSF?

Answer: NSF does not use an across-the-board inflation factor to formulate its budget requests. However, there may be unique instances where a factor is used for planning purposes, such as for large facilities and MREFC projects. In those instances, NSF uses economic assumptions that are shared across government.

Questions for the Record Submitted by
Jose E. Serrano

Hispanic-Serving Institutions Program

NSF has specialized undergraduate education programs for Blacks and Native Americans, but not specialized programs for Latinos. Since fiscal year 2010, there has been appropriations report language directing the NSF to address the needs of HSIs. The House passed bill for Fiscal year 2013 repeated report language that stated: "The Committee has previously asked NSF to consider the concept of creating a program within EHR to focus on Hispanic Serving Institutions (HSIs). NSF shall provide to the Committees on Appropriations a report outlining how the needs of HSIs will be addressed in fiscal year 2013 and any plans to establish an HSI-focused program in fiscal year 2014. This report shall be submitted no later than 120 days after the enactment of this Act." Although the House bill became stuck in the Senate, there are still several years of pending instructions in this area. While I appreciate the efforts NSF is making in expanding opportunities to underrepresented minorities, including through the establishment of a new program in this year's budget, I am troubled that NSF has not established a dedicated Hispanic Serving Institutions - Undergraduate program. Latinos are now the largest minority group in the United States, and are severely underrepresented in the STEM fields. More importantly, Congressional instruction was very clear in this regard. In addition to report language, the America COMPETES Act, P.L. 110-69 authorized the creation of a Hispanic-Serving Institutions Undergraduate Program at the NSF for $30 million. Earlier this month, 21 of my colleagues and I sent a letter to President Obama restating our support for the creation of a dedicated HSI STEM program within the NSF and encouraging the Administration to work with Congress as the America COMPETES Act Reauthorization approaches.

Question 1. What is the status of the report? Why has the NSF refused to comply with Congressional instruction?

Answer: The aforementioned HSI report is being drafted and will be submitted by the required deadline of May 17, 2014. NSF will address funding of HSIs through its existing programs in order to meet the specific needs of HSIs, as required by the joint explanatory statement.

Questions for the Record Submitted by
Michael M. Honda

Transitioning Innovations from the Lab to the Marketplace

Question 1. Often, startup companies and researchers have trouble transitioning discoveries and inventions from the lab to the market. The NSF Innovation Corps program is purposed with connecting NSF-funded research with the technological, entrepreneurial, and business communities to help bridge this gap between discoveries and downstream technological applications. How do the Innovation Corps and the "Nodes" and "Sites" that NSF supports work with researchers to "build, utilize, and sustain a national innovation ecosystem that augments the development of technologies, products, and processes that benefit the Nation"? How else is the NSF helping researchers transition their innovations from the lab to the marketplace?

Answer: The purpose of NSF I-Corps is to support NSF-funded researchers who, with teams, are interested in transitioning their research out of the lab. I-Corps awards are based on the maturity of the effort (i.e., whether the research is ready to leave the lab), strength of the team, and anticipated market value. The teams selected for I-Corps awards will receive additional support – in the form of mentoring and funding – to accelerate innovation that can attract subsequent third-party funding.

NSF established the **I-Corps Nodes** program to support regional needs for innovation education, infrastructure and research. The interconnected nodes of this network are diverse in research areas, resources, tools, programs, capabilities and geographic locations; while the network has the flexibility to grow or reconfigure, as needs arise.

I-Corps Nodes foster understanding on how to:
- Identify, develop and support promising ideas that can generate value,
- Create and implement tools and resources that enhance our Nation's innovation capacity,
- Gather, analyze, evaluate and utilize the data and insight resulting from the experiences of the I-Corps Teams/Sites, and
- Share and leverage effective innovation practices on a national scale to improve the quality of life for the U.S. citizenry.

I-Corps Regional Nodes contribute to the National Innovation Network in the following three ways:

Level 1 Contribution: *I-Corps Regional Training*: Nodes demonstrate the capacity to deliver an innovation-enhancing training program based on the hypothesis/validation "Customer Development" curriculum that is used to support NSF I-Corps teams. NSF may call upon I-Corps Regional Nodes up to twice a year to host a cohort of approximately 20-25 I-Corps teams in the delivery of the NSF-selected I-Corps curriculum.

Level 2 Contribution: *I-Corps Node Regional Infrastructure*: I-Corps Regional Nodes are developing near-term tools and resources that are intended to impact and expand the benefits of the entire I-Corps program within a 2-3 year timeframe. Level 2 efforts are also addressing the issues associated with accelerating the diffusion/adaption/adoption of effective innovation practices in the national ecosystem, while further building entrepreneurial capacity in the node environments.

Level 3 Contribution: *I-Corps Node Blue Sky Research*: I-Corps Regional Nodes are leveraging and analyzing data from Level 1 and Level 2 contributions. Key activities are focusing on: 1) developing an understanding of how institutions can improve support for innovation ecosystems; 2) sharing and developing methods for successfully scaling effective practices and models that foster innovation; 3) exploring how the National Innovation Network can enable new collaborations among geographic regions to support commercialization - independent of geographic locations; 4) examining and tracking the I-Corps teams' dynamics, activities and outcomes; and 5) identifying and proposing improvements to the I-Corps curriculum materials, training practices, and National Innovation Network utilization.

NSF established the **I-Corps Sites** program to contribute to the nation's innovation ecosystem. The goals of the Sites program are to spur translation of research, to encourage collaboration between academia and industry, to develop formal, active, local innovation ecosystems that contribute to a larger, national network of mentors, researchers, entrepreneurs and investors, and to train students to understand innovation and entrepreneurship. Through I-Corps Sites, NSF investments strategically strengthen the innovation ecosystem by addressing the challenges inherent in the early stages of the innovation process – the program supports activities that are designed to overcome many of the obstacles in the path of innovation. I-Corps Sites are housed in academic units whose mission is to provide resources to individuals and teams in the form of space, seed funding, entrepreneurial mentoring, curriculum, or other assets needed to transition technology into the marketplace.

As part of an evolving national innovation network, I-Corps Sites are funded at universities to nurture and support multiple, local teams by providing infrastructure, advice, resources, networking opportunities, training and modest funding ($1,000 to $3,000 per team over a 3-6 month period) to enable researchers to transition their ideas, devices, processes or other intellectual activities into the marketplace or into becoming I-Corps Team or SBIR applicants. While different institutions may choose different mechanisms for achieving the goals of their I-Corps Site, certain characteristics of a Site must be consistent – projects must be team-centric, the origin and nature of the projects must be STEM-focused, and the kind of support that is provided to the teams by the Site must include assets needed to explore transitioning technology into the marketplace.

The Innovation Corps program is a key element in a series of NSF-supported programs concentrating on the innovation ecosystem. I-Corps has its genesis in a number of long-standing programs within NSF that support the innovation ecosystem, such as Engineering Research Centers (ERC), Industry/University Cooperative Research Centers Program (I/UCRC), Partnerships for Innovation (PFI), Science and Technology Centers (STC), and Materials Research Science and Engineering Centers (MRSEC). In FY 2011 and FY 2012, investments in the inaugural year for I-Corps complemented these long-standing investments. All of these programs are built on the backbone of support for core research, primarily to individual investigators, found in every directorate at NSF.

Cybersecurity

I often hear from technology leaders in Silicon Valley that the government and this country must get more serious on cyber security. The number of attacks is increasing dramatically and as our lives, personal data and the Nation's critical infrastructure become more connected online, we put ourselves ever more at risk to large scale destructive breaches and attacks. A key step to addressing these cyber threats is bringing academics, government agencies, internet/telecommunication companies, and

cyber security companies together in a safe haven environment to share experience and strategies to more effectively combat this growing problem. I have introduced legislation (the Excellence in Cybersecurity Act) that would create centers of excellence around the country to bring together industry leaders with government agencies to identify and analyze existing and future cyber security challenges faced by various industries, to create solutions and promote best practices to address such challenges, and to collaborate with individuals in those industries to share knowledge.

Question 2. How is the NSF's Secure and Trustworthy Cyberspace (SaTC) program addressing the issue of cyber security? Will the SaTC program partner with cyber security industry leaders and try to find industry specific solutions by sharing experience and knowledge?

Answer:
How is the NSF's Secure and Trustworthy Cyberspace (SaTC) program addressing the issue of cyber security?

The NSF's Secure and Trustworthy Cyberspace (SaTC) is an NSF-wide investment that is building the knowledge base in cybersecurity by enabling discovery, learning and innovation, and that will lead to a more secure and trustworthy cyberspace. Through a focus on long-term, foundational research, SaTC is developing the scientific foundations for cybersecurity research that will be useful for years to come. It is also broadening the cybersecurity research portfolio to include more cross-disciplinary projects and to increase opportunities for implementing new technologies that emerge from the research. It is expanding the number of large, multi-institutional projects that provide high-level visibility to cybersecurity grand challenges; and it is establishing curricula recommendations for new courses, degree programs, and educational pathways to develop future cybersecurity experts. SaTC is building a cybersecure society and providing a strong competitive advantage for the Nation's ability to produce high-quality digital systems and a well-trained workforce.

In 2011, the National Science and Technology Council (NSTC), with the cooperation and involvement of NSF, put forward a strategic plan titled *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program*. This plan identifies a broad, coordinated research agenda to make cyberspace secure and trustworthy. The strategic plan details four goals that together cover a set of interrelated priorities for the federal agencies that conduct or sponsor research and development in cybersecurity. These four goals are: (1) inducing change, (2) developing scientific foundations, (3) maximizing research impact, and (4) accelerating transition to practice. SaTC is meeting these goals through investments in the following areas:

- Inducing change in the current state of cybersecurity by funding research that encourages an adversarial perspective (i.e., thinking like an attacker, with the same goals and methods as an adversary) and that closely examines the security, reliability, resiliency, privacy, usability, and overall trustworthiness of digital infrastructure. Areas of research include tailored trustworthy spaces, moving target, and economic and social incentives.
- Developing scientific and mathematical foundations for cybersecurity research to derive first principles and the fundamental building blocks of security and trustworthiness.
- Maximizing research impact by catalyzing integration across academic disciplines, increasing cooperation between government and the private sector, increasing collaboration across international borders, and protecting critical infrastructure.

- Accelerating transitions to practice by encouraging and enabling adoption and implementation of new technologies so as to create measurable improvements in the cybersecurity landscape.
- Addressing the pivotal issues in the education and preparation of tomorrow's cybersecurity researchers and professionals across all areas of science and engineering.

Will the SaTC program partner with cyber security industry leaders and try to find industry specific solutions by sharing experience and knowledge?

SaTC has, and continues to develop, partnerships with other agencies and industry to effectively achieve its long-term goals. The ongoing partnerships with industry for sharing expertise and knowledge that will lead to industry solutions are described in more detail in the following paragraphs.

The yearly SaTC solicitation has a Transition to Practice (TTP) Option that supports the leveraging of proposed research activities and ideas whose outcomes at the end of the award are capable of being implemented, matured, applied, experimentally deployed, or demonstrated as a useable capability. SaTC provides additional funding for these awards so that research results can be further developed, matured and experimentally deployed in organizations or industries, including in networks and end systems.

The SaTC solicitation established in FY 2012-2014 a project class for "Frontier" awards with budgets of up to $10 million and durations of up to five years. These are large, multi-disciplinary, multi-organizational, and/or multi-institution projects that provide high-level visibility to grand challenge research areas in cybersecurity. In FY 2012 and 2013, NSF funded five Frontier projects, including projects on cybersecurity for healthcare and wellness, cybersecurity for cloud computing, and cybercrime ecosystems. Some of these projects have collaborations with industry to further the linkages between knowledge and practice. For example, the cloud computing project, which started in FY 2013, plans to hold "Cloud Security Horizons" summits with industry stakeholders to help shape the future of security in cloud computing. The cybercrime ecosystems project is working with Twitter to improve the company's abuse detection infrastructure by integrating into it the project's findings on the underground market for fraudulent accounts.

In FY 2013, the SaTC program held a workshop in partnership with the Computing Community Consortium (CCC) and the Semiconductor Research Corporation (SRC) on fundamental cybersecurity issues of interest to both the semiconductor industry and academic researchers. SRC is a leading technology research consortium, comprising semiconductor companies and university research programs. One of the outcomes from this workshop was a joint partnership between NSF and SRC to support research on Secure, Trustworthy, Assured and Resilient Semiconductors and Systems (STARSS) with a focus on Design for Assurance. More specifically, in FY 2014, the STARSS program plans to fund its first awards on new strategies for computer hardware architecture, specification, and verification, with the aim of decreasing the likelihood of unintended behavior or access, increasing resistance and resilience to tampering, and improving the ability to provide authentication throughout the supply chain and in the field.

In FY 2014, NSF released a Dear Colleague Letter for Innovation Transition (InTrans) awards for project teams completing five-year Frontiers projects in the SaTC program. Research is expected to build on innovations developed within a given Frontier project through close

coordination with industry partner(s). The fundamental research results of the Frontier must drive more applied research with the potential to enable the industrial partner(s) to develop technological innovations with concrete and tangible positive impacts for society. The collaboration must also provide students with opportunities to work closely with industry researchers. To ensure industry commitment to the research grant, these awards will be co-funded by NSF and industry. Further, industry partners will be required to provide the majority of the funding as NSF support for InTrans awards will not exceed one-third of the total co-funding support provided by industry.

In FY 2013, the SaTC program held a first-ever Principal Investigators' (PI) meeting. The meeting brought together over 300 SaTC-funded PIs and co-PIs with interested parties from industry and government agencies and included a focus on results and open questions in the Science of Security. A second SaTC PI meeting is being planned for early- to mid-FY 2015 and will continue to involve industry and government agencies.

In FY 2014, the SaTC program sponsored a 2.5-day workshop centered on identifying high-impact actions that could be taken in any sector to better secure the Internet. The workshop, called the Cybersecurity Ideas Lab, brought together 35 invited experts in computer science, cybersecurity, economics, social science and policy. These experts were drawn from industry, academia, and the government. In addition to advancing the national dialogue on cybersecurity, the workshop yielded a list of concrete recommendations for enhancing the security of the Internet ecosystem that will be published in an upcoming report.

Also in FY 2014 NSF will initiate collaboration with Intel in the area of security for critical infrastructure. Cybersecurity threats exploit the increased complexity and connectivity of critical infrastructure systems, placing the Nation's security, economy, public safety, and health at risk. This partnership combines NSF experience in developing and managing successful large, diverse research portfolios with Intel's long history of building research communities in emerging technology areas through programs such as its Science and Technologies Centers Program.

In FY 2015, the SaTC program is planning to hold a cross-agency workshop that will review the progress made in developing a science of cybersecurity, and that will propose ways that requirements and results can be better communicated across the agencies, as well as among academics and industry.

High-Performance Computing

Question 3. I commend the NSF for its important and historic role in advancing the Nation's competitiveness through support of advanced computing infrastructure and the science and engineering applications it enables. In view of NSF's considerable expertise in high- performance computing for open science, what is NSF's vision for its leadership role in the broader federal context of science-supporting agencies? In particular, how is NSF planning for, and how committed is it to, its vision for maintaining and modernizing its world-class big data and high-performance computing infrastructure, software, and applications that support all areas of scientific research and education, including the most demanding "grand challenge" science problems, accelerating transition to practice?

Answer: Innovation and discovery in science and engineering is increasingly dependent on a cohesive yet dynamic and powerful cyberinfrastructure in which high performance computing (HPC) plays an essential and integral role. The National Science Foundation (NSF) has been

an international leader in high-performance computing deployment, application, research, and education for almost four decades. With the success of HPC modeling and simulation across an increasingly wide range of multidisciplinary research topics and teams, coupled with the advent of next generation instruments and sensors producing vastly larger and more diverse datasets available in real or near-real-time, NSF is committed to position and support the entire spectrum of its research communities, enabling them to be at the cutting edge of advanced computing technologies, hardware and software.

With the *Cyberinfrastructure for 21st Century Science and Engineering Advanced Computing Infrastructure Vision and Strategic Plan*, NSF seeks to promote a complementary, comprehensive, and balanced portfolio of advanced computing infrastructure and programs for research and education. This portfolio supports multidisciplinary computational and data-enabled science and engineering that in turn support the entire scientific, engineering, and education community. NSF is a leader in creating and deploying a comprehensive portfolio of advanced computing infrastructure, programs, and other resources to facilitate cutting-edge foundational research in computational and data-enabled science and engineering (CDS&E) and their application to all disciplines.

The strategies for fulfilling this vision include the following:

- Foundational research to fully exploit parallelism and concurrency through innovations in computational models and languages, mathematics and statistics, algorithms, compilers, operating and run-time systems, middleware, software tools, application frameworks, virtual machines, and advanced hardware.
- Applications research and development in use of high-end computing resources in partnerships with scientific domains, including new computational, mathematical and statistical modeling, simulation, visualization and analytic tools, aggressive domain-centric applications development, and deployment of scalable data management systems.
- Sustainable and innovative resources built, tested, and deployed into a collaborative ecosystem that encompasses integration/coordination with campus and regional systems, networks, cloud services, and/or data centers in partnerships with scientific domains.
- Comprehensive education and workforce programs, ranging in scope from programs designed to develop deep expertise in computational, mathematical and statistical simulation, modeling, and CDS&E to programs designed to enable an advanced technical workforce with career paths in science, academia, government, and industry.
- Transformational and grand challenge community programs that support contemporary complex problem-solving by engaging a comprehensive and integrated approach to science, utilizing high-end computing, data, networking, facilities, software, and multidisciplinary expertise across research communities, other government agencies, and international partnerships.

While support for larger and more complex multiscale, multiphysics simulations are encompassed in these strategies, NSF perceives that an opportunity exists for expanded discovery and economic impact with this comprehensive approach to advanced computing.

In 2013, NSF initiated a two-year National Academy of Science study to examine anticipated priorities and possible decision-making frameworks for NSF in the implementation of its computing strategy in the 2017 – 2020 timeframe. The committee has been recently charged and named. An interim report may be available in late calendar year 2014.

NSF's Assistant Director of the Directorate for Computer and Information Science and Engineering (CISE) is co-chair of the Networking and Information Technology Research and Development (NITRD) Subcommittee of the National Science and Technology Council's Committee on Technology. NSF works in close collaboration with other science-supporting agencies through the NITRD High End Computing (HEC) Interagency Working Group.

Questions for the Record Submitted by
Adam B. Schiff

Hispanic-Serving Institutions Program

As you know, the America COMPETES Act of 2007 authorized an NSF program to support Hispanic-Serving Institutions (HSIs). Despite language in the reauthorization of America COMPETES Act of 2010 directing the NSF to maintain support for each of its existing programs for minority-serving institutions -- including HSIs – an HSI-specific program has not yet been established. In both FY 2013 and 2014, the Committee weighed in on the issue and asked the NSF to report back on plans to establish an HSI-focused program and how existing and planned efforts will meet the specific needs of HSIs through NSF's other programs. Subsequently, the NSF reported on the logistical difficulties of establishing and managing such an initiative and then "proposed a multi-pronged approach... to meet the needs of HSIs by building on prior efforts and focusing on efforts to build capacity, especially in community colleges... including opportunities to increase the participation, retention, and graduation of Hispanics in STEM". While programs dedicated to Historically-Black Colleges and Universities (HBCUs) and Tribal-Serving Institutions (TSIs) have been in place at the NSF for over a decade, Hispanic-Serving Institutions (HSIs) remain one of the most crucial cohorts of minority-serving institutions yet to receive targeted NSF infrastructure development funding in the areas of science, technology, engineering, and math. Recognizing that NSF funding to HBCUs and TSIs have proven essential to the demonstrated success of strengthening STEM initiatives at these institutions and assisting in preparing a strong STEM workforce in a time of utmost need, it would be remiss for us not to continue encouraging and working with the NSF to assist HSIs as well.

Question 1. Can you elaborate on the logistical difficulties of establishing and managing a dedicated HSI program at the NSF, and explain why, in light of the existing program models for other minority-serving institutions that the NSF has managed for over ten years, these difficulties could or could not be overcome?

Answer: In FY 2013, NSF funds awarded to Hispanic-Serving Institutions (HSIs) totaled $155.65 million through 332 awards. NSF support to HSIs continues to be strong and exceeds the combined total of $104.52 million for Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs). While there are about 105 HBCUs and 30-35 TCUs, in 2010-2013 there were 370 HSIs (defined as institutions with 25 percent or more total undergraduate Hispanic full-time equivalent student enrollment), with an additional 277 "emerging HSIs" (defined as institutions with 15-24 percent undergraduate full-time equivalent Hispanic enrollment). These 370 institutions of higher education are very heterogeneous, including small community colleges, four-year primarily undergraduate institutions, and large research-intensive universities, all with different missions. The range of available STEM programs within these diverse institutions is quite wide. Crafting a single program, comparable to NSF's dedicated programs for HBCUs and TCUs, which has the potential for national scale and serves such a variety of institutions presents a logistical, programmatic, and financial challenge, particularly as the numbers of HSIs are increasing rapidly.

Question 2. Can you update the Committee on the progress of the NSF's proposed initiatives to meet the needs of HSIs that the Foundation committed to undertaking in its

August 2013 report to the Committee? In particular, how has the NSF proceeded to assist STEM initiatives in community colleges?

Answer: In the August 2013 response to Congress, NSF indicated a desire to implement a comprehensive approach to address the needs of HSIs including Dear Colleague Letters (DCLs) that focus on undergraduate education and/or express a commitment to broadening participation of underrepresented groups, engaging HSI community colleges, and creating opportunities for capacity building in HSIs. NSF has developed two DCLs to complement the letter (NSF 12-081) issued in FY 2012, which is still active.[6]

One of the new DCLs encourages HSIs, especially community colleges, to build research capacity through special grant opportunities including Early Concept Grants for Exploratory Research (EAGER) and Conferences, Symposia, and Workshops that focus on evidence-based practices that have been shown to be particularly effective for students at HSIs, as well as exploratory research that may lead to new models and best practices.[7] Examples of appropriate topics include:

- Understanding factors that will lead to improved retention of students in STEM programs at two-year HSIs.
- Understanding barriers and challenges that prevent the transfer of students at two-year HSIs to four-year colleges; understanding factors that promote the transfer of students including articulation agreements.
- Improving the quality of STEM undergraduate academic and research experiences at two-year HSIs.
- Research on strategies that enhance interest and motivation of students and improve persistence and graduation rates in undergraduate STEM programs at HSIs through innovations in STEM curricula, instructional materials, and research experiences.
- Building capacity at HSIs through collaborations with majority institutions that support faculty research, professional development, and mentoring.

The second DCL encourages current awardees, including HSIs, to apply for supplemental funding to active awards for the purpose of increasing the matriculation of graduates of two-year HSIs to four-year institutions while strengthening strategies for retention in STEM majors, such as providing research experiences for first and second-year undergraduates.[8]

These activities complement ongoing programmatic efforts, which resulted in 46 awards to HSIs in 2013 through several EHR programs including Advanced Technological Education, Louis Stokes Alliances for Minority Participation, and the Robert Noyce Scholarship Program.

Question 3. Has the NSF considered the possibility of creating, or at the very least beginning outlining a plan to create, an HSI-focused program in FY 2015 and to what extent has this been discussed?

Answer: NSF is developing plans to invest in approaches to improve STEM learning for all students, at all levels, including the rapidly growing number of Hispanic students in K-12 settings. NSF continues to explore strategies to increase funding for innovative approaches to improving STEM education at HSIs, especially two-year institutions. More than half of HSIs are two-year institutions. More than half of all undergraduates attend two-year institutions; however,

[6] www.nsf.gov/pubs/2012/nsf12081/nsf12081.jsp
[7] www.nsf.gov/pubs/2014/nsf14064/nsf14064.jsp
[8] www.nsf.gov/pubs/2014/nsf14065/nsf14065.jsp

relatively few Hispanic students who begin college at two-year institutions continue on to earn baccalaureate degrees, particularly in STEM. NSF is aiming to identify the factors that will facilitate the transfer of students from two-year to four-year institutions prepared to enter STEM majors. For FY 2015, discussions are underway to build on the Dear Colleague Letters issued in FY 2014 and to identify options for tracks within existing programs targeting HSI community colleges and critical junctures (high school to college, two-year to four-year institutions). These activities provide the foundation for future efforts designed to build capacity and improve undergraduate education at these institutions. Evaluation of the effectiveness of the DCLs and expanded program tracks will inform future efforts and directions regarding HSIs.

Questions for the Record
The Honorable Ralph M. Hall,
Chairman

HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science

Thursday, November 15, 2012
10:00 a.m.

QUESTIONS FOR DR. SURESH:

1. Has NSF heard any concerns from the scientific community regarding the impacts of the Blue Ribbon Panel's recommendations on the conduct of science in Antarctica? If so, how are those concerns being addressed?

   - NSF has generally received positive feedback for the overarching goal of improving science efficiency and broadening opportunities for the type and kind of science that could be supported in Antarctica. However, NSF managers have heard concerns about the Blue Ribbon Panel's (BRP) recommendation to redirect $4 million, or 6%, per year for four years from the NSF Antarctic science budget toward logistics improvements. NSF is implementing this recommendation by funding the science community to develop and improve remote sensing instrumentation and other technologies that will in turn increase the efficiency of the enterprise and make it possible to support more science. NSF management has and will continue to communicate this approach to the community through USAP channels, public forums, and conferences. We expect some concerns will remain until the approach has been more fully implemented.

2. It is my understanding that the repairs and renovations to the USCG heavy duty icebreaker, *Polar Star,* will soon be complete, and she will once again be available to provide support in the Antarctic. How does this affect the urgency for the U.S. to acquire a new heavy duty icebreaker?

   - The Coast Guard has informed NSF that the POLAR STAR is expected to be in service for the 2013-2014 USAP resupply mission at McMurdo. Coast Guard has indicated that the refurbishment is intended to extend the vessel life by 7-10 years. The lead-time for new vessel acquisition by the Coast Guard is such that it must proceed now to be in place by the time of retirement of the POLAR STAR if the Coast Guard is going to continue to serve the USAP resupply mission.

3. You testified that the Blue Ribbon Panel safety recommendations are paramount. I agree that the safety of those on the ice is essential. I understand you have already chartered the team of senior NSF staff to respond to the report. Can you share any initial conclusions or actions taken by the team or NSF in general to ensure the safety of those in Antarctica?

   - Safety of our personnel and operations in Antarctica is always a priority concern for NSF.

- Several of the safety and health implementing actions in the report have already been acted on. For example, a boat ramp and floating dock are being constructed this season at Palmer Station to address concerns about small boat operations (complete by June). Additionally, the flooring in the Building 120 warehouse was repaired shortly after the BRP visit to McMurdo Station.

- The new prime contractor, Lockheed Martin Corporation, has a comprehensive safety & hazard communication program for employees, including risk assessment, which is being implemented as part of the contract transition.

- The safety and health implementing actions that require engineering or large investment, including upgrading of fire suppression systems and replacing the Palmer Pier are being addressed in the long range plans for each of the Antarctic stations.

4. We look forward to receiving a copy of the point-by-point response to the Blue Ribbon Panel's recommendations, when can we expect this document to be shared with the Committee? Would you consider this a master plan for implementation, and if so, will you be prioritizing the recommendations? What can we expect to see in the FY14 Budget Request?

    - We are currently in the process of updating our response to the recommendations to account for recent activities and will provide a copy to the Committee by the end of the current Antarctic operating season (end of February 2013), coincident with briefings to the National Science Board and the Blue Ribbon Panel. A prioritized implementation plan is being developed that will continue to be updated as budget information and the results of various studies underway become known.

5. The Blue Ribbon Panel Report mentions potential circumvention of the Antarctic Treaty and related instruments as possible future single-point failures. Is this a current danger, and if so, please elaborate on the concern?

    - Despite growing international interest in Antarctica, there does not appear to be an immediate threat to the Antarctic Treaty System.

    - We concur with the Blue Ribbon Panel that maintaining an active and influential science presence in Antarctica is essential for ensuring that the US retain its governing role in the Treaty system. While the Treaty is in force, territorial claims remain in abeyance and an effective environmental protection framework is in play both helping to preserve Antarctica for peaceful, scientific purposes.

6. NSF recently announced a reorganization of several offices, including moving the Office of Polar Programs from the Office of the Director to the Geosciences Directorate. Why was this realignment necessary and how will it affect the Office of Polar Programs ability to manage the U.S. Antarctic Program? How will it affect the Foundation's ability to implement recommendations from the reports and carry out other Antarctic activities?

- The realignment is intended to strengthen science and engineering technical guidance, coordination, and leadership at NSF.

- The mission of OPP will be better addressed in a directorate where NSF's overall science and engineering programmatic responsibilities reside, and OPP staff will continue to exercise the same authorities that they currently maintain.

- The realignment will ensure that administrative resources, including resources for program oversight, are more readily available ensuring a continued commitment to polar research, infrastructure and logistics.

Sen. Tom Udall
Questions for the record
Senate Committee on Appropriations
Hearing on "Driving Innovation through Federal Investments"
April 29, 2014

Questions for Dr. France Cordova (National Science Foundation)

1. NRAO and radio astronomy in New Mexico (NSF)
Dr. Cordova, NSF plays a key role in supporting astronomy and STEM education activities at National Radio Astronomy Observatory (NRAO) facilities in Socorro, New Mexico. NRAO enables research into the birthplaces of stars and planets, super-massive black holes, gravitational waves, chemical precursors of life, and the remnant heat of the Big Bang. How is the NSF leveraging federal investments in NRAO and other scientific facilities to foster innovation?

2. NSF investments in international radio astronomy facilities
The Federal government is investing in ground-breaking international facilities such as the Atacama Large Millimeter/submillimeter Array in Chile. How is NSF ensuring that these investments leverage and contribute to our critical domestic science facilities?

3. NSF radio astronomy and solar observatories role in promoting STEM education
Dr. Cordova, we share a keen interest in attracting young American students to STEM fields and encouraging greater participation in STEM career fields. Given that astronomy is a field that often sparks a lifelong interest in science, how is NSF using federal research facilities such as those of the NRAO in Socorro, New Mexico and the National Solar Observatory (NSO) near Alamogordo, New Mexico to help foster a new generation of young scientists?

4. Impact of budget cuts and budget uncertainty on American scientific capabilities
Could you describe how recent budget cuts, budget uncertainty, and the recent government shutdown have impacted American researchers and scientific facilities, such as the NRAO and NSO observatories in New Mexico? How does this impact the retention of core US scientific capabilities?

5. Spectrum sharing and radio astronomy
How is NSF working with the Department of Commerce, the Federal Communications Commission and others to ensure that efforts to increase commercial access to radio spectrum for mobile broadband and other uses do not prevent the ability of radio astronomers to continue to make observations from NRAO facilities?

6. Leveraging commercial spaceflight investments to promote scientific research and STEM activities
New Mexico is home to some exciting research and STEM activities that take advantage of suborbital space launches. Test flights have already begun at Spaceport America for commercial reusable suborbital vehicles that could dramatically increase access to microgravity environments for scientific research. I have heard from scientists from New Mexico and across the country who eagerly anticipate doing more experiments at lower cost in microgravity and space environments thanks to America's burgeoning commercial spaceflight industry. This includes research relevant to numerous fields as well

as studying the upper parts of Earth's atmosphere itself. These upper parts of the Earth's atmosphere are currently so inaccessible--and so little understood--that scientists sometimes refer to it as the "ignorosphere." What plans does NSF have to support scientific research that takes advantage of access to suborbital space to advance the frontiers of science and technology? How can NSF encourage more researchers to take advantage of such opportunities as they become more widely available through commercial suborbital spaceflights?

7. National Solar Observatory site in New Mexico

New Mexico is home to the National Solar Observatory's Richard B. Dunn Solar Telescope (DST). Located on Sacramento Peak near Alamogordo, this telescope has revealed many intricacies of the surface features of the Sun. DST has also served as a test bed for adaptive optics technologies and the next generation of solar instrumentation. Yet my understanding is that the National Science Foundation is developing a plan to potentially close this facility by the time the new Daniel K. Inouye Solar Telescope (DKIST) in Hawaii becomes operational. I have serious concerns about a potentially costly closure of DST given the value of continuing to operate this telescope facility for scientific research and training purposes, even after the newer DKIST facility becomes operational.

- Will you assure me that NSF will keep me apprised of any plans regarding the future of the National Solar Observatory's Richard B. Dunn Solar Telescope?
- Before NSF decides to divest from or close DST, will you seek to find suitable entities willing and able to continue operating the facility?

8. Behavioral and social sciences funding

Many challenges facing society ranging from pollution to violence are often related to human behavior. Given the importance of studying human behavior, what implications do you see for the proposed cuts to NSF funding for the behavioral and social sciences?

9. Support for Hispanic Serving Institutions

The America Competes Act authorized the NSF "to establish a new program to award grants on a competitive, merit-reviewed basis to Hispanic Serving Institutions (HSIs) to enhance the quality of undergraduate STEM education at such institutions, and to increase the retention and graduation rates of students pursuing associate's or baccalaureate degrees in STEM." My understanding is that NSF did not submit a proposal to create such a program and has even expressed its intent to never fund this initiative. Why is it so difficult for the NSF to create an initiative focused on HSIs within its Directorate for Education and Human Resources?

QUESTIONS FOR THE RECORD
THE HONORABLE CYNTHIA LUMMIS (R-WY)
U.S. House Committee on Science, Space, and Technology
Next Generation Computing and Big Data Analytics
Wednesday, April 24, 2013

1. The massive volumes of data generated daily across a range of industries and public sector organizations necessitate new methods to store and manage the data. The National Science Foundation (NSF) Computer and Information Sciences and Engineering Directorate (CISE) helps develop and maintain cutting-edge national computing and information infrastructure for research and education. This data must be analyzed to extract knowledge and promote discovery. Often this data resides in scattered locations.

For the nation to take advantage of the discovery that can be derived from big data, please explain how an effective infrastructure can be constructed to connect the entities developing and using Big Data to drive discovery. Additionally, please describe how the infrastructure, connections, and broadband would be developed to enable the entire community of research universities, in particular those like the University of Wyoming from EPSCoR states.

The Division of Advanced Cyberinfrstructure (ACI) in NSF/CISE supports three major programs that emphasize the development of computational infrastructure and participation in Big Data activities: The first program is Data Infrastructure Building Blocks (DIBBS); the second is Campus Cyberinfrastructure - Network Infrastructure and Engineering (CC-NIE); and the third is Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21). All three programs support research and discovery efforts in data as well as helping campuses to obtain the infrastructure connections and facilities required to participate in Big Data. They are discussed below.
The DIBBS Program focuses on how to develop, implement, and support the new methods, management structures and technologies to store and manage the diversity, size, and complexity of current and future data sets and data streams. DIBBS has three types of awards:

- Conceptualization awards support design specifications for creating a sustainable data infrastructure that will be discoverable, searchable, accessible, and usable to the entire research and education community;
- Implementation awards support development and implementation of technologies and infrastructure that addresses elements of the data preservation and access; and
- Interoperability awards develop frameworks that provide consistency or commonality of design across communities and implementation for data acquisition, management, preservation, sharing, and dissemination.

The CC-NIE Program invests in improving and re-engineering networks at the campus level to support a range of data transfers supporting computational science and computer networks and systems research. CC-NIE has two major types of awards:

- Data Driven Networking and Infrastructure for the Campus and Researcher; and
- Network Integration and Applied Innovation awards.

The CIF21 effort has participation from every NSF Directorate. CIF21 focuses on foundational research, infrastructure support and deployment, and community building. Since CIF21 supports the entire cyberinfrastructure eco-system, it also supports projects involving data, computational science and building research communities.

NSF EPSCoR supports programs that focus on connectivity and cyberinfrastructure for Big Data. These are discussed below, specifically focusing on EPSCoR activities in Wyoming.

Connectivity: Wyoming is a founding member of the Front Range Gigapop (FRGP) in Denver, which provides 10Gbit/sec connectivity between the University of Wyoming and institutions in Colorado, including NCAR, as well as connectivity to the Abilene Network and National LambdaRail. A significant amount of the nation's long-haul telecommunications fiber transits through Wyoming's southern quarter along the mainline of the Union Pacific railroad and Interstate 80. Major telecommunications centers as well as the National Center for Atmospheric Research (NCAR) – Wyoming Supercomputing Center are located in Cheyenne. Fiber connectivity along with the availability of electrical power and favorable climate for data center operation is making southeastern Wyoming an important IT hub.

Managing Big Data: Wyoming has an NSF EPSCoR award that pilots an effective cyberinfrastructure that connects EPSCoR entities developing and using Big Data to drive discovery. The RII Track-2, CI-Water, allows a consortium of Utah and Wyoming researchers to acquire and develop hardware and software cyberinfrastructure to support the development and use of large-scale, high-resolution computational water resources models to enable comprehensive examination of integrated system behavior through physically-based, data-driven simulation. Successful integration requires data, software, hardware, simulation models, tools to visualize and disseminate results, and outreach to engage stakeholders and impart science into policy, management, and decisions. The computational requirements of stochastic methods to consider uncertainties, fine spatial and temporal resolutions to improve accuracy, and representation of dynamic processes that include feedbacks among system components demand use of state-of-the-art high-performance computing (HPC). CI-WATER is working to develop a robust and distributed CI consisting of integrated data services, modeling and visualization tools, and a comprehensive education and outreach program that will revolutionize how computer models are used to support water resources research in the Intermountain West and beyond.

2. Within NSF, the Computer and Information Sciences and Engineering Directorate (CISE) helps develop and maintain cutting-edge national computing and information infrastructure for research and education. NSF has significant investment in computing infrastructure, including the NCAR-Wyoming Supercomputing Center, among others. These high performance computers are capable of processing complex data sets at a greater rate, enabling scientific research and discoveries.

The ability to analyze and utilize information from increasing quantities of data sets is crucial to advancing knowledge. Please describe the contributions these facilities are expected to make to the development and use of Big Data over the next three to five years.

ACI supports national efforts in advanced and cutting edge computational facilities including the recently announced facilities in Texas (Stampede) and Illinois (Blue Waters). While both of these facilities support very high performance and complex data problems, the Blue Waters facility has the largest data storage and management system in the world. When these facilities are in full production, they will permit investigators across the country to engage in innovative research demanding petascale capabilities.

ACI also supports the XSEDE project, which manages and operates 17 different high performance systems across the nation with a common interface to ensure that researchers can get what they need without having to contact each site. XSEDE also manages the allocation process that provides researchers with the resources they need. Usage of these facilities is done via peer review so that the best research is supported.

The NCAR Wyoming Supercomputing Center (NWSC) provides high-performance CI that will enable researchers to perform high-resolution simulations of weather phenomena, global and regional climate, coastal oceans, sunspots, subsurface flow, and more. Earth System research and education will be transformed by the NWSC, as the next generation of Earth science researchers and computational scientists will be attracted by the importance of the problem and the scale of the facilities available to them. Current and planned education, outreach, and training programs built around the facility will help to broaden the impact of the NWSC project on both regional and national scales. Integration of the NWSC with other NSF high-performance CI will provide important linkages with other resource providers and will directly support NSF's vision of a transformative national petascale cyberinfrastructure for science and engineering. Finally, the NWSC has the potential to contribute to economic development in the State of Wyoming in the form of well-paying jobs, workforce training opportunities, and in the transformation of the state into a destination of choice for other high-technology enterprises. Through the facility partnership with Wyoming, these benefits can be extended to other EPSCoR states as well.

NCAR aims to improve researchers' abilities to analyze and utilize information via various efforts focused on data manipulation and visualization (e.g., Globally Accessible Data Environment, GLADE, http://www2.cisl.ucar.edu/resources/glade; data analysis and visualization, http://www2.cisl.ucar.edu/resources/software/dav).

QUESTIONS FOR THE RECORD
THE HONORABLE DEREK KILMER (D-WA)
U.S. House Committee on Science, Space, and Technology
Next Generation Computing and Big Data Analytics
Wednesday, April 24, 2013

There have been a number of big data reports generated recently by a number of industry leaders. I'm proud to say that companies, EMC and Isilon, which is headquartered in Washington State, have done a lot of great work on big data. EMC recently released their latest "Digital Universe" study, conducted by IDC. Amazingly, this study projects that the digital universe will reach 40 Zettabytes by 2020.

One of the issues I have been passionate about, both in the state legislature and in my first few months in Congress, is STEM education. It seems to be that many of these reports make a compelling case that there is a dire need for more data scientists.
I have two questions:

1. How are your organizations specifically addressing the need for more data scientists and employees with STEM backgrounds?

NSF has focused for many years on developing the STEM workforce through investments in its research and education programs and projects. Increasingly, the development of skills in the use of large data sets is a critical part of the training needed for the STEM workforce. Collectively, STEM programs support, for example, curriculum development, strategies to increase student retention and success in STEM, and student support through scholarships and fellowships. As part of the merit review of these projects, they have to show evidence that the measures taken will ensure effective learning.

Many of these programs focus on undergraduate and graduate students in formal and informal education settings. In addition, across NSF – in all the science directorates – research projects support graduate students as research assistants. Increasingly, these assistantships require data-intensive research, often involving large-scale data sets. These hands-on learning opportunities are critical in helping to develop a workforce with sophisticated and real experience in deploying these skills.

In the FY14 Budget Request, NSF proposes STEM-C Partnerships (i.e., STEM with an emphasis on computing) as one of its primary approaches to advance K-12 teacher and student development of computational skills. NSF also supports research that develops and evolves the knowledge base that informs improvements in the preparation of the workforce. (See http://www.nsf.gov/about/budget/fy2014/pdf/25_fy2014.pdf.)

2. In your testimony, you both discuss how our nation is facing a data scientist shortage. What policies would you recommend Congress consider to address that shortage?

Congress should continue to support STEM education at all levels – from kindergarten through lifelong learning. In particular, NSF is looking to invest in evidence-based and evidence-generating approaches to achieve specific educational outcomes. While anecdotal evidence may point to a variety of policy options, NSF, working in partnership with private and public sector stakeholders, is laying the foundation for policies and programs that are rooted in empirical evidence. In particular, retraining efforts, and initiatives that are aligned with the changing needs of business and industry, may be promising areas for strategic investment.

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Science, Space, and Technology
Subcommittee on Research
Hearing on
An Overview of the National Science Foundation Budget for Fiscal Year 2014
April 17, 2013
Dr. Cora Marrett, Director (Acting), National Science Foundation
Questions for the Record Submitted by
Larry Bucshon

National Science Board

Question 1. What are examples of NSF-related policy issues that you and the board currently disagree? Please elaborate.

Answer: The National Science Board and the Director jointly pursue the goals and functions of the NSF. There are no policy issues on which there is significant disagreement.

Research Misconduct

Question 2. The pressure by investigators to obtain research grants will increase, especially in this competitive research funding climate. I believe most investigators will apply for NSF grants with integrity and also conduct their research in a noble manner. However, the number of cases of research misconduct is growing. Do you believe that this situation will get worse with time? If yes, what is behind this growth? Please explain.

Answer: Research misconduct includes fabrication, falsification, and plagiarism. Most of the research misconduct cases addressed by NSF fall into the category of plagiarism. NSF takes seriously all types of research misconduct and takes measures to prevent its occurrence. For example, NSF requires that organizations submitting proposals certify that they have a plan to provide training in ethical research and verify that the students and post-doctoral associates on NSF-funded awards have received the training. Additionally, NSF provides training to its staff and outreach to the research community. Selected NSF funding opportunities include ethics components on the promotion of ethical research, such as Ethics Education in Science and Engineering. Such measures are intended to address the multiple causes of research misconduct.

Clean Energy Research

Question 3. I am concerned that the emphasis on clean energy research may be at the expense of other potentially transformative research. How can we ensure that this will not become the case?

Answer: The National Science Foundation (NSF) funds fundamental potentially transformative research proposals from all disciplines of science and engineering. These proposals may be submitted in response to topical specific solicitations or to any of NSF's fundamental research programs. This structure ensures that NSF supports research in areas the scientific community considers currently promising. Clean energy research is only one general topic within a broad portfolio. The "emphasis" on clean energy research is mainly driven by the *unsolicited* proposals received addressing fundamental science and engineering questions and strong interest in the science and engineering research communities in this general topic area NSF

partners with the research community through the peer-review process to ensure that the most meritorious, impactful, and potentially transformative research proposals are recommended for funding.

INSPIRE

Question 4. In your NSF budget, you have $63 Million being devoted to the INSPIRE program. Your testimony states that this investment will strengthen "NSF's support of interdisciplinary, potentially transformative research by complementing existing efforts." Which 'existing efforts' are you specifically targeting?

Answer: The INSPIRE program comprises proposal opportunities for ideas that are required ***both*** to be interdisciplinary and to exhibit potentially transformative research (IDR and PTR, respectively). It is complementary to existing efforts in that INSPIRE was created to handle proposals whose:

- Scientific advances lie in great part outside the scope of a single program or discipline, such that substantial funding support from a single distinct program or discipline is unlikely.
- Lines of research explore bold methodologies that are beyond well-established practices in accordance with expected progress in their fields.
- Evaluation through non-standard merit review processes might reveal prospective discoveries hidden at the interfaces of disciplinary boundaries.

Also, although NSF has specific solicitations for IDR or PTR in selected targeted areas of science, INSPIRE complements these since it is open to all areas of science supported by NSF and there are no favored topics. INSPIRE is an experimental activity that will be assessed over the next five years to determine if its various funding opportunities have resulted in support for proposals that normally would not be submitted to NSF.

Cognitive Science and Neuroscience

Question 5. In your NSF Budget request, you have $14 million going to cognitive science and neuroscience. It seems a big part of this funding will be going towards workshops to identify specific gaps in our current understanding of the brain. Why are you taking this approach? Don't you think the National Academy of Sciences should commission a study? After all, acting in their capacity as our nation's main scientific advisory body, aren't these gaps what they are best tasked to determine? What alternative approaches could be used with this money? How are these proposed workshops going to be productive, with consensus being reached on the scientific framework?

Answer: While some of the enhanced funding will certainly be used productively in workshops—which are important starting points for scientific collaboration and discussion across disciplines and in framing research agendas—most of the funds will not be used for that purpose. NSF is committed to making targeted investments in collaborative science and innovative technologies to accelerate discovery that will revolutionize our understanding of the brain. NSF is uniquely positioned to lead a broad multi-disciplinary effort that brings the imagination of scientists and engineers together to advance a comprehensive understanding of brain structure and function. Progress in this area holds an almost unlimited potential for improving our educational, economic, health, and social institutions and for enhancing the lives of Americans.

The proposed cross-foundation activity responds to a number of societal needs and scientific community challenges. The integration of research in cognitive science and neuroscience across scales has the potential to accelerate scientific discovery and innovation, promote advances in technology, and contribute to improved U.S. economic competitiveness.

In FY 2013, the Cognitive Science and Neuroscience Working Group, with representatives from six NSF directorates, drafted a Dear Colleague Letter (DCL) titled "Accelerating Integrative Research in Neuroscience and Cognitive Science (AIR-NCS)." The intent of this DCL is to direct researchers interested in integrative neuroscience to use existing funding mechanisms (EAGERs, Research Coordination Networks (RCNs), and INSPIRE) to further their scientific endeavors.

In FY 2014, NSF plans to enhance support (+$13.85 million) for an NSF-wide integrative activity on neuroscience and cognitive science. Support will continue for the EAGERs, RCNs, and INSPIRE, and will include research on understanding the brain, including mapping of circuits that drive behavior in a variety of organisms. A cross-foundation AIR-NCS solicitation will be released that builds on the foundation and themes in the FY 2013 DCL.

Consolidation of federal STEM education programs

Question 6. The Administration's FY 2014 budget request includes a proposal to reduce or consolidate 114 STEM programs across the federal government. The proposal shifts a number of those programs being consolidated to NSF, and NSF is consolidating some of its own programs. How were programs evaluated to determine whether or not they should be consolidated or cut? Does NSF have the capacity to effectively and efficiently run all of the programs that are being brought from other agencies?

Answer: NSF does not interpret the President's proposed STEM-education reorganization to mean that programs from other agencies will be "shifted" to NSF. Rather, NSF programs will be expanded and coordinated within new frameworks and will introduce additional approaches for improved impact and efficiencies. The *functions* of consolidated programs will be reviewed jointly by the lead and collaborating agencies during the implementation planning and transition into this new system of delivering STEM education. As appropriate, critical functions will then be incorporated into existing or new programs at the lead agencies. Under NSF leadership, cross-agency planning has already been underway among the agencies involved in the reorganization of programs in the areas of undergraduate education reform and graduate fellowships.

For the internal undergraduate consolidations at NSF, programs based in the Research and Related Activities (R&RA) directorates that have a full or partial focus on undergraduate education were identified as suitable for inclusion in the broader framework, Catalyzing Advances in Undergraduate STEM Education (CAUSE), to bring coherence to NSF's undergraduate STEM-education reform investment. The programs brought together under the CAUSE framework share common goals such as: improving the quality of undergraduate preparation in STEM; increasing the retention of undergraduates in STEM fields and the quantity of STEM graduates; and addressing issues of institutional capacity and scale. Key findings from past and ongoing evaluations, along with Committee of Visitor recommendations, will be carefully considered as CAUSE planning and implementation proceeds.

The CAUSE program will be managed by NSF's Directorate for Education and Human Resources' Division of Undergraduate Education (DUE). The scientific staff in DUE includes thirty program officers whose expertise span all STEM disciplines as well as research in undergraduate STEM education. DUE expertise will be augmented with program expertise from NSF's R&RA directorates that oversee programs included in the internal consolidation, and through collaborations with staff in undergraduate programs from other agencies. CAUSE will be anchored by the consolidation of three major DUE programs: Transforming Undergraduate STEM Education (TUES), Widening Implementation and Demonstration of Evidence-Based Reforms (WIDER), and the STEM Talent Expansion Program (STEP). Combining these three programs into a single program will enable significant efficiencies in reviewing proposals, project oversight, evaluation, and program design and improvement. NSF is confident it has and can amass sufficient scientific, education, and administrative capacity to lead this initiative within the proposed budget.

Several programs in the proposed STEM education reorganization are graduate fellowship programs at mission agencies. As the lead agency for STEM graduate fellowships under the reorganization, NSF has proposed expanding its Graduate Research Fellowship Program to include a set of "targeted opportunities" that will enable graduate fellows funded by NSF to participate in the mission-specific graduate experiences that would improve their career readiness and address national scientific needs. NSF's Division of Graduate Education is adequately staffed to design and manage the initial stages of this expansion, and will partner with colleagues across government who work together regularly on graduate fellowships.

Questions for the Record Submitted by
Daniel Lipinski

Advanced Manufacturing

Question 1. Dr. Marrett, the National Science Foundation (NSF) is proposing an increase in nearly $50 million in support for advanced manufacturing in fiscal year (FY) 2014. Can you describe NSF's contribution to the Administration's efforts in advanced manufacturing R&D? Specifically, can you describe NSF's role in and level of commitment to the National Network for Manufacturing Innovation?

Answer: NSF's core scientific and engineering programs have produced many fundamental advances that have enabled and continue to enable breakthrough manufacturing technologies, many implemented worldwide. Now, core research programs and special initiatives will achieve similar results by bringing research communities together to address critical manufacturing needs that cross disciplines. The Foundation's Cyber-Enabled Materials, Manufacturing, and Smart Systems (CEMMSS) portfolio will spur marketplace innovation, leading to high technology jobs and industrial growth in the United States. Many efforts will be highly coordinated with our interagency partners to avoid duplication and increase effectiveness of NSF funded efforts.

The Foundation's FY 2014 Request of $159.73 million includes major emphasis areas such as:

- Research to advance sensor- and model-based smart manufacturing, advanced robotics and materials, and nano-manufacturing;
- Research on Cyber Physical Systems (CPS) will transform static manufacturing systems into adaptive, "smart" systems that can sense and adapt to environmental change;
- Likewise, the multi-agency National Robotics Initiative (NRI) will help develop robots that work beside, interact cooperatively with, or assist people in performing a variety of tasks;
- In response to the Administration's Materials Genome Initiative (MGI) research will continue through NSF's Designing Materials to Revolutionize and Engineer our Future (DMREF) activity. Research focuses on the manufacturing aspects of the synergistic use of experiment, theory, computation, and data driven research approaches to more rapidly discover, process, and deploy useful materials, including bio-inspired materials.
- Manufacturing enterprise systems, manufacturing and construction machines, and materials processing and manufacturing of materials and biomaterials;
- Advanced semiconductor and optical device design, fabrication and processing, for application in biomedical, alternative energy, communications, computing and sensing systems;
- Fundamental research in chemical and materials syntheses and processing, especially at the nanoscale underpins and will accelerate developments in advanced manufacturing of commodity chemicals and functional materials.
- The National Nanotechnology Initiative (NNI) Signature Initiatives: Sustainable Nanomanufacturing and Nanoelectronics for 2020 and Beyond;
- Capabilities for the 21st century, specifically those associated with complex engineering systems design and manufacturing; and
- A variety of activities aimed at bolstering industry/university interactions, such the Industry/University Cooperative Research Centers (I/UCRC) program.

Concerning NSF's contribution to the Administration's efforts in advanced manufacturing R&D, and specifically, the Foundation's role in and level of commitment to the National Network for Manufacturing Innovation (NNMI), NSF has been participating in meetings with the National Economic Council (NEC), Office of Science and Technology Policy (OSTP), and senior leaders from various agencies to strengthen interagency coordination and improve efficiency and effectiveness of the U.S. Government's advanced manufacturing investments through coordinated and collaborative ventures. NSF feels that participation in these efforts significantly increases the impact of our basic research investments in areas cited above while increasing the relevance of our research programs.

NSF's greatest strength is its university-based research community. The pilot institutes planned under NNMI offer the opportunity to more tightly integrate NSF basic research activities and our STEM educational programs with the more focused and applied research and development activities occurring at the institutes. We plan to do this in ways that were recommended in the Advanced Manufacturing Partnership (AMP) report published by PCAST in July, 2012: *Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing.* Toward that end, NSF's role in the 2012 pilot institute and the additional three planned institutes is described below.

NSF supported the first pilot institute on additive manufacturing managed by the Department of Defense (DOD) through a $1.0 million direct investment with the goal of facilitating collaboration, enhancing opportunities for technology transition, and coordinating educational activities with existing NSF grantees. NSF is an active partner in this multi-agency management team. It is noteworthy that the fundamental research in additive manufacturing was supported by NSF in the early 1990s.

NSF will partner with DOD and the Department of Energy (DOE) to support three additional institutes (2 DoD, 1 DOE) that were described during the President's State of the Union address. NSF plans on investing directly in the two new DOD institutes, and we envision supplements to NSF Grantees' research to establish collaborations with institutes, including supplements to support students/post-docs working with/onsite at the institutes; establishment of linkages between institutes and existing NSF/ATE programs; as well as potentially placing students on site, sharing best practices, curricula development with industry, etc. In addition to these DOD and DOE efforts, NSF anticipates working closely with the Department of Commerce on additional institutes, if the full NNMI is authorized and funded by Congress.

Informal STEM Education

2. Dr. Marrett, NSF is proposing a significant cut to the informal STEM education program (AISL) even as the overall Education and Human Resources budget grows. I understand this may be part of the larger Administration STEM overhaul that creates a new role for Smithsonian in federal informal STEM efforts, but I still have concerns.

Question: How do you justify this cut in an otherwise growing budget? How will you work with the Smithsonian to help build their capacity to support informal STEM education and outreach across the nation? How will you work with science centers across the country as you refocus the AISL program? Also, I worry this cut could diminish NSF's opportunities for branding, which increases public recognition and support for the NSF mission. Can you comment on that aspect of it too?

Answer: NSF's unique role in informal STEM learning/engagement is to support research and development in order to develop an evidence base around exciting, innovative models for informal learning. This is accomplished through collaborations among educators, scientists, and other technical professionals, and is supported through multiple NSF programs, including Advancing Informal STEM Learning (AISL). The FY 2014 funding level proposed for AISL is to ensure its research focus on innovative learning and engagement strategies amidst the increasingly broad set of environments in which STEM learning occurs outside of school. Coordination of NSF programs that fund informal STEM-education [primarily AISL plus Discovery Research K-12 (DR-K12), Research on Education and Learning (REAL), Innovative Technology Experiences for Students and Teachers (ITEST), and Cyberlearning Learning Transforming Education (CTE)] with the public engagement and outreach programs of NSF-funded Research and Related Activities (R&RA) projects will not only achieve resource efficiencies but will provide real-time, ongoing test beds for understanding how STEM learning occurs beyond the school environment.

New "non-traditional" players in informal STEM education, such as the business community, private foundations, civic groups, technology developers, and other out-of-school entities, also create new opportunities to leverage resources through strategic collaborations. New social models, approaches to scientific research, and emerging technologies, such as citizen science, virtual networks, cyber-enabled learning, and educational gaming, create rich but unexplored opportunities to reach broad out-of-school and lifelong learning communities.

AISL investments will continue to advance the field by funding innovative projects that further understanding of how best to increase the STEM knowledge, practice, infrastructure, and professional capacity of people participating in informal STEM-learning settings. Those interventions can then serve as tested models, with strong evidence bases, for wider implementation and use at full scale through partnerships with other entities, such as the Smithsonian Institution, and be taken to scale through networks funded by the Department of Education.

Through the Office of Legislative and Public Affairs, NSF seeks opportunities to highlight all NSF-funded research. Those efforts would not be impacted.

Consolidation of federal Graduate and Undergraduate STEM Education programs

3. Dr. Marrett, as part of the broad overhaul of STEM education programs being proposed by the Administration, NSF has been designated the lead agency for federally supported undergraduate and graduate-level programs, including programs that have been managed within their respective mission agencies for years.

Question

- **At the graduate level, the NSF Graduate Research Fellowship Program is being expanded to be a National Graduate Fellowship Program (NGFP). As mission agencies phase out their own graduate fellowship programs, how will you ensure that the mission-specific needs of those agencies continue to be met under NGFP? What interagency infrastructure is in place or will you have to establish to meet this goal?**

- **Likewise, how will you address consolidation at the undergraduate level in terms of making sure that the mission-specific needs of the agencies and the research communities they support are being met?**

Answer: The President's proposed STEM-education reorganization, which designates NSF as the lead federal agency for STEM undergraduate and graduate education, expands and coordinates NSF programs within new frameworks that introduce additional approaches to achieve improved impact and efficiency. NSF staff will continue to collaborate with colleagues from agencies whose undergraduate programs and graduate fellowship programs are being realigned to fully understand the specific goals and operational features of those programs, as well as the agency assets (e.g. laboratories, facilities, scientists, and instruments) that have been available to participants in those programs. As much as possible, NSF will incorporate into these realigned programs (Catalyzing Advances in Undergraduate STEM Education or CAUSE, National Graduate Research Fellowships, and NSF Research Traineeships) the intentions and goals of programs from other agencies, and will be cognizant of how NSF's programs can meet the particular educational goals of science mission agencies. NSF staff will work collaboratively with other agencies to determine how participants in the NSF programs can have appropriate access to facilities and assets of other agencies as part of their preparation for the STEM workforce.

Although pre-planning had been underway, the White House organized a meeting of agencies after the release of the FY 2014 Budget to move forward in implementation planning of realigned programs, including the National Graduate Research Fellowship Program (NGRF). As described in the FY 2014 Budget, the NGRF design will include opportunities for fellows to obtain the technical and professional development specified by the mission agencies. In addition, NGRF administration will include mechanisms for mission agencies to be involved in selecting fellows in general, and, more specifically, for participation in specialized technical and professional development relevant to their agencies. The Interagency Working Group on STEM Graduate Fellowships and the NSTC Committee on Science, Technology, Engineering, and Mathematics Education (CoSTEM) are two interagency groups that provide infrastructure to help ensure the mission-specific needs of agencies are met. Meetings between NSF and individual agencies are underway to address considerations specific to each agency.

NSF's new CAUSE program is a natural evolution and consolidation of the Foundation's ongoing efforts to couple STEM disciplinary expertise with education-research expertise to better understand and improve undergraduate STEM learning and persistence of students from all groups and to support STEM workforce development. Developing the framework for CAUSE will be informed by input from others who have been managing undergraduate programs in their respective mission agencies. Conversations with those agencies are underway and will continue.

OMB hosted a meeting with representatives from NASA, the National Oceanic and Atmospheric Administration, the National Institutes of Health, and the Department of Defense to initiate conversations about goals, priorities, and ways to leverage each other's assets to support the implementation of the STEM reorganization, including in the area of undergraduate education. NSF staff have initiated subsequent meetings with USDA and the Department of Energy and will soon host a gathering of all federal agencies that have investments in undergraduate education. In addition, we will continue to engage with agencies one on one. Our conversations build upon and are guided by the extensive collaborative work that has been underway for several years through CoSTEM to leverage our collective expertise and assets to improve undergraduate STEM education.

Astronomy Portfolio Review

4. Dr. Marrett, last year the Astronomy Division carried out a community-based review of its full portfolio of facilities. Taking into consideration limited budgets and new telescopes coming online over the next several years, the reviewers recommended that NSF take steps to divest a number of older telescopes. I am hearing concerns from the community that the proposed schedule for divestment decisions by the end of 2013 may be unattainable even as stakeholders work together to develop new sources of funding to keep some of these telescopes operational.

Question: What would be the consequences of granting additional time for potential consortia to develop more fully?

Answer: NSF has stated publicly that decisions regarding divestment paths will need to be taken near the end of Calendar Year 2013 in order to realize savings in the FY 2017 budget. NSF also has stated publicly that this does not require fully formed consortia and signed Memoranda of Understanding by the end of 2013, but does require significant evidence of likely commitment levels beyond e-mail expressions of interest. Deferring divestment decisions will carry the realization of savings out to time frames beyond FY 2017.

Depending on the amount of delay, this most likely will result in one or more of the following:

(1) reduction of individual investigator funding rates to less than 10 percent, or complete cancellation of individual investigator programs in some years beginning in FY 2015-2016, depending on which budget scenarios are realized for MPS/AST;
(2) delay of the Mid-Scale Innovations Program that was the number two priority for large ground-based projects in the 2010 decadal survey and is included in the NSF FY 2014 Budget Request to Congress;
(3) inability to commit to operations of the Advanced Technology Solar Telescope (ATST) beginning in FY 2015;
(4) deferral of the construction start of the Large Synoptic Survey Telescope, also in the FY 2014 Budget Request, because of a lack of projected funding available for operations, which begin in 2018-2019.

Question: Can you tell us where things stand with respect to considering and implementing the Portfolio Review recommendations, including any schedule for management decisions on these facilities?

Answer: NSF has separated two telescopes, the Green Bank Telescope and the Very Long Baseline Array, from the primary management competition for the National Radio Astronomy Observatory (NRAO), in order to provide maximum flexibility for the development of funding partnerships. NSF is preparing solicitations for competition of the management of the National Optical Astronomy Observatory (NOAO) and of NRAO that describe the scope of those observatories beyond 2015. NSF has asked its observatory management organizations to solicit expressions of interest from potential partners, which in some cases have led to direct discussions between NSF and the possible partners or consortia. Some of these potential partners are university-based, and some are other federal agencies. NSF continues to hold to its schedule of making divestment decisions by the end of 2013.

Question: Finally, how will you seek community input on the implementation of the Portfolio Review?

Answer: The Portfolio Review was an inherently community-based process, with a broadly representative committee of community astronomers that solicited input from individual astronomers and from representatives of all the national astronomy facilities. Furthermore, the Portfolio Review instructions required them to accept the science and program priorities set by the National Academy decadal surveys, which were based on extensive community input and discussion. The results of the Portfolio Review, and the NSF plans as they develop, have been presented in multiple town hall meetings of the American Astronomical Society, to multiple standing National Academy advisory committees, to the Astronomy and Astrophysics Advisory Committee (AAAC, chartered by Congress), to a meeting of the country's astronomy department chairs, and via a web-based presentation to the entire community; in all these forums, ample opportunity was given to ask questions. Discussions regarding implementation have been held with the managing organizations of the national facilities as well as with representatives of tenant organizations that operate on NSF observatory sites.

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Appropriations
Subcommittee on Commerce, Justice, Science, and Related Agencies
Hearing on
Hearing on NSF Oversight
March 19, 2013
Dr. Subra Suresh, Director, National Science Foundation
Questions for the Record Submitted by
Frank R. Wolf

Social, Behavioral and Economic Sciences

Question 1. A recently adopted amendment to NSF's fiscal year 2013 appropriations bill seeks to limit spending on political science research to only those grants with a certified link to economic or national security. How does NSF plan to implement this limitation?

Answer: NSF is currently developing a plan to implement this restriction on the Political Science program, which will take into account both the legislative requirements and NSF's existing policies and procedures.

Question 2. What is the expected impact of this amendment on the amount and kind of political science research that you will fund?

Answer: We expect that the portfolio of awards will be intellectually constrained, because a narrower set of requirements has been imposed for this program alone. The restrictions in the legislation will curtail our ability to support research projects that would further fundamental knowledge of how democracies are created and maintained as well as connections between the governed and their government, which seems particularly germane in the wake of Arab Spring and more broadly in the wake of thirty years of efforts to understand and improve democracy around the world. In the long term, these types of restrictions will have a chilling effect on NSF's ability to support basic research across its entire scientific portfolio.

Cross Foundation Initiatives

Question 3. Does the agency's recent emphasis on "OneNSF" initiatives imply that NSF has historically been too stove-piped in its research approach?

Answer: OneNSF is an organizational philosophy that emphasizes the need to continuously look for linkages in research and learning that might transcend disciplines to advance more effectively science, engineering, and education. In fact, depth in traditional research disciplines and cross-collaborations is required to tackle increasingly complex scientific questions.

Question 4. In just a few years, the OneNSF initiatives have come to consume a significant part of the agency's total budget, which means that NSF has become increasingly focused on programs addressing a few predetermined research goals. Is this focus pushing NSF to become more like a mission-specific research agency and less like a basic research agency, whose research focus goes wherever the science takes it?

Answer: All NSF programs support the Foundation's mission "to promote the progress of science, to advance the national health, prosperity, and welfare; to secure the national defense

and for other purposes." NSF's initiatives temporarily crystalize funding opportunities that are particularly ripe for scientific advancement or address high priority national needs. While some initiatives promote basic research to support specific national needs, this is a fraction (about 12 percent of the FY 2014 request) of NSF's overall support for research and education.

Question 5. How does the management of the OneNSF initiatives differ from the management of a typical NSF program? How have you made these differences transparent and understandable to the research community?

Answer: Most NSF initiatives are managed in the same way they were developed. There is a program announcement or solicitation that results in proposals that are reviewed according to well established processes. These processes are either specified in the solicitation or found in the Proposal and Award Policies and Procedures Guide. Webinars, posting of FAQs, presentations at conferences, and other forms of communication commonly are used to explain NSF's management practices to the research community. This is especially important when NSF is piloting new procedures, such as those being used to manage INSPIRE.

Question 6. Some directorates have had to reduce the funding available for their core programs and infrastructure in order to make their contributions to the OneNSF initiatives. What process do you use to make the trade-offs between decreasing funding for existing programs and providing money to initiate new programs?

Answer: Initiatives support areas that are ripe for scientific advancement or address a high priority national need. The decision to allocate funding to an initiative rather than to another program or funding opportunity is based on where the possibility is greatest for significant programmatic outcomes. By supporting a diverse portfolio of research funding opportunities, NSF has been able to support transformative research across the frontiers of science, engineering, and education.

NSF Headquarters

Question 7. The prospectus for a new NSF headquarters facility has been approved by the House but not the Senate. What do you know about the status of the Senate's consideration of your prospectus?

Answer: NSF's FY 2011 prospectus for a new NSF headquarters lease was approved by the Senate Committee on the Environment and Public Works on April 18, 2013.

Question 8. What is the latest that you could receive Senate approval without impacting GSA's planned schedule for awarding a new NSF headquarters lease?

Answer: Given the recent approval of the NSF prospectus by the Senate Committee on Environment and Public Works, there is no anticipated impact on GSA's schedule to award the lease during the summer of 2013.

Question 9. What impact would a potential delay in the lease award have on NSF's headquarters planning? Would such a delay increase your budget needs associated with the new headquarters lease?

Answer: GSA informs us that the NSF lease procurement was extremely competitive and will

yield extraordinary economic advantages resulting from the current inexpensive financing market. With the approval of the NSF lease prospectus by the Senate Committee on Environment and Public Works on April 18, 2013, we believe the benefits of GSA-negotiated financing terms can be realized. Because the procurement will not be delayed, no additional NSF budgetary requirements are anticipated at this time.

Security

Question 10. The NSF Inspector General has told us that the number and level of sophistication of hacking attempts on NSF information technology systems has increased. Are your IT security protections keeping pace with the increased threat?

Answer: The number of IT security threats continues to increase at a rapid pace, and attackers display an increasing level of sophistication. With recognition that the threat landscape is constantly evolving, NSF continuously monitors potential threats and is proactive about preventing and addressing them. NSF faces threats that are common to all agencies, including attempted attacks from external networks, zero day threats, phishing schemes, and the potential for insiders with malicious intent. We use a combination of technologies and user education to help mitigate the risk associated with these threats.

NSF's vulnerability management program employs layers of defense against potential threats. We continuously monitor systems, network devices, workstations, laptops, and mobile devices to quickly identify security vulnerabilities. Our vulnerability remediation activities are centrally tracked and managed. We have strengthened our patch management processes and activities in accordance with National Institute of Standards and Technology (NIST) recommendations.

NSF employs intrusion detection systems to monitor internal and external network traffic on a continuous basis. With the Foundation's transition to the Trusted Internet Connection (TIC) service, NSF relies on the CenturyLink Security Operations Center and the Department of Homeland Security's intrusion detection system, along with NSF's onsite network operations center, to provide 24/7 monitoring. Should we identify areas of potential exposure, we move quickly to mitigate risks.

User education is an important part of NSF's strategy to stay ahead of cybersecurity threats. We regularly advise and train agency staff about their responsibilities for protecting agency information.

NSF's cybersecurity activities have helped us to keep pace with external threats, even as new ones continue to emerge. As reported to US-CERT, NSF's average number of security incidents per year remains in the single digits. However, NSF recognizes the importance of continually reviewing and enhancing our overall security posture. For example, we consistently evaluate our IT security tools to ensure they remain current and effective in light of emerging challenges. NSF will continue to be proactive in monitoring the growing number and types of cybersecurity threats.

Question 11. One potential weakness that your IG has highlighted is NSF's lack of a formal cybersecurity incident response plan. Why doesn't NSF have such a plan? What risks are created by not having a standardized set of policies and procedures to follow whenever an incident occurs?

Answer: NSF has a standard set of policies and procedures for incident response. NSF's

science educators and administrators representing the 138 schools in the Pittsburgh metropolitan region (October 2011).

Print Dissemination

- Copies of the 2011 NRC report have been distributed at major professional meetings such as NSTA and the National Council of Teachers of Mathematics (NCTM).
- Copies of the 2011 NRC report have been widely disseminated to the National Science Board, the EHR Advisory Committee, NSF staff members, and to EHR principal investigators.
- As of March 2013, 14,604 free copies of *Successful K-12 STEM Education* were downloaded from the NRC web site, and nearly 5,000 print copies had been sold.
- The Smithsonian's National Science Resource Center purchased and disseminated 300 copies at Science Education Institutes for Leadership Development and Strategic Planning meetings in North Carolina and New Mexico. During the events, leadership teams from school districts developed a long-range plan to enact systemic change in their district, with the goal of implementing and expanding a research-based science education program for students.
- In June and July 2011, report committee member Jerry Valadez, a professor at California State University in Fresno, disseminated 100 copies to directors of the California Science Project and staff of the Oakland Unified and San Francisco Unified School Districts.
- National Academies Press provided 200 copies to a STEM Summit focused on bringing the Pittsburgh region the best information about successful STEM-education strategies by using cutting-edge research and other examples from throughout the region.
- NSF distributed approximately 1,500 copies at the national roll-out event in Philadelphia and the four "Smart STEM" regional meetings.

Professional Societies and Policy Organizations

- Briefings on *Successful K-12 STEM Education* have been held with major policy organizations, such as the National Governors Association, the Council of Chief State School Officers, the Council of State Science Supervisors, and the National Conference of State Legislatures, to initiate conversations about policy implications of the report.
- The report was featured at a June K-12 STEM Education Summit organized by *U.S. News and World Report* in Dallas.
- Report committee chair Adam Gamoran gave keynote speeches at meetings of the Southern Region Education Board State Leaders' Forum in Jacksonville, Fla., (November 2011), and at the annual meeting of the Oak Ridge Associated Universities in Tennessee (March 2012). Gamoran, committee member Barbara Means, and an NSF representative participated in a panel discussion of the report at the annual meeting of the American Educational Research Association in Vancouver, Canada (April 2012).

Congressional Communications

- In October 2011, report committee chair Adam Gamoran and member Barbara Means, Board on Science Education (BOSE) member Suzanne Wilson, and two others testified at a hearing on "What Makes for Successful K-12 STEM Education" before the House of Representatives Committee on Science, Space, and Technology Subcommittee on Research and Science Education.
- In June 2011, Adam Gamoran briefed staff from EHR and members of the House of Representatives Committee on Appropriations, Subcommittee on Commerce, Justice, Science, and Related Agencies.

- NSF was one of 13 organizations (federal agencies and scientific societies) that participated in an event at the Rayburn House Office Building entitled "Celebrating U.S. Science and Engineering." Invitees included members of Congress, their staff, scientists and engineers, and students. The event was facilitated by the Alliance for Science & Technology Research in America and Institute of Electrical and Electronics Engineers (IEEE). The NSF display featured the report along with issue briefs developed for the "STEM Smart" regional meetings. About 300 postcards with information about how to obtain the reports were distributed.
- In January 2013, NSF engaged in conversations with staff members from Representative Wolf's office about holding a STEM event in his district (scheduled for September 27-28, 2013) based on findings of the report and other developments.

Question 14. Late last year, the National Research Council released a list of 14 key indicators that would allow NSF to track the implementation of the recommendations contained in the best practices report. What steps have you taken to begin collecting data on those indicators? How long do you estimate it will take to get a complete monitoring scheme in place for all 14 indicators?

Answer: The Directorate for Education and Human Resources, in consultation with the National Center for Science and Engineering Statistics, has developed a five-year plan to collect data on the indicators identified by the National Research Council (NRC) and published in the 2013 report *Monitoring Progress Toward Successful K-12 STEM Education: A Nation Advancing?* In FY 2014, NSF will determine the current state of the STEM indicators, analyze and report existing data, and identify data sources that could be expanded to include the data called for in the NRC report. Further, a summary of the NRC report will appear in the 2014 *Science and Engineering Indicators* issued by the National Science Board. Also starting in FY 2014, and continuing through FY 2015, NSF will be working to ensure that newly developed indicators align with the recommendations in the NRC report. The final phase of the plan, establishing a research and development agenda for the development and tracking of new success indicators, is expected to take place from FY 2014 to FY 2019.

NSF has already begun to lay the groundwork for the phases of this plan by holding meetings around this topic with key groups in the Department of Education, such as the National Center for Education Statistics, those involved in Race to the Top Grants, and those responsible for the State Longitudinal databases at the Institute of Education Sciences, whose cooperation will be necessary to accomplish this plan. By FY 2019, plans will be in place to collect data on all 14 indicators.

RECOVERY ACT FUNDING

Question 15. OMB gave you the option to seek waivers to allow certain Recovery Act awards to continue expending funds beyond the government-wide September 30 deadline. How many waivers did you seek, and how much funding is covered by those waivers?

Answer: NSF's waiver request was comprised of 512 awards totaling $133.60 million (less than 5 percent of ARRA obligations). Specifically, it included: Faculty Early Career Development program (CAREER) (304 awards, $20.0 million out of $165.0 million); Robert Noyce Scholarship program (59 awards, $12.60 million out of $59.0 million); and a multi-programmatic request, comprised of (149 awards, $101.0 million out of $555.0 million).

Question 16. The Recovery Act was enacted with the goal of providing a short term stimulus to an economy in major crisis. At this point, four fiscal years later and amidst a stronger general economy, that justification is much less compelling for the use of your remaining unspent Recovery Act funds. What is the justification you used for seeking waivers to continue paying out some of these awards?

Answer: NSF's primary economic impact in connection with the Recovery Act is to advance the long-term goals – innovation and reinvestment – inherent in the statement of purpose set forth in Sections (3) & (4) of the Act. § (3), "to provide investments needed to increase economic efficiency by spurring technological advances in science and health"; and § (4), "to invest in transportation, environmental protection, and other infrastructure that will provide long-term economic benefits". As justification for seeking waivers, the Foundation utilized the criteria set forth in OMB Memorandum M-11-34 including projects that were long-term by design, had contractual commitments, environmental considerations and other special circumstances. NSF sought waivers to continue paying out only about 10 percent of the grant agreements in NSF's Recovery Act portfolio. NSF's request was narrowly tailored to only include those awards that the Foundation determined met the M-11-34 criteria, and the agency estimates that there will be less than 5 percent of the total Recovery Act funds obligated remaining unexpended after the expenditure deadline of September 30, 2013.

Question 17. What have you heard from OMB about the status of your waiver requests?

Answer: With regard to the Recovery Act awards included in NSF's agency waiver package, NSF received approval from OMB on April 29, 2013, for all outstanding requests. NSF has instructed awardee institutions that Principal Investigators (PIs) should proceed with work in accordance with the terms and conditions of the award while continuing to responsibly accelerate when possible.

U.S. ANTARCTIC PROGRAM

Question 18. Please provide a list of any of the 84 actions recommended by last year's Antarctic Blue Ribbon Panel with which NSF does not agree or does not currently have sufficient information to implement.

Answer: NSF is engaged with its Department of Defense (DoD) partners to explore the feasibility of implementing recommendations made by the Blue Ribbon Panel. Two primary topics under discussion are the recommendations to reduce the operational LC-130 fleet from ten to six aircraft, and to construct a compacted snow runway at South Pole Station to allow wheeled aircraft operations. While NSF believes that construction of such a runway is technically feasible, there are many operational issues associated with landing wheeled aircraft at the South Pole (such as infrastructure and equipment for fire and emergency response, refueling, and cargo handling) that must be understood in order to conduct a cost-benefit analysis. NSF is also updating the master plans for McMurdo and Palmer stations that will guide decisions on recommendations related to, for example, fire protection, consolidated warehousing, and energy improvements. NSF's Response to the Blue Ribbon Panel report may be found at: http://www.nsf.gov/news/news_summ.jsp?cntn_id=127345&org=NSF&from=news

Question 19. One of the Blue Ribbon Panel's "concluding observations" was that a temporary reduction in spending for Antarctic science activities could help to free up funds for critically needed logistics and infrastructure improvements. Does NSF support this idea?

Answer: NSF is implementing this recommendation by ensuring that a portion of Antarctic science funding is directed towards developing and improving remote sensing instrumentation and other technologies that will increase the efficiency of the enterprise and make it possible to support more science. NSF management has and will continue to communicate this approach to the community through, for example, U.S. Antarctic Program channels, public forums, and conferences.

Question 20. Lockheed Martin told us that they incorporated many of the fiscal and process improvements recommended by the Blue Ribbon Panel into their contract bid. Do you agree with this statement? If there are additional savings measures that can be implemented beyond what Lockheed assumed in its bid, how can those additional measures be incorporated into their contract?

Answer: Yes, many of the fiscal and process improvements recommended by the Blue Ribbon Panel were included in Lockheed Martin's proposal. NSF works very closely with Lockheed Martin to ensure an environment of continuous fiscal and process improvements. When identified, these improvements are incorporated either by making adjustments to Annual Program Plans or via official modifications to the contract.

Question 21. What is the status of your efforts to close out the previous Antarctic logistics support contract?

Answer: GEO's Polar Division is working with the Division of Acquisition and Cooperative Support to contract for the incurred cost audits that are required before the final invoice can be paid. This process is expected to be completed in the summer of 2014

CLIMATE CHANGE RESEARCH

Question 22. NSF tracks and reports on its investments in the U.S. Global Change Research Program, but this is only a portion of what the agency spends on climate change science in a given year. How much does NSF spend on climate change each year, across all activities? How have your investments in these activities changed over the last five fiscal years?

Answer: NSF reports expenditures for not only the U.S. Global Change Research Program (USGCRP), but other categories of climate change research as well. Investments in Clean Energy Technologies (CET) help to reduce, avoid, or sequester greenhouse gas emissions. International Assistance (IA) programs demonstrate continued U.S. leadership in forging a global solution to the climate challenge and helping developing countries focus their climate investments strategically over the coming years, and creating robust means of measuring, monitoring, and verifying domestic emissions in developing countries. Both of these types of investments reduce vulnerability to climate change.

These data are also reported to Congress by the Office of Management and Budget (OMB) in the *Federal Climate Change Expenditures Report to Congress.*

NSF's Climate Change Expenditures

(Dollars in Millions)

	FY 2010 Enacted	FY 2011 Enacted	FY 2012 Enacted	FY 2013 Budget	FY 2014 Request
USGCRP	$320	$321	$333	$333	$326
CET	324	312	341	355	372
IA	3	6	6	6	3
Total, NSF	$647	$639	$681	$694	$702

Overall, NSF has seen a relatively stable 8.5 percent growth in climate change expenditures over the last five years, which is similar to overall NSF growth (the FY 2014 Request is 10.9 percent above the FY 2010 Enacted level). However, the substance of the climate change investments has evolved over time. The new USGCRP Strategic Plan released in April 2012 places a greater emphasis on providing the information needed to respond to global change impacts and vulnerabilities. Accordingly, NSF programs are encouraging more interdisciplinary efforts, which not only will advance scientific knowledge of the integrated natural and human components of the Earth system, but also provide the scientific basis to inform and enable stakeholders to make timely decisions on adaptation and mitigation actions. This trend toward more interdisciplinary activities across the spectrum of climate change activities at NSF is particularly prominent in NSF's Science, Engineering, and Education for Sustainability (SEES) program, which has significant elements related to climate change.

Question 23. Last year the House voted to approve an appropriations amendment that would prohibit NSF from spending funds on the Climate Change Education Program. What do you believe would be the impact of such an amendment being enacted? Could your other more general STEM education programs serve the same purposes as the climate change-specific program?

Answer: The Climate Change Education Program (CCEP), initiated by Congress in FY 2009, made six awards in FY 2012 and one in FY 2013; the awards ranged in size from $1 million to $5 million for periods of four to five years. As continuing grants, many of the awardees have received only a portion of their total funding. In the FY 2014 Budget Request, CCEP is consolidated into the new NSF-wide Catalyzing Advances in Undergraduate STEM Education (CAUSE) program. CAUSE will integrate and leverage NSF's investments in undergraduate education to advance STEM education and workforce development. CAUSE will provide for continuing CCEP commitments in FY 2014, 2015, and 2016. No new CCEP awards will be made.

WORKFORCE MANAGEMENT

Question 24. NSF has seen recent decreases in employee satisfaction as measured by the OPM Employee Viewpoint Survey and the Partnership for Public Service's Best Places to Work in Government ratings. Why do you believe this is the case, and what steps is NSF taking to reverse this trend? What additional steps do you believe are necessary?

Answer: The National Science Foundation (NSF) is committed to being among the best places to work in the federal government. The Federal Employee Viewpoint Survey (FEVS) results confirm many of the positive aspects of NSF: our staff is highly motivated; we put in extra effort

when needed to get the job done; we are constantly looking for ways to do our jobs better; and we know the work we do is important. Our workforce is excited about our mission and knows that the results from awards we make inspire the imagination while advancing the progress of science, contributing to a prosperous and secure nation. At the same time, the FEVS identifies areas where employee perceptions do not demonstrate the level of organizational excellence to which we all aspire. NSF has initiated specific actions aimed at improving the NSF climate: workload, performance management and recognition, career development, and career-life balance.

1) **Workload** – Although NSF employees believe the workforce has the right knowledge and skills to accomplish the Foundation's goals, workload continues to be the area with the largest unfavorable discrepancy between NSF and the government-wide average. NSF will continue its workload modeling efforts and some experimental activities aimed at controlling workload, while more in-depth discussions get at the nature of the dissatisfaction.

2) **Career Development** – FEVS data indicate a continued downward trend in training and development indicators, including assessment of training needs and specific training to improve job performance, as well as opportunities for advancement within NSF.

3) **Performance Management and Recognition** – Our 2012 survey results revealed some encouraging increases related to performance management, which the Foundation attributes to improving performance management training for supervisors and employees and to implementing performance management for IPAs. However, some FEVS indicators and anecdotal evidence from employees and management indicate that performance management and related rewards and recognition require continued improvement.

4) **Career-Life Balance** – Like most organizations in both the Federal government and the private sector, we have spent the past several years placing a strong emphasis on the importance of career-life balance. As such, the Foundation has supported telework and other career-life initiatives geared toward improving morale and employee satisfaction, and we plan to continue to improve these areas.

The FEVS is an important set of indicators to be used, along with other tools and information, to address our commitment at NSF to continual improvement of the workplace culture and climate. NSF has developed its FEVS Action Plan (available at http://www.nsf.gov/about/career_opps/fevs_nsfactionplan_2013.pdf) to address these four areas along with over-arching activities related to leadership and communications. FEVS analyses also identified disparate opinions across internal organizations indicating that implementing "local" solutions could significantly contribute to improving culture and climate at the organization level. As such, each directorate and office has developed its own focused plan based upon the review of its local FEVS data and other pertinent information. NSF is tracking the progress of these action strategies to identify best practices that may be scalable to the entire organization.

Question 25. One of NSF's more unique workforce characteristics is its heavy use of "rotators", or non-Federal employees who work temporarily at NSF. How has NSF's use of these rotators changed over time? Are they becoming more common, or filling different types of jobs than was previously the case?

Answer: NSF's use of rotators has remained steady in all categories over the last five years. Visiting Scientists (VSEEs) and Intergovernmental Personnel Act assignees (IPAs), known collectively as rotators, made up between 13 and 15 percent of NSF's overall workforce each year during the period between FY 2008 and FY 2012. NSF has not seen a notable change in either the rate at which it uses rotator appointments or the type of positions it fills with them.

Question 26. One of the most common means for hiring non-permanent employees is through the Intergovernmental Personnel Act (IPA), which allows an influx of outside technical expertise to the agency but is also very expensive. In fact, the OIG estimated that NSF's use of IPAs created $6.7 million in added costs in fiscal year 2012 alone. Is the value NSF receives from bringing in these IPAs always worth the added cost above hiring a regular Federal employee? What kind of analysis have you done to support your conclusions?

Answer: NSF relies upon the expertise of some of the Nation's leading scientists, engineers, and educators to execute its mission, thereby ensuring our Nation remains at the forefront of scientific and engineering discovery. We believe the use of IPAs strengthens the ties between NSF and the communities it serves, and the flow of ideas and experience both ways enriches the science and engineering enterprise and enhances NSF's intellectual capacity. Individuals serving at NSF under the Intergovernmental Personnel Act come from universities and institutions throughout the nation. The active participation of these respected and highly skilled scientists, engineers and educators is important to NSF in ensuring that the best research is being funded with taxpayer dollars. Having the IPA as one of our tools for recruiting rotators enables NSF to tailor a compensation package to the circumstances of those we are trying to recruit so that their losses for public service at NSF are minimized and balanced by the benefits of being at the forefront of the research process. As a practical matter, we find we would be unable to attract this talent if we were restricted to paying for their services under the current Federal pay scale. Consequently, NSF strikes a balance between a highly educated permanent workforce that creates stability and helps retain institutional knowledge, and individuals who bring fresh ideas and new approaches to research at the frontier. Overall, the impact of rotators in our merit review and award oversight processes more than compensates for the potential added cost of bringing them to NSF as IPAs.

In response to the OIG report on IPA costs, NSF is planning to conduct a review of those costs to determine where efficiencies or policy changes may reduce the overall cost of the IPA program to NSF.

Question 27. Many NSF executives are IPA employees who don't necessarily have any experience managing a Federal agency, and they only stay on the job for a few years before returning to their non-Federal positions. What kind of risk does this leadership strategy pose to the agency's management? How are these risks being mitigated?

Answer: IPA assignees in executive positions typically bring with them a wide variety of management experience, including academic positions such as university presidents, provosts, vice provosts, deans and department chairs, as well as directors of research-based organizations. They have experienced most of the key elements of management, including managing budgets, hiring and managing employees (including subordinate managers), conducting and managing research projects, evaluating research proposals, and long range planning. Therefore, we believe the risks of this strategy to agency management are minimal.

However, NSF understands that there are some risks associated with this strategy, and manages those risks using two primary sets of tools: 1) ensuring an appropriate balance in the composition of the executive corps in each of its organizations; and 2) having an active training program for all executives. For example, the New Executive Transition (NExT) Program is designed to enable new executives (both Career and IPA) to quickly reach their full potential and to provide existing managers with the tools and resources for effective leadership. NExT is designed to enhance NSF's capacity by quickly and effectively integrating new members of the executive corps by aiming to:

1. Develop executive **knowledge** about NSF mission, culture, organization, people, and business processes.
2. Provide executives the **tools**, information, skill-enhancement, and support to reach full performance as quickly as possible.
3. Support **transitions** into NSF executive positions from outside the government, from other Federal agencies, & from within NSF.

Question 28. What kind of protections are in place to ensure the independence of IPAs, who may be in a position to make decisions about research awards affecting themselves or their home institutions? Do you believe the existing protections are sufficient?

Answer: Like regular employees, IPAs are subject to criminal conflict of interest statutes (statutes) as well as the Government-wide Standards of Ethical Conduct of Employees of the Executive Branch (regulations) which prohibit IPAs from participating in NSF proposals and awards affecting themselves and their home institutions. To bolster awareness of and compliance with these statutes and regulations, IPAs, like regular federal employees who file financial disclosure reports, are subject to mandatory conflict of interest training. IPAs, like regular federal employees who make award recommendations must file financial disclosure reports. Failure to file may result in disciplinary action (those required to file public reports are subject to statutory fines for failure to do so). Conflicts checks are part of the ethics program to avoid situations wherein IPAs make decisions about in their research awards or those of their home institution. NSF ethics officials counsel IPAs and regular employees to avoid even the appearance of conflicts, and recusal from matters is a common mechanism to prevent even an appearance of impropriety. NSF firmly believes that these protections are sufficient.

RESEARCH MISCONDUCT

Question 29. NSF requires that each grantee certify that it has a plan to address and prevent research misconduct. However, it is largely up to the grantees to decide what to put in their plans; NSF only offers examples and best practices. Why doesn't NSF establish more concrete requirements and criteria that each plan must meet?

Answer: NSF believes that the research community, encompassing both individual researchers and institutions, is best placed to determine the content of Responsible Conduct of Research ("RCR") training without a need for NSF-specified standards. NSF recognizes that specific training needs may vary depending on specific circumstances of research or the specific needs of students intending to pursue careers in basic or applied science after completing their education. Therefore, it is the responsibility of each institution to determine both the content and the delivery method for the training that will meet the institution's specific needs for RCR training in all areas at that institution for which NSF provides support. Furthermore, each institution must decide if development of content or pedagogical methods is

required, or if appropriate content and training can be provided from some existing sources or capabilities, and then take appropriate action to implement their decisions.

Question 30. How often does NSF review grantees' research misconduct plans for adequacy? Is there a regular, comprehensive review process, or are plans checked only on a case-by-case basis?

Answer: NSF can ask to see a proposer's RCR plan at any time after a proposal for funding is submitted. Therefore, if a Program Officer or Grants Officer has a concern about how RCR will be addressed during the project, they can request to see the plan before making a funding decision. Additionally, plans may be reviewed by NSF when deemed necessary post-award, to ensure implementation is proceeding as committed.

Questions for the Record Submitted by
Robert B. Aderholt

CLIMATE MODELING

Question 1. I am told that there are refereed, peer-reviewed publications showing that climate models over the past 35 years are running significantly warmer than the actual observations. This would raise serious questions for the Congress about how well the Earth's complex climate system is actually understood, with implications on the scientific basis for energy policy as well as for assessing how our national policy might realistically impact the Earth's climate in a desirable way. What is your agency doing to better understand why the most widely-used climate models are not able to reproduce the actual climatic observations, particularly those made from space?

Answer: NSF is not aware of any peer-reviewed publications showing that climate models are systematically too warm over the past 35 years. To continuously improve the nation's ability to model climate, NSF supports researchers who examine the quality of climate model simulations using a wide of variety of observations, including comparison with satellite observations.

Question 2. What has NSF done to actively promote and solicit scientific investigations that are consistent with the evidence (of very modest climate change) yet which contradict the popular view that global warming is rapid, human-caused, and dangerous? What steps does your agency take to ensure that all expert perspectives, including those that might call into question popular theories, are considered in developing, executing, and assessing your agency's current climate change programs?

Answer: NSF accepts unsolicited proposals for research into the causes of climate variability and climate change, without regard for whether the hypothesized causes are natural or anthropogenic. Projects are supported on their scientific merit, that is, the appropriateness of the proposed methodology to answer a question or test a hypothesis.

Question 3. What has NSF done to ensure that the scientists who are involved in measuring the agreement between the models and the data had no role in developing the models?

Answer: NSF funds a number of research projects that assess the agreement between models and observations, and much of this research is done by university researchers not involved in model development. NSF recently made several awards to examine the quality of the climate model simulations prepared for the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment report. NSF also supports university researchers who are not involved in model development to perform their own simulations to assess the model's ability to simulate a particular process. The results can provide important input to developers for improving the models.

Question 4. What metrics can you present to demonstrate that the development, execution, and assessment of your climate change programs includes all expert perspectives, including those that may not agree with or support the most popular climate system theories? (This is the "red team" concept commonly used in industry and government for expensive programs.)

Answer: NSF receives and supports proposals to conduct research, including the development or evaluation of climate models. NSF does not survey or track the views of scientists regarding climate change. Through its merit review process, NSF seeks input from members of the scientific community based on their expertise relevant to the topic. Reviewers are asked to objectively evaluate proposals utilizing the two merit review criteria established by the National Science Board: intellectual merit and broader impacts. There is no attempt to screen potential reviewers or panelists to select those who do or do not hold particular viewpoints.

REALIGNMENT

Question 5. Your testimony indicates that several of your directorates have been merged and consolidated since September 2012. How has this changed enabled the NSF to prepare for the impact of sequestration? Was it done to help ease the financial burden of sequestration or was it done for other purposes?

Answer: NSF embraces decisions that bring about increased operational efficiency. Periodically, we review organizational structures to determine if the science or our own internal pressures dictate a more desirable organizational structure. Those decisions are balanced with the productivity costs that accompany any organizational change. Where the benefits and scientific fit outweigh the productivity costs, we work to realize the benefits. It was in this vein that NSF undertook a review of the units reporting to the Office of the Director. That review resulted in the recommendation to realign several offices last fall. The former Office of International Science and Engineering was combined with the Office of Integrative Activities to form the Office of International and Integrative Activities. The former Office of Polar Programs was combined with the Geosciences to form the Polar Division. Finally, the Office of Cyber-infrastructure was combined with the Computer and Information Science and Engineering Directorate to form the Division of Advanced Cyberinfrastructure.

GRADUATE RESEARCH OPPORTUNITIES WORLDWIDE (GROW) PROGRAM

Question 6. Recently, this subcommittee heard testimony from the Director of the FBI that discussed the threat of foreign cyber-spying on U.S. universities, corporations, and federal agencies for newly developed technologies. With the GROW Program, I understand that we are partnering with eight partner countries to further science research. However, how do we ensure that technologies and other discoveries that are being researched in partnership with other countries will be safeguarded in GROW and other similar endeavors?

Answer: GROW is administered through NSF's Graduate Research Fellowship program and is subject to the same laws and guidelines for research conduct as other federal grant programs. Specifically, "...all academic and research activities carried out in or outside the US comply with the laws or regulations of the US and/or of the foreign country in which the academic and/or research activities are conducted. These include appropriate human subject, animal welfare, copyright and intellectual property protection, and other regulations or laws, as appropriate. All academic and research activities should be coordinated with the appropriate US and foreign

government authorities, and necessary licenses, permits, or approvals must be obtained prior to undertaking the proposed activities."[1]

These safeguards, which apply to NSF-supported principal investigators, graduate students, and other award recipients working in the United States or abroad, help mitigate the concerns raised in the question. In addition, NSF does not support the conduct of classified research. Also, NSF supported research is basic research that is pre-commercial and published in the open scientific literature.

[1] National Science Foundation, Directorate for Education and Human Resources Division of Graduate Education. (2011) *Graduate Research Fellowship Program: Administrative Guide for Fellows and Coordinating Officials*. Arlington, VA.

Questions for the Record Submitted by
Jose E. Serrano

LATINOS AND THE SCIENCES

NSF has specialized undergraduate education programs for Blacks and Native Americans, but not specialized programs for Latinos. Since fiscal year 2010, there has been appropriations report language directing the NSF to address the needs of HSIs. The House passed bill for Fiscal year 2013 repeated report language that stated: "The Committee has previously asked NSF to consider the concept of creating a program within EHR to focus on Hispanic Serving Institutions (HSIs). NSF shall provide to the Committees on Appropriations a report outlining how the needs of HSIs will be addressed in fiscal year 2013 and any plans to establish an HSI-focused program in fiscal year 2014. This report shall be submitted no later than 120 days after the enactment of this Act." Although the House bill became stuck in the Senate, there are still several years of pending instructions in this area. While I appreciate the efforts NSF is making in expanding opportunities to underrepresented minorities, including through the establishment of a new program in this year's budget?, I am troubled that NSF has not established a dedicated Hispanic Serving Institutions- Undergraduate program. Latinos are now the largest minority group in the United States, and are severely underrepresented in the STEM fields. More importantly, Congressional instruction was very clear in this regard.

Question 1. Are steps being planned to follow the previous language on this issue?

Answer: NSF recognizes that Hispanics are the largest and fastest-growing minority group in the nation; the U.S. Hispanic population grew four times faster than the total U.S. population between 2000 and 2010. To ascertain the support provided to Hispanic Serving Institutions, NSF conducted an internal portfolio analysis to identify the educational efforts that focus on the needs of HSIs. This analysis showed that over the past five years, NSF investments in HSIs have increased considerably and exceeded that of other minority serving institutions with dedicated programs, such as Historically Black Colleges and Universities (HBCUs) and Tribal Colleges and Universities (TCUs). In FY 2012, investments in HSIs reached more than 70 colleges and universities, and 66 percent of NSF's FY 2012 funding to HSIs came from the Research and Related Activities category. Given this significant level of investment, NSF plans to continue activities that are successfully meeting the needs of HSIs, including encouraging proposals from HSIs to appropriate, existing NSF programs that focus on improving undergraduate education and/or express a commitment to broadening participation of groups underrepresented in STEM, and continuing the emphasis within NSF programs such as Louis Stokes Alliances for Minority Participation (LSAMP) and Advanced Technological Education (ATE) to support community colleges. NSF will focus on areas of critical need, such as capacity building at community colleges, particularly those with a high level of Hispanic student enrollment, and evaluation of the overall impact of NSF-wide HSI activities to inform future actions and ascertain the need for additional HSI specific efforts in FY 2014 and beyond. NSF will use data on HSI community college success rates and other relevant findings to better target those institutions and augment the investment's overall impact, which will be essential to future planning.

DIVERSITY IN THE SCIENCES

Statistics show that Latinos and Blacks are under-represented in the science, technology, engineering, and math (STEM) fields – sciences, technology, engineering, and mathematics. The latest National Science Foundation statistics available show that while Blacks represent more than 12% of the population, they only represent 8.2% of bachelor's degree recipients in the sciences in 2009. In addition, Latinos now represent more than 15% of the US population, but only 8.6% of students graduating with a bachelor's degree in the sciences in 2009. In this vein, last year, the American Association for the Advancement of Science (AAAS) issued a report called "Measuring Diversity: An Evaluation Guide for STEM Graduate Program Leaders," based on work with NSF's Alliance for Graduate Education and the Professoriate (AGEP). The report offers a framework and tools for assessing the strengths and weaknesses of graduate programs. Statistics continue to show that Blacks and Latinos are significantly under-represented in the sciences and other STEM fields.

Question 2. How has the Administration approached this problem? Does the Administration have a government-wide policy in place to increase minority participation in these fields? Does the National Science and Technology Council's (NSTC) Committee on STEM plan to specifically address this issue?

Answer: The February 2012 progress report of the National Science and Technology Council Committee on STEM Education (CoSTEM) indicated that the Administration identified "serving groups traditionally under-represented in STEM fields" as one of four priority areas for interagency coordination. The primary objective is to provide higher quality education opportunities to individuals from under-represented groups for the purpose of increasing representation of under-represented groups in STEM fields. The progress report also suggested that the following criteria for investments in STEM education of under-represented groups should be considered: design investments with input from under-represented groups; ensure that investments draw upon the interests, knowledge, practices, and culturally relevant STEM experiences of under-represented groups; and support investments that build capacity and sustained relationships between participants and STEM partners. The five-year Federal STEM Education Strategic Plan that is under development will further delineate the approach with a priority area roadmap of the near, mid- and long-term goals and related metrics and outcomes to facilitate federal coordination for increasing the participation and representation of under-represented groups in STEM fields. Additionally, a goal of the Administration's proposed reorganization of STEM education programs is increasing opportunities and participation for individuals from underrepresented groups in STEM fields.

Question 3. Furthermore, does the NSF factor in the framework set forth in the "Measuring Diversity" report when awarding grants to graduate institutions?

Answer: The *Measuring Diversity* report continues to be a useful guide for conceptualizing broadening participation in graduate education as well as a tool to help graduate institutions improve the quality of data collected and make meaningful use of participation and performance data. When appropriate, proposers to NSF programs are asked to provide baseline data and evaluation plans with measurable metrics. The *Measuring Diversity* report was intended as a tool for proposers to NSF programs to develop relevant graduate education proposals, particularly for underrepresented groups in STEM as well as include well-designed data

collection and project evaluation. The *Measuring Diversity* report provides a framework to inform the review of this aspect of proposals and annual reports from funded projects.

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Appropriations
Subcommittee on Commerce, Justice, Science, and Related Agencies
Hearing on NSF Oversight
March 19, 2013
Dr. Subra Suresh, Director, National Science Foundation
Additional Questions for the Record Submitted by
Frank R. Wolf

Funding Rates Across the Agency

Question 1. Under the levels proposed in the budget, research grant funding rates across the agency would vary significantly. For example, according to the budget request, it would be nearly twice as difficult to get a research grant in engineering as it would in geosciences. Is this disparity problematic, or are there reasons why the disparity is necessary or useful?

Answer:

There are a number of reasons why success rates vary in different disciplines that reflect the variation in the structure and culture of different research communities. Some of these are the following:

- Some parts of NSF issue a significant number of specialized solicitations each year while in other areas proposals are primarily submitted to long-term programs. In general, solicitations tend to generate significantly more proposals and tend to be associated with lower success rates.
- Some program areas rely on deadlines for proposal submission while others accept proposals at any time. The latter approach tends to be associated with reduced proposal pressure.
- In some disciplinary areas, the majority of researchers have nine-month academic appointments while in others, a significant number of researchers have soft-money positions. The report of the Impact of Proposal and Award Management Mechanisms Working Group (NSF 07-45, 2007) noted that, initially, communities with fewer academic positions and more soft-money positions may be more inclined to continue submitting proposals in the face of declining success rates. In the longer term, however, such pressure may result in a loss of researchers from the field and a reduction in new entrants because of the difficulty of sustaining a soft-money research career. Such a feedback mechanism could help create an apparent stability in success rates while masking deterioration in the health of the research community.

Such differences make it difficult to compare directly proposal success rates. However, the low success rate of engineering research proposals is something that NSF has been seeking to address. For example, over the past decade, comparing the FY 2014 Congressional Request to FY 2004 actual obligations, support from the Research and Related Activity (R&RA) account for Directorate for Engineering research has risen about 61 percent compared to a growth of about 45 percent for the R&RA account overall.

Question 2. Please provide a list of agencies/programs whose operations are being subsumed into NSF's portions of the reorganized, consolidated government-wide STEM education enterprise.

Answer: Attachment 1 contains the list of all programs affected by the reorganization government-wide. NSF does not interpret the President's proposed STEM-education reorganization to mean programs from other agencies will be "subsumed" by NSF. Rather, NSF programs will be expanded and coordinated within new frameworks and will introduce additional approaches for improved impact and effectiveness.

NSF's staff has ongoing relationships with colleagues at agencies whose undergraduate programs and graduate fellowship programs are proposed for termination and NSF will pursue discussions to fully understand the specific goals and operational features of those programs, as well as the agency assets (e.g. laboratories, facilities, instruments) that have been available to participants in those programs. NSF's realigned programs (Catalyzing Advances in Undergraduate STEM Education, NSF Graduate Research Fellowships, and NSF Research Traineeships) will incorporate the intentions and goals of other agencies' programs as appropriate, and will be cognizant of how NSF's programs can meet the particular educational goals of science mission agencies. NSF staff will work collaboratively with other agencies to determine how participants in the NSF programs can have appropriate access to facilities and assets of other agencies as part of their preparation for the STEM workforce.

Question 3. Did NSF have any conversations with the agencies/programs referenced in question 1 about how the restructured program would be administered in order to meet those agencies' needs?

Answer: NSF staff are engaged in conversations and planning with counterparts from other agencies regularly, through such vehicles as the National Science and Technology Council's Committee on STEM Education (CoSTEM) and its two subcommittees (Federal Coordination in STEM Education Task Force and Federal Inventory of STEM Education Fast Track Action Committee), as well as through other groups that meet regularly, such as the Interagency Graduate Fellowship Group, and the Graduate Education Modernization group organized by the Office of Science and Technology Policy. Detailed planning for how the restructured NSF programs can best understand and meet the needs of agencies whose programs are proposed for termination has begun with the release of the President's FY 2014 budget request. These conversations will build on the preliminary, high-level planning conversations begun among agency leaders during development of the budget.

Question 4. If the answer to the previous question is yes, when did these conversations take place and what was decided? If the answer to the previous question is no, does this lack of pre-planning introduce risk that the reconfigured program will not meet all of the existing needs?

Answer: CoSTEM was established through the America COMPETES Reauthorization Act of 2010, was chartered in February 2011, and has focused its work on the federal STEM program inventory and strategic plan. Through CoSTEM, agency representatives have been engaged in identifying priority areas for federal investment and developing coordination objectives and mechanisms. The general frameworks and foundations established by CoSTEM will serve as a

basis for more detailed planning and transition now that the FY 2014 budget request has been released.

Question 5. The general philosophy behind the STEM reorganization is to consolidate K-12 programs at the Department of Education, informal education programs at the Smithsonian, and undergraduate/graduate programs at NSF. However, NSF is retaining more than $250 million of K-12 programs, as well as its informal education programs. Why aren't NSF's own programs subject to the reorganization being imposed on the rest of government?

Answer: The general design framework was intended to lead to a more nuanced approach, developed through consultation, feedback, and consideration of programs and agency assets. NSF's K-12 and informal education programs are remaining at NSF because they primarily invest in STEM education research and development. NSF's research and development investments in K-12 STEM education and informal STEM learning are aimed at building an understanding of how to improve STEM learning and learning environments inside and outside of school. Most of the investments support evidence-based design, implementation, and research on innovative interventions, often implemented at small scales. Those interventions can then serve as tested models for wider implementation and use at full scale through partnerships with other entities. The NSF-supported projects in the K-12 and informal areas are then available to programs such as those that will be developed at the U.S. Department of Education and the Smithsonian Institution to be taken to scale through the Department of Education's STEM innovation networks and disseminated widely through the virtual STEM Learning Network.

Question 6. For the third consecutive fiscal year, NSF is proposing substantial realignments within the EHR budget. These realignments complicate efforts to track programs over time and imply a constant rethinking of the EHR program strategy. When will the EHR program structure finally be stabilized?

Answer: The past three EHR budget requests represent progressive stages in a planned, strategic reformulation of EHR. The primary and consistent emphasis across all three years is establishing EHR as a leader in investments in research and development to understand and improve STEM education and learning. Establishing this focus requires both internal capacity-building and external engagement with stakeholder communities, which is necessarily a gradual strategic process. This emphasis serves also as a vehicle toward a more coherent and focused mission and role for EHR, with a goal of moving gradually toward a set of core programs that encompass smaller programs in the directorate. The FY 2012 request introduced the strong commitment to EHR's role in building the research and development-based understanding of STEM teaching and learning as a critical function, and emphasized evaluation of STEM education programs. In the FY 2013 request, the research emphasis is reinforced and implemented with the introduction of the EHR core research launch. The four core research and development areas (STEM learning, STEM learning environments, STEM workforce, and broadening participation) were introduced to align with EHR's current four divisions. In the FY 2014 request, the four core areas serve as organizers for the budget presentation within each division, and there is some additional consolidation introduced. For the programs that have been combined or consolidated, NSF can track investments and can provide portfolio analyses as needed for activities that are less prominent following this realignment. The realignments presented in the past three budget requests have laid the groundwork for EHR's transformation. EHR does not anticipate any subsequent change of direction from the four thematic areas or the research and development focus.

Grants Management

Question 7. The agency operations budget remains relatively flat in the budget request (after excluding an increase intended for rent payments), and reductions in travel and other administrative activities continue. How will this pressure on your operations budget affect your plans for grants management activities in FY 14? Do you anticipate any changes in the number of expected site and desk reviews or any other oversight activities intended to ensure that grantees are spending Federal dollars appropriately and efficiently?

Answer: The pressure on the NSF operations budget affects grants management activities in a number of ways.

Specifically, reductions in travel impact the ability to conduct site visits. In some circumstances, NSF has been able to conduct these site visits virtually, which helps mitigate the impact of travel constraints and maintain the number of annual site visits in our Award Monitoring and Business Assistance Program (AMBAP) at approximately 30. While virtual site visits have been successful, on-site assessments remain valuable, providing the opportunity to "kick the tires," so to speak.

Desk reviews in the AMBAP program receive significant support from contractor resources. NSF conducts between 100 to 120 desk reviews a year. Reductions to the operations budget that reduce contractor oversight support will tend to decrease the number of desk reviews, and in turn shrink NSF's oversight footprint.

Similarly, constrained travel and contract resources will also constrain implementation of NSF's Business System Review program, which provides oversight of complex large facilities.

NSF also relies on contract support for the complementary financial controls and oversight that are part of our overall approach to managing risk. The frequency and extent of NSF's baseline monitoring of grants expenditures may be reduced. Grant expenditure testing is used to identify and resolve erroneous reporting of grants transactions and is an important part of NSF's overall post award monitoring program.

Testing for improper payments in grant recipient transactions may be done less frequently. Assessing the risk that NSF's grants program may be susceptible to significant improper payments and related testing and monitoring is necessary to comply with legal requirements. NSF has a robust risk assessment underway, which will provide additional insights into the impact of resource constraints.

It is also anticipated that there will be a reduction in the ability of grant and cooperative agreement staff to actively participate in various program readiness and performance reviews taking place off-site from NSF; these include regularly scheduled meetings of groups, such as the Gemini Observatories Finance Committee, and periodic performance reviews of the Arctic Regions Research Vessel construction, Ocean Observatories Initiative construction, and Network for Earthquake Engineering Simulation operations.

Attachment 1: List of Programs Affected by STEM Reorganization

FY 2012 Inventory of STEM Programs

Program	Program Type
Agriculture	
Consolidations (Funding Redirected Outside of Agency)	
Agriculture in the Classroom	Engagement
AITC Secondary Postsecondary Agriculture Education Challenge Grants (SPECA)	Engagement
Food and Agricultural Sciences National Needs Graduate and Postgraduate Fellowship Grant Program	Fellowship/ Scholarship
Higher Education Challenge Grants (HEC)	Undergraduate Education
Higher Education Multicultural Scholars Program (MSP)	Fellowship/ Scholarship
Women and Minorities in Science, Technology, Engineering and Mathematics Fields Program (WAMS)	Fellowship/ Scholarship
Internal Consolidations/Eliminations (Funding Remains within the Agency)	
Distance Education Grants for Institutions of Higher Education in Insular Areas (DEG)	Fellowship/ Scholarship
Resident Instruction Grants Program for Institutions of Higher Education in Insular Areas	Fellowship/ Scholarship
Existing Programs Maintained (Not Consolidated)	
1890 Facilities Grant Program	Minority Serving Institutions
1890 Institutions Capacity Building Grants Program: Extension	Minority Serving Institutions
1890 Institutions Capacity Building Grants Program: Teaching	Minority Serving Institutions
4-H Science, 4-H Youth Development Program	Engagement
AgDiscovery	Fellowship/ Scholarship
Alaska Native-Serving and Native Hawaiian-Serving Institutions Education Competitive Grants Program	Minority Serving Institutions
Hispanic-Serving Institutions Education Grants Program	Minority Serving Institutions
NIFA Fellowship Grants Program	Minority Serving Institutions
New Programs	
Insular Programs	None
Commerce (includes National Oceanic and Atmospheric Administration)	
Consolidations (Funding Redirected Outside of Agency)	
Competitive Education Grants (including Environmental Literacy Grants)	STEM Instruction
Dr. Nancy Foster Scholarship Program	Fellowship/ Scholarship
National Sea Grant College Program*	STEM Instruction
NIST Summer Institute for Middle School Teachers	STEM Instruction
NOAA Office of Ocean Exploration and Research (Education Only)	Engagement
NOAA Teacher at Sea Program	STEM Instruction
Internal Consolidations/Eliminations (Funding Remains within the Agency)	

Coral Reef Conservation Program	Engagement
National Estuarine Research Reserve System	STEM Instruction
NOAA Bay Watershed Education and Training (B-WET)	STEM Instruction
NOAA Fisheries Education Program	STEM Instruction
Satellite and Information Service	Engagement
Existing Programs Maintained (Not Consolidated)	
Educational Partnership Program with Minority Serving Institutions	Minority Serving Institutions
Ernest F. Hollings Undergraduate Scholarship Program	Fellowship/ Scholarship
STEM Pipeline for the Next Generation Scientists and Engineers.	Fellowship/ Scholarship
Summer Undergraduate Research Fellowship (SURF)	Fellowship/ Scholarship

* $4M in activities within the National Sea Grant College Program (including funding for the Sea Grant Knauss Policy Fellowships, Sea Grant/NMFS Graduate Fellowship Program, and STEM Instruction) was redirected outside of the agency.

Defense

Consolidations (Funding Redirected Outside of Agency)	
DoD STARBASE Program	Engagement
Iridescent Learning	Engagement
National Defense Education Program (NDEP) K-12 component	Engagement
National Science Center (NSC)	Engagement
Uniformed Services University of the Health Sciences (USUHS)	Fellowship/ Scholarship
University Laboratory Initiative (ULI)	Fellowship/ Scholarship
Existing Programs Maintained (Not Consolidated)	
Army Educational Outreach Program (AEOP)	STEM Instruction
Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE)	Fellowship/ Scholarship
Historically Black Colleges and Universities/Minority Institutions Research and Education Partnership	Minority Serving Institutions
National Defense Education Program (NDEP) Science, Mathematics And Research for Transformation (SMART)	Fellowship/ Scholarship
National Defense Science and Engineering Graduate (NDSEG) Fellowship Program	Fellowship/ Scholarship
Navy - Science and Engineering Apprenticeship Program (SEAP)	Engagement
SeaPerch	Engagement
Stokes Educational Scholarship Program	Fellowship/ Scholarship
The Naval Research Enterprise Intern Program (NREIP)	Engagement
University NanoSatellite Program	Engagement

Education

Internal Consolidations/Eliminations (Funding Remains within the Agency)	
Improving Teacher Quality State Grants/Effective Teacher and Leader State Grants Set Aside	STEM Instruction
Teacher Incentive Fund	STEM Instruction
Existing Programs Maintained (Not Consolidated)	
Developing Hispanic Serving Institutions STEM and articulation programs	Minority Serving Institutions
Graduate Assistance in Areas of National Need (GAANN)	Fellowship/ Scholarship
High School Longitudinal Study of 2009	None

Investing in Innovation	STEM Instruction
Mathematics and Science Partnerships/Effective Teaching and Learning for a Complete Education	STEM Instruction
Minority Science and Engineering Improvement Program	Minority Serving Institutions
Research in Special Education	None
Research, Development, and Dissemination	None
Strengthening Predominantly Black Institutions	Minority Serving Institutions
Teacher Loan Forgiveness	STEM Instruction
Upward Bound Math and Science Program	STEM Instruction
New Programs	
Fund for the Improvement of Education (FIE): Math Inititative	None
STEM Innovation	STEM Instruction
Energy	
Consolidations (Funding Redirected Outside of Agency)	
American Chemical Society Summer School in Nuclear and Radiochemistry	Engagement
Computational Science Graduate Fellowship	Fellowship/ Scholarship
Global Change Education Program	Fellowship/ Scholarship
Graduate Automotive Technology Education	Fellowship/ Scholarship
National Undergraduate Fellowship Program in Plasma Physics and Fusion Energy Sciences	Fellowship/ Scholarship
Plasma/Fusion Science Educator Programs	STEM Instruction
QuarkNet	STEM Instruction
Wind for Schools	Engagement
Existing Programs Maintained (Not Consolidated)	
Advanced Vehicle Competitions	Engagement
Community College Internships (formerly Community College Institute of Science and Technology)	None
Visiting Faculty Program (formerly Faculty and Student Teams)	Engagement
HBCU Mathematics, Science & Technology, Engineering and Research Workforce Development Program	Minority Serving Institutions
Industrial Assessment Centers	Engagement
Minority Educational Institution Student Partnership Program	Minority Serving Institutions
Minority University Research Associates Program (MURA)	Minority Serving Institutions
National Science Bowl	Engagement
Science Undergraduate Laboratory Internships	Engagement
Solar Decathlon	Engagement
Special Recuitment Programs/Mickey Leland Fellowship	Engagement
New Programs	
Office of Science Graduate Fellowship (SCGF) program	Engagement

Environmental Protection Agency

Consolidations (Funding Redirected Outside of Agency)	
Greater Research Opportunities (GRO) Fellowships for Undergraduate Environmental Study	Fellowship/ Scholarship
Science to Achieve Results Graduate Fellowship Program	Fellowship/ Scholarship
Internal Consolidations/Eliminations (Funding Remains within the Agency)	
Environmental Education Grants	Engagement
National Environmental Education and Training Partnership	Engagement
Existing Programs Maintained (Not Consolidated)	
Cooperative Training Partnership in Environmental Sciences Research	Fellowship/ Scholarship
P3-People, Prosperity & the Planet-Award: A National Student Design Competition for Sustainability	Engagement
University of Cincinnati/EPA Research Training Grant	Fellowship/ Scholarship
Health and Human Services (includes National Institutes of Health)	
Consolidations (Funding Redirected Outside of Agency)	
Clinical Research Training Program	Fellowship/ Scholarship
Curriculum Supplement Series	STEM Instruction
NIAID Science Education Awards	STEM Instruction
NINDS Diversity Research Education Grants in Neuroscience	Fellowship/ Scholarship
NLM Institutional Grants for Research Training in Biomedical Informatics	Fellowship/ Scholarship
OD Science Education Partnership Award	STEM Instruction
Office of Science Education K-12 Program	Engagement
Public Health Traineeship	Fellowship/ Scholarship
Science Education Drug Abuse Partnership Award	Engagement
Short Term Educational Experiences for Research (STEER) in the Environmental health Sciences for Undergraduates and High School Students	Fellowship/ Scholarship
Internal Consolidations/Eliminations (Funding Remains within the Agency)	
Health Careers Opportunity Program	Engagement
Short Courses on Mathematical, Statistical, and Computational Tools for Studying Biological Systems	Engagement
Existing Programs Maintained (Not Consolidated)	
Bridges to the Baccalaureate Program	Fellowship/ Scholarship
Initiative for Maximizing Student Development	Engagement
MARC U-STAR NRSA Program	Minority Serving Institutions
Mathematics and Science Cognition and Learning (MSCL) Program	Engagement
National Cancer Institute Cancer Education and Career Development Program	Fellowship/ Scholarship
RISE (Research Initiative for Scientific Enhancement)	Minority Serving Institutions
Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants (T32, T35)	Fellowship/ Scholarship
Ruth L. Kirschstein NRSA for Individual Predoctoral Fellows, including Underrepresented Racial/Ethnic Groups,Students from Disadvantaged Backgrounds, and Predoctoral Students with Disabilities	Fellowship/ Scholarship
Short Courses in Population Reseach (Education Programs for Population Research R25)	Engagement
Short-Term Research Education Program to Increase Diversity in Health-Related	Engagement

Research	
Student Intramural Research Training Award Program	
Summer Institute for Training in Biostatistics	Engagement
Undergraduate Scholarship Program for Individuals from Disadvantaged Backgrounds	Fellowship/ Scholarship
New Programs	
Medical Research Scholars Program (MRSP)	Fellowship/ Scholarship
Homeland Security	
Consolidations (Funding Redirected Outside of Agency)	
Homeland Security STEM Career Development Grant Program	Fellowship/ Scholarship
Existing Programs Maintained (Not Consolidated)	
National Nuclear Forensics Expertise Development Program	Fellowship/ Scholarship
Scientific Leadership Awards Program	Minority Serving Institutions
Interior	
Existing Programs Maintained (Not Consolidated)	
Conservation and Land Management Internship Program	Engagement
EDMAP	Engagement
George Melendez Wright Climate Change Youth Initiative	Fellowship/ Scholarship
Geoscientists-in-the-Parks Program	Fellowship/ Scholarship
National Aeronautics and Space Administration	
Consolidations (Funding Redirected Outside of Agency)	
Aeronautics Academy	Fellowship/ Scholarship
Aeronautics Content - Smart Skies/Product Content Upgrade	Engagement
Aeronautics Scholarship	Fellowship/ Scholarship
Aqua	Engagement
Astrophysics Forum	Engagement
Aura	Engagement
Cassini	STEM Instruction
Chandra	STEM Instruction
DAWN	STEM Instruction
Design Competitions	Engagement
Earth Science E/PO Forum	Engagement
eEducation Small Projects/Central Operation of Resources for Educators (CORE)	Engagement
EPOESS	Engagement
GCCE - Global Climate Change Education	STEM Instruction
GRAIL	Engagement
GSRP - Graduate Student Researchers Program	Fellowship/ Scholarship
Heliophysics E/PO Forum	Engagement
HEOMD-NASA's Beginning Engineering, Science and Technology (BEST) Students (NBS)	Engagement
HST	STEM Instruction
Innovation in Higher Education STEM Education	Fellowship/ Scholarship

INSPIRE - Interdisciplinary National Science Program Incorporating Research and Education Experience	Engagement
JPFP - Jenkins Pre-Doctoral Fellowship Program	Fellowship/ Scholarship
Juno	Engagement
LDCM	Engagement
LEARN - Learning Environment and Research Network	STEM Instruction
Mars E/PO Formal Ed	Engagement
Mars E/PO Informal Ed	Engagement
MESSENGER	Engagement
NAS - NASA Aerospace Scholars	Engagement
NES - NASA Explorer Schools	Engagement
Planetary Science E/PO Forum	Engagement
Reduced Gravity Student Flight Opportunity Project	Engagement
SEMAA - Science Engineering Mathematics and Aerospace Academy/FIRST Buckeye	Engagement
SOFIA (Stratospheric Observatory for Infrared Astronomy) Education and Public Outreach	STEM Instruction
SOI - Summer of Innovation/NASA IV&V Engineering Apprenticeship Program	Engagement
Spaceward Bound	Engagement
USRP - Undergraduate Student Research Project	Engagement
Internal Consolidations/Eliminations (Funding Remains within the Agency)	
AESP - Aerospace Education Services Project	Engagement
CEP - Career Exploration Project	Engagement
Curriculum Improvement Partnership Award for the Integration of Research into the Undergraduate Curriculum (CIPAIR)	Minority Serving Institutions
EFP - Education Flight Projects	Engagement
ESMD Space Grant Project	Fellowship/ Scholarship
HEOMD-Goldstone Apple Valley Radio Telescope (GAVRT) Project	None
HEOMD-University Student Launch Initiative	Engagement
Informal STEM Education	Engagement
Innovation in Aeronautics Instruction Competition	None
LARSS - NASA Langley Aerospace Research Summer Scholars Program	Fellowship/ Scholarship
LERCIP - Lewis Educational Research Collaborative Internship Project (College)	Fellowship/ Scholarship
LTP - Learning Technologies Project	Engagement
MUST - Motivating Undergraduates in Science and Technology	Fellowship/ Scholarship
NETS - NASA Education Technologies Services	Engagement
NSBRI Higher Education Activities - National Space Biomedical Research Institute	Fellowship/ Scholarship
Research Cluster	None
SEED - Systems Engineering Educational Discovery	Engagement
Existing Programs Maintained (Not Consolidated)	
GLOBE Program	Engagement
Space Grant - National Space Grant College and Fellowship Program	Engagement
Space Technology Research Fellowships	Fellowship/ Scholarship

MUREP (4 STEM programs in FY 2012 Inventory: MUREP Small Projects, NASA Science and Technology Institute for Minority Institutions, NASA Tribal College and University Project, University Research Centers)	Minority Serving Institutions
New Programs	
STEM Education & Accountability Project*	

*NASA's STEM Education & Accountability Project will take on a new structure to ensure the continuation of the most effective functions of its engagement and STEM instruction activities.

National Science Foundation

Internal Consolidations/Eliminations (Funding Remains within the Agency)	
Climate Change Education (CCE)	Undergraduate Education
Computing Education for the 21st Century (CE21)	Undergraduate Education
Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM)	STEM Instruction
Engineering Education (EE)	Undergraduate Education
Geoscience Education	Undergraduate Education
Geoscience Teacher Training (GEO-Teach)	Undergraduate Education
Global Learning and Observations to Benefit the Environment (GLOBE)	Engagement
Graduate Teaching Fellows in K-12 Education (GK-12)	STEM Instruction
Integrative Graduate Education and Research Traineeship (IGERT) Program	Fellowship/ Scholarship
Math and Science Partnership (MSP)	STEM Instruction
Nanotechnology Undergraduate Education in Engineering	Undergraduate Education
Opportunities for Enhancing Diversity in the Geosciences	Undergraduate Education
Research in Disabilities Education (RDE)	Fellowship/ Scholarship
Research on Gender in Science and Engineering (GSE)	Engagement
Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)	Undergraduate Education
Transforming Undergraduate Biology Education (TUBE)	Engagement
Transforming Undergrad Education in STEM (TUES)	Undergraduate Education
Widening Implementation and Demonstration of Evidence-based Reforms (WIDER)	Undergraduate Education
Existing Programs Maintained (Not Consolidated)	
Advanced Informal STEM Learning (AISL), formerly Informal Science Education (ISE)	Engagement
Advanced Technological Education (ATE)	STEM Instruction
Alliances for Graduate Education and the Professoriate (AGEP)	Fellowship/ Scholarship
Centers for Ocean Sciences Education Excellence	STEM Instruction
Discovery Research K-12 (DR-K12)	STEM Instruction
East Asia & Pacific Summer Institutes for U.S. Graduate Students (EAPSI)	Fellowship/ Scholarship
Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)	Fellowship/ Scholarship
Excellence Awards in Science and Engineering (EASE)	STEM Instruction
Federal Cyber Service: Scholarship for Service (SFS)	Fellowship/ Scholarship

Graduate Research Fellowship Program (GRFP)	Fellowship/ Scholarship
Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	Minority Serving Institutions
Innovative Technology Experiences for Students and Teachers (ITEST)	STEM Instruction
International Research Experiences for Students (IRES)	Engagement
Louis Stokes Alliances for Minority Participation (LSAMP)	Fellowship/ Scholarship
NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)	Fellowship/ Scholarship
Research Experiences for Teachers (RET) in Engineering and Computer Science	STEM Instruction
Research Experiences for Undergraduates (REU)	None
Research on Education and Learning (REAL), formerly Research and Evaluation on Education in Science and Engineering (REESE)	STEM Instruction
Robert Noyce Scholarship (Noyce) Program	STEM Instruction
Tribal Colleges and Universities Program (TCUP)	Minority Serving Institutions
New Programs	
Catalyzing Advances in Undergraduate STEM Education (CAUSE)	Undergraduate Education
STEM-C Partnerships	STEM Instruction
NSF Research Traineeships (NRT)	None
Nuclear Regulatory Commission	
Consolidations (Funding Redirected Outside of Agency)	
Integrated University Program*	Fellowship/ Scholarship
Nuclear Education Curriculum Development Program*	Undergraduate Education
Existing Programs Maintained (Not Consolidated)	
Minority Serving Institutions Program (MSIP)	Minority Serving Institutions

*Funding was retained at the agency due to the nature of the program's funding mechanism (it is largely funded through a fee). Once 2014 funding is final, funds would be transferred to NSF through a mechanism to be determined for undergraduate and graduate programs.

Smithsonian Institution	
New Programs	
STEM Informal Education and Instruction	Engagement
Transportation	
Existing Programs Maintained (Not Consolidated)	
Air Transportation Centers of Excellence	None
Dwight David Eisenhower Transportation Fellowship Program	Fellowship/ Scholarship
Garrett A. Morgan Technology and Transportation Education Program	Engagement
National Summer Transportation Institute Program (STI)	Engagement
Summer Transportation Institute Program for Diverse Groups (STIPDG)	Engagement
University Transportation Centers Program	None

Agency Summary	N
Consolidations (Funding Redirected Outside of Agency)	**78**
Agriculture	6
Commerce	6
Defense	6
Energy	8
Environmental Protection Agency	2
Health and Human Services	10
Homeland Security	1
National Aeronautics and Space Administration	37
Nuclear Regulatory Commission	2
Internal Consolidations (Funding Remains with the Agency)	**48**
Agriculture	2
Commerce	5
Education	2
Environmental Protection Agency	2
Health and Human Services	2
National Aeronautics and Space Administration	17
National Science Foundation	18
Existing Programs Maintained (Not Consolidated) and New Programs	**110**
Agriculture	9
Commerce	4
Defense	10
Education	13
Energy	12
Environmental Protection Agency	3
Health and Human Services	14
Homeland Security	2
Interior	4
National Aeronautics and Space Administration	8
National Science Foundation	23
Nuclear Regulatory Commission	1
Smithsonian	1
Transportation	6

The Honorable Frank R. Wolf
Chairman, Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on NSF Oversight

SOCIAL, BEHAVIORAL AND ECONOMIC SCIENCES

1. A recently adopted amendment to NSF's fiscal year 2013 appropriations bill seeks to limit spending on political science research to only those grants with a certified link to economic or national security. How does NSF plan to implement this limitation?

2. What is the expected impact of this amendment on the amount and kind of political science research that you will fund?

CROSS FOUNDATION INITIATIVES

3. Does the agency's recent emphasis on "OneNSF" initiatives imply that NSF has historically been too stove-piped in its research approach?

4. In just a few years, the OneNSF initiatives have come to consume a significant part of the agency's total budget, which means that NSF has become increasingly focused on programs addressing a few predetermined research goals. Is this focus pushing NSF to become more like a mission-specific research agency and less like a basic research agency, whose research focus goes wherever the science takes it?

5. How does the management of the OneNSF initiatives differ from the management of a typical NSF program? How have you made these differences transparent and understandable to the research community?

6. Some directorates have had to reduce the funding available for their core programs and infrastructure in order to make their contributions to the OneNSF initiatives. What process do you use to make the trade-offs between decreasing funding for existing programs and providing money to initiate new programs?

NSF HEADQUARTERS

7. The prospectus for a new NSF headquarters facility has been approved by the House but not the Senate. What do you know about the status of the Senate's consideration of your prospectus?

8. What is the latest that you could receive Senate approval without impacting GSA's planned schedule for awarding a new NSF headquarters lease?

9. What impact would a potential delay in the lease award have on NSF's headquarters planning? Would such a delay increase your budget needs associated with the new headquarters lease?

SECURITY

10. The NSF Inspector General has told us that the number and level of sophistication of hacking attempts on NSF information technology systems has increased. Are your IT security protections keeping pace with the increased threat?

11. One potential weakness that your IG has highlighted is NSF's lack of a formal cybersecurity incident response plan. Why doesn't NSF have such a plan? What risks are created by not having a standardized set of policies and procedures to follow whenever an incident occurs?

12. What policies do you have in place to ensure that your grantees are complying with export control laws and regulations in all relevant instances?

MONITORING AND IMPLEMENTATION OF K-12 STEM EDUCATION REPORT RECOMMENDATIONS

13. NSF released a report in 2011 on best practices in K-12 STEM education. There were a number of public events at the time to get that report into the hands of education practitioners and policymakers who could implement its findings, but your efforts to disseminate that report have continued since the report's release. What is the current status of your dissemination efforts?

14. Late last year, the National Research Council released a list of 14 key indicators that would allow NSF to track the implementation of the recommendations contained in the best practices report. What steps have you taken to begin collecting data on those indicators? How long do you estimate it will take to get a complete monitoring scheme in place for all 14 indicators?

RECOVERY ACT FUNDING

15. OMB gave you the option to seek waivers to allow certain Recovery Act awards to continue expending funds beyond the government-wide September 30 deadline. How many waivers did you seek, and how much funding is covered by those waivers?

16. The Recovery Act was enacted with the goal of providing a short term stimulus to an economy in major crisis. At this point, four fiscal years later and amidst a stronger general economy, that justification is much less compelling for the use of your remaining unspent Recovery Act funds. What is the justification you used for seeking waivers to continue paying out some of these awards?

17. What have you heard from OMB about the status of your waiver requests?

U.S. ANTARCTIC PROGRAM

18. Please provide a list of any of the 84 actions recommended by last year's Antarctic Blue Ribbon Panel with which NSF does not agree or does not currently have sufficient information to implement.

19. One of the Blue Ribbon Panel's "concluding observations" was that a temporary reduction in spending for Antarctic science activities could help to free up funds for critically needed logistics and infrastructure improvements. Does NSF support this idea?

20. Lockheed Martin told us that they incorporated many of the fiscal and process improvements recommended by the Blue Ribbon Panel into their contract bid. Do you agree with this statement? If there are additional savings measures that can be implemented beyond what Lockheed assumed in its bid, how can those additional measures be incorporated into their contract?

21. What is the status of your efforts to close out the previous Antarctic logistics support contract?

CLIMATE CHANGE RESEARCH

22. NSF tracks and reports on its investments in the U.S. Global Change Research Program, but this is only a portion of what the agency spends on climate change science in a given year. How much does NSF spend on climate change each year, across all activities? How have your investments in these activities changed over the last five fiscal years?

23. Last year the House voted to approve an appropriations amendment that would prohibit NSF from spending funds on the Climate Change Education Program. What do you believe would be the impact of such an amendment being enacted? Could your other more general STEM education programs serve the same purposes as the climate change-specific program?

WORKFORCE MANAGEMENT

24. NSF has seen recent decreases in employee satisfaction as measured by the OPM Employee Viewpoint Survey and the Partnership for Public Service's Best Places to Work in Government ratings. Why do you believe this is the case, and what steps is NSF taking to reverse this trend? What additional steps do you believe are necessary?

25. One of NSF's more unique workforce characteristics is its heavy use of "rotators", or non-Federal employees who work temporarily at NSF. How has NSF's use of these rotators changed over time? Are they becoming more common, or filling different types of jobs than was previously the case?

26. One of the most common means for hiring non-permanent employees is through the Intergovernmental Personnel Act (IPA), which allows an influx of outside technical expertise to the agency but is also very expensive. In fact, the OIG estimated that NSF's use of IPAs created $6.7 million in added costs in fiscal year 2012 alone. Is the value NSF receives from bringing in these IPAs always worth the added cost above hiring a regular Federal employee? What kind of analysis have you done to support your conclusions?

27. Many NSF executives are IPA employees who don't necessarily have any experience managing a Federal agency, and they only stay on the job for a few years before returning to their non-Federal positions. What kind of risk does this leadership strategy pose to the agency's management? How are these risks being mitigated?

28. What kind of protections are in place to ensure the independence of IPAs, who may be in a position to make decisions about research awards affecting themselves or their home institutions? Do you believe the existing protections are sufficient?

RESEARCH MISCONDUCT

29. NSF requires that each grantee certify that it has a plan to address and prevent research misconduct. However, it is largely up to the grantees to decide what to put in their plans; NSF only offers examples and best practices. Why doesn't NSF establish more concrete requirements and criteria that each plan must meet?

30. How often does NSF review grantees' research misconduct plans for adequacy? Is there a regular, comprehensive review process, or are plans checked only on a case-by-case basis?

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on NSF Oversight

CLIMATE MODELING

1. I am told that there are refereed, peer-reviewed publications showing that climate models over the past 35 years are running significantly warmer than the actual observations. This would raise serious questions for the Congress about how well the Earth's complex climate system is actually understood, with implications on the scientific basis for energy policy as well as for assessing how our national policy might realistically impact the Earth's climate in a desirable way. What is your agency doing to better understand why the most widely-used climate models are not able to reproduce the actual climatic observations, particularly those made from space?

2. What has NSF/NASA/NOAA done to actively promote and solicit scientific investigations that are consistent with the evidence (of very modest climate change) yet which contradict the popular view that global warming is rapid, human-caused, and dangerous? What steps does your agency take to ensure that all expert perspectives, including those that might call into question popular theories, are considered in developing, executing, and assessing your agency's current climate change programs?

3. What has NSF/NASA/NOAA done to ensure that the scientists who are involved in measuring the agreement between the models and the data had no role in developing the models?

4. What metrics can you present to demonstrate that the development, execution, and assessment of your climate change programs includes all expert perspectives, including those that may not agree with or support the most popular climate system theories? (This is the "red team" concept commonly used in industry and government for expensive programs.)

5. You state that your recommendations were being made in an effort to "ensure that these problems were finally remedied and that we do not need to issue a fourth report on the subject." Do you have plans to re-audit this division, as part of your process to see these recommendations fully implemented?

REALIGNMENT

6. Your testimony indicates that several of your directorates have been merged and consolidated since September 2012. How has this changed enabled the NSF to prepare for the impact of sequestration? Was it done to help ease the financial burden of sequestration or was it done for other purposes?

7. Recently, this subcommittee heard testimony from the Director of the FBI that discussed the threat of foreign cyber-spying on U.S. universities, corporations, and federal agencies for newly developed technologies. With the GROW Program, I understand that we are partnering with eight partner countries to further science research. However, how do we ensure that technologies and other discoveries that are being researched in partnership with other countries will be safeguarded in GROW and other similar endeavors?

The Honorable José Serrano
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Hearing on NSF Oversight

LATINOS AND THE SCIENCES

NSF has specialized undergraduate education programs for Blacks and Native Americans, but not specialized programs for Latinos. Since fiscal year 2010, there has been appropriations report language directing the NSF to address the needs of HSIs. The House passed bill for Fiscal year 2013 repeated report language that stated: "The Committee has previously asked NSF to consider the concept of creating a program within EHR to focus on Hispanic Serving Institutions (HSIs). NSF shall provide to the Committees on Appropriations a report outlining how the needs of HSIs will be addressed in fiscal year 2013 and any plans to establish an HSI-focused program in fiscal year 2014. This report shall be submitted no later than 120 days after the enactment of this Act." Although the House bill became stuck in the Senate, there are still several years of pending instructions in this area.

While I appreciate the efforts NSF is making in expanding opportunities to underrepresented minorities, including through the establishment of a new program in this year's budget?, I am troubled that NSF has not established a dedicated Hispanic Serving Institutions- Undergraduate program. Latinos are now the largest minority group in the United States, and are severely underrepresented in the STEM fields. More importantly, Congressional instruction was very clear in this regard.

1. Are steps being planned to follow the previous language on this issue?

DIVERSITY IN THE SCIENCES

Statistics show that Latinos and Blacks are under-represented in the science, technology, engineering, and math (STEM) fields – sciences, technology, engineering, and mathematics. The latest National Science Foundation statistics available show that while Blacks represent more than 12% of the population, they only represent 8.2% of bachelor's degree recipients in the sciences in 2009. In addition, Latinos now represent more than 15% of the US population, but only 8.6% of students graduating with a bachelor's degree in the sciences in 2009.

In this vein, last year, the American Association for the Advancement of Science (AAAS) issued a report called "Measuring Diversity: An Evaluation Guide for STEM Graduate Program Leaders," based on work with NSF's Alliance for Graduate Education and the Professoriate (AGEP). The report offers a framework and tools for assessing the strengths and weaknesses of graduate programs. Statistics continue to show that Blacks and Latinos are significantly under-represented in the sciences and other STEM fields.

2. How has the Administration approached this problem? Does the Administration have a government-wide policy in place to increase minority participation in these

fields? Does the National Science and Technology Council's (NSTC) Committee on STEM plan to specifically address this issue?

3. Furthermore, does the NSF factor in the framework set forth in the "Measuring Diversity" report when awarding grants to graduate institutions?

The Honorable Frank R. Wolf
Chairman, Subcommittee on Commerce, Justice, Science, and Related Agencies
Additional Questions for the Record
Hearing on NSF Oversight

FUNDING RATES ACROSS THE AGENCY

1. Under the levels proposed in the budget, research grant funding rates across the agency would vary significantly. For example, according to the budget request, it would be nearly twice as difficult to get a research grant in engineering as it would in geosciences. Is this disparity problematic, or are there reasons why the disparity is necessary or useful?

EDUCATION REORGANIZATION PROPOSAL

2. Please provide a list of agencies/programs whose operations are being subsumed into NSF's portions of the reorganized, consolidated government-wide STEM education enterprise.

3. Did NSF have any conversations with the agencies/programs referenced in question 1 about how the restructured program would be administered in order to meet those agencies' needs?

4. If the answer to the previous question is yes, when did these conversations take place and what was decided? If the answer to the previous question is no, does this lack of pre-planning introduce risk that the reconfigured program will not meet all of the existing needs?

5. The general philosophy behind the STEM reorganization is to consolidate K-12 programs at the Department of Education, informal education programs at the Smithsonian, and undergraduate/graduate programs at NSF. However, NSF is retaining more than $250 million of K-12 programs, as well as its informal education programs. Why aren't NSF's own programs subject to the reorganization being imposed on the rest of government?

6. For the third consecutive fiscal year, NSF is proposing substantial realignments within the EHR budget. These realignments complicate efforts to track programs over time and imply a constant rethinking of the EHR program strategy. When will the EHR program structure finally be stabilized?

GRANTS MANAGEMENT

7. The agency operations budget remains relatively flat in the budget request (after excluding an increase intended for rent payments), and reductions in travel and other administrative activities continue. How will this pressure on your operations budget affect your plans for grants management activities in FY 14? Do you anticipate any changes in the number of expected site and desk reviews or any other oversight activities intended to ensure that grantees are spending Federal dollars appropriately and efficiently?

Keeping America Secure: The Science Supporting the Development of Threat Detection Technologies
Thursday, July 19, 2012

1. Questions from the Honorable Ralph Hall

(a) How do your agencies stay up to speed on what other federal entities and the private sector are doing in threat detection technology?

ANSWER:

The National Science Foundation (NSF) has multiple partnerships with other agencies, some of which are described in Dr. Peterson's testimony. Among these partnerships are those with the Department of Homeland Security (DHS), Defense Threat Reduction Agency (DTRA), and National Geospacial Intelligence Agency (NGA). See, for example, the following links:

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503427

http://www.nsf.gov/news/news_summ.jsp?cntn_id=108398

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503223

Through NSF's "Industry University Cooperative Research Center (I/UCRC)" program, NSF develops liaisons with private industry who are active in specific areas, including those industry segments addressing threat detection technologies. Federal agencies comprise 15% of all I/UCRC membership support, and large and small business comprises over 75%. Industry and government members work in partnership with center universities to assure the center's research portfolio addresses unmet research needs and complements existing efforts in the private and government sectors. Federal members of I/UCRCs network across government in their sectors. For example the Member Advisory Board Chair of the I/UCRC for Identification Technology Research (referenced in Dr. Peterson's testimony) is a DHS Program Director. He is also the co-chair of the National Science & Technology Council (NTSC) Subcommittee on Biometrics and Identity Management composed of representatives from all federal agencies using biometric technology.

Additionally, a number of NSF's standard research grants involve private industry partners (see Dr. Peterson's testimony for examples).

(b) Do you have personnel dedicated to seeking out such technologies to inform agency work and to avoid potential duplication of efforts?

ANSWER:

NSF does not have personnel dedicated solely to such activity, but instead such activity is part of the portfolios of several program officers in various directorates, including Engineering (ENG), Mathematical & Physical Sciences (MPS), Computer & Information Science & Engineering (CISE), and Social, Behavioral & Economic Sciences (SBE).

NSF participates in a number of Office of Science and Technology Policy (OSTP) groups and other interagency coordination focused on addressing threat issues.

(c) Finally, how do you ensure that threat detection technologies developed through federal research funding will be both economical and usable?

ANSWER:

Because NSF funds basic research, it relies on its partnerships with mission agencies for the evaluation of economics and usability. For example, research grants made by NSF under the Domestic Nuclear Detection Office (DNDO)/DHS-NSF partnership are transferred to DNDO after the initial year, for evaluation of progress and promise, as well as supervision and further funding (if warranted).

Possibilities for major breakthroughs in usability, relevance and "bang for the buck" are high on the list of what we would ask panelists to look for in evaluating research proposals, and in guidance we give at grantees' conferences. We have had some discussion about whether focused workshops would be useful in better illuminating the strategic landscape of high-risk possibilities for larger breakthroughs in this area.

2. Question from the Honorable Dan Benishek

Dr. Gowadia's testimony mentions the inherent technical difficulties in developing nuclear detection technologies security applications (including limitations related to speed, distance, shielding, and source strength). How is the National Science Foundation working to improve the ability to detect threats in challenging environments?

ANSWER.

The inherent technical difficulties are very serious and sobering. NSF's primary means of trying to address those difficulties have been:

- use of scientific panel discussion (see questions 1) in review of ARI proposals,
- thoughtful discussions with partners at DNDO after reading some of their written material, and
- modest participation in ARI grantees' conferences.

Some of the technical difficulties (such as the difficulty of detecting shielded highly enriched uranium at a distance) are deeply rooted in our practical understanding of how the physics works. These are hard problems and the joint NSF-DNDO Academic Research Initiative (ARI) effort has several ongoing fundamental research projects that are addressing them.

NSF has partnered with DNDO/DHS and other agencies to support fundamental research at universities, sometimes in collaboration with private industry, on this topic (see links above).

3. Question from the Honorable Ben Lujan

It is extremely important to test threat detection technology in a realistic manner. Does the Nation have realistic test and evaluation capabilities for the threats that range from nuclear and explosive to chemical and biological? For example, do we have adequate capability to test radiation-detection gear with real threat materials such as special nuclear materials?

ANSWER.

NSF does not have these capabilities, but is partnered with agencies, such as DHS and Department of Defense (DOD), that do.

DTRA carries out this type of work at the Technical Evaluation Assessment Monitor Site (TEAMS) in Albuquerque, and with partners at the Nevada National Security Site and Idaho National Labs.

Operations-level facilities for testing nuclear detection equipment are a specialty of the National Labs and of other agencies, not NSF.

Initial laboratory testing, unique to each project, is a standard part of research projects in this area. Adequacy of empirical testing in any given project is part of what review panels normally discuss and evaluate in deciding what to recommend for funding; in some cases, the research includes collaborations with national labs for subsequent testing.

4. Question from the Honorable Randy Neugebauer

What is unique about the development of technologies designed to detect intentional threats versus accidental threats or natural disasters?

ANSWER.

Intentional threats include IEDs, chemical explosives laced with radioactive materials ("dirty bombs"), "small" nuclear bombs, poison gas, biological weapons (such as weaponized anthrax), etc. Accidental threats and natural disasters include chemical and oil spills, gas leaks, nuclear plant failures (sometimes caused by natural disasters), burst water mains, floods, earthquakes, tsunamis, hurricanes, tornadoes, wildfires, etc. Intentional threats are covert and hidden by human design, while accidental threats and natural disasters are not. As a rule (there are exceptions), the technologies required to detect intentional threats (e.g., IEDs) are of a different character than those for detecting natural disasters (tornadoes) or accidental threats (e.g. oil spills).

The difference between methods and systems to address natural threats and methods to address malicious threats is quite fundamental, even when we design systems like power grids to cope with both. The main difference is that when we cope with malicious threats, our models and analysis must account for the presence of intelligent adversaries, who try to be extremely creative about focusing on the weakest link of any system we may devise. For example, if we build a system which is provably stable or safe under certain assumptions, an intelligent adversary will typically focus on things which go outside of our normal assumptions.

Natural hazards of tornadoes, hurricanes and earthquakes are recorded by federal agencies such as US Geological Survey(USGS) and National Oceanic and Atmospheric Administration(NOAA). The data base of these hazards goes back to 60 to 100+ years.

Tornadoes are recorded by NWS regional offices when they occur in their regions. Based on the damage, length and path (the area affected by tornado) are recorded. And based on the level of damage,

intensity of a tornado is recorded as EF – Scale; the scale is from EF0 to EF5. EF stands for Enhanced Fujita scale. Each scale is assigned wind speed range. NWS/NOAA started keeping records since around 1970 when Dr. Ted Fujita at University of Chicago developed Fujita Scale. Storm Prediction Center, SPC/NOAA reviewed news papers and other sources to assign Fujita scale to recorded tornadoes since 1950. NWS changed F – scale to Enhanced Fujita, EF – Scale starting February 2007.

Hurricanes are recorded by National Hurricane Center, NHC/NOAA by satellite images in recent years. The parameters recorded for hurricanes are barometric pressure in the eye, diameter of eye, maximum wind speed, diameter of damaging wind speed, speed of the storm movement, storm track etc. NHC/NOAA has gone back in the archive and has assembled database since late 1800s. For public announcement NHC uses Saffir-Simpson Scale for hurricanes from Category 1 through 5. Each Category has a range of wind speed.

Earthquakes (the following is exerpted from: http://pubs.usgs.gov/fs/2011/3021/pdf/fs2011-3021.pdf):

"The U.S. Geological Survey's National Earthquake Information Center reports on more than 30,000 earthquakes a year worldwide, automatically detecting, locating and characterizing events, providing alerts, maps of strong ground shaking, and impact estimates of potential fatalities and losses. These rapid earthquake information products, which enable the prompt mobilization of emergency resources by all levels of government and humanitarian organizations, depend on the high quality seismic stations that make up the Global Seismographic Network...Nearly all GSN stations transmit data in near real-time"..."GSN data enabled the USGS National Earthquake Information Center to provide within 30 minutes a project of the impact of the devastating 2010 Haiti earthquake"..."In addition, more than 50 stations of the GSN are part of the International Monitoring System of the Comprehensive Test Ban Treaty Organization (CTBTO) and contribute to nuclear test monitoring and treaty verification." (From Gee, L.S., and Leith, W.S., 2011, The Global Seismographic Network: U.S. Geological Survey Fact Sheet 2011–3021, 2 p.)

"The Global Seismographic Network (GSN) is a permanent, digital network of more than 150 modern stations in over 80 countries, from the South Pole to Siberia and from the Pacific basin to the southern tip of Africa. At the core of the GSN, are the very broadband, high-dynamic range seismometers that measure the vibrations of the Earth. These instruments are extremely sensitive over a wide range of frequencies and are capable of detecting the response of the Earth to the motions of the Sun and the Moon with periods of thousands of seconds, as well as the strong shaking near large earthquakes with periods less than a tenth of a second, with high fidelity. In many cases, these seismometers are combined with other sensors, such as microbarographs, anemometers, magnetometers, and Global Positioning System receivers, to form geophysical observatories. Advanced systems for data acquisition and communications transmit continuous digital data from the stations to collection points in the U.S. The GSN was formed in 1986 as a partnership involving the U.S. Geological Survey (USGS), the National Science Foundation (NSF), and the Incorporated Research Institutions for Seismology (IRIS, a university consortium) and serves as a multi-use scientific facility and societal resource for monitoring, research, and education. All GSN data are freely and openly available to the public and scientists around the world from the IRIS Data Management Center." IRIS is funded by NSF GEO/EAR division and IRIS operates part of the GSN (http://www.iris.edu/hq/programs/gsn)

Stenographic Transcript of

COMMITTEE ON
COMMERCE, SCIENCE AND TRANSPORTATION

UNITED STATES SENATE

THE SCIENCE AND STANDARDS OF FORENSICS

Wednesday, March 28, 2012

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has supported 147 awards just in the period 2009 to 2011 that contribute to the strengthening of the forensic sciences. So in keeping with my one NSF philosophy, each of the foundation's seven directorates contributes to this effort.

The awards represent many facets of NSF activity including basic research awards, major research instrumentation, small-business innovation research, student support as well as workshops.

Just in this period from 2009 to 2011, more than $50 million of research has been awarded to institutions in 36 states and in the District of Columbia, large and small colleges and universities, EPSCoR states, minority-serving institutions, community colleges and small businesses.

Let me provide you with just a taste of our activities in support of the forensic sciences. Our data analysis also shows that there are more than 200 current awards that are supported by NSF.

With support from the socio-behavioral and economic sciences directorate, or SBE, researchers at the University of Arkansas are investigating how to overcome obstacles to the assessment of likely age changes in facial features.

An award by the Computer and Information Science and Engineering Directorate is using computer approaches to handwriting examination, which contributes to the scientific

analysis of documents of questioned authorship.

NSF has long used workshops to identify cutting-edge opportunities for future directions. In fact, after the NRC report was published in 2009, NSF-supported workshops included one on cognitive bias and forensic science, and another one -- that was at Northwestern University -- and there was another one on nanoscale science and technology for forensics.

NSF supports activities designed to achieve excellence in U.S. science education. Students participate in supported research and thereby gain skills that are transferable to crime labs.

Some awards specifically expose students to research in a forensic setting. A project at Tuskegee University, Auburn University, as well as Mississippi State University provides occupational training to America's veterans in digital forensics.

Other awards, including one at Arkansas State University, capitalize on the popularity of shows such as CSI to engage students in science.

NSF provides funding for small business innovation research to stimulate technological innovation in the private sector, and a number of awards support commercial development of technologies applicable to forensic settings.

Likewise, investments in infrastructure provide

databases and instrumentation used in forensic applications and research.

NSF also works collaboratively with other agencies. The award that supports training of veterans was made in coordination with the Department of Veterans Affairs.

Our science staff serves on the National Science and Technology Council Subcommittee on Forensic Science, and SBE, our Directorate on Social, Behavioral and Economic Sciences, is developing a memorandum of understanding with the National Institute of Justice to facilitate support of relevant forensic sciences.

So, in summary, NSF has supported and is committed to continue supporting the basic sciences that form the foundation for forensic applications, to collaborate with other mission agencies and to support science education opportunities necessary for the Twenty-First Century, especially in the -- area of forensic sciences.

Thank you, Mr. Chairman. I'll be happy to answer any questions.

[The prepared statement of Dr. Suresh follows:]

that into the field? You know, this isn't like pure science in the sense of, you know, oh, creating some sort of scientific breakthrough that you're going to market and perhaps make, you know, many, many dollars, you know, out of it.

You know, when we're talking about bite marks and stuff like that, the commercial aspect of that is not, you know, would not be very great. How do we get that from your laboratory, you know, when there's a breakthrough made, how do we get that out in the field to the small-town policeman?

Dr. Suresh: Okay. So maybe let me take a stab at that. In fact, I want to go back to the chairman's question to Dr. Lander. You know, the level of uncertainty that you have in DNA interpretation is no different from the level of uncertainty we have in any scientific experimental work. So let me give you an example that we all know.

Whenever we develop new materials, for example, so Alcoa, not too far from West Virginia, designs a new material and Boeing puts that into a plane. It's a 20-year process.

So what does Alcoa do? They design a material outside of Pittsburgh in their research center, and they make the material in Davenport, Iowa. And they do a lot of testing, and they pull the material, they twist the material, they bend the material, they break the material, and they give

the material to Boeing.

And Boeing doesn't believe anybody else's data because human lives are involved in a flying plane. They do their own in-house testing. And in order to make sure that the testing is reliable, and the interpretation of the testing is reliable, there are standards, which have come into existence thanks to the work of NIST.

So there is a whole organization called American Society for Testing and Materials that over the course of many, many decades has established standards. If you want to pull a piece of metal, what are the standards by which you do your experiment? And those standards are established by NIST and various professional societies. And it's that kind of validation of scientific data that needs to exist for the interpretation of DNA. And that's what is lacking. That's where the scientific method comes in.

So, historically, what NSF has done in these is we fund the research at universities that work with industry and create the kind of basic scientific data. Agencies like NIST come in and help develop the standards. These, too, are then adopted by industry and that becomes the bread and butter of how the industry develops a new material and puts it into service. And I think it's that kind of a scientific method that needs to be established in forensics.

So to your question, Mr. Boozman, what I would -- so

with respect to how do we bring it to the attention of people, we can, with these standards, with these new tools and technologies, we have a variety of things in place. I can only speak for NSF here. We have a variety of things in place.

So if there are basic scientific discoveries, we can have engineering research centers that work with industry. We have small business innovation research. We have partnerships for innovation. We have innovation research. These are all programs that NSF supports.

Those kinds of programs, and not just the SBIR program, is not just at NSF, it's in nine federal agencies. Those kinds of programs can help take the basic scientific discoveries and help translate them into commercial practice for small businesses, entrepreneurs, bring them in touch with venture-capital community.

And the program we launched last year, the NSF Innovation Corps, is another attempt by NSF to bring that kind of thinking from basic discoveries to the marketplace to the community.

Senator Boozman: Go ahead.

Dr. Gallagher: I didn't want to take your time, but just very quickly, you asked sort of two questions. One is how do you set priorities, and that happens at the junction between the world that's practicing forensics and the

process I have seen in my 18 years of government. In fact, what's striking is it's much broader than just federal involvement. We have representatives from state crime labs and other experts involved directly in the federal interagency process, and they've made a lot of progress in addressing certification requirements and a whole list of other things, so that once the structural answer is put on the table, we're ready to roll. And so it's kind of mixed.

Dr. Suresh: So I can point to three or four different activities that are evolved or continuing to evolve in response to the NRC report. One is the two workshops that I mentioned, one on cognitive bias and DNA analysis. The other one is on nanotechnology and forensic science. These workshops were organized and supported by NSF in response to the NRC report. So that's the first one.

The second is, I mentioned in my opening remarks, the memorandum of understanding that's in the works between NSF and NIJ, and that's something that's a direct outcome of the NRC report.

The third is the activity as part of the National Science and Technology Council Subcommittee on Forensic Science, and there are several possibilities there. One is to develop a white paper that summarizes recommendations to achieve the goals of the NRC report. The other one would be to create a prioritized national forensic-science research

agenda. A third would be to draft a detailed strategy for developing interoperability standards. So those at least a discussion is taking place through NSTC. So those are three tangible outcomes following the NRC report.

Senator Udall: Thank you.

And I think, Chairman Rockefeller, your efforts here at the committee, I think, have spurred things to move along. And I think we need to get to the point where we get an organizational part of this, as you just talked about, that's really going to come to grips with it and take advantage of all the energy that's going on out there in this respect. Thank you very much. Thanks for your attention.

The Chairman: You were a prosecutor.

Senator Udall: I was a prosecutor. That's correct, both at the, at the federal level, I was Assistant United States Attorney and prosecuted criminal cases.

I was thinking the same thing that you said. I always had the impression when we went into court that the judge was the arbiter over the science. And you had the sense that, you know, and the rules all say that, that the judge, he makes sure that the best scientific information comes in, and whenever it's fingerprint evidence or whatever.

And you get the sense as a prosecutor, well, that's up there with the judge, and if he lets it in, then it's all

our smaller communities, you know, where many times that entity is looked to, and, yet, in many of our states, you know, there's no training at all.

Well, yes, sir.

Dr. Suresh: I just wanted to add a couple of points to the comment that the chairman made about NSF's ongoing investments. The 147 projects or so amounting to about $50 million that I mentioned were identified by doing a search with the term forensics. So there is a lot of funding that NSF provides which feeds into this, but it's not directly aimed at forensic science.

For example, we fund genetics and genomics research in our Biological Sciences Directorate. The basic discovery there has a lot of potential implications for forensic science. So that's background basic research.

Likewise, in computer and information science and engineering, there is a lot of funding that goes into data analytics, image processing. And those kinds of things have huge implications for the development of forensic science within the NSF context.

So if I were to look at basic science funding with the implication for forensic science, it's likely to be a lot more than $50 million. So I just wanted to mention that.

Senator Boozman: Good. Again, thank you all for being here. That was, you know, your testimony today has been

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Appropriations
Subcommittee on Commerce, Justice, Science, and Related Agencies
Hearing on
FY 2013 National Science Foundation Budget Request

March 6, 2012

Dr. Subra Suresh, Director
National Science Foundation

Questions for the Record Submitted by
Frank R. Wolf

STEM EDUCATION

Question 1. There have been a number of major reviews of Federal STEM education efforts over the last few years, each of which came with recommendations for changes and improvements. Do you feel that NSF has been generally successful in implementing those recommendations? Are there significant areas of suggested reform and improvement where NSF still has substantial work to do?

Answer: NSF welcomes the guidance provided by these reviews of federal STEM education efforts and has made significant progress implementing their recommendations. Yes, NSF has been generally successful in implementing these recommendations, especially in the area of evidence-based research and development (R&D). We are strengthening the Directorate for Education and Human Resources' (EHR) core research and development (R&D) portfolio to put EHR's programs on a solid evidence base and to continue to advance foundational knowledge about learning and education that will be broadly relevant to all education programs in the NSF-wide and federal portfolios, including the frontier science envisaged in the Expeditions in Education (E^2) investment. There do remain significant areas of suggested reform and improvement that require substantial work, and we are positioning EHR to do that work, particularly in the domains of K-12 STEM student and teacher learning and building a diverse and highly qualified STEM workforce. The E^2 effort and a number of intra-agency working groups have begun to spread the reform agenda across the entire Foundation. This movement outside EHR is important because the research directorates and offices play a significant role in NSF's STEM education portfolio.

Reports issued in the last twelve months by the National Science and Technology Council (NSTC)[1] and the Government Accountability Office (GAO),[2] have examined aspects of the federal R&D STEM portfolio and considered questions of overlap and redundancy. The GAO report identified areas of potential overlap but cautioned that this finding called for attention to

[1] *Coordinating Federal Science, Technology, Engineering, and Mathematics (STEM) Education Investments: Progress Report* (National Science and Technology Council, February 2012); *The Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio* (National Science and Technology Council, December 2011).

[2] *Science Technology, Engineering, and Mathematics Education: Strategic Planning Needed to Better Manage Overlapping Programs across Multiple Agencies* (Government Accountability Office, January 2012).

coordination and strategic planning. The more refined inventory by NSTC, which employed the GAO definitions in a more granular analysis of programs, concluded there was "only modest overlap in investments and no duplication among the STEM education investments, as defined by GAO" (p. xiii). All of the studies agree, however, that there are opportunities for alignment and coordination.

Several recent National Research Council (NRC) reports[3] call attention to the need for a strong R&D core to support the improvement of STEM education. EHR is in the process of refining solicitations in current programs to ensure attention to some of the recommendations in these reports. For example, the Successful K-12 STEM Education report calls for deeper understandings of how contextual factors relate to student success in STEM, and EHR is examining its portfolio to determine how to improve the knowledge base in this area.

The FY 2013 NSF Budget Request to Congress provides a new framing of the EHR Research and Development (R&D) investment portfolio: STEM Learning, STEM Learning Environments, Broadening Participation and Institutional Capacity in STEM, and STEM Professional Workforce Preparation. NSF believes that this approach, which leverages its position as the only science research agency whose mission covers all of the sciences and education, is responsive to the recommendations of the reports cited, the needs of the research community, and makes a unique contribution to the federal research portfolio.

Question 2. One of those major reviews was conducted by the National Science and Technology Council's Committee on STEM Education, of which you are a co-chair. The Committee has produced an inventory of Federal STEM programs and is working on a STEM strategic plan. How did your experiences working on these projects inform the budget request that you put together for your own STEM programs?

Answer: The February 2012 progress report[4] released by the National Science and Technology Council's Committee on STEM Education outlines a five-year strategic plan for federal STEM investments around a common vision: a set of goals designed to develop a STEM workforce, promote STEM literacy, and a series of four coordination objectives. These coordination objectives include: (i) use evidence-based approaches; (ii) identify and share evidence-based approaches; (iii) increase efficiency and coherence; and (iv) identify and focus on priority areas. The four priority areas identified are: effective K-12 STEM teacher education; engagement in STEM; undergraduate STEM education; and serving groups traditionally underrepresented in STEM fields.

These goals, objectives, and priority areas are reflected in EHR's programmatic emphases beginning in FY 2012 and are expected to continue into successive years. The directorate's commitment to evidence-based R&D in the core programs is consistent with the thrust of the strategic approach, as is the directorate's participation in cross-foundation collaborations through E^2 and its interagency partnerships. In particular, the Department of Education (ED) and NSF have forged three proposed partnerships to start in FY 2013. EHR will collaborate with ED in three areas:

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[3] *Learning Science In Informal Environments: People, Places, and Pursuits* (2009); *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics* (2011); and *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads* (2011).

[4] http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_federal_stem_education_coordination_report.pdf

i. Math Science Partnership (MSP). Investments in the NSF Math and Science Partnerships (MSP) program will be aligned with ED's Effective Teaching and Learning: STEM initiative to build and use the evidence base for improving STEM education at the state and local level.

ii. K-16 Math Education. In FY 2013, $30 million from the Discovery Research K-12 (DR-K12) and Transforming Undergraduate Education in STEM (TUES) programs will be directed towards a new evidence-based grant competition to be jointly administered with ED that will focus on developing, evaluating, and scaling proven practices that can help increase student learning in K-16 mathematics.

iii. Standards for evidence/improving the evidence base. Efforts to establish joint standards of evidence for STEM education innovations and research are underway between EHR and ED's Institute of Education Sciences (IES) to improve the evidence base for STEM education programs across the government.

Question 3. The budget proposes to reorganize your Education and Human Resources Directorate portfolio by creating core research programs within each division, implementing the Expeditions in Education initiative and realigning several small programs. What is the overarching strategy at work behind this reorganization?

Answer: The FY 2013 Budget Request implements a strategy of situating EHR's programs and all NSF education programs supported in other directorates on a strong research base and positions the programs to continue to advance knowledge about science education and learning. The strategy is motivated by the need to position the EHR investment so that its impact on STEM education and workforce development is substantial. To do so, the strategy has three parts:

i. Build a coherent base of research and development that helps us understand the following core areas: STEM Learning, STEM Learning Environments, Broadening Participation and Institutional Capacity in STEM, and STEM Professional Workforce Preparation. The principal objective of this FY 2013 budget proposal is to establish an (EHR Directorate) Research and Development (R&D) core. This core is essential to improving STEM education and to discovery in the disciplines within NSF's other directorates. Nearly all major STEM education reports over the past decade, including the recent NRC report, *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*, call for more rigorous, systematic, focused, and/or use-inspired research that can move the Nation toward evidence-based solutions to challenges in STEM education at all levels. This focus responds to that call.

ii. Use the growing knowledge base for leadership investments that will accelerate the development of the next generation of diverse and well qualified STEM researchers and educators through recognition, fellowship, traineeship, and scholarship awards.

iii. Use the fact that EHR is part of NSF to mobilize science assets as a key tool to engage, energize, and empower learners in STEM and formalize a series of partnership activities with other directorates and offices through Expeditions in Education (E^2). The core notion is to infuse cutting-edge science, engineering, and innovation into the preparation of a world-class scientific workforce for the twenty-first century, and to ensure that all of

NSF's education and workforce investments are drawing on the latest educational theory, research, and evidence. The initiative will draw in new ideas on the best and most exciting of NSF-supported scientific advances and knowledge and will help embed learning and educational activities as integral components of the foundational research programs.

Question 4. The Administration has touted joint initiatives between NSF and the Department of Education to produce 100,000 new STEM education teachers and to improve math instruction in grades K-16. However, NSF is not proposing any new programs to achieve these goals. How will you incorporate these new goals into your existing work?

Answer: The EHR directorate has strong core programs that are central to advancing the Administration's goals. The Robert Noyce Teacher Scholarship Program (NOYCE) seeks to encourage talented STEM majors and professionals to become K-12 mathematics and science teachers. Tracks within this program provide funds to institutions of higher education for:

- Scholarships, stipends, and academic programs for undergraduate STEM majors and post-baccalaureate students holding STEM degrees who earn a teaching credential and commit to teaching in high-need K-12 school districts;
- 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; and
- The development of NSF master teaching fellows by providing professional development and salary supplements for exemplary mathematics and science teachers to become master teachers in high-need school districts.

Each track supports capacity building projects to develop the capacity of institutions to provide innovative teacher preparation programs to enable increasing numbers of STEM majors and STEM professionals to become effective K-12 mathematics and science teachers and to develop the capacity to prepare master science and mathematics teachers.

In addition to the Noyce program, EHR invests in building the research base on how to prepare effective STEM teachers and STEM learning, including instruction in mathematics. The Research and Evaluation on Education in Science and Engineering (REESE) program seeks to advance research at the frontiers of STEM learning, education, and evaluation, and to provide the foundational knowledge necessary to improve STEM teaching and learning at all educational levels and in all settings. The Widening Implementation and Demonstration of Evidence-based Reforms (WIDER), the Math and Science Partnership (MSP), and the Transforming Undergraduate Education in STEM (TUES) programs also are critical to the best undergraduate preparation that is the foundation for achieving these Administration goals. Solicitations will be revised to call attention to these building capacity and improvement goals.

Question 5. The fiscal year 2012 minibus conference statement directed NSF to begin taking steps to track and assess the implementation in the field of the NRC's report on best practices in K-12 STEM education. What is your progress to date on this task?

Answer: The Foundation appreciates the encouragement that the Chair, Ranking Member, and other members have provided in stimulating this important work and outreach to the many concerned communities. To support tracking and assessment of implementation, EHR has awarded a grant to the National Research Council (NRC) to create an evaluation framework to

identify measures and indicators to track the recommendations in the NRC report, *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics* (2011). The expert committee has been organized and the first meeting has been scheduled for April 23-24, 2012. It is expected that a report will be released by November 2012, as stipulated by Congress.

EHR also intends to initiate discussions with the National Center for Science and Engineering Statistics (NCSES), the National Center for Education Statistics (NCES), and the Institute for Education Sciences (IES) to develop collection of appropriate data, including but not limited to achievement and students' interest and engagement in STEM, and the relevant analyses of the data collected.

USE OF RECOVERY ACT FUNDING

Question 6. What steps is NSF taking to comply with recent OMB guidance on speeding up the outlay of Recovery Act funding? How much can you do to reasonably improve your expenditure rate when most of your funds are tied up in multiyear research grants?

Answer: Shortly after OMB issued M-11-34, the NSF ARRA Steering Committee and agency senior management were briefed, and an ARRA Acceleration Work Group was charged with implementation. The work group included NSF program staff, staff from the Office of Budget, Finance and Award Management, and staff from the Office of the General Counsel to ensure that expenditure acceleration efforts are done responsibly and in accordance with all applicable federal-wide policy and legal requirements. The NSF Office of Inspector General has also been consulted to ensure transparency and collaboration on matters of stewardship throughout NSF's accelerated expenditure process.

Throughout M-11-34 implementation, NSF has collaborated extensively with HHS/NIH to ensure that both agencies' messages on ARRA expenditure acceleration to their shared research community have been clear and consistent. NSF has also shared information and strategies with other federal agencies and has demonstrated leadership on M-11-34 implementation government-wide.

The agency's implementation steps include:

- On December 13, 2011, NSF posted the OMB Memorandum M-11-34 and NSF Notice of Intent to Revise American Recovery and Reinvestment Act Award General Terms and Conditions to Ensure Project Completion by September 30, 2013 on both its internal and external Recovery Act websites. Through this Notice, NSF informed its research community that the agency would amend ARRA awards limiting awardees' authority to unilaterally extend awards beyond 9/30/13. This action forces awardees to complete the project within the originally proposed timeline or within a limited period beyond the original timeline. Limiting the options for extending the project period should generate more expenditures prior to the September 30, 2013 deadline.

- NSF also put in place an extensive internal and external communications strategy that includes: agency-wide briefings, including a town hall and multiple senior management and program briefings; external meetings for hundreds of members of the research community, who are recipients of ARRA awards from multiple federal agencies; direct email communications to grantee sponsored project offices and grantee principal investigators

(PIs) and co-PIs; social media outreach strategies including Facebook groups of research administration professionals; Frequently Asked Questions (FAQs) for NSF program officers; FAQs for the external research community; revision of the internal NSF ARRA website; and an upcoming revision of the external ARRA website.

- NSF is also using new tools to track awards affected by OMB Memo M-11-34, monitoring expiration dates, expenditure balances, and other pertinent award information.

While it is impossible to know the precise amount that the agency will increase its expenditure rate, we do know that awardees are taking concrete, responsible steps to accelerate spending that vary by the facts and circumstances of the particular award. Examples include:

- An awardee is accelerating procurements of key components for telescope construction that will result in approximately $12 million of accelerated expenditures.
- Some PIs are securing release time from their universities in order to increase time dedicated to the project, and hiring additional students where possible to work on the project before the expenditure deadline.
- Some PIs are purchasing needed equipment and services earlier in the project, as appropriate, in order to have it delivered and operational by the expenditure deadline.

Question 7. OMB has also directed agencies to attempt to reclaim stimulus funding that remains unexpended at the end of fiscal year 2013. How much of NSF's Recovery Act funding do you expect will remain unexpended at that time? Do you expect to reclaim those funds, or will you seek a waiver to allow your grantees continued access to that money?

Answer: Currently, over 600 NSF awards are scheduled to expire after September 30, 2013. Based on a prorated calculation of budgeted amounts and notwithstanding awardee acceleration efforts, NSF estimates that if the agency were to end these awards on September 30, 2013, approximately $195 million would remain unexpended. This estimate assumes that OMB waivers are not secured.

NSF, however, will submit a focused waiver request to OMB that is narrow in both size (dollar amount) and scope (waiver justification). Though the Foundation is still analyzing its portfolio to determine the awards for which waivers will be sought, the agency plans to submit requests to OMB well in advance of the September 2012 deadline.

NSF will take action to amend expiration dates of any awards expiring after September 30, 2013 for which a waiver request was not granted by OMB, and will continue to encourage responsible acceleration, particularly for those awardees whose grants will terminate early. At that point, not including the awards for which waivers are secured and based on historical unexpended fund balances, NSF expects approximately $4 million to $6 million to remain unexpended, and the agency will reclaim those funds to the extent allowable by law.

MAJOR RESEARCH EQUIPMENT AND FACILITIES CONSTRUCTION

Question 8. You testified that NSF leadership has been in regular discussions with the NSF Inspector General about how to resolve your disagreement about unallowable construction contingency costs. How long do you expect it to take before you finally reach an agreement?

Answer: NSF management's goal is to reach agreement with the NSF Inspector General on what the Defense Contract Audit Agency (DCAA) auditors, which have been engaged by the NSF Office of Inspector General (OIG) to conduct audits on the OIG's behalf, have identified as unallowable construction contingency costs. It is our intent to achieve this by September 30, 2012, the end of the fiscal year 2012 financial statement audit cycle. However, because this is an extremely complex issue, September 30th is an aggressive goal, which may have to be reassessed at a later date. NSF management and the Inspector General may not be able to agree on how to resolve certain aspects of this issue. In that case, in accordance with NSF policy, the issue can be referred to the Agency's Audit Follow Up Official for final decision.
NSF management is meeting at least bi-weekly with the OIG with the goal of resolving differences related to the development and monitoring of construction contingency. What we do agree upon is that all costs incurred to NSF awards must be allowable under cost principles. We are also jointly meeting with DCAA and the OIG since the OIG has contracted with DCAA to audit a number of NSF funded projects on this issue. All of these audits currently remain open.

DOCUMENTING THE IMPACT OF SCIENTIFIC RESEARCH

Question 9: How much does NSF expect to spend on the STAR METRICS program in fiscal year 2013, and what concrete results do you believe will be achieved with this funding? What is the earliest that you believe employment and other impacts captured by STAR METRICS could begin being reported along with the budget requests of participating science agencies?

Answer: NSF expects to spend $1.40 million on STAR METRICS in FY 2013. A goal of the effort is to document the levels and trends in the scientific workforce supported by federal funding. This work builds on data voluntarily supplied by a group of universities about expenditures associated with federally-supported research. This work has begun in FY 2012 and will accelerate in FY 2013.

It is important to note that the program did not begin to expand beyond a seven university pilot project until September 2010. Since then, the STAR METRICS program has grown to almost 90 institutions, whose research represents over 40 percent of NSF and NIH funding; many of these institutions have joined and have contributed data only in the past few months. Because of the importance of the activity, both the program and the participating institutions are moving very carefully, applying due diligence to quality control, and addressing issues of quality, coverage, and representativeness.

In order to be able make national estimates from a voluntary activity, the STAR METRICS program plans to commission a statistical study to begin during FY 2012 to determine the enrollment targets that permit reliable estimates of the scientific workforce at a national level, paying particular attention to institutions of all types, including large and small ones, and those that serve both a general population and minority populations. Once this analysis is complete, and the program has achieved the requisite enrollment targets, it will be possible to report the employment and other impacts captured by STAR METRICS.

CONTRACTING

Question 10. For the first time in several years, NSF's fiscal year 2011 financial statements did not include a significant deficiency for the monitoring of contracts. 1) What steps did NSF take to improve its contract management, and 2) how much work do

you have left to complete under your existing contracting corrective action plan? 3) How are you coordinating your work on the corrective action plan with your Inspector General?

Answer: Every fiscal year the NSF OIG conducts an audit of NSF's Financial Statement known as the Financial Statement Audit (FSA). In the FSA's for FY 2009 and FY 2010, a significant deficiency was discovered concerning contract monitoring. As part of its efforts to improve contract monitoring, NSF revised its internal policy to institute increased oversight procedures focusing on high-risk actions such as high dollar cost reimbursable contracts. NSF also introduced such tools as the Contract Type Guide and Contract Administration Plan as well as increasing contract monitoring training for the entire NSF acquisition community. In addition, NSF has provided funding for conducting cost incurred audits (CIAs) for high risk actions such as the Antarctic contract with Raytheon. Audit resolution work has been substantially completed for questioned costs on this contract through 2004, and NSF has arranged with DCAA to conduct audits for the 2005 – 2010 period, which are on-going. NSF also did not allow high-risk Advance Payment provisions under the Antarctic re-compete contract. As a result of these efforts, NSF addressed all major contracting related issues identified in the previous years' (2009, 2010) Financial Statement Audits (FSA's) resulting in the removal of the significant deficiency.

NSF collaborated closely with the NSF OIG to complete the Corrective Action Plan (CAP) actions for the prior year audits. NSF has also worked closely with the OIG to develop a CAP for issues raised in the FY 2011 Management Letter. The major actions identified for the Management Letter CAP include (1) seeking funding for the timely completion of DCAA or third party incurred cost audits for the final two years of the Antarctic contract with Raytheon; (2) issuing additional internal policy guidance concerning the monitoring of CIAs (3) issuing a Price Negotiation Memorandum guide; and (4) continuing previous efforts concerning contract monitoring. NSF is continuing to work closely with the OIG to complete the efforts associated with the FY 2011 FSA Management Letter CAP.

Question 11. In 2008, OMB asked agencies to complete an acquisitions assessment under its Circular A-123. Have you completed your A-123 assessment? If not, why, and what are you doing to ensure that your assessment (and any future assessments) are completed in a timely manner?

Answer: NSF completed the A-123 acquisition assessment checklist in March 2012. The estimated completion date for NSF's analysis of the checklist results is April 2012. Annually, NSF conducts Business Process reviews and NSF's acquisition business processes are addressed within the Contract Management, Awards Management, & Charge Card Reviews. Future acquisition assessments related specifically to the acquisition assessment checklist will be conducted with a risk-based approach; relying on the results of the acquisition assessment checklist analysis, findings, and reporting.

Question 12. What steps is NSF taking to continuing improving its acquisitions workforce while operating in a time of fiscal restraint?

Answer: NSF has taken a number of steps to continue improving its acquisition workforce. In March 2010, NSF prepared and issued its Office of Federal Procurement Policy (OFPP) approved Acquisition Workforce Policy. NSF continues to coordinate with OFPP and the Federal Acquisition Institute (FAI) to ensure the policy is up to date with any and all new OMB/OFPP acquisition workforce requirements. NSF has a dedicated Acquisition Career

Manager (ACM) who is a member of the Inter-Agency Career Management Council (IACMC). NSF works to utilize its training budget to target training events that meet the acquisition workforce needs for on-going certification maintenance training requirements and to address competency skill gaps identified in the NSF 2010 Acquisition Human Capital Plan (AHCP) submitted to OFPP. NSF currently has 165 fully certified staff eligible to perform as Contracting Officer Representatives (COR's) when needed, and 90 percent of operational contracting personnel or acquisition policy analysts are FAC-C certified at the appropriate level within the Contracts Division.

Question 13. NSF's single biggest contract, which funds Antarctic logistical support, has a troubled history, including significant problems with reconciling costs. Incurred cost audits conducted to date suggest that NSF may have overpaid on this contract in substantial amounts, but there are still several years of contract activity yet to be examined. When do you expect to complete contract close-out audits for the old Antarctic support contract, and what will you do with any questioned costs that are ultimately recovered by NSF?

Answer: NSF has contracted with the Defense Contract Audit Agency (DCAA) for incurred cost audits for FY 2005 – FY 2010, and these audits are currently in process as detailed in the FY 2011 NSF Financial Statement Audit Management Letter Corrective Action Plan. It is anticipated that agreements with DCAA for cost incurred audits for the remaining contract periods, FY 2011 – FY 2012, will be ordered and funded in FY 2012. In regards to completion of the contract close-out audits, NSF is dependent on DCAA as the cognizant federal audit agency. While there is no firm completion date, NSF will work with DCAA to ensure contract close-out audits are completed as soon as possible. Questioned costs that are ultimately recovered by NSF are applied to offset the expenses for the current Antarctic contract that expires on March 31, 2012.

Questions for the Record Submitted by Jose E. Serrano

DIVERSITY IN THE SCIENCES

1. Statistics show that Latinos and Blacks are under-represented in the science, technology, engineering, and math (STEM) fields – sciences, technology, engineering, and mathematics. The latest National Science Foundation statistics available show that while Blacks represent more than 12% of the population, they only represent 8.2% of bachelor's degree recipients in the sciences in 2009. In addition, Latinos now represent more than 15% of the US population, but only 8.6% of students graduating with a bachelor's degree in the sciences in 2009. In this vein, last year, the American Association for the Advancement of Science (AAAS) issued a report called "Measuring Diversity: An Evaluation Guide for STEM Graduate Program Leaders," based on work with NSF's Alliance for Graduate Education and the Professoriate (AGEP). The report offers a framework and tools for assessing the strengths and weaknesses of graduate programs.

Question a. Statistics continue to show that Blacks and Latinos are significantly under-represented in the sciences and other STEM fields. How has the Administration approached this problem? Does the Administration have a government-wide policy in

place to increase minority participation in these fields? Does the National Science and Technology Council's (NSTC) Committee on STEM plan to specifically address this issue?

Answer: In their February 2012 report, the NSTC Committee on STEM Education (CoSTEM) identifies four priority areas for federal investments in STEM education. The CoSTEM believes that the federal government, through coordinated and collaborative interagency efforts, can achieve significant, measurable impacts on the following four priority areas:

1. *Effective K-12 STEM Teacher Education*
2. *Engagement in STEM*
3. *Undergraduate STEM Education*
4. *Serving Groups Traditionally Underrepresented in STEM Fields*

The fourth priority is aimed at increasing the number of individuals from underrepresented groups that graduate with STEM degrees. A roadmap for addressing each of the priority areas in a coordinated way across agencies will be developed. The roadmaps will identify specific actions needed to address the priority areas and describe how specific investments fit within the roadmap. In addition, the roadmap will identify a multi-agency "network" of core investments that will make the initial changes needed to address the priority areas.

Question b. Furthermore, does the NSF factor in the framework set forth in the "Measuring Diversity" report when awarding grants to graduate institutions?

Answer: The framework presented in the AAAS report "Measuring Diversity: An Evaluation Guide for STEM Graduate Program Leaders" provides guidance to all graduate institutions interested in increasing the diversity of their STEM graduate education programs. NSF currently has two programs that make awards to graduate institutions to enhance STEM graduate education programs, the Alliances for Graduate Education and the Professoriate (AGEP) program and the Integrative Graduate Education and Research Traineeship (IGERT) program. In fact, the components in the AAAS framework and guide are based on the work of graduate programs that have received funding from the NSF AGEP program since 1998. Other NSF programs, such as the Graduate Research Fellowship program, provide direct support to graduate students through research assistantships, traineeships, or through fellowships.

Both IGERT and AGEP programs evaluate many of the components within the AAAS framework as part of the NSF merit review process via the intellectual merit and broader impacts selection criteria. The AAAS framework components that are typically included in the merit review of AGEP and IGERT proposals are: baseline disaggregated student and faculty data; the commitment and ability to collect and use data for decision making and reporting; and the review of policies and procedures related to STEM graduate education and training. In addition, AGEP and IGERT projects are required to have project evaluation plans to evaluate the impact and effectiveness of the project and activities.

LATINOS AND THE SCIENCES – NATIONAL SCIENCE FOUNDATION

2. NSF has specialized undergraduate education programs for Blacks and Native-Americans, but not specialized programs for Latinos. Since fiscal year 2010, there has been appropriations report language directing the NSF to address the needs of HSIs. The FY 2012 CJS Conference Report directed NSF to address the needs of Latinos and

establish a Hispanic Serving Institution-focused program. The language from the Conference Report is as follows: "Over the past several years, NSF and the Congress have discussed the concept of creating a program within Broadening Participation at the Core to focus on Hispanic Serving Institutions (HSI). NSF is directed to provide to the Committee a report outlining how the needs of HSIs will be addressed in fiscal year 2012 and any plans to establish an HSI-focused program in fiscal year 2013." It is unclear if existing NSF education programs interact with the instructions of the CJS Conference Report, and what specialized efforts there will be to recruit Latinos into the Science, Technology, Engineering and Mathematics fields. While I appreciate the efforts NSF is making in expanding opportunities to underrepresented minorities, including through the establishment of a new program in this year's budget, I am troubled that NSF has not established a dedicated Hispanic Serving Institutions- Undergraduate program. Latinos are now the largest minority group in the United States, and are severely underrepresented in the STEM fields. More importantly, Congressional instruction was very clear in this regard.

Question a. Are steps being planned to follow the FY 2012 report language?

Answer: Yes, NSF is engaged in a number of efforts in response to the FY 2012 report language and in preparation for the report to Congress. We are working on determining how to best serve Latino students and Hispanic-serving institutions within the OneNSF context, and see this as a Foundation-wide effort. In FY 2009, NSF initiated a series of listening sessions with the Hispanic Serving Institution (HSI)/High Hispanic Enrollment (HHE) community to better understand the diverse needs and opportunities for broadening participation of Latino students in STEM fields. From those sessions, NSF learned that many of the challenges facing HSI/HHEs in increasing participation are the same challenges faced by other minority-serving institutions, and that many of the strategies that have been most promising in engaging Latino students in STEM show promise for engaging all students. During that same time period, NSF launched internal studies to examine our current programmatic portfolio to identify possible models for adaptation to HSI/HHEs, and to learn about success rates for HSI/HHEs in current programs. In FY 2011 NSF funded a study by the American Institute for Research which includes a thorough analysis of underrepresented group STEM enrollment and graduation over time in institutions of higher education in the United States. The final report from this project is anticipated for September 2012.

The trends for funding (excluding funds provided through the American Recovery and Reinvestment Act of 2009) to HSI/HHEs in NSF programs are positive. NSF funds awarded to HSI/HHEs in FY 2010 totaled $146.59 million or 2.9 percent of the funding to all institutions of higher education (IHEs) ($5.08 billion). This investment at HSI/HHEs represents a 14.5 percent increase ($18.62 million) over the FY 2009 HSI/HHE funding level of $128.0 million. NSF support to HSI/HHEs has increased every year since FY 2007, and the percentage of total IHE funds awarded to HSI/HHEs has also increased consistently since FY 2007. Sixty-five percent of total FY 2010 funding to HSI/HHEs was from the Research and Related Activities (R&RA) Account, 30 percent was from the Education and Human Resources (EHR) Directorate, and 5 percent was provided through H-1B Visa funds managed by EHR.

NSF's intent is to ensure that programmatic opportunities in research and education, across the Foundation, are available to broaden participation in STEM at the undergraduate level in anticipation of tomorrow's changing demographics. This must include increased engagement

with HSI/HHEs. Our approach is multi-pronged, and is evolving over FY 2011- 2013. It currently includes the following elements:

- *Targeted efforts to encourage HSI/HHEs to apply to programs* that have emphasis on broadening participation, and related outreach and grants development activities in FY 2012-2013.

- *Strategic approaches in FY 2012-13 to enhancing the engagement of community colleges, the largest cohort of HHE institutions,* in several NSF programs, through the Louis Stokes Alliances for Minority Participation (LSAMP) in FY 2012, and then expanding to the Advanced Technological Education program (ATE) in FY 2013. These efforts are to enhance transfer bridges to baccalaureate degree programs, provide professional development and growth opportunities for faculty, and improve preparation of the STEM workforce, including technicians. Community colleges have the greatest potential to reach Latino populations.

- *Interagency partnerships to leverage existing program investments that serve HSI/HHEs and Hispanic students.* Collaborations are underway with the US Department of Education and the US Department of Labor to ensure that broadening participation efforts can reach all groups that are underrepresented in STEM, particularly the Hispanic student demographic group. We are exchanging best practices; partnering in the development/utilization of resource networks; and engaging in community building among NSF, ED, and Labor awardees and relevant stakeholders.

- *Leverage existing discipline-specific efforts.* Several directorates and offices have broadening participation emphases and have made key awards to HSIs. For instance, in the Directorate for Computer and Information Science and Engineering (CISE), the Computing Alliance for Hispanic-Serving Institutions (CAHSI), in its 7th year, is a consortium of 10 HSIs that focuses on recruiting, retaining, and advancing Latinos in computing through undergraduate and graduate degrees. CAHSI uses effective practices including mentoring, building skills and knowledge in community, introducing computing concepts in innovative ways, and integrating students into higher-level research practice. It has recently formed a partnership with SACNAS that will bring its strategies and best practices to students outside of CAHSI member institutions. The Engineering Directorate (ENG) supports the Broadening Participation Research Initiation Grants in Engineering (BRIGE) program, which funds new junior faculty to become mentor-scholars and to build research capacity for students from underrepresented groups. We also provide support to HSIs through major research centers such as ENG's Engineering Research Centers and NSF's Science and Technology Centers, as well as through EHR's support for Minority-Serving Institutions through the Centers for Research Excellence in Science and Technology (CREST), including CREST collaborations with the Directorate for Mathematical and Physical Sciences. We are examining the full HSI/HHE portfolio to identify additional leveraging possibilities.

As NSF moves forward, we will use the results of previous internal and external studies to build on the efforts of FY 2012 and FY 2013 in designing options for continued programmatic opportunities that can be especially appropriate for HSI/HHEs and Hispanic students' participation in STEM. It is essential to provide opportunities to increase the participation, retention and graduation rates of Latinos, the youngest and fastest-growing population in the United States.

RALPH M. HALL, TEXAS
CHAIRMAN

EDDIE BERNICE JOHNSON, TEXAS
RANKING MEMBER

U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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October 27, 2011

Dr. Cora Marrett, Deputy Director
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Dear Dr. Marrett:

On behalf of the Committee on Science, Space, and Technology, I want to express my appreciation for your participation in the September 26, 2011, hearing, *STEM Education in Action: Communities Preparing for Jobs of the Future.*

I have attached a verbatim transcript of the hearing for your review. The Committee's rule pertaining to the printing of transcripts is as follows:

> *The transcripts of those hearings conducted by the Committee and Subcommittees shall be published as a substantially verbatim account of remarks actually made during the proceedings, subject only to technical, grammatical, and typographical corrections authorized by the person making the remarks involved.*

Transcript edits, if any, should be submitted no later than Thursday, November 10, 2011. If no edits are received by the above date, I will presume that you have no suggested edits to the transcript.

I am also enclosing questions submitted for the record by Members of the Committee. These are questions that the Members were unable to pursue during the time allotted at the hearing, but felt were important to address as part of the official record. **All of the enclosed questions must be responded to no later than Thursday, November 10, 2011.**

All transcript edits and responses to the enclosed questions should be submitted to me and directed to the attention of Ashley Flanagan at ashley.flanagan@mail.house.gov. If you have any further questions or concerns, please contact Mrs. Flanagan at (202) 225-9644.

Thank you again for your testimony.

Sincerely,

Ralph M. Hall

Ralph M. Hall
Chairman

Enclosures: Transcript and Questions for the Record

Questions Submitted for the Record
Committee on Science, Space, and Technology
STEM Education in Action: Communities Preparing for Jobs of the Future
Texarkana, Texas
September 26, 2011

Question 1: ***We have heard testimony that it is difficult for community colleges to get NSF funding due to inexperience in grant-writing and the perception that it mostly funds research institutions. How does NSF reach out to community colleges and smaller 4-yr schools about its programs and opportunities for funding? Can you also address the ways the Foundation provides assistance with grant-writing?***

Response: Each year, the National Science Foundation (NSF) provides numerous outreach training sessions to inform colleges and universities about its programs and outline procedures for submitting grant proposals to the agency. These activities are supplemented by discipline-focused workshops, conferences, and professional meetings that encourage and train faculty at all institution types to pursue NSF support. Community colleges and smaller four-year colleges are regularly invited to participate in these opportunities to ensure the submission of highly competitive proposals from their institutions. In FY 2011, NSF's overall success rate was 22 percent; notably, 21.5 percent of proposals submitted to the agency by community colleges were funded.

The Foundation employs a number of outreach tools in order to assist community college faculty members in identifying NSF funding opportunities and preparing proposals. For example, the NSF Advanced Technological Education (ATE) program—which focuses on two-year colleges and expects two-year colleges to have a leadership role in all of its projects—has made awards to community colleges to develop resource centers (http://atecenters.org). Through these centers, community college faculty members have access to resources for developing and writing proposals, to information on managing projects, and to guidance for effectively interacting with their institutional support staff and administrators. The ATE program also supports workshops by the American Indian Higher Education Consortium to assist faculty in proposal preparation. NSF works cooperatively with the American Association of Community Colleges (AACC) to advise faculty members on NSF funding opportunities, and NSF program officers regularly make presentations at AACC conferences.

Further, The Quality Education for Minorities (QEM) Network, based in Washington, DC, has been funded by NSF to provide technical assistance to increase the participation of faculty members from minority-serving institutions (of which there are a number of qualifying community colleges) in NSF's Math and Science Partnership (MSP) Program and in the Robert B. Noyce Teacher Scholarship program. QEM has also received funding from the NSF Directorate for Education and Human Resources (EHR) and the Directorate for Engineering (ENG) to provide mentoring to faculty in minority-serving institutions, including advice on successful proposal writing.

NSF program officers regularly participate in regional or local NSF conferences such as "NSF Day" workshops and Regional Grants Conferences, some of which are specifically organized for community

colleges.) They also participate in meetings and conferences, such as the American Association of Community College events, that involve community colleges at which they make presentations on funding opportunities and proposal writing. Community college faculty members are regularly invited to serve on NSF grant review panels, which provide an opportunity to become aware of the qualities of competitive proposals.

In FY 2012, NSF, through research and education investments to community colleges, and the Advanced Technological Education (ATE) Program, which has historically been the primary EHR vehicle for engagement with community colleges, will anchor EHR's newly coordinated efforts toward a more comprehensive and systematic engagement with the Nation's community colleges. Drawing on ATE program expertise, the following EHR undergraduate education programs will work synergistically to engage community colleges and address community college priorities:

- *Federal Cyber Service: Scholarship for Service/Cybercorps (SFS);*
- *Historically Black Colleges and Universities Undergraduate Program (HBCU-UP*); and
- *Louis Stokes Alliances for Minority Participation (LSAMP);*
- *Math and Science Partnership (MSP);*
- *Robert Noyce Teacher Scholarship (NOYCE);*
- *Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM);*
- *STEM Talent Expansion Program (STEP);*
- *Transforming Undergraduate Education in STEM (TUES);*
- *Tribal Colleges and Universities Program (TCUP).*

Question 2: ***How do both 2-yr and 4-yr institutions cope with the fast-paced changes in modern technological advances and the specialized requirements for many 21st century technical jobs when it comes to keeping the curriculum current to meet the needs of the employers?***

Response: NSF continues to collaborate with industry and professional societies to ensure that curricula are current and innovative, and that cutting- edge technology is incorporated in all NSF-funded STEM technician education programs. A mechanism used by both two-year and four-year institutions to deal with rapid advances in technological fields is the establishment of strong industry partnerships—an essential feature of NSF's Advanced Technological Education (ATE) program. The ATE program requires the educational community to partner with both industry and economic development agencies to respond to workforce needs. This requirement has led to industry representatives serving on advisory boards for technician education programs; becoming adjunct faculty and teaching courses within the programs; developing curricula that are responsive to industry needs; and providing internship opportunities for students in technician education programs. Industry representatives help inform curriculum development and provide the training on the latest technological advances within their field.

Technician education programs housed in community colleges have developed several mechanisms to serve both prospective students and incumbent workers. Many programs offer "quick" courses on specific techniques, certificates requiring various numbers of credits, and Associate in Science (A.S.) degrees to meet a variety of student and industry needs. Community colleges are developing Contract Research Organizations (CROs) on their campuses, and both high school and community college students work on local industry projects. A number of ATE-funded projects integrate industry

certifications into their academic programs. For example, manufacturing technician education programs are using the National Association of Manufacturer's credentials that are industry certified and validated. Technician education programs in information technology and aerospace are also embeding certifications in their academic programs.

Responses to QFR submitted August 22, 2011 by Chairman Mo Brooks

Question #1. As requested during the hearing, please provide the total amount of federal funding awarded to those proposals rated from "Poor" to "Good or Very Good" for FY 10. While you touched on it briefly at the hearing, please also expand on why those proposals received funding over proposals rated "Very Good to Excellent" and "Excellent."

All funded proposals are determined to be highly meritorious based on a combination of reviews by individuals, panel deliberations and program officer evaluations. On average, NSF proposals are reviewed by 4-6 individuals, depending on the type of review. All reviewers are chosen for their specific expertise related to the subject, and the collection of persons brings different points of view to the decision making process. When the average reviewer score is in the "good" range, it often represents a split of "excellent" or "very good" reviews with some "fair" or "poor" review scores that lowered the average. It is important to note that the proposal ratings data included in the annual NSB Merit Review Report reflects proposal ratings **before** panel deliberations and, therefore, not the final panel evaluation. The panel evaluation is based on a thorough discussion of the proposal's strengths and weaknesses in the context of the full set of proposals being reviewed; this discussion forms the basis for placing a proposal in a particular category. These in-depth discussions can often clarify perceived weaknesses and result in a proposal being recommended for funding despite the initial average review score. Likewise, some proposals with high average review scores are not recommended by panels as a result of a detailed discussion that uncovers weaknesses that might not have been reflected in the initial reviews.

The expertise of the NSF Program Officer making the final recommendation is also an important voice in the process. Program Officers take into consideration other factors that might not have been considered by expert reviewers. For example, proposals for innovative new ideas often use unproven methods or techniques that might be considered risky by reviewers and panelists. Risky proposals often result in transformative research that accelerates the pace of discovery. Although Program Officers consider concerns about risk expressed by panels, they also see the value of funding potentially transformative research. Proposals that do not review well at panel because the methods are unproven or risky can be given small awards to allow enough work for a "proof of concept". Program Officers will also consider broader impacts that might not be obvious to reviewers, such as an infrastructure need that will serve a large number of people. There are also many dimensions of portfolio balance that influence the final recommendation. In addition to maintaining a diverse scientific portfolio, Program Officers strive to fund proposals from diverse institution types across the U.S., and from both young and experienced investigators.

As explained above, the reviewer rating data reported in the Merit Review Report are only initial reviewer ratings, which is just the beginning of the merit review process leading to a final determination of whether any given proposal should be funded. Initial reviewer ratings do not reflect panel deliberations or program officer input. In FY 2010, NSF funded approximately $46K in proposals initially rated as poor, $21M in proposals initially rated as Fair, $818M in proposals initially rated as good, and $1.6B in proposals initially rated as very good. Following

panel discussion and analysis, all of these proposals were determined to be highly meritorious notwithstanding their initial rankings.

Question #2. In your testimony you described experimenting with innovative approaches to identify potentially transformative research. Please expand on the "ideas factory sandpit" approach and tell us what you are learning from it and other novel approaches.

NSF has experimented with an approach to identifying potentially transformative high risk research that it is now calling "Ideas Lab." The Ideas Lab is closely modeled on the "sandpit" process developed by the UK's Engineering and Physical Sciences Research Council (EPSRC). The essential element of the Ideas Lab is an intensive interactive residential workshop involving 20-30 participants, with the aim of developing bold, often risky, new approaches to grand challenge questions in areas that could benefit from creative "out-of-the-box" thinking. A fundamental aspect of the EPSRC sandpit that has been incorporated into the Ideas Lab is the use of a highly multidisciplinary mix of participants (including active researchers from diverse fields and potential users of research outcomes) to address specific research challenges. A description of the process used follows. Slight variations should be anticipated as NSF gains experience with the process and as it is adapted to different topics.

To identify potential participants, a solicitation is issued that includes an open call for participants. Interested individuals submit short preliminary proposals that include concise descriptions of their pertinent experience and expertise as well as their communication skills, collaborative activities, and creative abilities. A panel of reviewers evaluates the applications, and identifies a pool of potential participants from a range of disciplines and backgrounds who have high potential to work at the interface between disciplines and to develop new and highly original research ideas. NSF Program Officers make the final selection from the pool to ensure a diverse mix of participants. Industrial psychologists provide advice that guides but does not decide participant selection.

During the multi-day Ideas Lab workshop, participants interact in unconventional new ways to develop innovative research project ideas on the selected topic area. Professional facilitators, experienced in sandpit-like activities, integrate creative problem-solving techniques, iterative project-development activities, and real-time peer review by both participants and a resident panel of experts (called the mentor group) to advance the most innovative ideas. Outcomes at the end of the workshop are research project concepts that vary in scale and scope in addressing the grand challenge topic of the Ideas Lab. At the end of the Ideas Lab, the panel of reviewers provides a consensus report summarizing its evaluation of each project concept. Based on this review, the Program Officers invite the submission of full proposals for some, none, or all of the project concepts. The invited groups have six to eight weeks to submit full proposals, which are then reviewed by the same panel of mentors using NSF's two merit review criteria. Based on that review, NSF then makes a decision whether to fund some or all of the proposals. Taking part in the Ideas Lab does not mean that the participant is guaranteed to be funded under an award resulting from the Ideas Lab process.

Experimentation with the Ideas Lab is still at an early stage. A total of four Ideas Labs have been conducted to date. The first three resulted in 12 awards and the fourth is currently awaiting full proposal submissions. Feedback from participants in the Ideas Labs has been positive. However, the resulting funded projects are still in their beginning phases. As they progress, NSF will look at the outcomes of these projects to evaluate whether they resulted in transformative research.

Question #3. Researchers will send in proposals whenever they have an idea that they would like to have funded. However, NSF also puts out solicitations for specific areas of research. Please explain how decisions are made on what type s of research areas warrant a specific solicitation from the Foundation? What happens if the Foundation does not receive high quality proposals for a solicitation? Do you pick from what you have or do you rework the solicitation?

Solicitations are formal NSF publications that encourage the submission of proposals in specific program areas of interest to NSF. Solicitations are generally more focused than program announcements, and normally apply for a limited period of time. Ideas for new solicitations can be initiated within Divisions by Division Directors, at the Directorate level by Assistant Directors, or by groups of Assistant Directors who see the need for a new cross-cutting activity. Program Directors also commonly suggest ideas for new initiatives. The initial spark for a new initiative often comes from interaction with the scientific community through scientific meetings or other communications. When an idea for a new solicitation is suggested, a working-group is formed that includes program officers who are expert in the research area. The working group collaborates on a detailed plan for the new solicitation, which is then discussed and reviewed by various levels of leadership before approval.

Specific factors that are considered when deciding whether to develop a new solicitation include the following:

- the intellectual reason for the Program, activity, or initiative;
- whether the new activity(ies) will generate sufficient interest in the targeted community;
- whether the Program, activity, or initiative is new, how it supports the long-range goals of the Directorate and/or NSF;
- whether the size of the effort justifies a separate announcement and/or competition;
- the total funding available for the proposal competition, including estimated proposal receipts and anticipated number of awards and funding levels;
- cross-Directorate participation (and implications) in the Program,

Program Solicitations often specify submission limits, award conditions or reporting requirements, and provide supplemental proposal preparation guidance in addition to what is in the Grant Proposal Guide. Program Solicitations also provide specific review criteria in addition to the usual merit review criteria and reviewers consider these specific criteria when reviewing proposals. In cases where the Foundation does not receive high quality proposals for a solicitation, we decline the proposals that are not of high quality. The solicitation could be revised and re-competed to attract high quality proposals. Because NSF funding opportunities generally attract more high quality proposals than we can fund, this would be a rare occurrence.

Question # 4. After reviewing the flow chart for the proposal and award process and timeline, the Directorate Assistant Director seems conspicuously absent from the process. Please describe what the role and responsibilities of the Assistant Director are in the funding process, both from a programmatic and overall agency funding priorities perspective.

While Assistant Directors (ADs) are not involved in the day-to-day review and processing of proposals submitted to the Foundation, as described in the NSF *Grant Proposal Guide* Exhibit III-1 (http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_3ex1.pdf), they fulfill a vital role in the overall funding process. (See the attached referenced flowchart).

ADs are knowledgeable about the award portfolios in their directorates, but they are not involved in the decision making process itself, because their role is to set the vision and strategic goals and objectives for the divisions/offices that report to them.

Assistant Directors also play an important role in the formal reconsideration process. If a PI is dissatisfied with the explanation they receive for why a proposal has been declined, he/she may request a reconsideration of the decision. ADs/Office Heads are responsible for responding to these requests, and review the proposal record to determine whether NSF's review of a declined proposal was fair and reasonable, substantively and procedurally. If they were involved in the decision-making process, they would have a conflict of interest in responding to any official reconsideration request.

Question #5. How does the Foundation leadership ensure that program officers "produce and manage a balanced portfolio of awards that addresses a variety of considerations and objectives" as the FY10 NSB Report states?

Portfolio balance is reviewed at a variety of levels at different times during the decision making process. Program Officers consider many dimensions of portfolio balance when they are making decisions about what proposals should be recommended for awards. Some of the factors that are considered include: balance across disciplines and sub-disciplines, award size and duration, awards to new investigators, geographical distribution of awards, awards to different types of institutions, innovative/potentially transformative projects, projects with elements of risk, inter- and multi-disciplinary projects, projects that integrate research and education, and projects that are relevant to agency mission or national priorities. Division Directors review the recommendations by Program Officers for portfolio balance before they concur with the award recommendations. Portfolio balance is also reviewed by our Committees of Visitors who review programs at three-year intervals. Some programs also contract for external evaluations of their portfolio periodically to inform how they might make changes to their programs. The results of both COV reports and external portfolio analyses are reviewed by Directorate Advisory Committees.

Question #6. According to the FY10 Board Report, NSF awarded approximately five percent of its annual budget to Federal agencies and laboratories. What kind of awards were these and did they go through the formal merit review process.

The 2010 Merit Review Report to the National Science Board reported that NSF funded $351.2M in awards to Federally Funded Research and Development Centers (FFRDCs). The majority of this funding went to two organizations that build and manage large astronomy facilities for University consortia: Associated Universities Inc. (AUI) and the Association of Universities for Research in Astronomy (AURA). AUI received $111M in funding associated with the National Radio Astronomy Observatory, the Atacama Large Millimeter Array (ALMA), and other related projects. The Association for Universities for Research in Astronomy (AURA) received $234.3M for a number of projects including building the Advanced Technology Solar Telescope and the Advanced Technology Solar Telescope and operations and management of the Gemini Observatory, the National Optical Astronomy Observatory, and the National Solar

Observatory. In addition, $0.4M in funding went to fund several much smaller projects through another FFRDC, Aerospace Corporation. Proposals submitted to NSF by FFRDCs go through the same merit review process as other proposals. The large awards for building and operating large facilities go through a very lengthy and detailed review process that includes site visits, cost reviews, design reviews, and approval by the National Science Board.

The $351.2M reported in the Merit Review Report also includes $5M in contracts to fund the Science and Technology Policy Institute (STPI) operated by the Institute for Defense Analyses. STPI provides rigorous and objective analysis of science and technology (S&T) policy issues for the White House Office of Science and Technology Policy (OSTP) and other offices and councils within the executive branch of the U.S. government and federal agencies. IDA was selected to operate STPI in 2003 following a competition and undergoes reviews at 5 year intervals.

Note that the funding to FFRDCs described in the FY2010 Merit Review Report did not include contract funds to or from other federal agencies through interagency agreements.

Question #7. What kind of peer reviewers are coming from industry, non-profits, and government? Do they all have PhDs? What role does a panelist from the government play? What qualifications do they have?

Reviewers are chosen for their expertise in areas covered by the proposals that they are asked to review. For research proposals, reviewers are typically researchers in domains of science relevant to the topic of the proposal. In the review of proposals for facilities, in addition to reviewers who can provide input on the research impacts, technical feasibility and soundness of the facility's design, Program Officers may also include reviewers with expertise in other relevant fields such as project management, systems engineering, complex acquisition processes, architectural design, etc.

In many scientific and engineering disciplines, some of the leading researchers work in industry, non-profits, government laboratories and FFRDCs. Examples include computer science and engineering, materials research, chemistry, high-energy physics, ocean science and a number of others. Such researchers are very much the peers of their academic counterparts and are included in NSF's pool of peer reviewers. Some of these researchers may have spent part of their research careers in academia and some in industry or an FFRDC, allowing them to bring important perspectives on the state of the art in the different environments and their potential broader impacts. These reviewers tend to have the qualifications that are typical for the research communities to which they belong. In many disciplines, this is often a Ph.D. although occasionally it is simply long experience doing cutting-edge research. Typically, what signals the expertise of a researcher is his or her record of research achievement, including significant publications in peer-reviewed journals and conference proceedings.

Reviewers from government and industry are often more familiar with project management and complex acquisition processes than some of their academic counterparts and so such individuals are sometimes asked to bring this expertise to review teams looking at proposals for research facilities. Such individuals may or may not have Ph.D.s.

In general, what NSF looks for in its choices of reviewers is expertise in the topics under review.

Question # 8. How does the Foundation train reviewers to prevent the phenomenon of implicit bias?

The frontline of the merit review process are the approximately 520 NSF Program Officers (POs) who select experts who can provide the information needed to make a recommendation in accordance with the National Science Board (NSB) approved criteria for selection of projects. Program Officers are trained on conflicts of interest, the importance of getting a diversity of perspectives, and guarding against the influence of subjective or biased input.

Proposals submitted to NSF receive rigorous and objective treatment and POs ensure that this takes place. Proposals are evaluated by independent reviewers consisting of scientists, engineers, and educators who do not work at NSF or for the institution that employs the proposing researchers. NSF selects the reviewers from among a pool of experts in each field, and their evaluations are anonymous. On average, about 50,000 experts give their time to serve on review panels each year. POs ensure that there is diverse representation within the review group. The goal is to achieve a balance among various characteristics, including type of organization represented, reviewer diversity, age distribution and geographic balance.

The reviewer's job is to provide advice to NSF on which projects are the highest priorities. This competitive process ensures that many voices are heard and that only the best projects make it to the funding stage. When someone is asked to review a proposal (either as an *ad hoc* or panel reviewer), they are provided with information on the confidentiality of the process and the potential for conflicts of interest. Panelists sign a "Conflict-of-Interests and Confidentiality Statement" whenever they participate in a panel. For *ad hoc* reviewers, by submitting their review, they are acknowledging that they've been informed of such policies. Again, NSF POs are responsible for assuring that appropriate, qualified merit reviewers are selected and the entire process is overseen by Section Heads and/or Division Directors who supervise the Program Officers.

Question #9. The 2010 reauthorization of the America COMPETES Act required the Foundation to "apply a Broader Impacts Review Criterion to achieve" various goals. Witnesses at the hearing raised some concerns with the draft criteria that is currently being weighted by the Board. Have the goals, now specified in statute, been considered in the past when making funding decisions? Are the peer reviewers taking these goals into consideration during their review or are simply the program officers tasked with this responsibility? Based on the work being conducted by NSB and NSF and your experience with the merit review process is the legislative requirement achievable and is it necessary?

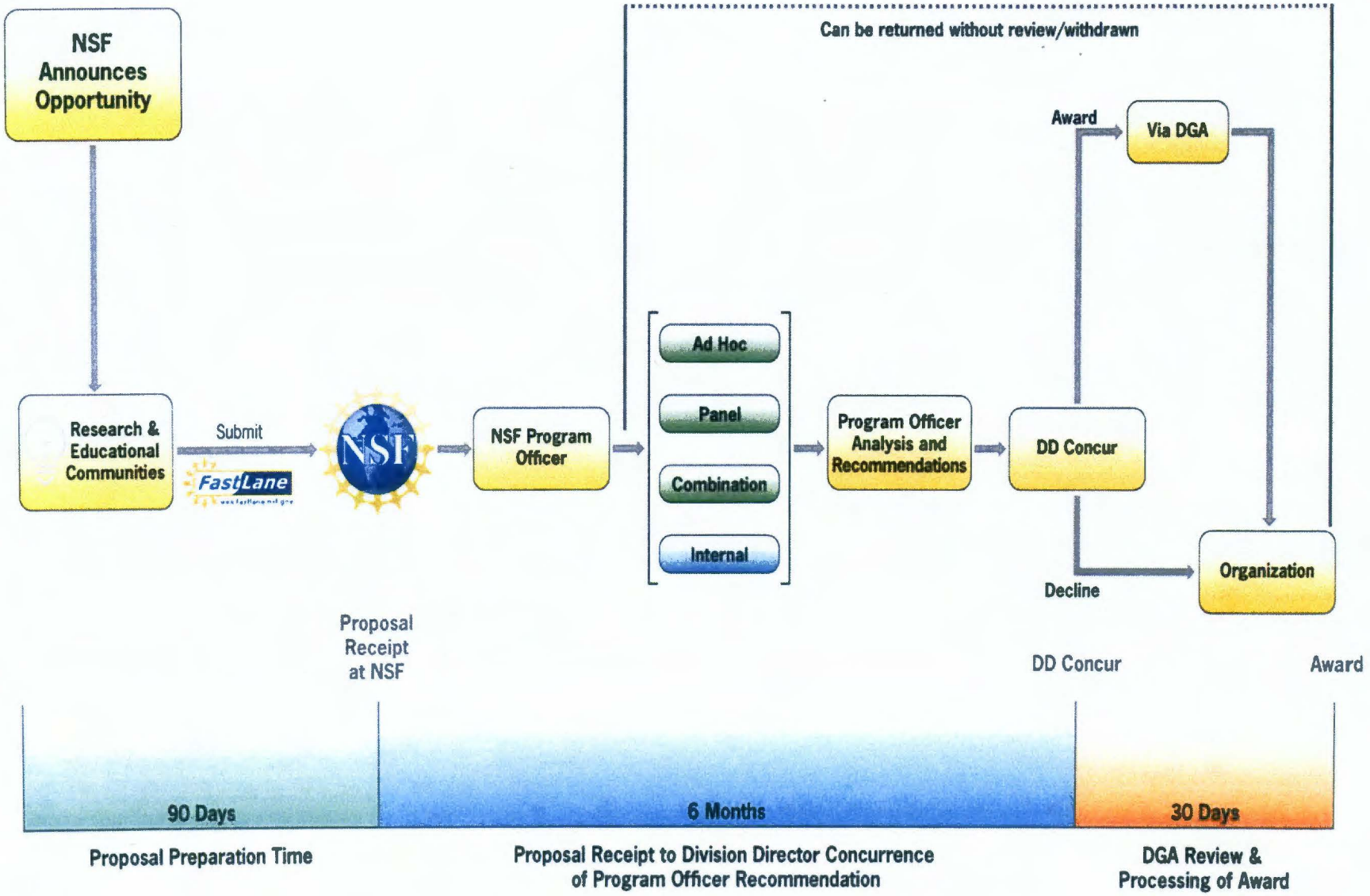
NSF strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical merits of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." In 1997, these considerations were put into action through the two primary merit review criteria of Intellectual Merit and Broader Impacts. Each reviewer must consider, and address, both merit review criteria for each proposal.

As noted in your question, the importance of incorporating consideration of potential broader impacts in deciding which projects to fund was re-emphasized in the America COMPETES

Reauthorization Act of 2010. Having the reinforcement of Congressional support on the fundamental nature of the Foundation's Organic Act is always an important, and appreciated, development. However, there is a danger of viewing the Broader Impacts criterion as a "one size fits all" checklist, which would be a mistake.

This COMPETES Reauthorization identified a number of societally relevant outcomes that may result as a consequence of NSF-funded research. Stated more broadly, these outcomes include (but are not limited to) increased participation of women, persons with disabilities, and underrepresented minorities in STEM; improved STEM education at all levels; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a globally competitive STEM workforce; increased partnerships between academia, industry, and others; increased national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education. These represent examples of societally relevant outcomes. The NSF will strive to clarify that these examples should not be considered either comprehensive or prescriptive, and that investigators may include appropriate outcomes not covered by these examples.

Exhibit III-1: NSF Proposal & Award Process & Timeline



Questions submitted by Chairman Mo Brooks

1. **The 2009 NSTC Report, *Social, Behavioral, and Economic Research in the Federal Context*, noted that not all social, behavioral, or economic sciences "require or are even appropriate for government support." Please identify which of the sciences, in your opinion, do not require or are even appropriate for government support, and which of these sciences NSF does not provide funding for?**

The 2009 NSTC report addressed social, behavioral, and economic research in the Federal context, that is to say, SBE research that is conducted throughout all of the federal agencies, which differ in their mission and in the mechanisms they employ for sponsoring research or conducting it themselves, either internally or through contract vehicles. This phrase is part of the first sentence of the second paragraph of the introduction to Chapter II of this report, "Federal Context." The passage reads, in full, as follows:

> "It may be noted that not all the SBE sciences require or are even appropriate for government support. For example, consumer behavior and the successes and failure of commercial marketing campaign are major targets of SBE research but are well funded through industry support. What, then, is the role of the Federal Government in support of the human sciences? What does and should it support and what are the potential benefits of this support to citizens and institutions?
>
> "There are human dimensions of every policy matter, and today's societal challenges demand that Federal agencies utilize the human sciences for insights to achieve their missions efficiently and effectively."

NSF's mission is to promote transformative fundamental science on behalf of the American people. NSF/SBE's goal at the directorate level is to examine fundamental aspects of human behavior at multiple levels, scales, and contexts. NSF/SBE supports a broad range of high-quality fundamental research, and the results can have practical implications. Unlike the market research supported by industry, targeted toward specific results for specific products or companies, the research funded by NSF/SBE and other Federal agencies leads to publicly available results that can be used by many sectors of society. In my response to Ranking Member Lipinski's question, I also provide examples of areas in which NSF supports fundamental research but does not support applied and translational research, because other Federal agencies support the applied and translational research to translate NSF-supported fundamental knowledge to agency-relevant mission capabilities.

2. **The FY12 SBE budget for the Science, Engineering, and Education for Sustainability (SEES) portfolio is $57 million, a 174 percent increase over last year and nearly a quarter of the entire SBE budget request. What is the national urgency and transformational qualities of this additionally needed work, and who determined this research to be a priority? If this research is so critical to our nation, why isn't the Department of Energy Funding? You mention SBE research on functional magnetic resonance imaging research that may help with autism, matching markets and kidney transplants, and "understanding regional conflicts and local cultural values" in the context of national security, to name a few. What happens to this type of research if SBE is not funded at the FY12 request? Will they suffer so that SEES can remain a priority?**

Science, Engineering, and Education for Sustainability (SEES) is a Foundation-wide effort to undertake fundamental research addressing our advancement toward reliable and sustainable energy resources that will not degrade essential ecosystems and environmental services, will not lead to unacceptable social or economic consequences, and will prepare society to adopt them responsibly. Thus, the SBE sciences are knit into understanding reliable and sustainable energy uses. Precisely because energy and environmental issues require an integrated understanding, NSF/SBE, which is unique in its portfolio covering basic research across all of the SBE sciences, plays an essential and coordinative role. We note further that DOE's basic research portfolio does not include the SBE sciences, making NSF/SBE's role an important one. Consequently, slightly less than $57 million has been requested in FY2012 to build new infrastructure in the directorate's research divisions and Office of Multidisciplinary Activities (SMA) and to support relevant research in SMA and through the standing programs in Social and Economic Sciences (SES) and Behavioral and Cognitive Sciences (BCS). It is important to note that the 2009 NSTC Report, ***Social, Behavioral, and Economic Research in the Federal Context*** that was referenced in the first question lists "Energy, Environment and Human Dynamics" as one of six priority areas for increased emphasis due to its importance in addressing society's fundamental challenges.

The eventual balance between activities undertaken within the framework of SEES and the rest of SBE's portfolio will be achieved in accordance with funding levels in 2012 appropriations and priorities set by the Congress and the Administration. We expect that future decisions on funding allocations with NSF and SBE will also reflect the advice we obtain from the National Science Board and our own science advisory committees. Actual awards will be made through the merit review process.

3. **RAPID grants are not peer reviewed grants, but grant decisions NSF staff can make in order to get needed funding to the field more quickly, usually when time not allow for peer-review like in the case of a natural disaster. You mention several in your testimony related to Katrina, Chile and the oil spill in the Gulf. The ability to use these grants when urgency is of essence is useful and important. However, there are several other active grants that seem questionable on the surface as being of national importance and urgency. Could you please explain why the federal government should be spending $197,000 on "Bridging the Gap: Musical Training and Literacy in Underserved Adolescents," $215,000 on "Affective and Deliberative Processes Motivating Charitable Decisions," $200,000 on "Documenting the Mechanisms of Belief and Attitude Change on Controversial Issues: The case of Global Warming and Trust in Scientists," or $89,000 on "What Makes Lay/Expert Scientific Collaborations Succeed" on non-peer-reviewed research? Why were those deemed timely and urgent, and who made the decision to approve and fund them without the merit-review process?**

RAPIDs are subject to rigorous internal scrutiny and review by the appropriate program officers and require approvals by the cognizant division directors as well as by other units within the Foundation (e.g., DGA). A statement of need, documenting the time-criticality of the request, is required to justify any award made. The research may be urgent because of the need for, availability of, or access to, data, facilities, and specialized equipment, including quick-response research to natural or human disasters and unanticipated events. These substantive and procedural requirements were met in each of cases mentioned in the request:

(1) Bridging the Gap: Musical Training and Literacy in Underserved Adolescents (Award No. 1015615)
Prior research in neurocognitive functioning, speech, language, and literacy abilities in youth suggests that musical training and literacy might be an avenue for remediation for students of

low as well as high income socio-economic background. Conducting research in schools can be challenging, given the requirements of the academic year. As stated in the proposal (Section II), where the request for RAPID funding is explicitly justified, the investigators need to test the participating students within their first year of high school, and the cooperation of two schools in Chicago, who serve families of low socioeconomic status and who volunteered to participate in the work, offered an "uncommon opportunity" not only in access to students but also in the potential to support a full four years of longitudinal study if the work were launched early in the students' high school careers. Thus, funding to proceed with the research was time critical.

(2) Documenting the Mechanisms of Belief and Attitude Change on Controversial Issues (Award No. 1042938)

This is a public opinion research study. Prior work had indicated that public opinion on political issues changes slowly; sudden shifts are rare and typically in response to a dramatic event. Public opinion on climate change, however, seems to defy that model, seeming to shift quite rapidly in about two years. The project seeks to examine both the apparent shift and the underlying theory through two new surveys, one of which would take place in the summer in order to gauge the extent to which experience of weather affects attitudes toward climate change. Thus, the data are necessarily time sensitive and ephemeral because the investigator needs to capture the information as quickly as possible after the weather event(s). Hence the criteria for a RAPID award were met and the justification fully documented both in the request for funding and the review analysis.

(3) What Makes Lay/Expert Scientific Collaborations Succeed (Awards No. 1049782 and No. 1049807)

This is a collaborative award to two institutions (Tulane University and Washington State University) to study collaborations between laymen and experts among environmental scientists, social scientists, and a community of Vietnamese-American fishermen in Louisiana in response to the Gulf of Mexico oil disaster. The urgency of the research is justified in the proposal and documented in the review analysis: As the contaminants disperse, either into more protected Gulf wetlands or further inland, community impacts would be differentially experienced and existing hardships intensified, compelling residents to leave the area. Key sources of experiential knowledge would thus be lost and a rare opportunity to collect evanescent social and environmental data would be lost. The urgency arises from both the fragile and changing nature of the environmental effects together with the social and demographic responses, potentially resulting in depopulation and loss of the community.

A question has also been raised about a fourth award, $215,000 for "Affective and Deliberative Processes Motivating Charitable Decisions" (Award No. 1024808). The research mentioned in the question has not been funded as a RAPID award. The amount is the first year of a larger award, which was evaluated through the full merit review process. The proposal received thorough, full panel review, with seven expert reviewers from outside NSF. The fully-documented award was approved by the Program Director and the Division Director.

4. **In your testimony you state that "These partnerships [with other NSF directorates]" are critical to understanding science in its human context and to developing effective new technologies that will be used by Americans and will contribute to jobs and economic development." What is the role of industry in understanding science in its human context and developing new technologies? Is industry doing some of this work? Can and should they be doing more?**

We see little interest in industry in conducting basic research in the SBE sciences. Understandably and appropriately, their focus is on social, economic, and cultural issues surrounding aspects of their product development, market research, and public relations and communication. Moreover, their findings are typically proprietary. Absent transparency and peer reviewed publication in accepted professional outlets, their activities do not contribute to advancing scientific research broadly nor are their objectives necessarily directed toward addressing shared challenges in areas such as public safety, disaster response and mitigation, and law enforcement and national security. Thus, it is essential for the Federal government to sustain its leading role in basic research in the SBE sciences.

5. **NSF is essentially the only federal agency that historically does not receive earmarks. It prides itself on the merit-review process which, while not perfect, is currently the best we have. Given its imperfections and the reality that some less than stellar grants are funded in ALL scientific disciplines, how would you recommend that it be improved?**

The NSF merit review process lies at the heart of the agency's strategy for accomplishing its overall mission and vision. As such, NSF is continuously striving to maintain and improve the quality and transparency of the process. As is noted in the most recent annual Report to the National Science Board on NSF's Merit Review Process (http://www.nsf.gov/nsb/publications/2011/nsb1141.pdf), during FY 2010, NSF received and reviewed over 55,000 proposals. The vast majority of the proposals received at NSF (~96%) are subject to both external peer review by members of the scientific community and internal merit review by NSF program officers. To ensure that they have substantive reviews from a variety of perspectives, the program officers reach out to a broad range of people for input—in FY 2010, over 46,000 external reviewers provided expert advice to the Foundation. The program officers (who are subject matter experts in their own right) synthesize all of the external advice in the context of the overall program portfolio when developing their award recommendations.

Currently, the National Science Board is reviewing the two Merit Review Criteria that are used to evaluate every proposal that is submitted to the Foundation. As part of this process, NSF and the Board have reached out to a wide range of stakeholder groups for their input on the strengths and weaknesses of the criteria, and how they might be improved. Informed by the external input as well as data derived from reports of Committees of Visitors (external bodies who review all of NSF's programs for the integrity of the process) and an analysis of submitted proposals, the Task Force on Merit Review developed a proposed revision of the criteria. The NSB and NSF have invited comment from the NSF community (both internal and external) on the proposed revisions. NSF has already begun internal discussions on how best to implement revised criteria, which will include a robust plan for providing guidance to PIs, reviewers, and program officers on how to use the criteria during the review and decision-making processes.

6. **In this testimony, Dr. Wood mentioned an oversupply of SBE PhDs in the labor force. Do you agree with his statement, and if so, why does NSF currently continue to financially support and encourage SBE graduate students? Wouldn't this be a good opportunity for savings, particularly in our current economy?**

The health and composition of the educational pipeline for future scientists is of profound importance to the competiveness of the nation and is of particular interest to the Foundation and its leadership. In keeping with its mission as a statistical research unit that provides neutral and reliable data for use by others and in support of the Foundation's role in maintaining a robust scientific research enterprise, the

National Center for Science and Engineering Statistics (NCSES), which is housed within the SBE directorate, conducts two relevant surveys: (1) Survey of Earned Doctorates that provides the production of doctorates by field annually (http://www.nsf.gov/statistics/doctorates/); and (2) Survey of Doctoral Recipients (http://www.nsf.gov/statistics/doctoratework/) that provides data on career patterns. Preliminary analysis of the most recent (2009) Survey of Earned Doctorates (SED) suggests that the proportion of 2009 doctorate recipients with employment prospects in the coming year was about the same as reported in 2007, the year before the advent of the recession; the proportion of SBE doctorate recipients with definite employment commitments increased from 72.9 percent in 2008 to 73.5 percent in 2009 (http://www.nsf.gov/statistics/infbrief/nsf11305/, Table 3). In general, unemployment among scientists and engineers with doctoral degrees in the SBE sciences remained slightly below the national average for all Ph.D. scientists in 2008, the year of the most recent data. That year, the unemployment rate among those who hold U.S. doctorates in social sciences was 1.3 percent; the unemployment rate across all fields of science, engineering, and health was 1.7 percent (http://www.nsf.gov/statistics/infbrief/nsf11308/, Table 1).

Many factors enter into analyses of employment and career decisions and paths. Some of the issues relating to definitions and patterns of employment in higher education and in other sectors are laid out in *Science and Engineering Indicators: 2010* (see especially sections of Chapter 3, Science and Engineering Labor Force, Scope of the S&E Workforce, http://www.nsf.gov/statistics/seind10/c3/c3s1.htm, and Employment Patterns, http://www.nsf.gov/statistics/seind10/c3/c3s2.htm). Research supported by our Science of Science and Innovation Policy program suggests that there are strategies during graduate training to encourage future scientists to identify careers in industry as well as in higher education and advanced research. The directorate, through NCSES and the research divisions will, therefore, continue to support continued analysis of this important topic.

7. **You have mentioned the report being drafted by the NSF's Advisory Committee on Social, Behavioral, and Economic Sciences on the future areas of scientific development in SBE sciences. Can you tell us more about this report? Why is it being drafted? How are the future areas of scientific development being identified? I understand that it will not be released until the fall but can you tell us anything about what we can expect from the report?**

In June 2010, the NSF/SBE directorate launched a series of planning activities that have included contributions from the Program Officers and consultation with SBE researchers. As part of this effort, members of the SBE Advisory Committee decided to write a report based on their perspectives as senior scholars. This report would set forth the key research issues facing the SBE sciences over the next 10-to-20 years. It is an advisory report and is one source for establishing programmatic priorities. The structure of this collaborative document has undergone several iterations and the document is now anticipated for release later this year.

Questions Submitted by Ranking Member Daniel Lipinski

1. **During the June 2 hearing, some expressed concern about potential duplication of efforts across agencies, as well as about NSF encroaching on the purview of other agencies. For example, one Member expressed concern that NSF should not be funding social, behavioral, and economics (SBE) research that is known to have relevance our nation's energy challenge, because that should be the role of the Department of Energy (DOE) alone; one witness suggested that SBE research relevant to national security should be the responsibility of the Department of Defense (DOD)**

alone; and so on. Currently, DOE does not support any SBE research, but DOD does support some through the Army Research Institute.

The current budget challenge compels us all to seek opportunities to reduce waste in government, including through reduction of duplication. How is NSF's support for SBE sciences unique from that of all other federal agencies? Why can't, or why don't mission agencies such as DOE and DOD assume responsibility for funding all SBE research relevant to their respective missions, from basic to applied? If they do currently support SBE research (or were to establish new programs in the SBE sciences), how is the research they support different from the research that NSF supports? In addition to any general responses to these questions, please provide specific responses to the examples of energy and national security discussed above.

NSF is unique in that it supports research across all of the social, behavioral, and economic sciences, which allows the directorate to identify research that may not fall easily into a single, well-defined program or discipline and to foster cross-fertilization of ideas within the directorate and across the Foundation. The work that we have sponsored in detecting deception is a case in point. There is a core body of research in the neurological, cognitive, and behavioral dimensions of deception, deceptive speech, and its detection. However, deceptive speech and behaviors occur among many different combinations of individuals and in many settings. For example, the conversation between a teacher and a student who may be trying to explain his or her behavior is quite different from the interview between a foreign service officer at a consulate and an applicant for visa, and both differ from the exchange between a TSA agent and a possibly suspicious airline passenger. Each of these applications requires substantial translational research that might enable the teacher, foreign service officer, or TSA agent to make a good decision, but that research rests on a shared core of basic research about deception that can be explored through controlled laboratory studies and other kinds of systematic scientific research.

Over the past decade, the SBE Directorate has funded a host of studies that tested and developed basic social and cognitive psychological theories of human (interpersonal) deception. Such studies have also advanced our understanding of factors that distinguish liars and truthtellers across various social contexts. Relevant awards have been sponsored by a variety of programs, including Law and Social Sciences, Social Psychology, Cognitive Neuroscience, Developmental and Learning Sciences, Physical Anthropology, and Cultural Anthropology. Studies sponsored by these programs have examined the complexity of verbal and nonverbal behavior in dynamic interpersonal communications that involve deception, the role of social motivation and cognitions in discriminating lies and truths, and the neural bases of deception. This basic, theoretical research has been used by other mission agencies for translational and applied purposes – including the Department of Justice, the Department of Defense, the Department of Homeland Security, and the Intelligence Community. Examples of translational and applied research from such agencies would include the Screening of Passengers by Observation Techniques (SPOT) and Future Attribute Screening Technology (FAST) programs within the Department of Homeland Security, and related research supported by the National Center for Credibility Assessment within the Department of Defense.

Thus the NSF's basic research programs allow the mission agencies to focus on their missions. Burdening them with developing the basic research could result in duplication, redundancy and possible waste. Indeed, NSF cooperates with other agencies precisely to foster the flow of information across agency boundaries. This rich history of NSF's funding the basic research that mission agencies rely upon for translational and applied research is a powerful tool for the nation and one that we will continue to rely upon to fuel the nation's engine of innovation.

In the following list, we lay out some specific examples of cooperative work where NSF sponsored the basic research and the mission agencies provided translational research and feedback. We note further that DOE's basic research portfolio does not currently include the SBE sciences. However, we have cooperated with DOE and the final bullet summarizes our work with this and other agencies.

1. Basic Research in Forensic Science

The National Science Foundation has a rich history of funding basic research that is relevant to the practice of forensic science. Such awards span a variety of disciplines, including biology, chemistry, cyberinfrastructure, engineering, statistics, and the social, behavioral, and economic sciences. This research generally seeks to provide a theoretical foundation for the development of forensic science methods, including (for the SBE Directorate) the influence of human perception, judgment, and decision-making in this context. This basic research would not be funded by mission agencies, such as the National Institute of Justice or the National Institute of Standards and Technology, though these agencies have relied upon basic research findings supported by the NSF in translational and applied research.

Dr. Mark Weiss is currently co-chair of the Research, Development, Testing, and Evaluation Inter-Agency Working Group for the Subcommittee on Forensic Science (National Science and Technology Council), and Dr. Christian Meissner also participates as a member of the IWG. The IWG is charged with identifying the foundational science that underlies forensic science applications, and NSF staff have assisted in the identification of basic research that underlies forensic science.

A recent Workshop supported by the Division of Behavioral and Cognitive Sciences (see Award No. 1048484) examined the potential role of cognitive/perceptual biases in the forensic evaluation process. This issue received much attention in a report published by the National Academies of Science entitled, *Strengthening Forensic Science in the United States: A Path Forward*. The workshop brought together basic researchers in perception, judgment, and decision-making to discuss the various psychological factors that may influence forensic pattern recognition. The workshop led to suggestions for basic research in this area that would address concerns raised by the National Academies report. This research, given its basic, theoretical focus, is unlikely to be supported by mission agencies within the federal government, though findings from such research would likely lead to the development of interventions and modifications to training that would be further assessed in translational or applied research contexts.

2. Theories of Spatial Pattern Detection, Geospatial Technologies, and Crime Mapping

The SBE Directorate has supported basic research on theories of spatial pattern detection, as well as human interaction with geospatial technologies in the criminological and epidemiological contexts. For example, funded research has extended theories and methods of spatial pattern detection from the detection of prior events to the monitoring and detection of on-going events (see Award No. 9905900), as well as developed geospatial theories of crime that account for a variety of sociological and criminological factors (see Awards No. 0528232, No. 9601764, No. 0080091). This basic, theoretical research has been used for translational and applied purposes

by the National Institute of Justice's Geospatial Technology program, a program that seeks to translate geospatial technologies and research to aid various criminal justice agencies.

3. Social and Behavioral Dimensions of National Security, Conflict, and Cooperation (NSCC)

This competition was the NSF side of the Minerva initiative in the Department of Defense. DoD provided NSF with funds ($8,000,000) and NSF/SBE ran a competition on topics that were of mutual interest. We understand that DoD was very pleased with our review process and our selection of proposals to support. There are two important differences between DoD funded research and that funded by NSF. First, NSF funds basic research while DoD funds research that tends to be tailored specifically to their mission. Our funded research, at times, provides the basis for their funded research. Second, the results of NSF-funded research is in the public domain. This is not always the case for the DoD. As such, researchers funded by NSF provide information that can be used to advance science. Work done for DoD, even in the social and behavioral sciences, is frequently classified. This means that other scientists are unable to use that work to advance our understanding of social and behavioral processes. While many of the NSCC projects are in their early stages and no results have been reported, there have been significant results in the areas of conflict over fresh water, the processes by which terrorist organizations develop, the fundamental nature of conflict, and the characteristics of authoritarian regimes. This basic research, supported in partnership with the Department of Defense, promises to produce promising outcomes for U.S. security interests.

4. Applications to energy usage and examples of cooperation with DOE.

NSF/SBE funds research on basic behaviors and motivations, which can be applied to numerous areas of decision-making, including adopting new technologies (sustainable or otherwise), building human capital and subsequent labor market decisions, financial decision-making, and reactions to natural disasters, among others. In addition, NSF/SBE has established a cooperative relationship with DOE through DOE's work in integrated assessment modeling (IAM). The DOE program has inserted language in its IAM solicitation to encourage applicants to work with NSF's Decision Making Under Uncertainty (DMUU) centers and the urban Long-term Ecological Research (LTER) sites. In addition and in cooperation with NOAA, DOE and NSF have supported a National Academy workshop (Award No. 1003678, *Support for a Workshop on Socioeconomic Scenarios for Climate Change Impact and Response Assessments*).

UNITED STATES HOUSE OF REPRESENTATIVES
Committee on Science, Space, and Technology
Full Committee
HEARING ON
03/11/2011
Dr. Subra Suresh, Director, National Science Foundation

QUESTIONS FOR THE RECORD SUBMITTED BY
Ralph M. Hall

Clean Energy Activities

Question 1: Scattered throughout the entire federal budget request are dramatic increases in spending on "clean technologies." At the Department of Energy alone, there are enormous spending increases for clean tech through ARP A-E, EERE, the Office of Science, the Loan Guarantee Program, and Energy Innovation Hubs, to name just a few. Similar programs are proposed throughout the government, including NSF's "Science, Engineering, and Education for Sustainability (SEES)" portfolio intended to "spark innovations for tomorrow's clean energy sources with a cross-disciplinary approach to sustainability science." The FY12 budget request is $998 million for this effort. This is a 51 percent increase over the FYI0 amount and reflects 13 percent of the entire NSF budget.

a. Given that President Obama said in the State of the Union that he was "willing to eliminate whatever we can honestly afford to do without," and the immense amount of spending across the federal government on clean energy activities, do you really believe the NSF can't "afford to do without" this $338 million in new spending on this one topic?

Answer: NSF's involvement in clean energy is driven by the fundamental research questions that underlie future energy pathways. NSF's investments in clean energy support research and education in alternative energy for electricity (solar, wind, wave, geothermal) and fuels (chemical and biofuels). NSF grantees also address the collection, conversion, storage and distribution of energy from diverse power sources (including smart grids), the science and engineering of energy materials, energy use and energy efficiency. As an integral part of the NSF Science, Engineering, and Education for Sustainability (SEES) portfolio, clean energy research addresses our advancement toward reliable and sustainable energy resources that will not degrade essential ecosystems and environmental services, not lead to unacceptable social or economic consequences, and will prepare society to responsibly adopt them.

In FY 2012, the SEES activity, which is designed to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being, is proposed to include a major emphasis on sustainable energy. NSF will mobilize the social, behavioral, and economic science research community to work in close collaboration with natural scientists and engineers to provide a comprehensive and integrated approach to solving questions of sustainability. NSF views this investment to foster insights into the environment-energy-society nexus as vital to increasing the effectiveness of our energy and ecosystem management policies, and to securing a prosperous future for the Nation.

Future U.S. economic competitiveness, energy independence, and sustainable growth greatly depend upon a talented and motivated workforce with strong competencies in science and

engineering. NSF's long track record of supporting the development of creative faculty, and their students, form the backbone of the Nation's strength in science, technology, engineering, and mathematics. These faculty and students go on to be the leaders in efforts supported by other agencies such as the Department of Energy (DOE), entrepreneurial start-ups, and large companies. NSF's integration of research and education is vital for the future of the country. Specific efforts under SEES will support postdoctoral researchers and early career scientists at the interfaces between social sciences and engineering disciplines so that they might gain the skills necessary to address critical scientific and societal challenges.

b. Further, is it even possible for NSF to responsibly absorb and spend such dramatic increases in funding? How is NSF working with the Administration to ensure that there is a government-wide coordinated research strategy, with specific, government-appropriate research to confined areas? How can you prevent "research crawl," when identical research proliferates into every agency? How can you assure us that the research NSF is supporting is not identical to the research being supported by the plethora of other agencies performing similar research?

Answer: NSF funds research that is performed external to the government and across traditional disciplinary lines. This approach to research is critical to address highly complex areas, such as the environment-energy-society nexus, where disciplinary boundaries need to be broken to solve seemingly intractable problems and enhance energy independence.

Last year some $2 billion in funding requests that were judged to be meritorious and worthy of support were declined due to unavailability of sufficient resources. Initial SEES activities in 2010 and 2011 were significantly oversubscribed, demonstrating the tremendous need for investment in this area, and the requested $338 million increase in SEES would support approximately 700 typical NSF research grants. Importantly, the complex nature of the environment-energy-society dynamic will, in many cases, best be understood through the coordinated work of teams of investigators and require research at multiple organizational, spatial, and temporal scales. Funding these teams will require support at levels above the NSF average.

The issue of possible duplication of effort across agencies is important to NSF. Our activities in the sustainability arena are developed in close consultation with DOE, NOAA, USGS, USDA, and other federal agencies to specifically leverage, not duplicate, federal investments. Already, DOE partners with NSF in Engineering Research Centers focusing on the engineering, science, social science, economics and human behavioral aspects associated with disruptive changes in energy strategies. Discussions with other federal agencies indicate considerable interest in building joint programs and sharing infrastructure. Leveraging these programs internationally is also important to meet sustainability challenges. The proposed SEES activity explicitly includes support for networks of diverse investigators in order to optimize collaboration and reduce duplication.

NSF is a key player in the inter-agency sustainability arena because of our unique involvement with all the areas of science, engineering, and science education required to address the complex system level problems of sustainability. As the only agency specifically dedicated to advancing fundamental scientific and technological understanding across all science and engineering fields, NSF-supported research typically precedes direct application by mission agencies or others by years to decades. In addition to closing key knowledge gaps about the interplay of environment, energy, and society, NSF will link the academic community with private partners to address sustainability issues and educate the next generation

interdisciplinary workforce. Here is how NSF SEES sets us apart from the other agencies and plays to our strengths:

- NSF has developed a "pathways approach" to SEES. This approach involves cross-directorate and interdisciplinary research that integrates the physical, engineering, social, and environmental sciences to provide a comprehensive and integrated approach to solving questions of sustainability.
- Our "sustainable energy pathways" integrates resource characterization and the technology needed to develop and effectively use the resource with the social and environmental impact of widespread adoption of that energy source.
- NSF will invest in graduate students and postdoctoral scholars with the aim to develop a scientific workforce trained in new technologies for emerging markets in energy and other aspects of sustainability science.
- NSF uses a total systems approach to the sustainability challenge that involves cutting-edge science and technology coupled with a strong commitment to education and training.

National Nanotechnology Initiative (NNI)

Question 2: The budget request calls for a 10.6 percent increase for the NSF contribution to the National Nanotechnology Initiative (NNI). Please tell us how this increase of funding will be spent and why it is necessary at this time?

Answer: The NNI investment at NSF will focus primarily on priority areas driven by national needs (manufacturing, electronics, and energy), public safety (nanotechnology environment, health and safety (EHS)), and partnerships with other agencies (NNI-NSTC crosscuts) and industry.

A portion of NSF's NNI investment, $117.40 million, will be invested in three NNI Signature Initiatives (partially covered by the requested increase in addition to the reallocation of funds within the current budget)

Sustainable Nanomanufacturing ($35.40 million) -- This request will support single investigator and interdisciplinary research teams in the following areas:

- Novel processes and techniques for continuous and scalable nanomanufacturing;
- Directed (physical/chemical/biological) self-assembly processes leading to heterogeneous nanostructures with the potential for high-rate production;
- Principles and design methods to produce machines and processes to manufacture nanoscale structures, devices and systems; and
- Long-term societal and educational implications of the large-scale production and use of nanomaterials, devices and systems, including the life-cycle analysis of such nanomaterials, devices and systems.

Partnerships with NIST, DOD and other NNI agencies are planned.

Nanoelectronics for 2020 and Beyond ($50.0 million) -- This request will fund grants to advance the forefront of computation, information processing, sensor technologies, and communications infrastructure beyond the physical and conceptual limitations of current technologies. The initiative is intended to support proposals by single investigators and interdisciplinary teams of investigators committed to exploring innovative research concepts in nanoelectronics involving

fundamental challenges from novel materials, chemistry, and logic devices, to circuit designs and systems architectures, algorithms, and perhaps entirely new paradigms of computation, sensing, and processing of information. The following themes will receive priority:

- Exploring new chemistries and materials for nanoelectronics;
- Exploring alternative state variables and heterogeneous integration for nanoelectronic devices and systems; and
- Exploring novel paradigms of computing.

Co-funding with the Semiconductor Research Corporation and other NNI agencies is planned.

Nanotechnology for Solar Energy Collection and Conversion ($35.40 million). This request will fund single investigators and interdisciplinary research teams in the following areas:

- Improve efficiency of photovoltaic solar electricity generation with nanotechnology;
- Develop thermoelectric converters for solar thermal energy generation and conversion with nanotechnology; and
- Improve solar-to-fuel conversions with nanotechnology.

NSF will collaborate with DOE and other NNI agencies.

Environmental, Health and Safety (EHS). In FY 2012, funds are transferred from several Program Component Areas (PCAs) to increase funding for the Environmental, Health and Safety (EHS) PCA to reach a total FY 2012 funding level of $34.51 million. This shift reflects the prioritization of EHS within the overall NNI portfolio. Requests for research are primarily directed at environmental, health, and safety implications and methods for reducing the respective risks of nanotechnology development. The support for EHS represents 7.6 percent of total NNI funding at NSF.

The three signature initiatives and nano-EHS research increases have been recommended by interagency working groups, workshops organized with the research communities and the President's Council of Advisors on Science and Technology (PCAST). In addition, NSF sponsored an international study entitled "Nanotechnology Research Directions for Societal Needs in 2020" (NSF/WTEC report in 2010, available on www.nsf.gov/nano.) It provides assessment of nanotechnology development over the last ten years (2000-2010) and a long-term vision of the field over the next decade (2010-2020).

MREFC

Question 3: As you are well aware, the recently passed House Continuing Resolution reduces funding for the MREFC account significantly. Should that amount become law, please describe how NSF will distribute the funding across current projects.

Answer: If expected funding levels are not appropriated in FY 2011, NSF will give priority to completing projects in construction – with highest priority to those farthest along. NSF plans to minimize the disruption to the portfolio of projects in construction by making budget alterations to the smallest number of projects necessary to stay within the available budget. For early-phase construction projects and new starts, NSF will assess their plans to see where funding reductions would produce the least impact on project performance and risk, and result in the best overall outcome under the circumstances. Changes to the proposed funding plans – which were based on technically limited cost profiles (i.e. expenditure profiles based on planning projects at the maximum rate technical work can be performed because that profile provides the

lowest total cost to the government) – could result in net increases to the total project costs of each of the projects affected. NSF is quantifying these cost impacts and will make adjustments to the proposed distribution across the portfolio of projects based on an understanding of the costs of various options.

QUESTIONS FOR THE RECORD SUBMITTED BY
Mo Brooks

Budget Priorities

Question 4: Could you please identify and explain the processes and criteria used to establish the priorities for NSF in the FY12 Budget Request?

Answer: NSF establishes scientific priorities based on a myriad of inputs and considerations. To ensure that NSF's research funding is focused on the needs of the scientific community, the agency takes seriously the important feedback obtained through workshops, Advisory Committee meetings, outreach efforts, and everyday interactions between NSF program staff and their peers and colleagues in the science and engineering community. In addition, the Foundation closely follows guidance and priorities identified by OMB and OSTP in official documents, such as the annual joint memorandum on Science and Technology Priorities, and statutory requirements and other Congressional priorities.

High-level planning begins early in the budget cycle and is a highly collaborative and evolutionary process. NSF's senior management team, which represents all directorates and offices, works closely together throughout the planning stages to brainstorm, share, build, and refine their ideas. Ultimately the NSF director, in concert with the National Science Board, determines NSF's strategic budget directions.

Question 5: The Administration's Innovation Strategy details its efforts to strengthen our nation's competitiveness and long-run economic growth. What role does the Foundation and Board play in measuring and evaluating the economic impacts of basic research funding? What methods does the Federal Government use to prioritize funding areas of basic research, both within an area of science and across areas of science?

Answer: The National Science Foundation (NSF), including the National Science Board (NSB), undertakes a number of actions that inform government, industry, and academic officials about the economic impact of basic research funding. The *Science and Engineering Indicators* report, issued biennially by NSB, provides a broad base of quantitative information on the U.S. science and engineering (S&E) enterprise including: patents awarded (e.g., academic patents awarded per 1,000 S&E academic doctorate holders); scientific publications (e.g., academic S&E article output per $1.0 million of academic research and development (R&D)); investments in R&D (e.g., academic and federal R&D obligations as share of gross domestic product); and trends in R&D performance and international R&D comparisons (e.g., "wealthy economies generally devote larger shares of their gross domestic product to R&D than do less developed economies"). In addition, NSF's Science of Science and Innovation Policy (SciSIP) program invests in research designed to develop, improve, and expand models, analytical tools, data, and metrics that can be applied in the science policy decision making process. Among the research topics supported under the SciSIP program is the evaluation of the tangible and intangible returns from investments in science and in research and development. Retroactive impact assessments (including research-submitted highlights) also enable NSF to measure and evaluate the impact of its investments. Methods used by federal agencies – including NSF – to prioritize basic research investments include: Administration-identified national challenges, the OMB-OSTP R&D priorities, National Science and Technology Council deliberations and decisions, Congressional authorizations and budget allocations, and input from the U.S. research community though NSF advisory committees and other mechanisms such as the President's Council of Advisors on Science and Technology.

Question 6: The NSF FY12 Budget eliminates and reduces several programs across the Directorates, but does not go nearly far enough in my opinion. At the same time, several new programs are being created and many directed programs are receiving increases. I am concerned that while programs like the Graduate STEM Fellows in K-12 Education and the National STEM Distributed Learning Program are on your list because evaluations have shown that they are not necessarily proven programs, it seems that NSF is simply looking to shift those dollars (and more) into new, unproven programs. Can you explain the decision-making process for the terminations and reductions as well as the creation of the new programs? Is the scientific community driving these decisions or is the Administration?

Answer: NSF undergoes a continual portfolio assessment process in order to ensure that investments are closely aligned with agency priorities and at the leading edge of science and engineering. The Foundation uses its evaluation processes to identify where the potential might lie for more innovative and effective investments.

The six terminations and reductions proposed for FY 2012 reflect this ongoing process of review and reprioritization. A number of these were informed by recent program evaluations, while others reflect findings from major reviews by the National Science Board and other key stakeholders.

Question 7: The word "new" appeared 34 times in your testimony and 17 times in Dr. Bowen's. Most of these references were to new programs or initiatives. In light of our current economic reality, when the American people are begging us to change our spending habits and resources are precious, why is it necessary to begin new programs? Can you provide a better justification for the creation of these new programs mentioned in your testimony, especially those that seem to duplicate existing programs, such as Teacher Learning for the Future, and Transforming Broadening Participation through STEM?

Answer: To effectively transform the frontiers and innovate for society, NSF engages in a dynamic and ongoing process of strategic realignment and refinement of program emphases. To do so requires phasing out programs that have met their goals, while preserving the key elements of those programs in new formulations that anticipate future needs. These realignment and refinement decisions are based on a range of factors, including key national reports, input from the research and education communities in schools and universities, input from NSF's advisory groups, evolving collaborations with other agencies such as the U.S. Department of Education (ED), and analyses of evidence growing out of NSF's funded portfolios.

The proposed Teacher Learning for the Future (TLF) and Transforming Broadening Participation through STEM (TBPS) programs do not duplicate existing programs. Instead, they will build on the lessons and successes of current programs, and will draw heavily on recent research and synthesis studies, to catalyze needed innovations and new models in two areas that are essential for progress in improving STEM education: the effectiveness of STEM teaching, and the recruitment, development, and retention of a broadly diverse STEM workforce that includes people from all groups traditionally underrepresented in STEM, including women and persons with disabilities. These two programs will challenge NSF grantees to transform the frontiers of education and innovate in ways that are critical for society.

Question 8: I understand and respect that, as mentioned in hearing testimony, "neglecting scientific research and education now will have serious consequences for the future of our country." However, Congress is faced with many difficult funding decisions in our current economic situation. Every Committee is hearing similar pleas from education to transportation and from energy to defense. Federal funding cuts are a likely reality over the next few years. How would you suggest we look at reigning in government expenditures across the board? How do we prioritize programmatic funding for the Foundation?

Answer: The President's budget for FY 2012 identifies a path to restrain spending overall while also protecting essential investments in the Nation's future. The Foundation's vital role has been recognized in significant ways: *The President's Plan for Science and Innovation* calls for doubling the federal investment in key basic research agencies, including NSF; and the America COMPETES Reauthorization Act of 2010 acknowledges that "the National Science Foundation is the finest scientific foundation in the world, and is a vital agency that must support basic research needed to advance the United States into the 21st century." Consistent with this, NSF's FY 2012 Budget Request capitalizes on promising research areas where new discoveries can help regain U.S. competitiveness and leadership in the science and engineering enterprise.

Question 9: Dr. Bowen identified NSF as the "only federal agency dedicated to the support of basic research and education in all fields of science and engineering." Are the more applied areas of research identified in the America COMPETES Reauthorization Act, coupled with many Administration applied priorities for NSF in the FY12 budget request diluting the funding for basic, fundamental research? Please explain your response.

Answer: This is not the case. Congress and the Administration recognize the importance of funding basic, fundamental research, and the FY 2012 Request strengthens these investments.

The 2010 Act recognizes that NSF, as the only federal agency dedicated to fundamental research in all fields of science and engineering, supports advances that lead to downstream applications. For example, in manufacturing research, such as nanomanufacturing and advanced sensing and control techniques, NSF's contributions will be in "fundamental research leading to transformative advances in manufacturing technologies, processes and enterprises that will support United States manufacturing..." The 2010 Act also recognizes that NSF can play a key role in developing collaborations "that promote innovation and increase the impact of research by developing tools and resources to connect new scientific discoveries to practical uses."

STEM Education

Question 10: The Administration plans to invest $3.4 billion across the federal government for STEM education, including many new initiatives primarily at the Department of Education. While the Department of Education should certainly take a more active role in STEM, do you know what the rationale is for shifting this support from NSF to Education? How actively involved can NSF be in decisions being made at the Department of Education on STEM-related issues? What steps are being taken to ensure that these new activities are research-based and will have input from not only the education community but also the scientific community?

Answer: NSF continues to play the leading role across federal agencies in advancing and improving K-12 science, technology, engineering, and mathematics (STEM) education, through the design, creation, implementation, and study of models, approaches, and instructional materials for STEM student learning, and through investment in ensuring effective STEM teaching through teacher preparation and development. Building on its past accomplishments and anticipating the future, NSF is uniquely situated among federal agencies to advance this kind of education because of its strong connections with the Nation's leading STEM researchers, faculty, education researchers, science, technology, and education policy makers, and other professionals.

NSF programs supporting STEM education encompass a wide range of disciplines, including biology, chemistry, engineering, mathematics, physics, computer science, social science, economics, behavioral science, geological sciences, Arctic and Antarctic studies, and a range of interdisciplinary areas. Among federal agencies, this immediate access to such a broad range of cutting-edge science for activities in K-12 education is unique. Complementary programs at other agencies focus on mission-oriented areas of STEM. This unique NSF context allows for an investment that is STEM education-specific and that complements the more general and wide-ranging investments of the U.S. Department of Education (ED). The Administration's request does not signal a shift of support from NSF to ED. Rather, it conveys the more deliberate complementarity of the two agencies' investments resulting from very strong communication and coordination activities that have been underway between the two agencies over the past two years. Currently, there is a working group comprised of NSF and the Institute of Education Sciences (IES) staff developing common "evidence standards" that will serve as a basis for both NSF and ED STEM programs.

Question 11: Everyone touts the importance of America COMPETES and the America COMPETES Reauthorization Act, but rather than sticking to funding proven and established programs at NSF like Noyce Scholarships and the Math and Science Partnership (MSP), the FY12 budget request reduces their funding by $20 million in order to create a new teacher development program. The Noyce program was expanded in the original COMPETES Act to include a new program called 10,000 Teachers, 10 Million Minds. The FY12 budget is now calling for a NEW 100,000 STEM teachers program with the same hoped for end result. Other than the focus being at the Department of Education versus NSF, do you have any idea how this new program will be different? Is there a problem with the program currently in place at NSF?

Answer: NSF's MSP program is a broadly defined research and development program aimed at improving K-12 student learning in the STEM fields. There are a number of strategies and approaches funded in this program, including teacher professional development; strong engagement of STEM faculty; efforts to work with standards, frameworks and curricula; and, to some extent, efforts to improve teachers' preservice preparation. Evaluation evidence indicates that MSP is effective in building professional learning communities and, in particular contexts, raising student achievement. The Robert Noyce Scholarship (NOYCE) program is primarily a scholarship program, and the program evaluation being launched at this time will include examining the impact of Noyce scholars on their students' learning. Neither of these programs is explicitly focused on building the research knowledge to support the innovation and improvement needed in teacher preparation to prepare 100,000 new STEM teachers who will be effective in ensuring student learning of tomorrow's complex STEM content.

NSF's proposed TLF program would likely attract applications from PIs who have become involved in teacher preparation research on the basis of their implementation experiences in

MSP and Noyce, and would allow a focused and rapid development of learning about quality teacher preparation that would serve as the foundation for the larger scale-up activity proposed by the Department of Education.

Question 12: A few weeks ago, the new National Science and Technology Council STEM Education Committee convened. Please describe the role NSF will play in this Committee. Do you think it will be able to effectively identify duplicative and ineffective STEM programs across the federal government? And if so, how and what actions can be taken to save the American taxpayer from continuing to support these programs?

Answer: NSF Director Subra Suresh, together with OSTP Associate Director Carl Wieman, serves as co-chair of the newly constituted STEM Education Committee (Co-STEM). Work is already well underway in two task groups–Federal Inventory of STEM Education (FI-STEM) Task Force and the Strategic Plan Preliminary Task Force. Dr. Joan Ferrini-Mundy, NSF's Assistant Director for Education and Human Resources, is the NSF representative on both of these task groups. The inventory group has already created a draft template for gathering relevant information about STEM programs, including information about effectiveness and metrics, and has begun collecting the relevant information. This inventory will serve as a key foundation for the Strategic Plan group. NSF is confident that the kind of deliberate planning for complementarity and interfacing of programs that has been started between the NSF and the Department of Education can serve as a model that can be expanded to ensure appropriate complementarities and coordination among other agency programs. We do anticipate that this may require the realignment and refocusing of several programs across agencies.

Broadening Participation

Question 13: NSF is proposing to eliminate funding for the Research Initiation Grants to Broaden Participation in Biology program (RIG) because "the number of proposals from underrepresented groups did not increase." Is this the same case for other broadening participation programs within the Foundation? What evidence do we have that these programs are achieving the desired results? Why do we need yet another new $20 million "Transforming Broadening Participation through STEM (TBPS) program?

Answer: After the introduction of the Research Initiation Grants to Broaden Participation in Biology program, the number of Biology principal investigators from under-represented groups did not increase. Consequently, the Biological Sciences Directorate is evaluating its strategy for broadening participation and discussing a different model to reach the goal of increasing competitive regular research proposals from underrepresented groups. Every NSF Directorate goes through a similar analytical process with respect to its programs, and NSF's Priority Goal for STEM workforce development focuses on establishing evaluation that will inform program improvement for more strategic impact. NSF's Transforming Broadening Participation through STEM program would take advantage of new possible emphases and partnerships, based on continued understanding of best practices and needs. At the undergraduate level, recruitment and retention of students from groups traditionally underrepresented in STEM is an especially serious challenge. TBPS would invest in strategies to place exciting and substantial access to cutting-edge science at the center of efforts to recruit and retain students; none of the current HRD programs at the undergraduate level has this particular focus as the main strategy.

QUESTIONS FOR THE RECORD SUBMITTED BY
Randy Neugebauer

NEON

Question 14: Your FY 2012 budget request includes $224.7 million for the Major Research Equipment & Facilities Construction program (MREFC), which is an increase of nearly 92 percent over FY 2010 levels. A large chunk of this funding would be applied to the second year construction of the National Ecological Observatory Network (NEON), which will collect data across the U.S. on the impacts of climate change, land use change, and invasive species. What assurances can you provide and what practices and safeguards will be put in place in NEON to ensure that scientific objectivity will not be compromised in favor of more agenda-driven research practices?

Answer: NSF-supported fundamental science assures an objective science baseline upon which managers and public officials can make sound decisions that impact the health and welfare of this country, and from which the R&D enterprise can provide the innovations that drive U.S. industry and business.

The NSF review processes both for MREFC project planning and oversight and basic merit review for individual science projects are highly structured with inherent safeguards. The MREFC process includes "Guidelines and Design Review Processes" that define the practices, processes, and criteria for the design, construction, and operations of all NSF Large Facilities. The MREFC process evaluates the scope, scientific and technical requirements, cost, and schedule. Using expert panels, Directorate evaluation, and the Directors Review Board, the scientific conceptual design, project execution, management, and operations plans are evaluated. This includes approval by numerous external review panels (that include cost analysts and engineers), internal review, and approval by the National Science Board. NEON has been through all stages of these processes and has been certified at all levels as a scientifically-sound and well engineered construction project with carefully reviewed and certified cost and schedule.

Scientific objectivity has been at the center of the NEON design and deployment at all stages of the project development. Infrastructure will be deployed to advance our understanding of the biosphere at regional to continental scales. The science requirements, the design and construction plans and processes, and maintenance and operations plans have been vetted by thousands of scientists and engineers.

QUESTIONS FOR THE RECORD SUBMITTED BY
Sandy Adams

STEM Education

Question 15: As mentioned in the hearing, within the Education and Human Resources Directorate, there is a Human Resource Development Division that up until the FY12 budget request was intended to "play a central role in increasing opportunities in STEM education for individuals from historically underserved populations - minorities, women, and persons with disabilities." The FY12 budget request realigns the Division, reducing funding for and shifting several programs to another Division. Of the $160 million budget request for the Division ($20 million of which is for a new broadening participation program), only $1.6 million is available for "increasing opportunities in STEM education" for women and zero is available for "increasing opportunities in STEM education" for persons with disabilities. Can you please explain the rationale for this and why this Division has become more narrowly focused?

Answer: The Division of Human Resource Development (HRD) within EHR is described in the following link: http://www.nsf.gov/ehr/hrd/about.jsp. HRD serves as a focal point for NSF's agency-wide commitment to enhancing the quality and excellence of science, technology, engineering, and mathematics (STEM) education and research through broadening participation by underrepresented groups and institutions. The Division's programs aim to increase the participation and advancement of underrepresented minorities and minority-serving institutions, women and girls, and persons with disabilities at every level of the science and engineering enterprise. Programs within HRD have a strong focus on partnerships and collaborations in order to maximize the preparation of a well-trained scientific and instructional workforce for the new millennium.

There has been no change in the division's commitment to broadening participation for all groups traditionally underrepresented in STEM. All HRD programs, including the Louis Stokes for Minority Participation (LSAMP), the Historically Black Colleges and Universities Undergraduate Program (HBCU-UP), and the Tribal Colleges and Universities Program (TCUP) share the commitment to broadening participation for all, including women and persons with disabilities. In fact, a number of projects funded in these and other HRD programs have specific focus on issues facing women and persons with disabilities. The proposed administrative shift for the Research in Disabilities Education (RDE) and the Research on Gender in Science and Engineering (GSE) programs is to improve program management, leverage resources, and build coherence across all of EHR in the research domain. The two expert scientific staff who manage these programs will remain members of the HRD staff, and will continue to play key roles in ensuring that a full-scale view of broadening participation for all groups is central in all HRD investment areas and across EHR.

Broadening Participation

Question 16: Also, per our hearing exchange, including the Human Resource Development Division programs, would you please provide us with funding and programmatic details on all programs within the Foundation that are either specific to serving "historically underserved populations - minorities, women, and persons with disabilities" or provide special considerations for these populations?

Answer: NSF has taken a variety of approaches to broaden participation across its many programs. While broadening participation is included in the NSF review criteria, some program announcements and solicitations go beyond the standard criteria. They range from encouraging language to specific requirements. The following table represents the set of programs that have been historically tracked as Broadening Participation for budget purposes. These programs support broadening participation activities that serve historically underrepresented populations - minorities, women, and persons with disabilities.

For a complete listing of NSF's Broadening Participation portfolio please see the website http://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp.

NSF Programs to Broaden Participation
FY 2012 Request to Congress

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
EHR/HRD	ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)	The goal of the ADVANCE program is to develop systemic approaches to increase the representation and advancement of women in academic science, technology, engineering and mathematics (STEM) careers, thereby contributing to the development of a more diverse science and engineering workforce. ADVANCE focuses on ensuring that women faculty with earned STEM degrees consider academia as a viable and attractive career option.	$21.01	-	$21.02	$21.65
EHR/DUE	Advanced Technological Education (ATE)	With an emphasis on two-year colleges, the 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 levels.	64.51	-	64.00	64.00
EHR/HRD	Alliances for Graduate Education and the Professoriate (AGEP)	The AGEP program enables seamless transitions from the STEM baccalaureate to attainment of the doctorate and entry to the STEM professoriate. Its main goal is to increase the number of students successfully completing quality degree programs in science, technology, engineering and mathematics (STEM) with particular emphasis placed on transforming STEM education through innovative academic strategies and experiences in support of groups that historically have been underrepresented in STEM disciplines: African-Americans, Alaskan Natives, Native Americans, Hispanic Americans, and Native Pacific Islanders. 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 professorate.	16.73	-	16.75	16.75
CISE	Broadening Participation in Computing (BPC)	The BPC program aims to significantly increase the number of U.S. citizens and permanent residents receiving post secondary degrees in the computing disciplines. Initially, its emphasis will be on students from communities with longstanding underrepresentation in computing: women, persons with disabilities, and minorities. Included minority groups are African Americans, Hispanics, American Indians, Alaska Natives, Native Hawaiians, and Pacific Islanders. While these efforts focus on underrepresented groups, it is expected that the resulting types of interventions will improve research and education opportunities for all students in computing.	14.00	-	14.00	-
EHR/HRD	Centers of Research Excellence in Science and Technology (CREST)	The 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.	30.32	-	30.53	30.53
EHR/HRD	Transforming Broadening Participation through STEM (TBPS)	Transforming Broadening Participation through STEM (TBPS) is new program that will seek innovative solutions for broadening participation in STEM at the undergraduate level in anticipation of tomorrow's changing demographics, including increased engagement with Hispanic-serving institutions.	-	-	-	20.00

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
OCI	Cyberinfrastructure Training, Education, Advancement and Mentoring (CI-TEAM)	The CI-TEAM program supports Demonstration and Implementation Projects aimed at positioning the national science and engineering community to more effectively engage in national and global research and education activities that promote and leverage cyberinfrastructure. CI-TEAM awards will: • Prepare current and future generations of scientists, engineers, and educators to use, support, deploy, develop, and design cyberinfrastructure; and • Foster inclusion in cyberinfrastructure activities, of diverse groups of people and organizations, with particular emphasis on traditionally underrepresented groups.	4.85	-	5.00	4.00
IA	Experimental Program to Stimulate Competitive Research (EPSCoR)	The Experimental Program to Stimulate Competitive Research (EPSCoR) is a program designed to fulfill the National Science Foundation's (NSF) mandate to promote scientific progress nationwide. The EPSCoR program is directed at those jurisdictions that have historically received lesser amounts of NSF Research and Development (R&D) funding. Twenty-seven states, the Commonwealth of Puerto Rico and the U. S. Virgin Islands are currently eligible to participate. Through this program, NSF establishes partnerships with government, higher education and industry that are designed to effect lasting improvements in a state's or region's research infrastructure, R&D capacity and hence, its national R&D competitiveness.	147.11	20.00	147.12	160.53
GEO	GEO LSAMP Linkages	The LSAMP-Linkages account provides co-funding for projects submitted to the GEO Education and Diversity programs that help to infuse geoscience content areas into existing LSAMP programs that have limited geoscience focus.	1.00	-	1.00	1.00
ENG	Graduate Research Diversity Supplements (GRS)	Graduate Research Diversity Supplements is an opportunity to broaden participation particularly of underrepresented students in Ph.D. programs in engineering through supplements to current research grants funded by the divisions in the Directorate for Engineering (ENG) at the National Science Foundation. The establishment of Graduate Research Supplements (GRS) reflects the continuing effort by ENG to promote increased participation of new Ph.D. students in all fields of engineering research with particular emphasis on individuals from underrepresented groups. The long-term goal of GRS is to increase the number of persons from underrepresented groups in advanced academic and professional careers.	2.06	-	1.50	1.50
ENG/CISE	Graduate Research Fellowship - Women in Engineering and Computer Science	The Graduate Research Fellowship Program awards fellowships for graduate study leading to research-based master's or doctoral degrees in the fields of science, technology, engineering, and mathematics (STEM) relevant to the mission of the National Science Foundation. The Women in Engineering and Computer and Information Science awards are for women who intend to pursue graduate research degrees in Engineering or Computer and Information Science and Engineering. Additional funding for these awards is provided by the Directorate for Computer and Information Science and the Directorate for Engineering. Eligibility, application, and review criteria are the same as for applicants in other fields.	9.88	-	9.55	-
EHR/DRL	Innovative Technology Experiences for Students and Teachers (ITEST)	The ITEST program invests in K-12 activities that addresss shortages of STEM professionals and information and communications technology workers in the U.S. and K-12 activities that seek to expand the beadth and depth of the STEM workforce, through programs for students and teachers and educational research. The ITEST program advances the EHR themes of broadenting participation to improve workforce development, promoting cyber-enabled learning starategies, and advancing STEM literacy. ITEST is supported by H-1B VISA fees.				

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
EHR/DUE	Scholarships in Science, Technology, Engineering and Mathematics (S-STEM)	The S-STEM program 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. The program was established by the National Science Foundation (NSF) in accordance with the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277) as modified by P.L. 106-313 and P.L.108-447 in 2004. The predecessor program to S-STEM is the NSF Computer Science, Engineering, and Mathematics Scholarships (CSEMS) program. The major change from CSEMS is that S-STEM increased the number of disciplines that could participate in the program.	96.81	-	100.00	100.00
EHR/HRD	Historically-Black Colleges and Universities-Undergraduate Program (HBCU-UP)	The Historically Black Colleges and Universities-Undergraduate Program (HBCU-UP) supports awards that enhance the quality of undergraduate STEM programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrading of scientific instrumentation, and improvement of research infrastructure.	32.06	-	32.00	32.00
EHR/DRL	Informal Science Education (ISE)	Informal Science Education (ISE) will continue to emphasize projects that advance informal STEM education nationally and build on lessons learned from education research. Priority is placed on projects that strengthen infrastructure; engage underserved audiences, including young children and older adults; incorporate inquiry in after-school programs; involve the public in the scientific process; and apply new technologies to informal learning.	65.85	-	66.00	68.14
EHR/MPS/ BIO	Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM)	The UBM program aims to enhance undergraduate education and training at the intersection of the biological and mathematical sciences and to better prepare undergraduate biology or mathematics students to pursue graduate study and careers in fields that integrate the mathematical and biological sciences.	2.70	-	2.70	-
EHR/HRD	Louis Stokes Alliances for Minority Participation (LSAMP)	Louis Stokes Alliances for Minority Participation (LSAMP) strengthen and encourage STEM baccalaureate degree production of students from underrepresented populations by utilizing the knowledge, resources, and capabilities of a broad range of organizations.	44.55	-	44.75	44.75
EHR/DUE	Math and Science Partnership (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. In particular, MSP projects seek to integrate the work of higher education, especially its science, technology, engineering and mathematics (STEM) disciplinary faculty, with that of K-12 to strengthen and reform mathematics and science education. 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. In order to improve the mathematics and science achievement of the Nation's students, MSP projects contribute to the knowledge base for mathematics and science education and serve as models that have a sufficiently strong evidence base to be replicated in educational practice.	57.93	-	58.22	48.22
BIO	BIO Minority Post-Doctoctoral Research Fellowships	The Directorate for Biological Sciences (BIO) awards postdoctoral research fellowships to recent recipients of the doctoral degree for research and training in selected areas supported by BIO. The BIO Minority Postdoctoral Research Fellowships have been offered since FY 1990 in order to increase the participation of under-represented groups in biology. The program supports a wide range of biological research and training across the full range of BIO's research programs.	2.82	-	2.50	2.50

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
SBE	SBE Minority Post-Doctoctoral Research Fellowships	The Directorate for Social, Behavioral and Economic Sciences (SBE) offers Minority Postdoctoral Research Fellowships and Research Starter Grants in an effort to increase the diversity of researchers who participate in NSF programs in the social, behavioral and economic sciences and thereby increase the participation of scientists from underrepresented groups in selected areas of science in the United States. These activities (postdoctoral fellowships and follow-up research starter grants) support training and research in the areas of social, behavioral and economic sciences within the purview of NSF.	0.94	-	1.00	1.00
EHR/DUE	Noyce Scholarships	The Robert Noyce Teacher Scholarship 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.	54.93	-	55.00	45.00
GEO	Ocean Sciences Postdoctoral Fellowship[2]	The Division of Ocean Sciences (OCE) awards Postdoctoral Fellowships to highly qualified investigators within 3 years of obtaining their PhD to carry out an integrated program of independent research and education. The research and education plans of each fellowship must address scientific questions within the scope of OCE disciplines. The program supports researchers for a period of up to 2 years with fellowships that can be taken to the institution or national facility of their choice.	-	-	-	1.90
GEO	Opportunities to Enhance Diversity in the Geosciences (OEDG)	The OEDG program provides targeted education, research, and mentoring activities that will increase the number of members of underrepresented groups involved in formal pre-college and informal geoscience education programs, pursuing undergraduate and advanced degrees in the geosciences, and entering geoscience careers.	4.18	-	4.60	3.60
IA	Partnerships for Innovation (PFI)	The Partnerships for Innovation (PFI) program is intended to forge connections between new knowledge created in the discovery process and learning and innovation. The PFI program defines innovation as the transformation of knowledge into products, processes, systems, and services that are novel and of economic value to society. One of the general goals of the Partnerships for Innovation Program (PFI) is to stimulate the transformation of knowledge created by the research and education enterprise into innovations that create new wealth; build strong local, regional, and national economies; and improve the national well-being.	9.25	-	9.19	28.69
MPS	Partnerships in AST & Astrophysics Rsch Educ (PAARE)[3]	The objective of Partnerships in Astronomy & Astrophysics Research and Education (PAARE) is to enhance diversity in astronomy and astrophysics research and education by stimulating the development of formal, long-term, collaborative research and education partnerships among minority-serving institutions and partners at research institutions, including academic institutions, private observatories and NSF Division of Astronomical Sciences (AST) supported facilities.	0.74	-	2.00	-

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
MPS	Partnerships for Research and Education in Materials (PREM)	The objective of PREM is to enhance diversity in materials research and education by stimulating the development of formal, long-term, collaborative materials research and education partnerships between minority-serving institutions and the National Science Foundation (NSF) Division of Materials Research (DMR) supported groups, centers, and facilities.	5.52	-	5.53	6.00
ENG	Pre-Engineering Education Collaboratives (PEEC)[4]	Pre-Engineering Education Collaboratives (PEEC) provides support for pilot efforts to establish or enhance engineering pipelines in TCUP institutions, alone or in collaboration with other TCUP institutions and colleges of engineering.	1.00	-	1.00	1.00
EHR/HRD	Research in Disabilities Education (RDE)[6]	The RDE program seeks to broaden the participation and achievement of people with disabilities in all fields of STEM education and associated professional careers. The RDE program places particular emphasis 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. Research project results inform the delivery of innovative, transformative and successful practices employed by the Alliances for Students with Disabilities in STEM to increase the number of students with disabilities completing associate, undergraduate and graduate degrees in STEM and to increase the number of students with disabilities entering our nation's science and engineering workforce.	6.92	-	6.50	6.50
BIO	Research Initiation Grants in Biology (RIG)	Research Initiation Grants in Biology (RIG) is intended to broadening participation to all biologists including members from groups under-represented in biology. These grants are intended to increase the diversity of researchers who apply for and receive BIO funding to initiate research programs early in their careers. Currently, African Americans, Hispanics, Native Americans, Alaska Natives, and Native Hawaiians and other Pacific Islanders are under-represented in biology.	1.91	-	2.00	-
EHR/HRD	Research on Gender in Science and Engineering (GSE)[5]	The Research on Gender in Science and Engineering (GSE) program supports efforts to understand and address gender-based differences in 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. The focus of the GSE program is on building resources--developing the nation's knowledge capital, social capital, and human capital--toward the goal of broadening the participation of girls and young women in STEM education from kindergarten through undergraduate education. The program targets the creation of new knowledge and the dissemination of that knowledge to practitioner communities. The program does not currently fund direct intervention or education projects that directly serve students as their primary purpose. In 2003 the program changed focus from direct implementation projects for women and girls (e.g., summer camps, women in science programs on campuses, etc.) to research and the targeting of practitioners with pedagogical, recruitment, retention and other strategies with some evidence of success.	11.57	-	11.50	10.50
EHR/DUE	Science, Technology, Engineering and Math Talent Expansion Program (STEP)	The 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 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.	31.64	-	32.53	35.53

(Dollars in Millions)

Directorate/ Office	Program Name	Program Description	FY 2010 Omnibus Actual	FY 2010 ARRA Actual	FY 2010 Enacted/ Annualized FY 2011 CR[1]	FY 2012 Request
GEO	Significant Opportunities in Atmospheric Research and Science (SOARS)	SOARS seeks to broadening participation in the atmospheric and related sciences. It is an undergraduate to graduate program built around a summer research internship, mentoring by top scientists, and a supportive learning community.	0.67	-	0.60	0.60
EHR/HRD	Tribal Colleges and Universities Program (TCUP)	Tribal Colleges and Universities Program (TCUP) promotes the improvement of STEM instructional and community outreach programs, with an emphasis on the leveraged use of information technologies at Tribal Colleges and Universities, Alaska Native-serving institutions and Native Hawaiian-serving institutions. This program provides awards to enhance the quality of STEM instructional and outreach programs at Tribal Colleges and Universities, Alaska Native-serving and Native Hawaiian-serving institutions of higher education. 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 prepare students for careers in science, mathematics, engineering, and technological fields. Proposed activities should be the result of a careful analysis of institutional needs, address institutional and NSF goals, and have the potential to result in significant and sustainable improvements in STEM program offerings.	13.35	-	13.35	14.35
MPS	Undergraduate Research Collaboratives (URC)	The URC program develops new models and partnerships between research universities, 4-year colleges and 2-year colleges with the potential to expand the reach of undergraduate research to include first- and second-year college students, to broaden participation, and increase diversity in the student talent pool from which the nations's future technical workforce will be drawn and to enhance the research capacity, infrastructure and culture of participating institutions.	1.00	-	1.00	-
BIO	Undergraduate Research Mentoring in Biology (URM)	URM funds projects that have strong research and mentoring activities designed to prepare students for successful entry into graduate programs. URM will support projects involving the recruitment, retention and development of undergraduate students, especially those from underrepresented groups, for the purpose of preparing them for graduate study in the biological sciences. Proposed projects are expected to create a URM program that will actively engage students in interesting and exciting research ideas, provide hands-on research experience, and develop their academic skills.	9.00	-	3.00	-
	TOTAL, NSF		**$766.80**	**$20.00**	**$765.44**	**$770.24**

[1] A full-year 2011 appropriation for these programs was not enacted at the time the budget was prepared; therefore, these programs are operating under a continuing resolution (P.L. 111-242, as amended). The amounts included for 2011 reflect the annualized levels provided by the continuing resolution.

[2] The Ocean Sciences Postdoctoral Fellowship is a new program beginning in FY 2012.

[3] Partnerships in Astronomy and Astrophysics Research Education (PAARE) replaces Research Partnerships for Diversity (RPD).

[4] Pre-Engineering Education Collaboratives (PEEC) replaces Tribal College Pathways in ENG.

[5] Funding for Research in Disabilities Education (RDE) and Research on Gender in Science and Engineering (GSE) for FY 2012 is proposed to reside in the Research & Evaluation on Education in S&E (REESE) program in EHR.

QUESTIONS FOR THE RECORD SUBMITTED BY
Representative Randy Hultgren

DUSEL

During this time in which the energy frontier and some of our brightest minds have been shifting to Europe for the development, operation, and promise of science from the Large Hadron Collider, the U.S. must not cede our leadership in a future discovery frontier. A robust national program in elementary particle physics is a central component of both the NSF and DOE contributions to fundamental physics research and it is required for the U.S. to remain competitive on the international scale.

Question 17: Over the last decade, a series of reports outlined compelling questions in modern science that can be answered only in a deep underground environment. In response to this, the science community has overwhelmingly supported the construction and operation of a national underground laboratory. Research communities in physics, geosciences, engineering, biology, and other fields have further refined the questions and defined the critical experiments that would require access to scientific facilities deep underground. As planning continues for this project, early and formal continued participation by the NSF is critical.

Recognizing the importance of this facility, the commitment of Fermilab in my district of Illinois, and the overwhelming support of the scientific community, how does the National Science Foundation, which supports research across science and engineering fields, intend to continue to be formally involved in the development of the Deep Underground Science and Engineering Laboratory (DUSEL) along with the Department of Energy?

Answer: NSF will continue to consider grant proposals for future particle physics research and other fields, including underground experiments that might be conducted at Homestake, should DOE decide to support the core infrastructure there, or at other existing sites in the United States and around the world.

Question 18: In addition, in this time of budgetary constraints, it is more important than ever for the U.S. and NSF to be leveraging financial commitments made by other partners and demonstrating a sustainable development process to keep facilities costs down. Increasingly, the construction of these large facilities not only requires non-federal contributions but multi-agency collaboration within the federal government.

I was discouraged to see that the NSF has proposed zero funding for DUSEL in FY 2012 after more than $250 million invested to date from federal, state, and private sources and hundreds of jobs already created.

In the America COMPETES Act enacted in 2010, Congress recognized the need for NSF "in its planning for construction and stewardship of large facilities, to coordinate and collaborate with other Federal agencies, including the Department of Energy's Office of Science, to ensure that joint investments may be made when practicable."

What is the current status of negotiations and participation of NSF with the DOE in the future of the Long-Baseline Neutrino Experiment (LBNE) and the development of an underground laboratory?

Answer: DOE has initiated a scientific assessment to determine the optimal location for the Long Baseline Neutrino Experiment (LBNE) far detector and the full suite of experiments in which their programs are highly engaged, namely dark matter and double beta-decay. This assessment, which will include Homestake and other possible sites, is expected to conclude in time to inform preparation of DOE's FY 2013 budget request.

Pending a DOE decision on the location of the LBNE far detector, NSF and DOE are working together to preserve the viability of the Homestake site in FY 2011. NSF has agreed to provide $4.0 million during the remainder of FY 2011 to sustain pumping operations at the Homestake site. DOE has included $15.0 million in its FY 2012 budget request, presently before Congress, to extend pumping operations through FY 2012.

Question 19: Will NSF complete its funding of the 15 awards it has made to date to study initial experiments for early science which could be conducted in such a unique underground laboratory environment?

Answer: Yes. The final allotment (third year) of funding for the Directorate for Mathematical and Physical Sciences, Physics Division (MPS/PHY) component of the DUSEL Solicitation 4 (S4) awards are included in the FY 2011 Budget Request. These nine continuing awards in MPS/PHY will be made and the S4 commitments completed. The Directorate for Geosciences intends to fund the final year of the seven DUSEL S4 awards that were co-funded with the Directorate for Engineering and Directorate for Biological Sciences.

Question 20: The implications of the future research at DUSEL go far beyond the science discoveries themselves, as opportunities to attract students at all ages have been built into the plan, with the potential to redirect future scientists to the U.S. rather than our foreign competitors. Most importantly, the impact this facility will have can be seen from the impact it is already having. Summer scholarships, intern programs for students in science to conduct research at DOE's Fermi National Accelerator Laboratory in Batavia, Illinois, and a new Master's degree and doctoral degree program in physics within the South Dakota university system have all been developed as a result of the future DUSEL facility. Is NSF working with the relevant partners to identify ways to ensure that these activities and our nation's commitment to science education continue while the federal agencies are working on the appropriate stewardship model?

Answer: NSF continues to be committed to workforce development in all fields of science and engineering.

Question 21: How is NSF prepared to work with the university community to ensure that the research needs will still be met with any proposed changes to the existing plans for DUSEL?

Answer: The NSF Directorate for Mathematical and Physical Sciences, Physics Division (MPS/PHY) is prepared to work with the nuclear and particle physics university communities to pursue underground research through the normal grant and proposal peer-review process.

QUESTIONS FOR THE RECORD SUBMITTED BY
Daniel Lipinski

Research Infrastructure

I'm greatly concerned that we are under-investing in research and teaching laboratories, instrumentation, and shared-use facilities. I am worried that not only will this make it difficult to compete for top talent with countries like China, but that it will lead to the inefficient use of limited research dollars.

Question 22: As a former Dean of Engineering, what is your impression of the state of our nation's academic research infrastructure? Is it limiting researchers or causing problems recruiting or retaining top talent? I realize this might not be such an issue at MIT, but I would like to know your perspective on the country as a whole.

Answer: NSF's National Center for Science and Engineering Statistics (NCSES) collects data from academic institutions about the state of their science and engineering (S&E) research facilities space. Nationally representative data are not available specific to instrumentation, and shared-use facilities. There are no comparable international data on research infrastructure.

In FY 2007, the most recent year for which data are available, there were 188 million net assignable square feet (NASF) of S&E research space at academic institutions. Institutions rated 17 percent of that space as requiring renovation and 5 percent of that space as requiring replacement. The condition of the space varies by S&E field (see Table 5).

The federal government is a relatively small source of the total funding used by academic institutions for repair and renovation or new construction of S&E research space. Academic institutions reported that the completion costs for repair, renovation, and new construction of S&E research facilities begun during FY 2006 and FY 2007 were $3.362 billion and $5.924 billion, respectively. The federal government was the source of $134 million (4 percent) and $361 million (6 percent) of those funds, respectively.

Since the mid-1990s, the federal government's share of funding for repair and renovation of academic S&E research space has fluctuated between 4 percent and 10 percent, and the share of funding for new construction of academic S&E research space has fluctuated between 4 percent and 9 percent.

In FY 2007, the estimated costs of deferred projects included in academic institutional plans to repair or renovate S&E research space was $5.154 billion; estimated costs of deferred projects included in academic institutional plans to construct new S&E research space was $10.423 billion. Consequently, in FY 2007 total estimated costs of deferred projects were $15.577 billion. In FY 2005, total estimated costs of deferred projects were $13.786 billion. In FY 2003, total estimated costs of deferred projects were $12.781 billion.

Research infrastructure is essential to scientific discovery and a strong U.S. scientific and engineering enterprise. In today's environment, shared-use facilities which are accessed by the broader U.S. scientific and engineering research community are encouraged and supported by NSF. While access to high-quality, research infrastructure is one factor that influences individual researchers' employment decisions, and space and equipment packages routinely are part of new recruitment and retention negotiations, data on the impact of the current status of S&E research space on recruiting and retention are scarce. A variety of other factors are as

likely to influence recruitment and retention decisions including – salary/compensation, career advancement, access to research funding, the opportunity to work with the best in a given field, and family considerations. The extent to which the adequacy of research infrastructure is the determining factor is not known and may be discipline dependent with some disciplines having greater research infrastructure requirements than others.

Data Notes:

- Data are reported for academic institutions with $1.0 million or more in research and development (R&D) expenditures (from all sources). The data are collected on the NCSES Survey of Science and Engineering Research Facilities.
- Research space is space where research activities occur. For example, it includes laboratories used for research, shared-use facilities, and space used to house fixed equipment or equipment costing $1.0 million or more that is used for research. It does not include teaching laboratory space.
- Deferred projects are those that are (1) not funded and (2) not yet scheduled to start in the next 2 years. They do not include projects planned for developing new programs or expanding current programs.
- Institutional plans usually will include goals, strategies, and budgets for fulfilling the institution's mission during a specific time period.
- According to the survey definitions, space requiring renovation "will no longer be suitable for current research without undergoing major renovation within the next 2 years." Space requiring replacement is defined as "should stop using space for current research within the next 2 years."
- According to the survey definitions, space in superior condition is "suitable for the most scientifically competitive research over the next 2 years." Space in satisfactory condition is "suitable for continued use over the next 2 years for most levels of research... but may require minor repairs or renovation."

TABLE 5. Condition of science and engineering research space in academic institutions, by field: FY 2007

Field	NASF[a] (millions)	Condition (% NASF)			
		Superior	Satisfactory	Requires Renovation	Requires Replacement
All research space	187.6	34	45	17	5
Agricultural and natural resources	27.8	24	51	19	6
Biological and biomedical sciences	44.8	39	41	17	3
Computer and information sciences	4.8	45	45	7	2
Engineering	28.4	31	48	15	6
Health and clinical sciences	37.0	41	40	16	3
Mathematics and statistics	1.6	31	58	10	1
Physical sciences					
Earth, atmospheric, and ocean	8.4	26	47	20	7
Astronomy, chemistry, and physics	20.3	30	44	20	6
Psychology	4.9	34	49	15	3
Social sciences	6.0	28	51	16	5
Other sciences	3.7	43	37	16	3
Research animal space	17.8	31	50	14	5

NASF = net assignable square feet

[a] NASF is the amount of NASF located at only those institutions that also rated the condition of their space.

NOTES: Details may not add to totals due to rounding. Condition was assessed relative to current research program. Research animal space is listed separately and is also included in individual field totals.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Science and Engineering Research Facilities, FY 2007

Question 23: In the Recovery Act, we spent about $200 million on infrastructure through the NSF's ARI-R2 program. Based on that program, do you have any insights into how much need there is out there, and whether this kind of investment can help address it?

Answer: The *FY 2007 Survey of Science and Engineering Research Facilities*, the most recent year for which data are available, estimated that academic institutions had at least $5.15 billion in deferred projects to repair and renovate science and engineering research space and at least $10.42 billion in deferred projects to construct new science and engineering research space. Proposals totaling $1.02 billion were submitted to the ARI-R^2 program. Indirect cost recoveries through federal grants may also be used by universities to offset costs incurred for maintenance, repair, and upkeep of buildings or equipment. Funding for academic research infrastructure also comes from other federal agencies, industry, state governments, and private endowments. In short, academic infrastructure needs are large and are best addressed through these multiple funding streams.

QUESTIONS FOR THE RECORD SUBMITTED BY
Ben Ray Lujan

Broadening Participation

Dr. Suresh, thank you for your commitment to increasing minority and women participation in STEM fields of study. Thank you also for your request of $14.35 million for the Tribal Colleges and Universities Program that will enhance STEM programs in tribal colleges across the country.

Question 24: The America COMPETES Reauthorization Act requires NSF to support the Historically Black Colleges and Universities Undergraduate Program, the Tribal Colleges and Universities Program and Hispanic Serving Institutions programs as separate programs. The FY 2012 budget request funds HBCU-UP and TCUP separately; however, the budget request does not include a "Hispanic Serving Institutions Program." As you noted in your written testimony, the National Science Foundation requested $20 million for a new program called Transforming Broadening Participation through STEM (TBPS). While it is clear that this program will be available to HSIs, it seems that it might be available to other Minority Serving Institutions as well. Can you provide clarification on TBPS, and the NSF's plans to comply with the requirement in COMPETES that HSIs are supported as a separate program?

Answer: In FY 2008 and 2009, NSF initiated a series of listening sessions with the Hispanic-serving institution (HSI) community to understand the diverse needs and opportunities for broadening participation of Hispanic students in STEM fields. From those sessions, NSF learned that many of the challenges facing HSIs in increasing participation are the same challenges faced by other minority-serving institutions, and that many of the strategies that have been most promising in engaging Hispanic students in STEM show promise for engaging all students. NSF continues to analyze, engage, and inform the higher education communities' direction and approach to workforce development and broadening participation in science, technology, engineering, and mathematics (STEM). NSF's ongoing study includes a thorough analysis of underrepresented group STEM enrollment and graduation over time in institutions of higher education in the United States.

As a result of this work, NSF will develop strategies for strengthening STEM education at the undergraduate level in colleges and universities throughout the Nation. Data about the particular needs and contexts in the wide range of HSIs across the Nation will be essential in this future planning. NSF will also address these opportunities through the proposed new Transforming Broadening Participation through STEM (TBPS) program included in the FY 2012 Budget Request. This new program will seek innovative solutions for broadening participation in STEM at the undergraduate level in anticipation of tomorrow's changing demographics including increased engagement with HSIs.

NSF continues to engage in planning across agencies, including with the White House Initiative on Educational Excellence for Hispanics, to ensure that the multiple programmatic offerings across government that serve Hispanic-serving institutions are well coordinated, and that the NSF contribution is aligned with the unique role that the agency can best play.