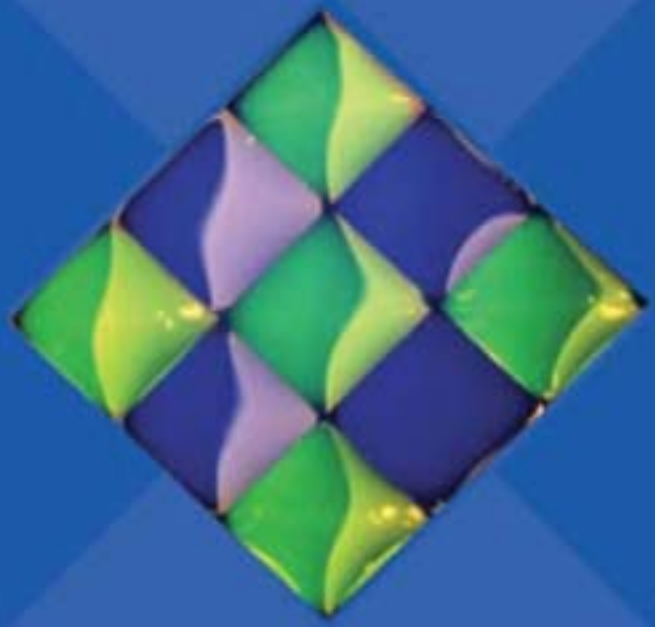
National Science Foundation



FY 2003
Performance and Accountability Report

The NSF Statutory Mission

To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense.

The NSF Vision

Enabling the Nation's future through discovery, learning and innovation.

Realizing the promise of the 21st century depends in large measure on today's investments in science, engineering and mathematics research and education. NSF investment – in people, in their ideas, and in the tools they use – will catalyze the strong progress in science and engineering needed to secure the Nation's future.

On the cover: Felice Frankel photographed colored drops of water in the laboratory of Harvard chemist and National Medal of Science winner Professor George Whitesides. The water drops are responding to a grid of hydrophobic and hydrophilic materials on a flat surface. The water drops take squarish shapes by spreading across the hydrophilic surface and stopping at hydrophobic gridlines etched at 3 mm intervals. The hydrophilic surface is a self-assembled monolayer.

Frankel is a research scientist in the School of Science at the Massachusetts Institute of Technology. In 1997, she was awarded an NSF grant for "Envisioning Science," a project in which she works with students and researchers to raise the standards in scientific imaging and visual expression of data. In March 2002, The MIT Press published Frankel's book, Envisioning Science: The Design and Craft of the Science Image. Envisioning Science *provides a guide to creating compelling photographs that illuminate science and make research more accessible.*

NATIONAL SCIENCE FOUNDATION
FY 2003 Performance and Accountability Report

http://www.nsf.gov/pubsys/ods/getpub.cfm?par

V. Appendixes

I. MANAGEMENT'S DISCUSSION AND ANALYSIS

A MESSAGE FROM THE DIRECTOR

I am pleased to present the National Science Foundation's *Performance and Accountability Report* for FY 2003. This report summarizes the Foundation's programmatic achievements, core business priorities and accomplishments as well as its financial status of the past year.

For more than 50 years, NSF has invested in a wide range of research and education programs in fundamental science and engineering. These investments have generated discoveries and advances in science and engineering that have enhanced every facet of our lives – from computing and communications to transportation, national security and the arts, architecture, design and countless other areas.

Today, the progress of science and engineering is not only more central to our lives but has also taken on new dimensions of complexity and integration, making NSF's role both more vital and more challenging. Advances in science and engineering are integral for strengthening the Nation's economic future and overcoming the challenge of securing the homeland and reducing international threats of all types. As an example, in May 2003, computer researchers around the Pacific Rim were mobilized to fight the SARS epidemic, helping to establish a cutting-edge communication grid among quarantined hospitals across Taiwan. In addition to linking the hospitals to each other the grid connected doctors to global sources of health information. NSF's support for the PRAGMA (Pacific Rim Applications and Grid Middleware Assembly) partnership that responded to this call for help from Taiwan's National Center for High-performance Computing has fostered a spirit of trust and cooperation among the sites. Clearly, NSF investments not only transform scientific research and learning but also the handling of critical global events.

Underlying the Foundation's programmatic achievements is NSF's commitment to organizational excellence and sound financial management. In FY 2003, for the sixth consecutive year, NSF received an unqualified "clean" audit opinion on our financial statements. NSF also continued to provide leadership in achieving government-wide goals under the President's Management Agenda. NSF remains the only agency to achieve two "green" successful ratings, for financial management and E-government, and this year advanced to "yellow" status for budget and performance integration. Last spring, the U.S. General Accounting Office (GAO) identified NSF as one of five exemplary federal agencies that successfully demonstrated evaluation capacity in their performance reports due to its evaluation culture, data quality, analytical expertise and collaborative partnership. With respect to the Improper Payments Information Act of 2002, NSF is committed to ensuring that taxpayer money is appropriately spent; the agency's draft action plan was recently submitted to OMB.

As required by section 1116(e) of title 31 of the United States Code, I am pleased to report that the financial and performance information contained in this report is complete and reliable. I am also pleased to report that NSF is in substantial compliance with the requirements of the Federal

Managers' Financial Integrity Act of 1982 (FMFIA) and the Federal Financial Management Improvement Act of 1996 (FFMIA), and that there are no material weaknesses in the agency's management controls. My assessment is based on an independent external consulting firm's recent verification and validation review of the agency's GPRA performance results; NSF Management Controls Committee's organizational review conducted in late summer; and the Independent Auditor's Report received on November 6, 2003.

It is our job here at NSF to ensure that U.S. capabilities are the best in the world and that the returns to the American people who support these activities with their tax dollars meet their highest expectations. It is the dedication of an outstanding staff here at NSF that makes all this possible.

Dr. Rita R. Colwell

November 13, 2003

AGENCY PROFILE

The National Science Foundation (NSF) supports and promotes progress in science and engineering to ensure that our nation maintains its global leadership in science and technology. Congress, recognizing the important contributions made by science and engineering in World War II, established the National Science Foundation (NSF) through the National Science Foundation Act of 1950 (P.L. 81-507), to "promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense." Unlike other federal agencies whose support of research and development is mission-focused, NSF is the only federal agency responsible for advancing research and education across all disciplines of science and engineering. Over the years, the agency has acquired additional responsibilities, including fostering and supporting the development and use of computers and other scientific methods and technologies; providing Antarctic research, facilities and logistic support; and addressing issues of equal opportunity in science and engineering.

Despite its small size, NSF has had an extraordinary impact on America's scientific and engineering knowledge and capacity. With an annual budget of about $5 billion, NSF represents only four percent of the total federal budget for research and development (Figure 1). However, NSF accounts for 13 percent of federal support for basic research and 20 percent of federal support for basic research conducted at colleges and universities (Figure 2). In many fields, NSF is a major source of federal funding to academic institutions, including math and computer sciences (75 percent), the social sciences (64 percent), the environmental sciences (49 percent), engineering (42 percent) and the physical sciences (35 percent).[1]

Figure 1.

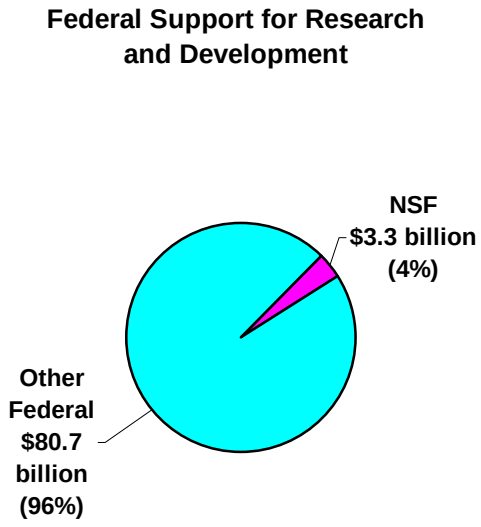
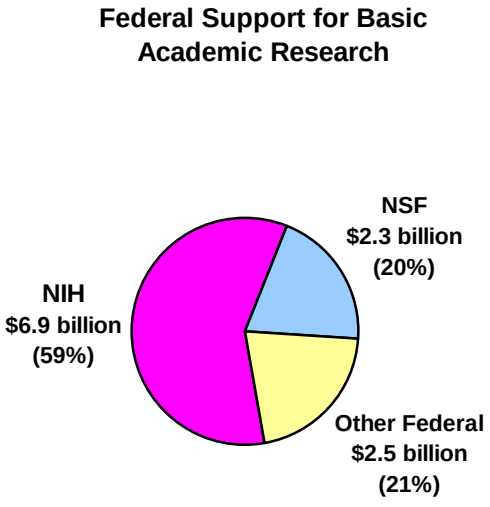


Figure 2.



[1] Source: NSF/SRS/R&D Statistics Program, Survey of Federal Funds for Research and Development, FY 2001-2003.

The NSF Vision: Enabling the Nation's Future through Discovery, Learning and Innovation

Since the end of World War II, the world has received a continuous stream of benefits from science and technology. Economic growth has been driven by high technology industries and advances in science and engineering have enhanced every aspect of our lives – from computing and communications to transportation, national security and the arts, architecture, design and countless other areas.

NSF support of basic research, the source of discoveries and new capabilities, is wide-ranging – from developing new superconducting and super hard materials; understanding climate change to facilitate policy decisions; building better earthquake prediction models; to developing information technology systems that secure privacy and ensure data integrity. NSF's focus on emerging fields – like nanotechnology where work is at a scale one thousand times smaller than most of today's human-made devices; terascale computing, that takes us three orders of magnitude beyond prevailing computing capabilities; and cognition, where focus on the science of learning can advance our capability in everything from teaching children how to read to building human-like computers and robots – has the potential to revolutionize our lives.

Moreover, not since World War II has progress in science and engineering been more important for ensuring our national security. Research on the ecology of infectious diseases and microbial genome sequencing can contribute to a better understanding of potential bioterrorism threats and how to combat them. NSF's Scholarship for Service program trains students in information security and assurance in exchange for service in federal government agencies, thus increasing the nation's capacity to protect vital information. Identifying vulnerabilities in the nation's critical infrastructures like power grids, communications and transportation networks and the water supply systems will allow strengthened protection. Today, in a society defined by and dependent on science and technology, advances in science and engineering are integral to overcoming the challenge of securing the homeland and reducing international threats.

What NSF Does and How We Do It

To achieve its mission to promote the progress of science, NSF invests in three strategic areas: People, Ideas, and Tools.

People: NSF's first priority is to facilitate the creation of a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens. NSF supports efforts to improve formal and informal science, mathematics, engineering and technology education at all levels, as well as public science literacy projects that engage people of all ages in life-long learning. NSF is also committed to enhancing diversity in the science and engineering workforce.

Figure 3.

Estimated Number of People Involved in NSF Activities in FY 2003	
Senior Researchers	30,000
Other Professionals	12,000
Postdoctoral Associates	6,000
Graduate Students	27,000
Undergraduate Students	32,000
K-12 Students	14,000
K-12 Teachers	85,000
Total	206,000

Broadening the participation of individuals who are members of underrepresented groups in the science and engineering workforce as well as the institutional base that trains them will not only further scientific progress by drawing on all intellectual talent but also help meet the need for a broad-based technically trained workforce. Across its science, mathematics, engineering, technology research and education programs, NSF investments support over 200,000 people, including students, teachers, researchers, post-doctorates and trainees.

Ideas: NSF supports cutting edge research and education that yield new and important discoveries and promote the development of new knowledge and techniques within and across traditional fields of study. These investments help maintain the nation's academic institutions at the forefront of science and engineering. The results of NSF-funded projects provide a rich foundation for broad and useful applications of knowledge and the development of new technologies. Support for Ideas also promotes the education and training of the next generation of scientists and engineers by providing students with an opportunity to participate in discovery oriented research.

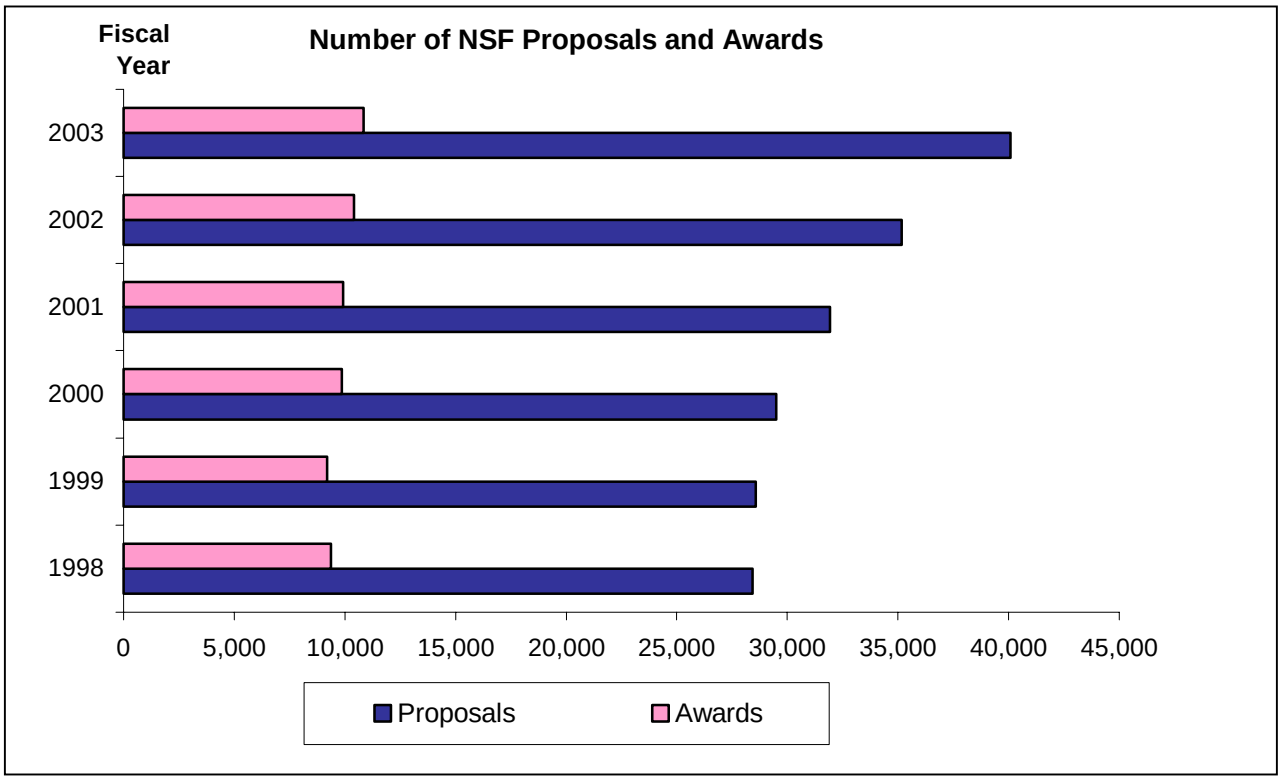
Tools: NSF investments provide state-of-the-art tools for research and education, such as instrumentation and equipment, multi-user facilities, digital libraries, accelerators, telescopes, research vessels and aircraft, and earthquake simulators. In addition, resources support large surveys and databases as well as computation and computing infrastructures for all fields of science, engineering and education. Support for these unique national facilities is essential to advancing U.S. research and education, with the need driven predominately by research opportunities and priorities. NSF-supported facilities also stimulate technological breakthroughs in instrumentation and are the site of research and mentoring for many science and engineering students.

Except for the South Pole Station and other Antarctic Program facilities, NSF does not conduct research or operate laboratories. Instead, the Foundation seeks and funds the best ideas and most capable people, to produce the fundamental knowledge base that enhances progress and promotes discovery in all of science and engineering. In addition, NSF fosters partnerships that connect discovery and learning to innovation and service to society.

In FY 2003, the Foundation processed a record number of proposal actions – over 40,000 – and made 10,844 competitive awards. With a 14 percent increase in proposals in FY 2003, the NSF's funding rate dropped to 27 percent – nearly five percentage points below the average 32 percent rate of the last five years (Figure 4.).

Nearly 90 percent of NSF funding is allocated through a merit-based competitive process that is critical to fostering the highest standards of excellence and accountability – standards for which NSF is known the world over. Reviewers focus on two primary criteria – the intellectual merit of the proposed activity and its broader impacts, e.g., how well the activity promotes teaching, training, and learning and what may be the benefits of the proposed activity to society. Reviewers also consider how well the proposed activity fosters the integration of research and education and broadens opportunities to include a diversity of participants, particularly underrepresented groups.

Figure 4.

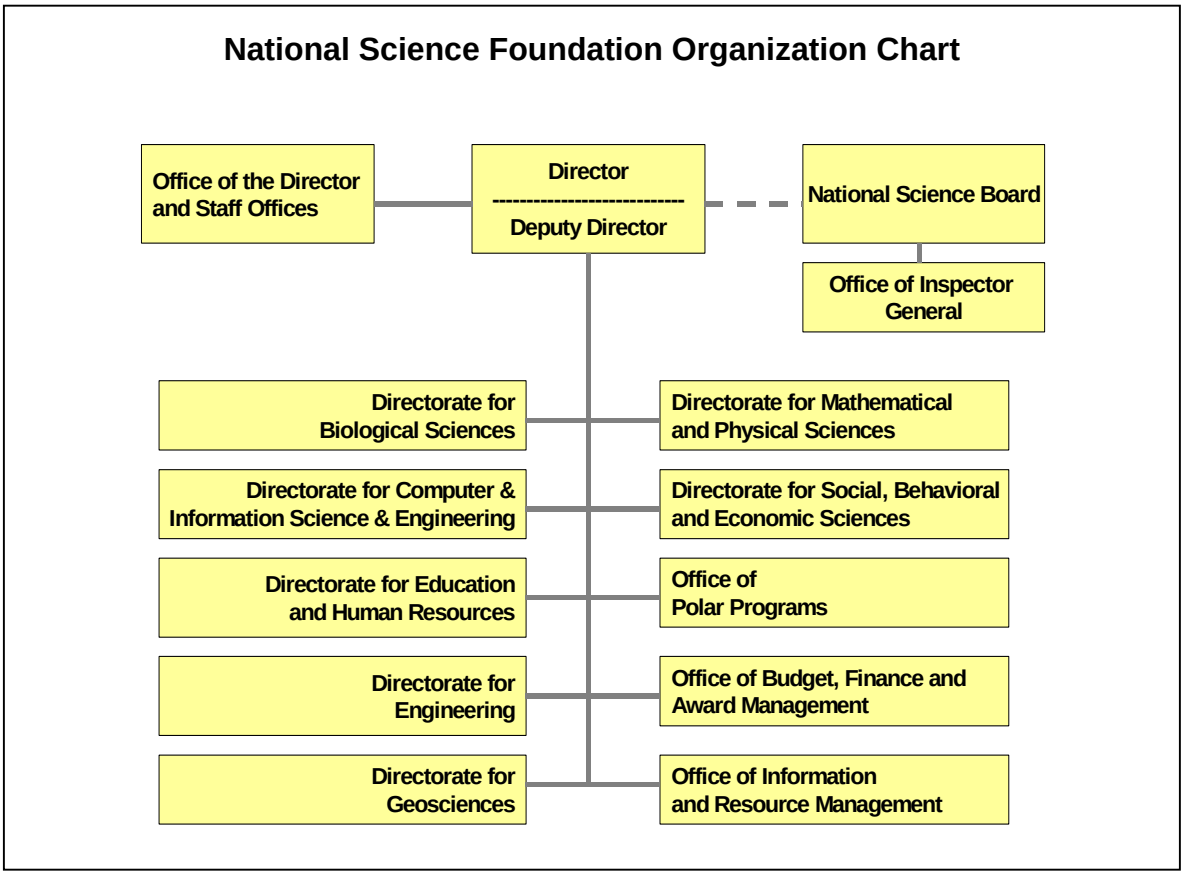


Organizational Structure

NSF is headed by a Director appointed by the President and confirmed by the U.S. Senate. In 1998, distinguished biologist Dr. Rita R. Colwell became the Foundation's eleventh Director and the first woman to head the Foundation. A 24-member National Science Board (NSB) establishes policies and reviews programs of the Foundation. NSB members, prominent contributors to the science, mathematics, engineering and education communities, are appointed by the President with the consent of the Senate. The NSF director is a member *ex officio* of the Board. Both the director and NSB members serve six-year terms. The Board also serves the President and the Congress as an independent advisory body on policies related to the U.S. science and engineering enterprise.

NSF is structured much like an academic institution, with directorates organized by discipline and fields of science and engineering, and for science, math, engineering and technology education. There are seven program directorates, an Office of Polar Programs and two business offices (Figure 5). Appendix 1 provides a detailed description of each directorate and business office.

Figure 5.



NSF is funded primarily by Congressional appropriations and maintains a staff of about 1,250. To ensure that the science and engineering projects funded by the Foundation remain at the frontier of the research enterprise, NSF regularly recruits visiting scientists, engineers, mathematicians and educators who are at the forefront of their fields, to spend one to three years with the agency to complement the permanent workforce.[2] These individuals bring valuable perspectives to NSF's investments in science and engineering.

Operations Management: Doing Business More Efficiently and Effectively

Underlying NSF's commitment to advancing the progress of science and engineering is its commitment to excellence in administration and management. NSF is recognized as a well-managed agency with a long record of success in leveraging its agile, motivated workforce, management processes and technological resources to enhance productivity and effectiveness. NSF is also recognized as a leader in financial management and electronic government (E-Gov), and remains the only federal research agency routinely receiving and processing virtually all its full and complete proposals electronically. However, although NSF's budget has nearly doubled in the last ten years, the agency's staffing level has only increased by about four percent.

[2] These are appointments are made under the Intergovernmental Personnel Act (IPA) and funded through program accounts. In FY 2003, there were 148 IPA appointments at NSF.

Maintaining operations overhead at five percent of the agency's budget is an ongoing challenge, as workload complexity has increased with the increase in multi-disciplinary, collaborative and international activities, as well as new large research facility projects and increased interest in oversight and accountability.

Cost Efficiencies Realized

As a consequence, the Foundation continually strives to do more with less and work smarter by instituting more efficient and cost-effective business processes. In FY 2003, technological and business practices implemented in recent years continued to yield cost efficiencies for the agency. For example, in FY 2003, costs efficiencies realized from electronic dissemination of publications, decrease postage costs and use of videoconferencing totaled nearly $250,000.

- *Electronic dissemination:* NSF launched its external business web site in 1994. As customer access to the Internet expanded over the years, NSF began offering its most requested documents online. Today, virtually all NSF publications are electronically available, and since FY 2002, all program announcements have been available online. A comparison of FY 2002 and FY 2003 demonstrates the effectiveness of the electronic dissemination program. In FY 2002, nearly $348,000 was spent on print dissemination; in FY 2003, that number dropped to about $268,000 – a decrease of $80,000 or 23 percent. This is a notable accomplishment considering that in FY 1998, agency costs for printing publications was about $745,000. Thus, over the last five years, NSF printing costs have decreased by 64 percent.

- *Postage costs*: Postage costs continued to decline this year from a record decline last year. In FY 2003, NSF postage costs were $199,098 – a $102,339 or 34 percent decrease from prior year FY 2002 costs of $301,437. Since FY 1999, NSF postage costs – which were $742,000 – have dropped a remarkable 73 percent.

- *Videoconferencing*: Videoconferencing has become a mainstream meeting technology at NSF. It is estimated that from the 96 tracked videoconferences that were held in FY 2003, NSF realized savings of nearly $60,000 in travel and per diem expenses. Moreover, an additional unquantified benefit of videoconferencing is that it allows wider staff participation at meetings – those from offices with limited travel budgets or staff whose schedules would not have allowed time for travel.

Overall, in FY 2003, NSF engaged considerable efforts in a wide range of management issues. NSF's efforts to improve management and oversight of its complex and diverse portfolio included establishing a formal Award Monitoring and Business Assistance Program (AMBAP); conducting site visits at 32 awardee institutions with nearly 1,400 active awards representing $700 million in NSF support; and the drafting of the Award Monitoring and Business Assistance Program Guide. To enhance large facilities management, a new Deputy Director for Large Facilities position was filled in June 2003, and a Facilities Management & Oversight Guide was released. [3] NSF enhanced the agency's overall security posture in FY 2003 by implementing an agency-wide information technology security program that encompasses all aspects of information security including policy and procedures, risk assessments and security plans, managed intrusion detection services, vulnerability assessments, and technical and management

[3] www.nsf.gov/pubsys/ods/getpub.cfm?nsf03049

security controls. Significant time and resources were devoted to the certification and accreditation of NSF's general support systems; by year-end, 18 of 19 systems were completed. NSF also invested considerable efforts to address workforce planning and training issues, including development of a strategic plan for human capital management and initiation of an agency-wide workload analysis. The following discussion of the President's Management Agenda addresses many of NSF's current management issues.[4]

Meeting Future Challenges

The current environment in which NSF operates is changing. NSF faces an unprecedented opportunity over the next five to 15 years to influence the course of the nation. NSF's achievements have the potential to make a profound impact on the strength of the U.S. and world economy and on the continued leadership of the U.S. well into the 21st century. Moreover, NSF faces an invaluable opportunity to influence the number, quality and focus of America's student population. A key need is to increase the number of degree candidates in science, mathematics, engineering and technology thereby contributing to the number of citizens qualified to participate in the nation's science and technology workforce.

This year, NSF is undergoing several major organizational reviews, all of which should yield significant information to help re-structure and re-position the agency to meet the challenges of the 21st century. In response to Congressional guidance provided in House Report 107-740, the National Academy of Public Administration is conducting a review of NSF's organizational, programmatic, and personnel structures to assure that the agency is positioned to maximize opportunities that may accrue from future increased funding. Results from this study are expected in early 2004. The National Academy of Science is conducting a study of NSF's priority setting for major facilities projects at NSF and its report is expected in April 2004.

NSF itself, as part of its Administration and Management Strategic Plan, is currently engaged in a major multi-year comprehensive Business Analysis that is examining the agency's core business processes, workforce management and information technology architecture.[5] In FY 2002, NSF began working with an external management consulting firm, undertaking a three-year project that will highlight agency needs and opportunities. The outcomes of this Business Analysis will help guide NSF's long-term administration and management investments.

[4] Included in the appendix is a report, "NSF's Management Challenges and Reforms," which also addresses many of NSF's current management issues.

[5] http://www.nsf.gov/od/am/StrategicPlan/am_fullreport.htm

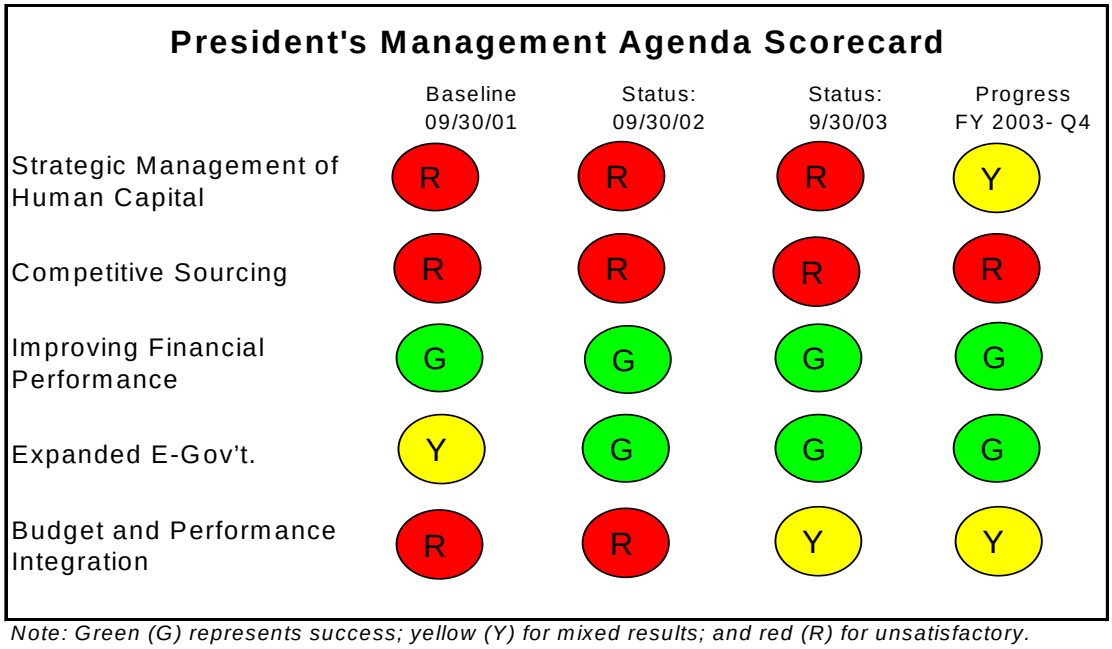
PRESIDENT'S MANAGEMENT AGENDA

In September 2001, the President's Management Agenda (PMA) launched a government-wide strategy to improve the management, performance and accountability of federal agencies.[1] The PMA consists of management initiatives in five areas: Strategic Management of Human Capital; Competitive Sourcing; Improved Financial Performance; Expanded Electronic Government (E-Gov); and Budget and Performance Integration.

The White House Office of Management and Budget (OMB) has closely monitored the implementation of the PMA initiatives by establishing a stoplight scoring system to track the progress of agencies in meeting specific criteria under each of the PMA initiatives. In FY 2001 and FY 2002, NSF was the only federal agency to receive a "green" successful rating for any of the PMA initiatives – for financial performance in FY 2001 and for both financial performance and E-Gov in FY 2002.

In FY 2003, NSF retained its "green" successful status for financial performance and E-Gov and advanced from a "red" to "yellow" status for the Budget and Performance Integration initiative. NSF continued to work closely with OMB to clarify specific management improvements, establish accountability and develop useful management tools and a set of milestones for each initiative to achieve success in future years. NSF's current priority is to achieve a green rating on the Human Capital initiative. Figure 6 shows NSF's current PMA status; a discussion of each of the initiatives follows.

Figure 6.



Note: Green (G) represents success; yellow (Y) for mixed results; and red (R) for unsatisfactory. Ratings are issued quarterly by the Office of Management and Budget. For more information on the President's Management Agenda, see www.results.gov/agenda/scorecard.html.

[1] www.whitehouse.gov/omb/budget/fy2002/mgmt.pdf

PMA Initiative 1 – Strategic Management of Human Capital: Build, sustain, and deploy a skilled, knowledgeable, diverse and high performing workforce; develop human capital strategies that are linked to agency mission and goals; develop a vision and roadmap for strategically managing the agency workforce to better accomplish the agency's mission.

Status as of September 30, 2003: Red
Progress as of September 30, 2003: Yellow

Progress: NSF is developing a Human Capital Management Plan that will provide the strategic framework for achieving the PMA Human Capital initiative. To date, NSF has completed the overview and outline for the initial Human Capital framework that integrates and links human capital activities to the NSF Business Plan and to the Human Capital Assessment and Accountability Framework provided by the Office of Personnel Management (OPM). An inventory of business functions and activities for the NSF-wide workload analysis has been completed and the competencies for all key occupations have been defined. Competency models have been developed for 90 percent of NSF positions; the remainder is scheduled to be completed in early FY 2004.

Upcoming Action/Challenges: Portions of the Human Capital Management Plan are already being implemented; for instance, a major research directorate is currently undergoing reorganization and is serving as the pilot/model for other implementations recommended by the Business Analysis. Implementation of the remaining action plans and strategies is scheduled to begin in early FY 2004.

PMA Initiative 2 – Competitive Sourcing: Use competitive sourcing to perform commercial functions more efficiently.

Status as of September 30, 2003: Red
Progress as of September 30, 2003: Red

Progress/Upcoming Action: NSF is developing a strategic approach to workforce planning and deployment. Initial results from the NSF Business Analysis, including the initial version of an agency Human Capital Plan, will be available during the first quarter of FY 2004. Based on its assessment of the Business Analysis, which will inform possible structural or functional realignments across the agency, NSF will develop a preliminary strategy for addressing the competitive sourcing initiative.

PMA Initiative 3 – Improved Financial Performance: Provide accurate and timely financial information that will enhance better management decisions; integrate financial and performance management systems that support daily operations; maintain financial systems that meet federal requirements; prepare clean and timely financial statements with no material weaknesses.

Status as of September 30, 2003: Green
Progress as of September 30, 2003: Green

Progress: NSF has successfully met all the core criteria for financial performance and has been rated "green" for success since 2001. NSF is a leader in federal financial management and expects to retain this position.

Upcoming Action/Challenges: NSF is required to submit audited financial statements to the Office of Management and Budget on an accelerated schedule of 45 days after the end of the fiscal year beginning in FY 2004. This is approximately two months earlier than is currently required. NSF has developed an automated data warehouse environment from our financial system that will allow the agency to compile automated financial statements virtually on demand for timely and accurate reporting. NSF piloted the new reporting in FY 2003 and is well positioned to meet the upcoming accelerated timeframes.

PMA Initiative 4 - Expanded Electronic Government (E-Gov): Using technology to the fullest to provide services and information focused on citizens.

Status as of September 30, 2003: Green
Progress as of September 30, 2003: Green

Progress: NSF has maintained a green status in electronic government since FY 2002. NSF has a long and distinguished history of electronic grants management efforts and since October 2000, has conducted virtually all business interactions electronically with its external grantee community. NSF is actively engaged in supporting numerous E-Government initiatives such as E-Payroll, the E-Human Resources Initiatives, E-Travel, Integrated Acquisition Environment, E-Authentication, and is integrating existing systems into government-wide capabilities when they become available. The Foundation is a full-fledged Grants.gov Partner Agency, contributing both financial and staff support to participate in technology evaluations, technical panels, steering committees, stakeholder committees, and working groups. NSF is continuing to evolve FastLane, the agency's interactive real-time system that is used to conduct business with the grantee community over the Internet, to seamlessly integrate with Grants.gov. In addition, a new Electronic Jacket System (E-Jacket) is being developed and released in phases as a path-finding effort for NSF's back office grants management functions. The implementation of E-Jacket will significantly reduce paper documents by maintaining proposal and award records electronically and allowing the electronic signing of official documents by staff.

Security of information technology (IT) systems is a management issue of the highest priority for NSF. In FY 2003, the Foundation made significant investments to enhance an already strong security program and produced remarkable results. At the close of FY 2003, NSF had completed the 19 major milestones and 54 subtasks planned for the year, and is on schedule to complete the remaining tasks. Equally important, 18 of 19 general support systems were certified and accredited (C&A) in FY 2003. In addition, for the second consecutive year, over 90 percent of NSF staff and contractors completed security awareness training. Based on an audit and review of the Foundation's security program, the NSF Office of Inspector General (OIG) closed out three prior year findings and reported three new findings that they consider to be "significant deficiencies." The three new findings and recommendations address certification and accreditation; the United States Antarctic security program; and security policies and procedures. Management generally agrees with the recommendations and, in fact, has already taken or completed action in many of the areas. We strongly disagree, however, with the "significant

deficiency" classification of each of the three findings, as they do not represent a weakness in a policy, procedure, or practice that materially impacts the effectiveness of the entity-wide security program.

Upcoming Action/Challenges: All of NSF's investments in information technology are guided by and consistent with the Federal Enterprise Architecture. NSF continues to ensure that its five-year IT Plan is consistent with government-wide E-Gov efforts. NSF will continue to focus its efforts on planning and integrating next generation technology initiatives with E-Government initiatives and implementation of initiatives to address security needs. Recognizing there are always risks that must be appropriately assessed and mitigated, NSF's overall security program and posture continues to be positive and reflects a commitment to continuous and sustained improvement to what will remain complex and challenging issues in the years ahead.

PMA Initiative 5 – Budget and Performance Integration (BPI): Align planning, budgeting and performance, in order to develop an integrated process in which strategic planning drives budgetary decisions and tracks accountability for performance and cost.

Status as of September 30, 2003: Yellow
Progress as of September 30, 2003: Yellow

Progress: NSF has made steady progress toward Budget and Performance Integration (BPI). Its score on the PMA scorecard rose from "red" to "yellow" on the most recent scorecard issued in October 2003. This improvement was driven largely by the update of NSF's Strategic Plan, as the plan now aligns NSF's strategic outcome goals with ten "investment categories." These investment categories provide the framework both for completing the PART (Program Assessment Rating Tool) and for the linkage of full budgetary and proprietary cost accounting. In addition, the agency's FY 2005 Budget submission to OMB incorporated the new alignment and included a presentation of the request with full budgetary costing.

Upcoming Action/Challenges: NSF is now in the process of aligning its Financial Accounting System with these investment categories so that budgeted cost, actual cost, and performance can be tracked in tandem for NSF's investments.

GPRA PERFORMANCE RESULTS

NSF is engaged in a wide range of assessment activities and has a long-standing practice of conducting evaluation projects. In May 2003, the U.S. General Accounting Office (GAO) identified NSF as one of five exemplary federal agencies successfully conducting evaluative activities.[7] Committees of Visitors (COVs) and Advisory Committees (AC) reporting on Directorate/Offices are two review panels that the Foundation has used for over 20 years to conduct independent assessments of the quality and integrity of NSF's investments. With respect to broader issues, NSF often uses external third parties such as the National Academy of Sciences for outside review. NSF may also convene an external panel of experts for a special study.[8] In FY 1999, NSF began reporting on the agency's annual GPRA (Government Performance and Results Act of 1993) performance goals and in FY 2002, NSF began using a new assessment tool – the Program Assessment Rating Tool (PART). PART is an evaluative questionnaire developed by the White House Office of Management and Budget (OMB) for rating federal programs.

As required by the Reports Consolidation Act of 2000, NSF's FY 2003 GPRA performance results are reported here in an integrated agency Performance and Accountability Report. This report includes a two-part presentation of NSF's GPRA performance results. The GPRA discussion included in this Management's Discussion and Analysis (MD&A) chapter highlights some of NSF's GPRA performance results. Pertinent background information and a brief discussion of some relevant GPRA performance issues are included to help put NSF's GPRA results in proper context for those who may not be familiar with the GPRA process. For a comprehensive discussion of each GPRA goal see Chapter II, "Detailed Performance Information." Chapter II also includes a summary table of NSF's GPRA results as well as other performance information specified in OMB Circular A-11, "Preparation, Submission and Execution of the Budget."

NSF began implementation of GPRA in 1997 by developing an agency GPRA Strategic Plan.[9] The plan was updated in October 2000 and established three strategic outcome goals – People, Ideas and Tools (PIT) – that provided the guiding framework for NSF's FY 2003 Annual Performance Plan as well as NSF's FY 2003 Budget Request. The FY 2003 Annual Performance Plan[10] and the FY 2003 Budget Request[11] were developed concurrently to ensure a direct link between programmatic activities and the achievement of NSF's strategic outcome goals.

GPRA implementation has been a particular challenge for agencies like NSF whose mission involves long-term investments like research and education. This is primarily due to: (1) the difficulty of linking outcomes to annual investments and the agency's annual budget; it is not unusual for the benefits of research to appear years or even decades after the initial investment,

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[7] GAO-03-454, GAO Report to Congressional Committees: *Program Evaluation: An Evaluation Culture and Collaborative Partnerships Help Build Agency Capacity*, May 2003.

[8] See Appendixes 5, 6, and 7 for more detailed information on NSF's assessment activities, a list of evaluations completed in FY 2003 and a schedule of NSF program evaluations.

[9] Both the recently updated strategic plan (*NSF's GPRA Strategic Plan, FY 2003-2008)* and the prior plan (*NSF's GPRA Strategic Plan, FY 2001-2006)* are available on NSF's website. See www.nsf.gov/od/gpra/Strategic_Plan/FY2003-2008.pdf and www.nsf.gov/pubs/2001/nsf0104/start.htm .

[10] www.nsf.gov/od/gpra/perfplan/fy2003/FY2003RevisedFinalPlan.pdf

[11] http://www.nsf.gov/bfa/bud/fy2003/start.htm

and (2) the fact that assessing the impact of advances in science and engineering is inherently retrospective and is best performed through the qualitative judgment of experts. Nonetheless, as previously noted, NSF was one of five exemplary federal agencies recently identified by the GAO as having demonstrated evaluation capacity in their performance reports due to its evaluation culture, data quality, analytic expertise, and collaborative partnerships.

NSF has developed an alternative GPRA reporting format that has been approved by OMB, using an external expert review panel to assess program results and achievement with respect to research outcome goals on a qualitative rather than a quantitative basis. The use of external expert panels to review results and outcomes is a common, long-standing practice used by the academic research and education community. NSF's use of such panels (e.g., Committees of Visitors) predates GPRA and was specifically cited as an example of a good quality assessment tool in the GAO report as well as in a memorandum on research and development investment criteria issued jointly by OMB and the Office of Science and Technology Policy (OSTP) on June 5, 2003, to all federal agency heads.[12]

In FY 2002, in response to the Administration's mandate to accelerate the reporting of agency performance results, NSF reengineered its GPRA assessment and reporting process. An Advisory Committee for GPRA Performance Assessment (AC/GPA) was established, comprising experts from various disciplines and fields of science, engineering, mathematics and education. The AC/GPA was charged with evaluating agency performance with respect to NSF's FY 2002 GPRA strategic outcome goals. In June 2003, the AC/GPA was reconvened to evaluate the Foundation's FY 2003 outcomes of prior investments in People, Ideas and Tools. However, as the reporting and determination of results for performance goals are inherently governmental functions, NSF makes the final determination on achievement using the Advisory Committee as one critical input.

Because it was impractical for an external committee to review the contributions to the associated performance goals by each of the over 22,000 active awards, NSF Program Officers provided the Committee with about 875 summaries of notable results relevant to the GPRA goal performance indicators. The Committee also had access to three years of Committee of Visitor (COV) reports – program assessments conducted by external programmatic expert panels that are routinely used by NSF program management, and the Project Reports on NSF-funded awards submitted by Principal Investigators.

Collections of outstanding accomplishments and examples ("nuggets") from awards obtained from expert sampling by Program Officers, together with COV reports and investigator project reports, formed the primary basis for determining, through the recommendations of the external Advisory Committee for GPRA Performance Assessment, whether or not NSF demonstrated significant achievement with respect to its FY 2003 GPRA Strategic Outcome Goals for People, Ideas and Tools. The Committee, which included experts in statistics and performance assessment, had thorough discussions on the sampling technique used for the nuggets. The approach to nugget collection is a type of non-probabilistic sampling, commonly referred to as "judgmental" or "purposeful" sampling, that is best designed to identify notable examples and

[12] June 5, 2003 memoranda from John H. Marburger III and Mitchell E. Daniels to the Heads of Executive Departments and Agencies, "FY 2005 Interagency Research and Development Priorities."

outcomes resulting from NSF's investments. It is the aggregate of collections of notable examples and outcomes that can, by themselves, demonstrate significant agency-wide achievement in the Strategic Outcome Goals. It is possible that the Committee could incorrectly conclude that NSF failed to show significant achievement, due to the limited set, when it actually achieved the goals. That is, the Committee could conclude that NSF did not show sufficient achievements based upon only hundreds of results while, if time permitted, reviewing hundreds or thousands more would add enough to show sufficient total results.

The inverse, however, could not occur. If a subset were sufficient to show significant achievement, then adding more results would not change that outcome. Therefore, the limitation imposed by using a "judgmental" sample is that there is a possibility, though likely small given hundreds of examples, that significant achievement would not be sufficiently demonstrated while a larger sample would show otherwise.

Regarding sampling, the Committee noted in their report that "The Committee believes that a purposeful sampling technique, i.e., one that relies on the judgment of internal experts (NSF program staff) combined with review by an external group of experts, is appropriate, reasonable and useful for GPRA reporting purposes. Such a technique will provide adequate data on which to base conclusions about performance relative to NSF's outcome goals."[13]

The process of assessment by our external advisory committee was itself assessed by IBM Consulting, our verification and validation contractor (V&V). Their report concluded that "We also verified and validated that the AC/GPA process to evaluate NSF's achievement against its Strategic Outcome Goals involves a robust collection of performance information, reviewed qualitatively by a highly qualified and diverse Committee of science experts, with sufficient documentation and transparency to assure accountability and confidence in the AC/GPA's assessments."[14]

While NSF will continue to monitor whether there are significant gaps in nuggets from segments of our portfolio, IBM Consulting studied the materiality, relevance and significance of the nugget sample. For materiality, they "conclude that the nuggets materially represent a sufficient share of overall NSF resources, committed to funding research, for the AC/GPA to rely upon to make its assessments."[15] Regarding relevance, IBM concluded "that the judgmentally selected nuggets roughly represent an equivalent level of NSF resources devoted to each directorate. This provides some assurance that relevant elements of NSF's program awards portfolio are being reflected in the nuggets provided to the AC/GPA."[16] For significance, IBM determined that NSF is using the appropriate approach for sampling and that significance would be impacted if judgmental sampling were replaced, for example, by random sampling: "On the issue of judgmental verses random sampling of nuggets, we believe that the use of judgmental sampling is appropriate for the purposes of the AC/GPA. Judgmental sampling assures that those programs that NSF professional staff judge as scientifically significant are included in the nuggets for use by the

[13] "Report of the Advisory Committee for GPRA Assessment," September 12, 2003; see http://www.nsf.gov/od/gpra/reports/ACGPA%20Report%20for%20FY%202003%20accessible.pdf
[14] "Government Performance and Results Act (GPRA) Performance Measurement and Verification. Report on FY 2003 Results." IBM Consulting, October 2003.
[15] *Ibid.*
[16] *Ibid.*

Committee. Because of the importance of applying professional judgment in the selection process, the traditional audit approach of random sampling would not meet the standard of "significance" in this instance."[17]

The Committee had access to over 50,000 project reports and three years of COV reports in addition to nuggets. While it is correct that some COV reports do not address all three strategic outcome goals, the volume of information covering the NSF portfolio from these various sources vastly overshadows these minor gaps. The work of COVs is well known to the Committee membership as most currently and formerly served as COV members. IBM Consulting concluded that "Given the charge of the AC/GPA to provide a qualitative, rather than quantitative, judgment on NSF's outcomes, we believe that NSF fulfilled its responsibility to provide adequate performance information by giving the committee access to all available sources of information via the AC/GPA website and allowing the committee to determine for themselves how best to use this information."[18] NSF will continue to fulfill its responsibility in this area and to work to improve this process.

Selected Performance Goals and Results

For FY 2003, NSF's annual performance goals are organized into two categories – Strategic Outcome Goals and Management Goals.

- The Strategic Outcome Goals focus on the long-term results of NSF grants and programs. They represent what the agency seeks to accomplish with the investments that are made in science and engineering research and education. NSF's outcomes from its awards provide evidence of the success of its investments in People, Ideas and Tools. For a more detailed discussion of each of the Foundation's FY 2003 Strategic Outcome Goals, see Chapter II.

- NSF's Management Goals focus on the factors and strategies that enable the Foundation to successfully implement and attain its strategic outcomes. The Management Goals address five performance areas: proposal and award processes; award portfolio; award oversight and facilities management; business practices; and human resources and workplace issues. For a more detailed discussion of each of the Foundation's FY 2003 Management Goals, see Chapter II.

FY 2003 Strategic Outcome Goals: Among agency achievements were the following:

- NSF demonstrated significant achievement in developing a diverse, internationally competitive and globally-engaged workforce of scientists, engineers, and well-prepared citizens.

- NSF demonstrated significant achievement in enabling discovery across the frontier of science and engineering, connected to learning, innovation and service to society, and

[17] "Government Performance and Results Act (GPRA) Performance Measurement and Verification. Report on FY 2003 Results." IBM Consulting, October 2003.
[18] *Ibid*.

- NSF demonstrated significant achievement in providing broadly accessible, state-of-the-art and shared research and education tools.

The following examples illustrate the impact and success of NSF's investments in People, Ideas and Tools. Because many research results appear long after the period when the investment is made, these are outcomes and results of NSF support of research and education projects made in prior years that emerged in FY 2003. Additional examples can be found in Chapter II.

✓ PEOPLE: *Digital Libraries for Children: Computation Tools That Support Children as Researchers***:** This was a three-year demonstration project[19] to develop a children's digital library environment. A team working with children ages 7-9 years and teachers as "design partners," developed new digital library technologies focusing on multimedia information resources donated by the Discovery Channel and the Patuxent Wildlife Research Center. The project has resulted in: (1) development of a digital library prototype (SearchKids) that can be used by multiple children at the same time, thanks to a special interface that enables multiple mice to be used simultaneously on one computer; (2) a linked zoomable presentation tool (KidPad); (3) evaluation of the software with 120 second- and third-grade children, demonstrating that young children not normally capable of complex Boolean searches can do so more efficiently and accurately given a visual interface; and (4) generalization of the technology to work with other databases. The team is collaborating with the Library of Congress and the Internet Archive to develop the largest international children's book digital library in the world. The research has attracted media coverage, e.g. *Online Library Project Plans a Cultural Trove for Children* (The New York Times Online, December 5, 2002) and *Library for Kids Goes Online* (National Public Radio, November 18, 2002).

✓ PEOPLE: *Louis Stokes Alliances for Minority Participation Program (LSAMP)*: Collectively, the reach of the LSAMP program is extensive, including Alaska, Washington, Montana, Texas, Florida, Puerto Rico, Massachusetts, New York, Rhode Island, Pennsylvania, the Carolinas, Illinois, Indiana, Ohio, Missouri, Oklahoma, Tennessee, Colorado, New Mexico, Arizona, California and Hawaii.[20] In 2002, more than 22,000 under-represented minority students received science, technology, engineering and mathematics (STEM) baccalaureate degrees via the LSAMP program. The program now includes 31 alliances representing nearly 400 individual institutions. Beginning Fall 2003, 130 new LSAMP graduates are expected to enter graduate school programs in STEM disciplines at 13 graduate institutions across the country. These outcomes of the LSAMP program indicate progress toward addressing the long-term goal of increasing the production and diversity of Ph.D.s in science, technology, engineering and mathematics with an emphasis on entry into faculty and research positions.

✓ IDEAS: *African Ice Cores Reveal Prolonged Tropical Droughts***:** Ohio State University professors Lonnie Thompson and Ellen Mosley-Thompson led an

[19] www.cs.umd.edu/hcil/kiddesign/searchkids.shtml
[20] http://www.ehr.nsf.gov/hrd/amp.asp

international team of researchers to the summit of Mt. Kilimanjaro to collect glacial ice cores in order to study the history of tropical climate and the African monsoon system. What they discovered was completely astonishing. Through careful analyses, the researchers recreated an unprecedented and highly detailed record of three catastrophic droughts that plagued the region 8,300, 5,200 and 4,000 years ago. Glaciers at the top of Mt. Kilimanjaro in Tanzania began forming 11,700 years ago. Data from the ice cores reveal a wetter landscape in the region some 9,500 years ago than compared to today. Lake Chad, now the fourth largest body of water on the African continent with an area of 17,000 square kilometers, then covered 350,000 square kilometers – an area larger than the modern day Caspian Sea. But beginning around 8,300 years ago, the ice cores reveal a climate of recurring and prolonged droughts, some lasting 300 years. While the causes of such climatic events are under active study by the Thompsons and colleagues, their recurrence is of major concern because 70 percent of the world's population now lives in the tropics, and social systems can be dramatically stressed by climate events of the magnitude recorded in the ice. The study of paleoclimates from ice cores is at the cutting edge of new insights and technologies that enable broader understanding of the interaction of climate and society.

- ✓ IDEAS: *Discovering How Some Plants Resist Insects May Lead to Safer Insect Control*: When plants are chewed by insects, they often respond by producing proteins that protect them from being eaten. Doctors Dawn S. Luthe, Peter Ma, and Tibor Pechan of Mississippi State University, have discovered an enzyme in corn that drastically slows the growth of caterpillars by damaging their midgut. This is a fundamentally new mechanism of plant resistance to insects that could greatly benefit the agricultural industry. It may be possible, in the future, to use this to genetically engineer plants to resist insect feeding, which is currently responsible for 15 percent of the world's crop losses, a major economic and ecological problem that decreases the supply of food to a growing human population. The availability of effective and environmentally safe insect control is important to everyone. The discovery of this fundamentally new mechanism of plant resistance could revolutionize the control of insect damage to crops.

- ✓ IDEAS: *Research across disciplines – earthquakes and supershear*: Jean Carlson is a condensed matter theorist who has discovered a new phenomenon involved in earthquake rupture dynamics: locally stronger fault sections, rather than slowing ruptures, drive them forward at velocities exceeding the shear wave speed. This work helps us to understand not only the damage mechanism of earthquakes but also the failure of engineering materials. The research involved performing computer simulations of models for the rupture process that occurs during an earthquake, taking into account variations in stresses or the presence of non-uniform geophysical materials that have different strengths. This research has yielded a possible explanation of earthquake phenomena observed in the earthquakes of 1999 in Turkey and in 1984 at Morgan Hill, California, and possibly others, while at the same time providing insight into the shear fracture failure of materials.

- ✓ TOOLS: *High-Performance Probes Developed at NHMFL*. A unique capability of the National High Magnetic Field Laboratory (NHMFL) at Florida State University is

to develop high-performance probes for nuclear magnetic resonance (NMR) spectroscopy and imaging. These probes, which are used, for example, to study membrane proteins and materials chemistry under high magnetic fields, are not commercially available. The unique magnets at the NHMFL generate unique instrumentation requirements; the NHMFL instrumentation staff works with an international group of application scientists, users, academic and industrial collaborators to meet user needs. Probes have been developed for NMR studies of inorganic solids and for magnetic resonance imaging (MRI). More probes are in development for biological and inorganic solids. One such probe has been used to obtain spectra sensitive enough to resolve different valence states in a solid sample. Other probes used for solid-state NMR provide measurements over a wide temperature range for samples smaller than 5 mm. High-sensitivity cryoprobes for solution NMR experiments are in great demand, and probes are currently being developed for NMR at the highest fields available. These probes enable investigations of the behavior of a wide variety of materials that would otherwise be impossible or much too time-consuming.

- ✓ TOOLS: *Most Detailed Images of the Early Universe:* Using a powerful new instrument deployed at the South Pole, a team of cosmologists led by the University of California at Berkeley has produced the most detailed images of the early Universe ever recorded. The new results provide additional evidence to support the currently favored model of the Universe in which 30 percent of all matter is in the form of dark matter. Sixty-five percent is in the form of dark energy that appears to be causing the expansion of the Universe to accelerate. Only the remaining five percent of the Universe takes the form of familiar matter like that which makes up planets and stars. This new information was made possible by a new sensitive instrument – the Arcminute Cosmology Bolometer Array Receiver (ACBAR). ACBAR was specifically designed to take advantage of the unique capabilities of the 2.1-meter Viper radio telescope, installed by NSF at the Amundsen-Scott South Pole Station in Antarctica. The receiver is an array of 16 detectors that create images of the sky in 3-milllimeter wavelength bands near the peak in the brightness of the Cosmic Microwave Background.

FY 2003 Management Goals: Among agency achievements were the following:[21]

- Despite a 14 percent increase in the number of proposals to over 40,000 received this year, nearly 80 percent of award/decline decisions were made within six months of receipt. From customer satisfaction surveys conducted in the past, the amount of time it takes to process a proposal is one of the most significant concerns of the science and engineering research community; NSF has exceeded its 70 percent target goal for the second consecutive year.

[21] For more detailed information about each of NSF's GPRA performance goals and results, including baseline data, recent trends, performance targets, explanations of unachieved goals and the agency's plans to meet these goals in the future, see Chapter II.

- Allocated nearly 90 percent of funds to projects reviewed by external peers and selected through merit-based competition. This is the sixth consecutive year that the Foundation has exceeded the goal of 85 percent, a target that was set consistent with OMB guidance.

- Ninety-nine percent of the agency's program announcements were available at least three months prior to proposal submission deadline. This is the second time that the agency has achieved its 95 percent target goal since its establishment in 1999. Last year the goal was missed by one percentage point; clearly the additional efforts made towards achieving this goal, which included better planning for competitions requiring individual announcements and solicitations and improved clearance processes, were successful.

- Nearly 100 percent of Principal Investigator (PI) award transfers were received and processed electronically through FastLane, substantially exceeding the target goal of 90 percent. This goal focuses on award transfers between organizations, a process that is initiated when a PI moves from one institution to another. The capability to process PI award transfers was a frequent request of the grantee community. This was a new goal established in FY 2003.

Among the Management Goals that were not achieved were the following:

- NSF did not achieve its goal to increase the average duration of awards for research projects to at least three years. This largely reflected the limited resources available to Program Directors who must balance competing needs of increasing award size and duration and/or making more awards. Although this is the third consecutive year that the agency failed to achieve this goal, NSF has made progress over the last five years in increasing the average duration rate – from the FY 1998 baseline of 2.7 years to the FY 2003 rate of 2.9 years. The Foundation is committed to its long-term goal of increasing award duration to five years; even though the Foundation was not able to reach the target for FY 2003, there is now a much higher level of awareness and appreciation of the importance of continuing to work toward the long-term goal.

- NSF did not fully implement Phase III of the Electronic Jacket (E-Jacket) application. The E-Jacket is part of the Foundation's effort to create an integrated, paperless proposal and award-processing environment; E-Jacket extends NSF's paperless processing environment to internal systems and allows staff to process a proposal from submission through closure, and eventually, will also have the ability to archive all proposals electronically. Although Phase III capabilities were developed as planned, implementation was delayed to ensure staff was properly trained and ready to use the new capabilities. Additional efforts for outreach and training, and testing for pilot deployments are underway to assure a smooth transition in FY 2004.

Data Verification and Validation

Foundation staff verified and validated all NSF performance data. In addition, for the fourth consecutive year, NSF engaged an independent, external consulting firm to conduct verification and validation review of all the performance measures. The assessment was based on criteria established by the General Accounting Office's *Guide to Assessing Agency Annual Performance Plans (GAO/GCD-10.1.20).*

Their review of the Management Goals included assessing the accuracy of NSF's performance data and reported outcomes of performance goals and indicators; describing the reliability of the processes NSF uses to collect, process, maintain and report data; reviewing system controls to confirm that quality input results in quality output; creating detailed process descriptions and process maps for those goals being reviewed for the first time; and identifying changes to processes and data for those goals undergoing an update review. The final verification and validation review report stated the following:

> "We commend NSF for undertaking this fourth-year effort to confirm the reliability of its GPRA data and results and its processes to collect, process, maintain, and report data for its performance goals. From our FY 2003 review, we conclude that NSF has made a concerted effort to assure that it reports its performance results accurately and has effective systems, policies, and procedures to promote data quality. Overall, we verify that NSF relies on sound business practices, internal controls, and manual checks of system queries to report performance. NSF maintains adequate documentation of its processes and data to allow for an effective verification and validation review. Further, we validate the reliability of NSF's third and fourth quarter results through our successful recalculation or reconfirmation of these results based on processes, data and systems."[22]

The consulting firm was also asked to review the work of the AC/GPA. The team verified that the AC/GPA process of evaluating NSF's achievements against its Strategic Outcome Goals involved a robust collection of performance information and that this performance information was reviewed qualitatively by a highly qualified and diverse committee of science experts with sufficient documentation and transparency to assure accountability and confidence in the AC/GPA's assessments.

The Linkage Between Budget, Performance and Costs

NSF's budget is funded though six Congressional appropriations:[23] Research and Related Activities (R&RA); Major Research Equipment and Facilities Construction (MREFC); Education and Human Resources (EHR); and Salaries and Expenses (S&E). A fifth appropriation funds the Office of the Inspector General. In FY 2003, Congress authorized and provided a separate sixth appropriation to fund the National Science Board.

Approximately 95 percent of NSF's budget goes directly to the investments it makes in support of its Strategic Outcome Goals of People, Ideas and Tools. The remaining five percent of the budget goes toward Administration and Management, which provides support for the immediate activities of the agency, e.g., processing proposals, issuing awards and overseeing projects.

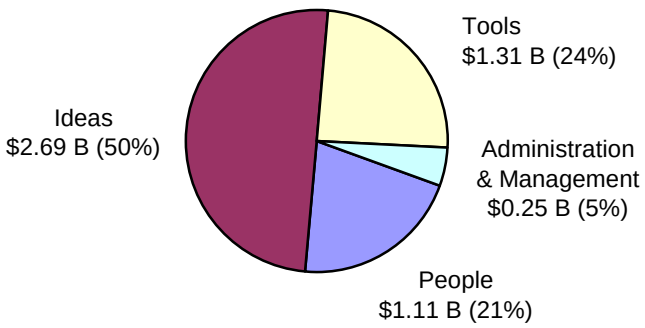
[22] "Government Performance and Results Act (GPRA) Performance Measurement and Verification. Report on FY 2003 Results." IBM Consulting, October 2003, page 1.

[23] Other revenue sources such as reimbursable authority, appropriations transfers from other federal agencies, donations and H-1B Nonimmigrant Petitioner receipts account for a minor portion of NSF's budget.

As shown in Figure 8, NSF's the Strategic Outcome Goals were supported at the following levels: $1.11 billion for People, $2.69 billion for Ideas and $1.31 billion for Tools. Support for Administration and Management activities, which are addressed by the Management Goals, is at $250.63 million.

Figure 7.

NSF FY 2003 Budget Obligations- $5.37 Billion



[Note: Total does not add due to rounding.]

Figure 9 shows how each of NSF's budget accounts support the agency's Strategic Outcome and Management Goals. The Research and Related Activities and Education and Human Resources accounts have components distributed among all three strategic outcome goals. The deployment of funds in these two accounts to the People, Ideas or Tools goals is done on a program-by-program basis. In practice, each of NSF's several hundred programs is assigned to one of the People, Ideas or Tools strategic areas based on the program's principal objective. A list of programs associated with each strategic outcome goal can be found in the NSF Strategic Plan. NSF's Statement of Net Cost is also presented in terms of the agency's three strategic outcome goals of People, Ideas and Tools. Cost data are also developed at the programmatic level, by tracking the program elements and their alignment with the People, Ideas, and Tools goals.

However, this view of how NSF deploys its budget does not reflect a key facet of NSF's approach – the multiple purposes each investment serves. For example, research projects in programs categorized under Ideas commonly provide funds that involve graduate students. They contribute, therefore, to the People strategic outcome goal. These indirect investments are important to the attainment of the Foundation's goals, and NSF program officers are expected to take such potential contributions into account when making awards. The synergy attained across the three strategic goals attests to the real strength of the NSF process.

Figure 8.
FY 2003 Support of NSF's Strategic Outcome and Management Goals
(Obligations in Millions of Dollars)

	Strategic Outcome Goals			**Management Goals**	
Account	*People*	*Ideas*	*Tools*	*Administration & Management*	*Total*
R&RA	$365.83	$2,539.81	$1,111.24	$37.55	$4,054.43
EHR	748.21	152.15	22.43	12.09	934.88
MREFC	-	-	179.03	-	179.03
S&E	-	-	-	189.42	189.42
OIG	-	-	-	8.70	8.70
NSB	-	-	-	2.88	2.88
Total	$1,114.04	$2,691.96	$1,312.70	$250.64	$5,369.34

Note: R&RA=Research & Related Activities; EHR=Education and Human Resources; MREFC=Major Research Equipment and Facilities Construction; S&E=Salaries and Expenses; OIG=Office of Inspector General; and NSB=National Science Board. Totals may not add due to rounding.

MANAGEMENT INTEGRITY: CONTROLS, COMPLIANCE AND CHALLENGES

The Federal Managers' Financial Integrity Act of 1982 (FMFIA) requires annual review of an agency's internal accounting and administrative controls. The results of NSF's assessment are being reported here in the agency's *FY 2003 Performance and Accountability Report*, consistent with the provisions of the Reports Consolidation Act of 2000.

The National Science Foundation's Management Controls Committee (MCC), chaired by the Chief Financial Officer, is responsible for reviewing and reporting on management controls to the Director. The Committee requires that NSF Assistant Directors and Staff Office Directors provide annual statements on FMFIA reviews and the status of management controls within their organizations. These statements serve as the primary basis for the Foundation's assurance that management controls are adequate.

Based on the organizational reviews conducted in late summer 2003, MCC reported to the Director, NSF, that the agency's management controls and financial management systems, taken as a whole, provide reasonable assurance that provisions of FMFIA Section 2 (internal and administrative controls) and Section 4 (financial systems) were achieved for FY 2003, as well as requirements of the Federal Financial Management Improvement Act (FFMIA). NSF systems are in compliance with applicable laws and administrative requirements, including OMB Circular 123 (Management Accountability and Controls) and OMB Circular 127 (Financial Management Systems).

During the FY 2003 management controls evaluation process, MCC did not identify any material weaknesses as defined by OMB guidance. The Committee's review did identify two issues that have risen to a significant level of concern across the agency: human resource support and IT security. While not of the magnitude to put them within the boundary conditions of FMFIA as material weaknesses, the concerns are serious and widespread, and have the potential to impact the agency's ability to accomplish its mission. NSF already gives high priority to addressing these issues. Steps taken include an ongoing business analysis, with plans for the development and implementation of human capital strategies; a strengthened IT security management structure and the continual improvement of IT security; the certification and accreditation of information systems; and budget requests for additional resources. NSF has also elevated its commitment by establishing a new goal for organizational excellence in its recently updated Strategic Plan, addressing human capital, business processes, and technology and tools for the workplace.

As in previous years, during the FMFIA assessment process senior management also identified other management challenges. These challenges are not of the magnitude of those of noted above. They are, nevertheless, important to NSF. They are complementary to the challenges identified by the Office of Inspector General, and in line with the initiatives covered by the President's Management Agenda, including Human Capital Management; Financial Management; Expanded Electronic Government; Budget and Performance Integration; and Competitive Sourcing. Several of the challenges noted in the FY 2003 reports have been or can be resolved through processes already in place. Other challenges will be addressed by increased management attention. MCC also noted that, following GAO recommendations, NSF changed the way it apportioned Salaries and Expenses funds during a period covered by one of the FY 2003 Continuing Resolutions, to base apportionment on calendar rather that compensable days.

In the FY 2003 Independent Auditors' Report, NSF received an unqualified opinion on its financial condition, with no material weaknesses and one reportable condition: post-award monitoring. The Foundation has made substantial progress in the development of policies and procedures for post-award management. The reportable condition, cited also in two previous audits, focuses now on the need for resources to ensure full implementation of the agency's plans. NSF is committed to continuing to enhance its activities for post-award monitoring and to seek additional resources.

The Director of NSF has determined that the National Science Foundation is in substantial compliance with FMFIA and FFMIA. Her statement of assurance is included in the Director's letter, on page I-1.

DISCUSSION AND ANALYSIS OF THE FINANCIAL STATEMENTS

The National Science Foundation is committed to providing quality financial management to all its stakeholders. It honors that commitment by preparing annual financial statements in conformity with generally accepted accounting principles in the United States and then subjecting the statements to an independent audit to ensure their reliability in assessing the performance of NSF. For FY 2003, NSF received an unqualified opinion that the principal financial statements were fairly stated in all material respects. The independent auditors did not report any material weaknesses. However, there was one reportable condition related to post-award management.

Understanding the Financial Statements

NSF's FY 2003 financial statements and notes are presented in the formats required for the current year by OMB Bulletin No. 01-09, *Form and Content of Agency Financial Statements*, dated September 25, 2001, and OMB Memorandum entitled *FY 2003 Financial and Performance Reporting*, dated August 13, 2003. NSF's current year financial statements and notes are presented in a comparative format providing financial information for FY 2003 as well as for FY 2002. The Stewardship Investment Statement presents information over the past five years.

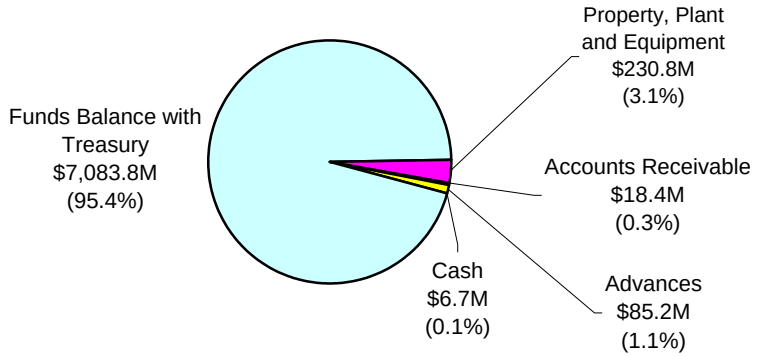
The following provides a brief description of the nature of each required financial statement and its relevance to NSF. Some significant balances or conditions are explained to help clarify their link to NSF operations.

Balance Sheet: The Balance Sheet presents the combined amounts available for use by NSF (assets) against the amounts owed (liabilities) and amounts that comprise the difference (net position).

Three line items consisting of *Fund Balance with Treasury; Property, Plant and Equipment;* and *Advances* represent 99 percent of NSF's current year assets. *Fund Balance With Treasury* is funding available through the Department of Treasury accounts from which NSF is authorized to make expenditures and pay amounts due. *Property, Plant and Equipment* comprises capitalized property located at NSF headquarters and NSF-owned property in New Zealand and Antarctica that support the United States Antarctic Program (USAP). *Advances* are funds advanced to NSF grantees, contractors, and other government agencies.

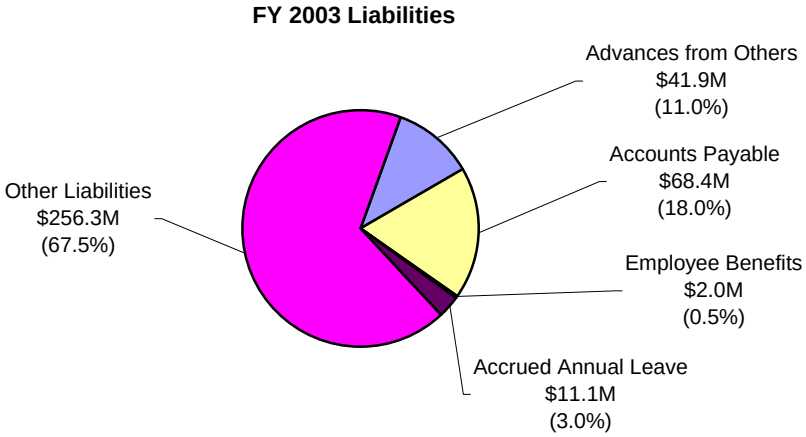
Figure 9.

FY 2003 Assets



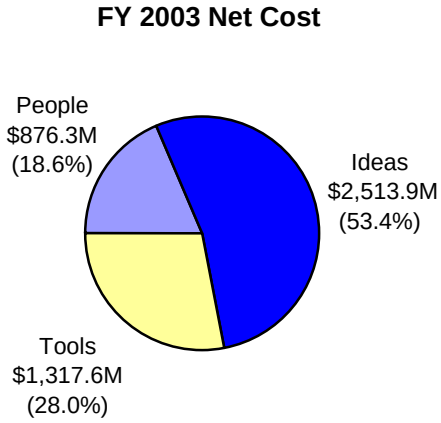
Three line items, *Advances From Others, Accounts Payable* and *Accrued Liabilities* (*Other Liabilities)* represent 95 percent of NSF's current year liabilities. *Advances From Others* are prior year amounts remaining advanced to NSF from other federal entities for the administration of grants on their behalf. NSF maintains the expertise and automated systems for the administration of research grants upon which other federal entities rely to assist in the administering of their grants. *Accounts Payable* includes liabilities to NSF vendors for unpaid goods and services received. *Accrued Liabilities* are amounts recorded for NSF's grants and contracts for which work has been completed, although payment has not been rendered.

Figure 10.



Statement of Net Cost: This statement presents the annual cost of operating NSF programs. The gross cost less any offsetting revenue for each NSF program is used to arrive at the net cost of specific program operations. *Intragovernmental Earned Revenues* are recognized when the related program or administrative expenses are incurred and are deducted from the full cost of the programs to arrive at the net cost of operating NSF's programs.

Figure 11.



Note: Included in People, Ideas and Tools is approximately four percent of Salaries & Expenses, National Science Board and OIG costs.

Approximately 96 percent of all current year NSF costs incurred were directly related to the support of NSF People, Ideas and Tools programs. Costs were incurred for indirect general operation activities – e.g., as salaries, training, activities related to the advancement of NSF information systems technology, and the activities of the National Science Board and the Office of Inspector General. Salaries and Expenses activities account for slightly more than four percent of the total current year NSF Net Cost of Operations. NSF is continually committed to administrative efficiency.

Statement of Changes in Net Position: This statement presents those accounting items that caused the net position section of the Balance Sheet to change from the beginning to the end of the reporting period. NSF's Net Position increased to $7,045 million in FY 2003 – an increase of 11 percent – due to the $15.6 million increase in *Cumulative Results of Operations* and the $682.5 million increase in *Unexpended Appropriations*. *Cumulative Results of Operations* is affected mainly by *Appropriations Used* and *Net Cost of Operations* with minor impact from *Donations* received and *OPM Imputed Financing Costs. Unexpended Appropriations* is affected mainly by *Appropriations Received* and *Appropriations Used*, with minor impact from *Appropriation Transfers from USAID* and *Other Adjustments*, which include appropriation rescissions and cancellations.

Statement of Budgetary Resources: This statement provides information on how budgetary resources were made available to NSF for the year and the status of those budgetary resources at year-end. For FY 2003, Budgetary Authority for Research and Related Activities, Education and Human Resources, Major Research Equipment and Facilities Construction, the National Science Board, OIG and Salaries & Expenses were $4,083 million, $974 million, $150 million, $3 million and $200 million, respectively. *Total Budgetary Resources* and *Net Outlays* both increased by 12 percent in FY 2003 and are consistent with NSF's increase in appropriated funds. The *Net Outlays* reported on this statement reflects the actual cash disbursed for the year by Treasury for NSF obligations; it is reduced by the amount of Trust Fund receipts, to include donations and interest received by NSF.

Statement of Financing: This statement illustrates a relationship between *Net Obligations* derived from NSF's budgetary accounts and the *Net Cost of Operations* reported on the Statement of Net Cost, which is derived from NSF's proprietary accounts. The statement is structured to first identify total resources classified by obligations, and then other adjustments are made to those resources based on how additional items financed those resources or contributed to net cost. The result of the relationship adjustments is a *Net Cost of Operations* total that reconciles to the Statement of Net Cost. *Total Resources Used to Finance Activities* are only resources that have been obligated and are derived from information provided on the Statement of Budgetary Resources. *Total Resources Used to Finance Items not Part of Net Cost of Operations* consists mainly of an adjustment to undelivered orders of the agency that are reflected in net obligations but not part of *Net Cost of Operations. Components Requiring or Generating Resources in Future Periods* adjusts for future funded expenses that are recognized in *Net Cost of Operations* but resources will not be provided until subsequent periods.

Stewardship Investments: Stewardship investments are NSF-funded investments that yield long-term benefits to the general public. NSF investments in research and education yield quantifiable outputs shown in this statement as the number of awards made and the number of researchers, students and teachers supported in the pursuit of discoveries in science and engineering and in

science and math education. Stewardship investments from FY 2002 to FY 2003 showed consistent incremental increases in research and human capital activities in support of NSF's overall mission as reported in monetary investments and measured output/outcomes. This is also in line with overall funding increases over the past four years.

Budgetary Integrity: NSF Resources and How They Are Used

NSF is funded primarily through six Congressional appropriations that totaled $5.3 billion in FY 2003, a 10.4 percent increase from the prior year.[24] As of September 30, 2003, other FY 2003 revenue sources included $108.9 million in reimbursable authority, $13.1 million in appropriation transfers from other federal agencies, and $42.2 million in donations to support NSF activities. Additional resources were also received from the Department of Justice under the American Competitiveness and Workforce Improvement Act, enacted in 1998, which provides for a temporary increase in access to skilled personnel from abroad under the H-1B visa program. As of September 30, 2003, NSF had received $65.3 million from H-1B nonimmigrant petitioner fees, to support education activities and scholarships for financially disadvantaged students in computer science, engineering, and mathematics.

As indicated in the Statement of Net Cost, the Foundation made investments in education and fundamental research in support of its three strategic outcome goals of People, Ideas and Tools. Administrative support for the Foundation is provided through five appropriation accounts: Salaries and Expenses, Research and Related Activities, and Education and Human Resources. The Office of Inspector General is funded under a separate appropriation, and this year there is a new account for funding the Office of the National Science Board.

In FY 2003, in addition to funding disciplinary research, the Foundation supported five key multidisciplinary priority areas: Biocomplexity in the Environment, Information Technology Research, Nanoscale Science and Engineering, Mathematical Sciences, and Human and Social Dynamics. Support was also provided for polar programs, major research instrumentation, as well as education activities that span from pre-K to the post-doctoral level. Among major research and equipment and facilities construction projects funded were the Atacama Large Millimeter Array (ALMA) aperature-synthesis radio telescope; the High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER); the IceCube Neutrino Detector Observatory in Antarctica; and the Large Hadron Collider.

At the time of this report, NSF had not yet received an FY 2004 appropriation. However, NSF's FY 2004 Request includes ongoing support for the five FY 2003 priority areas. Among the research and education activities slated for support in FY 2004 are: investments in cyberinfrastructure, to bring next-generation computer and networking capabilities to researchers and educators nationwide; fundamental research that will help address new homeland security challenges facing the nation; the Administration's Climate Change Research Initiative; and ongoing research on the genomics of plants of major economic importance. NSF will maintain its long-term goal to increase the size and duration of research grants and special emphasis is being focused on investments in the mathematical and physical sciences. Ongoing support is also being provided for several major research equipment and facilities construction projects.

[24] Includes a government-wide 0.65 percent rescission.

Improper Payments Information Act of 2002

In May 2002, Congress enacted legislation that requires federal agencies to identify and reduce improper payments in government programs and activities. In OMB Circular A-11, Exhibit 57B, Information on Erroneous Payments, the Office of Management and Budget identified NSF research and education grants and cooperative agreements as the programs for which erroneous payment information is required on an annual basis. While NSF has pre-award internal controls to effectively reduce any risk of improper payments to a low level on all programs, adopting expanded techniques to reduce improper payments made by third party recipients of NSF funds is also an important part of our plans to address this issue. NSF performed a full inventory assessment of all our appropriation activities and determined the Exhibit 57B programs and major research equipment awards present the most significant risk to NSF for third party improper payments. For NSF commercial activities, contracts are significantly less than $500 million annually, which is the OMB threshold requirement for recovery audits. The level of incorrect payments for purchase and travel cards is minimal, and we are expanding monitoring activities in these areas.

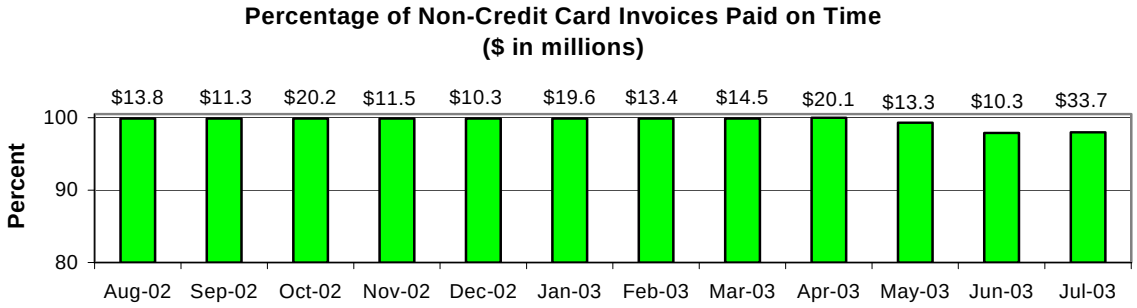
On October 17, 2003 NSF submitted to OMB a draft action plan for preventing and reducing improper payments in compliance with the Improper Payments Information Act of 2002 . We requested OMB provide any comments to our draft action, which can be considered and included in our final plan. The final NSF plan to prevent and reduce improper payments will be submitted to OMB by November 30, 2003.

Financial Metrics.

This section is intended to relate key financial measures of NSF's core business of awarding grants and our progress in associated electronic processes. NSF is always striving to leverage automation to accomplish our mission. Figures 13, 14, and 15 focus on the agency's Federal Cash Transaction Report (FCTR) process, a key part of our core award business. Figures 16, 17 and 18 depict the latest available information on key measures for NSF as reported in the federal Measurement Tracking System (MTS) sponsored by OMB's Office of Federal Financial Management.[25] The third chart summarizes some of NSF's key workload and financial indicators.

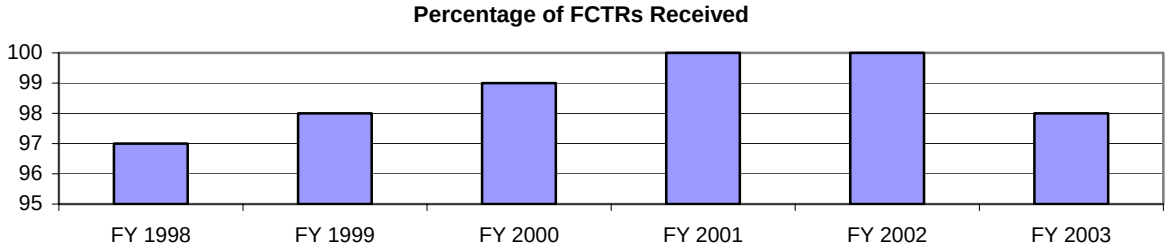
[25] http://www.fido.gov/mts/

Figure 12.



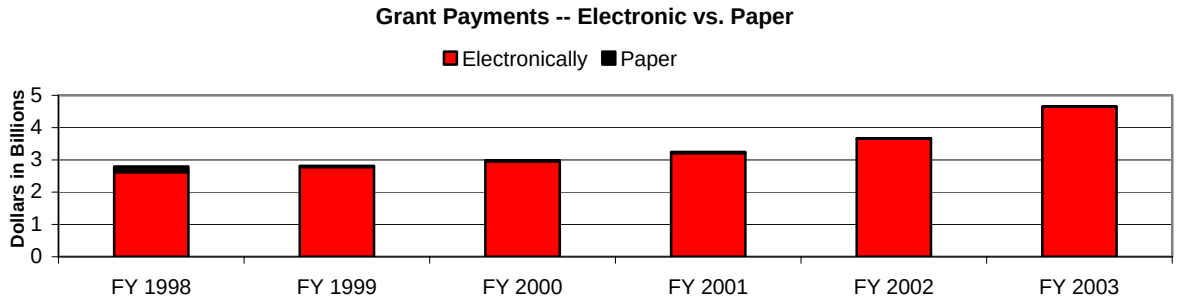
In FY 1998, NSF established the capability for grantees to go online through a web-based "FastLane" system to electronically transmit Federal Cash Transaction Reports (SF 272), required by nearly all federal grant-making agencies. Within two years, virtually 100% of NSF grantees were submitting FCTR reports online.

Figure 13.
NSF receives close to 100% of FTCR reports from those grantees eligible to use



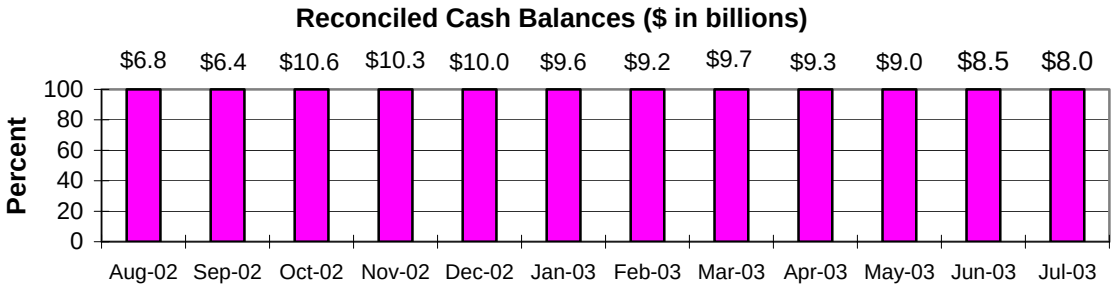
electronic transmission of the report. Foreign grantees without U.S. banks are not eligible to use FastLane Cash Request.

Figure 14.



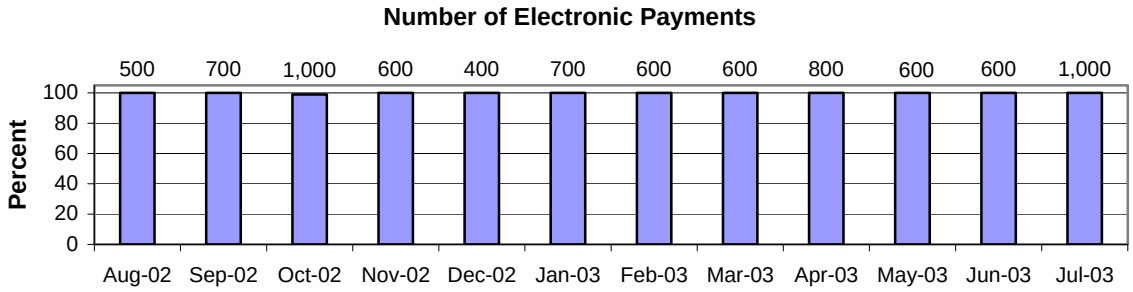
Customer-friendly enhancements to the FastLane FCTR module have greatly enhanced the efficiency of payments to grantees. Nearly 100% of grantee payments are transmitted electronically.

Figure 15.



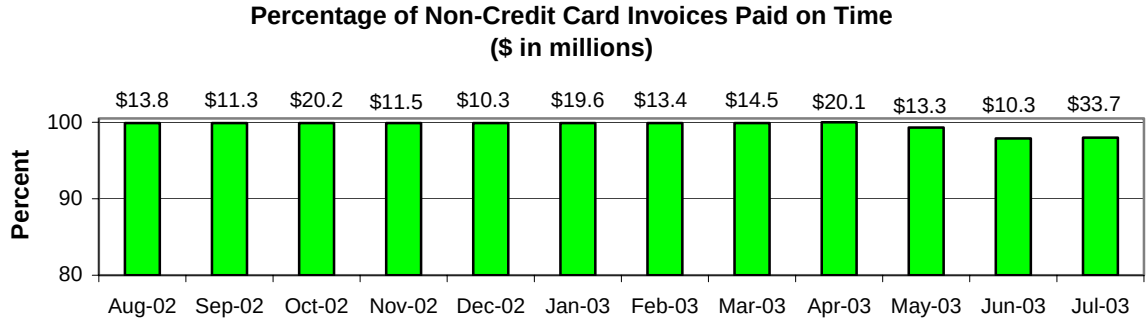
NSF continually reconciles our Fund balances with Treasury. (Note: July 2003 is currently most recent data available.)

Figure 16.



NSF requires all commercial vendor payments be made through EFT, except foreign ones. (Note: July 2003 is currently most recent data available.)

Figure 17.



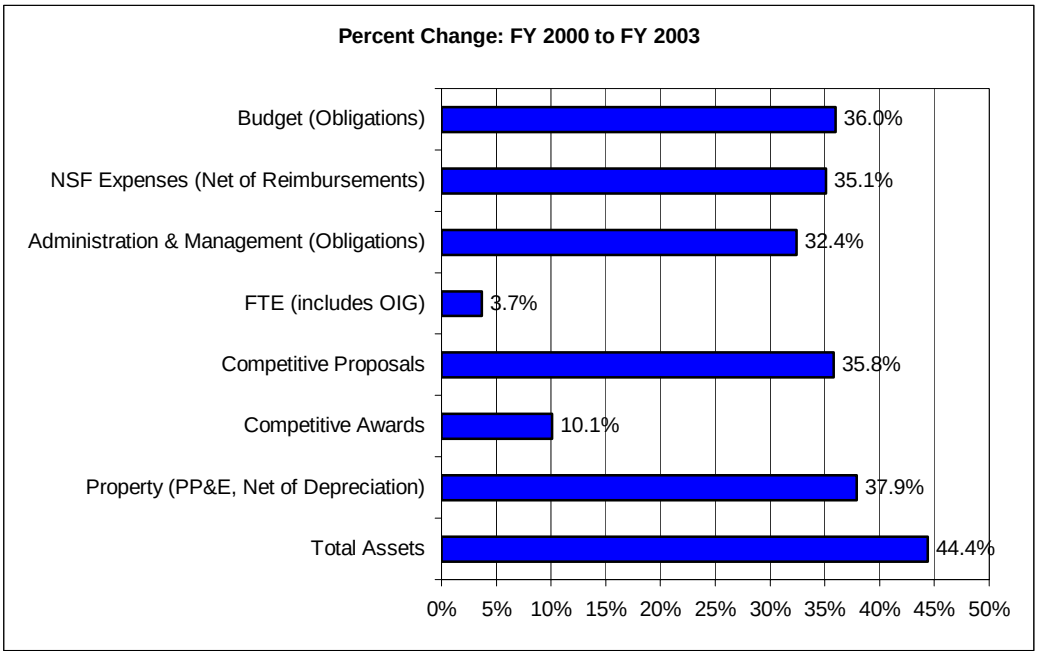
NSF has implemented an accounts payable module in its financial accounting system which ensures that Prompt Payment Act requirements are met. (Note: July 2003 is currently most recent data available.)

Figure 18.

Recent Trends

The following table summarizes several of NSF's key workload and financial indicators. For the period FY 1999-2003, NSF's expenses, administrative and management costs, competitive proposals and competitive awards all increased, reflecting the increase in NSF's budget. However, over this period, there has been only a small increase in staff. NSF property increased substantially due to the Antarctic South Pole Station Modernization multi-year project that is underway. NSF's total assets increased mainly due to a larger cash balance with Treasury, which is also related to NSF's budget increase.

	FY 2000	FY 2001	FY 2002	FY 2003	% Change FY 00-03
Budget (Obligations)	$3,948.43 M	$4,532.32 M	$4,774.06 M	$5,369.34 M	36.0%
NSF Expenses (Net of Reimbursements)	$3,484.51 M	$3,698.14 M	$4,132.27 M	$4,707.77 M	35.1%
Administration & Management (Obligations)	$189.32 M	$213.72 M	$230.58 M	$250.64 M	32.4%
FTE (incl. NSB & OIG)	1,200	1,220	1,242	1,244	3.7%
Competitive Proposals	29,508	31,942	35,164	40,075	35.8%
Competitive Awards	9,850	9,925	10,406	10,844	10.1%
Average Annual Research Grant Size	$105,800	$113,601	$115,666	$135,609	28.2%
Average Research Grant Duration (in yrs)	2.8	2.9	2.9	2.9	3.6%
Property (PP&E, Net of Depreciation)	$167.36 M	$203.24 M	$224.14 M	$230.78 M	37.9%
Total Assets	$5,140.31 M	$6,001.90 M	$6,713.15 M	$7,424.92 M	44.4%



Future Business Trends and Events

NSF is continuously evolving as we focus on new priorities and challenges. The future will require NSF to focus on demonstrating management excellence through sharpened attention to specific financial operational issues. For example, the President's Management Agenda (PMA) and other new administrative policy initiatives mandate that NSF, like other agencies, demonstrate consistent results and progress in improving financial management practices. NSF, although continuing to receive high marks from OMB and the financial community, will need to engineer constant improvements in achieving ever evolving management and policy initiatives. NSF is also committed to improving service to its stakeholders and leveraging technology. In addition, the agency also pro-actively addresses management challenges identified through internal review and oversight. Some of the areas NSF will focus on in both the immediate future and long term are:

- *Accelerated and Interim Reporting:* The Administration has set aggressive criteria to measure agency success in improving financial performance as part of the PMA. The goal is for agencies to produce accurate, timely, and reliable financial information on a regular, recurring basis and use that information to make informed decisions. The first part of the "improving financial performance" PMA initiative was to produce reliable financial information more than once a year. OMB Bulletin 01-09, *Form and Content of Agency Financial Statements*, provided guidance on interim reporting requirements for financial statements. OMB Bulletin 01-09 requested semi-annual financial statements to be prepared in FY 2002 and quarterly financial statements in FY 2003 and thereafter. NSF was able to achieve the first part of this initiative and produce interim statements by implementing many changes in its financial statement process to include: on-demand general ledgers, automated year-end and closing entries, accrual automation, and automated financial statements generated from a crosswalk in a data warehousing environment.

  The second part of the initiative was to produce more timely financial information by accelerating due dates for reporting from March 31 to November 15. OMB Circular A-11 and OMB Bulletin 01-09 provide instructions on accelerated reporting dates. Agency Performance and Accountability Reports (PAR) are due to the President, OMB, and Congress on January 31, for FY 2002 and FY 2003 and November 15, for FY 2004. NSF met the January 31 date last year and the current report for FY 2003 was prepared as a "dry run" to meet the November 15 date. NSF is currently implementing major changes in order to meet the accelerated reporting deadlines. A significant effort was undertaken in FY 2002 to re-tool and re-schedule NSF's GPRA process and for FY 2003 related advisory committee and validation efforts were moved three months earlier. NSF's Performance and Accountability Report preparation schedule and work plan were also revamped. Meetings were held early in the year with OMB and the OIG regarding efforts on an accelerated schedule. The outcome was a jointly signed CFO and OIG correspondence to OMB dated April 24, 2003 that detailed NSF's pilot attempt in FY 2003 at accelerating the PAR process. A key factor has been working collaboratively with the agency's OIG and external auditors to reengineer our combined schedule. Overall, this Herculean effort significantly increased demands on human capital resources across-the-board and at a small agency like NSF, required innovative ideas to achieve.

- *Budget, Cost and Performance Integration*: NSF has taken a broader, systemic view of the PMA initiative in Budget Performance Integration by including the cost element, thereby establishing a fully integrated process that provides the agency with more complete information to make informed resource allocation decisions. In developing its plan for Budget, Cost and Performance Integration (BCPI), NSF sought input from OMB, the OIG and the NSF Advisory Committee on Budget and Operations. A key step to developing the BCPI Plan has been the update of the agency's GPRA Strategic Plan, which was completed in September 2003. The updated plan establishes a framework for integrating budget, cost and performance by identifying a set of investment categories under NSF's strategic outcome goals. These investment categories represent the "programs" that are used to align NSF's portfolio, as each can be clearly identified with resources and performance goals. NSF is now beginning to map this new budget and program framework to its financial system and its, Statement of Net Cost, and developing methodologies for full budgetary costing. FY 2005 OMB Budget Request incorporated the new alignment and an illustration of full budgetary costing, and NSF expects the FY 2005 Congressional justification will as well.

- *E-Grants*: NSF continues our support as a full-fledged Grants.gov partner agency among the eleven partner agencies in the Government-wide Grants.Gov Initiative, and we continue to be a leader in this important President's Management Agenda activity. See PMA discussion on E-Gov.

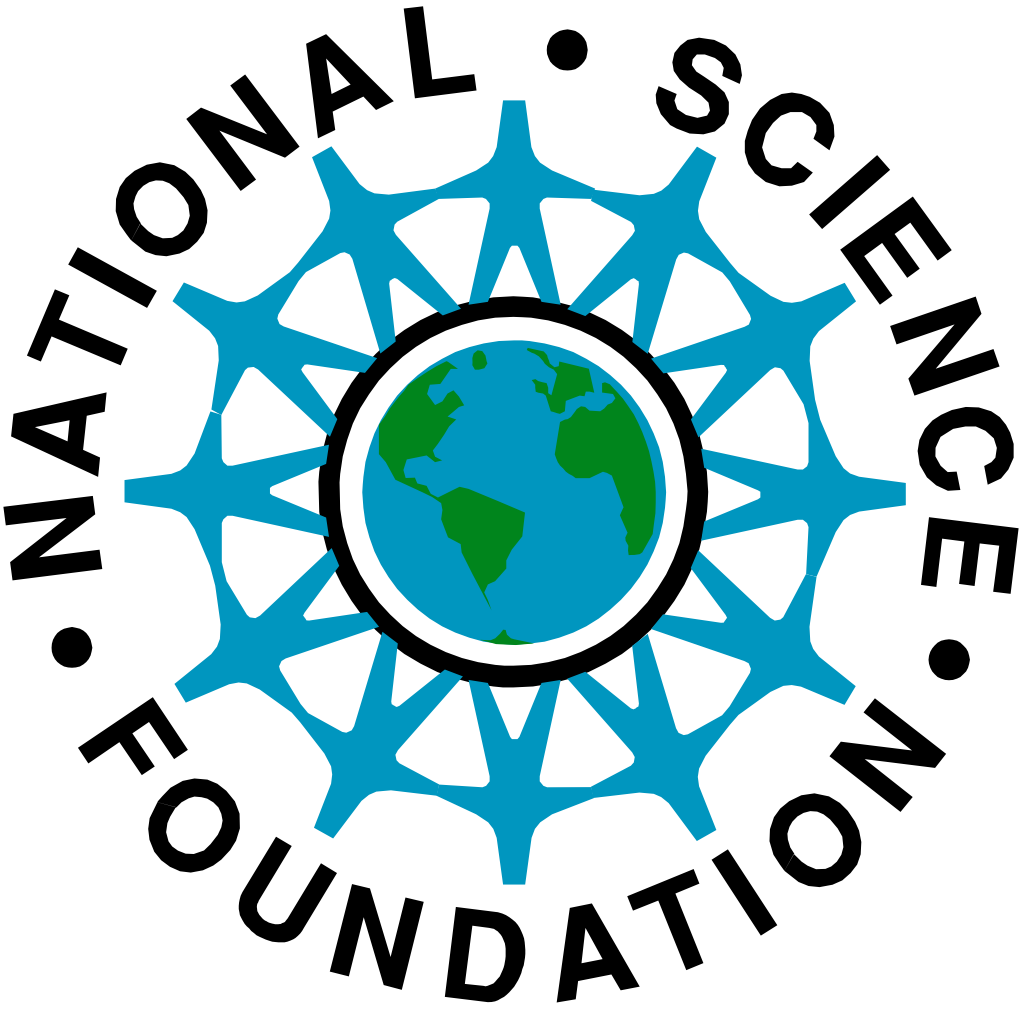
- *E-Payroll:* OMB has charged the Office of Personnel Management (OPM) with leading the E-Payroll effort to transform the current federal payroll service environment into a more efficient system, as mandated by the President's Management Agenda. Currently, 22 executive branch payroll providers use varying customized capabilities and technology. The initiative plans to standardize and consolidate payroll processing and reduce the number of payroll systems. NSF selected the Department of Interior, National Business Center (DOI) to convert both our payroll and personnel process. NSF currently has separate payroll and personnel systems that interface to process payroll. The new DOI system will be completely integrated in capturing payroll and personnel information. This outsourcing initiative will require NSF to undergo a substantial effort to transition agency employees involved in personnel and payroll to the new system processes. NSF has created a steering committee to oversee the process and workgroups to accomplish the many required tasks, including developing new internal management plans, a robust communication plan, as well as a detailed migration plan with DOI. NSF's migration to the new system is scheduled for March 2004. The agency is making a large commitment of resources to ensure this effort is successful and has minimal impact on all employees, while seamlessly integrating the new system into NSF's enterprise technology system architecture.

- *E-Travel*: NSF is working with GSA in FY 2003 as a participating pilot agency on the E-Travel solution (E-TS). This project, one element of the President's Management Agenda E-Gov initiative, will provide a government-wide, integrated state of the art web-based solution for travel authorization; reservation and ticketing; and vouchering and payment processes. NSF has been a participating agency in the E-Travel initiative from the beginning, providing both financial and personnel support to this effort. Benefits expected from the new E-TS include a significant savings of staff time, reduced costs, elimination of paperwork, better customer service, improved internal controls and faster reimbursement to travelers. NSF plans to implement the staff portion of the travel solution in FY 2004. By participating

in the government-wide commercial solution, NSF ensures that the technology will remain current and changes in travel policy will be implemented quickly. This initiative will require a commitment of NSF personnel resources throughout the pilot initial planning, testing and implementation at the agency. GSA was recently awarded the E-Travel contract and NSF implementation of the staff portion of the travel solution is planned for FY 2004.

Limitations of the Financial Statements

In accordance with OMB Bulleting 01-09, *Form and Content of Agency Financial Statements*, we are disclosing the following limitations of NSF's FY 2003 financial statements, which are contained in NSF's FY 2003 Performance and Accountability Report. The financial statements have been prepared to report the financial position and results of operations of NSF, pursuant to the requirements of 31 U.S.C. 3515(b). While the statements have been prepared from NSF's books and records in accordance with generally accepted accounting principles (GAAP) for federal entities and the formats prescribed by OMB, the statements are in addition to the financial reports used to monitor and control budgetary resources, which are prepared from the same books and records. The statements should be read with the realization that they are for a component of the U.S. Government, a sovereign entity.



Detailed Performance Information

Table of Contents

PAGE

Overview

Supporting Information for Fiscal Year 2003 GPRA Reporting

Appendix

EXECUTIVE SUMMARY

This report, prepared pursuant to the Government Performance and Results Act of 1993, covers activities of the National Science Foundation during Fiscal Year 2003.

NSF goals are divided into two broad areas: Strategic Outcome Goals and Management Goals.

Strategic Outcome Goals: Our strategic outcome goals focus on PEOPLE, IDEAS, and TOOLS and concern the practical, concrete, long-term results of NSF grants and programs. They represent what we seek to accomplish with the investments we make in science and engineering research and education.

Management Goals: Our management goals relate to the effectiveness and efficiency of our activities. They relate to the procedures we use to make awards, fund and manage capital projects, and otherwise serve our customers.

FY 2003 Results: For FY 2003 we have met 14 (70%) of our 20 goals. Foundation staff verified and validated all NSF performance data. In addition, IBM Business Consulting Services, an independent contractor, was engaged by NSF, to verify and validate performance information and data.

Outcome Goals: We were successful for all (100%) of our four annual performance goals associated with our strategic outcome goals. Our strategic outcome goals are:

- People – Developing "a diverse, internationally competitive and globally-engaged workforce of scientists, engineers, and well-prepared citizens";
- Ideas – Enabling "discovery across the frontier of science and engineering, connected to learning, innovation and service to society"; and,
- Tools – Providing "broadly accessible, state-of-the-art and shared research and education tools."

Examples of accomplishments for each of the outcome goals are provided within the body of the report. They represent only a small fraction of the results identified by external experts.

Management Goals: We were successful for 10 of our 16 goals (63%) in this area: We were able to:

- Allocate at least 85% of basic and applied research funds to projects that undergo merit review (Goal IV-1). We achieved 89%.
- Ensure that at least 70% of reviews with written comments address aspects of both generic review criteria (Goal IV-2). We achieved 90%.
- Ensure that 95% of program announcements are available at least three months prior to proposal submission deadlines (Goal IV-4). We achieved 99%.
- Process 70% of our proposals within six months of receipt (Goal IV-5). Seventy-seven percent of our proposals were processed within six months of receipt.
- Increase our average annualized award size for research projects to $125,000 (Goal IV-6). Our average annualized award size was $135,609.
- Continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of Principal Investigator award transfers (Goal IV-10). Greater than ninety-nine percent of Principal Investigator award transfers were processed electronically.
- Maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets by having a) 95% of major systems with approved security plans on file and b) 95% of major systems with documented certification and accreditation. (Goal IV-12).
- Ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers through initiating development of a NSF S&E diversity plan (Goal IV-13).
    - Align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities through the initiation

of development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training (Goal IV-15).

- Develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems through identification of workforce competencies for all current NSF job families and initiation of identification of competency-based, classification alternatives (Goal IV-16).

We were not successful for 6 of our 16 management goals. These were:

- Ensuring that NSF Program Officers address both generic review criteria when making award decisions (Goal IV-3). Approximately 53% of Program Officers themselves commented on aspects of both merit review criteria for the particular proposal specified in the review analysis.
- Increasing the average duration of awards for research projects to at least three years (Goal IV-7). Our average duration was 2.9 years. Sufficient resources were not available to achieve both the average annualized award size and the average duration goals. We will continue to focus on increasing both award size and duration.
- For 90 percent of construction, acquisition and upgrade projects, keeping any negative cost and schedule variances to less than 10 percent of the approved project plan (Goal IV-8). Eighty-eight percent of projects kept negative cost and schedule variances to less than 10 percent of the approved project plan.
- For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent (Goal IV-9). Eighty-seven percent of facilities kept scheduled operating time lost to less than 10 percent.
- Continuing to advance "e-business" by implementing Phase III of the Electronic Jacket application by implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority (Goal IV-11). Phase III is expected to be available for NSF staff use in FY 2004.
- Showing an increase over FY 2000 in the total number of appointments to NSF science and engineering positions from underrepresented groups (Goal IV-14).

SOME NSF ACHIEVEMENTS

PEOPLE

Indicator P1. Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future.

Advanced Training Institutes in Social Psychology
Advanced Training Institutes in Social Psychology[1] provide quality training in new methodologies, statistical procedures, and other tools to support and enhance social psychological research. NSF funding helps to establish training institutes where researchers can spend time acquiring basic skills and knowledge.

One institute provides training in the use and development of immersive virtual environment technology (IVET). Another institute focuses on the use of Internet technology to conduct social and behavioral science research. A third institute offers instruction in newly developed statistical methods for understanding social relations.

It is difficult both for those who are early in their careers and for senior investigators to obtain quality training in new areas. Advanced Training Institutes in Social Psychology provide one way in which such training can be obtained. These training institutes focus on the people of social psychological science, and they emphasize the integration of methods and technology from other disciplines. The training received by researchers can then be put to use in their own programs of scientific research and they can teach these new methods to their own students.

Digital Libraries for Children: Computation Tools that Support Children as Researchers
This project[2] was devoted to developing a children's digital library environment containing rich multimedia resources.

Over the three years of the project, the team developed visual interfaces that support young children (ages 7-9 years) in querying, browsing, and organizing multimedia information. In doing so, the team worked with children and teachers as "design partners" to develop new digital library technologies that support the learning challenges of young children. This demonstration project focused on multimedia resources of animal information donated by the Discovery Channel and the Patuxent Wildlife Research Center. The outcomes of the project to date include:

- The development of a digital library prototype (SearchKids) where children can search for animals using a zoomable visual querying interface. Multiple children can use this tool at the same time thanks to a special interface that enables multiple mice to be used simultaneously on one computer. This tool is linked to a zoomable presentation tool (KidPad), which enables children to use their animal resources to tell stories.

- The evaluation of the software with 120 second- and third-grade children. These studies have shown that young children not normally capable of complex Boolean searches can do so more efficiently and accurately given a visual interface. In addition, collaboratively navigating information necessitates various interface technologies that encourage cooperation and peer learning.

- Generalization of the interface has begun on two fronts. The team has begun generalizing

[1] Advanced Training Institutes in Social Psychology

[2] http://www.cs.umd.edu/hcil/kiddesign/searchkids.shtml

the technology infrastructure to work with other databases. They have begun generalization efforts by working with the University of Michigan's *Bio Diversity* animal database. In addition, the team has initiated a new research project with the Library of Congress and the Internet Archive to develop the largest international children's book digital library in the world. The project has just been notified that it will receive another $3 million from NSF's ITR initiative over the next five years to complete this research.

Media Coverage of this activity can be found at Online Library Project Plans a Cultural Trove for Children, (The New York Times Online, December 5, 2002) and Library for Kids Goes Online (National Public Radio, November 18, 2002).

Increasing U.S. Citizens and Women in Mathematical Sciences Graduate Programs
The VIGRE (Vertical Integration of Graduate Research and Education) program whose main purpose is to increase the number of U.S. citizens and permanent residents who have completed a Ph.D. in the mathematical sciences is succeeding in that objective. Of the sites reviewed in their third year this year, all but one increased the number of their graduate students from before VIGRE to their third year of operation. The numerical increases are between 3 and 59 with percentage increases ranging as high as 71%. The number of U.S. citizens and permanent residents went up at all but one with increases ranging between 1 and 26 (including a percentage increase of 55%). For example, the University of California, Los Angeles (UCLA) increased the number of U.S. citizens in its entering class from 12 in 1998 to 55 in the Fall of 2002. The number of third-year women graduate students increased at VIGRE sites by 31.7% between the start of VIGRE and this year. At the University of Chicago, for example, the collegial atmosphere helps to attract a large number of female students to the Department of Mathematics. The success in and satisfaction with the department on the part of the current students works as a magnet for incoming prospective female students, even though there are no tenured faculty who are women. The principal investigators (PIs) and graduate students credit the structure of the graduate program for the large percentage of women graduate students, as it works to ensure a collegial atmosphere, without harsh competition among graduate students and without the intimidation of qualifying exams. The number of women increased by nearly 50% from the time the grant started. The substantive increase in the number and percentage of U.S. Citizens and Permanent Residents in graduate school in a priority area is impressive.

NCAR Undergraduate Leadership Workshop
In June 2002, the National Center for Atmospheric Research (NCAR) hosted the first annual NCAR Undergraduate Leadership Workshop[3]. Its purpose was to inform students about the potential for exciting research and career opportunities in the atmospheric and related sciences. The five-day workshop established informal dialogues between students and research scientists as they explored laboratories, instrumentation, and computing facilities that support studies on weather, climate change, solar dynamics, the Sun-Earth system, and the impacts of severe weather and climate change on societies around the world. Science faculty nominated student leaders in junior standing to apply for the workshop, from which 16 students were selected as participants. Applicants were assessed on the basis of their demonstrated interest in atmospheric and related sciences, academic excellence, aptitude for research, and potential to gain from the experience. Students benefited from this experience by gaining insight into the breadth of research topics in the atmospheric and related sciences, while they also learned about NCAR's collaborative role in university research that positively impacts society. They became better informed about opportunities for graduate and post-doctoral studies in the University Corporation for Atmospheric Research (UCAR) community of member and affiliate universities and colleges. The workshop also encouraged them to consider the many ways scientists serve in leadership roles and how they might

[3] http://www.ncar.ucar.edu/eo/

themselves act as leaders by communicating their workshop experiences to other students at their sponsoring university. The sponsoring academic institutions benefited by demonstrating the links between undergraduate studies and NCAR's examples of research and careers in the sciences. Students participating in the program were also expected to become more interested in continuing their studies in the sciences through graduate school. The provision of hands-on information and contact time for undergraduate students who typically have limited experience with geoscientists and their work is a key step in ensuring future graduate student interest in these disciplines.

Indicator P2. Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities (Includes women, underrepresented minorities, or persons with disabilities.)

Using Inquiry-Based Science to Help English Learners Increase Achievement

The Valle Imperial Project in Science (VIPS) is a collaborative effort of the Imperial County Office of Education and the San Diego State University. It was implemented to strengthen K-6 science education in 16 school districts through district-wide professional development of teachers. Located on the California-Mexico border, the Imperial Valley region experiences geographic isolation and poverty. The student body is 82% Latino and 47% limited language proficient, and has historically had limited access to science education training.

An important component of the VIPS project has been the study of effective ways to increase student achievement through kit-based science programs, while strengthening the acquisition of language skills for students with limited English proficiency. The research study, *Helping English Learners Increase Achievement Through Inquiry-Based Science Instruction*, published in the Bilingual Research Journal, summarizes results of a four-year study of K-6 students in the El Centro Elementary School District. Data measuring student achievement in science, writing, reading, and mathematics were analyzed relative to the number of years that students participated in kit- and inquiry-based science instruction that included the use of student science journals. Results indicated that the achievement of English learners increased in relation to the number of years they participated in the project. The longer they were in the program, the higher their scores were in science, writing, reading, and mathematics[4].

The push for accountability demonstrated by student achievement is unparalleled; performance on state mandated tests is required of all students, even those with limited English proficiency. To meet expectations, many districts focus on "the basics," often at the expense of other subjects (*e.g.*, science). Relating science learning to gains in achievement in tested subjects ensures its place in school curricula. This also shows strategy for bringing quality science and mathematics education to students from under-represented populations.

A Workshop to Develop Minority Faculty Leaders in Chemical Engineering

The purpose of the workshop was to provide a forum for aspiring minority faculty currently in Ph.D. programs to network with established minority faculty. More than 60 participants were also able to meet program managers in their relevant disciplines from the major funding agencies such as NSF and the National Institutes of Health (NIH). This targeted mentoring was geared towards increasing the number and success of Minority Faculty in Chemical Engineering. Mid-career minority faculty currently in academic positions in chemical engineering were able to initiate collaborative research (and identify available post-doctoral fellows) among the aspiring minority faculty, with each other, and with the relevant funding agencies. The workshop also provided information focused on career options (*e.g.*, administration, national leadership, *etc*.) for "mid-career" faculty.

Highlights of the program included: (1) Panel discussions with engineering deans, with senior faculty, and with college administrators; (2) Research presentations by participants and poster sessions by aspiring faculty; (3) Meetings with NSF program officers with overview presentations of research-funding opportunities; and (4) Structured opportunities for mentoring and collaboration. A Survey Analysis Method was designed in Spring 2001 by Professor Grant and Saundra Williams (North Carolina State University Adult and Community College Education) to evaluate the impact of the workshop on the participants. The survey was analyzed using the statistical analysis package Statistical Program for Social Sciences (SPSS), the results of which are available to design future mentoring activities. A website was also

[4] The paper is available on-line at http://brj.asu.edu/content/vol26_no2/pdf/ART2.PDF

developed to facilitate the application/selection process for job placements; this provided the foundation for the current website for the Minority Affairs Committee (MAC) of the American Institute of Chemical Engineers (AIChE).

This workshop, aimed at minority chemical engineering faculty at various stages of their career, provided information on how to enhance their careers. It also provided access to various NSF program officers for networking purposes.

Arctic Research Community Coordination and Outreach

The complex interactions of disciplinary and interdisciplinary research in the Arctic region require a great deal of communication to maintain a high degree of efficiency, to propel research initiatives and to facilitate discoveries involving research across disciplines. Outreach by the arctic research community makes research results available to the public and encourages students to pursue arctic science. The Arctic Research Consortium of the U.S. (ARCUS) continues to enable a high level of communication among the arctic research community through their email listserv ArcticInfo with over 5000 subscribers, their web site that includes a searchable directory of arctic researchers (over 3500 entries), a calendar of events, downloadable publications, and the Arctic Logistics Information and Support (ALIAS) web site. ARCUS hosts an annual interdisciplinary arctic research conference, the *Arctic Forum,* in Washington D.C. Each year a competition is held for the best graduate or undergraduate student research paper and the awards in 4 categories are conferred after the students present their work at the Arctic Forum. ARCUS publishes the abstract proceeding from the meeting, reports from ad hoc meetings they facilitate and a bi-annual newsletter, *Witness the Arctic,* which chronicles current developments and opportunities in the NSF arctic research program. ARCUS organizes an Arctic Visiting Speakers' program that provides the opportunity for researchers to travel to a host town to give talks and work with local people, schools, universities and community groups on arctic research topics.

Understanding the arctic region is an inherently interdisciplinary undertaking requiring communication and planning among researchers from a wide variety of fields including the natural, physical and social sciences. ARCUS has done an exceptional job of facilitating communication through email, the World Wide Web, meetings, and publications. Furthermore they have undertaken several outreach efforts to include young scientists and arctic communities in arctic research. The workforce at ARCUS is approximately 50% female–including the executive director and other high-level positions–and 11% minority.

Catalysis for Alternate Fuels

Catalytic Fischer-Tropsch Synthesis (FTS) provides a route for producing gasoline, diesel fuels, oils, and chemicals from smaller organic molecules. However, selectivity limitations for existing FTS catalysts impose significant economic penalties due to costly product separation and the need for further upgrading of lower-grade product fractions. These problems remain unresolved due in part to the lack of understanding of the fundamental reaction mechanisms. Research being conducted at Hampton University is examining a novel catalyst system previously discovered by researchers at the University of Virginia for ammonia synthesis. A broad range of experimental conditions, involving variations in the temperature, pressure, and reactor flow rates, are being systematically examined for the first time. New insights into the reaction pathways have been developed, and the new catalysts have been confirmed to exhibit significantly enhanced selectivity.

This research involves a partnership between chemical engineering departments at Hampton University, a historically black university with no graduate program, and the University of Virginia. Catalysts prepared at Virginia under an established NSF graduate-research project are investigated by a select group of undergraduate students at Hampton. These students receive

their first exposure to a post-graduate educational experience by using advanced microreactor apparatus and state-of-the-art analytical tools. They also learn to make detailed literature surveys on specific subjects and to analyze the acquired data. The principal investigators and collaborators at Virginia mentor their academic progress closely, and an exchange of graduate and undergraduate students is also involved. The Hampton students and principal investigators have co-authored research publications with the Virginia researchers and have presented results at regional conferences. A poster paper was be presented at the 18th North American Catalysis Society meeting in June, 2003.

The collaborative research program introduces underrepresented minorities to leading-edge research conducted at both Hampton University and the University of Virginia. Students are exposed to a catalysis-research area highly relevant to national priorities related to the development of alternate fuels.

Center Aims to Bring More Women and Minorities into Engineering

Women and minorities have always been underrepresented in engineering fields, although their numbers have been increasing recently. The Center for Wireless Integrated MicroSystems (WIMS), an Engineering Research Center (ERC) headquartered at the University of Michigan, has expanded its work in secondary schools with four summer programs that use microsystems to excite students about using engineering to tackle important societal problems. The courses are designed to improve precollege students' skills in science, math, computer science, and communications. More than half of those enrolled were females, and one program targeted students from underrepresented groups (mainly African-Americans from urban schools). "*Legos to WIMS*" is a 5-day commuter program open to fifth through seventh grade students. The "*Detroit Area Pre-College Engineering Program (DAPCEP)/ WIMS Short Course*" is a three-week residential program for students entering 11th and 12th grades, which has been offered through the Diversity Programs Office at WIMS partner institution Michigan State University since Summer 2000. "*WIMS for Women*" was introduced as a 6-day/5-night residential summer program in Summer 2002, and will be expanded to a two-week program in Summer 2003. "*WIMS for Teens*" was offered as a 7-day/6-night residential summer program for the first time in Summer 2002. The program was conducted on the University of Michigan campus but was managed by WIMS staff from Michigan State University. In each of these summer programs the students have a curriculum focusing on math integrated with science, Lego Mindstorm challenge activities, communication skills, and pre-engineering motivational activities.

By working with underrepresented groups at the pre-college level and working to spark their interest in engineering at a young age, the WIMS programs are likely to broaden the future base of the engineering profession.

Change and Its Impact on Culture, Economy and Identity in Three North Bering Straits Alaskan Inupiat Societies: Little Diomede Island, King Island, and Wales

Anthropologist Carol Jolles of the University of Washington has been working with three subsistence-oriented Alaska Native communities in northwest Alaska researching sociocultural and economic change and its association to globalization processes from the 1930's to the present. A crucial aspect to this research is the collaboration between the scientists and the Alaska Native communities. Dr. Jolles has included local people in the research design and fieldwork. These activities, particularly the training of local research assistants, contribute to developing a "diverse workforce" among Alaska Native people.

Dr. Jolles research includes education for minority and Alaska Native students and will help to provide a more diverse workforce for the future.

COACh: Committee on the Advancement of Women Chemists

The Committee on the Advancement of Women Chemists (COACh) was founded by a group of

individuals that wanted to enhance the rate of progress of attaining gender equity in the chemical sciences. Two major goals of COACh are to provide women chemists with the professional skills necessary for advancement in academe, and to increase the overall number, rank and visibility of women faculty in the field. To this end, COACh provides training programs in the development of communication, negotiation, and leadership skills. The programs comprise a series of one-day workshops held prior to National American Chemical Society (ACS) and American Institute of Chemical Engineers (AIChE) meetings. Anyone interested in assisting in the promotion of women chemists is eligible to join COACh. Their web site, http://www.coach.uoregon.edu/, contains information about the workshops and COACh membership as well as other information, such as lists of women academic chemists, job listings, funding opportunities, the results of COACh research efforts on academic climate issues, and a conversation room to discuss current topics of interest to members. Over 100 women faculty have participated thus far in the COACh workshops, with 30 more to participate at the Spring, 2003 ACS national meeting. COACh has received a number of requests to assist in setting up similar training workshops at other professional meetings and at various types of institutions. Following the precedent set by COACh, other professional organizations such as the American Physical Society have started COACh-style workshops at their professional meetings.

The COACh project represents a national effort to enhance opportunities for women in academic positions in chemistry and chemical engineering departments. Through focused workshops and mentor networks, the PIs are promoting gender equity and strengthening the workforce in academic institutions. Assessment of the effort is a component of the project.

Cooperative Agreement with the Alaska Native Science Commission
The Alaska Native Science Commission (ANSC) is made up of Alaska Native scholars and scientists that facilitate the connections between rural communities and NSF supported research. Working with the Arctic Section of the Office of Polar Programs the ANSC, through workshops, personal contacts and meetings, has assisted scientists in making contact with Native Alaskan communities and facilitated Native peoples voices in Arctic science. In this way, scientific research can better meet the needs of Alaskan rural communities. The ANSC also has an internship program for Alaska Native students that helps increase the exposure of students to the many disciplines of science and engineering. In addition, the ANSC publishes a quarterly newsletter to inform Alaskan communities about NSF science projects in their regions. The ANSC is a critical link between science, education, and local community concerns and needs and represents the future of cooperation in scientific research.

The ANSC provides opportunity for the participation of Alaska Native people in NSF activities.

Dispersed REU Site
Research Experiences for Undergraduates (REU) are arguably some of the most important experiences students will have while in college. The REU experience has been enhanced by mechanisms that enable students to share research ideas, experimental designs, and interpretations of data with a group of professors from other campuses and their REU students. Such an REU consortium, the first in the Chemistry Division, has implemented this strategy by engaging 6 research groups with common interests in organic synthesis located at Juniata College (PA), Trinity University (TX), Trinity College (CT), St. Michael's College (VT), Northern Kentucky University (KY), and Macalester College (MN). The entire faculty in this consortium teaches at schools where undergraduate students are the principal, and sometimes only, collaborators. The entire faculty has track records of successfully synthesizing previously unknown chemical compounds with their undergraduate students. They have joined together in a consortium with a common interest in "Synthesis of Theoretically Interesting Molecules." The group works together in spite

of the distance between research sites by making use of electronic communication and face-to-face meetings at each other's campuses and at an annual national meeting. At the end of the summer they converge for a symposium in which the students present their results. The students also prepare a poster of their summer's work to be displayed at their home institution and on the consortium web site. Each campus group has noted the value added to their work through the effective intellectual exchanges that take place via consortium interactions.

This innovative, distributed REU program links the faculty and students at six sites from Texas to Vermont. Using a shared set of research problems in the general area of organic chemistry, participants have an opportunity for professional development as individuals and as part of a scientific community.

Educational Renewal in Rural Alaska
Rural schools in Alaska are redefining their roles. Stimulating this reconstruction is the Alaska Rural Systemic Initiative (AKRSI-Phase II), now completing its seventh year of rural school reform initiatives. AKRSI focuses on increasing the connections between what students experience in school and what they experience outside of school by utilizing the Alaska Standards for Culturally Responsive Schools. This approach is reaping benefits. Historically showing the lowest student achievement levels in Alaska and the nation, the 20 AKRSI school districts are now making gains in student achievement. For example, AKRSI schools have shown:

- *An increase in student achievement scores*. The indicators of the effects of the first phase of implementation of the school reform initiatives in the 20 AKRSI school districts (which historically had the lowest student achievement levels in the Alaska and the nation) pointed to a differential gain between AKRSI partner schools and non-AKRSI rural schools of 5.9 percentage points in the percentage of students who were in the top quartile on the 8th grade standardized achievement test in mathematics. The 8th grade AKRSI students showed significant progress in closing the achievement gap with their non-AKRSI counterparts from 20 to 15 percentage points (standards-based Benchmark tests – Mathematics).

- *A decrease in the dropout rate*. For example, the dropout rate for grades 7-12 in AKRSI partner schools has declined from a mean of 4.4 to 3.6 over a five year period, whereas the dropout rate decreased from 2.7 to 2.4 in non-AKRSI rural schools in the same time period.

- *An increase in the number of rural students attending college*. Enrollment of first-time freshmen students at the University of Alaska from AKRSI schools had a net gain of 26% compared to the net gain of 8% for freshmen students from Non-AKRSI schools over a seven-year period.

- *An increase in the number of Native students choosing to pursue studies in fields of science, math and engineering*. Of the 12 major fields available at the University of Alaska Fairbanks (UAF), the percent of Alaska Natives student enrollment has increased significantly in most fields over the past seven years. Enrollments of Alaska Native students increased in math, science and engineering fields from 36 in 1994 to 84 in 2000. Enrollment of Alaska Native students in the life/biological science fields (especially biology, fisheries and wildlife biology) have also increased, which is consistent with the interests shown by younger students as they select topics for developing a project to enter the AKRSI-sponsored science fair.

- The consistent improvement in student performance and participation shows that the Alaska Standards for Culturally Responsive Schools have had a significant impact on expanding the opportunities for Alaskan students.

The work of the AKRSI is addressing the mathematics and science perceptions,

performance, and participation of Alaska Natives. A significant contribution is capitalizing on cultural knowledge and values to guide and enhance systemic practices and outcomes.

Louis Stokes Alliances for Minority Participation Program

In 2002, more than 21,429 underrepresented minority students received science, technology, engineering and mathematics (STEM) baccalaureate degrees via the Louis Stokes Alliances for Minority Participation (LSAMP)[5] program. Collectively, the reach of the LSAMP program extends north to Alaska, Washington, Montana and New York; south to Texas, Florida and Puerto Rico; east to Massachusetts, Rhode Island, Pennsylvania and the Carolinas; through Middle America, including Illinois, Missouri, Oklahoma, Tennessee, Colorado and New Mexico; and West to Arizona, California and Hawaii. The program now includes 30 alliances representing over 400 individual institutions. In 2003, the number of STEM students impacted directly by the LSAMP program reached an all-time high of 206,893.

For the National Science Foundation, the outcomes of the Louis Stokes Alliance for Minority Participation indicate progress toward addressing the long-term goal of increasing the production and diversity of Ph.D.s in STEM fields with an emphasis on entry into faculty and research positions.

North Carolina LSAMP

The North Carolina LSAMP[6] was granted a Phase III award in FY 2003 to increase the number of STEM degrees for minority students and prepare and increase student interest in transitioning into graduate school. Significant highlights of the North Carolina LSAMP include:

- 841 Bachelor of Science degrees awarded to minority STEM students in 2002.
- Minority STEM enrollment increased 17.8%, from 4,744 in Fall 1997 to 5,588 in Fall 2001.
- Faculty and students throughout the Alliance participated in 50 STEM-related local, state, and national conferences and professional meetings. Many students made both oral and poster presentations at several of these events.
- During summer 2002, a North Carolina-LSAMP biology faculty mentor and three North Carolina-LSAMP biology students from North Carolina A&T participated in the Faculty and Student Team (FaST) Research Program. The ten-week program at Argonne National Laboratory provided a research experience for the participants with national laboratory scientists.

NC LSAMP is in the capstone phase of their efforts to increase the number of minority students in STEM. Now in its twelfth year, the Alliance has attracted, retained and graduated significant numbers of students who are prepared to move to the next steps in training for STEM careers.

REU -- Spanish Language Retention among Mexican Americans

Why do some Mexican Americans retain Spanish while others lose their native language? In a study conducted as part of the Research Experience for Undergraduates Program funded by the National Science Foundation, Geneva Villarreal, a student from West Texas A&M University, sought to identify factors that are associated with Spanish language retention among Mexican Americans. Using data from the 1990 Public Use Microdata Sample (PUMS), she found that Mexican Americans who are more likely to speak Spanish are persons 35 and older, those with lower levels of education, those who are born in the United States, those whose parents are not intermarried, those living in areas with larger Mexican-origin populations, and those residing in the southwestern region of the country. Ms. Villarreal presented her paper titled "*Correlates of Spanish Language Maintenance: The Case of Mexican Americans*" at the annual meeting of the Southwestern Social Science

[5] http://www.ehr.nsf.gov/hrd/amp.asp
[6] http://www.ncat.edu

Association. Ms. Villlarreal was one of 10 students who participated in this REU Site, an NSF program that contributes to the Foundation's continuing efforts to attract talented students into careers in science through active undergraduate research experiences.

This REU recruits predominantly from underrepresented minority student populations. These undergraduates then spend the summer working with a faculty mentor on an independent research project.

REU Site at Santa Clara University - Ethics Component A Case Study: *Noah's Dilemma*
Under pressure to complete the project, to get the data "right", and to publish the findings, what does Noah do? In the highly acclaimed ethics component of the REU program at Santa Clara University, the summer research students in the Departments of Chemistry and Biology consider case studies dealing with ethical issues related to plagiarism, data manipulation, intellectual property, authorship, deviations from proper research protocol, and the use of human subjects.

Case studies produced by the American Association for the Advancement of Science (AAAS) are first presented to the students as video vignettes. After watching the videos, the students and their faculty mentors break into small groups led by a faculty member to begin discussions. The analysis is typically undertaken within a framework developed by Dr. Margaret McLean, Director of Biotechnology and Health Care Ethics at Santa Clara University's Markkula Center for Applied Ethics. The students later reconvene as a large group to share the more important insights arising from the small-group discussions. In addition to the ethical issues that the videos raise, they open the door for discussions on the everyday process of science, including, for example, the administrative structure of the laboratory, how funding and publication processes work, and the importance of keeping accurate notebooks. This leads to informal discussion in the lab and other venues outside of the ethics meetings.

A response from a student to an evaluation question of the ethics component was: "The ethical issues that actually come up on a daily basis in a real world work field was surprising to me. Confronting these issues and dealing with the problems of integrity is not an easy task and may not have an obvious solution." This Ethics in Science program is underscoring to both students and faculty that workplace ethical dilemmas are not restricted to human cloning or genetic engineering. They arise in everyday issues such as maintaining laboratory notebooks and acknowledging the contributions of others.

This REU program teaches technical skills and scientific methodology, as well as provides an ethical framework for scientific conduct. It directs students on a path of technical and character development that will enhance their effectiveness in the workforce of tomorrow.

The Consortium for Undergraduate Research Experience (CURE)
The CURE consortium consists of the California School Leadership Academy (CSLA), Pasadena City College, Los Angeles City College, Los Angeles Southwest College, East Los Angeles College, and the Jet Propulsion Laboratory (JPL). The goal of the program is to recruit, train, and retain under-represented minorities in science and engineering. Ten students from the consortium schools are recruited annually. Participating students work on research projects with mentors from CSLA and JPL; most of the students observe at JPL's Table Mountain Observatory. Julie Rivera, a recent alumna of the CURE program, finished her B.A. at Pomona College after starting at CSLA. In June, 2002 she was hired as an observatory assistant at Hawaii's Keck Observatory, home of the world's largest telescopes.

This program has been successful in recruiting and training under-represented minorities.

University of Puerto Rico, Mayaguez Undergraduate Creates Nano-filter for Bio-medical Lab-on-a-Chip
Nancy Guillen, an undergraduate at the University of Puerto Rico, Mayaguez, and a participant in the NSF's Research Experience

for Undergraduates (REU) program, spent last summer with a Cornell University research team manufacturing and testing a collagen membrane that could one day be used as a miniaturized lab-on-a-chip for rapid screening of blood samples. Guillen's membrane has nanometer-sized pores small enough to sift biomolecules by size alone. The membrane blocked hemoglobin while allowing DNA molecules to pass through. Guillen's presentation on her project won first place in the Chemical Sciences competition at the 2002 Annual Biomedical Research Conference for Minority Students, held last November in New Orleans[7]. The Cornell team also presented the work in a paper at the Materials Research Society Fall Meeting in December 2002. Guillen worked under the guidance of Lori Lepak, a graduate student in the research group of electrical engineering professor Michael Spencer. She conducted her research at Cornell's Nanobiotechnology Center, an NSF Science and Technology Center, and manufactured her filter on a chip at the Cornell Nanofabrication Facility, a node of the NSF-supported National Nanofabrication Users Network.

Guillen's efforts broke new ground on several fronts. She used collagen monomers as raw material, which are up to 50 times thinner than the collagen fibrils used in commercially produced collagen membranes, and prepared them by the spin-deposition technique, which is also one of the easiest and cheapest ways to make the 100-nanometer-thick membrane. The successful use of collagen, the main connective tissue protein in the human body, offers the major advantage for the filter of biocompatibility –meaning that implantable devices using *Guillen's membrane would be free from immune reactions*. For example, a coating for transplanted pancreatic islet tissues would let glucose and insulin pass through freely, but block the larger immune system molecules that lead to rejection. Biomedical devices using collagen membranes may thus someday free organ-transplant recipients from lifetime regimens of powerful immunosuppressant drugs.

The first uses of the filter will likely be to prepare DNA chips for quick medical analysis or newborn screening tests. Such a filter may also be used one day as part of implantable devices such as an artificial liver.

[7] http://www.abrcms.org/2002Winners.asp

Indicator P3. ***Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal. (For example, broad-based, program-wide results that demonstrate success related to improved math and science performance for preK-12 students, or professional development of the STEM instructional workforce, or enhancement of undergraduate curricular/laboratory/instructional infrastructure, or highly synergistic education and research activities, or international collaborations, or communication with the public regarding science and engineering.)***

Award Winning *DragonflyTV* Brings Science Investigations to 25,000,000 Children and Parents in its First Season

DragonflyTV[8] has broken new ground in presenting science to children, ages 9-12, via television, the Web and publications. The program exclusively features real children engaged in their own science investigations, and these investigations are crafted and presented—in collaboration between the show producers and the featured children—to model complete inquiry experiences. *DragonflyTV* young investigators explore every kind of science, from the mysteries of the human body to the power of a tornado. More than 50% of young investigators are girls and more than 50% are children of color. Nearly 70% of the show segments feature uses of technology, the application of which is of growing importance to the workplace and society.

The program and its supplementary products are impacting millions of children and adults. Program evaluations have demonstrated that children who watch *DragonflyTV* increase their interest in doing science investigations and have a better appreciation of experimental techniques. As a result of viewing the show, 80% of kids tested wanted to try their own science projects.

In 2002, the first season of *DragonflyTV* aired on 250 PBS stations, with the potential for reaching 87 percent of U.S. households. It was carried in both large and small markets, and has become a featured part of the video curriculum on state educational networks (*e.g.*, Georgia, Iowa, South Dakota). According to Nielsen Research for February 2002, 1,600,000 viewers tuned in each week; and total viewers for 2002 exceeded 25,000,000. Nearly 25% of the audience was composed of children, ages 6-11; 33% was adults, suggesting that many families watch the show together. Season Two and Three are in production with plans to expand the outreach and web activities.

NSF funding has helped leverage major corporate underwriting from Best Buy, which has recently committed $1.1 million to the continuation of the series.

DragonflyTV has already been recognized through national awards for its innovative approach to science and commitment to excellence. It won the CINE Golden Eagle Award, the World Silver Award from the New York Festivals, and the Chris Award from the Columbus International Film and Video Festival. The *DragonflyTV* Web site has won the Broadcast Design Association Bronze Award.

This importance of this project is that it has provided quality broadcast programming to increase student interest in science and mathematics; increased access to science for children from underrepresented groups; and increased parental involvement in science and mathematics education.

An Environmentally-benign ('Green') Organic Chemistry Curriculum

The University of Oregon is:

(1) Developing new organic chemistry laboratory experiments that teach the fundamental concepts and skills of organic chemistry in a safer manner, while teaching the tools and strategies of "green" chemistry;
(2) Disseminating these materials through workshops, a laboratory textbook and a searchable web-based database; and
(3) Promoting the participation of a broad spectrum of educators in higher education.

[8] http://www.dragonflytv.org/

In all, 25 new laboratory experiments have been developed and classroom tested with support from the Course, Curriculum, and Laboratory Improvement (CCLI) Program. The new experiments teach the core concepts and techniques typically associated with organic chemistry lab courses while teaching students a process with which to evaluate and redesign chemical products and processes to make them "greener." The new experiments are safer, reduce waste and inspire students to use chemistry to solve environmental problems.

More than 40 educators have participated in the project's annual weeklong Green Chemistry in Education Workshops. Nearly all of these educators are now introducing green chemistry into their courses. Articles describing selected experiments have been published in Green Chemistry and Journal of Chemical Education[9] The textbook "*Green Organic Chemistry: Strategies, Tools and Laboratory Experiments*" is being published by Brooks/Cole. Five of the project's experiments have also been published in an American Chemical Society (ACS) publication "*Greener Approaches to Undergraduate Chemistry Experiments*." To assist educators in choosing between the growing numbers of educational materials, the PI has established an electronic database on the web[10].

New organic chemistry laboratory experiments are being developed that are safer, reduce waste and inspire students to use chemistry to solve environmental problems.

An Integrated Undergraduate Program in Bioinformatics

Modern molecular biology has come to depend more and more upon the analysis of large amounts of data to identify trends and patterns in the complex workings of natural systems. The sequencing of the human genome has paved the way for new methods based on a coupling of high-throughput methods in biology with state-of-the-art computational analysis. The pharmaceutical and bioinformatics industries are demanding scientists and professionals that are trained in both computational analysis and biological experimentation to perform this research. Unfortunately, the entrance requirements for graduate programs in computational molecular biology and bioinformatics are often prohibitively extensive.

The content of Wright State University's introductory-level, interdisciplinary bioinformatics course has been developed into the first undergraduate textbook in bioinformatics, "*Fundamental Concepts of Bioinformatics*," published by Benjamin Cummings in the Fall of 2003. In addition, PocketMol, the first molecular graphics tool for the PocketPC platform, was developed by undergraduate students involved in the research arm of the bioinformatics program at Wright State. PocketMol allows biological macromolecules, such as proteins, to be viewed, rotated in 3D, colored and modeled on a palm-sized PocketPC computing device.

The undergraduate bioinformatics program at Wright State University is designed to serve as a national model for undergraduate bioinformatics education, allowing universities to prepare students for careers and graduate education in bioinformatics with a minimum overhead in terms of new courses and faculty. An associated undergraduate research program has been established to provide unique research opportunities to undergraduate students pursuing their degree in bioinformatics.

Culturally Situated Design Tools

Rensselaer Polytechnic Institute (RPI) is developing and evaluating Culturally Situated Design Tools (CSDTs). These software applications use ethnomathematics–the mathematical practices embedded in artifacts such as cornrow hairstyles, native American beadwork, rhythm patterns in music, *etc*.–to teach students how their cultural background can become a bridge, rather than a barrier, to information technology careers. An example of a graphic provides a specific illustration of the learning potential of CSDTs. The graphic was

[9] Green Chemistry 2001, 267-270; J. Chem. Ed. 1999, 77,1627-1629, J. Chem. Ed., in press

[10] http://www.uoregon.edu/~greenlab

created by an 8th grade African American student in RPI's after-school ethnomathematics course that was carried out in a public housing project in Troy NY, using the cornrow software. The student wrote the following description of his design process:

"I made this braid when I was fooling around with the program. What I did was start with one braid, and then copied all the numbers from the first braid, and then mirrored the braid, then I was done."

Quantitative analysis of attitude surveys of students who had taken the course using this tool showed a statistically significant increase in interest in IT careers.

MLIAM: NESPOLE! - Negotiating Through Spoken Language in E-commerce

This research in the area of multi-lingual speech translation and communication has produced a prototype system that enables native users to connect with a "commercial" service provider that speaks a different language and receive detailed information via a live video-conferencing channel, in which speech-to-speech translation is seamlessly embedded. A simple and easy to use "whiteboard" application that allows the two parties to simultaneously view shared WebPages, maps, images and annotated gestures complements the speech communication channel, significantly enhancing the effectiveness of communication. The speech-to-speech translation is accomplished via a unique server architecture, which is distributed over the Internet. Very minimal software is physically required on the standard personal computers (PCs) of the end users. This technology opens the door to new global e-commerce applications for common users that transcend the language barriers of today. The project uses an "*interlingua*" so that it can support multiple language pairs, and has managed to achieve successful speech recognition of relatively low quality speech taken from video conferencing equipment.

The NESPOLE! Project is funded under the MLIAM program with one US partner (Carnegie Mellon) and three European research partners: University of Karlsruhe (Germany), Joseph Fourier University (France), and ITC-irst (Italy). Two European industrial partners are also involved in the project: AETHRA (an Italian telecommunications company), and APT (the Trentino provincial government tourism bureau). NSF funded Carnegie Mellon University's (CMU) participation in the project. The European Community (EC) funded the European participants. The collaboration has been very successful, with the partners working closely on overall system architecture, interlingua design, evaluation, user studies, and Human Language Technology (HLT) component design. The prototype system developed accomplishes the tasks described above.

The project has made technological advances in developing a distributed architecture for machine translation that integrates multimodal communication with speech technology for multiple language pairs. The NESPOLE! Project has established two users groups: an industrial affiliate group of about 10 technology and service provider companies, and a research interest group involving four research institutions external to the project.

New Approaches for Teaching Power Electronics and Electric Drives in the Electrical Engineering Curriculum

An NSF/Office of Naval Research (ONR) sponsored workshop on teaching of power electronics-related curriculum was organized jointly by University of Minnesota and Arizona State University (ASU), and held at ASU, Tempe, January 5 – 7, 2003. More than 120 faculty from U.S. universities engaged in teaching power engineering participated in the workshop. The workshop consisted of presentations and discussions on new developments in teaching undergraduate power electronics and electric drives courses, as well as discussions on the contents of advanced course on power systems applications of power electronics. A very interesting part of the workshop was the demonstration of newly developed laboratories for power electronics and electric drives. Many universities have already expressed a desire to adopt these new laboratories. Tutorials on Pspice and

MATLAB/Simulink for power electronics applications were very well attended and appreciated. Leading experts in academia, industry and federal research agencies conducted panel sessions on identifying challenges and solutions in power electronics education. Twenty faculty exhibited posters on best practices in power electronics education. More information on the workshop and the new approaches can be found at http://www.ece.umn.edu/groups/workshop2003.

As a result of the 2002 workshop in this series, 23 universities adopted the new approach to teaching electric drives and 21 universities submitted Course, Curriculum, and Laboratory Improvement (CCLI) proposals to adopt the new laboratory. The CCLI program[11] seeks to improve the quality of Science, Technology, Engineering, and Mathematics (STEM) education for all students and targets activities affecting learning environments, course content, curricula, and educational practices. At the 2003 workshop, 43 professors have stated that they plan to submit CCLI proposals to adopt the newly developed laboratories.

Supercritical Carbon Dioxide Technologies

The Science and Technology Center for Environmentally Responsible Carbon Dioxide Processes enables researchers from the University of North Carolina-Chapel Hill, North Carolina State University, North Carolina A & T, University of Texas-Austin, Georgia Institute of Technology, Los Alamos National Laboratory, and industry to conduct cutting-edge research on the uses of supercritical carbon dioxide in innovative processes. The basic research fostered at the Center has been adopted by a variety of industries. Use of supercritical carbon dioxide has led to environmentally friendlier processes and reduced pollution. Examples include the manufacture of polymers (Dupont Process G to make Teflon), and dry cleaning. The dry cleaning company Hangers received the "Most Valuable Pollution Prevention Award" from the National Pollution Prevention Roundtable in recognition of the fact that use of supercritical carbon dioxide eliminated the need to use a more toxic chemical that had been traditionally employed in dry cleaning. The Center also recruits outstanding K-12 mathematics and science teachers from North Carolina to develop novel curriculum tools for K-12 education and creates engaging exhibits at the North Carolina Museum of Natural Sciences[12].

This partnership between a research center, K-12 teachers, and a science museum make advances in research accessible to pre-college instructors, their students, and the public. The Center has also been extraordinarily effective at technology transfer: two very different industries, polymer manufacturing and commercial dry cleaning, have made extensive use of the Center's research.

[11] NSF02-095

[12] See: http://www.nsfstc.unc.edu/

IDEAS

Indicator I1. Discoveries that expand the frontiers of science, engineering or technology.

Bose-Einstein Condensation Proved
About 75 years ago a peculiar kind of condensation at low temperatures was predicted to occur in some gases whose atoms were of a special quantum-mechanical type called "bosons." This condensation, called a Bose-Einstein condensation after the inventors, was believed to occur, but was only indirectly verified until a few years ago when convincing experiments could be done in "cold traps."

The open question, from the mathematical point of view, was whether this phenomenon actually follows from Schroedinger's equation of quantum mechanics that is supposed to govern such gases. Lieb and Seiringer, whose paper was published in the Physical Review Letters achieved this proof by a careful analysis of the behavior of the gas at several different, but relevant length scales. This work was followed by a further analysis by Lieb, Yngvason and Seiringer in which superfluidity was proved to occur for the same physical system.

An experimental phenomenon of great importance for both fundamental physics and applications is found to be a rigorous prediction of the Schroedinger equation.

The Computer Science of Biologically Embedded Systems
Illness or injury may impair the ability of humans to sense or act in their environment. Interdisciplinary research at Brown University is exploring new ways to restore lost function by directly connecting brains and computers. These hybrid human-machine systems represent a new form of "biologically embedded" computing. Building such systems requires answers to the following questions:

1) What "signals" can we measure from the brain, from what regions, and with what technology?
2) How is information represented (or encoded) in the brain?
3) What algorithms can we use to infer (or decode) the internal "state" of the brain?
4) How can we build practical interfaces that take advantage of the available technology?

This approach exploits neural signals recorded from the motor cortex using an array of chronically implanted microelectrodes. Various statistical models are used to model the activity of these cells and study how this activity relates to hand and arm motions. Linear, non-linear, and non-parametric probabilistic models have been explored. The group adopted a Bayesian formulation of the decoding problem in which they infer the motion of the hand from the firing rates of a small population of cells (between 20 and 100). The resulting reconstructed motion is sufficiently accurate to permit the neural control of unconstrained 2D cursor movement or simple robotic functions. The work at Brown is advancing basic understanding of neural coding, is providing new methods for decoding neural signals, and is building a foundation for a new class of assistive technologies for the severely disabled.

The focus is on the statistical modeling of populations of motor cortical neurons using probabilistic methods. The project has developed new Bayesian methods for decoding neural activity that provide accurate reconstruction of hand motions.

A New Telescope is Born!
The dream, now more than 40 years old, of constructing a radically different telescope has been realized by the innovative Antarctic Muon and Neutrino Detector Array (AMANDA)-II project. Instead of sensing light, AMANDA responds to a fundamental particle called a neutrino. Neutrino messengers provide a startlingly new view of the Universe. Members of the AMANDA team designed the first practical implementation of the generic ideas formulated many years ago, and re-introduced in late 80's using ice instead of water. Due to the remoteness of the site in Antarctica, the team decided to minimize complexity of the design while recognizing that the simplest devices and system architectures were sufficient to answer the key questions. This concept proved highly

effective. AMANDA is now an international collaboration involving institutions from the U.S., Germany, Sweden, Belgium, and Venezuela.

Black Hole at the Galactic Center
Recent work by Dr. Andrea Ghez of the University of California, Los Angeles has solidified the case for a massive black hole at the center of our Galaxy. Over several years, with NSF support, she has used the orbits of stars near the center of the galaxy to infer the density of the dark mass at the Galactic core. Most recently, using adaptive optics, and with a 7-year baseline, she has been able to follow the detailed orbits of a larger sample of fainter stars. One of these stars passes a mere 60 astronomical units from the central dark mass at a velocity of 9000 km/s. The orbit of this star increases the constraints on the density of the dark mass by four orders of magnitude over her previous estimates, and eliminates several remaining alternatives to a supermassive black hole. Our own galaxy has now become the strongest case for a normal galaxy containing a supermassive black hole.

Characteristics of Extrasolar Planets Emerging
The discovery of planets around stars beyond the Sun is one of the most exciting results of the last decade. Now the international Anglo-Australian Planet Search Team, in part sponsored by the NSF, has found more extrasolar planets in the Southern Hemisphere than any other group. With recent finds, the total number of planets found to date by all groups is about 117. Given this total, astronomers are beginning to see patterns in planet characteristics. The first ones found were close in to their parent stars, but now they are finding more planets farther out and in nearly circular orbits similar to our own solar system.

One of the most recent planets found has a mass of about 1.2 times the mass of Jupiter. The planet is located about the same distance from its star as our asteroid belt is from our Sun (2.5 times the Earth-Sun distance), and its orbit is roughly circular.

Based on the 15-year survey, which Paul Butler of Carnegie Institution of Washington and Geoff Marcy of the University of California, Berkeley have headed (with team members Debra Fisher and Steven Vogt), about 12% of the Sun-like stars in our galaxy have planets that can be detected orbiting their stars within about 5 astronomical units (an astronomical unit is the average distance of the Earth from the Sun, about 93,000,000 miles). As the number of extrasolar planets found grows, more planets are being found farther out from the star they are orbiting. This finding supports the idea that giant planets in solar systems may form at great distances from their stars and later move inward.

This research has depended on special instrumentation and analytical techniques developed by the investigators (and shared with other groups). It is at the core of fundamental problems in astrophysics, and captures the public imagination stimulating interest in science.

Fertility Control in China
Until the 1970s, weaving was an important subsistence activity that rural women in southern China were engaged in. This research in Xiaoshan reveals that women not only used the loom for weaving, but also used it to carry out voluntary abortions before modern birth control facilities had become widely available. The working method–the pregnant woman repeatedly battering the lower abdomen (uterus) with the handle while weaving–may seem brutal, yet it helped women realize the necessity of voluntary fertility control without informing the husband. The discovery of the women's use of the loom for deliberate abortion sheds light on the debate over the roles of rational decision-making on historical demographic transition in China. It reveals that deliberate fertility control was a reality among some subgroups of the poor rural population in Xiaoshan. Women's usage of the loom for abortion also touches on issues of gender. It shows that family fertility was not uniformly regulated by the collective good of the male-headed family. Rather, women themselves

often had great individual power in manipulating and making rational decisions in fertility control.

This research expands the frontier of cultural anthropology research and has great broader impacts.

Gold Discovered in Outer Space
An astronomer at the University of Oklahoma has been making major advances in understanding the formation of the heavy elements in nature by searching for gold. Recently John Cowan and coworkers identified, for the first time, a number of heavy elements, in particular gold, in some of the very oldest stars in our Galaxy. These results also provide new insights into the conditions at the time of formation of our Galaxy. They have also identified radioactive elements such as thorium and uranium in the spectra of some of these stars. They then employed the abundances of these elements and knowledge of how they are likely produced in the interiors of stars to make estimates of the ages of the oldest stars. They find them to be approximately 15 billion years old. Such age estimates provide us with strong constraints on the age of our Galaxy and add further limits on the age determination for our Universe.

Five undergraduate students [including two Research Experiences for Undergraduates (REU) students] participated in this work. In the course of these studies they developed new techniques in stellar spectroscopy, elemental and isotopic abundance determinations, and for theoretical heavy element abundance predictions.

This research promotes understanding of the formation of the elements, the age and formation of our Galaxy, as well as the development of new analysis techniques, and it provides research training for undergraduate students.

How to See Invisible Matter
One of the most stunning scientific findings of the 20th century is that "normal" matter–the atoms, protons, neutrons, and electrons that comprise our material existence–makes up just a tiny fraction of our Universe. Most of the matter in the Universe is known to be some as yet undiscovered particle that neither emits nor blocks light, and passes right through "normal" matter as if it were not there. How do we know that this "dark matter" exists if we cannot see it and don't even know what it's made of? Even dark matter obeys the laws of gravity: the primary evidence for dark matter is that we see normal matter moving in ways that imply it is being pulled by the gravity of some invisible material.

Professor Gary Bernstein, PhD recipient Michael Jarvis, and several collaborators have conducted an inventory of the amount and distribution of this dark matter by measuring its subtle gravitational effects. If we look past a lump of (invisible) dark matter at a normal galaxy in the background, the image of the background galaxy will be distorted because its light rays are bent by the gravity of the dark matter as they pass by. This "weak gravitational lensing" distortion is extremely subtle, so it is impossible to detect on any individual background galaxy. But by comparing the shapes of millions of galaxies, the pattern of dark matter in the foreground can be revealed.

Results by this group and others confirm that the dark matter greatly outweighs all the atoms in the Universe. More interestingly, the pattern of dark matter is seen to be consistent with the theory that all the structures in the Universe are descendents of the tiny fluctuations in the early Universe that are seen by cosmic background radiation measurements such as the Wilkinson Microwave Anisotropy Probe satellite. These tiny "seeds" accumulate matter under the influence of gravity until they become galaxies and clumps of galaxies hundreds of millions of light-years across. So now we can "see" the dark matter, and understand how it fills the Universe and builds galaxies - but we still do not know what it's made of.

Incarceration and Fragile Families
The U.S. Bureau of the Census recently reported that the number of single mothers in the United States has grown nearly 200 percent since 1970 and that in 1998, 9.8 million mothers were unmarried. Coupled to this trend, the male

prison population grew from 200,000 inmates in 1974 to 1.3 million by 2001. Could the growth in the penal population explain some of the rise in single-motherhood, particularly among poor and minority couples, whose men are at greatest risk of incarceration?

Using data from the Fragile Families and Child Wellbeing Study, the researchers conducted a cohort study mainly comprised of children born to unwed parents. Analysis of these data indicates that fathers in the survey are unlikely to be living with the mothers of their children at the child's birth and are very unlikely to get married later. Among men not living with the mother only 4.3% of African Americans, 12% of Hispanics, and 14.5% of whites were married 12 months after their child's birth. Serving time in prison or jail reduces marriage rates even more. A prison or jail record is estimated to reduce the probability of marriage by 47% for African American fathers, 19% for Hispanic fathers, and 43% for white fathers. If these effects are applied to the population as a whole, they imply that the marriage rate among white men would be about 2% higher, and among black men about 12% higher, if the rate of incarceration were zero.

This research is on the cutting-edge of sociology and explores important social issues.

New Cells in Adult Mammalian Brain Can Make Functional Connections

Contrary to dogma, the adult brain exhibits considerable plasticity. New cells that are born in particular brain regions migrate within the forebrain and differentiate into neurons. But do these new cells make functional connections that allow them to be influenced by events in the environment? Using adult male hamsters, Eric L. Bittman and colleagues discovered that newborn brain cells could make functional connections that are activated by exposure to estrous female hamsters. They also found that the survival of these cells for seven weeks required the presence of testosterone in the animal's bloodstream. These discoveries pioneer the exploration of basic mechanisms of cell birth, migration, and death that may prove useful in treatment of damaged or diseased nervous systems.

New cells in the brain of an adult mammal can make functional connections, and their survival depends upon the animal's physiological state. These discoveries expand the frontiers of neuroscience in the exploration of basic mechanisms of cell birth, migration, and death throughout the life span of the organism.

Research across Disciplines -- Earthquakes and Supershear

Jean Carlson is a condensed matter theorist and a former Packard Fellow. She is actively involved in giving public lectures and in the local Physics Circus Outreach Program for K-12. Her research interests build on her background in condensed matter and statistical physics. Her present research group is comprised of students and postdocs from physics, geophysics, geography, systems biology, engineering and materials science. This vibrant group is addressing problems such as models of earthquake rupture dynamics, models of friction and granular materials, merging concepts from statistical physics and control theory, networks in ecology and finance, systems biology and forest fires.

Carlson's work on earthquake rupture dynamics has recently appeared in Science magazine, where Carlson and collaborators report "a new phenomenon unique to three-dimensional cracks: Locally stronger fault sections, rather than slowing ruptures, drive them forward at velocities exceeding the shear wave speed." This work helps us to understand not only the damage mechanism of earthquakes but also the failure of engineering materials. Motivated in part by the study of earthquakes, Carlson and collaborators have been performing computer simulations of models for the rupture process that occurs during an earthquake. Rupture is initiated by stresses that push material above a fault plane in one direction while pulling material below the plane in the opposite direction. If the resulting stress is high enough, the cohesiveness of the material is lost resulting in the formation of a crack and the materials on either side of the fault plane sliding

over each other behind the crack front. An analysis of ground motion reveals that such a crack follows a complicated path due to variations in stresses or the presence of nonuniform geophysical materials that have different strengths.

Carlson has been investigating the different roles of these heterogeneities in determining the way these shear cracks move. The limiting rupture velocity of most earthquakes seems to be the Rayleigh speed, the speed of surface waves, but there have been several reports of shear crack fronts moving faster than the shear wave velocity (most notably in the 1999 earthquakes in Turkey). In the course of investigating heterogeneities on the fault, she discovered an interesting new mechanism to excite this supershear transition.

This is an example of theoretical research that has yielded a possible explanation of earthquake phenomena observed in the 1999 Turkey and 1984 Morgan Hill earthquakes and possibly others and at the same time provides insight into the shear fracture failure of materials. This cross disciplinarity and high impact are signature of Professor Carlson's wide-ranging work that also includes granular materials and networks.

***Indicator I2.* - Connections between discoveries and their use in service to society.**

African Ice Cores Reveal Prolonged Tropical Droughts

Ohio State University professors Lonnie Thompson and Ellen Mosley-Thompson led an international team of researchers to the summit of Mt. Kilimanjaro in 2000 to collect ice cores from glaciers at the summit in order to study tropical climate and the African monsoon system. What they discovered was completely astonishing. Through careful analyses, the team of researchers recreated an unprecedented and highly detailed record of three catastrophic droughts that plagued the region 8,300, 5,200 and 4,000 years ago. Glaciers at the top of Mt. Kilimanjaro in Tanzania began forming 11,700 years ago. Data from Kilimanjaro's ice cores reveal a wetter landscape in the region some 9,500 years ago than compared to today. Lake Chad, now the fourth largest body of water on the African continent with an area of 17,000 square kilometers, covered 350,000 square kilometers – an area larger than the modern day Caspian Sea. But beginning around 8,300 years ago, the ice cores reveal a climate of recurring and prolonged droughts, some lasting 300 years. While the causes of such climatic events are under active study by the Thompsons and colleagues, their recurrence is of major concern because seventy percent of the world's population now lives in the tropics and social systems can be dramatically stressed by climate events of the magnitude recorded in the ice.

The study of paleoclimates from ice cores is consistently at the cutting edge of new insights and technologies that enable broader understanding of the interaction of climate and society.

Discovering How Some Plants Resist Insects May Lead to Safer Insect Control

When plants are attacked by insects that eat them, they often respond by producing proteins that protect them from being eaten. Drs. Dawn S. Luthe, Peter Ma, and Tibor Pechan, of Mississippi State University, have discovered a unique enzyme in corn that is capable of drastically slowing the growth of caterpillars by damaging their midgut structure. This is a fundamentally new mechanism of plant resistance to insect feeding that could greatly benefit the agricultural industry. It may be possible, in the future, to use this to genetically engineer plants to resist insect feeding. Insect feeding is responsible for 15% of the world's crop losses, a major economic and ecological problem that decreases the supply of food to a growing human population. The availability of effective and environmentally safe insect control is important to everyone.

The discovery of this fundamentally new mechanism of plant resistance could revolutionize the control of insect damage to crops.

International Water Vapor Project

The International H2O Project (IHOP) field experiment, one of the largest weather-related studies in U.S. history, took place from 13 May through 25 June 2002. The project tracked swaths of moisture across the southern U.S. Great Plains. The chief aim of IHOP was to improve characterization of the four-dimensional distribution of water vapor and in turn improve the understanding and prediction of convection.

Over 200 investigators and technical personnel spent a large part of their summer in Oklahoma and Kansas to support this NSF-funded project, which involved important contributions from groups at UCLA (Wakimoto), Penn State (Richardson), Oklahoma (Xue) and was coordinated by NCAR scientists David Parsons and Tammy Weckwerth. Because improved rain and snow forecasts are one of the main goals of the U.S. Weather Research Program (USWRP), the project also received support from the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA) and the Department of Energy (DOE).

IHOP 2002 was motivated in part by the significant impact on society of flash floods, which in the U.S. cause billions of dollars in

property damage and the largest number of weather-related fatalities. The full impact of the IHOP 2002 experiment on operational forecast systems and the associated impacts to society from improved prediction of flash floods and other warm season hazardous weather is likely years away due to the time required for careful analysis of the observations and the associated theoretical and numerical work.

Researchers anticipate two of what may be many potential dramatic impacts of the IHOP 2002 efforts. Accurate forecasting of hazardous weather is typically a "nowcasting" problem. For example, the average lead-time for flash flood warnings in this country is approximately one hour.

Early in the project, scientists found an interpretation of data that from a relatively new technique called "radar refractivity" was able to provide additional clues on where storms might form. At times this provided several hours of lead-time on where fine lines might occur. A potential implication of this approach is that forecast times for nowcasting storms may be dramatically extended.

In addition to potentially improving weather prediction, such analysis also allows us to address the long-standing question of whether boundaries between irrigated and non-irrigated croplands are significant from a weather standpoint.

Further details on other IHOP activities can be found at www.atd.ucar.edu/dir_off/projects/2002/IHOP.html

There is a known societal need is to improve the reliability of our forecasts of severe weather and flash floods in order to prevent loss of life and mitigate economic losses. While the acute effects of these storm systems may have impacts at highly localized scales, their clearer description, understanding and prediction requires study across large space and time scales.

Retreat History of the West Antarctic Ice Sheet, Marie Byrd Land

This award supported the reconstruction of a retreat history of the West Antarctic ice sheet along a flowline through the Ford Ranges in Marie Byrd Land, from the last glacial maximum to present. The ice surface elevation history of the region was reconstructed using cosmogenic isotope exposure dating of moraine boulders and ice-abraded bedrock surfaces. As the covering layer of ice thinned and disappeared, the rocks were exposed to bombardment by cosmic rays, altering their isotopic composition. Using a particle accelerator to count the cosmic ray-produced atoms in a rock allows scientists to determine its age and, as a result, the time the glacier disappeared from the rock surface. Previous research has inferred the history of the ice sheet indirectly, from such things as changing beach levels or volcanic debris. In this study, the scientists gathered rocks deposited by glaciers on mountain peaks and dated them using cosmogenic exposure age dating which allowed them to track the thinning of the ice sheet over the last few thousand years.

The most surprising conclusion of the project so far is that deglaciation took place mostly in the late Holocene, and is probably still underway in parts of West Antarctica. These results contribute to our understanding of the history and dynamics of the West Antarctic ice sheet and will help forecast its future stability. They show that:

(i) Deglaciation of the Marie Byrd Land sector of the ice sheet occurred gradually over a period of 7,000 - 10,000 years, not catastrophically:
(ii) West Antarctic melting has contributed to eustatic sea level change since 6000 years B.P., the widely assumed 'end' of late Pleistocene/Holocene deglaciation; and
(iii) Parts of West Antarctica are still undergoing gradual deglaciation, contributing to the present-day background rate of eustatic sea level rise.

This work establishes a background pattern of steady decline in the West Antarctic ice sheet. This project received a lot of media attention at

the time of publication of a paper in Science on January 3, 2003. There were several media stories about these results including an article on CNN.com on Jan. 3, 2003 entitled "*Antarctic ice sheet may melt in 7000 years*." A story featuring the principal investigator, John Stone, and his results also appeared on CBS Sunday morning on January 19, 2003.

Spider Venom may Yield Environmentally Friendly Pesticides

The venom of the Australian funnel-web spider contains a poisonous mixture of potent neurotoxins, and a bite from one of these spiders is usually fatal. Dr. Glenn King at the University of Connecticut Health Center has been studying the molecular structures of several of these toxins that selectively target the nervous systems of insects. Because these toxins do not affect the mammalian nervous system, it may be possible to use these insect-specific toxins as the bases for environmentally friendly insecticides.

Dr. King's work has focused on determining the molecular structures of the toxins, since this is critical to understanding the mechanism of action of the toxins at the cellular level. Dr. King and colleagues determined the three-dimensional structures of one excitatory neurotoxin and two paralytic neurotoxins from the funnel-web spider at the atomic level. Dr. King is also introducing mutations into the toxins to identify the areas of the toxin surfaces that are important for their insecticidal activities. He foresees several ways in which it may be possible to use the insect-specific neurotoxins in agriculture, thus reducing dependence on chemical pesticides.

The genes for the neurotoxins could be inserted directly into the plant genome, or insect-specific viruses could be used as vectors to deliver the toxins to a restricted number of species. Dr. King's work has been done in collaboration with scientists in Australia. Reports of his work have appeared in the press[13] and on national television.

Dr. King's group is the first to study the structures of these insect-specific neurotoxins and to devise creative potential applications for agriculture.

Vocational Education in the Metalworking Industries

The machining and tool and die industries are significant contributors to the American economy in terms of providing jobs and creating value. Like nearly all other industries, the viability and competitiveness of machine shops and tool and die shops depend, in part, on hiring and retaining skilled employees. In this study, anthropologist Garry Chick examined, compared, and evaluated the ways in which machinists and toolmakers are trained in western Pennsylvania, an area with one of the highest concentrations of small- and medium-sized machine and tool and die shops in the world.

Chick was interested in how potential employers saw the effectiveness of high school vocational training in the metalworking trades. The most striking contrasts between potential employers and potential employees were apparent in terms of what individuals in each group felt that machinists and toolmakers must know in order to succeed on the job. Students in high school vocational programs in machine-tool technology did not believe that topics such as trigonometry, algebra, oral communication, critical thinking, problem solving, and computer programming would be particularly important to them in their occupational futures while skills in these areas were precisely what potential employers regarded most highly. On the other hand, students felt that "machine-tool technology," basically learning to run machines, was extremely important while company owners felt that they could teach new employees how to run machines but they could not teach algebra, trigonometry, and problem solving skills.

The fact that students who attend vocational high school programs are often there because they are unsuccessful at or uninterested in academic classes is a major human resource problem in the machining and tooling industries. Similarly, the mismatch between what students think that they need to know in order to be

13 http://www.uchc.edu/ocomm/newsreleases01/april01/funnelwebspider.htm

successful and what employers want them to know is a serious problem in vocational education for the metal working industries.

Reports based on Chick's research have been provided to academic and vocational high schools in western Pennsylvania, the Northwest Pennsylvania and Southwest Pennsylvania branches of the National Tooling and Machining Association, the Northwestern Pennsylvania Tech Prep Consortium, the Western Pennsylvania School-to-Work Tech Prep Clearinghouse, and the Pennsylvania Department of Education. The results of the study are also being communicated via conference presentations and publications in journals devoted to research in vocational education.

<u>Indicator I3.</u> - Partnerships that enable the flow of ideas among the academic, public or private sectors.

A Stellar Relic in the Milky Way: The Lowest Metallicity Star Known
Exploding stars that add heavier chemical elements continuously contaminate the gas of our galaxy, which was presumably composed of only hydrogen and helium initially. Consequently, the oldest stars should contain very little of these elements. Now, a research group of astronomers from the U.S., Germany, Sweden, Australia, and Brazil has found a giant star with 1/200,000 of the solar content of heavy elements. This is about 20 times more metal-poor than the previous record for any kind of star.

The discovery of this star gives astronomers the unique opportunity of studying stellar gas with a composition close to the state it had directly after the Big Bang. Timothy Beers of Michigan State University and collaborators have conducted a systematic search for the most metal-deficient stars in the outer reaches of our galaxy over the past two decades. The star they found is named HE 0107-5240 (HE stands for Hamburg/European Southern Observatory Survey). It is many thousand times fainter than the faintest stars that can be seen with the naked eye, roughly 16th magnitude.

This is the closest astronomers have come to having direct knowledge of the chemistry of the Universe shortly after the Big Bang. However, it is not the whole story, since in spite of its deficiency of heavy metals, the small abundance of metals seen in this star is evidence of a previous generation of yet older massive stars that exploded as supernovae. HE 0107-5240 may be the first example of a truly second-generation star.

This research provides clues to the earliest environmental conditions in our galaxy, expands our understanding of the history of the Universe, and contributes to the international exchange of ideas.

Curbing Chagas disease in Argentina
Chagas disease is a sizeable public health problem. It infects 10–18 million people in the Americas, including women who may eventually transmit it to their newborns. While the spraying of insecticides against the vector and the screening of blood donors has produced a decreasing disease incidence, experts are now recognizing the importance of mother-child transmission. Congenital cases are mostly asymptomatic, but can seriously affect the newborn's survival and illness rate. Although such cases cannot be prevented because the available drugs have adverse effects, early detection and prompt treatment are frequently successful. However, as screening of pregnant women and newborns has not been routinely conducted, the amount of mother-child transmission has not been established. Using demographic and epidemiological data and a novel but elementary model, the researchers estimated that transmission of infection from infected mothers to newborn infants is 6.3 times greater than officially reported, and may even exceed transmission by biting bugs.

This project represents a partnership between an American academic scientist (Joel Cohen, Rockefeller University), an Argentine academic scientist (Ricardo E. Gürtler, Universidad de Buenos Aires), and an Argentine public health official (Elsa L. Segura, Centro Nacional de Diagnóstico e Investigación en Endemo-epidemias).

The data from this study is important for making policy recommendations and health service planning. The finding reported here is but one piece of a much larger project on the ecology and epidemiology of Chagas disease that is designed to ensure that academic research flows to public health workers and results in measurable public health benefits.

Smart Sensors and Integrated Devices
One of the Integrative Graduate Education and Research Traineeships (IGERT) research projects in the biomedical area, "*Cancer Detection using 3-D Ultrasonic Imaging*", is a collaboration between the Wayne State

University Smart Sensors and Integrated Microsystems program and the Karmanos Cancer Research Institute. Since the beginning of this collaborative effort in 2000, both IGERT trainees and associates have been involved.

The objective of this project is to develop a detection technique with image resolution smaller than 2 mm (typical precursor size of cancer tumors) so that early detection and diagnosis of the tumors could lead to possible therapeutic treatments and higher survival rates. They are working not only on holographic data accumulation and analysis, but also focusing their research efforts on the development of ultrasonic piezoelectric detector sensor arrays based on AlN wideband gap semiconductors. This is truly a multidisciplinary research project that involves faculty from engineering, physics, and medicine as well as medical clinicians. Based on preliminary work, they have been able to secure additional funding of $100,000 through the prestigious Wilson Foundation.

Scientific research groups in the U.S. (supported by NSF) and Europe (supported by the European Community) are working together to create advanced nanoscale materials for a broad range of possible technological applications. A major problem they are addressing is that interfaces between thin film ceramic materials are often unstable. At nanoscale dimensions, stable films with thicknesses engineered by controlling chemical composition will lead to novel physical properties. These findings will enable nanomaterials to be used in new devices, and due to their general applicability to many inhomogeneous films, they promise application to a broader arena. For example one researcher in the group, a spectroscopist affiliated with both the University of Pennsylvania and Dupont, has obtained results that may impact NIH-supported research on biological films.

Wildfire Hazard Estimation

Dr. Frederic Schoenberg, a statistician at the University of California, Los Angeles (UCLA), led a project to accurately estimate wildfire hazard in Los Angeles County and to assess the uncertainty in these estimates. Furthermore, the project sought to determine how various meteorological and environmental variables are related to wildfire hazard.

The researchers worked closely with the Los Angeles (LA) County Fire Department, the LA County Department of Public Works, the National Parks Service, and atmospheric scientists to obtain detailed records of wildfire occurrences in LA County and of variables such as temperature and precipitation. Among the early findings from analysis of these data was that it is extremely infrequent that a wildfire affects an area that has burned recently. This lends some support to the practice of prescribed burning, which is highly controversial due to the 2000 Los Alamos fire.

In examining other meteorological and environmental variables, the researchers found some expected relationships. For example, up to a point, wildfire incidence increases as temperature increases, but this is true only up to about 70 degrees. Above that, further increases in temperature do not significantly increase the wildfire risk. These findings are consistent with the theory that for wildfire to occur, certain sufficient conditions must exist, but extreme conditions do not increase the wildfire risk. These relationships have important implications in fire management, insurance, and public policy at the high-risk end of the spectrum.

One important variable examined by the UCLA researchers was the Burning Index (BI), a conglomerate measure of wildfire risk that is widely used by the Fire Department, Forest Service, and National Parks Service. The researchers were able to find better ways of combining BI records from different weather stations to obtain more accurate estimates of wildfire risk. Because the LA County Fire Department is committed to a national program involving the use of BI for predicting wildfire danger, the question of how to optimally use this information is critical.

This example enhanced the training of all the researchers, some of whom are women. It also advanced the theory of statistical modeling methods in a way that had potential for direct societal impact.

Indicator I4. - Leadership in fostering newly developing or emerging areas.

Constraint Based Genome-Scale Model of *E. coli*

For many years, drug manufacturers have manipulated the genetic code in *E. coli* strains, creating species that can produce important substances, such as the hormone insulin for use by people with diabetes or the experimental cancer drug angiostatin. Using the new constraints-based techniques Bernhard Palsson[14] and his colleagues developed, drug manufacturers and bioprocessing companies could use computers to determine the genetic code that could yield the most efficient and productive versions of *E. coli,* and then use adaptive evolution to create bacterial strains that have the desired properties.

Palsson has created a computer model that accurately predicts how *E. coli* metabolic systems adapt and evolve when the bacteria are placed under environmental constraints. Palsson, along with Rafael Ibarra[15] and Jeremy Edwards[16] report their findings in the November 14, 2002 issue of Nature, and indicate that their model is the only existing genome-scale model of *E. coli*. The new model takes a whole-system approach. Changing one aspect of a genetic code could be irrelevant if an organism adapts and evolves, says Palsson. The constraints-based models allow the *E. coli* to evolve more naturally along several possible paths.

The investigators based their digital bacteria on earlier laboratory studies and *E. coli* genome sequences, and detailed genetic codes that have been augmented with experimental information about the function of every gene. Such digital models are known as "*in silico*" experiments -- a play on words referring to biological studies conducted on a computer.

Scientists may use the approach to design new bacterial strains on the computer by controlling environmental parameters and predicting how microorganisms adapt over time. Then, by recreating the environment in a laboratory, researchers may be able to coax living bacteria into evolving into the new strain. The resulting strains may be more efficient at producing insulin or cancer-fighting drugs than existing bacterial colonies engineered by researchers using standard techniques.

Bernhard Palsson has created a constraints-based computer model that accurately predicts how *E. coli* metabolic systems adapt and evolve when the bacteria are placed under environmental constraints.

Electronic Structure for the 21st Century

Gabriel Kotliar co-organized an international workshop held at the Kavli Institute of Theoretical Physics (KITP) located at the University of California at Santa Barbara. The workshop entitled "*Realistic Theories of Correlated Electron Material*" brought together researchers with the aim of combining theoretical and computational advances to work toward a quantitative and predictive approach to strongly-correlated electron materials.

These materials are of significant interest, both scientifically and in several cases technologically. They include: Mott-insulators, insulators that would be metals were it not for strong electron-electron interactions; high temperature superconductors and related compounds; heavy fermion materials, a class of compounds that exhibit unusual metallic, magnetic, and superconducting states; and low-dimensional organometallic compounds which yield novel metallic, superconducting, and insulating states. Combining a quantum many body theory technique known as dynamical mean field theory (DMFT) with modern density-functional-theory based techniques was a main thrust of the workshop.

The workshop has brought together two communities that have been contentious in recent years to focus on the challenging strongly correlated electron materials problem with an aim to making significant progress. There was

[14] Department of Bioengineering, University of California at San Diego
[15] GenVault Corporation in Carlsbad, California
[16] now at the University of Delaware at Newark

also strong participation from international researchers and national laboratories. KITP provides an environment where researchers can gather for extended periods (three weeks or more) for substantial collaboration. KITP schedules about four or so workshops per year on a variety of topics spanning physics, materials research, and astronomy. The experience involves an intense exchange of ideas from formal and informal presentations to one-on-one interactions.

This activity makes use of facilities at the Kavli Institute for Theoretical Physics to attack a challenging problem in condensed matter and materials physics. It brings together the methods and techniques developed by two research communities with differing cultures. The intense interaction also involves professional development as techniques and ideas are exchanged among these communities, and an environment is created to encourage further collaborative work.

International Roundtable in Comparative Developmental Physiology
This NSF-supported workshop, held in June 2002, promoted discussions about comparative developmental physiology, an emerging scientific area that links comparative animal physiology and evolutionary developmental biology. Among the 33 participants, the seasoned scientists came away with new perspectives while the 15 junior faculty members, postdocs, and graduate students were newly enthused about the future of the field and their role in it.

From the workshop's papers and intense discussions, the meeting's organizers have compiled a multi-authored book, "*New Directions in Comparative Developmental Physiology*," to be published by Cambridge University Press. In order to enhance communication among the participants, a listserve has been established. In addition, a Web site for the general community now exists at Developmental Physiology. More than 800 hits in one month suggest that the workshop instilled a sense of identity and enthusiasm in a community of comparative physiologists and developmental biologists that had not previously been cohesive or even self-aware.

This workshop promoted discussions about comparative developmental physiology, a newly developing area of biology. The meeting and the resulting listserve, Web site, and book have fostered this emerging scientific area.

IP-Based Embedded Systems Design
The project emphasizes new design methods to deal with today's high-capacity embedded computer chips. The most fundamental change in required methods is a unified view of hardware and software. The project develops methods for tuning highly configurable system-on-a-chip designs, including memory reconfiguration and hardware/software partitioning, to specific embedded applications.

The main research outputs of the project are the techniques embodied in a prototype system-on-a-chip exploration tool called Platune. An embedded system typically runs one or a few applications for its lifetime. Tuning a system-on-a-chip architecture to that application can greatly reduce power and improve performance, but the number of possibilities has thus far prevented designers from doing a good job of tuning. The project developed efficient search methods to rapidly explore the enormous tuning solution space and to quickly find the best set of architecture configurations.

Tony Givargis, the key graduate student involved in the research, and now an Assistant Professor at the University of California, Irvine, developed an easy to use prototype tool, Platune, that is presently used by several researchers and in several classes worldwide. Platune's website is http://www.cs.ucr.edu/~dalton/Platune/.

One outcome is a new textbook, "*Embedded System Design*"[17] that is the first to present embedded system design at the level of principles, emphasizing the new unified hardware/software computing view that is

[17] John Wiley and Sons, 2002, by Frank Vahid and Tony Givargis

essential in today's world of embedded computing.

The widely used software tool is facilitating research and education in this new area. The ideas are exploring the new area of embedded systems and developing new models to analyze and design these systems.

Left-Handed Materials

The direction that light bends when passing through a physical material depends on its index of refraction. Normally, this index is positive, but 35 years ago, it was predicted by a Russian theorist that materials with a negative index could exist. Unlike conventional positive-index materials, which require curved surfaces or material inhomogeneities to focus light, a flat slab of material with a negative index of refraction could act as a lens.

A project at the Massachusetts Institute of Technology's Center for Bits and Atoms[18] has experimentally realized an artificially structured composite material that exhibits a negative index in the microwave regime. Following techniques introduced two years ago by a group at the University of California, Santa Barbara (UCSB), the group was able to use metallic wires and ring resonators patterned on microwave substrates arranged in a three dimensional pattern. Their measurements produce the first conclusive experimental evidence showing that transmission through these materials obeys Snell's Law with a negative index, and provides preliminary evidence of focusing behavior.

Beyond its fundamental interest, this example of designing and fabricating the structure of an artificial material could transform the practice of wireless communications by adding a long-sought converging electromagnetic element.

The result was announced at the American Physical Society's March Meeting: http://www.aps.org/meet/MAR03/baps/vpr/general.html and a number of press stories reported on this result.

A novel, surprising, and almost bizarre material has been invented, with potential applications in a variety of areas, such as wireless communications.

[18] CCR-0122419

TOOLS

Indicator T1. Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities.

Data Mining the National Virtual Observatory

As part of their mission to create the infrastructure to support computational science, National Partnership for Advanced Computational Infrastructure (NPACI) researchers at the San Diego Supercomputer Center (SDSC) have developed the Storage Resource Broker (SRB). The Information Age is driving an explosion in data generation across all scientific disciplines, and researchers are facing unprecedented challenges in acquiring, managing, analyzing, and mining the abundance of data and publishing their results in digital libraries. This SRB middleware lets researchers powerfully and flexibly manage not only their own data but also create virtual data collections that span widespread locations and diverse formats. Freeing scientists from manual data management, the SRB greatly expands researchers' ability to share data and collaborate, forming a key component of the Grid and accelerating the advance of science.

In astronomy, researchers from 17 institutions are collaborating to establish standards that will support the National Virtual Observatory (NVO), a discipline-wide, expandable database of astronomical images, catalogs, measurements, and scientific publications that will unite more than 100 terabytes of data collected from 50 ground- and space-based telescopes and instruments.

By linking all of this data, along with analysis and visualization tools, in the form of easily-accessible Web services, the project will make a "virtual observatory" available to professional researchers, amateur astronomers, and students alike, greatly broadening and speeding astronomy research and education. The SRB is used as a data grid within the NVO, and is already managing two important collections, the 2-Micron All Sky Survey (2MASS) and the Digital Palomar Observatory Sky Survey (DPOSS). Together, these are the largest data collections under SRB management at SDSC, totaling 18 terabytes of data in more than five million files.

High-Performance Probes Developed at NHMFL

A unique capability of the National High Magnetic Field Laboratory (NHMFL) is to develop high-performance probes for nuclear magnetic resonance (NMR) spectroscopy and imaging. These probes, which are used, for example, to study membrane proteins and materials chemistry under high magnetic fields, are not commercially available. The unique magnets at the NHMFL generate unique instrumentation requirements, and the outstanding instrumentation staff of the NHMFL works with an international group of application scientists, users, academic and industrial collaborators to meet user needs. Probes have been developed to support the NHMFL user programs in NMR studies of inorganic solids and for magnetic resonance imaging (MRI). More probes are in development for biological and inorganic solids. One such probe has been used to obtain spectra sensitive enough to resolve different valence states in a solid sample. Other probes used for solid-state NMR provide measurements over a wide temperature range for samples smaller than 5 mm. Still other probes have been developed for stray-field imaging. High-sensitivity cryoprobes for solution NMR experiments are in great demand, and probes are currently being developed for NMR at the highest fields available.

These probes enable investigations of the behavior of a wide variety of materials that would otherwise be impossible or much too time-consuming.

Internet Satellite Connection to Under-served Sites

The Internet Satellite Project (ISP) uses a satellite infrastructure for purposes of enhancing research, instruction and learning in a diverse set of institutions of higher education. The project has brought advanced computer networking

applications to geographically remote campuses, including tribal colleges, historically black colleges and Hispanic-serving institutions. Different sites are taking advantage of access to remote instruments, data sources, and other instructional and learning resources not available locally.

The project has encouraged and enabled collaboration among a diverse student population and has also allowed access by the research university community to cultural and human resources from otherwise inaccessible institutions and extension offices. A total of approximately 70 geographically remote institutions enjoy advanced Internet connectivity through this project.

Most Detailed Images of the Early Universe
Using a powerful new instrument deployed at South Pole, a team of cosmologists lead by the University of California at Berkeley has produced the most detailed images of the early Universe ever recorded. The research team has published their measurements of the most subtle temperature differences in the Cosmic Microwave Background (CMB) radiation. The CMB is the remnant radiation that escaped from the rapidly cooling Universe about 400,000 years after the Big Bang. The new results provide additional evidence to support the currently favored model of the Universe in which 30% of all content is a strange form of dark matter that does not interact with light and 65% is in an even stranger form of dark energy that appears to be causing the expansion of the Universe to accelerate. Only the remaining five percent of the Universe takes the form of familiar matter like that which makes up planets and stars.

The new sensitive instrument - Arcminute Cosmology Bolometer Array Receiver (ACBAR) produced high-resolution images of the CMB that reveal the seeds that grew to form the largest structures seen in the Universe today. These results add to the description of the early Universe provided by several previous ground-based, balloon-borne and space experiments. Previous to the ACBAR results, the most sensitive, fine angular scale CMB measurements were produced by the NSF-funded Cosmic Background Investigator (CBI) experiment observing from a mountaintop in Chile.

ACBAR is specifically designed to take advantage of the unique capabilities of the 2.1-meter Viper radio telescope, installed by NSF at the Amundsen-Scott South Pole Station in Antarctica. The receiver is an array of 16 detectors that create images of the sky in 3-millimeter wavelength bands near the peak in the brightness of the CMB. In order to reach the maximum possible sensitivity, the ACBAR detectors are cooled to two-tenths of a degree above absolute zero, or about -273 degrees Celsius (-459 Fahrenheit).

This work provides new and unprecedented information about the structure and development of the early Universe.

National Nanofabrication Users Network (NNUN)
The National Nanofabrication Users Network (NNUN) provides the nation's researchers with effective and efficient access to advanced nanofabrication equipment and expertise. The five sites of the NNUN comprise a networked partnership of state-of-art facilities with common as well as complementary infrastructure with emphasis on training and open access, staff expertise and support for experiments, focus on user needs, ease of use, and access, expand the applications of nanotechnology, provide a bridge between disciplines through technical liaison and catalysis of new developments. There is considerable emphasis on education through workshops, short courses, dissemination of results and technology transfer.

Speech Assisted Learning (SAL) for Braille Students
The world's first stand-alone Braille learning station was made possible by an NSF grant to Exceptional Teaching Aids, Inc. of Castro Valley, CA. This small firm specializes in products for the visually impaired. Speech Assisted Learning (SAL), developed under the

Small Business Innovation Research (SBIR) program, offers high quality Braille instruction to more blind students (of all ages) than was ever possible before.

SAL can be used to augment classroom instruction or provide sequentially programmed lessons in several Braille codes. Newly blinded adults are moving more quickly back into the work force and regaining control of their personal and professional lives.

The curriculum courseware consists of data diskettes with corresponding bar-code technology Braille worksheets. Worksheets are placed on the touch screen of the SAL System. Through SAL's synthesized speech, the student listens to spoken tutorials and then is asked questions. The student will indicate an answer by pressing on the worksheet or typing it on the 8-dot keyboard. SAL will then provide spoken feedback as to the accuracy of the answer. A slight press of a finger prompts SAL to speak a word. With a second press, SAL will spell the word with the correct Braille contractions. The curriculum provides educators with everything they need to teach Braille mathematics, science, reading, computer codes, and more. A record-keeping feature allows educators to monitor progress of their students.

Duxbury Systems, Inc. has recently completed software that will allow Exceptional Teaching Aids, Inc. to offer high quality speech and Braille courseware in Spanish. Additional software is available to individuals who want to create their own materials for SAL.

The simplicity of SAL extends the ability of teachers to provide instruction over longer periods of time with amazing, proven results while maintaining student interest. With SAL, Braille has never been easier and faster to teach and learn, promoting self-management skills, vocational options, social interaction, and equality of opportunity in private and professional lives.

Freedom Scientific, licensed by Exceptional, has just recently brought the first SAL units to the market.

This project provides a new and effective approach for the blind in math learning.

Telemicroscopy

Mark H. Ellisman, leader of the National Partnership for Advanced Computational Infrastructure (NPACI) Neuroscience thrust area and director of the National Center for Microscopy and Imaging Research (NCMIR) at the University of California, San Diego has developed a transparent interface, a Telescience Portal for Neurosciences. The Telescience Portal is now in wide multidisciplinary use by structural neurobiologists, molecular and cell biologists, electron microscopists, and computer scientists within and beyond NPACI. Use of the portal, linking instruments and analysis among the Netherlands, Japan, Taiwan, and the United States over a dedicated, state-of-the-art (IPv6) network, was demonstrated at iGrid 2002 in Amsterdam. Moreover, the designers have transferred and used the same technology in a National Institutes of Health (NIH)-funded nationwide effort called the Biomedical Informatics Research Network (BIRN). The BIRN Portal is a direct descendant of the Telescience Portal. For Ellisman and his many collaborators, these portals exemplify the advantages of a full computational infrastructure and can serve as models for others to build on.

NCMIR scientists have made their microscopes capable of remote operation over the Internet, and they have joined with colleagues at Osaka University in Japan to do the same for a more powerful 3 MeV ultrahigh-voltage electron microscope, a unique, world-class resource. They have also inaugurated another international telescience collaboration–with the National Center for High-Performance Computing in Taiwan.

The Telescience Portal is an application environment supplying centralized access to all the tools and applications necessary for performing end-to-end electron tomography. It is Web-enabled, so it can be reached with a single login from any Internet-capable location. One simple Web interface allows the user to accomplish many scientific tasks that invoke many kinds of software, yet the user need not be

expert in any of the software. The portal guides a user through a session, launching whatever software is needed as it is called for.

This project contributes to the development or provision of tools that enable discoveries or enhance productivity of NSF research communities. It adopts a web-based approach for utilization of very expensive scientific instrumentation.

Indicator T2. - Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure.

Constellation Observing System for Meteorology, Ionosphere, and Climate

The Global Positioning System (GPS) provides a wide variety of useful applications from precise geographic positioning for automobile and other navigation to science applications such as monitoring small movements of the Earth's crust. The GPS is a constellation of satellites that transmit radio waves to Earth which are captured by ground receivers and the data used to determine position. As the radio waves pass through the Earth's atmosphere, they are retarded and bent. The altered paths of the radio waves are due to the properties of the atmosphere and are considered "noise" relative to the original radio signal.

NSF funded a proof-of-concept study to determine if this noise can be used to aid studies and prediction of weather, climate and space weather. Based on that successful experiment, radio occultation sounding techniques using GPS radio signals have emerged as a promising basis for a global observing system for weather, climate and space weather. A GPS occultation receiver onboard a low Earth orbiting (LEO) satellite can measure the phase delay of the radio signals transmitted by the GPS satellites as they set or rise with respect to the LEO. From accurate measurements of phase delays, atmospheric refractive bending can be deduced with high precision. Vertical profiles of bending angles can be used to derive refractive index, which is a function of electron density in the ionosphere and a function of temperature and water vapor in the troposphere and stratosphere.

As demonstrated by the NSF-funded study and subsequent ongoing studies, the GPS radio occultation (RO) sounding data are of high accuracy and high vertical resolution, and serve as an excellent complement to the traditional nadir-viewing, passive microwave satellite measurements. As a result of the successful proof-of-concept project, NSF, through an award to the University Corporation for Atmospheric Research, is now leading a consortium of five Federal agencies in partnership with Taiwan, to launch a fleet of GPS RO satellites. The project will culminate in a joint U.S.-Taiwan COSMIC (Constellation Observing System for Meteorology, Ionosphere, and Climate) mission launched in late 2005 and is expected to collect approximately 3,000 RO soundings per day. Compared to present upper air soundings (about 1,400 per day, with most concentrated over mid-latitude continental areas), COSMIC soundings will be twice as many and will cover both oceans and land regions. The COSMIC data will be available in near real-time for global weather and space weather analysis and prediction.

This is a highly leveraged, multi-agency and international project that will result in an unprecedented data set for operational and research purposes.

Gemini Transforms a Desert

Looking well outside our galactic neighborhood, an international team has equipped the Gemini telescopes with a unique and powerful technique that counteracts the fluorescence that contaminates the far-red end of the optical spectrum in the night sky. The result of this work is that Gemini can obtain much deeper spectra in this far region than has ever been possible before. Called "nod and shuffle," this method synchronizes a small shift in the telescope's pointing on the sky with a precise shuffling of the images on a charge-coupled device (CCD) detector to significantly increase the signal-to-noise ratio of the data. Using this technique, Gemini astronomers have discovered that the apparent "redshift desert" of galaxies that was thought to exist at an epoch of about one-third to one-half the age of the universe is actually well-populated with galaxies.

Solving the puzzle of the *Forma Urbis Romae*

The Forma Urbis Romae is a giant marble map of ancient Rome approximately 60 feet wide and 45 feet high. The map is broken into 1,186 pieces, and some pieces are missing. Putting together this "jigsaw" puzzle has been a major unsolved problem in archaeology.

Finding fits among the fragments is difficult because of the weight of the fragments. At Stanford University researchers are using computer shape matching algorithms to search for matches among the fractured side surfaces of the fragments. It is not clear that this will lead to a solution of the problem, but the project will result in a web-accessible relational database giving descriptions and bibliographic information about each fragment. A sample database, containing 28 selected fragments, is currently online. The long-term plan of the project is to make the entire database (1,186 fragments) freely available to the archeological (and computer graphics) research communities, educators, museum curators, and the general public.

U.S. & Europe Sign Agreement for the World's Most Powerful Radio Telescope
NSF director Dr. Rita Colwell and European Southern Observatory (ESO) director general Dr. Catherine Cesarsky have signed a joint agreement to construct and operate the Atacama Large Millimeter Array (ALMA) in Chile. ALMA will provide unprecedented resolution and sensitivity at very high radio frequencies, and will help probe planet and star formation, the formation of early galaxies and galaxy clusters, and the detection of organic molecules in space, among other topics. Expected to be complete in 2011, ALMA will cost approximately $550 million U.S. (FY 2000 dollars) and will “usher in a new age of research in astronomy,” according to Dr. Colwell.

ALMA will expand the frontiers of radio astronomy by facilitating the highest resolution imagery at the highest sensitivity of any existing radio telescope. This international collaboration will involve researchers, technicians, and project management personnel of diverse nationalities. The development, construction, and use of ALMA will be a truly global project.

Indicator T3. - Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal (For example, broad-based, program-wide results that demonstrate success related to management/utilization of large data sets/information bases, or development of information and policy analyses, or use of the Internet to make STEM information available to NSF research or education communities, or exceptional examples of broadly accessible tools shared by NSF research and education communities.)

Automated Compilation and Computational Analysis of Regulatory Networks

GeneWays[19] is a fully automated system designed to extract relations between substances (genes, proteins, RNAs, small molecules, *etc*.) or processes using a natural-language processing technology from full-text research articles published in scientific journals.

GeneWays has been recently applied to discover missing links in the reverse cholesterol transport pathway. Over 120,000 articles from 25 journals were processed using GeneWays pipeline. The extracted information resulted in a knowledge base with over 2.7 million individual statements on molecular interactions, corresponding to over 1.5 million unique molecular interactions. A subset of statements mentioned more than once (> 1 million) corresponds to a collection of highly reliable molecular interactions. GeneWays database is currently the largest existing database of molecular interactions.

The GeneWays system can search tens of thousands of journal articles, extract relevant pathway information for genes and proteins, display those pathways in diagrams, and put the information in a database. This may reduce or eliminate much of the manual work in searching literature and databases for new discoveries and existing relations between substances because the system can analyze and represent relationships in scientific text.

[19] http://genome6.cpmc.columbia.edu/~krautham/geneways/

Mining the Bibliome: Information Extraction from the Biomedical Literature

The many millions of biomedical publications available in electronic form contain a vast quantity of scientific information. Researchers would like access to this information structured in terms of well-defined relations (like "inhibition" or "mutation") among entities of interest (like "gene", "compound" or "cell line"). Recent techniques from computational linguistics can make more of this information accessible to biomedical researchers. This project has developed or adapted software tools that allow human experts to annotate biomedical texts for relevant entities and relations, to mark syntactic structure, and to indicate shallow semantic structure, such as co-reference relations and predicate-argument relations. The software allows multiple independent forms of text annotation to be created and used in an integrated way. This group is producing annotation specifications and training materials for syntactic and semantic annotation of biomedical text. Further details can be found at http://www.ldc.upenn.edu/myl/ITR

The goal of this research is qualitatively better methods for automatically extracting information from the biomedical literature, relying on three techniques: high-accuracy parsing, shallow semantic analysis, and integration of existing databases. An initial step is to create annotated corpora in collaboration with biomedical researchers: two test cases are gene variations in pediatric oncology, and inhibition of CYP450 enzymes.

Analysis of Microbial Communities Using a DNA Array Approach

This research led to the development of an approach termed oligonucleotide fingerprinting of ribosomal RNA genes (OFRG). OFRG analyses were developed for both bacteria and fungi. The PIs are currently in the process of developing an OFRG approach that will be useful for identifying any type of organism (universal OFRG). They are also developing a high throughput OFRG approach. Current OFRG protocols allow analysis of 1536 rDNA clones. Utilization of microarray technologies should allow them to examine tens of thousands

of rDNA clones simultaneously. They have also established a website that will provide downloadable algorithms for data analysis.

They also developed two new approaches for analyzing the data produced by the OFRG analysis. More specifically, they have developed effective new strategies for transforming the signal intensity data from the array experiments into hybridization fingerprints. These advances will increase the accuracy and speed of the analyses. This approach involves new array-based methods and innovative data analysis strategies developed by the research group. Utilization of this new experimental approach should lead to a greater understanding of the organisms inhabiting our planet, their functional roles in ecosystems and their potential for biotechnology.

OFRG provides the first cost-effective experimental approach for analysis of microbial community composition.

Collaborative Research for National eWorkshops: Interactive On-line Workshops
The eWorkshop is an on-line meeting developed by the CeBASE (Center for Empirically Based Software Engineering) team which replaces the usual face-to-face workshop. It is structured to accommodate the needs of a workshop without becoming an unconstrained on-line chat discussion. The goal is to synthesize new knowledge from a group of experts in an efficient and inexpensive format. In addition to a web-based chat tool, an eWorkshop includes a process and a support team to ensure that more than a random discussion results. This process is at the heart of the eWorkshop concept. The support team consisted of the following roles: moderator, director, scribe, tech support, and analyst. The moderator is responsible for monitoring and focusing the discussion (e.g., proposing items on which to vote). The director is responsible for assessing and setting the pace of the discussion and decides when it is time to redirect the discussion onto another topic. As the discussion moves from topic to topic, the scribe highlights the current agenda item and captures the results on the whiteboard area of the screen. When the participants reach a consensus on a particular item through a vote, the scribe summarizes and updates the whiteboard to reflect the outcome. The contents of the whiteboard become the first draft of the meeting minutes. The analyst codes the responses according to a pre-defined taxonomy. The tech support is responsible for handling any problems that may occur with the tools. For example, some participants accidentally close their sessions and have difficulty logging into the meeting for a second time. The eWorkshop has been used in a variety of settings. CeBASE has held several meetings on defect detection, COTS development, and agile development, with attendees from Europe, North America, Hawaii and Japan. Various groups within the DoD are now planning on using the technology to manage meetings without the expense and time of face-to-face gatherings.

The technology and methodology associated with eWorkshops facilitates Software Engineering activities as well as other requirements-driven processes in the increasingly global collaborative environment and significantly reduces the cost of doing so.

Computational Tools for K-12 Science Education
A research collaborative based at the University of Michigan is designing and implementing a learning technologies architecture to allow third party tools to operate and share data using a common, supportive interface suitable for K-12 learners. In learning science, students need to use a broad range of computer applications, from data analysis and simulation tools, from visualization tools to argumentation tools. In order to make such a diverse range of applications learnable and usable by individuals who are not technology experts, the applications must be presented with a common, supportive interface. The researchers are constructing learning technologies architecture to guide educational tool development by others. The research team has produced an integrated learning environment, *Symphony*, which embodies the learning technology architecture. *Symphony* provides a common interface across

tools and provides scaffolds that support learners in coming to understand the science underlying the use of tools. Many prior stand-alone tools have been integrated into the *Symphony* environment and tested in classrooms.

Upon completion, *Symphony,* together with learning technologies architecture should provide a third-party friendly delivery environment for K-16 classrooms.

Development of Biosensors for Rapid Screening

This project has resulted in the development of biosensors that can be directly interfaced with digital computers. The sensor can detect the presence and motion of individual cells, using an array of many cell-sized sensing sites that can be individually addressed using electrical signals. Electrical sensing makes it possible to easily connect the sensor to a computer and to rapidly and efficiently monitor many cells. Such an electronic array can be used for live cell screening, replacing present optical sensing techniques. Optical sensing is slow and inefficient because it requires precise mechanical translation of the microscope followed by focus and complex image processing. The sensor could be used for the rapid screening of new drug candidates. Alternatively the sensor could be used for the detection of biological agents that kill cells. Such an array might provide rapid detection of biological warfare agents. In our work to date the sensing mechanism has been demonstrated and modeling of the sensor has been performed in order to understand the sensing mechanism. Test sensor arrays have been fabricated and are now being tested.

Industry Impact

NSF-funded research had broad societal impact by transitioning research advances into industry enabling new capabilities in the commercial arena. The project "*Supporting Complex Application Requirements in Metasystems*" developed new and enhanced Grid Applications scheduling capabilities and a Grid Programming Model in the Grid computing environment Legion.

This software was used on the NPACI computational grid to enable large Protein Folding simulations and involved researchers both from the University of Virginia and the Scripps Research Institute. In June 2001 the PI launched Avaki[20], commercializing several aspects of *Legion* and collaborating with several pharmaceutical companies for advanced drug design[21]. In addition Avaki announced that IBM will use Avaki's Grid Computing Software at IBM's Grid Innovation Center.

New Statistical Tools for Analyzing Natural Selection at the Molecular Level

By identifying natural selection at the level of the DNA, Dr. Rasmus Nielsen[22] of Cornell University is addressing questions about molecular evolution and identifying genomic regions of special functional importance. Nielsen has developed new statistical methods for identifying and interpreting patterns of selection. These methods will provide a more powerful and versatile tool for identifying selection at the level of the DNA sequence. Nielsen is also developing methods for estimating the age, distribution and correlated evolution of changes in DNA. The new methods are being applied to several data sets, particularly data sets of viral sequences such as HIV-1 sequences. One of the questions addressed is how often compensatory mutations occur in the evolution of drug resistance in the HIV-1 virus. The new methods will be applicable in many genomic studies, particularly for identifying regions or sites of functional importance. As it is perfected, the software for using these methods is made available on Dr. Nielsen's website.

These new statistical tools will be of broad use in the community of scientists who are addressing questions about how evolution operates at the molecular level. They will be particularly useful for analyzing the large data sets that genomic projects are producing.

[20] www.avaki.com

[21] Gene logic Inc., Infinity Pharmaceuticals, Structural Bio Infomatics

[22] http://www.bscb.cornell.edu/Homepages/Rasmus_Nielsen/files.html

II. SUMMARY OF PERFORMANCE RESULTS

Overall, we were successful in achieving 70% (14 of 20) of our performance goals.

RESULTS FOR STRATEGIC OUTCOME GOALS: We achieved all of our four annual performance goals related to our strategic outcome goals (100%) in FY 2003.

FY 2003 Performance Results	
Number of Goals Achieved	
Outcome Goals	**4 of 4 (100%)**
Management Goals	**10 of 16 (63%)**
TOTAL	**14 of 20 (70%)**

RESULTS FOR MANAGEMENT GOALS: We achieved 10 of our 16 management goals (63%).

FY 2000 – FY 2003 Performance Results
Number of Goals Achieved

	FY 2000	FY 2001	FY 2002	FY 2003
Annual Performance Outcome Goals	**6 out of 8 (75%)**	**4 out of 5 (80%)**	**4 out of 4 (100%)**	**4 out of 4 (100%)**
Management Goals	**12 out of 20 (60%)**	**11 out of 18 (61%)**	**14 out of 19 (74%)**	**10 out of 16 (63%)**
Total	**18 out of 28 (64%)**	**15 out of 23 (65%)**	**18 out of 23 (78%)**	**14 out of 20 (70%)**

Note: In FY 2000 and FY 2001, Management Goals include goals that have been identified in previous years as Investment Process Goals.

The following table provides a summary of NSF's FY 2003 results.

ANNUAL PERFORMANCE GOALS FOR NSF'S STRATEGIC OUTCOMES

Strategic Outcome	FY 2003 Annual Performance Goal	Results for National Science Foundation
People Strategic Outcome **Outcome Goal III-1:** Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."	***Performance Goal III-1a:*** **NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:** • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future. • Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities. • Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal. FY 2003 Result: External expert assessment found that NSF has demonstrated significant achievement for each of the performance indicators associated with this goal.	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003: NSF is successful for goal III-1a.** • Demonstrated significant achievement • Demonstrated significant achievement. • Demonstrated significant achievement.

ANNUAL PERFORMANCE GOALS FOR NSF'S STRATEGIC OUTCOMES (continued)

Strategic Outcome	FY 2003 Annual Performance Goal	Results for National Science Foundation
People Strategic Outcome	***Performance Goal III-1b:*** **NSF will significantly enhance the quality of K-12 mathematics and science education available to all students in Math and Science Partnership schools.** Performance Indicators: • to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers.) • infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc. FY 2003 Result: Significant achievement was demonstrated for both indicators.	**(New Goal)** **FY 2003: NSF is successful for goal III-1b.** • Demonstrated significant achievement. • Demonstrated significant achievement.

ANNUAL PERFORMANCE GOALS FOR NSF'S STRATEGIC OUTCOMES (continued)

Strategic Outcome	FY 2003 Annual Performance Goal	Results for National Science Foundation
Ideas Strategic Outcome **Outcome Goal III-2:** Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."	***Performance Goal III-2:*** **NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:** • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; • Leadership in fostering newly developing or emerging areas. FY 2003 Result: External expert assessment found that NSF has demonstrated significant achievement for each of the performance indicators associated with this goal.	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003: NSF is successful for goal III-2.** • Demonstrated significant achievement. • Demonstrated significant achievement. • Demonstrated significant achievement. • Demonstrated significant achievement.

ANNUAL PERFORMANCE GOALS FOR NSF'S STRATEGIC OUTCOMES (continued)

Strategic Outcome	FY 2003 Annual Performance Goal	Results for National Science Foundation
Tools Strategic Outcome **Outcome Goal III-3:** Providing "broadly accessible, state-of-the-art and shared research and education tools."	***Performance Goal III-3:*** **NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:** • Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities. • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure. • Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal. FY 2003 Result: External expert assessment found that NSF has demonstrated significant achievement for each of the performance indicators associated with this goal.	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003: NSF is successful for goal III-3.** • Demonstrated significant achievement. • Demonstrated significant achievement. • Demonstrated significant achievement.

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Proposal and Award Processes		
Use of Merit Review	***Performance Goal IV-1:*** At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review. FY 2000 Goal 80% FY 2000 Result 87% FY 2001 Goal 85% FY 2001 Result 88% FY 2002 Goal 85% FY 2002 Result 88% FY 2003 Goal 85% FY 2003 Result 89%	**FY 1999:** NSF successful for related goal **FY 2000:** NSF successful **FY 2001:** NSF successful **FY 2002:** NSF successful **FY 2003: NSF is successful for goal IV-1.**
Implementation of Merit Review Criteria – Reviewers	***Performance Goal IV-2:*** At least 70 percent of reviews with written comments will address aspects of both generic review criteria. FY 2001 Result 69% FY 2002 Result 84% FY 2003 Goal 70% FY 2003 Result 90%	**FY 2001:** NSF not successful for related goal **FY 2002:** NSF successful for related goal **FY 2003: NSF is successful for goal IV-2.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Proposal and Award Processes		
Implementation of Merit Review Criteria – Program Officers	***Performance Goal IV-3:*** For at least 80 percent of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria. FY 2001 Result: Program reports prepared by external experts during FY 2001 GPRA reporting led NSF to conclude it was successful in implementation of both merit review criteria by program managers. FY 2002 Result: A statistically determined sample of FY 2002 review analyses was evaluated by NSF staff to determine the extent of Program Officer usage of both review criteria. It was determined that approximately 78% of review analyses commented on aspects of both merit review criteria. FY 2003 Result: NSF staff evaluated a statistically determined sample of FY 2003 review analyses to determine the extent of Program Officer usage of both review criteria. It was determined that approximately 53% of review analyses commented on aspects of both merit review criteria. To improve performance in the future, the issue of what constitutes program officer comments on aspects of both generic review criteria will be examined and clarified.	**FY 2001:** NSF successful for related goal **FY 2002:** NSF successful for related goal **FY 2003: NSF is not successful for goal IV-3.**
Customer Service - Time to Prepare Proposals	***Performance Goal IV-4:*** Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date. FY 1998 Baseline 66% FY 1999 Result 75% FY 2000 Goal 95% FY 2000 Result 89% FY 2001 Goal 95% FY 2001 Result 100% FY 2002 Goal 95% FY 2002 Result 94% FY 2003 Goal 95% FY 2003 Result 99% FY 2003 Result: In FY 2003, 99% (119 of 120) of program announcements and solicitations were made available at least 90 days before the proposal deadline or target date.	**FY 1999:** NSF not successful **FY 2000:** NSF not successful **FY 2001**: NSF successful **FY 2002**: NSF not successful **FY 2003: NSF is successful for goal IV-4.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Proposal and Award Processes		
Customer Service - Time to Decision	***Performance Goal IV-5:*** For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt. FY 1998 Baseline 59% FY 1999 Result 58% FY 2000 Goal 70% FY 2000 Result 54% FY 2001 Goal 70% FY 2001 Result 62% FY 2002 Goal 70% FY 2002 Result 74% FY 2003 Goal 70% FY 2003 Result 77%	**FY 1999:** NSF not successful **FY 2000:** NSF not successful **FY 2001:** NSF not successful **FY 2002:** NSF successful **FY 2003: NSF is successful for goal IV-5.**
Award Portfolio		
Award Size	***Performance Goal IV-6:*** NSF will increase the average annualized award size for research grants to a level of $125,000, compared to a goal of $113,000 in FY 2002. FY 1998 Baseline $90,000 FY 1999 Result $94,000 FY 2000 Result $105,800 FY 2001 Goal $110,000 FY 2001 Result $113,601 FY 2002 Goal $113,000 FY 2002 Result $115,666 FY 2003 Goal $125,000 FY 2003 Result $135,609 FY 2003 Result: NSF sought a very ambitious one-year increase of over 10% in average annualized award size -- from $113,000K to $125,000. In contrast to previous years, in FY 2003 collaborative proposals submitted as individual proposals from the collaborating institutions were counted as a single proposal as NSF treats them as a single proposal for review and award/decline decisions. If such collaborative proposals are counted individually, the average annualized award size for FY 2003 is $121,380.	**FY 2001:** NSF successful **FY 2002:** NSF successful **FY 2003**: **NSF is successful for goal IV-6.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Award Portfolio		
Award Duration	***Performance Goal IV-7:*** NSF will maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants. FY 1998 Baseline 2.7 years FY 1999 Goal 2.8 years FY 1999 Result 2.8 years FY 2000 Result 2.8 years FY 2001 Goal 3.0 years FY 2001 Result 2.9 years FY 2002 Goal 3.0 years FY 2002 Result 2.9 years FY 2003 Goal 3.0 years FY 2003 Result 2.9 years FY 2003 Result: Progress on this goal is budget dependent. Program Directors must balance competing requirements: increasing award size, increasing duration of awards, and/or making more awards. NSF will continue to focus on increasing award size and duration in order to improve the efficiency of the research process.	**FY 1999:** NSF successful **FY 2000:** Goal not included in Performance Plan **FY 2001:** NSF not successful **FY 2002:** NSF not successful **FY 2003: NSF is not successful for goal IV-7**.

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Award Oversight and Facilities Management		
Construction and Upgrade of Facilities	***Performance Goal IV-8:*** For 90 percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan. FY 2003 Result: Data collected from Facilities Managers external to NSF indicate that 88% (30 out of 34) of facilities kept any negative cost and schedule variances to less than 10 percent of the approved project plan. NSF will continue to work with Facility Managers to improve performance in this area.	**FY 2003: NSF is not successful for goal IV-8.**
Operations and Management of Facilities	***Performance Goal IV-9:*** For 90 percent of facilities, keep operating time lost due to unscheduled downtime to less than 10 percent of the total scheduled operating time. FY 1999 Result: Reporting database under development. FY 2000 Result: Of the 26 reporting facilities, 22 (85%) met the goal of keeping unscheduled downtime to below 10% of the total scheduled operating time. FY 2001 Result: Of the 29 reporting facilities, 25 (86 percent) met the goal of keeping unscheduled downtime to below 10 percent of the total scheduled operating time. FY 2002 Result: Of the 31 reporting facilities, 26 (84 percent) met the goal of keeping unscheduled downtime to below 10 percent of the total scheduled operating time. FY 2003 Result: We were not successful in achieving this goal. Data collected from Facilities Managers external to NSF indicate that 87% (26 out of 30) facilities kept scheduled operating time lost to less than 10 percent. NSF will continue to work with Facility Managers to improve performance in this area.	**FY 1999:** Inconclusive for related goal **FY 2000:** NSF not successful for related goal **FY 2001:** NSF not successful **FY 2002:** NSF not successful **FY 2003: NSF is not successful for goal IV-9.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Business Practices		
Electronic Business	***Performance Goal IV-10:*** NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of Principal Investigator award transfers. FY 2003 Result: 99.8% of Principal Investigator award transfers were processed electronically.	**(New Goal)** **FY 2003: NSF is successful for goal IV-10.**
Electronic Business	***Performance Goal IV-11:*** NSF will continue to advance "e-business" by implementing Phase III of the Electronic Jacket application. Performance Indicator: Implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority. FY 2003 Result: NSF is not successful for this goal. Phase III is expected to be available for NSF staff use prior to the end of the first quarter of FY 2004.	**(New Goal)** **FY 2003: NSF is not successful for goal IV-11.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Business Practices		
Information Technology Security	***Performance Goal IV-12:*** NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets. Performance Indicators: • 95 percent of major systems will have approved security plans on file. • 95 percent of major systems will have documented certification and accreditation. FY 2002 Result: NSF initiated actions to meet the requirements of the Security Act, OMB Circular A-130, and the National Institute of Standards and Technology Security Self-Assessment Guide for Information Technology Systems. The agency met all four FY 2002 performance indicators. FY 2003 Result: As planned, security plans have been developed and approved for 95% of major systems. Ninety-five percent have been certified and accredited.	**FY 2002:** NSF successful for related goal. **FY 2003: NSF is successful for goal IV-12.**
Human Resources and Workplace		
NSF Staff – Diversity	***Performance Goal IV-13:*** NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers (S&E). Performance Indicator: Initiate development of a NSF S&E diversity plan. FY 2003 Result: A multi-disciplinary team of employees from various levels in the organization was established and began development of the NSF S&E Diversity plan.	**(New Goal)** **FY 2003: NSF is successful for goal IV-13.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Human Resources and Workplace		
	Performance Goal IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups. FY 2000 Result: 35 females and 19 members of underrepresented minority groups were hired. FY 2001 Result: 38 females and 22 members of underrepresented minority groups were hired. FY 2002 Result: 41 females and 27 members of underrepresented minority groups were hired. FY 2003 Result: As of September 30, 2003, 48 females and 25 members of underrepresented minority groups were hired compared to our goal of appointing more than the 46 females and 25 underrepresented minority groups to NSF science and engineering staff and management positions in FY 2003. In FY 2003 we have expanded the scope of our goal to include additional S&E positions in the agency. Broadening the positions included in this measure allows us to assess our efforts throughout all professional recruitment opportunities, including executive hiring. The baseline to be used will be total S&E hires from underrepresented groups in FY 2000. In FY 2004 additional emphasis will be placed on the hiring of female and minority employees. An additional staff member will be hired to specifically address diversity issues. In addition, the Diversity Plan, which is under development, will help provide strategies for recruiting and retaining a diverse staff.	**FY 2000:** NSF successful for related goal **FY 2001:** NSF successful for related goal **FY 2002:** NSF successful for related goal **FY 2003: NSF is not successful for goal IV-14.**

ANNUAL PERFORMANCE GOALS FOR NSF'S MANAGEMENT (continued)

Performance Area	FY 2003 Annual Performance Goal	Results for National Science Foundation
Workforce		
Workforce Learning	***Performance Goal IV-15:*** NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities. Performance Indicator: Initiate development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training. FY 2002 Result: During FY 2002, 76 courses were offered, 30 of which were new. In addition, 3 courses were revised to be more responsive to the needs and requirements of our staff. FY 2003 Result: Twenty-four new courses were developed and 26 existing courses were revised to address the areas in the indicator statement.	**FY 2002:** NSF is successful for related goal **FY 2003: NSF is successful for goal IV-15.**
Workforce Planning	***Performance Goal IV-16:*** NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: • Identification of workforce competencies for all current NSF job families. • Initiate identification of competency-based, classification alternatives. FY 2002 Result: NSF met its goal related to strategic business processes. A Request for Proposals was released in March 2002. A contract to conduct the business analysis was awarded in June 2002. A report on initial review of workforce competencies and skill mix was completed and delivered to NSF. FY 2003 Result: Job families and their corresponding competency models have been identified for all of NSF's core missions and support functions. The NSF Human Capital Plan outlines strategies and lays out action plans to develop a more uniform occupation classification system.	**FY 2002:** NSF is successful for related goal **FY 2003: NSF is successful for goal IV-16.**

SUPPORTING INFORMATION

FOR FY 2003 GPRA REPORTING

Performance Reporting Requirements and Where to Find Them in Our Report

The Government Performance and Results Act of 1993 requires each Federal agency to report, no later than 180 days following the close of each fiscal year, to the President and the Congress on its performance for the previous fiscal year.

According to OMB Circular No. A-11 Part 6, Section 230-2, dated July 2003, each report must include the following elements[1]:

1. *A comparison of your actual performance with the projected (target) levels of performance as set out in the performance goals in your annual performance budget (or your annual performance plan for for fiscal years prior to FY 2005);*
2. *An explanation, where a performance goal was not achieved, for why the goal was not met;*
3. *A description of the plans and schedules to meet an unmet goal in the future, or alternatively, your recommended action regarding an unmet goal where you have concluded it is impractical or infeasible to achieve that goal;*
4. *An evaluation of your performance budget (although use the FY 2004 performance plan for the FY 2003 report) for the current fiscal year, taking into account the actual performance achieved in the fiscal year covered by your report;*
5. *An assessment of the reliability and completeness of the performance data included in the report); and*
6. *Actual performance information for at least four fiscal years.*

Other features as they apply to the agency[2]:

1. Program evaluations;
2. Information on use of non-Federal parties;
3. Classified appendices not available to the public;
4. Budget information.

[1] Elements 1-4 and 6 are provided with each goal discussed in our report. Element 5 is discussed in Section VI.
[2] Information on program evaluations is given in Appendices 6 and 7. The other features are discussed in Section IX.

NSF STRATEGIC OUTCOME GOALS

III. NSF STRATEGIC OUTCOME GOALS

Introduction to Section III: NSF Strategic Outcome Goals

NSF assessment activities are based on an OMB-approved alternative reporting format that utilizes external experts for qualitative, retrospective evaluations of Foundation outcome results. In years prior to FY 2002, NSF used external independent assessments of NSF's outcome goal indicators provided by Committees of Visitors and Directorate Advisory Committees[3].

These committees provided assessment at program, divisional, or directorate levels. In FY 2002, NSF created a new external advisory committee – the Advisory Committee for GPRA Performance Assessment (AC/GPA) – to provide advice and recommendations to the National Science Foundation (NSF) Director regarding the Foundation's performance under the Government Performance and Results Act (GPRA) of 1993.

The charge to the NSF AC/GPA asked for development and transmittal to NSF of a report that included:

(1) An assessment of NSF retrospective results for indicators associated with the PEOPLE, IDEAS, and TOOLS strategic outcome goals;
(2) Comments on the quality/relevance/balance of NSF award portfolios; and
(3) Comments on NSF investment portfolios for their potential future impact.

The format of Section III is the following:

- An NSF assessment of performance with respect to the strategic outcome goal;
- Comments by the AC/GPA concerning the strategic outcome goal; and
- For each indicator or area of emphasis associated with a strategic outcome goal:
    - Comments by the AC/GPA,
    - Retrospective and prospective examples selected by AC/GPA.

A Diverse, Balanced Portfolio

Maintaining a diverse, balanced portfolio of high quality is an essential aspect of any investment strategy, and this holds true for investments NSF makes in science and engineering research and education. We recognize that there is a significant probability of failure associated with high-risk research, that there is often a lack of experimental data or methodologies, little consensus on theory, information and/or approach. If successful, however, such high-risk research can result in a significant advance in a scientific or technological field. In addition to our regular grants, our Small Grants for Exploratory Research (SGER) are meant to encourage Program Officers to invest in new, innovative concepts and ideas and to support small-scale, high-risk exploratory work.

Both Committee of Visitors (COV) and the AC/GPA assessed our investment portfolio for FY 2001, FY 2002 and FY 2003 with respect to quality and balance. The vast majority of their comments indicated that investments made by the Directorates contained an appropriate balance of high-risk, multidisciplinary or innovative activities. Some comments from the AC/GPA on quality and balance follow.

[3] See Section V for further details on these committees.

AC/GPA Comments on Quality

"In constructing its assessment of the overall quality of the retrospective portfolio of outcomes and outputs, the Committee relied on an extensive database of NSF supported projects provided by NSF program staff, individual project reports, reports from external Committees of Visitors (COVs) and other information. In addition, individual members of the Committee possess deep familiarity with various aspects of NSF's portfolio; thus, the Committee was able to rely in part on its own expertise and independent assessment.

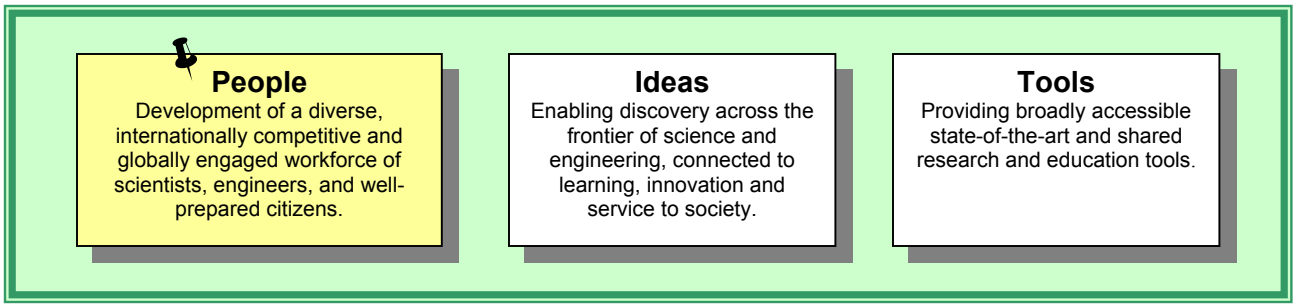
The Committee concluded that the quality of the retrospective portfolio was high in all three outcome goals. The breadth, depth, and diversity of the collective set of projects funded by NSF not only represent significant achievement, but also represent a spectrum of research modes. NSF supports individual investigators, multiple investigator teams, large centers, as well as shared facilities, databases and other infrastructure vital to support the national research enterprise."

AC/GPA Comments on Innovative, Risky, and Multi-disciplinary Research and Education

"With regard to innovative, "risky", and multi-disciplinary research and education, the Committee saw evidence of accomplishment as well as continuing leadership by NSF in this area. It is reasonable to accept that some fraction of the research that NSF funds will not lead to new paradigms or transform our thinking. No obvious formula exists to guide NSF as to the fraction of the portfolio that should be multi-disciplinary (defined as research or education activities that cross traditional discipline boundaries and creates synergistic interactions at those junctions). This type of research could, in many cases, be considered "high risk" since it often involves competing data, methods, theories and experimental approaches. The Committee notes that the COVs are explicitly asked to examine this issue and in most cases have concluded that the balance is appropriate. In addition, program managers continue to encourage high-risk proposals through the Small Grants for Exploratory Research (SGER) mechanism. NSF's Small Business Innovation Research Program (SBIR/STTR) is also recognized as a leader in the federal government in supporting novel research and technology with potentially high payoff. Lastly, the Committee notes that the encouraging trend continues for cross-disciplinary programs wherein multiple NSF directorates collaborate to fund a single research activity (e.g., mathematics and biology, environmental research, cyberinfrastructure). While this can serve as a proxy for investment in high-risk, multi-disciplinary research and education, more definitive analyses of these investments is needed."

III. NSF OUTCOME GOALS

A. PEOPLE



PEOPLE STRATEGIC OUTCOME GOAL: Developing "a diverse, internationally competitive and globally engaged workforce of scientists and engineers, and well-prepared citizens."

Annual Performance Goal III-1a: Our performance for this goal is successful when, *in the aggregate*, results reported in the period FY 2003 demonstrate significant achievement in the majority of the following indicators:

- Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future;
- Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities;
- Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.

✓ Goal Achieved

To achieve this outcome, we invest in the best and brightest students, researchers and educators to ensure a well-prepared workforce and citizenry. We provide support for formal and informal science, mathematics, engineering and technology education at all levels – pre K-12, undergraduate, graduate – in addition to professional development and public science literacy projects that engage people of all ages in life-long learning. Our efforts serve as a catalyst and a test bed for a gradual change in the process and philosophy of educating the workforce.

RESULT FOR PERFORMANCE GOAL III-1a: External experts provided examples of significant achievement during FY 2003 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators and areas of emphasis for this goal.

Implications for the FY 2004 Performance Plan: This goal will be continued in FY 2004.

PEOPLE: Comments by the Advisory Committee for GPRA Performance Assessment (AC/GPA)

The following statements concerning NSF achievement with respect to the Indicators and Areas of Emphasis for the PEOPLE goal are excerpted from the AC/GPA Report on NSF's PEOPLE portfolio. Additional comments as well as examples in support of significant achievement for each indicator are available at http://www.nsf.gov/pubs/2004/nsf04207/acgpa_report_2003.pdf

"The NSF Strategic Outcome Goal for People is: Developing a "diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens." NSF is to be commended for its many programs at all levels that strive to provide the nation with a diverse and competitive science and engineering workforce. While there is still room for improvement, NSF's efforts to engage administrators, faculty, and students at all levels in this strategic outcome goal have produced significant results. Progress has been made toward the attainment of both annual performance goals. The Committee judges that NSF has made significant achievement in three of the five indicators for this outcome goal (P1, P2, P3 associated with the first annual performance goal). For indicators P4 and P5 (associated with the second annual performance goal), both of which are focused exclusively on the very new Math and Science Partnership program (MSP), while there was evidence of future achievement, the Committee did not have enough information to reach a conclusion about NSF's performance."

INDICATOR 1: Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future.

RESULT: *Demonstrated significant achievement.*

"Under the first indicator, *"Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future,"* NSF is funding a host of programs that provide a path to achievements for a diverse, internationally competitive, and globally engaged workforce of scientists, engineers and well-prepared citizens. Examples of programs that support this indicator are: Research Experiences for Undergraduates and Research Experiences for Teachers. While there were no accomplishments in the database for the Minority Institutions Infrastructure Grants program, the Committee notes that this program also supports this indicator. In particular, a very successful activity that supports the development of a diverse science, technology, engineering and mathematics (STEM) workforce has been the Research Experiences for Undergraduates (REU) program that NSF has now institutionalized across the Foundation through REU sites, REU supplements, collaborative Research in Undergraduate Institutions programs, and other mechanisms. Innovative implementation of the Research Experiences for Undergraduates (REU) concept has provided excitement both within and among institutions that has led, in some cases, to groundbreaking research results prompted by the involvement of undergraduate students. While not specifically cited here, the Louis Stokes Alliances for Minority Participation (LSAMP) continues to represent one of the most important programs, contributing to significant achievement for this indicator. The Committee notes that it also strongly supports the second indicator for the Ideas goal. The point here is that LSAMP participation now extends to over 30 alliances representing over 400 individual institutions. The impact extends to over 206,000 underrepresented minority students. The original goal of LSAMP was to increase the number of underrepresented minorities receiving undergraduate degrees in science, engineering, and mathematics. While significant progress has been made in achieving this goal,

LSAMP has recently been expanded to include a strong emphasis on graduate studies as well. Just in the last three years over 80 LSAMP students have completed the doctorate in science, engineering or mathematics and are working in their fields. An additional 20 LSAMP students are currently enrolled in Ph.D. programs. While the numbers are still small, this program has had a significant positive impact on the number of doctoral degrees received by underrepresented minorities in the U.S. and thus contributes materially to this indicator."

INDICATOR 2: Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities.

RESULT: *Demonstrated significant achievement.*

"Projects and accomplishments under the second indicator, "*Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities"* are impressive and contribute significantly toward the attainment of the overall People goal. While the portfolio supporting this indicator is strong, the Foundation will be challenged in the future to sustain current programs that have this indicator as their primary focus and to enhance all the programs in its People portfolio. Nearly every NSF program has the opportunity to impact this indicator. The LSAMP cited above is a good example of this "cross fertilization." In light of this, the Committee believes that NSF has both the obligation and the opportunity to use a varied armamentarium of programmatic initiatives (from all Directorates and programs) to the achievement for this indicator."

INDICATOR 3: Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.

RESULT: *Demonstrated significant achievement.*

"Under the third indicator, *" Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE Outcome Goal,"* the NSF portfolio contains important examples of education and research programs that are designed to enable students, educators and researchers to explore the challenges of science, technology, engineering and mathematics and related fields. Overall there is a balance of programs supporting learning and exploration at the K-12 level; teacher and faculty development activities; curriculum development and dissemination activities for K-12 and college classrooms; mass media, print and web-based public awareness activities; and activities to encourage women and underrepresented minorities to develop interest and pursue STEM careers."

Emphasis Areas for GPRA Reporting

- **PreK-12 Education, e.g., Systemic Reform;**
- **Undergraduate Education, e.g., REU;**
- **Graduate and Professional Development, e.g., IGERT, GK-12, CAREER;**
- **Centers for Learning & Teaching (CLT);**
- **Broadening Participation, e.g., Partnerships for Innovation, Programs that serve underrepresented groups**

"NSF is investing in a broad range of activities that aim to improve the performance of preK-12 students in mathematics and science. There are awards focused on issues relating to preK-12, undergraduate and graduate students. There are also awards that support center type activities as well as activities that are designed to encourage participation from underrepresented groups. The Committee provides some outcome accomplishments that highlight NSF's investment in specific areas."

*"**PreK-12 Education -*** Under an integrated program for middle school science teachers, a new middle school curriculum was developed from collaboration among university faculty, community college faculty, science content teachers and science education teachers. This project also contributed to prepare middle school science teachers.

The Houston Urban Systemic Initiative reported rather impressive results in improving K-12 student performance. For example, it was reported that the Texas Assessment Academic Skills mathematics test for all students indicated an eight percentage point increase at the 3rd grade level and a three percentage point increase at the 5th and 8th grade levels."

"***Undergraduate Education -*** Over the years, an increasing number of undergraduate students have been involved in research through NSF funding. Principal investigators could seek supplemental funding under the Research Experiences for Undergraduates (REU) program to engage undergraduate students in their projects. About ten years ago, NSF institutionalized this activity by funding REU sites where undergraduate students from different universities were brought together for a period of time to gain research experience.

NSF funds projects that have created unique opportunities for undergraduate students. For instance, an award to the Association of American State Geologists made it possible for undergraduate students to conduct field work with professionals outside of the university setting and prepared them for a successful career in earth sciences."

"***Graduate and Professional Development*** – There are various forms of NSF support for graduate students. Some of the support is used to fund collaborative research. An IGERT award was used to fund a parallel multi-unit neurophysiological recording lab. The supported students were doing rotations in the lab and brought their background from different disciplines to bear in the project. An IGERT award in the neuroscience and computational/physical science areas brought together researchers and graduate students from eight departments to work on projects that transcend disciplines."

"***Centers for Learning and Teaching (CLT)*** – The retrospective examples all represent innovative, primarily multi-institutional efforts that appear to be highly promising in terms of their impact on the development and enhancement of diversity in STEM education and research. All of these projects have

initiated the recruitment of faculty and graduate students who are involved in studies and publishable efforts that should lead to tangible and important outcomes in the near future. Nonetheless, since they are all still in the initial stages of their five-year awards, the full significance of the impact is yet to be determined."

"***Broadening Participation -*** Many NSF funded activities serve to promote science and engineering to a wide audience. For example, a TV mini-series called "*The Shape of Life*" that presented an evolution of the animal kingdom was broadcast nationwide by PBS. In the production of the program, media professionals collaborated with researchers from different universities. A summative evaluation indicated that the program was well received by many viewers. Another example involved career enhancement of high school teachers through improvement of mathematics curriculum in the Greater Philadelphia area. There are also examples of NSF providing support for teacher education. These projects resulted in two new mathematics textbooks that employed research-based teaching strategies."

Annual Performance Goal III-1b: NSF will significantly enhance the quality of K-12 mathematics and science education available to all students in Math and Science Partnership schools.

Our performance for this goal is successful when, in the aggregate, results reported for the period FY 2003 show:

- Evidence in the award portfolio of the infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers.);
- Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc.

✓ Goal Achieved

The Math and Science Partnership (MSP) program responds to a growing national concern: the lackluster performance of U.S. children in mathematics and science. No Child Left Behind, which enunciates the President's vision for K-12 education, articulates this concern and identifies the main underlying factors for the poor performance of U.S. students: too many teachers teaching out of field, too few students taking advanced coursework, and too few schools offering challenging curricula and textbooks.

The MSP builds on the nation's dedication to improve mathematics and science education through support of partnerships that unite the efforts of local school districts with science, mathematics, engineering and education faculties of colleges and universities and with other stakeholders. The MSP seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels. As the achievement of students rises, the MSP expects to significantly reduce achievement gaps in mathematics and science education among diverse student populations.

In FY 2003, each partnership school system documented the current status of the K-12 science and mathematics curriculum, its teacher workforce, professional development needs, assessment and accountability systems, and policies. School systems collected baseline student participation and achievement data with comparisons to state and/or national averages on achievement in math and science. Higher education partners described their history in educating mathematics and science teachers and prior involvement of math and science faculty in K-12 education. Funded awards provide details of plans for increasing numbers of math and science teachers participating in professional development and for increasing involvement of math and science faculty in teacher education.

RESULT FOR PERFORMANCE GOAL III-1b: Although the AC/GPA stated that there was not enough data available to assess achievement on this goal, assessment done by NSF staff at the conclusion of FY 2003 found that significant achievement was demonstrated for both indicators associated with this goal.

Implications for the FY 2004 Performance Plan: Math and Science Partnerships will continue to be analyzed as one of the programs contributing to the People Strategic Outcome Goal and within the Program Assessment Rating Tool for Collaborations.

INDICATOR 1: Evidence in the award portfolio of the infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers).

RESULT: ***Demonstrated significant achievement.***

INDICATOR 2: Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, *etc.*

RESULT: ***Demonstrated significant achievement.***

NSF reviewed the MSP proposals, the results of the merit review process, the project strategic plans, and an analysis provided by Westat, Inc. to reach its conclusion on the achievement of the GPRA performance indicators related to the MSP program (Goal III-1b).

The following statement concerning NSF achievement with respect to the PEOPLE goal III-1b is excerpted from the IBM Business Consulting Services GPRA Performance Measurement Verification and Validation Repor[4]*t.*

"Based on our review, we verify the reliability of the processes NSF used to collect, process, maintain and report data for this goal and the analyses of the MSP proposals and strategic plans performed by NSF staff, external panels of reviewers, and Westat. We also validate that the Directorate of Education and Human Resources reached a reasonable conclusion that NSF achieved Goal III-1B based on the quality of the performance information and analyses of the MSP program results to date."

Comments by the Advisory Committee for GPRA Performance Assessment (AC/GPA)

The following statements concerning NSF achievement with respect to the PEOPLE goal III-1b are excerpted from the AC/GPA Report on NSF's PEOPLE portfolio.

"This is a new initiative for NSF with the first awards granted in fall 2002. Consequently, the portfolio is limited and materials substantiating and documenting achievement (or the lack of one) are insufficient. In its inaugural year NSF funded seven awards to Comprehensive projects. There are early indications based on the awards given last fall, that the "infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including pre-service education and in-service professional development of math and science teachers as well as alternative routes into the profession" is being addressed by the funded programs. The three-year *Building Evaluation Capacity of STEM Projects* provides assistance to MSP projects and their stakeholders in designing and implementing context-sensitive, user-friendly evaluation approaches, as well as in developing and sustaining a culture of evidence that supports decision-making based on data. The MSP awarded programs are expected to

[4] Page 146 of IBMBCS Report.

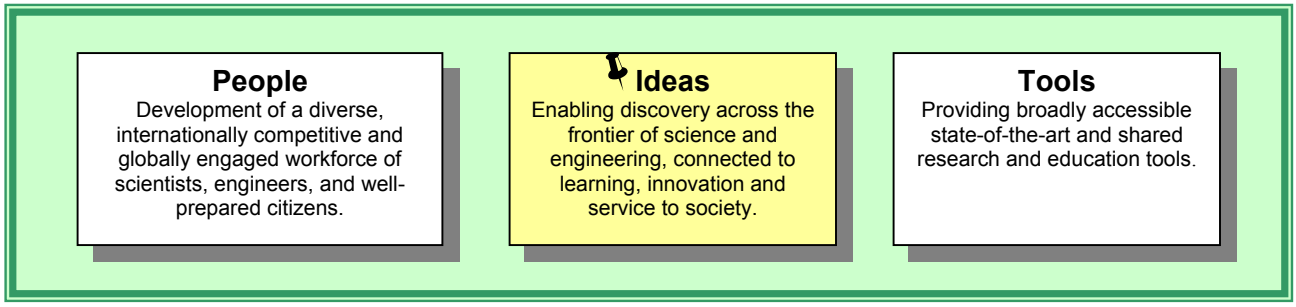
improve student success and teacher capacity and quality in science and mathematics in the future. A major component of the Math and Science Partnership program is the implementation of change in mathematics and science education practices in both higher education and in K-12, to result in improved student achievement across the K-12 continuum. Several of the funded projects aim to improve teachers' content knowledge and ability to use effective pedagogical strategies that ensure student learning."

"All of these programs have just started and there is insufficient information at this time to conclude that together they constitute a portfolio that demonstrates significant achievement."

"Program is too new. Not enough information to make a judgment. The first MSP awards were made in September 2002. Consequently, there is not enough information to determine whether there has been significant achievement for this indicator. However, the Committee notes that NSF has funded similar partnerships before and some of those partnerships are still ongoing. The Committee would have preferred to have those partnerships included in this indicator so that a more concrete assessment could have been made regarding NSF's contribution to improving the performance of K-12 students in mathematics and science. Based on the MSP awards made, however, the committee feels that attempts are being made to improve student performance and that in the future there will be information to document the level of improvement achieved."

NSF STRATEGIC OUTCOME GOALS

B. IDEAS



STRATEGIC OUTCOME GOAL III-2: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

Annual Performance Goal III-2: Our performance is successful when, *in the aggregate*, results reported in the period FY 2003 demonstrate significant achievement in the majority of the following indicators:

- Discoveries that expand the frontiers of science, engineering, or technology;
- Connections between discoveries and their use in service to society;
- Partnerships that enable the flow of ideas among the academic, public or private sectors;
- Leadership in fostering newly developing or emerging areas.

✓ Goal Achieved

NSF invests in ideas to provide a deep and broad fundamental science and engineering knowledge base. Investments in ideas support cutting-edge research that yields new and important discoveries and promotes the development of new knowledge and techniques within and across traditional boundaries. The results of NSF-funded research and education projects provide a rich foundation for broad and useful applications of knowledge and the development of new technologies. Support in this area also promotes the education and training of the next generation of scientists and engineers by providing them with an opportunity to participate in discovery-oriented projects.

RESULT: NSF achieved this goal. External experts provided examples of significant achievement during FY 2003 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators and areas of emphasis for this goal.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: This goal will be continued in FY 2004.

IDEAS: Comments by the Advisory Committee for GPRA Performance Assessment

The following statements concerning NSF achievement with respect to the Indicators and Areas of Emphasis for the IDEAS goal are excerpted from the AC/GPA Report on NSF's IDEAS portfolio. Additional comments as well as examples in support of significant achievement for each indicator are available at http://www.nsf.gov/pubs/2004/nsf04207/acgpa_report_2003.pdf

"Based on a review of extensive documentation of NSF supported research projects provided by the Committees of Visitors, the database of accomplishments assembled by NSF, project reports, and NSF budget and other information, the Committee concludes that NSF has demonstrated significant achievement in all four indicators for the Ideas Strategic Outcome Goal, *enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."* The Committee reached this conclusion based on the evaluation of the results related to the indicators (see Appendix) as well as an evaluation of priority and emphasis areas.

The results reported in this section span NSF's research directorates and are indicative of both breadth and depth in the scientific and educational communities supported by NSF. The Committee was very excited about and impressed with the research outcomes. This research holds considerable promise for expanding fundamental understanding of the origins of our universe and of humankind's long-term survivability and well-being. NSF researchers were awarded several notable prizes for their research, including a Nobel Prize for Bose-Einstein condensate work, the prestigious Japan prize for complex systems, chaos and fractals, and the Panofsky prize for experimental particle physics. In addition, NSF funded 80 percent of mathematicians who received 2003 Sloan fellowships. Such notable achievements by these researchers reflect the caliber and importance of the research that NSF supports.

Equally striking, the record of accomplishments includes considerable research directly connected to important societal concerns, including earthquake behavior, wildfire management, avalanche prediction, global climate change and its effects on society, novel insecticides from spider neurotoxins that are not toxic to humans, brain function, and preservation of historical artifacts. This research has both a currency of application and the promise of new and deeper understanding of the fundamental science that can yield future societal benefit.

The Committee is impressed with NSF's continuing endeavor to foster integration of research and education. Also noteworthy is NSF's continuing objective and recent accomplishments in increasing the participation of underrepresented groups in the sciences. These outcomes include recruiting students and providing mentoring to guide and encourage them to become active members of the scientific community. There are several excellent examples of these efforts in the Mathematical Sciences Priority Area.

The record of performance for FY 2003 is noteworthy as well for the extent of collaborations between U.S. academic researchers and a large and diverse set of partners in the public and private sectors in the U.S. as well as scientists in other countries.

NSF's achievements represent a spectrum of research modes, including single investigator projects and larger, multi-disciplinary projects involving researchers at a single institution or researchers at several institutions. It is clear from the Committee's review that NSF is actively building a research capacity to address problems at the interface of scientific disciplines and even the emergence of new fields at the frontiers of science. Examples of these efforts include initiatives in Biocomplexity in the Environment, Mathematical Sciences, and Human and Social Dynamics."

INDICATOR 1: Discoveries that expand the frontiers of science, engineering, or technology.

RESULT: ***Demonstrated significant achievement.***

"The Committee was impressed by the importance of the research findings, the degree to which the research frontiers crossed traditional disciplinary boundaries, and the breadth of discoveries. Examples include new findings in brain cell research, a Nobel prize for Bose-Einstein condensate, research uncovering order in Chaos, which led to the Japan prize, high energy physics research that resulted in the American Physical Society's prestigious Panofsky award, a multidisciplinary study on understanding earthquake behavior, cognitive science research into the creation of false memories in children, anthropological research on fertility control in China, and a sociological study of incarceration and its impact on family."

INDICATOR 2: Connections between discoveries and their use in service to society.

RESULT: ***Demonstrated significant achievement.***

"A review of the summaries clearly indicates that NSF funding has enabled researchers to collaborate and produce a broad range of research findings that will improve the quality of life for peoples of the world. The seven project summaries chosen for illustrative purposes, from a group of 104 projects, have made discoveries that provide significant service to society. These range from projects with important climate implications including glacier studies and Antarctic ice sheets, to improving the lead time for severe weather forecasts, to the development of insecticides without harmful environmental effects and the use of spider venom toxins which affect insects but not mammals, to the preservation of Alaskan native artifacts, to new insights in vocational training of metalworkers."

INDICATOR 3: Partnerships that enable the flow of ideas among the academic, public or private sectors.

RESULT: ***Demonstrated significant achievement.***

"NSF support has provided the basis for an array of partnerships that have contributed to its outcome goal of enabling discovery at the frontier of science and engineering, connected to learning, innovation, and service to society. These partnerships have influenced the content of research agendas, made possible research undertakings that would otherwise not have been possible, increased the likelihood that research findings will contribute to societal benefits in the public and private sectors, benefited from and contributed to improved international collaboration and forged closer linkages between research and education. The dominant forms of these partnerships, as illustrated by the examples below are:

- international collaboration between U.S. scientists and research institutions and scientists and research organizations in other countries;
- interdisciplinary collaboration among scientists in different fields across multiple institutions:
- collaboration between university scientists and public sector organizations that integrate basic and applied research directed at specific national, state or local government problems;
- collaboration between and among universities, government agencies and the private sector directed at integrating research and educational experiences for students."

INDICATOR 4: Leadership in fostering newly developing or emerging areas.

RESULT: ***Demonstrated significant achievement.***

"There is a broad range of developing and/or emerging activities that are taking place under NSF leadership. These research and education activities occur across and among many scientific fields. NSF uses workshops as well as centers (e.g, physics frontier centers) to bring researchers together to identify, seed, and bring coherence to important new research areas.

Emphasis Areas for GPRA Reporting

- **Balance of portfolio, including projects that are innovative, high-risk, or multidisciplinary**
- **Priority Areas: *e.g.*, Biocomplexity in the Environment, Information Technology Research, Nanoscale Science & Engineering, Life & Earth's Environment, Information Technology for the 21st Century, Knowledge & Distributed Intelligence**
- **Core research and education activities**
- **Centers, *e.g.*, STCs, ERCs, MRSECs**
- **EPSCoR**

*"**Balance of Portfolio*** – With regard to innovative, "risky", and multi-disciplinary research and education, the Committee saw evidence of accomplishment as well as continuing leadership by NSF in this area. It is reasonable to accept that some fraction of the research that NSF funds will not lead to new paradigms or transform our thinking. No obvious formula exists to guide NSF as to the fraction of the portfolio that should be multi-disciplinary (defined as research or education activities that cross traditional discipline boundaries and create synergistic interactions at those junctions). This type of research could, in many cases, be considered "high risk" since it often involves competing data, methods, theories and experimental approaches. The Committee notes that the COVs are explicitly asked to examine this issue and in most cases have concluded that the balance is appropriate. In addition, program managers continue to encourage high-risk proposals through the Small Grants for Exploratory Research (SGER) mechanism. NSF's Small Business Innovation Research Program (SBIR/STTR) is also recognized as a leader in the federal government in supporting novel research and technology with potentially high payoff. Lastly, the Committee notes that the encouraging trend continues for cross-disciplinary programs wherein multiple NSF directorates collaborate to fund a single research activity (e.g., mathematics and biology,

environmental research, cyberinfrastructure). While this can serve as a proxy for investment in high-risk, multi-disciplinary research and education, more definitive analyses of these investments is needed."

"***Biocomplexity in the Environment -*** The outcomes from this priority area demonstrate particularly promising efforts in expanding the frontiers of science, engineering and technology. Projects are highly multidisciplinary, collaborative and contain significant educational components. Examples include studies in gene regulation linked to the external environment, remote sensing in aqueous environments, and studies of the interactions between urban development and riparian ecosystems. The NSF supports new interdisciplinary research combining broad areas of biology and chemistry, engineering, mathematics, computational and information technology, and social and material sciences. The NSF's new project portfolio includes the application of novel analytical and sensing methods and instruments and large-scale studies of atmospheric and aquatic environments."

"***Information Technology Research(ITR) -*** The ITR program provides extremely effective interdisciplinary research funding with an information technology basis, with a wide and compelling variety of examples. The first example focuses on epidemiological studies enabled by information technology, the second on interfaces and interactions for "systems" constructed of biological and electronic components, and the third on novel physical methods for implementing functionality required in modern security protocols. These examples demonstrate the important interactions between fields stimulated by collaborative research in information technology. Each of these projects represents an excellent emerging opportunity and all are likely to have significant impact. Concerns exist that some proposals, although representing excellent science, may be more appropriately placed in discipline-specific existing NSF programs rather than ITR that is intended for multidisciplinary approaches. Examples might include research that is either conventional IT, or appears (at least on the surface) to have an inadequate IT component."

"***Nanoscale Science and Engineering -*** Within the confines of areas of investment and emerging opportunities for the field of Nanoscale Science and Engineering, the NSF has sought to strategically invest in research programs that provide a foundation for new technology. The range of conceivable applications is extremely broad, including improvement in pollution control, new medicine delivery modalities, ultra-miniature electronic devices, unique optical material required for photonics applications as well as the impact of these nascent technologies on society in general, Catalysis for Alternate Fuels, Cells as biological nanomachines, Electronic Devices at the Atomic and Molecular Scale: Structure and Charge, Left-Handed Materials, Philosophical and Social Dimensions of Nanoscale Research. Looking to the future, some NSF supported programs have begun to focus on new types of synthesis/symbiosis between electronic systems and biological systems, even down to the genetic level, Development, Functionalization, and Assembly of Nanoscale Biological Sensors, Ink-Jet Production of Nanostructured Matrices and Particles for Controlled Gene Delivery.

"Core Research and Education Activities -"The Committee found the collection of core research activities to be very impressive. Research areas include (but are not limited to) cosmology, quantum science and technology, cyberinfrastructure, computational sciences and environmental sciences. With few exceptions, the accomplishments and examples demonstrate important core research with significant societal value and important investments for future scientific discovery. One excellent example is a collaborative research program that introduces underrepresented minorities to leading-edge research conducted at both Hampton University and the University of Virginia. This example combines important, societally relevant research with education and diversity. Another example is a multidisciplinary research effort that addresses the important issues associated with earthquakes. In yet another example, research into insect-specific neurotoxins has the potential to lead to insecticides

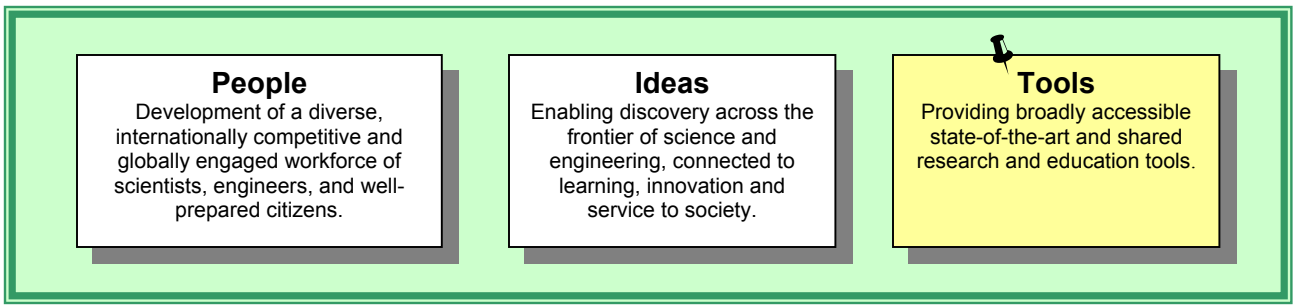
that are not harmful to humans. A new research effort illustrates NSF's leadership in cutting-edge, relevant research. This project is noteworthy because it is one of the first to offer the possibility of using a designed shape and structure formed by aggregates of special surface-active molecules to impose a desired structure onto more stable polymer materials. Finding conditions where these shapes are stable has been an important accomplishment necessary to enable practical production methods."

Centers **–** No comments from AC/GPA.

EPSCoR **–** No comments from AC/GPA.

NSF STRATEGIC OUTCOME GOALS

C. TOOLS



STRATEGIC OUTCOME GOAL III-3: Providing "broadly accessible, state-of-the-art and shared research and education tools."

Annual Performance Goal III-3: Our performance is successful when, *in the aggregate*, results reported in the period FY 2003 demonstrate significant achievement in the majority of the following indicators:

- Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure;
- Provision of broadly accessible facilities, databases or other infrastructure that are widely shared by NSF research or education communities;
- Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.

✓ Goal Achieved

NSF invests in tools to provide widely accessible, up-to-date science and engineering infrastructure. This strategic outcome supports the parts of NSF's mission directed at (1) programs to strengthen scientific and engineering research potential and (2) an information base on science and engineering appropriate for development of national and international policy.

As emerging research opportunities increasingly involve phenomena at or beyond the limits of our measurement capabilities, many research areas can only be studied and problems solved through the use of new generations of powerful tools. NSF investments provide state-of-the-art tools for research and education, such as instrumentation and equipment, multi-user facilities, digital libraries, research resources, accelerators, telescopes, research vessels and aircraft and earthquake simulators. In addition, resources support large surveys and databases as well as computation and computing infrastructures for all fields of science and engineering research and education. Support includes funding for construction, upgrade, operations, and maintenance of facilities, and for personnel to assist scientists and engineers in conducting research and education at the facilities.

RESULT: External experts provided examples of significant achievement during FY 2003 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators and areas of emphasis for this goal.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: This goal will be continued in FY 2004.

TOOLS: Comments by the Advisory Committee for GPRA Performance Assessment

The following statements concerning NSF achievement with respect to the Indicators and Areas of Emphasis for the TOOLS goal are excerpted from the AC/GPA Report on NSF's TOOLS portfolio. Additional comments as well as examples in support of significant achievement for each indicator are available at http://www.nsf.gov/pubs/2004/nsf04207/acgpa_report_2003.pdf .

"The Committee concludes that there is significant achievement in all indicators of the TOOLS strategic outcome goal.

The goal of the TOOLS portfolio is to provide broadly accessible, state-of-the art and shared facilities and infrastructure to support research and education across the Foundation. NSF provides support for large, multi-user facilities that allow researchers access to state-of-the-art facilities. Support for these unique national and global facilities is necessary to advance and maintain the U.S. capabilities as the world leader in research. NSF investments include internet-based and distributed user facilities, advanced computer resources, research networks, major research instrumentation, digital libraries, and large databases, all of which contribute to a state-of-the-art research and education infrastructure.

In reaching its overall conclusions, the Committee evaluated the TOOLS Goal Indicators, Areas of Emphasis for Investment in Emerging Opportunities, and Areas of Emphasis for GPRA Reporting. In addition to the TOOLS retrospective accomplishments and prospective examples, the Committee reviewed budget requests, COV reports and documents selected from the NSF ACGPA website, including information on awards. The combination of the documents reviewed and the Committee's collective experience provides a basis for the Committee's overall conclusions and detailed findings.

The Committee concluded that NSF made significant achievements across the entire set of TOOLS Indicators, Emerging Opportunities, and Areas of Emphasis. NSF support of research infrastructure allowed wider and more effective dissemination of data and materials, enhanced the productivity of and enabled the capacity for discovery by researchers and educators, and increasingly expanded access to and availability of resources. NSF-supported activities continue to determine a high rate of progress in many science and engineering disciplines including astronomy and Earth science. Examples of the types of new tools that support the Committee's findings include: widely-available and networked state-of-the-art instruments, World-scale digital libraries and repositories of data from unique sources ranging from many distinct spectral bands in astronomy to real-time data from integrated networks of advanced sensors on phenomena in the Earth's interior, new educational hard- and software that enables the visually impaired to engage in leading-edge research in the sciences and Internet technology that enables capacities for discovery and enhances the productivity of researchers, educators, and students in remote locations.

The Committee observed that there seemed to be a "gap" between the types of projects supported by the Major Research Equipment and Facilities Construction (MREFC) program and those supported by the Major Research Instrumentation (MRI) program. That is, instrumentation and facilities in the range of $2 million to $50 million did not seem to have an obvious "home." This range of instruments and facilities is of great importance to many disciplines and to a wide range of institutional types. Therefore, the Committee recommends that NSF give strong consideration to developing a program to support the acquisition of mid-sized instrumentation in the range of $2-$50 million.

The Committee also observed that NSF has played a large and vital leadership role in developing and providing access to research facilities. The Committee recommends that NSF consider ways in which these facilities investments can be sustained over the long-term to maximize their value to intellectual

endeavor. In this regard, NSF should continue to reassess the balance between ongoing commitments and new opportunities in the Tools portfolio."

INDICATOR 1: Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities.

RESULT: ***Demonstrated significant achievement.***

"The seven project summaries chosen for illustrative purposes from a group of more than one hundred projects show significant achievement in the several facets of this indicator: The High Performance Nuclear Magnetic Resonance Probes developed at the National High Magnetic Field Laboratory, the Arcminute Cosmology Bolometer Array Receiver and the Telemicroscopy Portal hosted by the National Partnership for Advanced Computational Infrastructure are enabling questions to be posed and discoveries to be made at the very frontiers of knowledge. The Telemicroscopy Portal, National Nanofabrication Users Network, Data Mining of the National Virtual Observatory and the project in Internet Satellite Connection to Under-served Sites support significant achievements in both discovery enabling and productivity enhancing activities by supporting wide utilization of large, centralized facilities, leading-edge instruments and databases through networked facilities. The project on Speech Assisted Learning for Braille students is a significant TOOL development in education infrastructure that enables and enhances the participation of the visually impaired in the nation's science and technology enterprise."

INDICATOR 2: Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure.

RESULT: ***Demonstrated significant achievement.***

"Partnerships with other research and funding agencies, both national and international, have become a successful and integral part of the resources and tools available to support NSF research. Through these partnerships, the reach of NSF research extends far beyond what can be accomplished through the investment of NSF resources alone. Observational, analytical and computational resources are expanded and disciplinary diversity is enhanced. In addition to expanding the infrastructure base, partnerships in the development and operation of large facilities can stimulate interactions in cross-disciplinary research and the application of new technologies in sensor design, data storage and communication.

NSF is a world leader in research and in international collaboration. In some cases, international partnerships are driven by fiscal reality (e.g. experimental facilities for high-energy physics, radio astronomy, deep sea drilling) – the projects would simply not be feasible without significant investment and cost-sharing from international partners. In other cases (e.g. oceanographic facilities, global atmospheric and geophysical networks) the global breadth of the observation systems requires multinational participation. In others, unique geographic requirements demand that the facilities be established outside the U.S., usually in partnership with the host country (e.g. high altitude telescopes, Antarctic support services).

University researchers often gain access to special purpose tools and observational systems, and participate in the development of new systems, through NSF leadership in partnership with other U.S. federal research and mission agencies. For example, experiments in high energy physics depends heavily on shared use of facilities at Department of Energy (DOE) supported national labs. Research throughout

the geosciences is carried out using facilities developed and shared with National Aeronautics and Space Administration, National Oceanic and Atmospheric Administration, United States Geological Survey, DOE and Department of Defense. NSF leadership and coordination have been especially important in the myriad of partnerships (national and international; government and private) that impact research in the area of computer science and information technology."

INDICATOR 3: Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.

RESULT: ***Demonstrated significant achievement.***

"NSF has funded a diverse group of projects that illustrates notable approaches or new paradigms that promote progress toward the TOOLS outcome goals. Significant achievement is demonstrated in the area of software development that could lead to the generation of large databases for the analyses of genes, proteins, RNAs, small molecules, microorganisms and human resources for science and engineering. These databases will be central for the success of future NSF funded projects."

Emphasis Areas for GPRA Reporting

- **Major Research Equipment and Facilities Construction (current and former): e.g., ALMA I, LIGO, Gemini, LHC, NEES, SPSM, Terascale Computing**
- **Major Research Instrumentation (MRI) Program**
- **Science and Engineering policy analyses, information, reports and databases**
- **Scientific databases and tools for using them, including the National STEM Education digital library**

"***Major Research Equipment and Facilities Construction*** **–** NSF has demonstrated significant achievement in the MREFC program. It continues to fund major scientific facilities that provide unique environments for discovery in a range of disciplines. In fact, it is the principal funder of large-scale non-military scientific infrastructure in the nation. It funds a remarkable spectrum of activities that range from the Polar research facilities (which in turn support a diverse research portfolio, including projects in physics and environmental sciences), through an array of widely-differing scientific facilities focused on deepening and improving our fundamental understanding of the universe, to the country's premiere open high performance computing centers. "

"***Major Research Instrumentation*** – NSF has demonstrated significant achievement in the MRI program. This is an outstanding program of enormous importance to the nation's institutions of higher education. Since 1997 the MRI program has funded over 1,200 instrumentation projects at hundreds of colleges and universities."

"***Science and Engineering Policy Analyses, Information, Reports and Databases*** – NSF has demonstrated significant achievement in the funding of the development of scientific databases. In addition to supporting more traditional scientific databases, the NSF has supported the development of

some highly innovative databases (thought of in a broad sense) that are using modern sophisticated IT tools to provide new and deeper insights into widely diverse areas of research."

"***Scientific Databases and Tools for Using Them, Including the National STEM Education Digital Library –*** NSF has demonstrated significant achievement in the funding of the development of scientific databases. In addition to supporting more traditional scientific databases, the NSF has supported the development of some highly innovative databases (thought of in a broad sense) that are using modern sophisticated IT tools to provide new and deeper insights into widely diverse areas of research."

NSF MANAGEMENT GOALS

NSF MANAGEMENT GOALS

Success in achieving our outcome goals is dependent upon the award portfolio developed by our program staff. The following sections provide information on how our management shapes the award portfolio and supports our outcome goals. Management goals focus on means and strategies for successful performance – in merit review and award oversight and management processes, human capital development, and facilities oversight.

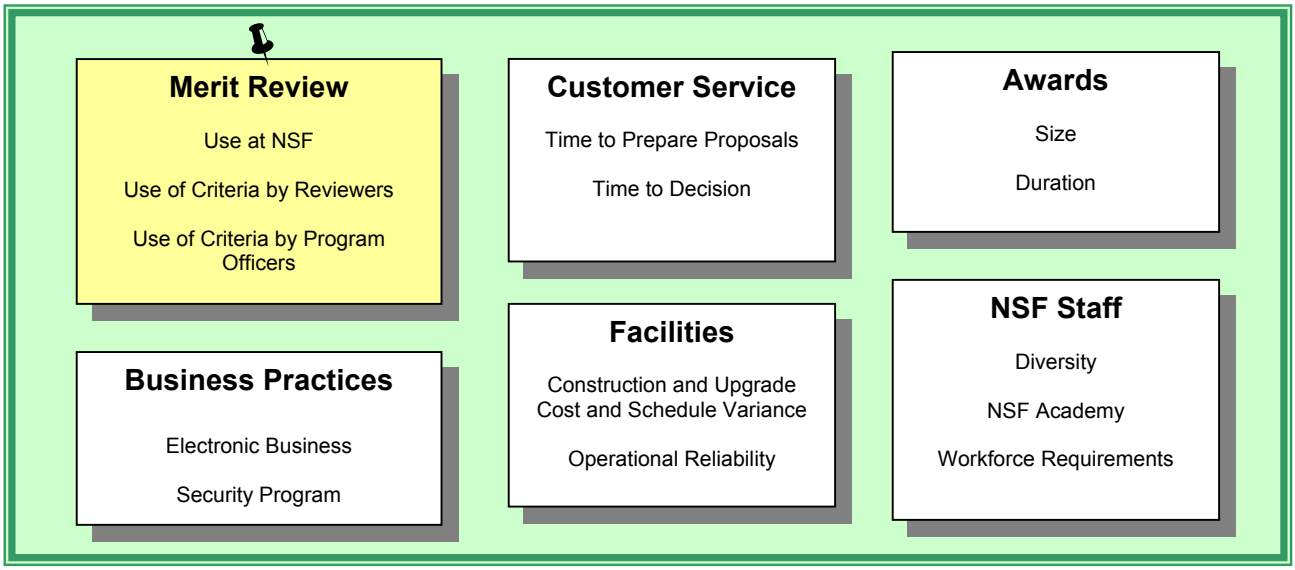
Summary of Results for Management Goals

We achieved 10 of our 16 Management Goals in FY 2003. We achieved our goals for allocation of funds to merit-reviewed projects, use of the two merit review criteria by reviewers, time for the science and engineering community to prepare proposals, the time it takes to make a decision on funding or declining a proposal, average annualized award size, electronic processing of Principal Investigator award transfers, maintenance and enhancement of the agency-wide security program, initiation of an NSF S&E diversity plan, development / revision of courses offered via the NSF Academy, and development of competency-based occupation classification alternatives.

We did not meet our Management Goals for use of the two merit review criteria by program officers, average award duration, facility construction / upgrade cost and schedule performance, operating efficiency at facilities, implementation of Phase III of the Electronic Jacket, and appointments to the NSF S&E staff from underrepresented groups.

As in FY 2002, we engaged an outside accounting firm to verify and validate performance information for our Management goals.

IBM Business Consulting Services (IBMBCS) reviewed the data collection, maintenance, processing, and reporting procedures used to calculate results for all NSF Management goals on which data have been reported. They concluded that the procedures related to these goals were sufficient and adequate and yielded valid results. We provide the Executive Summary of their entire report, as well as a table listing their conclusions as to whether the processes we used were verifiable and the results valid, in the Appendix.



PROPOSAL AND AWARD PROCESSES

A. MERIT REVIEW

Merit review is the keystone to identification of the most promising People, Ideas, and Tools and is critical to fostering the highest standards of excellence and accountability – standards for which NSF is globally recognized. We evaluate proposals for research and education projects using two criteria – the intellectual merit of the proposed activity and its broader impacts.

Evaluations of proposals and funding decisions made through the process of merit review rely on evaluation by experts. Each year, more than 250,000 merit reviews are conducted to help program officers evaluate the proposals submitted for consideration.

The two NSF merit review criteria are:

What is the intellectual merit of the proposed activity?
How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Goal IV-1 – Use of Merit Review
✓ Goal Achieved

Goal IV-1: At least 85% of basic and applied research funds will be allocated to projects that undergo merit review.

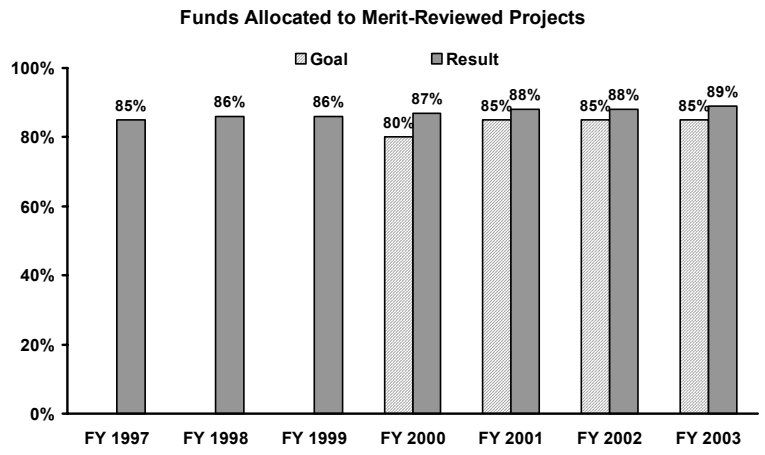
The vast majority of proposals we receive undergo external merit review. The Foundation makes a small number of exceptions to this general requirement in situations where timeliness is crucial such as for studies of volcanic eruptions or earthquakes or where objective external reviewers may be difficult to find. It also considers exceptions when researchers propose such new ideas that knowledgeable external reviewers do not exist.

As of FY 2000 NSF utilizes OMB's definition of merit-reviewed scientific research[1]. NSF has established the 85% target to be consistent with the OMB recommended range of 70% to 90%.

RESULTS: NSF successfully achieved this goal.

PERCENT OF FUNDS TO PROJECTS THAT UNDERGO MERIT REVIEW								
	FY 1997	**FY 1998**	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	85%							
Goal			N/A	80%*	85%	85%	85%	85%
Result		86%	86%	87%	88%	88%	**✓89%**	

* The 80% estimated goal, recalculated from NSF's original goal of 90%, is based on the FY 2000 OMB definition of merit-reviewed scientific research.



IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: An examination of our performance over the last six years shows that we have consistently exceeded our current goal of 85%. We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

*Goal not established for FY 1997 – FY 1998, related goal for FY 1999.

[1] *"Merit-reviewed scientific research with competitive selection and external (peer) evaluation: Intramural and extramural research programs where funded activities are competitively awarded from a pool of qualified applicants following review by a set of external scientific or technical reviewers (often called peers) for merit. The review is conducted by appropriately qualified scientists, engineers, or other technically-qualified individuals who are apart from the people or groups making the award decisions, and serves to inform the program manager or other qualified individual who makes the award."*

Goal IV-2 – Reviewer Use of Both Merit Review Criteria
✓ Goal Achieved

Goal IV-2: At least 70% of reviews with written comments will address aspects of both generic review criteria.

On September 20, 1999, NSF issued Important Notice 125, *Merit Review Criteria*, to Presidents of Universities and Colleges and Heads of other NSF Grantee Organizations. It reminded proposers of the importance of ensuring that, in addition to the criterion related to intellectual merit, the criterion relating to broader impacts be considered and addressed in the preparation and review of proposals submitted to NSF. Over the past four years, NSF has implemented a number of process enhancements to assist proposers in responding to and complying with this requirement, such as posting examples illustrating activities likely to demonstrate broader impacts on the NSF website. The requirement to address both merit review criteria is in every NSF program announcement and solicitation and reminders have been added to the Project Summary and Project Description screens in FastLane. NSF has emphasized the importance of compliance with this requirement during outreach to constituent communities, including at Regional Grants Conference.

To reinforce the importance of this requirement, NSF issued Important Notice 127 in July 2002. It specified that effective October 1, 2002, NSF would return without review proposals that do not separately address both merit review criteria within the Project Summary. This requirement is clearly stated in the relevant sections of the Grant Proposal Guide (GPG) and a Proposal Preparation Checklist has been added to the GPG to aid in assuring compliance with NSF proposal preparation guidelines.

The FastLane site that reviewers utilize to provide their reviews to NSF reminds them to address each merit review criterion and provides separate text boxes for the reviewers to use for each criterion. It requests that reviewers provide "detailed comments on the quality of this proposal with respect to **each** of the two NSF Merit Review Criteria identified below, noting specifically the proposal's strengths and weaknesses…. In addition, please provide an overall rating and **summary statement** that includes comments on the relative importance of the two criteria in assigning your rating."

RESULTS: This goal was achieved. NSF data indicates that **90%** of reviews received by NSF address both review criteria compared with the 84% response rate in FY 2002 and 69% response rate in FY 2001. In FY 2001 assessment focused on the percent of reviews that addressed only the broader impacts criterion. Based on the assumption that all reviews address the intellectual merit criterion, the 69% value shown here represents a maximum percent for proposals addressing both review criteria. In FYs 2002 and 2003, the assessment explicitly included the use of both criteria.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

Goal IV-3 – Program Officer Use of Both Merit Review Criteria
✖ Goal Not Achieved

Goal IV-3: For at least 80% of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria.

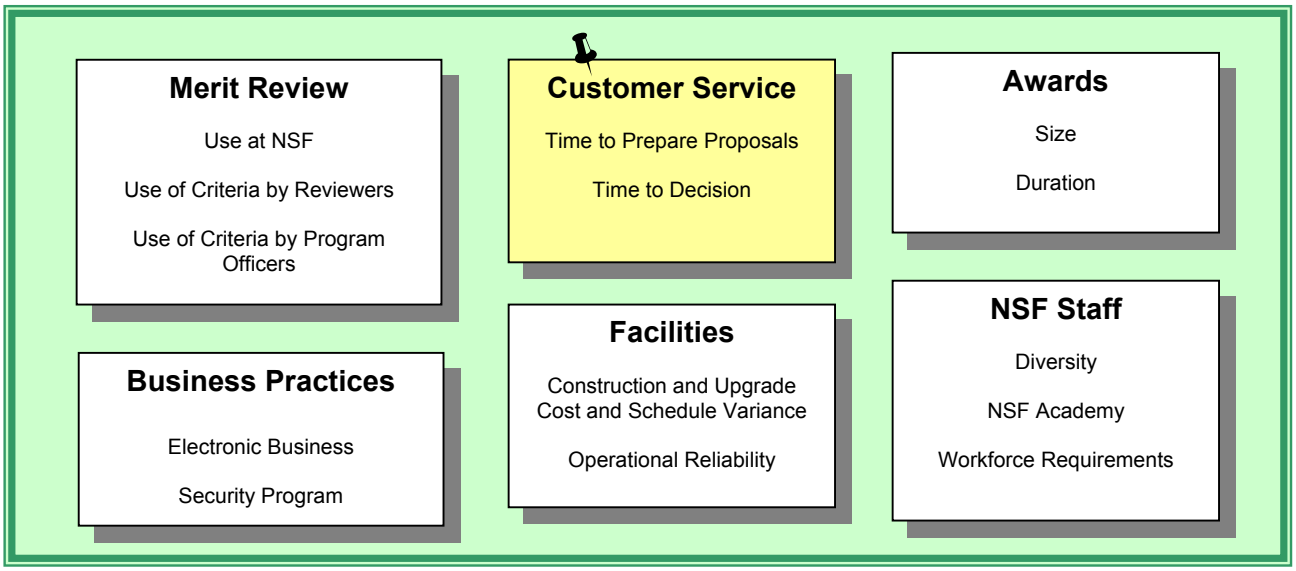
After a proposal has been subjected to external peer review, a NSF Program Officer makes a recommendation concerning support of the proposal. The matters to be discussed in this recommendation are described in our Proposal and Award Manual, Chapter VI, Section B-4. We state "*Program Officers must comment on the intellectual merit and the broader impacts of the proposed activity*."

RESULTS: NSF is not successful for this goal. During FY 2003 we examined a statistically determined sample of FY 2003 review analyses to determine the extent of Program Officer usage of both review criteria. We found, overall, that approximately **53**% of review analyses contained comments on both merit review criteria.

WHY WE DID NOT ACHIEVE THIS GOAL: There were a number of factors that contributed to NSF's failure to achieve this goal. In some cases, program officers did not address aspects of both review criteria. In other cases, the review analysis contained generic or boilerplate comments on aspects of both review criteria, rather than specific comments with respect to the particular proposal in question. Some review analyses contained only the reviewer and/or panel comments on both review criteria. In all these situations, NSF evaluated the review analysis as not meeting the goal.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: The issue of what constitutes program officer comments on aspects of both generic review criteria will be examined and clarified.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.



PROPOSAL AND AWARD PROCESSES

B. CUSTOMER SERVICE

Customer service has a potential impact on the number and quality of proposals received and thus on our ability to meet all Outcome goals. In 1995, we adopted a set of customer service standards, primarily related to the merit review process, treating grantees and potential grantees (*applicants*) as the primary *customers* for NSF's administrative processes. In a survey, applicants valued three standards most highly: (1) clear guidelines for proposal content and preparation, (2) a minimum of three months between release of program announcements and proposal deadlines, and (3) notification of proposal funding recommendation within six months of proposal submission.

For our FY 2003 Performance Plan, we focused on the latter two of these standards, ones to which our staff have devoted special attention since the standards were adopted. The first of these standards (provision of clear guidelines) is addressed in internal processes.

Goal IV-4 – Time to Prepare Proposals
✓ Goal Achieved

Goal IV-4: Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.

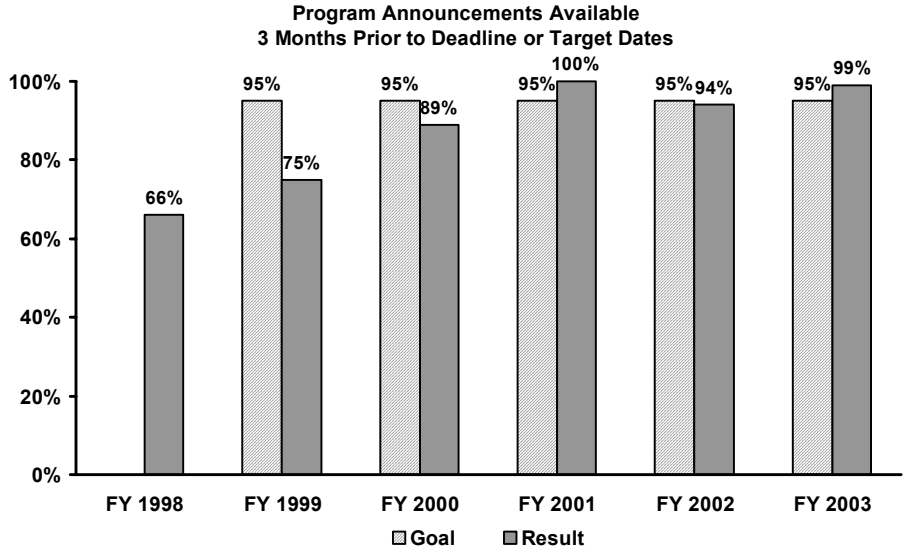
We realize that researchers and educators require sufficient time to prepare submissions. To encourage new investigators and solicit quality proposals, and based on responses to customer surveys, program announcements and solicitations should be available a minimum of 90 days prior to the deadline for submission. We define this time as the time between the posting of the announcement on the web and the deadline for proposal submission given in the web posting.

RESULTS: We were successful in achieving this goal. In FY 2003, **99%** (119 out of 120) of program announcements and solicitations were made available at least 90 days before the proposal deadline[2].

PERCENT OF PROGRAM ANNOUNCEMENTS AND SOLICITATIONS AVAILABLE AT LEAST 3 MONTHS PRIOR TO PROPOSAL DEADLINE OR TARGET DATES

	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Baseline	66%						
Goal		95%	95%	95%	95%	95%	95%
Actual		75%	89%	100%	94%	**✓99%**	

*No goal established for FY 1998



IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

[2] A number of continuing programs have standing or previously established deadline dates. Some of these programs reissue announcements within 90 days of a proposal due date. As long as that deadline date was previously announced, thereby providing the community with at least 90 days to prepare a proposal, the announcement is considered to be in compliance with this GPRA goal.

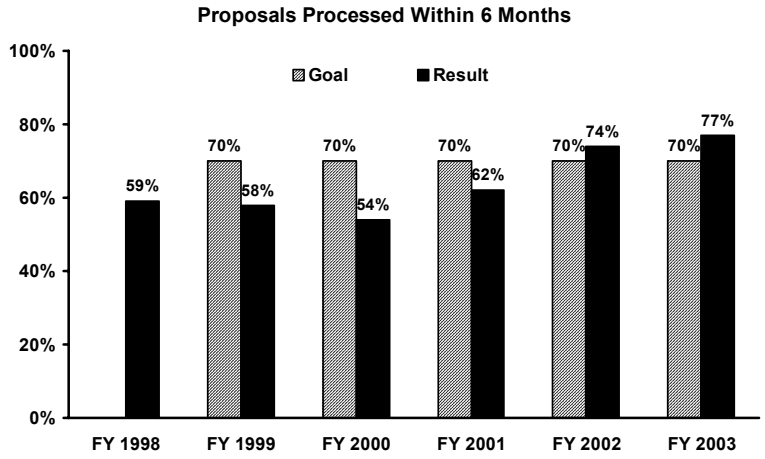
Goal IV-5 – Time to Decision
✓ Goal Achieved

Goal IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.

One of the most significant issues raised in customer satisfaction surveys is the amount of time it takes us to process proposals. We recognize the importance of this issue.

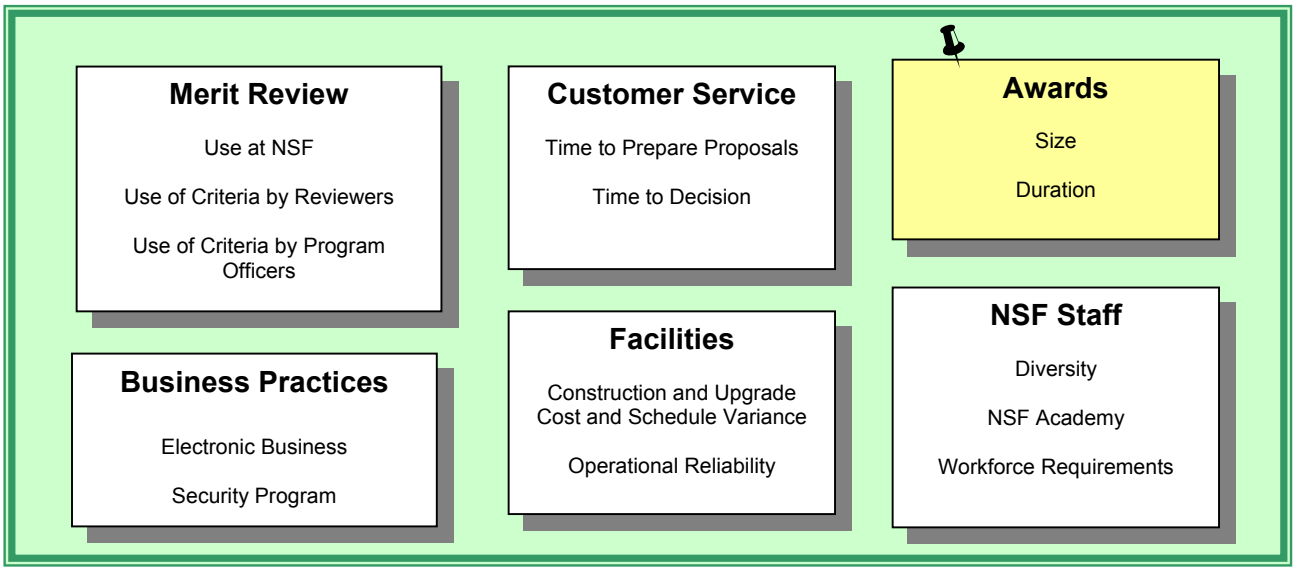
RESULTS: We were successful in achieving this goal. In FY 2003 we processed **77%** of all proposals within six months of receipt.

PERCENT OF PROPOSALS PROCESSED WITHIN 6 MONTHS OF RECEIPT								
	FY 1997	**FY 1998**	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	61%							
Goal			70%	70%	70%	70%	70%	70%
Actual		59%	58%	54%	62%	74%	**✓77%**	



In FY 2004, we will continue to focus on improving the efficiency of proposal processing.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.



AWARD PORTFOLIO

C. AWARDS

The size and duration of NSF awards impact research and education activities at many institutions. Increasing award size and duration will allow scientists and engineers to devote more time to productive research and education in comparison to the time spent preparing proposals. Adequate award size and duration are important both to obtaining high quality proposals and to ensuring that proposed work can be accomplished as planned.

Goal IV-6 – Increased Average Annualized Award Size
✓ Goal Achieved

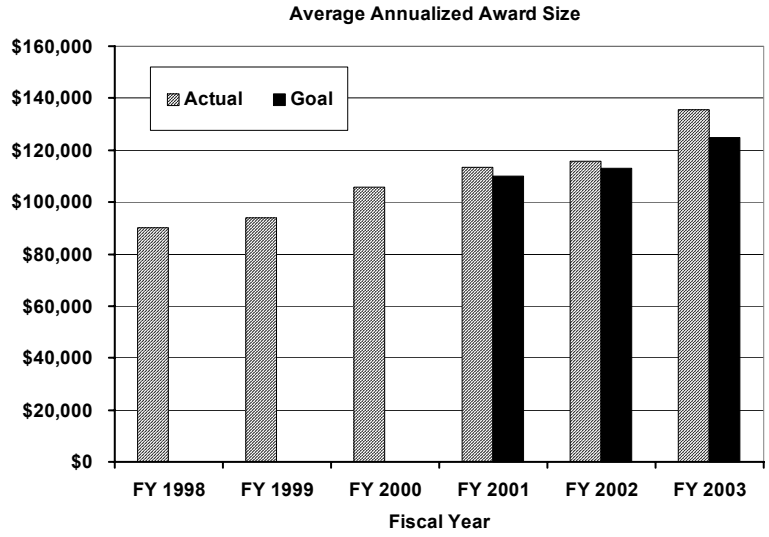
Goal IV-6: NSF will increase the average annualized award size for research grants to a level of $125,000, compared to a goal of $113,000 in FY 2002.

NSF is continuing its goal of increasing award size[3]. Our long-term goal is to reach an average annualized award size of $250,000.

Adequate award size is important both for attracting high-quality proposals and for ensuring that proposed work can be accomplished as planned. Larger awards increase the efficiency of the system by allowing scientists and engineers to devote a greater portion of their time to actual research rather than to proposal writing and other administrative work.

RESULTS: We were successful in achieving this goal.

AVERAGE ANNUALIZED AWARD SIZE FOR RESEARCH GRANTS							
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	$90,000						
Goal				$110,000	$113,000	$125,000	$128,000
Actual		$94,000	$105,800	$113,601	$115,666	✓**$135,609**[4]	



IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan. Individual programs have award size targets in NSF PARTs.

[3] The award size and duration performance goals are applicable only to competitive research grants (a subset of awards that focuses on awards to individual investigators and small groups).
[4] In FY 2003 collaborative proposals submitted as individual proposals from the collaborating institutions were counted as a single proposal as NSF treats them as a single proposal for review and award/decline decisions. If such collaborative proposals are counted individually, the average annualized award size for FY 2003 is $121,380.

Goal IV-7 –Average Award Duration
✖ Goal Not Achieved

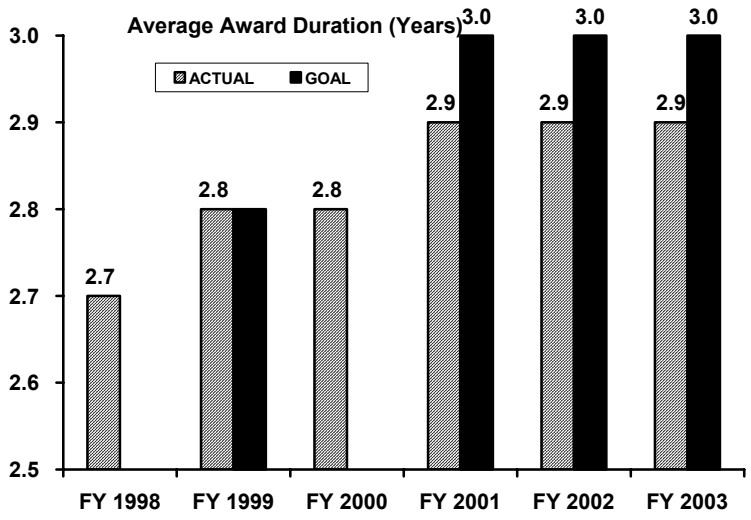
Goal IV-7: NSF will maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants.

Our long-term goal is to reach an average award duration of 5 years[5].

RESULTS: We were not successful in achieving this goal.

AVERAGE AWARD DURATION FOR RESEARCH GRANTS							
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Baseline	2.7 years						
Goal		2.8 years	N/A	3.0 years	3.0 years	3.0 years	3.0 years
Actual		2.8 years	2.8 years	2.9 years	2.9 years	**×2.9 years**	

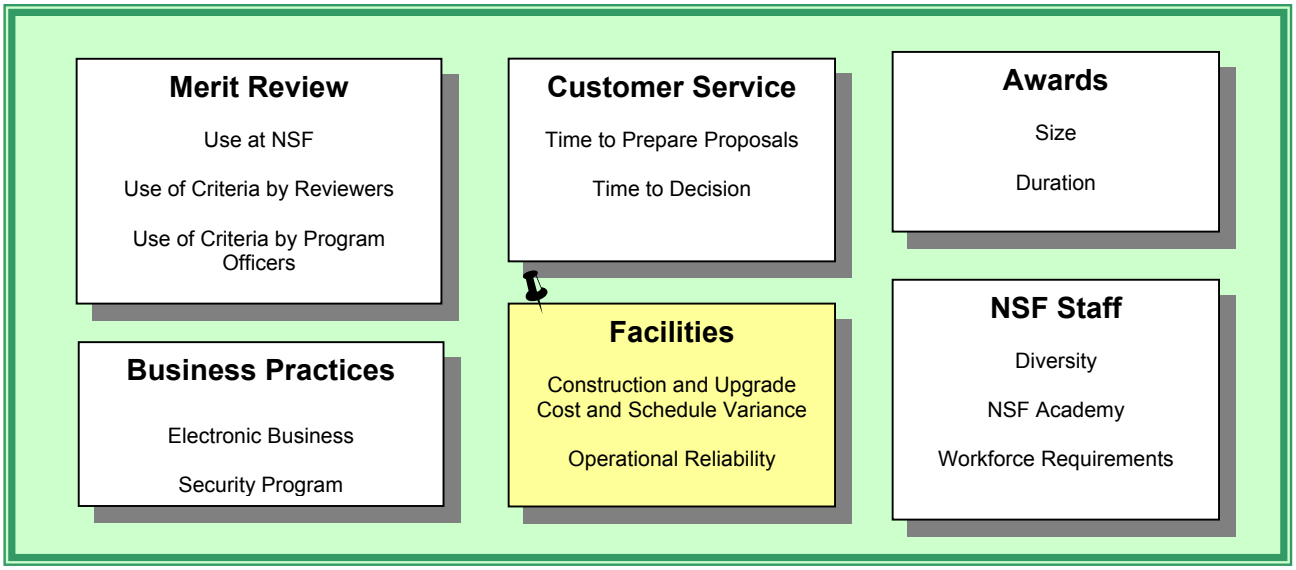
WHY WE DID NOT ACHIEVE THIS GOAL: NSF is committed to its long-term goal of increasing award duration to 5 years. Even though the Foundation was not able to reach the target for FY 2003, there is now a much higher level of awareness and appreciation of the importance of continuing to work toward the long-term goal.



STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: Progress on this goal is budget dependent. Program Directors must balance competing requirements: increasing award size, increasing duration of awards, and/or making more awards. NSF will continue to focus on increasing award size and duration in order to improve the efficiency of the research process.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

[5] The award size and duration performance goals are applicable only to competitive research grants (a subset of awards that focuses on awards to individual investigators and small groups).



AWARD OVERSIGHT AND MANAGEMENT

D. FACILITIES

NSF has responsibility for supporting the operation of multiple user facilities that provide state-of-the-art equipment with unique capabilities. In addition, we put a high premium on initial planning for construction and upgrade of facilities. Planning for unique, state-of-the-art facilities must take into account the exploratory nature of the facilities themselves as such facilities test the limits of technological capability.

In FY 2003 24% of our budget was allocated to the support of "Tools." Within Tools, FY 2003 funding for the Major Research Equipment and Facilities Construction (MREFC) account was approximately $149 million, an increase of $33 million over FY 2002.

Although we have done well in the past in keeping large projects on schedule and within budget, OMB asked us to develop a plan for costing, approval, and oversight of major facility projects. In response, we have completed a Large Facility Projects Management and Oversight Plan that was submitted to OMB in September 2001. This facilities plan has four major foci:

- Enhance organizational and staff capabilities to improve coordination, collaboration, and shared learning among our staff and external partners;
- Implement comprehensive guidelines and procedures for all aspects of facilities planning, management, and oversight;
- Improve the process for reviewing and approving Large Facility Projects; and
- Practice coordinated and proactive oversight of all facility projects to ensure success.

We have established a new position–Deputy, Large Facility Projects–to enable the efficient and effective evolution of our large facility projects from pre-formulation through operations. This position was filled on a permanent basis in FY 2003.

In order to report on the performance goals related to Facility Operations and Construction and Upgrades, we initiated, in FY 1999, development of a Facilities Reporting System. This is linked to the Performance Reporting System, a module of the existing FastLane system. The module is used to collect information on operations and construction from Facilities Managers external to NSF.

In FY 2001[6] and FY 2002 NSF engaged IBM Business Consulting Services to review the process for collection and reporting of GPRA data for the facilities goals. IBM Business Consulting Services' recommendations, along with NSF's own review of the facilities goals and associated data collection methods, were further examined by NSF staff in FY 2002. As a result NSF revised its goals for facilities construction, acquisition, and upgrade to incorporate earned value management, a widely accepted technique for measuring project progress. The data collection system and procedures were revised to reflect this change.

[6] In FY 2001 the firm we engaged was Pricewaterhouse Coopers, LLP. The unit that conducted the review has been sold to IBM and is now part of IBM Business Consulting Services.

Goal IV-8 – Construction and Upgrade of Facilities
✖ Goal Not Achieved

Goal IV-8: For 90 percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.

In FY 2001 and FY 2002 NSF undertook a comprehensive internal review of the facilities goals. As of FY 2003 NSF improved the construction goals by combining cost and schedule performance into a single goal. The revised goal assesses performance based on the Earned Value technique, a widely accepted project management tool for measuring progress that recognizes that cost or schedule data alone can lead to distorted perceptions of performance.

RESULTS: We were not successful in achieving this goal. Data collected from Facilities Managers external to NSF indicate that **88%** (30 out of 34) of facilities kept any negative cost and schedule variances to less than 10 percent of the approved project plan.

WHY WE DID NOT ACHIEVE THIS GOAL: Causes of cost and schedule variances include unanticipated repairs of major equipment, vendor delays in supplying critical components and the opportunity with a small delay to acquire significantly higher computing capacity without a corresponding increase in cost.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: NSF program staff will continue to work with project managers to identify obstacles to successful performance and to ensure that progress will be made toward the achievement of this goal in FY 2004.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan. This goal appears in NSF's Facilities PART.

Goal IV-9 – Operating Time
✖ Goal Not Achieved

Goal IV-9: For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.

To provide the flexibility necessary for NSF to report realistic goals, we maintained the level deemed "successful" at 90% of the facilities.

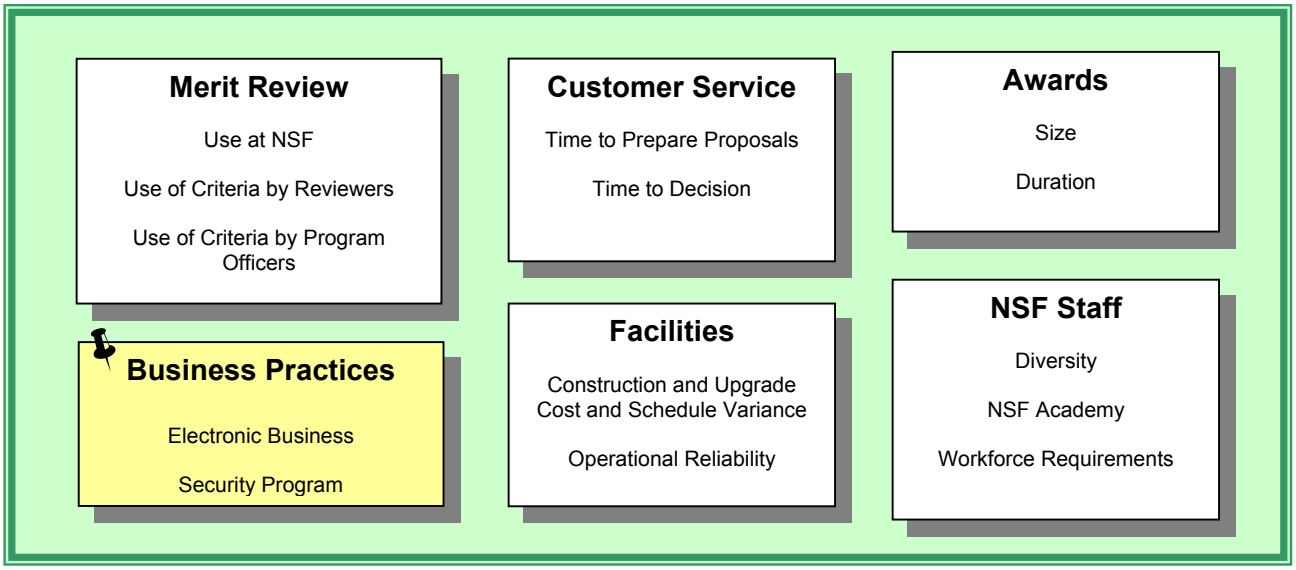
RESULTS: We were not successful in achieving this goal. Data collected from Facilities Managers external to NSF indicate that **87%** (26 out of 30) of facilities kept scheduled operating time lost to less than 10 percent.

OPERATING TIME LOST						
	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Goal	Keep operating time lost due to unscheduled downtime to less than 10% of the total scheduled operating time.	Keep operating time lost due to unscheduled downtime to less than 10% of the total scheduled operating time.	For 90% of facilities, keep operating time lost due to unscheduled downtime to less than 10% of the total scheduled operating time.	For 90% of facilities, keep operating time lost due to unscheduled downtime to less than 10% of the total scheduled operating time.	For 90% of operational facilities, keep scheduled operating time lost to less than 10%.	For 90% of operational facilities, keep scheduled operating time lost to less than 10%.
Actual	Majority of facilities successful.	22 of 26 (85%) reporting facilities met goal.	25 of 29 (86%) reporting facilities met goal.	26 of 31 (84%) reporting facilities met goal.	26 of 30 (87%) reporting facilities met goal.	

WHY WE DID NOT ACHIEVE THIS GOAL: Some causes of scheduled operating time losses include repairs and maintenance exceeding expected durations and instrumentation technical performance issues exceeding anticipated levels.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: NSF program staff will continue to work with project managers to identify obstacles to successful performance and to ensure that progress will be made toward the achievement of this goal in FY 2004.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan. This goal appears in NSF's Facilities PART.



E. BUSINESS PRACTICES

Goal IV-10 – Electronic Award Transfers

✓ Goal Achieved

Goal IV-10: NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of Principal Investigator award transfers.

This goal focuses on award transfers between organizations, a process that is initiated when a Principal Investigator moves from one institution or organization to another. The addition to FastLane of the capability to process a Principal Investigator award transfer was frequently requested by the grantee community.

RESULTS: NSF is successful for this goal. Approximately 99.8% of PI award transfers were processed electronically in FY 2003. There were 462 PI award transfers processed, and all but one was accomplished electronically.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: This goal will not be continued in FY 2004.

Goal IV-11 – Electronic Jacket
✖ Goal Not Achieved

Goal IV-11: NSF will continue to advance "e-business" by implementing Phase III of the Electronic Jacket application.

Performance Indicator: Implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority.

This goal focuses on development of an Electronic Jacket (eJacket). The Electronic Jacket is part of the Foundation's effort to create an integrated, paperless proposal and award-processing environment at NSF. Presently, paper "jackets" (folders) are used for retaining the official records associated with proposals and awards. As NSF moves toward processing through electronic systems, the Electronic Jacket will become the primary electronic environment for internal proposal and award processing.

The eJacket extends NSF's paperless processing environment to internal systems and works seamlessly with FastLane. Using eJacket, NSF staff can process a proposal from submission through closure, and will eventually have the ability to archive all proposals electronically. Designed by a group of NSF employees representing a large cross-section of job functions throughout NSF, the system not only displays information electronically but also integrates with other corporate applications to create a total workflow system.

The eJacket project is multi-phased. Phase I replaced the client-server version of NSF's Electronic Jacket with a web-based system that provides secure anywhere, anytime access and added the ability to transfer files, e-mails and diary notes into the eJacket. Phase II was implemented in FY 2003 and incorporated various independent, internal FastLane systems into the eJacket and permitted staff to take actions on reviews, proposals and post-award requests without leaving the eJacket system. Phase III, originally planned for implementation in FY 2003, will permit staff in program offices to process proposals electronically from submission through closure for declines; provide a fully functional, personalized "My Work" area to notify staff of proposals, reviews and reports submitted in their area; and provide the ability to share information and responsibilities with other NSF organizations. Additional phases are planned for future years.

RESULTS: NSF is not successful for this goal. Phase III capabilities were developed as planned but implementation (roll-out) was delayed to ensure staff was properly trained and ready to use the new capabilities.

WHY WE DID NOT ACHIEVE THIS GOAL: Although Phase III capabilities were developed as planned, implementation (roll-out) was delayed to ensure staff was properly trained and ready to use the new capabilities. Additional efforts for outreach and training, and testing for pilot deployments are underway to assure a smooth transition.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: We will continue to provide staff training and will implement Phase III of the eJacket in FY 2004.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: This goal will not be continued in FY 2004.

Goal IV-12 – IT Security
✓ Goal Achieved

Goal IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets.

Performance Indicators:

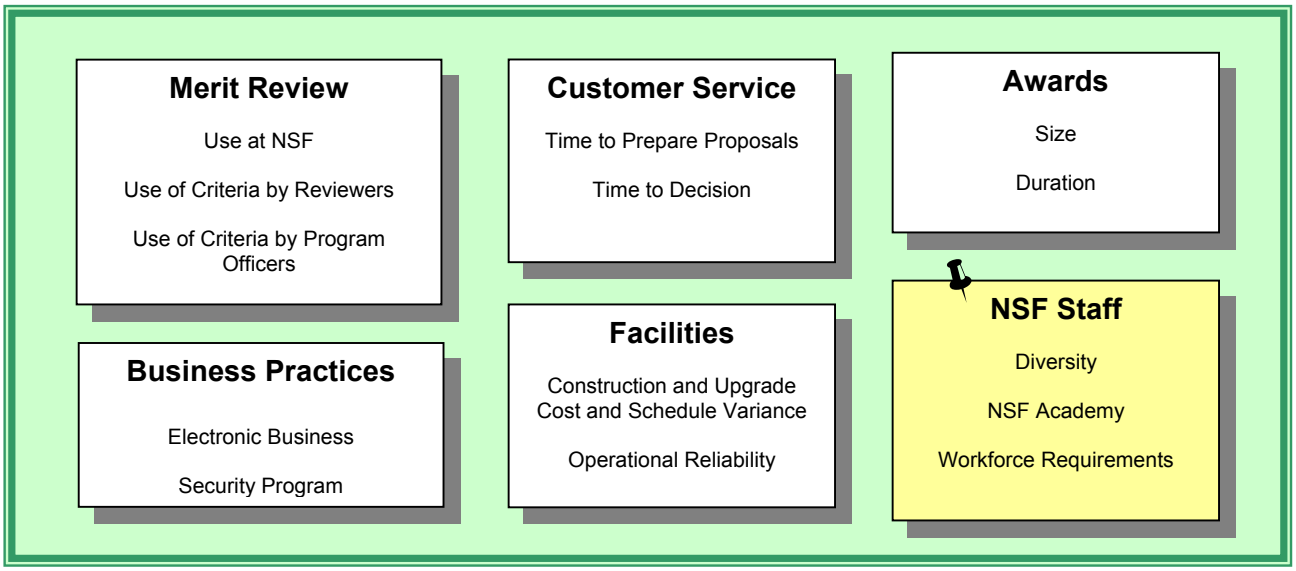
- **95 percent of major systems will have approved security plans on file.**
- **95 percent of major systems will have documented certification and accreditation.**

NSF added an Information technology security goal in FY 2002 and continues this emphasis in FY 2003, in-line with requirements mandated by the Government Information Security Reform Act (Security Act or GISRA). The Security Act addresses program management and evaluation aspects of security, and was designed to ensure proper management and security for the information resources supporting Federal operations and assets.

NSF's information security (IS) program encompasses all aspects of information security, including policy and procedures, risk assessments, self-assessments and security plans; incident prevention, detection and response; infrastructure security component audits and penetration tests; and training and education. NSF's Security Program focuses on assuring that the NSF infrastructure and critical assets are appropriately protected while maintaining an open and collaborative environment for scientific research and discovery.

RESULTS: NSF is successful for this goal. As planned, security plans have been developed and approved for 95% of major systems. Ninety-five percent of these systems have been certified and accredited. The United States Antarctic Polar Program is the custodian of the remaining system that requires certification and accreditation.

IMPLICATIONS FOR FY 2004 PERFORMANCE PLAN: Information security is an on-going effort reported through various means (e.g. Federal Information Systems Management Act (FISMA) reports and the Electronic Government scorecard in the President's Management Agenda). We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.



F. HUMAN RESOURCES AND WORKPLACE

Goal IV-13 – Staff Diversity
✓ Goal Achieved

Goal IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers.

Performance Indicator: Initiate development of a NSF S&E diversity plan.

NSF recognizes that a diverse workforce – e.g., one that includes members of underrepresented groups and reflects institutional and geographic differences – broadens the agency outlook and talent base and enables it to better serve both its research and education communities and ultimately all citizens.

RESULTS: We were successful in achieving this goal. A multi-disciplinary team of employees from various levels in the organization was established and began development of the NSF S&E Diversity plan. Demographic data from FY 1998 through FY 2002 was compiled for each Directorate and Division and for NSF in total to help determine appropriate diversity goals. Data were also collected on the geographic and institutional diversity of NSF IPAs and VSEEs where available. Findings from the NSF Business Analysis and Human Capital Planning Team were also used to inform strategies for recruiting, developing and retaining a diverse staff. Strategies and Action Plans were incorporated into the Human Capital Management Plan to further integrate diversity considerations into NSF's human capital management.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

Goal IV-14 – Staff Diversity – Staff Appointments
✖ Goal Not Achieved

Goal IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.

The NSF Strategic Plan notes that a diverse, capable, and motivated staff is one of the critical factors for our success. We are committed to diversifying our staff of scientists and engineers (S&E) in both permanent and visiting positions.

RESULTS: NSF is not successful for this goal. While we achieved the goal with respect to the hiring of women, we did not with respect to the number of minorities hired. FY 2003 results were identical to the FY 2000 baseline for minority hires.

In FY 2003 we have expanded the scope of our goal to include additional S&E positions in the agency. Broadening the positions included in this measure allows us to assess our efforts throughout all professional recruitment opportunities, including executive hiring. The baseline to be used will be total S&E hires from underrepresented groups in FY 2000.

APPOINTMENTS TO SCIENCE & ENGINEERING POSITIONS FROM UNDERREPRESENTED GROUPS						
	FY 1999	**FY 2000**	**FY 2001**	**FY 2002**	**FY 2003**	**FY 2004**
Goal	Efforts to attract underrepresented groups	More than 16 Female, 15 Minority	More than 16 Female, 15 Minority	More than 35 Female, 19 Minority	More than 46 Female, 25 Minority	More than 46 Female, 25 Minority
Actual	Achieved[7]	35 Female 19 Minority	38 Female 22 Minority	41 Female 27 Minority	48 Female 25 Minority	

WHY WE DID NOT ACHIEVE THIS GOAL: While we continue to focus on the hiring of female and minority science and engineering staff, we were not able to attain our goal, due in part to the revised, more comprehensive goal that was implemented this year.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: For FY 2004 additional emphasis will be placed on the hiring of female and minority employees. An additional staff member will be hired to specifically address diversity issues. In addition, the Diversity Plan, which is under development, will help provide strategies for recruiting and retaining a diverse staff.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

[7] In FY 1999, our goal was "In FY 1999, as all appointments for scientists and engineers are considered, the recruiting organization will demonstrate efforts to attract applications from groups that are underrepresented in the science and engineering staff as compared to their representation among Ph.D. holders in their fields."

Goal IV-15 – Workforce Learning
✓ Goal Achieved

Goal IV-15: NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities.

> **Performance Indicator: Initiate development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training.**

This goal reflects the Foundation's commitment to cultivate a world-class staff to sustain the level of excellence required to fulfill the NSF mission.

Originally conceived in September 2000, the Academy is evolving in incremental steps. Consolidation of training functions commenced in FY 2001, initial seed money was provided in FY 2002, and additional funding was provided for FY 2003 to initiate a broader curriculum and expanded programs. Once fully operational, the Academy will serve as the central locus of learning, and provide continual learning opportunities for NSF staff. Development of new and revised courses reflected the needs and requirements of NSF staff.

RESULTS: NSF is successful for this goal. Twenty-four new courses were developed and twenty-six existing courses revised to address the areas in the indicator statement. E-learning, classroom training and satellite broadcasts were methodologies utilized to provide training. In addition, a Certificate program in Project Management, in partnership with George Washington University, was also initiated.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

Goal IV-16 – Workforce Planning
✓ Goal Achieved

Goal IV-16: NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems.

Performance Indicators:

- **Identification of workforce competencies for all current NSF job families.**
- **Initiate identification of competency-based, classification alternatives.**

NSF requires a multi-year strategic business analysis effort to assess its core business processes and supporting human capital and technology requirements in order to prepare for anticipated budget growth and an accompanying increase in the complexity of the NSF portfolio and to address new and existing management challenges presented by the President's Management Agenda and identified by NSF, the NSF Inspector General, the General Accounting Office, and others.

RESULTS: Job families and their corresponding competency models have been identified for all of NSF's core functions and support functions. The NSF Human Capital Plan outlines strategies and lays out action plans to develop a more uniform occupation classification system. The competency based classification system will be the basis for recruitment, selection, and development of NSF employees as well as succession planning and workforce planning initiatives at NSF.

IMPLICATIONS FOR THE FY 2004 PERFORMANCE PLAN: We are currently reviewing our 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations and NSF's new strategic plan.

OTHER INFORMATION

V. ASSESSMENT AND EVALUATION PROCESS

We employ a mix of both qualitative and quantitative goals, and make use of both qualitative information and quantitative data in determining annual progress towards achieving goals. Our strategic outcome goals are generally expressed in a qualitative form, and most management goals are quantitative.

STRATEGIC OUTCOME GOALS

We have traditionally made use of various types of assessments and evaluations to monitor non-quantitative research and education outcomes, the quality of our investments, and the processes we use. Formalized examination takes place during merit review of proposals, COV and AC/GPA assessments, and GPRA reporting. Additionally, programs and plans are assessed and evaluated throughout the year on a continuing basis by NSF staff. Elements of GPRA reporting are highlighted in the figure below.

MANAGEMENT GOALS

We make use of internal data systems to monitor and report progress in achieving the quantitative management goals. For these goals, performance results are assessed and reviewed by our administrative staff and managers, with selected goals audited by external third parties. Selected results are verified and validated by a third party.

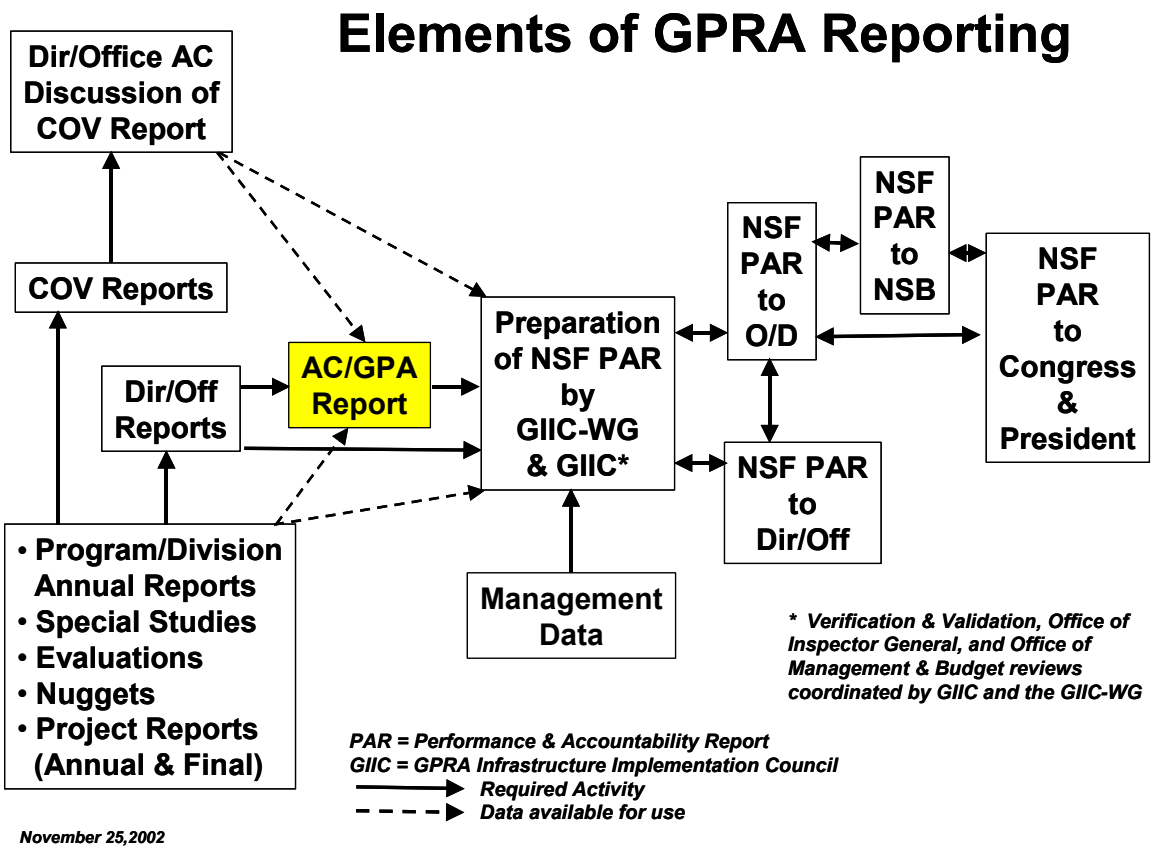
The assessment process for the quantitative goals is straightforward. We collect relevant data using internal corporate data systems and compare the result with the performance level targeted for the fiscal year. Progress towards achievement of most quantitative goals is reviewed by senior management on a quarterly basis. In FY 2000, an agency-wide GPRA module that collects data relevant to the quantitative goals was created to allow staff to track progress throughout the year. Development of that module continues.

Project Assessment During NSF Merit Review

Applicants and grantees provide results from previous NSF support, information about existing facilities and equipment available to conduct the proposed activity, biographical information on the Principal Investigators, other sources of support, federally required certifications and certifications specific to NSF. Such information is required at the time of application, at the time of an award, and in annual and final project reports. It is reviewed by NSF staff, is utilized during merit review, and is available to external committees (COVs and the AC/GPA) conducting performance assessment. The merit review process provides a rigorous, first phase of assessment of NSF's research and education portfolio. Thus, at the onset, this process selects for support only the most competitive one-third of proposals submitted for consideration.

Program Officers review the annual progress of awards. The progress report includes information on significant accomplishments, on progress achieved in the prior year, and on plans for the next year, and points out issues that may impact progress or completion of the project on schedule and within budget. On approval of this report by the Program Officer, NSF releases funds for the ensuing year.

All materials associated with the review of a proposal as well as subsequent annual reports are available to Committees of Visitors. NSF staff also prepares materials (reports, evaluations, highlights) for use by COVs and the AC/GPA in developing their reports and making their assessments.



Program Assessment by Committees of Visitors (COVs)

NSF's Committees of Visitors provide program assessments that are used both in program management and in annual GPRA reporting.

Each COV typically consists of five to twenty external experts who review one or more programs over a two or three day period. These experts are selected to ensure independence, programmatic coverage, and balanced representation. They typically represent academia, industry, government, and the public sector.

All COVs are asked to complete a report template with questions addressing how programs contribute to NSF's goals. Committees of Visitors are asked to address (A) the integrity and efficiency of the *processes* involved in proposal review; and (B) the results, including quality and other factors, of NSF's investments.

The FY 2003 COVs were asked to comment on program activities as they relate to NSF's strategic outcome goals. COVs are asked to justify their judgements and provide supporting examples or statements.

COVs are subcommittees of NSF Directorate Advisory Committees. As such, their reports, along with responses from the responsible Directorate addressing recommendations made by the COVs, are submitted to the parent Advisory Committee. NSF staff also reviews the reports.

Advisory Committee (AC) Reporting on Directorate/Office Performance

Advisory Committees advise the seven directorates and the Office of Polar Programs. They are typically composed of 18-25 external experts who have broad experience in academia, industry, and government. Advisory Committees are chartered and hence are subject to Federal Advisory Committee Act (FACA) rules. The role of the ACs is to provide advice on priorities, address program effectiveness, and review COV reports and directorate responses to COV recommendations.

In FY 2001 and previous years, directorate advisory committees assessed directorate progress in achieving NSF-wide GPRA goals. With the advent of the AC/GPA (see below), advisory committees no longer assess directorate progress towards these goals.

Advisory Committee for GPRA Performance Assessment (AC/GPA)

During FY 2002 NSF determined that a more effective and efficient process for the assessment of NSF performance with respect to the strategic outcome goals was to have a single external committee of experts review all Foundation accomplishments with respect to strategic goal indicators and areas of emphasis. This committee would then provide an assessment of NSF-wide performance with respect to these strategic goal indicators.

A request to create such an advisory committee, named the Advisory Committee for GPRA Performance Assessment (AC/GPA), was approved in the summer of 2002. Its first meeting was held in September. A second meeting, to assess FY 2003 achievement with respect to Outcome Goals, was held near the end of June 2003. The AC/GPA had access to information provided by each of the NSF Directorates and the Office of Polar Programs. It also had access to COV reports. The AC/GPA provided NSF with a report concerning NSF performance with respect to the indicators of each strategic goal. The report also discussed NSF areas of emphasis, priority areas, the quality of the NSF portfolio, balance within the portfolio, and other topics.

The Committee was given access to an extensive collection of information via a secure Website approximately two months prior to the meeting. Information made available to the Committee in this manner included, but was not limited to: brief descriptions ("nuggets") of judgmentally-sampled NSF-supported project outcomes and examples for FY 2003; all electronic Project Reports on NSF-funded awards submitted by Principal Investigators; Committee of Visitor (COV), Directorate and Advisory Committee reports of program assessments conducted by external programmatic expert panels that are routinely used by NSF program management; and other materials. The FY 2002 Committee's "*Report of the Advisory Committee for GPRA Performance Assessment*" was available for their use on NSF's website[1].

Agency GPRA Reporting

The COV and AC/GPA reports prepared by external experts address a broad set of issues ranging from staffing and quality of merit review to specifics of a scientific project. The GPRA components of these reports are used in assessing NSF's progress toward achieving its People, Ideas, and Tools outcome goals (Goals III-1a, III-1b, III-2 and III-3.).

The criterion for success for each of the People (III-1a), Ideas, and Tools annual performance goals can be stated:

[1] *www.nsf.gov/od/gpra/reports/transmittal_letter.doc*

"NSF is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the [associated indicators]."

This criterion is utilized for judgements about agency success for GPRA People-Ideas-Tools outcome goals. The agency decision for NSF is based on analysis of the statements contained within the AC/GPA and the COV reports.

NSF staff examines statements of significant accomplishment included in COV and the AC/GPA reports to ensure that ratings for the qualitative outcome goals and indicators are justified. In addition, they check for supporting evidence or examples sujpporting such judgements.

Principal factors contributing to NSF's decision that the agency is successful in FY 2003 for annual performance outcome goals III-1a, III-2, and III-3 related to People, Ideas, and Tools include:

1. The AC/GPA report that found that:
   - NSF indicator portfolios documented "significant achievement" with respect to all indicators for annual performance outcome goals III-1a, III-2, and III-3.
   - The extensive number and quality of retrospective examples demonstrating significant achievement for the 12 indicators associated with NSF's three outcome goals.
2. The NSF COV reports available as of June 30, 2003.

With respect to Goal III-1b, involving activities associated with the Math and Science Partnership, the AC/GPA determined that because of the relative newness of the program there was not enough data available in June 2003 for them to determine whether the two indicators associated with this goal had been achieved. However, assessment done by NSF staff, including information provided by an external group (Westat, Inc.), at the conclusion of FY 2003 found that significant achievement was demonstrated for both indicators associated with this annual program goal. This was a factor contributing to NSF's decision that the agency is successful in FY 2003 for annual performance outcome goal III-1b.

In previous years, selected goals were verified and validated (V&V) by external third parties. For the FY 2003 Performance and Accountability Report, **all goals**, both strategic outcome and management, were verified and validated by external third parties. The V&V process and this year's results are discussed in Section VI of this Performance and Accountability Report.

VI. Verification and Validation (V&V)

The Foundation has both qualitative and quantitative GPRA goals. Its qualitative goals include annual performance goals that support the three broad strategic outcome goals related to People, Ideas, and Tools. The outcome goals are presented in a format that requires qualitative assessment of achievement. These assessments are based largely on information included in reports prepared by committees of independent, external experts (e.g. Committees of Visitors and the Advisory Committee for GPRA Performance Assessment) who assess the quality of program results based on their collective experience-based norms. NSF's quantitative goals focus on management activities, with the majority presented in a format that enables quantitative assessment of progress toward goal achievement. Assessment for these goals is based on data collected with NSF's central data systems.

QUALITY OF REPORTED PERFORMANCE INFORMATION

NSF recognizes the ongoing need to improve data systems for collecting performance information and data. We view the improvement of the quality of data and data systems as an evolutionary process and intend to maintain it as a priority as budget and time allow. Implementing GPRA has enabled NSF to gather information in a structured way and to address issues in a more formal, focused manner than in the past[1].

In their October 2003 report[2] IBM Business Consulting Services (IBMBCS) addressed system aspects of NSF data quality for the Awards system, Enterprise Information System, Financial Accounting System, FastLane, Integrated Personnel System, and the Proposal, Principal Investigator (PI), and Reviewer System. IBM Business Consulting Services "*We reviewed NSF's information systems to evaluate the controls that are in place to produce reliable data. The control techniques presented in the table below are based on interviews with NSF managers and staff—rather than a full application review. Pursuant to GAO's assessment guide, we relied on previously conducted work and on departmental sources to determine whether there were any known problems with the data sources or the data itself that would cast doubt on the credibility of the information. It is important to note that we evaluated the same systems that were in place last year, and this year focused on any changes to the systems. In some instances, departmental sources clarified points from last year, which are documented in the Application Controls Matrix on the next page.*"

DATA V&V ACTIVITIES

We used a V&V process similar to the one used in FY 2002 to verify and validate selected FY 2003 GPRA performance information. In FY 2000 and FY 2001, we engaged an external third party, (PricewaterhouseCoopers LLP (PwC)), to verify and validate selected GPRA performance results as well as the process through which supporting data was compiled. The business unit within PwC responsible for this type of activity was sold to IBM in 2002 and is part of IBM Business Consulting Services (IBMBCS). For FY 2003 data verification and analyses, we engaged IBMBCS to document the processes we follow to collect, process, maintain, and report selected performance data. They identified relevant controls and commented on their effectiveness. Based on General Accounting Office (GAO) guidance, they provided an assessment of the validity and verifiability of the data, policies, and procedures we used to report results for the FY 2003 goals. For the outcome goals, IBM Business Consulting Services reviewed the processes NSF used to obtain external assessment of NSF activities with respect to these

[1] GPRA data quality was a management challenge cited by the OIG in FY 2002.
[2] Page 88 of the IBMBCS report.

goals. IBM Business Consulting Services also provided high-level review of NSF's information systems based on GAO standards for application controls[3].

In their October 2003 report[4], IBM Business Consulting Services states: "*From our FY 2003 review, we conclude that NSF has made a concerted effort to assure that it reports its performance results accurately and has effective systems, policies, and procedures to promote data quality. Overall, we verify that NSF relies on sound business practices, internal controls, and manual checks of system queries to report performance. NSF maintains adequate documentation of its processes and data to allow for an effective verification and validation review. Further, we validate the reliability of NSF's third and fourth quarter results through our successful recalculation or reconfirmation of these results based on processes, data and systems.*"

TYPES AND SOURCES OF PERFORMANCE DATA AND INFORMATION

Most of the data that underlie achievement assessments for strategic outcome goals originate outside the agency and are submitted to us through the Project Reporting System, which includes annual and final project reports for all awards. Through this system, performance information/data such as the following are available to program staff, third party evaluators, and other external committees:

- Information on People – student, teacher and faculty participants in NSF activities; demographics of participants; descriptions of student involvement; education and outreach activities under grants; demographics of science and engineering students and workforce; numbers and quality of educational models, products and practices used/developed; number and quality of teachers trained; and student outcomes including enrollments in mathematics and science courses, retention, achievement, and science and mathematics degrees received;
- Information on Ideas – published and disseminated results, including journal publications, books, software, audio or video products created; contributions within and across disciplines; organizations of participants and collaborators (including collaborations with industry); contributions to other disciplines, infrastructure, and beyond science and engineering; use beyond the research group of specific products, instruments, and equipment resulting from NSF awards; and role of NSF-sponsored activities in stimulating innovation and policy development; and
- Information on Tools – published and disseminated results; new tools and technologies, multidisciplinary databases; software, newly-developed instrumentation, and other inventions; data, samples, specimens, germ lines, and related products of awards placed in shared repositories; facilities construction and upgrade costs and schedules; and operating efficiency of shared-use facilities.

Most of the data supporting management goals can be found in NSF's central systems. These central systems include the Enterprise Information System (EIS); FastLane, with its Performance Reporting System and its Facilities Performance Reporting System; the Online Document System (ODS); the Proposal, PI, and Reviewer System (PARS); the Awards System; the Electronic Jacket; and the Financial Accounting System (FAS). These systems are subject to regular checks for accuracy and reliability.

The Division of Human Resources Management/Office of Information and Resource Management (HRM/OIRM) maintains information related to staff recruitment and staff training, under the guidance of the Chief Information Officer. The Office of Equal Opportunity Programs (OEOP) databases are also available for reporting purposes.

[3] An executive summary of the IBMBCS report is provided in the Appendix of this Chapter.
[4] Page 1 of the IBMBCS report.

Data / Information Limitations

For outcome goals, the collection of qualitative data during assessment may be influenced by factors such as a lack of long-term data/information to assess the impact of outcomes, the potential for self-reporting bias, the unpredictable nature of discoveries, and the timing of research and education activities. For the quantitative management goals, the assessment may be influenced by factors such as accuracy of data entry into central computer systems, lack of experience in using new reporting systems or modules, or individual non-responsiveness (e.g., self-reporting of diversity information; workplace surveys).

Finally, external expert assessments (presented in COV and AC/GPA reports) may lack sufficient justification or may provide incomplete information. To address this issue NSF is continuing to modify its reporting templates and improve guidance to committees and staff in order to improve the completeness and consistency of the reports. This will aid in compiling qualitative information. Additionally, we have focused on clarifying language in goal and indicator statements.

Judgmental Sampling

With respect to NSF's four annual performance outcome goals, since it is impractical for an external committee to review the contributions to the associated performance goals by each of the over 20,000 active awards, NSF Program Officers provided the Committee with about 800 summaries of notable results relevant to the performance indicators. The Committee also had access to recent Committee of Visitor (COV) reports of program assessments conducted by external programmatic expert panels that are routinely used by NSF program management.

Collections obtained from expert sampling of outstanding accomplishments and examples ("nuggets") from awards, together with COV reports, formed the primary basis for determining, through the recommendations of the external Advisory Committee for GPRA Performance Assessment, whether or not NSF demonstrated significant accomplishments in its FY 2002 GPRA Strategic Outcome Goals for People, Ideas and Tools. The approach to nugget collection is a type of non-probabilistic sampling, commonly referred to as "judgmental" or "purposeful" sampling, that is best designed to identify notable examples and outcomes resulting from NSF's investments. It is the aggregate of collections of notable examples and outcomes that can, by themselves, demonstrate significant agency-wide achievement in the Strategic Outcome Goals.

In their October 2003 report[5], IBM Business Consulting Services states: "*We also note that prior to the AC/GPA meeting and in response to a FY 2002 AC/GPA recommendation, NSF discussed the issue of nugget sampling with senior management and staff with expertise in statistics. Ultimately, NSF determined that judgmental sampling was appropriate given the nature of the AC/GPA's qualitative review. During the AC/GPA meeting, a number of committee members expressed satisfaction with the nugget sampling technique, especially given the availability of other types of performance information. Some committee members noted that their subcommittees went far beyond the nuggets in making their judgments. We concur with this assessment."* Additional comments from IBM Business Consulting Services can be found in the Appendix to this Chapter.

[5] Page 123 of the IBMBCS report.

VII. TRANSITION FROM FY 2003 TO FY 2004

This section compares goals contained in the FY 2003 Revised Final GPRA Performance Plan with those contained in the FY 2004 GPRA Final Performance Plan. Note that NSF is evaluating the FY 2004 Performance Plan based upon Program Assessment Rating Tool (PART) evaluations, results from a recent survey of NSF applicants, and suggestions to focus management goals on the ones most critical to the NSF mission. Significant changes between the FY 2003 Goals and the current FY 2004 goals are discussed. Minor wording revisions that were made to clarify goals are not included.

Strategic Outcome Goal	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
PEOPLE – Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."	*III-1a: NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators:* Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities; Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal. III-1b: NSF will significantly enhance the quality of K-12 mathematics and science education available to all students in Math and Science Partnership schools. Performance Indicators: Evidence in the award portfolio of the infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers.) Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc.	III-1: NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; Contributions to development of a diverse workforce through participation of underrepresented groups in NSF activities; Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.	Unchanged. Not included separately. MSP is evaluated in III-1 and in the Program Assessment Rating Tool for Collaborations.

Strategic Outcome Goal	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
IDEAS -- Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."	III-2: NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: Discoveries that expand the frontiers of science, engineering, or technology; Connections between discoveries and their use in service to society; Partnerships that enable the flow of ideas among the academic, public or private sectors; Leadership in fostering newly developing or emerging areas.	III-2: NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: Discoveries that expand the frontiers of science, engineering, or technology; Connections between discoveries and their use in service to society; Partnerships that enable the flow of ideas among the academic, public or private sectors; Leadership in fostering newly developing or emerging areas.	Unchanged.
TOOLS -- Providing "broadly accessible, state-of-the-art and shared research and education tools."	III-3: NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities; Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.	III-3: NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities; Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.	Unchanged.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
Use of Merit Review	IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.	IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.	Unchanged.
Implementation of Merit Review Criteria - Reviewers	IV-2: At least 70 percent of reviews with written comments will address aspects of both generic review criteria.	IV-2: At least 70 percent of reviews with written comments will address aspects of both review criteria.	Unchanged.
Implementation of Merit Review Criteria – Program Officers	IV-3: For at least 80 percent of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria.	IV-3: For at least 90 percent of decisions to fund or decline proposals, Program Officers will comment on aspects of both review criteria.	The target level for this goal has been increased from 80 percent to 90 percent.
Time to Prepare Proposals	IV-4: 95 percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.	IV-4: 95 percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.	Unchanged.
Time to Decision	IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.	IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline of target date, or receipt date, whichever is later.	The wording of the goal has been revised slightly to reflect the method used to calculate the "time to decision."
Award Size	IV-6: Increase average annualized award size for research grants to $125,000.	IV-6: NSF will increase the average annualized award size for research grants to $128,000.	The target level for this goal has been increased by $3,000.
Award Duration	IV-7: Maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants.	IV-7: The average duration of awards for research grants will be 3.0 years.	Unchanged
Facilities –Construction and Upgrade	IV-8: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.	IV-8: For ninety percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.	Unchanged.
Facilities – Operations and Management	IV-9: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	IV-9: For ninety percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	Unchanged.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
Cost Efficiency – Videoconferencing	No goal included.	IV-10: NSF will assess the cost efficiencies associated with administrative processes. Performance Indicator: Calculation of the agency-wide cost-savings realized by the use of videoconferencing.	A cost efficiency goal related to savings resulting from the use of videoconferencing has been added.
Electronic Business	IV-10: NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of PI award transfers. IV-11: NSF will continue to advance "e-business" by implementing Phase III of the Electronic Jacket application. Performance Indicator: Implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority.	IV-11: NSF will integrate its internal electronic grants process with the E-government initiative. Performance Indicators: 90 percent of program announcements will be posted to Fed Grants. 75 percent of declined proposals will be processed using E-decline signatures.	The Foundation is moving towards an electronic environment capable of performing all internal and external functions from proposal submission through final project closeout. The FY 2004 goal retains the emphasis on E-business while continuing progress on new tasks in this area.
Security Program – Information Technology and Physical Security	IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's IT infrastructure and critical assets. Performance Indicators: 95 percent of major systems will have approved security plans on file. 95 percent of major systems will have documented certification and accreditation.	IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF's infrastructure and critical assets. Performance Indicators: 95 percent of NSF's major systems will achieve Level 3 compliance in accordance with the NIST Security Self-Assessment Framework. Implementation of a "Smart ID" pilot to provide staff with a standard identification card for authentication and access control.	For FY 2004 the performance indicators retain the emphasis on information technology security while continuing progress on new tasks in this area. The "Smart ID" pilot indicator has been added.

Performance Area	FY 2003 Goal (Revised Final Plan)	FY 2004 Goal (Final Plan)	Explanation of Change
NSF Staff – Diversity	IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: Initiate development of a NSF S&E diversity plan. IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.	IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers. Performance Indicator: NSF will complete development of the NSF S&E diversity plan initiated in FY 2003 and begin implementation of its recommendations. IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.	Future goals and associated performance indicators have not yet been developed. The recommendations of the FY 2003 internal, ad hoc task force will guide their development. Unchanged.
Workforce Learning	IV-15: NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities. Performance Indicator: Initiate development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training.	IV-15: The NSF Academy will develop a broad array of competency-based learning opportunities that will enable all staff to perform critical functions supporting NSF's vision and goals. Performance Indicators: - Identification of staff requiring Facilities / Center Project Management training. - Initiation of development of a curriculum that leads to certification in Facilities / Center Project Management.	The FY 2004 indicator retains the emphasis on workforce learning while implementing specific curricula
Workforce Planning	IV-16: NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: Identification of workforce competencies for all current NSF job families. Initiate identification of competency-based, classification alternatives.	IV-16: NSF will develop competency-based occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. Performance Indicators: - Identification of workforce competencies needed to support the majority of NSF's strategic business processes. - Development of new positions or revision of position descriptions in order to address emerging business process requirements.	The FY 2004 indicators retain the emphasis on workforce planning. The first indicator expands NSF's focus to association of workforce competencies with NSF's business processes. The addition or revision of positions in accordance with the identified competencies is added as an indicator.

VIII. OTHER FEATURES

INFORMATION ON USE OF NON-FEDERAL PARTIES

This GPRA performance report was written and prepared solely by NSF staff.

Non-Federal external sources of information we used in preparing this report include:

- Reports from awardees demonstrating results.
- Reports prepared by evaluators – Committees of Visitors (COV) and Advisory Committees – in assessing our programs for progress in achieving Outcome Goals.
- Reports prepared by a consulting firm to assess the procedures we use to collect, process, maintain, and report performance goals and measures.
- Reports from facilities managers on construction/upgrade costs and schedules and on operational reliability.
- Data collected by Westat, Inc. and used by NSF staff in the assessment of NSF Strategic Outcome Goal III-1b.

Specific examples:

Highlights or sources of examples shown as results may be provided by Principal Investigators who received support from NSF.

We use external committees to assess the progress of our programs toward qualitative goal achievement. External evaluators provide us with reports of programs, and provide feedback to us on a report template we prepare. Examples are COV and Advisory Committee reports that provide an independent external assessment of NSF's performance.

We engaged an independent third-party, IBM Business Consulting Services, to conduct a review of data and information used in performance reporting. IBM Business Consulting Services reviewed NSF's performance data and information pertaining to our outcome goals, and management goals. This additional independent review helped to eliminate potential reporting bias that can develop in self-assessments. It also provides assurance of the credibility of performance reporting information and results.

CLASSIFIED APPENDICES NOT AVAILABLE TO THE PUBLIC

None to report.

ANALYSIS OF TAX EXPENDITURES

None to report.

WAIVERS OF ADMINISTRATIVE REQUIREMENTS

None to report.

APPENDIX

National Science Foundation

Government Performance and Results Act (GPRA) Performance Measurement Validation and Verification

Report on FY 2003 Results

October 2003

1 Executive Summary

The National Science Foundation (NSF), as a Federal agency, is subject to the performance reporting requirements of the Government Performance and Results Act (GPRA). Accordingly, NSF developed a series of performance goals to help the agency meet its mission, goals, and objectives. General Accounting Office (GAO) auditing standards require federal agencies to provide confidence that the policies and procedures that underlie GPRA performance reporting are complete, accurate and consistent. As such, the Foundation asked International Business Machines Corporation (IBM) Business Consulting Services to assess the validity of the data and reported results of its performance goals and verify the reliability of the methods used to compile and report data for these goals.[1] This is the fourth consecutive year that we have performed this assessment.

While we have traditionally conducted our assessment after the end of the fiscal year (FY), this year the Foundation asked us to conduct a comprehensive review of the first three quarters of GPRA results for FY 2003 with an update review at the end of the fiscal year once final results are reported. The purpose of this earlier third quarter assessment is to allow NSF to meet an accelerated GPRA reporting deadline, mandated by the Office of Management and Budget (OMB). Beginning in FY 2005, NSF and other federal agencies must submit their Performance and Accountability Reports (PAR) to OMB by November 15. NSF expects to submit its FY 2003 PAR by November 15, 2003, moving to the new deadline one year in advance of the statutory requirement. The earlier review also allows NSF to make any necessary adjustments to its processes or reports prior to the end of the fiscal year, based on our assessment.

We commend NSF for undertaking this fourth-year effort to confirm the reliability of its GPRA data and results and its processes to collect, process, maintain, and report data for its performance goals. From our FY 2003 review, we conclude that NSF has made a concerted effort to assure that it reports its performance results accurately and has effective systems, policies, and procedures to promote data quality. Overall, we verify that NSF relies on sound business practices, internal controls, and manual checks of system queries to report performance. NSF maintains adequate documentation of its processes and data to allow for an effective verification and validation review. Further, we validate the reliability of NSF's third and fourth quarter results through our successful recalculation or reconfirmation of these results based on processes, data and systems.

The scope of our independent verification and validation review includes an assessment of NSF's Management Goals and Strategic Outcome Goals as described in the NSF FY 2003 GPRA Revised Final Performance Plan.

1.1 Review of Management Goals

The FY 2003 Management Goals we reviewed fall under four categories:

- Six new goals being reviewed for the first time
- Ten goals, which we reviewed in prior years, receiving an update review in FY 2003

As part of our review of the processes and results for these Management goals, we:

- Assessed the accuracy of NSF's performance data and reported outcomes of performance goals and indicators

[1] GAO defines "verification" as a means to check or test performance data in order to reduce the risk of using data that contains significant errors. GAO defines "validation" as a way to test data to ensure that no error creates significant bias.

- Described the reliability of the processes NSF uses to collect, process, maintain, and report data
- Reviewed system controls to confirm that quality input results in quality output
- Created detailed process descriptions and process maps for those goals being reviewed for the first time
- Identified changes to processes and data for those goals receiving an update review

We applied GAO's *Guide to Assessing Agency Annual Performance Plans* (GAO/GGD-10.1.20) to guide our review. Based on GAO guidance, we assessed whether NSF's processes to collect, process, maintain and report data meet the following criteria:

- Does the process provide for periodic review of collection, maintenance, and processing procedures to ensure they are consistently applied and continue to be adequate?
- Does the process provide for periodic sampling and review of data to ensure completeness, accuracy, and consistency?
- Does the process rely on independent audits or other established procedures for verifying and validating financial information when performance measures require the use of financial information?
- Does NSF address problems in verification and validation procedures, known to GAO or the agency?
- Does the agency recognize the potential impacts of data limitations should they exist?

We did not consider the appropriateness of NSF's performance goals or indicators in our assessment of the validity of NSF's reported results. Rather, our validation is based strictly on whether NSF achieved or did not achieve its performance goals based on the indicators established by NSF in its FY 2003 Revised Final Performance Plan.

1.2 Review of Strategic Outcome Goals

In addition to its Management Goals, NSF measures its performance against annual performance goals associated with its three qualitative Strategic Outcome Goals: People, Ideas and Tools. A critical component of NSF's performance assessment in these areas is the Advisory Committee for GPRA Performance Assessment (AC/GPA), a group of external science experts who offer an independent opinion on whether NSF demonstrated significant achievement in a series of performance indicators associated with People, Ideas and Tools.

NSF asked us to verify the quality of the processes used to support the judgments of the AC/GPA and to validate the credibility of the AC/GPA's judgments based on the strength of these processes. Specifically, our methodology consisted of the following:

- Reviewed background information
- Observed the AC/GPA meeting, which took place at NSF on June 24-26, 2003
- Discussed the process with NSF staff and AC/GPA members
- Documented the AC/GPA process in narratives and process maps
- Verified the quality of the AC/GPA process to yield reliable results
- Assessed the validity of the AC/GPA performance assessment based on the quality of the processes
- Offered issues for consideration, as NSF seeks to improve the process in future years

To validate the reliability of the AC/GPA process, we developed a series of criteria, on which we assessed the quality of the processes. These criteria are:

- Expertise, independence and level of knowledge of the AC/GPA membership
- Quality, timeliness, impartiality, and relevance of the information available to the AC/GPA
- Independence of the committee's judgment from NSF influence
- Committee's determination of "significant achievement" with respect to the annual performance indicators
- Documentation and transparency of the AC/GPA process and results
- NSF's response to AC/GPA recommendations made as a result of the FY 2002 process

1.2.1 Review of Goal III-1B related to Math and Science Partnerships

NSF also asked us to review its processes to collect, process, maintain, and report data for Goal III-1B, which is an annual performance goal under the Strategic Outcome Goal of People. Goal III-1B is related to NSF's Math and Science Partnership Program (MSP). The AC/GPA determined that it could not reach an opinion of whether NSF had demonstrated significant achievement for Goal III-1B due to insufficient information. Consequently, NSF provided us with a comprehensive set of performance information and process documentation, from which we sought to verify the reliability of NSF's processes and performance information for NSF senior management to reach a valid and reasonable conclusion on achievement of the goal.

1.3 Results and Recommendations

Based on our third and fourth quarter review, we verified the reliability of the processes used to collect, process, maintain and report data for all 16 Management Goals. Overall, NSF relies on sound business processes, system and application controls, and manual checks of system queries to report performance. We believe that these processes are valid and verifiable. We also validated the accuracy of the results reported by NSF as of the third and fourth quarters.

We also verified and validated that the AC/GPA process to evaluate NSF's achievement against its Strategic Outcome Goals involves a robust collection of performance information, reviewed qualitatively by a highly qualified and diverse Committee of science experts, with sufficient documentation and transparency to assure accountability and confidence in the AC/GPA's assessments.

Finally, we verified the reliability of the processes NSF used to collect, process, maintain and report data for Goal III-1B related to Math and Science Partnerships (MSP) and validated that the Directorate of Education and Human Resources (EHR) reached a reasonable conclusion that NSF achieved Goal III-1B based on the quality of the performance information and analyses of the MSP program results to date.

We summarize the results of our review for each performance goal in the following tables. We indicate the third and fourth quarter results of each goal as reported by NSF in the "Q3 Result" and "Q4 Result" columns. In the "Process Verified" column, a check symbol (✓) indicates that we were able to verify the reliability of NSF's processes to collect, process, maintain and report data. In the "Result Validation" column, a check symbol indicates that we were able to validate the accuracy of NSF's reported results for the corresponding performance goal. Finally, where appropriate, we also summarize any recommendations or issues for consideration we determined through our review of each goal. The full results of our review are discussed in greater detail in the balance of this report.

New NSF FY 2003 Management Goals: Verification and Validation Summary

FY 2003 GPRA Management Goal	Q3 Result	Q4 Result	Process Verified	Result Validated	Recommendations/Issues for Consideration Summary
IV-8: For 90 percent of construction, acquisition and upgrade projects, keep any negative cost and schedule variances to less than 10 percent of the approved project plan.	No results	Not achieved 88%	✔	✔	• Place more stringent criteria on principal investigators (PIs) to estimate percent of project completed • Consider requiring Program Officers (POs) to maintain documentation to support PI estimates • Institute tighter guidelines for accepting/ rejecting PI submissions via Fastlane
IV-9: For 90 percent of operational facilities, keep scheduled operating time lost to less than 10 percent.	No results	Not achieved 87%	✔	✔	• Consider requiring POs to maintain documentation to support PI estimates • Institute tighter guidelines for accepting/ rejecting PI submissions via Fastlane
IV-10: NSF will continue to advance "e-business" by receiving through FastLane and processing electronically 90 percent of Principal Investigator award transfers.	99.78%	Achieved 99.78%	✔	✔	N/A
IV-11: NSF will continue to advance "e-business" by implementing Phase III of the Electronic Jacket application. *Performance Indicator:* Implementation of the electronic capability for assigning proposal processing tasks, forwarding proposals to other programs as necessary, and delegating proposal action authority.	In progress Phase III is in testing phase	Not achieved Phase III functionality complete. Implementation in progress in accordance with the Implementation Strategy Plan.	✔	✔	If goal is continued next fiscal year, revise goal language to replace “forwarding proposals” with “routing proposals” to be consistent with terms used in the e-jacket application
IV-12: NSF will maintain and enhance the agency-wide security program to ensure adequate protection of NSF’s IT infrastructure and critical assets. *Performance Indicators:* • 95% of major systems will have approved security plans on file. • 95% of major systems will have documented certification & accreditation.	In progress 18 of 19 systems with security plans; 9 of 19 systems certified/accredited	Achieved 18 of 19 systems with security plans and accredited and certified	✔	✔	Maintain all security plans and certification and accreditation packages in one centralized location
IV-13: NSF will ensure that diversity considerations are embedded in activities related to agency staffing of scientists and engineers (S&E). *Performance indicator:* Initiate development of a NSF S&E diversity plan.	Achieved Committee formed to draft diversity plan	Achieved	✔	✔	N/A

NSF Management Goals Receiving an Update Review in FY 2003: Verification and Validation Summary

FY 2003 GPRA Management Goal	Q3 Result	Q4 Result	Process Verified	Result Validated	Recommendations/Issues for Consideration Summary
IV-1: At least 85 percent of basic and applied research funds will be allocated to projects that undergo merit review.	87%	Achieved 89%	✔	✔	Capture and maintain EIS raw data used to calculate quarterly results.
IV-2: At least 70 percent of reviews with written comments will address aspects of both generic review criteria.	89%	Achieved 90%	✔	✔	• Supplement quantitative assessment of goal with qualitative review of a sample of merit review responses to assure both criteria are adequately addressed. • Capture and maintain EIS raw data used to calculate quarterly results.
IV-3: For at least 80 percent of decisions to fund or decline proposals, program officers will comment on aspects of both generic review criteria.	53%	Not achieved 53%	✔	✔	• Evaluate a smaller, more frequent sample of Form 7s to address problem areas throughout the year. • Standardize and automate Form 7 with possibly separate text boxes for PO responses.
IV-4: Ninety-five percent of program announcements will be publicly available at least three months prior to the proposal deadline or target date.	99%	Achieved 99%	✔	✔	Continue to review quarterly data to assure consistency and reliability of data processed by Clearance Officer.
IV-5: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of receipt.	82%	Achieved 77%	✔	✔	• Continue to pursue more automation of processes to calculate goal results. • Capture and maintain EIS raw data used to calculate quarterly results.
IV-6: NSF will increase the average annualized award size for research grants to a level of $125,000, compared to a goal of $113,000 in FY 2002.	$108,715	Achieved $135,609	✔	✔	Capture and maintain EIS raw data used to calculate quarterly results.
IV-7: NSF will maintain the FY 2002 goal of 3.0 years for the average duration of awards for research grants.	2.9	Not achieved 2.9	✔	✔	Capture and maintain EIS raw data used to calculate quarterly results.

FY 2003 GPRA Management Goal	Q3 Result	Q4 Result	Process Verified	Result Validated	Recommendations/Issues for Consideration Summary
IV-14: NSF will show an increase over FY 2000 in the total number of appointments to NSF science and engineering staff and management from underrepresented groups.	26 females 13 minorities	Not achieved 48 females 25 minorities	✔	✔	• Establish formal procedures to verify accuracy of data entered into IPERS. • Automate process to compile demographic information from directorates.
IV-15: NSF will align or develop competency-based curricula, through the NSF Academy, that provide cross-functional, work-based team learning opportunities. *Performance Indicator:* Initiate development of new courses or revision of existing courses to address program management, leadership development, and technology and business process training.	Achieved 15 new courses 21 revised courses	Achieved 24 new courses 26 revised courses.	✔	✔	▪ Revise the performance indicator to be more quantifiable and to set a minimum number of new or revised courses necessary to achieve the goal. ▪ Update NSF Academy online course catalog more frequently than annually
IV-16: NSF will develop competency-based, occupation classification alternatives that support the agency's strategic business processes and capitalize on its technology enabled business systems. *Performance Indicators:* • Identification of workforce competencies for all current NSF job families. • Initiate identification of competency-based, classification alternatives.	In progress Competencies completed for 10 most critical job families Research initiated for classification alternatives	Achieved Competencies completed for all 32 job families Research initiated for classification alternatives	✔	✔	N/A

NSF FY 2003 Strategic Outcome Goal Performance Indicators: Verification and Validation Summary

FY 2003 Strategic Outcome/Performance Goal	AC/GPA Assessment[2]	Process Verified	Result Validated	Issues for Consideration Summary
People: Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."				The following issues for consideration pertain to all three strategic outcome goals and are based on recommendations offered by the AC/GPA and our observations and assessment of the AC/GPA process: • Consider preparing an NSF-self assessment to be validated by the AC/GPA to maximize the limited time of the Committee members. This issue should be considered in light of the resources available and necessary to perform the self-assessment. • Directorates should provide more direction to programs to develop nuggets to assure that major and cross-directorate programs are adequately represented. • Consider providing AC/GPA with summary table of total award dollars represented by nuggets for each directorate and/or strategic outcome goal • Eliminate "Areas of Emphasis" from process, as the AC/GPA saw no compelling reason to single out
III-1a: NSF's performance for the People Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Development of well-prepared researchers, educators or students whose participation in NSF activities provides experiences that enable them to explore frontiers or challenges of the future; • Contributions to development of a diverse workforce through participation of underrepresented groups[3] in NSF activities; • Development or implementation of other notable approaches or new paradigms that promote progress toward the PEOPLE outcome goal.	Achieved	✔	✔	
III-1b: NSF will significantly enhance the quality of K-12 mathematics and science education available to all students in Math and Science Partnership schools. *Performance Indicators:* • Evidence in the award portfolio of the infrastructure to support high quality programs addressing issues related to teacher workforce capacity, including preservice education and inservice professional development of math and science teachers as well as alternative routes into the profession (e.g., scientists and engineers becoming teachers.) • Evidence within Partnership school systems of the infrastructure needed to improve math and science education and to measure improvement, i.e., the adoption of appropriate assessments of student achievement, as well as the initiation of the collection of achievement data that can be disaggregated by ethnicity, socioeconomic status, gender, etc.	Not enough information *(IBM reviewed the processes/data for this goal and validated the reasonableness of NSF' conclusion of achievement of this goal. See Section 9)*	✔	✔	

[2] The results for the annual performance goals associated with the Strategic Outcome Goals reflect the Advisory Committee for GPRA Performance Assessment (AC/GPA) assessment of the performance indicators for each performance goal. It should be noted that he AC/GPA is just one of several mechanisms NSF uses to assess performance in People, Ideas and Tools.

FY 2003 Strategic Outcome/Performance Goal	AC/GPA Assessment[2]	Process Verified	Result Validated	Issues for Consideration Summary
Ideas: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society"				individual programs for consideration. • Assure that subcommittee chairs are appointed and briefed well in advance of the AC/GPA meeting. • Reassess the value of the prospective portfolio in the AC/GPA process, as the AC/GPA will not have access to a full year's worth of grants and the prospective assessment is used for internal purposes only (not for GPRA reporting). • Consider lengthening the duration of the AC/GPA meeting depending on NSF resources and the time restraints of Committee members.
III-2: NSF's performance for the Ideas Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators: • Discoveries that expand the frontiers of science, engineering, or technology; • Connections between discoveries and their use in service to society; • Partnerships that enable the flow of ideas among the academic, public or private sectors; • Leadership in fostering newly developing or emerging areas.	Achieved	✔	✔	
Tools: Providing "broadly accessible, state-of-the-art and shared research and education tools."				
III-3: NSF's performance for the Tools Strategic Outcome is successful when, in the aggregate, results reported in the period demonstrate significant achievement in the majority of the following indicators • Development or provision of tools that enables discoveries or enhances productivity of NSF research or education communities; • Partnerships with local, state or federal agencies, national laboratories, industry or other nations to support and enable development of large facilities or other infrastructure; • Development or implementation of other notable approaches or new paradigms that promote progress toward the TOOLS outcome goal.	Achieved	✔	✔	

[3] For example, women, underrepresented minorities, or persons with disabilities

Nugget Sampling

As in FY 2002, members raised the issue of whether the "nuggets" provided by the Directorates were sufficiently representative of the entire NSF portfolio. The Directorates selected the programs, on which to write nuggets, based on judgmental sampling as opposed to random sampling. The committee discussed the relative value of each.

To assess the relative significance of the nuggets and their distribution across the NSF portfolio of grants, we applied GAO auditing standards related to materiality, relevance and significance.[4] We worked with NSF staff to obtain the total award dollar amounts represented by both the retrospective and prospective nuggets available to the Committee. We also examined the distribution of nuggets by directorate, as reported in the AC/GPA website. The results of our assessment are as follows:

- **Materiality.** From our review, we conclude that the nuggets materially represent a sufficient share of overall NSF resources, committed to funding research, for the AC/GPA to rely upon to make its assessments. We calculated that the nuggets represent awards totaling over **$3.4 billion** in funding, including multi-year commitments from continuing grants. Comparing this figure to NSF's estimated grant awards and future-year commitments toward research in FY 2003, we conservatively estimate that the nugget dollar amounts are equivalent to at least one-third of the awards and commitments made to support People, Ideas and Tools in FY 2003.
- **Relevance.** We also reviewed the relative distribution of the 875 total nuggets by directorate, as reported in the AC/GPA website, and compared it to the estimated FY 2003 funding for each directorate. From this review, we conclude that the judgmentally selected nuggets roughly represent an equivalent level of NSF resources devoted to each directorate. This provides some assurance that relevant elements of NSF's program awards portfolio are being reflected in the nuggets provided to the AC/GPA.
- **Significance.** On the issue of judgmental verses random sampling of nuggets, we believe that the use of judgmental sampling is appropriate for the purposes of the AC/GPA. Judgmental sampling assures that those programs that NSF professional staff judge as scientifically significant are included in the nuggets for use by the Committee. Because of the importance of applying professional judgment in the selection process, the traditional audit approach of random sampling would not meet the standard of "significance" in this instance. It is also important to reiterate that the charge of the AC/GPA is to provide a subjective, qualitative opinion on NSF's outcomes based on a wide range of performance information that extends beyond the nuggets, thus reinforcing the appropriateness of the judgmental sampling approach.

We also note that prior to the AC/GPA meeting and in response to a FY 2002 AC/GPA recommendation, NSF discussed the issue of nugget sampling with senior management and staff with expertise in statistics. Ultimately, NSF determined that judgmental sampling was appropriate given the nature of the AC/GPA's qualitative review. During the AC/GPA meeting, a number of committee members expressed satisfaction with the nugget sampling technique, especially given the availability of other types of performance information. Some committee members noted that their subcommittees went far beyond the nuggets in making their judgments. We concur with this assessment.

[4] While we applied GAO auditing standards, this review does not qualify as an audit.

III. FINANCIALS

A MESSAGE FROM THE CHIEF FINANCIAL OFFICER

I am delighted to join NSF Director Dr. Rita Colwell in presenting the National Science Foundation's *FY 2003 Performance and Accountability Report.* This report provides a combined reporting of the Foundation's programmatic performance, financial and management information for the past year.

I am pleased to report that the agency received an unqualified audit opinion for the sixth consecutive year. However, the Independent Auditor's Report included one reportable condition related to post-award monitoring. This reportable condition focuses on the need to ensure that adequate resources are devoted to achieving our post-award monitoring program goals. In the coming year, we will be working to realign staff and dedicate additional resources to further strengthen our post-award monitoring program. To an extent our ability to carry out this activity is reliant upon the outcome of the agency's annual Salaries and Expenses appropriations.

Over the past year, significant effort was devoted to enhancing NSF's information security program. In addition, NSF made significant efforts to enhance the monitoring of NSF-owned property in the custody of awardees, as part of more rigorous post-award monitoring. Both are no longer reportable conditions in the FY 2003 Audit Report.

With respect to overall management, doing business more efficiently and effectively is a long-standing priority for the Foundation. NSF's commitment to leading edge technology and management information systems is an important element in the infrastructure that supports our continued achievements. Whether it is making transactions with our stakeholders more user friendly, increasing the efficiency of our internal operations, or providing real time financial and management information and reporting for decision making purposes, our systems provide the framework for our success.

- Today, NSF is the only federal agency to process all its full and complete proposals electronically.
- Despite a 14 percent increase in the number of proposal received this year, nearly 80 percent of award decisions – over 40,000 FY 2003 – were made within six months of receipt.
- Nearly 90 percent of the Foundation's funds support projects reviewed by external peers and selected through a merit-based competition.
- The re-engineered business practices implemented in recent years continue to yield cost efficiencies for the agency in FY 2003.

Accountability reporting also remains a high priority for the agency. For the second consecutive year, our Highlights report on performance and management was rated as among the top 10 in a national competition of 900 annual reports, many from Fortune 500 companies. In addition, we are proud to have again received two "green" ratings from the Office of Management and Budget, for successful achievement in the financial management and electronic government initiatives of

the President's Management Agenda (PMA). We continue to make progress in all the PMA initiatives, and indeed, advanced from a "red" to "yellow" status for the Budget Performance and Integration Initiative in FY 2003.

NSF continues to face the future in a position of operational strength thanks to our sound financial management, our commitment to continuous improvement in business practices and, most importantly, the extraordinary talent and commitment of our staff. More than reacting to change, we are committed to leading change and setting new standards of excellence for the federal financial community. We look forward to achieving many more milestones in the years ahead.

Thomas N. Cooley

November 7, 2003

National Science Foundation

Financial Statements
as of and for the years ended
September 30, 2003 and 2002

National Science Foundation
Balance Sheet
As of September 30, 2003 and 2002
(Amounts in Thousands)

	2003	2002
ASSETS		
Intragovernmental		
Fund Balance With Treasury (Note 2)	$ 7,083,797	$ 6,419,700
Accounts Receivable (Note 3)	18,247	185
Advances (Note 4)	18,557	8,309
Total Intragovernmental Assets	7,120,601	6,428,194
Cash	6,729	7,766
Accounts Receivable, Net (Note 3)	202	571
Advances (Note 4)	66,610	52,479
General Property, Plant and Equipment, Net (Note 5)	230,777	224,141
Total Assets	$ 7,424,919	$ 6,713,151
LIABILITIES		
Intragovernmental Liabilities		
Advances From Others	$ 41,933	$ 100,531
Other Intragovernmental Liabilities (Note 7)	396	321
FECA Employee Benefits (Notes 8 and 9)	264	254
Total Intragovernmental Liabilities	42,593	101,106
Accounts Payable	68,420	38,370
Other Liabilities (Note 7)	255,923	214,266
FECA Employee Benefits (Notes 8 and 9)	1,649	1,637
Lease Liabilities	-	60
Accrued Annual Leave (Note 8)	11,120	10,567
Total Liabilities	379,705	366,006
NET POSITION		
Unexpended Appropriations	6,771,590	6,089,118
Cumulative Results of Operations	273,624	258,027
Total Net Position	7,045,214	6,347,145
Total Liabilities and Net Position	$ 7,424,919	$ 6,713,151

The accompanying notes are an integral part of these statements.

National Science Foundation
Statements of Net Cost
For the Years Ended September 30, 2003 and 2002
(Amounts in Thousands)

Program Costs	**2003**	**2002**
People		
Intragovernmental		
Program Cost	$ 2,363	$ 1,714
Salary & Expense, National Science Board (NSB) and Inspector General Cost	699	678
Total Intragovernmental Cost	3,062	2,392
With the Public		
Program Cost	865,126	766,020
Salary & Expense, NSB and Inspector General Cost	30,975	28,732
Total Public Cost	896,101	794,752
Total People Program Cost	899,163	797,144
Less: Intragovernmental Earned Revenues	22,880	17,903
Net People Program Cost	876,283	779,241
Ideas		
Intragovernmental		
Program Cost	3,188	13,293
Salary & Expense, NSB and Inspector General Cost	3,414	5,305
Total Intragovernmental Cost	6,602	18,598
With the Public		
Program Cost	2,464,532	2,166,046
Salary & Expense, NSB and Inspector General Cost	84,806	79,095
Total Public Cost	2,549,338	2,245,141
Total Ideas Program Cost	2,555,940	2,263,739
Less: Intragovernmental Earned Revenues	42,003	60,979
Net Ideas Program Cost	2,513,937	2,202,760
Tools		
Intragovernmental		
Program Cost	113,396	63,131
Salary & Expense, NSB and Inspector General Cost	34,295	30,860
Total Intragovernmental Cost	147,691	93,991
With the Public		
Program Cost	1,156,195	1,043,378
Salary & Expense, NSB and Inspector General Cost	42,174	39,216
Total Public Cost	1,198,369	1,082,594
Total Tools Program Cost	1,346,060	1,176,585
Less: Intragovernmental Earned Revenues	28,509	26,320
Net Tools Program Cost	1,317,551	1,150,265
Net Cost of Operations (Note 10)	$ 4,707,771	$ 4,132,266

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Changes in Net Position
For the Year Ended September 30, 2003
(Amounts in Thousands)

	Cumulative Results of Operations	Unexpended Appropriations
Beginning Balances	$ 258,027	$ 6,089,118
Budgetary Financing Sources		
Appropriations Received (Net of Offsetting Receipts)	-	5,410,035
Appropriations Transferred In/(Out)	-	13,143
Other Adjustments	-	(67,254)
Appropriations Used	4,673,452	(4,673,452)
Nonexchange Revenue	49	-
Donations and Forfeitures of Cash	42,113	-
Other Financing Sources		
Transfers-in/out Without Reimbursement	54	-
Imputed Financing from Costs Absorbed by Others	7,700	-
Total Financing Sources	4,723,368	682,472
Net Cost of Operations (Note 10)	4,707,771	-
Ending Balances	$ 273,624	$ 6,771,590

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Changes in Net Position
For the Year Ended September 30, 2002
(Amounts in Thousands)

	Cumulative Results of Operations	Unexpended Appropriations
Beginning Balances	$ 243,312	$ 5,343,547
Budgetary Financing Sources		
Appropriations Received (Net of Offsetting Receipts)	-	4,869,579
Appropriations Transferred In/(Out)	-	14,000
Other Adjustments	-	(30,086)
Appropriations Used	4,107,922	(4,107,922)
Nonexchange Revenue	87	-
Donations and Forfeitures of Cash	32,606	-
Other Financing Sources		
Imputed Financing from Costs Absorbed by Others	6,366	-
Total Financing Sources	4,146,981	745,571
Net Cost of Operations (Note 10)	4,132,266	-
Ending Balances	$ 258,027	$ 6,089,118

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Budgetary Resources
For the Year Ended September 30, 2003 and 2002
(Amounts in Thousands)

	2003	2002
Budgetary Resources		
Budgetary Authority: (Note 11)		
Appropriations Received	$ 5,452,197	$ 4,902,272
Net Transfers	13,143	14,000
Unobligated Balance – Beginning of Period	304,817	239,272
Spending Authority from Offsetting Collections:		
Earned:		
Collected	$ 75,568	$ 111,198
Receivable from Federal Sources	18,062	(5,403)
Change in Unfilled Customer Orders:		
Advance Received	(58,598)	(14,594)
Without Advance from Federal Sources	73,755	(5,309)
Subtotal	108,787	85,892
Recoveries of Prior Year Obligations	65,399	47,092
Permanently Not Available	(67,271)	(30,076)
Total Budgetary Resources	$ 5,877,072	$ 5,258,452
Status of Budgetary Resources		
Obligations Incurred:		
Direct	$ 5,469,724	$ 4,868,335
Reimbursable	108,920	85,300
Subtotal	$ 5,578,644	$ 4,953,635
Unobligated Balance:		
Apportioned	202,221	213,344
Unobligated Balance Not Available	96,207	91,473
Total Status of Budgetary Resources	$ 5,877,072	$ 5,258,452
Relationship of Obligations to Outlays		
Net Obligated Balance – Beginning of Period	$ 6,114,623	$ 5,480,812
Net Obligated Balance – End of Period		
Accounts Receivable	(18,247)	(185)
Unfilled Customer Orders from Federal Sources	(76,261)	(2,505)
Undelivered Orders	6,561,867	5,872,382
Accounts Payable	317,088	244,931
Total Net Obligated Balance – End of Period	$ 6,784,447	$ 6,114,623
Outlays:		
Disbursements	$ 4,751,604	$ 4,283,444
Collections	(16,970)	(96,604)
Subtotal	4,734,634	4,186,840
Less: Offsetting Receipts	42,162	32,693
Net Outlays	$ 4,692,472	$ 4,154,147

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Financing
For the Year Ended September 30, 2003 and 2002
(Amounts in Thousands)

Resources Used to Finance Activities	2003	2002
Budgetary Resources Obligated		
Obligations Incurred	$ 5,578,644	$ 4,953,635
Less: Spending Authority for Offsetting Collections and Recoveries	174,186	132,984
Obligations Net of Offsetting Collections and Recoveries	5,404,458	4,820,651
Less: Offsetting Receipts	42,162	32,693
Net Obligations	5,362,296	4,787,958
Other Resources		
Transfers-in	54	
Imputed Financing from Costs Absorbed by Others	7,700	6,366
Net Other Resources Used to Finance Activities	7,754	6,366
Total Resources Used to Finance Activities	5,370,050	4,794,324
Resources Used to Finance Items not Part of the Net Cost of Operations		
Change in Budgetary Resources Obligated for Goods, Services and Benefits Ordered but not yet Provided	(698,707)	(674,451)
Resources that Fund Expenses Recognized in Prior Periods	369	93
Budgetary Offsetting Collections and Receipts that do not affect Net Cost of Operations	42,162	32,693
Resources that Finance the Acquisition of Assets	(24,029)	(35,694)
Total Resources Used to Finance Items not Part of the Net Cost of Operations	(680,205)	(677,359)
Total Resources Used to Finance Net Cost of Operations	4,689,845	4,116,965
Components of the Net Cost of Operations that will not Require or Generate Resources in the Current Period		
Components Requiring or Generating Resources in Future Periods		
Other	516	516
Total Components of Net Cost of Operations that will Require or Generate Resources in Future Periods (Note 13)	516	516
Components not Requiring or Generating Resources		
Depreciation and Amortization	17,314	14,737
Revaluation of Assets or Liabilities	17	(9)
Other	79	57
Total Components of Net Cost of Operations that will not Require or Generate Resources	17,410	14,785
Total Components of Net Cost of Operations that will not Require or Generate Resources in the Current Period	17,926	15,301
Net Cost of Operations (Note 10)	$ 4,707,771	$ 4,132,266

The accompanying notes are an integral part of these statements.

Note 1. Summary of Significant Accounting Policies

A. Reporting Entity

The National Science Foundation (NSF or Foundation) is an independent federal agency created by the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75). Its aim is to promote and advance scientific progress in the United States. NSF initiates and supports basic scientific research and research fundamental to the engineering process and programs to strengthen scientific and engineering research potential. NSF also supports science and engineering education programs at all levels in all fields of science and engineering. NSF funds research and education in science and engineering by awarding grants and contracts to educational and research institutions in all parts of the United States. NSF, by law, cannot operate research facilities. By award, NSF enters into relationships to fund the research operations conducted by grantees.

NSF is led by a Presidentially-appointed director and the policy-making National Science Board (NSB). The NSB, composed of 24 members, represents a cross section of American leaders in science and engineering research and education. Members are appointed by the President for six-year terms. The NSF Director is a member *ex officio* of the Board.

NSF is authorized to accept (and use) U.S. and foreign funds into the NSF Donation Account per the General Authority of the Foundation as found in 42 U.S.C. 1862 Section 3 (a)(3), to foster the interchange of scientific and engineering information among scientists and engineers in the United States and foreign countries, and also in 42 U.S.C. 1870 Section 11 (f) which allows NSF to receive and use funds donated by others. Donations are received from foreign governments, private companies, academic institutions, non-profit foundations and individuals. Donated funds are either earmarked for a specific NSF program or unrestricted, and can be used on one or more of the general purposes of the Foundation. NSF maintains three interest bearing accounts; interest earned on the bank deposits are used for the same purpose as the principal donations. When needed for program support, donations are transferred into the trust fund account at the U.S. Treasury. Funds are made available for obligations as necessary to support NSF programs.

B. Basis of Presentation

These financial statements have been prepared to report the financial position and results of operations of NSF as required by the Chief Financial Officers Act of 1990; the Government Management Reform Act of 1994; the Reports Consolidation Act of 2000; and the Office of Management and Budget Bulletin No. 01-09, *Form and Content of Agency Financial Statements*. They have been prepared from the books and records of NSF in accordance with generally accepted accounting principles in the United States of America. These statements are therefore different from the financial reports, also prepared by NSF pursuant to OMB directives, that are used to monitor and control NSF's use of budgetary resources.

The *FY 2005 Budget of the United States* (also known as the President's Budget) will include actual numbers for FY 2003; the FY 2005 Budget was not published at the time these financial statements were issued. The President's Budget is expected to be published in February 2004 and will be available from the United States Government Printing Office. There are no differences in

the actual amounts for FY 2002 that have been reported in the FY 2004 Budget of the United States and the actual numbers that appear in the FY 2002 Statement of Budgetary Resources.

C. Basis of Accounting

The accompanying financial statements have been prepared using the accrual method of accounting in addition to recognizing certain budgetary transactions. Under the accrual method, revenues are recognized when earned and expenses are recognized when a liability is incurred, without regard to receipt or payment of cash. Budgetary accounting facilitates compliance with legal constraints and controls that guide the use of federal funds. NSF records grant expenses from expenditure reports submitted by the grantees.

D. Revenues and Other Financing Sources

NSF receives the majority of its funding through appropriations contained in the Departments of Veterans Affairs, Housing and Urban Development, and Independent Agencies Appropriations Act. NSF receives both annual and multi-year appropriations that may be expended, within statutory limits. Additional amounts are obtained through reimbursements for services provided to other federal agencies; allocation transfers from other federal agencies; and donations to the trust fund account. Also, NSF receives interest earned on overdue receivables and excess cash advances to grantees. The interest earned on overdue receivables is returned to the Treasury. Interest earned on excess cash advances to grantees is sent directly to the Department of Health and Human Services in accordance with OMB Circular A-110, *Uniform Administrative Requirements for Grants and Agreements with Institutions of Higher Education, Hospitals and Other Non Profit Organizations.*

Appropriations are recognized as a financing source at the time the related "funded" program or administrative expenses are incurred. Appropriations are also recognized when used to purchase property, plant and equipment. "Unfunded" liabilities result from liabilities not covered by budgetary resources and will be paid when future appropriations are made available for these purposes. Donations are recognized as revenues when funds are received. Revenues from reimbursable agreements are recognized when the services are provided and the related expenditures are incurred. Reimbursable agreements are mainly for grant administrative services provided by NSF on behalf of other federal agencies.

In FY 2002, separate funding was authorized for the National Science Board, in the National Science Foundation Authorization Act of 2002, P.L. 107-368 and was initially provided in the FY 2003 appropriation, P.L 108-7. The Board, established with the National Science Foundation in 1950, establishes policies and approves programs and budgets for the NSF. The Board is also called upon to provide advice to the President and the Congress on matters of science and engineering policy.

E. Fund Balance with Treasury and Cash

Cash receipts and disbursements are processed by the Treasury. The Fund Balance with Treasury is composed primarily of appropriated funds that are available to pay current liabilities and finance authorized purchase commitments, but also includes non-appropriated funding sources

from donations and other revenue received from an NSF cooperative agreement to register Internet domain names.

NSF has also established commercial bank accounts to hold some donated funds in trust, in interest bearing accounts as permitted by the contributors. These funds are collateralized by the bank through the U.S. Treasury.

F. Accounts Receivable, Net

Accounts Receivable consists of amounts due from governmental agencies, private organizations and individuals. NSF establishes an allowance for accounts receivable from private sources that are deemed uncollectible but regards amounts due from other federal agencies as fully collectible. Due to the small number and dollar amount of the private receivables, NSF analyzes each account independently to assess collectability and the need for an offsetting allowance or write-off.

G. Advances

Advances consist of advances to grantees, contractors, and employees. Advance payments are made to grant recipients so that recipients may incur expenses related to the approved grant. Payments are only made within the amount of the recorded grant obligation and are intended to cover immediate cash needs. Total grant expenditures for the year include an estimate of fourth quarter amounts due and payable to grantees. The estimate is compiled using historical grantee expenditure data. For those grantees with advance payments exceeding expenditures, the aggregate difference is reported as an advance. Additionally, for those grantees with expenditures exceeding advance payments, the aggregate difference is reported as a grant liability. Advances to contractors are payments made in advance of incurring expenses. Advances to employees are related to travel. Advances are reduced when documentation supporting the expenditures is received.

H. General Property, Plant and Equipment (PP&E)

PP&E

NSF capitalizes acquisitions with costs exceeding $25,000 and useful lives of two or more years. Acquisitions not meeting these criteria are recorded as operating expenses. NSF currently reports capitalized PP&E at original acquisition cost; assets acquired from General Services Administration's (GSA) excess property schedules are recorded at the value assigned by the donating agency; assets transferred in from other agencies are at the cost recorded by the transferring entity for the asset net of accumulated depreciation or amortization. Depreciation expense is calculated using the straight-line method. The economic life classifications for capitalized assets are as follows:

Equipment

5 years	-	computers and peripheral equipment, fuel storage tanks, laboratory equipment, and vehicles
7 years	-	communications equipment, office furniture and equipment,

pumps and compressors
10 years - generators, Department of Defense equipment

Aircraft and Satellites

7 years - aircraft, aircraft conversions, and satellites

Buildings and Structures

31.5 years - buildings and structures placed in service prior to 1993
39 years - buildings and structures placed in service after 1993

Internal Use Software

5 years - internal use software

Leasehold Improvements

The economic life of Leasehold Improvements is amortized over the number of years remaining on the lease for the NSF headquarters building. In FY 2003, Leasehold Improvements completed during FY 2003 will be amortized over 10 years, which represents the remaining years on NSF's lease with GSA.

The PP&E balance consists of Equipment, Aircraft and Satellites, Buildings and Structures, Leasehold Improvements, and Construction in Progress. Costs are accumulated in construction in progress until such time as the project is completed and at that time capitalized and depreciated over the respective useful life of the assets. These balances are comprised of PP&E maintained "in-house" by NSF to support agency operations and PP&E under the U.S. Antarctic Program (USAP). The majority of USAP property is currently the custodial responsibility of Raytheon Technical Services Company, the NSF contractor for the program. Additionally, the U.S. Navy's Space and Naval Warfare Center and the Air National Guard 109th also have custodial responsibility for some USAP property.

Office Space

The NSF headquarters building is leased through the GSA. NSF is billed by GSA for the leased space as rent based upon estimated lease payments made by GSA plus an administrative fee. The cost of the headquarters building is not capitalized by NSF. The cost of leasehold improvements performed by GSA is financed with NSF appropriated funds. The leasehold improvements are capitalized by NSF as they are transferred from CIP upon completion, if the leasehold improvements meet NSF's capitalization threshold. Amortization is calculated using the straight-line method over the lesser of their useful lives or the unexpired lease term.

Internal Use Software

NSF controls, values and reports purchased or developed software as tangible property assets, in accordance with the Statement of Federal Financial Accounting Standards (SFFAS) No. 10, "Accounting for Internal Use Software." NSF identifies software investments as accountable

property for items that in the aggregate cost $500,000 or more to purchase, develop, enhance or modify a new or existing NSF system. Software projects that are not completed at year end and are expected to exceed the capitalization threshold are recorded as software in development. All internal use software meeting the capitalization threshold is amortized over a five-year period using the straight-line method.

Assets Owned by NSF in the Custody of Other Entities

NSF awards grants, cooperative agreements and contracts to various organizations, including colleges and universities; non-profit organizations; state and local governments; Federally Funded Research and Development Centers; and private entities. The funds provided may be used in certain cases to purchase or construct Property, Plant, and Equipment to be used for operations or research on the projects or programs supported by NSF. In these instances, NSF funds the acquisition of property but transfers control to these entities. NSF's authorizing legislation specifically prohibits the Foundation from operating such property directly. In practice, NSF's ownership interest in such PP&E is similar to a reversionary interest. To address the accounting and reporting of these assets, specific guidance was sought by NSF and provided by the Federal Accounting Standards Advisory Board (FASAB). This guidance stipulated that NSF should: (i) Disclose the value of such PP&E held by others in its financial statements based on information contained in the audited financial statements of these entities (if available). Where separate audited amounts are not available for a specific entity, NSF should name the entity and note that these amounts are unavailable; and (ii) report information on costs incurred to acquire the research facilities, equipment, and platforms in the Research and Human Capital Activity costs as required by the Statement of Federal Financial Accounting Standards No. 8, *Supplementary Stewardship Reporting*.

I. Advances from Others

Advances from Others consist of prior year amounts obligated and advanced by other federal entities to NSF for grant administration and other services furnished under reimbursable agreements. Balances at the end of the year are adjusted by an allocated amount from the fourth quarter grantee expenditure estimate described under Note 1G, Advances. The amount to be allocated is based on a percentage of the reimbursable grant expenditures, by partner agencies to NSF, to the total grant expenditures. In FY 2003, NSF implemented OMB Memorandum M-03-01, *Business Rules for Intra-Governmental Transactions,* which establishes a set of guidelines that agencies must use in order to standardize the processing and recording of intra-governmental activity among federal entities. These new guidelines required NSF to transition from accepting advances from other agencies to billing on a reimbursable basis.

J. Accounts Payable

Accounts Payable consists of liabilities to commercial vendors, contractors, and disbursements in transit. Accounts payable to commercial vendors are expenses for goods and services received but not yet paid by NSF at the end of the fiscal year. At year end, NSF accrues for the amount of estimated unpaid expenses to commercial vendors. Contract liabilities are estimated expenses over and above the amount of advances given to contractors. At year end, NSF accrues the

amount of estimated expenses not covered by advances given to contractors. Intra-governmental accounts payable consists of disbursements in transit recorded by NSF but not paid by Treasury.

K. Other Liabilities

Other liabilities consist of grant accruals, accrued payroll, benefits, and income taxes withheld. Grant liabilities are estimated grantee expenses over and above the amount of advances given to grantees. At year end, NSF accrues for the amount of estimated grantee expenses not covered by advances given to grantees. Accrued payroll, benefits and income taxes withheld relate to services rendered by NSF employees but not yet paid. At year end, NSF accrues the actual amount of wages and benefits earned but not yet paid and income tax withholdings.

L. Annual, Sick, and Other Leave

Annual leave is accrued as it is earned and the accrual is reduced as leave is taken. Each year, the balance in the accrued annual leave account is adjusted to reflect changes. To the extent current and prior-year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future Salaries and Expenses appropriations. Sick leave and other types of non-vested leave are expensed as taken.

M. Employee Benefits

A liability is recorded for estimated and actual future payments to be made for workers' compensation pursuant to the Federal Employees' Compensation Act (FECA). The liability consists of the net present value of estimated future payments calculated by the U.S. Department of Labor (DOL) and the actual unreimbursed cost paid by DOL for compensation paid to recipients under FECA. The actual costs incurred are reflected as a liability because NSF will reimburse DOL two years after the actual payment of expenses. Future NSF Salaries and Expenses Appropriations will be used for DOL's estimated reimbursement.

N. Net Position

Net position is the residual difference between assets and liabilities and is composed of unexpended appropriations and cumulative results of operations. Unexpended appropriations represent the amount of unobligated and unexpended budget authority. Unobligated balances are the amount of appropriations or other authority remaining after deducting the cumulative obligations from the amount available for obligation. Cumulative results of operations are the net result of NSF’s operations since inception.

O. Retirement Plan

In FY 2003, approximately 31 percent of NSF employees participated in the Civil Service Retirement System (CSRS), to which NSF made matching contributions equal to 7 percent of pay. The majority of NSF employees are covered by the Federal Employees Retirement System (FERS) and Social Security. A primary feature of FERS is that it offers a thrift savings plan to which NSF automatically contributes one percent of pay and matches employee contributions up to an additional four percent of pay. NSF also contributes the employer's matching share for Social Security for FERS participants.

Although NSF funds a portion of the benefits under FERS and CSRS relating to its employees and withholds the necessary payroll deductions, the agency has no liability for future payments to employees under these plans, nor does NSF report CSRS, FERS, or Social Security assets, or accumulated plan benefits on its financial statements. Reporting such amounts is the responsibility of the Office of Personnel Management (OPM) and The Federal Retirement Thrift Investment Board. In FY 2003, NSF's contributions to CSRS and FERS were $2,448,930, and $7,108,098, respectively. In FY 2002, NSF's contributions to CSRS and FERS were $2,994,127 and $6,282,728, respectively.

SFFAS No. 5, *Accounting for Liabilities of the Federal Government*, requires employing agencies to recognize the cost of pensions and other retirement benefits during their employees' active years of service. OPM actuaries determine pension cost factors by calculating the value of pension benefits expected to be paid in the future, and communicate these factors to the agency for current period expense reporting. Information was also provided by OPM regarding the full cost of health and life insurance benefits. In FY 2003, NSF, utilizing OPM-provided cost factors, recognized $3,835,518 of pension expenses, $3,845,086 of post-retirement health benefits expenses, and $19,540 of post-retirement life insurance expenses beyond amounts actually paid. NSF recognized offsetting revenue of $7,700,144 as an imputed financing source to the extent that these intragovernmental expenses will be paid by OPM.

In FY 2002, NSF, utilizing cost factors dated September 11, 2002, recognized $2,845,333 of pension expenses; $3,502,521 of post-retirement health benefits expenses; and $18,444 of post-retirement life insurance expenses beyond amounts actually paid. NSF recognized offsetting revenue of $6,366,298 as an imputed financing source to the extent that these intragovernmental expenses will be paid by OPM.

P. Commitments, Contingencies, and Possible Future Costs

Commitments

Commitments are contractual agreements involving financial obligations. NSF is committed for goods and services that have been ordered but have not yet been delivered.

Contingencies - Claims and Lawsuits

NSF is a party to various legal actions and claims brought against it. In the opinion of NSF management and legal counsel, the ultimate resolution of the actions and claims will not materially affect the financial position or operations of the Foundation. NSF recognizes the contingency in the financial statements when claims are expected to result in a material loss, whether from NSF's appropriations or the "Judgment Fund" administered by the Department of Justice under Section 1304 of Title 31 of the United States Code and the payment amounts can be reasonably estimated.

Claims and lawsuits have also been made and filed against awardees of the Foundation by third parties. NSF is not a party to these actions and NSF believes there is no possibility that NSF will be legally required to satisfy such claims. Judgments or settlements of the claims against awardees that impose financial obligation on them may be claimed as costs under the applicable contract, grant, or cooperative agreement and thus may affect the allocation of program funds in

future fiscal years. In the event that the likelihood of loss on such claims by awardees becomes probable, these amounts can be reasonably estimated and NSF management determines that it will probably pay them, NSF will recognize these potential payments as expenses.

Contingencies – Unasserted Claims

For claims and lawsuits that have not been made and filed against the Foundation, NSF management and legal counsel determine, in their opinion, whether resolution of the actions and claims it is aware of will materially affect the agency's financial position or operations. NSF recognizes a contingency in the financial statements when unasserted claims are probable of assertion, and if asserted would be probable of an unfavorable outcome and expected to result in a measurable loss, whether from NSF's appropriations or the "Judgment Fund." NSF discloses unasserted claims if materiality or measurability of a potential loss cannot be determined or the loss is more likely than not to occur rather than probable.

Q. Use of Estimates

The preparation of the accompanying financial statements requires management to make estimates and assumptions about certain estimates included in the financial statements. Actual results will invariably differ from those estimates.

R. Tax Status

NSF, as a federal agency, is not subject to federal, state, or local income taxes and, accordingly, no provision for income taxes is recorded.

Note 2. Fund Balance with Treasury

Fund Balance with Treasury consisted of the following components as of September 30, 2003 and 2002:

(Amounts in Thousands)

	2003			
	Appropriated Funds	Trust Funds	Other Funds	Total
Obligated	$ 6,750,490	32,366	1,591	6,784,447
Unobligated Available	183,303	18,918	-	202,221
Unobligated Unavailable	96,109	98	922	97,129
Total Fund Balance	$ 7,029,902	51,382	2,513	7,083,797

(Amounts in Thousands)

2002

	Appropriated Funds	Trust Funds	Other Funds	Total
Obligated	$ 6,092,725	$ 11,186	$ 10,712	$ 6,114,623
Unobligated Available	192,762	20,582	-	213,344
Unobligated Unavailable	91,411	62	260	91,733
Total Fund Balance	$ 6,376,898	$ 31,830	$ 10,972	$ 6,419,700

***** Certain reclassifications have been made to previously reported 2002 amounts to conform to the 2003 presentation.

Appropriated funds are amounts provided by Congress for NSF operations. Included in appropriated funds are Indian rupees (Rs) in the amount of Rs13,577,123 and Rs14,063,769 converted as of September 30, 2003 and 2002, respectively, to U.S. dollars at the prevailing Treasury rate of 45.70 rupees to $1 US, or $297,092 and 48.38 rupees to $1 US, or $290,693 respectively.

The Trust Fund includes amounts donated to NSF. Other Funds and Trust Funds are restricted for intended purposes. Unavailable balances include recovered expired appropriations and other amounts related to expired authority and holdings, which are unavailable for NSF use.

"Other Funds" consists of $1,591,019 and $10,711,902, as of September 30, 2003 and 2002, respectively, received from a corporation that registered second level Internet domain names under NSF's cooperative agreement and nonexpenditure transfer authorizations, deposits, holdings, and miscellaneous receipt accounts. These "Other Funds" have no budgetary impact and therefore are not part of the unobligated balance per the Statement of Budgetary Resources.

Note 3. Accounts Receivable, Net

Intragovernmental

The Intragovernmental Accounts Receivable consists of reimbursements and repayments due from other government agencies. As of September 30, 2003 and 2002, the amount of intragovernmental accounts receivable was $18,246,756 and $184,572, respectively. The increase in our Intragovernmental Receivable balance is due to the implementation of OMB's Memorandum M-03-01: *Business Rules for Intragovernmental Transactions*. These rules required NSF to transition to bill agencies on a reimbursable basis after we have incurred costs. Previously, NSF billed most agencies on an advanced basis.

Public

As of September 30, 2003 and 2002, Accounts Receivable (net) due from private organizations and individuals consisted of:

(Amounts in Thousands)

	2003	2002
Accounts Receivable	$ 8,384	$ 8,753
Allowance for Uncollectible Accounts	(8,182)	(8,182)
Net Amount Due	$ 202	$ 571

As of September 30, 2003 and 2002, the reconciliation of the allowance for uncollectible accounts is as follows:

(Amounts in Thousands)

	2003	2002
Beginning Allowance	$ 8,182	$ 8,183
Additions	-	-
Reduction (write-offs)	-	(1)
Ending Allowance	$ 8,182	$ 8,182

An allowance was set up in FY 2000 for $7,929,465, which represents the allowance for a receivable from a grantee that filed for dissolution. The receivable has been forwarded to the Department of Justice, as required by OMB Circular A-129, *Policies for Federal Credit Programs and Non-Tax Receivables,* and U.S.C. 31 Section 3711, for concurrence on the termination of debt.

Note 4. Advances

As of September 30, 2003 and 2002, Advances consisted of the following components:

Intragovernmental

(Amounts in Thousands)

	2003	2002
Advances to Others	$ 18,557	$ 8,309

Public

(Amounts in Thousands)

	2003	2002
Advances to Grantees	$ 66,601	$ 52,472
Advances to Contractors	9	7
Total Advances with the Public	$ 66,610	$ 52,479

Note 5. Property, Plant and Equipment in the Custody of NSF

The components of Property, Plant and Equipment as of September 30, 2003 and 2002 were:

(Amounts in Thousands)

	2003		
	Acquisition Cost	Accumulated Depreciation	Net Book Value
Equipment	$ 67,066	$ 47,179	$ 19,887
Aircraft and Satellites	138,109	103,321	34,788
Buildings and Structures	89,537	41,169	48,368
Construction in Progress	122,700	-	122,700
Internal Use Software	4,714	1,087	3,627
Software in Development	1,407	-	1,407
Total PP&E	$ 423,533	$ 192,756	$ 230,777

(Amounts in Thousands)

	2002		
	Acquisition Cost	Accumulated Depreciation	Net Book Value
Equipment	$ 62,565	$ 44,805	$ 17,760
Aircraft and Satellites	135,865	94,842	41,023
Buildings and Structures	85,034	39,078	45,956
Construction in Progress	116,313	-	116,313
Internal Use Software	2,175	652	1,523
Software in Development	1,566	-	1,566
Total PP&E	$ 403,518	$ 179,377	$ 224,141

Note 6. Property, Plant and Equipment in the Custody of Other Entities

NSF received a ruling from FASAB on accounting for PP&E owned by NSF but in the custody of and used by others. The FASAB guidance requires that PP&E in the custody of others be excluded from NSF PP&E as defined in the Statement of Federal Financial Accounting Standards No. 6 *Accounting for Property, Plant and Equipment*, and instead based on information contained in the audited financial statements of the organizations holding the assets disclose the dollar amount of NSF PP&E held by others in the footnotes.

The amount of PP&E owned by NSF but in the custody of other entities identified in the following table was obtained from the respective entities' audited financial statements. If the audited financial statements were not published or released by September 1, or if NSF PP&E is not separately stated on the entities' audited financial statements, then the amounts relating to such entities are annotated as "NA" (Not Available) in the table.

The amounts reported by entities in their audited financial statements submitted as of September 1 are as follows:

(Amounts in Thousands)

Federally Funded Research and Development Centers

	2003	2002	Year End
National Astronomy and Ionosphere Center - Cornell	$ N/A	$ N/A	06/30
National Center for Atmospheric Research - UCAR	N/A	137,476	09/30
National Optical Astronomy Observatories - AURA	N/A	384,455	09/30
National Radio Astronomy Observatories - AUI	N/A	295,844	09/30
The Science and Technology Policy Institute - RAND	N/A	N/A	09/30

Colleges and Universities

	2003	2002	Year End
California Institute of Technology	$ N/A	$ N/A	9/30
Columbia University	N/A	N/A	9/30
Cornell University – Endowed	N/A	N/A	9/30
Duke University	N/A	N/A	9/30
Oregon State University	N/A	N/A	9/30
San Jose State University Foundation	N/A	N/A	9/30
University of Alaska Fairbanks Campus	N/A	N/A	9/30
University of California-San Diego	N/A	N/A	9/30
University of Hawaii	N/A	N/A	9/30
University of Miami Rosenstiel School of Marine & Atmospheric Science	N/A	N/A	5/31
University of Rhode Island	N/A	N/A	6/30
University of Texas at Austin	N/A	N/A	8/31
University of Washington	N/A	N/A	6/30
University of Wisconsin	N/A	N/A	6/30

Other Entities

	2003	2002	Year End
Aerodyne Research Inc	$ N/A	$ N/A	9/30
Brighton Technologies Group, Inc.	N/A	N/A	Not Audited
Fourth Wave Imaging Corporation	N/A	N/A	12/31
Imago Scientific Instruments Corp	N/A	N/A	9/30
Incorporated Research Institutions for Seismology	N/A	N/A	9/30
Information Systems Laboratories Inc	N/A	N/A	12/31
Joint Oceanographic Institutions Inc	N/A	N/A	9/30
Lucigen Corporation (formerly Microgen - a WI Corp)	N/A	N/A	Not Audited
Lynntech, Inc	N/A	N/A	Not Audited
Physical Optics Corporation	N/A	N/A	12/31
SRI International	N/A	N/A	12/31
T/J Technologies, Inc	N/A	N/A	Not Audited
UNVACO, Inc.	N/A	N/A	12/31
Veco Rocky Mountain Inc.	N/A	N/A	3/31
Weidlinger Associates Inc	N/A	N/A	12/31
Woods Hole Oceanographic Institution	N/A	N/A	12/31
Xencor	N/A	N/A	12/31

Note 7. Other Liabilities

Other Liabilities represent current accrued liabilities, which consist of grant and contract accruals, accrued employer contributions for payroll and benefits, disbursements in transit, accrued payroll and benefits, and various employee related liabilities for payroll and benefit deductions. As of September 30, 2003 and 2002, Other Liabilities consisted of the following:

(Amounts in Thousands)

	2003	2002
Intragovernmental		
Employer Contributions for Payroll Benefits	$ 396	$ 321
Total Intragovernmental	$ 396	$ 321
Other Liabilities		
Accrued Liabilities	$ 251,107	$ 210,738
Accrued Payroll and Benefits	3,893	3,269
State and Other Income Taxes Withheld	915	248
Employee Deductions for U.S. Savings Bonds	8	11
Total Other Liabilities	$ 255,923	$ 214,266

Note 8. Liabilities Not Covered by Budgetary Resources

Certain liabilities are not funded by current budgetary resources. As of September 30, 2003 and 2002, Liabilities Not Covered by Budgetary Resources consisted of the following:

(Amounts in Thousands)

	2003	2002
Intragovernmental: FECA Employee Benefits	$ 264	$ 254
Public: FECA Employee Benefits	1,649	1,637
Accrued Annual Leave	11,120	10,567
Liabilities Not Covered by Budgetary Resources to Fund Cost of Operations	$ 13,033	$ 12,458
Lease Liabilities	-	60
Total Liabilities Not Covered By Budgetary Resources	$ 13,033	$ 12,518

Note 9. FECA Employee Benefits

FECA Employee Benefits consisted of the following components as of September 30, 2003 and 2002:

(Amounts in Thousands)

	2003	2002
Intragovernmental: Unreimbursed Actual Costs	$ 264	$ 254
Public: Estimated Liability	1,649	1,637
Total Workers' Compensation Benefits	$ 1,913	$ 1,891

For Fiscal Years 2003 and 2002, these amounts represent $264,278 and $253,872 respectively, of unreimbursed cost to the DOL for actual compensation paid to recipients under FECA. FECA provides income and medical cost protection to cover federal employees injured on the job or who have a work-related injury or occupational disease, and beneficiaries of employees whose death is attributable to a job related injury or occupational disease. The DOL initially pays valid claims and then bills the employing federal agency.

As of September 30, 2003 and 2002, the estimated liability of $1,649,000 and $1,637,000, respectively, are for future worker compensation claims calculated by DOL and includes the expected liability for death, disability, medical, and miscellaneous costs for approved compensation cases. The liability is determined using a method that utilizes historical benefit payment patterns related to a specific incurred period and annual benefit payments discounted to present value using OMB's economic assumptions for 10-year Treasury notes and bonds. To account for the effects of inflation on the liability, wage and medical inflation factors are applied to the calculation of future benefits.

Note 10. Statements of Net Cost

Major Program Descriptions

NSF's primary business is to make merit-based grants and cooperative agreements to individual researchers and groups, in partnership with colleges, universities, and other public, private, state, local, and federal institutions, throughout the U.S. By providing these resources, NSF contributes to the health and vitality of the U.S. research and education enterprise, which enables and enhances the Nation's capacity to sustain growth and prosperity. These grants are managed through eight programmatic organizations within NSF that review and evaluate competitive proposals submitted by the science and engineering community for its consideration.

NSF is a single entity for net cost reporting purposes. The NSF programmatic organizations are the Directorates for the Biological Sciences; Computer and Information Science and Engineering; Education and Human Resources; Engineering; Geosciences; Mathematical and Physical Sciences; Social, Behavioral and Economic Sciences; and the Office of Polar Programs.

The Statement of Net Cost is a general overall presentation of NSF wide expenses incurred by the agency. The presentation of the statement of Net Cost is aligned with NSF's strategic goals of People (P), Ideas (I), and Tools (T). These goals are outlined in NSF's FY 2003 GPRA Performance Plan (www.nsf.gov/od/gpra/perfplan/fy2003/fy2003revisedfinalplan) and in NSF's FY 2003 Budget Request (www.nsf.gov/bfa).

In pursuit of its mission, NSF makes investments in People, Ideas, and Tools. These goals reflect outcomes at the heart of the research enterprise: a world-class science and engineering workforce (People); the generation of new knowledge across the frontiers of science and engineering (Ideas); and the Tools to get the job done efficiently and effectively. People produce the Ideas that are the currency of the new knowledge-based economy. The need for more sophisticated Tools has paralleled recent advances in science and engineering, creating a growing demand for access to them. NSF's overall strategy is to invest in state-of-the-art tools that add unique value to research and are accessible and widely shared among researchers across the nation.

Approximately 96 percent of NSF's investments are directly related to the People, Ideas, and Tools (PIT) strategic areas of focus. About four percent of NSF's investments are for support of management and administrative activities. All investment costs are assigned to the three strategic PIT areas.

In FYs 2002 and 2003, management and administration activities include Salary & Expenses, NSB and Office of Inspector General (OIG) expenses which provide for salaries and benefits of persons employed at the NSF; general operating expenses, including key activities to advance the NSF information systems technology and to enhance staff training, audit and OIG activities, and OPM and DOL benefits costs paid on behalf of NSF. These indirect costs are allocated to NSF programs based on each program's direct costs.

In accordance with OMB Bulletin 01-09, *Form and Content of Agency Financial Statements*, costs incurred for services provided by other federal entities are reported in the full costs of NSF programs and are identified as "intragovernmental." All earned revenues are funding sources provided through reimbursable agreements with other federal entities and are retained by NSF. Earned revenues are recognized when the related program or administrative expenses are incurred and are deducted from the full cost of the programs to arrive at the net cost of operating NSF's programs.

Gross Cost and Earned Revenue by Budget Functional Classification

Total Gross Cost and Earned Revenue by Budget Functional Classification for FYs 2003 and 2002 were as follows:

(Amounts in Thousands)

Budget Functional Classification		
NSF – General Science, Space and Technology (Code 250)		
	2003	2002
Gross Cost	$ 4,801,163	$ 4,237,468
Earned Revenue	93,392	105,202
Net Cost	$ 4,707,771	$ 4,132,266

Intragovernmental Gross Cost and Earned Revenue by Budget Functional Classification

Intragovernmental Gross Cost and Earned Revenue by Budget Functional Classification for FYs 2003 and 2002 were as follows:

(Amounts in Thousands)

Budget Functional Classification		
NSF – General Science, Space and Technology (Code 250)		
	2003	2002
Gross Cost	$ 157,356	$ 114,981
Earned Revenue	93,392	105,202
Net Cost	$ 63,964	$ 9,779

Note 11. Budget Authority

Budget Authority includes $42,161,490 and $32,693,473 of donations and interest as of September 30, 2003 and 2002, respectively. Budget Authority was increased for non-expenditure transfers from the U.S. Agency for International Development for $13,143,175 in 2003, and $14,000,000 in 2002. Budget Authority as of September 30, 2003 and 2002 was also adjusted for Congressional initiated rescissions contained in P.L. 108-7 totaling $34,740,498 and P.L. 107-206 totaling $314,000, respectively.

NSF maintains permanent indefinite appropriations for Research and Related Activities - 49x0100, Major Research Equipment - 49x0551, H-1B Nonimmigrant Petitioner fees - 49x5176, and Trust Fund donations - 49x8960.

The status of Budgetary Resources as of September 30, 2003, consisted of Budgetary Resources obligated of $5,578,644,000 available authority of $202,220,949 and unavailable authority of $96,207,143. The status of Budgetary Resources as of September 30, 2002, included Budgetary Resources obligated of $4,953,634,607, available authority of $213,343,532 and unavailable authority of $91,473,438.

Note 12. Commitments and Contingencies

Unasserted Claims

NSF has been informed of potential contractor claims for additional compensation under a contract, awarded by the United States Air Force, for reconfiguration of three NSF-owned aircraft. NSF will work with the Air Force to determine the validity of the potential contractor's claims. It is NSF's opinion that payment of some additional compensation is probable. Since the claims have not been formally presented, documented and assessed, the amount of additional compensation has not been determined.

Environmental Costs

NSF manages the U.S. Antarctic Program. The Antarctic Conservation Act and its implementing regulations identify the requirements for environmental cleanup in Antarctica. NSF continually monitors the U.S. Antarctic Program in regards to environmental issues.

A project that NSF is currently undertaking is limited clean-up of a former research station at Cape Hallett, in cooperation with the New Zealand Antarctic Program. The station was jointly operated by the U.S. and New Zealand from 1957 to 1973. In the past year, progress has been made in determining the scope of the effort that will need to be undertaken to assess clean-up activities. This assessment effort is being planned over the next two years. Approximately $85,000 will be spent in fiscal year 2004 for the initial assessment and equipment. At present, the full extent of the clean-up activities required at Cape Hallett has yet to be determined.

Note 13. Statement of Financing Disclosures

Explanation of the Relationship Between Liabilities Not Covered by Budgetary Resources on the Balance Sheet and the Change in Components Requiring or Generating Resources in Future Periods.

Liabilities Not Covered by Budgetary Resources of $13,032,863 and $12,517,321 for FY 2003 and 2002, respectively, represent NSF's FECA liability to DOL and employees, leave earned but not taken and lease liabilities. The amount reported on the Statement of Financing as Total Components of Net Cost of Operations that will Require or Generate Resources in Future Periods of $515,543 for FY 2003 and $516,689 for FY 2002, represents the change in NSF's expenses for unfunded liabilities for FECA, leave earned but not taken and lease liabilities.

Required Supplementary Information

Budgetary Resources by Major Budgetary Accounts

In the following table, NSF budgetary information for the fiscal years ended September 30, 2003 and 2002, as presented in the Statement of Budgetary Resources, is disaggregated for each of NSF's major budgetary accounts.

National Science Foundation
Required Supplementary Information
For the Year Ended September 30, 2003

2003
(Amounts in Thousands)

	Research and Related	Education	Major Research Equipment	OIG, S&E, and NSB	Trust Fund	Total
Budgetary Resources						
Budget Authority:						
Appropriations Received	$ 4,083,000	974,423	149,510	203,102	42,162	$ 5,452,197
Net Transfers	12,828	-	-	315	-	13,143
Unobligated Balances – Beginning of Period	56,677	128,172	96,551	2,773	20,644	304,817
Spending Authority from Offsetting Collections:						
Earned:						
Collected	62,487	8,261	-	4,819	1	75,568
Receivable from Federal Sources	17,067	621	-	374	-	18,062
Change in Unfilled Customer Orders:						
Advance Received	(50,871)	(7,724)	-	(3)	-	(58,598)
Without Advance from Federal Sources	70,396	3,359	-	-	-	73,755
Anticipated for Rest of Year, Without Advance	-	-	-	-	-	-
Spending Authority Subtotal	99,079	4,517	-	5,190	1	108,787
Recoveries of Prior Year Obligations	38,858	24,418	48	1,962	113	65,399
Permanently Not Available	(45,794)	(18,012)	(972)	(2,493)	-	(67,271)
Total Budgetary Resources	$ 4,244,648	1,113,518	245,137	210,849	62,920	$ 5,877,072
Status of Budgetary Resources						
Obligations Incurred:						
Direct	$ 4,062,220	983,131	179,029	201,440	43,904	$ 5,469,724
Reimbursable	99,384	4,508	-	5,028	-	108,920
Total Obligations Incurred	4,161,604	987,639	179,029	206,468	43,904	5,578,644
Unobligated Balances:						
Apportioned	28,075	87,914	66,060	1,254	18,918	202,221
Unobligated Balances Not Available	54,969	37,965	48	3,127	98	96,207
Total Status of Budgetary Resources	$ 4,244,648	1,113,518	245,137	210,849	62,920	$ 5,877,072
Relationship of Obligations to Outlays						
Net Obligated Balance – Beginning of Period	$ 4,441,353	1,499,264	137,418	25,402	11,186	$ 6,114,623
Net Obligated Balance – End of Period						
Accounts Receivable	(17,134)	(621)	-	(492)	-	(18,247)
Unfilled Customer Orders from Federal Sources	(72,895)	(3,359)	-	(7)	-	(76,261)
Undelivered Orders	4,699,456	1,616,122	191,010	20,083	35,196	6,561,867
Accounts Payable	246,434	49,247	7,472	16,765	(2,830)	317,088
Total Net Obligated Balance – End of Period	$ 4,855,861	1,661,389	198,482	36,349	32,366	$ 6,784,447
Outlays						
Disbursements	$ 3,620,775	797,117	117,916	193,186	22,610	$ 4,751,604
Collections	(11,616)	(537)	-	(4,816)	(1)	(16,970)
Subtotal	3,609,159	796,580	117,916	188,370	22,609	4,734,634
Less: Offsetting Receipts	-	-	-	-	42,162	42,162
Net Outlays	$ 3,609,159	796,580	117,916	188,370	(19,553)	$ 4,692,472

National Science Foundation
Required Supplementary Information
For the Years Ended September 30, 2003 and 2002

2002
(Amounts in Thousands)

	* Research and Related	Education	Major Research Equipment	** OIG and Salary Expense	Trust Fund	Total
Budgetary Resources						
Budget Authority:						
Appropriations Received	$ 3,598,639	955,339	138,800	176,800	32,694	$ 4,902,272
Net Transfers	13,664	-	-	336	-	14,000
Unobligated Balances – Beginning of Period	51,126	95,184	73,093	2,194	17,675	239,272
Spending Authority from Offsetting Collections:						
Earned:						
Collected	96,321	10,214	-	4,662	1	111,198
Receivable from Federal Sources	(4,976)	-	-	(427)	-	(5,403)
Change in Unfilled Customer Orders:					-	
Advance Received	(5,807)	(8,785)	-	(2)	-	(14,594)
Without Advance from Federal Sources	(5,316)	-	-	7	-	(5,309)
Subtotal	80,222	1,429	-	4,240	1	85,892
Recoveries of Prior Year Obligations	31,408	14,115	10	1,475	84	47,092
Permanently Not Available	(19,102)	(9,596)	-	(1,378)	-	(30,076)
Total Budgetary Resources	$ 3,755,957	1,056,471	211,903	183,667	50,454	$ 5,258,452
Status of Budgetary Resources						
Obligations Incurred:						
Direct	$ 3,619,230	927,135	115,352	176,809	29,809	$ 4,868,335
Reimbursable	80,051	1,164	-	4,085	-	85,300
Subtotal	3,699,281	928,299	115,352	180,894	29,809	4,953,635
Unobligated Balances:						
Apportioned	2,897	92,982	96,541	342	20,582	213,344
Unobligated Balances Not Available	53,779	35,190	10	2,431	63	91,473
Total Status of Budgetary Resources	$ 3,755,957	1,056,471	211,903	183,667	50,454	$ 5,258,452
Relationship of Obligations to Outlays						
Net Obligated Balance – Beginning of Period	$ 3,984,208	1,300,605	158,613	24,957	12,429	$ 5,480,812
Net Obligated Balance – End of Period						
Accounts Receivable	(66)	-	-	(119)	-	(185)
Unfilled Customer Orders from Federal Sources	(2,499)	-	-	(6)	-	(2,505)
Undelivered Orders	4,258,391	1,457,364	131,030	10,689	14,908	5,872,382
Accounts Payable	185,527	41,900	6,388	14,838	(3,722)	244,931
Total Net Obligated Balance – End of Period	$ 4,441,353	1,499,264	137,418	25,402	11,186	$ 6,114,623
Outlays						
Disbursements	$ 3,221,019	715,526	136,538	179,393	30,968	$ 4,283,444
Collections	(90,514)	(1,430)	-	(4,659)	(1)	(96,604)
Subtotal	3,130,505	714,096	136,538	174,734	30,967	4,186,840
Less: Offsetting Receipts		-	-	-	32,693	32,693
Net Outlays	$ 3,130,505	714,096	136,538	174,734	(1,726)	$ 4,154,147

***** Certain reclassifications have been made to previously reported 2002 amounts to conform to the 2003 presentation.
** Funding for the National Science Board became effective October 1, 2002 and was established by the National Science Foundation Act of 1950.

Required Supplementary Information

Intragovernmental Balances and Deferred Maintenance

Intragovernmental Assets by Partner Agency (Unaudited)

Intragovernmental assets on this schedule support the intragovernmental asset line items on NSF's Balance Sheets as of September 30, 2003 and 2002. Intragovernmental balances included in Fund Balance with Treasury as of September 30, 2003 and 2002, consisted of the following:

(Amounts in Thousands)

Agency	2003	2002
Department of State	$ 297	$ 291
Department of the Treasury	7,083,500	6,419,409
Total	$ 7,083,797	$ 6,419,700

Intragovernmental Accounts Receivable balances as of September 30, 2003 and 2002, consisted of the following:

(Amounts in Thousands)

Agency	2003	2002
Central Intelligence Agency	$ 3,374	$ 96
Department of Agriculture	66	-
Department of the Air Force	547	
Department of the Army	819	
Department of Commerce	886	-
Department of Defense	2,486	89
Department of Education	166	
Department of Energy	1,276	-
Department of Health and Human Services	4,796	-
Department of Homeland Security	117	
Department of Housing and Urban Development	135	
Department of the Interior	58	-
Department of Justice	7	
Department of Labor	44	
Department of the Navy	303	-
Department of State	70	
Department of Transportation	108	-
Department of Treasury	4	
Environmental Protection Agency	120	-
Federal Emergency Management Agency	1	
General Services Administration	4	
National Aeronautics and Space Administration	2,723	-
National Foundation on the Arts and Humanity	12	-
Office of the President	4	-
Smithsonian Institution	2	-
Social Security Administration	12	
U.S. Army Corp. Of Engineers	107	-
Total	$ 18,247	$ 185

Intragovernmental Advances balances as of September 30, 2003 and 2002 consisted of the following:

(Amounts in Thousands)

Agency	2003	2002
Department of the Navy	$ 18,557	$ 8,309

Intragovernmental Liabilities by Partner Agency (Unaudited)
(Amounts In Thousands)

Agency	2003 Advances From Others	2003 Other Liabilities	2003 Employee Benefits	2002 Advances From Others	2002 Other Liabilities	2002 Employee Benefits
Central Intelligence Agency	$ 1,833	$ -	$ -	$ 2,840	$ -	$ -
Department of Agriculture	194	-	-	773	-	-
Department of the Air Force	2,264	-	-	4,193	-	-
Department of the Army	259	-	-	853	-	-
Department of Commerce	1,647	-	-	5,890	-	-
Department of Defense	-	-	-	-	-	-
Department of Education	19,107	-	-	26,323	-	-
Department of Energy	2,205	-	-	9,920	-	-
Department of Health and Human Services	5,218	-	-	17,080	-	-
Department of Housing and Urban Development	973	-	-	1,675	-	-
Department of the Interior	28	-	-	432	-	-
Department of Justice	112	-	-	369	-	-
Department of Labor	237	-	264	395	-	254
Department of the Navy	702	-	-	2,805	-	-
Department of State	441	-	-	718	-	-
Department of Transportation	606	-	-	1,320	-	-
Department of the Treasury	111	-	-	180	-	-
Environmental Protection Agency	59	-	-	1,015	-	-
Federal Emergency Management Agency	-	-	-	258	-	-
General Services Administration	73	-	-	358	-	-
National Aeronautics and Space Administration	3,032	-	-	15,181	-	-
National Archives and Records Administration	-	-	-	744	-	-
National Foundation on the Arts and Humanities	2	-	-	107	-	-
Office of Personnel Management	-	396	-	-	321	-
Office of the President	6	-	-	-	-	-
Office of the Secretary – Defense Agencies	2,604	-	-	6,059	-	-
Smithsonian Institute	8	-	-	-	-	-
Social Security Administration	19	-	-	-	-	-
U.S. Army Corp of Engineers	193	-	-	-	-	-
Other	-	-	-	1,043	-	-
Total	$ 41,933	$ 396	$ 264	$ 100,531	$ 321	$ 254

Deferred Maintenance (Unaudited)

NSF performs condition assessment surveys in accordance with FASAB standards for capitalized property, plant and equipment to determine if any maintenance is needed to keep an asset in an acceptable condition or restore an asset to a specific level of performance. NSF considers deferred maintenance to be any maintenance that is not performed on schedule, unless it is determined from the condition of the asset that scheduled maintenance does not have to be performed. Also, deferred maintenance includes any other type of maintenance that, if not performed, would render the PP&E non-operational. Circumstances such as non-availability of parts or funding are considered reasons for deferring maintenance.

NSF considered whether any scheduled maintenance necessary to keep fixed assets of the agency in an acceptable condition was deferred at the end of FYs 2003 and 2002. Assets deemed to be in excellent or good condition are considered to be in acceptable condition. Assets in fair or poor condition are in unacceptable condition and the deferred maintenance required to get them to an acceptable condition are reported. NSF determines the condition of an asset in accordance with standards comparable to those used in the private industry. Due to the environment and remote location of Antarctica, all deferred maintenance on assets in fair or poor condition is considered critical in order to maintain operational status.

In FY 2002, NSF completed the maintenance deferred from FY 2001. In addition, NSF determined that scheduled maintenance on 99 items of Antarctic equipment was not completed and was deferred or delayed for a future period. The largest dollar amount of deferred maintenance for any single item approximated $5,000. The items included light and heavy mobile equipment with a few items of power distribution and shop equipment. 81 items were rated to be in fair condition and 18 were rated to be in poor condition. All of the equipment is considered critical to NSF operations and estimated to require $60,470 in maintenance.

During FY 2003, NSF determined that scheduled maintenance on 194 items of Antarctic equipment was not completed and was deferred or delayed for a future period. The largest dollar amount of deferred maintenance for any single item approximated $16,000. The items included light and heavy mobile equipment requiring $134,083 of maintenance and a few power distribution and shop equipment items requiring $3,167. There are 176 items rated to be in fair condition and 18 rated to be in poor condition. All of the equipment are considered critical to NSF operations and estimated to require $137,250 in total maintenance.

Required Supplementary Stewardship Information

Stewardship Investments

Stewardship Investments
Research and Human Capital

(Dollars in Thousands)
(Unaudited)

	2003	2002	2001	2000	1999
Research and Human Capital Activities					
Basic Research	$ 3,519,159	$ 3,092,060	$ 2,692,243	$ 2,636,518	$ 2,507,569
Applied Research	218,152	193,788	211,421	173,670	188,742
Education and Training	867,489	767,734	704,949	596,517	599,323
Non-Investing Activities	196,363	183,887	170,757	162,021	143,980
Total Research and Human Capital Activities	$ 4,801,163	$ 4,237,469	$ 3,779,370	$ 3,568,726	$ 3,439,614
Inputs, Outputs and/or Outcomes					
Research and Human Capital Activities					
Investments In:					
Universities	$ 3,310,365	$ 2,919,897	$ 2,631,405	$ 2,470,300	$ 2,385,492
Industry	178,000	185,062	162,176	160,573	154,555
Federal Agencies	144,792	106,458	125,823	132,790	150,959
Small Businesses	186,400	144,844	130,977	119,345	110,884
FFRDC's and Others	981,606	881,208	728,989	685,718	637,724
	$ 4,801,163	$ 4,237,469	$ 3,779,370	$ 3,568,726	$ 3,439,614
Support to:					
Scientists	$ 427,304	$ 394,144	$ 355,261	$ 359,228	$ 350,841
Postdoctoral Programs	163,239	148,334	128,499	117,504	120,386
Graduate Students	475,315	402,620	362,820	315,583	323,324
	$ 1,065,858	$ 945,098	$ 846,580	$ 792,315	$ 794,551
Outputs & Outcomes:					
Number of:					
Awards Actions	23,000	21,000	20,000	20,000	20,000
Senior Researchers	30,000	28,000	27,000	24,000	23,000
Other Professionals	12,000	11,000	10,000	8,000	9,000
Postdoctorals Associates	6,000	6,000	6,000	5,000	4,000
Graduate Students	27,000	26,000	25,000	22,000	20,000
Undergraduate Students	32,000	32,000	31,000	30,000	29,000
K – 12 Students	14,000	11,000	11,000	12,000	12,000

NSF's mission is to support basic scientific research and research fundamental to the engineering process as well as science and engineering education programs. To this end, NSF invests in the three strategic areas: People, Ideas, and Tools. Investment activities focused on "People" facilitate the creation of a diverse, internationally competitive and globally engaged workforce of scientists, engineers and well-prepared citizens. NSF supports activities to improve formal and informal science, mathematics, engineering and technology education at all levels, as well as public science literacy projects that engage people of all ages in life-long learning. Investment activities focused on "Ideas" support cutting edge research and education that yield new and

important discoveries and promote the development of new knowledge and techniques within and across traditional disciplinary boundaries. Investment in "Tools" provides state-of-the-art instrumentation, equipment, computation and computing infrastructure and multi-user facilities such as digital libraries, research vessels and aircraft, for all fields of science, engineering and education.

NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
ARLINGTON, VIRGINIA 22230

OFFICE OF
INSPECTOR GENERAL

November 17, 2003

To: Dr. Warren M. Washington
Chairman, National Science Board

Dr. Rita Colwell
Director, National Science Foundation

From: Dr. Christine C. Boesz Inspector General

Subject: Audit of the National Science Foundation's Fiscal Years 2003 and 2002 Financial Statements

This memorandum transmits KPMG LLP's financial statement audit report of the National Science Foundation (NSF) for its Fiscal Year 2003, which includes Fiscal Year 2002 comparative information.

Results of Independent Audit

The Chief Financial Officer's (CFO) Act of 1990 (P.L. 101-576), as amended, requires NSF's Inspector General or an independent external auditor, as determined by the Inspector General, to audit the Foundation's financial statements. Under a contract monitored by the Office of Inspector General (OIG), KPMG, an independent public accounting firm, performed an audit of NSF's Fiscal Years 2003 and 2002 financial statements. The contract required that the audit be performed in accordance with the Government Auditing Standards issued by the Comptroller General of the United States, and Bulletin 01-02, *Audit Requirements for Federal Financial Statements,* issued by the United States Office of Management and Budget.

KPMG issued an unqualified opinion on NSF's financial statements. In its Report on Internal Controls Over Financial Reporting, KPMG identified one reportable condition relating to NSF's post-award grant monitoring procedures. KPMG also reported that NSF's financial management systems substantially complied with the requirements of the Federal Financial Management Improvement Act of 1996 (FFMIA), and found no reportable noncompliance with laws and regulations it tested.

NSF management generally concurs with the findings regarding the reportable condition. Management's response dated November 7, 2003, follows KPMG's report.

Evaluation of KPMG's Audit Performance

To fulfill our responsibilities under the CFO Act of 1990, as amended, and other related financial management legislation, the Office of Inspector General:

- Reviewed KPMG's approach and planning of the audit;
- Evaluated the qualifications and independence of the auditors;
- Monitored the progress of the audit at key points;
- Coordinated periodic meetings with NSF management to discuss audit progress, findings and recommendations;
- Reviewed KPMG's audit report to ensure compliance with Government Auditing Standards and Office of Management and Budget Bulletin No. 01-02; and
- Coordinated issuance of the audit report.

Due to the acceleration of the completion date of the NSF Fiscal Year 2003 Accountability Report, we have not yet completed our review of the working papers prepared by KPMG.

KPMG LLP is responsible for the attached auditor's report dated November 3, 2003, and the conclusions expressed in the report. We do not express any opinion on NSF's financial statements, internal control, conclusions on compliance with laws and regulations, or on whether NSF's financial management systems substantially complied with FFMIA.

The Office of Inspector General appreciates the courtesies and cooperation extended to KPMG LLP and OIG staff by NSF during the audit. If you or your staff have any questions, please contact me or Deborah H. Cureton, Associate Inspector General for Audit.

Attachment

cc: Dr. Mark S. Wrighton, Chair, Audit and Oversight Committee

KPMG

2001 M Street, NW
Washington, DC 20036

Independent Auditors' Report

Dr. Warren M. Washington
Chairman, National Science Board

Dr. Rita Colwell
Director, National Science Foundation

We have audited the accompanying balance sheets of the National Science Foundation (NSF) as of September 30, 2003 and 2002, and the related statements of net cost, changes in net position, budgetary resources, and financing (hereinafter referred to as the financial statements) for the years then ended. The objective of our audits was to express an opinion on the fair presentation of these financial statements. In connection with our audits, we also considered NSF's internal control over financial reporting and tested NSF's compliance with certain provisions of applicable laws and regulations that could have a direct and material effect on its financial statements.

SUMMARY

As stated in our opinion on the financial statements, we concluded that NSF's financial statements as of and for the years ended September 30, 2003 and 2002 are presented fairly, in all material respects, in conformity with accounting principles generally accepted in the United States of America.

Our consideration of internal control over financial reporting identified one reportable condition related to NSF's post-award grant monitoring procedures. For NSF to fully implement its post-award grant monitoring procedures, adequate resources, both in terms of additional funding and staffing, are necessary before effective monitoring can take place. Further, additional policies and procedures are necessary to ensure that all post award activities are addressed comprehensively, and to improve existing policies and procedures.

However, the reportable condition identified above is not considered to be a material weakness.

The results of our tests of compliance with certain provisions of laws and regulations disclosed no instances of noncompliance that are required to be reported herein under *Government Auditing Standards*, issued by the Comptroller General of the United States, or Office of Management and Budget (OMB) Bulletin 01-02, *Audit Requirements for Federal Financial Statements*.

NSF management generally concurs with the findings regarding the reportable condition. Management's response dated November 7, 2003, follows our report.

The following sections discuss our opinion on NSF's financial statements, our consideration of NSF's internal control over financial reporting, our tests of NSF's compliance with certain provisions of applicable laws and regulations, and management's and our responsibilities.

KPMG

OPINION ON THE FINANCIAL STATEMENTS

We have audited the accompanying balance sheets of the National Science Foundation as of September 30, 2003 and 2002, and the related statements of net cost, changes in net position, budgetary resources, and financing for the years then ended.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the National Science Foundation as of September 30, 2003 and 2002, and its net costs, changes in net position, budgetary resources, and reconciliation of net cost to budgetary obligations for the years then ended, in conformity with accounting principles generally accepted in the United States of America.

The information in the *Management's Discussion and Analysis, Required Supplementary Stewardship Information,* and *Required Supplementary Information* sections is not a required part of the financial statements but is supplementary information required by accounting principles generally accepted in the United States of America or OMB Bulletin No. 01-09, *Form and Content of Agency Financial Statements.* We have applied certain limited procedures, which consisted principally of inquiries of management, regarding the methods of measurement and presentation of this information. However, we did not audit this information, and accordingly, we express no opinion on it. Based upon our limited procedures, we determined that NSF could not complete the intragovernmental balance reconciliations with its governmental trading partners, as required by OMB Bulletin No. 01-09, because, although NSF issued confirmations to its major partners, such partners did not respond with adequate information to assist in reconciling such balances.

Our audits were conducted for the purpose of forming an opinion on the financial statements as a whole. The Detailed Performance Information (Section II) is presented for additional analysis and is not a required part of the financial statements. Accordingly, it has not been subjected to auditing procedures and therefore we express no opinion on it.

INTERNAL CONTROL OVER FINANCIAL REPORTING

Our consideration of internal control over financial reporting would not necessarily disclose all matters in the internal control over financial reporting that might be reportable conditions. Under standards issued by the American Institute of Certified Public Accountants, reportable conditions are matters coming to our attention relating to significant deficiencies in the design or operation of the internal control over financial reporting that, in our judgment, could adversely affect NSF's ability to record, process, summarize, and report financial data consistent with the assertions by management in the financial statements.

Material weaknesses are reportable conditions in which the design or operation of one or more of the internal control components does not reduce to a relatively low level the risk that misstatements, in amounts that would be material in relation to the financial statements being audited, may occur and not be detected within a timely period by employees in the normal course of performing their assigned functions.

In our fiscal year 2003 audit, we noted a matter, described in Exhibit 1 involving the internal control over financial reporting and its operation that we consider to be a reportable condition. However, the reportable condition is not believed to be a material weakness.

A summary of the status of prior year reportable conditions is included as Exhibit 2.

We also noted other matters involving internal control over financial reporting and its operation that we have reported to the management of NSF in a separate letter dated November 3, 2003.

COMPLIANCE WITH LAWS AND REGULATIONS

The results of our tests of compliance with certain provisions of laws and regulations, as described in the Auditors' Responsibilities section of this report, exclusive of Federal Financial Management Improvement Act (FFMIA), disclosed no instances of noncompliance that are required to be reported herein under *Government Auditing Standards* or OMB Bulletin No. 01-02.

The results of our tests of compliance with FFMIA disclosed no instances in which NSF's financial management systems did not substantially comply with Federal financial management system requirements, applicable Federal accounting standards, or the United States Government Standard General Ledger at the transaction level.

We noted other matters involving compliance with laws and regulations that, under *Government Auditing Standards* and OMB Bulletin No. 01-02, were not required to be included in this report, that we have reported to the management of NSF in a separate letter dated November 3, 2003.

RESPONSIBILITIES

Management's Responsibilities. The Government Management Reform Act (GMRA) of 1994 requires Federal agencies to report annually to Congress on their financial status and any other information needed to fairly present the agencies' financial position and results of operations. To meet the GMRA reporting requirements, NSF prepares annual financial statements.

Management is responsible for:

- Preparing the financial statements in conformity with accounting principles generally accepted in the United States of America;
- Establishing and maintaining internal controls over financial reporting, and preparation of the Management's Discussion and Analysis (including the performance measures), required supplementary information, and required supplementary stewardship information; and
- Complying with laws and regulations, including FFMIA.

In fulfilling this responsibility, estimates and judgments by management are required to assess the expected benefits and related costs of internal control policies. Because of inherent limitations in internal control, misstatements, due to error or fraud may nevertheless occur and not be detected.

Auditors' Responsibilities. Our responsibility is to express an opinion on the fiscal year 2003 and 2002 financial statements of NSF based on our audits. We conducted our audits in accordance with auditing standards generally accepted in the United States of America; the standards applicable to financial audits contained in *Government Auditing Standards*; and OMB Bulletin No. 01-02. Those standards and OMB Bulletin No. 01-02 require that we plan and perform the audits to obtain reasonable assurance about whether the financial statements are free of material misstatement.

An audit includes:

- Examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements;
- Assessing the accounting principles used and significant estimates made by management; and
- Evaluating the overall financial statement presentation.

We believe that our audits provide a reasonable basis for our opinion.

In planning and performing our fiscal year 2003 audit, we considered NSF's internal control over financial reporting by obtaining an understanding of NSF's internal control, determining whether internal controls had been placed in operation, assessing control risk, and performing tests of controls in order to determine our auditing procedures for the purpose of expressing our opinion on the financial statements. We limited our internal control testing to those controls necessary to achieve the objectives described in OMB Bulletin No. 01-02 and *Government Auditing Standards*. We did not test all internal controls relevant to operating objectives as broadly defined by the Federal Managers' Financial Integrity Act of 1982. The objective of our audit was not to provide assurance on NSF's internal control over financial reporting. Consequently, we do not provide an opinion on internal control over financial reporting.

As required by OMB Bulletin No. 01-02, we considered NSF's internal control over required supplementary stewardship information by obtaining an understanding of NSF's internal control, determining whether these internal controls had been placed in operation, assessing control risk, and performing tests of controls. Our procedures were not designed to provide assurance on internal control over required supplementary stewardship information, and, accordingly, we do not provide an opinion thereon.

As further required by OMB Bulletin No. 01-02, with respect to internal control related to performance measures determined by management to be key and reported in *Management's Discussion and Analysis*, we obtained an understanding of the design of significant internal controls relating to the existence and completeness assertions and determined whether they had been placed in operation. Our procedures were not designed to provide assurance on internal control over reported performance measures, and, accordingly, we do not provide an opinion on such controls.

As part of obtaining reasonable assurance about whether the NSF's fiscal year 2003 financial statements are free of material misstatement, we performed tests of NSF's compliance with certain provisions of laws and regulations, noncompliance with which could have a direct and material effect on the determination of the financial statement amounts, and certain provisions of other laws and regulations specified in OMB Bulletin No. 01-02, including certain requirements referred to in FFMIA. We limited our tests of compliance to these provisions described in the preceding sentence, and did not test compliance with all laws and regulations applicable to NSF. Providing an opinion on compliance with laws and regulations was not an objective of our audit, and, accordingly, we do not express such an opinion.

Under OMB Bulletin No. 01-02 and FFMIA, we are required to report whether NSF's financial management systems substantially comply with (1) Federal financial management systems requirements, (2) applicable Federal accounting standards, and (3) the United States Government

Standard General Ledger at the transaction level. To meet this requirement, we performed tests of compliance with FFMIA Section 803(a) requirements.

DISTRIBUTION

This report is intended for the information and use of NSF's management, the National Science Board, the NSF Office of Inspector General, OMB, GAO, and the U.S. Congress, and is not intended to be and should not be used by anyone other than these specified parties.

KPMG LLP

November 3, 2003

KPMG

Exhibit 1

Fiscal Year 2003 Reportable Condition

03-01 Post-award Grant Monitoring

The National Science Foundation (NSF) was established in 1950 to promote and advance scientific and engineering progress in the United States. To carry out its mission, NSF funds research and education in science and engineering by making awards to various organizations, including colleges and universities, non-profit organizations, state and local governments, Federally Funded Research and Development Centers, and private entities. Through an award, NSF enters into a relationship to fund a particular science research or educational activity conducted by a grantee. In FY 2003, NSF had a budget of over $5 billion and managed an estimated 30,000 awards. NSF awards are becoming larger, more cross-disciplinary and more complex. In addition, Federal requirements are increasingly calling for improved accountability for federal entities and their awardees. NSF expends approximately 90 percent of its appropriated funds on grants annually.

An effective post award monitoring program is necessary, in order to accurately report expenditures on NSF's financial statements and ensure that the awardees are expending their grant funds in accordance with their award agreements and federal regulations. Post-award oversight consists of activities after an award has been made that are necessary to ensure that Federal funds are accounted for and are used for the purpose of the grant or cooperative agreement. This includes reviewing and approving administrative changes to grants; monitoring projects for performance and financial compliance; providing technical assistance and feedback on their progress; reviewing awardees final project outcomes and disseminating the results; and closing out expired grants in a timely manner. For these efforts to be fully effective, management must be committed to implement a comprehensive post award monitoring program, with adequate resources, in a manner that is cost effective and does not place undue burden on grantees.

In our FY 2001 and 2002 audits, we reported that even though NSF has a robust system of award management over its pre-award and award phases, NSF did not have a comprehensive and systematic risk-based internal grants management program to monitor its post-award phase. In FY 2002, we reported that NSF had made progress in improving its post award monitoring by developing a Risk Assessment and Award Monitoring Guide (Guide) that included post award monitoring policies and procedures, a systematic risk assessment process for classifying high-risk grantees and various grantee analysis techniques. However, we also reported that NSF needed to further improve its monitoring procedures and then fully implement them before effective monitoring could take place. Specifically, at that time, we found that the monitoring procedures did not identify who would conduct the review, how the reviews would be performed, what types of reviews would be done based on the risk level of the awardee, or the documentation standards for the review files. We also found that the criteria for identifying high-risk grantees was limited, analysis techniques were not fully developed to evaluate whether the grantee's internal controls were adequate, and the guide did not identify follow up procedures. Although NSF performed on-site reviews of grantees, they were not consistently conducted, documented, or reported.

In FY 2003, NSF revised its monitoring guide and conducted several on-site monitoring visits. We found that the revised guide had been improved, but still needed further revision. Specifically:

- The criteria developed for identifying high-risk grantees are not comprehensive. Additional risk characteristics such as history of poor programmatic performance, delayed or lack of submission of required financial and progress reports, financial instability, or inadequate financial management systems should also be evaluated when evaluating grantee's risk.
- The guide does not provide sufficient review procedures for medium and low-risk grantees. A lesser degree of oversight could be performed in these instances, which would greatly increase the level of oversight at minimal cost.
- The guide should include details of the types of review activities that should be conducted on each grantee depending on the type of grantee, the level of risk assessed, and the area of focus where oversight is needed.
- The guide does not provide for periodic internal monitoring of grantee financial expenditure reports. This is necessary in order to ensure grantee compliance with NSF's grant reporting guidelines, and to ensure that amounts reported are reasonable and consistent with the terms and nature of the grant.

However, more importantly, we found that NSF management did not require that the guide be followed when conducting grant monitoring reviews. Accordingly, many of the reviews were not comprehensive and did not include a review of all the core areas identified in the guide such as general management, internal controls, accounting system, procurement, property, and travel. In addition, Grant monitoring officials did not fully document their monitoring activities, which raised questions as to the extent of monitoring that was conducted. As a result, we were not able to evaluate the results of the work performed.

In addition to the quality of the reviews performed, we have concerns that the amount of resources (training, tools, staff) available to implement an effective post award grant monitoring program is not sufficient. Currently, two staff on a part time basis are primarily responsible for performing the comprehensive post award monitoring reviews. Also, as part of their annual certification of the agency's management controls, several of NSF's division directors and office heads have reported that they do not have sufficient resources to conduct effective oversight of awards.

This is the third year that post award monitoring has been identified as a reportable condition. NSF has begun to address these issues by revising its guide, performing limited reviews, and by hiring a contractor to assist in analyzing and assessing NSF's post award monitoring needs. In addition, NSF has proposed to establish a separate division within the Office of Budget, Finance and Award Management to concentrate on post award management. In order to have an effective post award monitoring program, NSF senior management must provide a clear message to both its employees and the awardee community that award administration and monitoring is essential to allow NSF to fulfill its fiscal responsibilities. Senior management needs to ensure that adequate resources including staffing, training, and funding are available to implement an effective post award monitoring program.

Recommendations

We recommend that the Chief Financial Officer:

1. Provide the staffing, training, and funding resources necessary to effectively conduct grant monitoring activities.

2. Require full implementation of post award grant monitoring policies and procedures provided in the Award Monitoring and Business Assistance Program Guide (the Guide).

3. Develop the following for inclusion in the Guide:

    (i) Policies and procedures for the review of NSF grantees that fall into the medium and low-risk categories.

    (ii) Additional criteria for identifying high-risk grantees.

    (iii) Requirements for reviewers to maintain documentation in grant files on their monitoring activities in terms of what transactions and documents were reviewed, what questions were asked, what responses were received, what corrective actions resulted, etc.

    (iv) Policies and procedures to monitor the accuracy of grantee expenditure reports submitted to the NSF.

    (v) Policies and procedures for the types of review activities that should be conducted on each grantee depending on the type of grantee, the level of risk assessed, and the area of focus where oversight is needed.

KPMG

Exhibit 2

Status of FY 2002 Reportable Conditions

02-01: Post–award Management

A. Financial Monitoring of Grant Awards

Although NSF has a robust system of award management over its pre-award and award phases, NSF continues to need improvement in implementing a comprehensive and systematic risk-based internal grants management program to monitor its post-award phase. Our review of NSF's corrective actions in fiscal year 2003 revealed that it needs to fully implement its post-award monitoring procedures, dedicate adequate resources both in terms of additional funding and staffing before effective monitoring can take place. As a result, this reportable condition is being repeated in fiscal year 2003.

B. Monitoring of Assets Owned by NSF in the Custody of Other Entities

NSF has developed and substantially implemented procedures in fiscal year 2003 to monitor NSF assets in the custody of other entities to ensure that such assets are protected from loss, misuse, or theft, and reliable and timely information is obtained on the value of these assets. As a result, this reportable condition is considered resolved.

02-02: Information Security

Our review of NSF's corrective actions in fiscal year 2003 revealed that NSF has made significant progress in developing, refining, and implementing its information security program, although certain improvements are still needed to strengthen NSF's security posture and to ensure compliance with the Federal Information Security Management Act. As a result, this reportable condition is considered resolved, and the remaining issues will be communicated in a management letter.

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

November 7, 2003

To: Christine C. Boesz
Inspector General

From: Thomas N. Cooley
Chief Financial Officer

Subject: Management's Response to Independent Auditors' Report
Fiscal Year 2003

This memorandum and attachments transmit NSF management's response to KPMG LLP's audit report for fiscal year 2003. We have included detailed responses to the findings as Attachment 1.

SUMMARY

The auditors' report concluded that NSF's financial statements as of and for the years ended September 30, 2003, are presented fairly, in all material respects, and are in conformity with generally accepted accounting principles in the United States of America.

Reportable Conditions

The FY 2003 auditors' report identified one repeat audit finding that was deemed to be a reportable condition. The finding has moved to the next step in our post-award management program and is focusing on resources to fully implement our plans. The report also concluded that significant progress was made in part (ii) of last year's finding related to NSF owned property in awardees' custody. This part of the finding was not repeated in FY 2003.

- Post-Award Management

The auditors identified one reportable condition related to NSF's post award grant monitoring procedures. For NSF to fully implement its post award grant monitoring procedures adequate resources both in terms of additional funding and staffing are necessary before effective monitoring can take place. Further, additional policies and procedures are necessary to ensure that all post award

activities are addressed comprehensively, and to improve existing policies and procedures.

NSF Management Response:

NSF management generally agrees with the recommendations related to the Post Award Grant Monitoring activities, and has continued to take actions to address these concerns. We are pleased that the Office of the Inspector General (OIG) and the KPMG Audit staff have recognized our progress in this regard. We have made credible and significant improvements by establishing and implementing our Award Monitoring and Business Assistance Program. We are seeking both additional resources and the optimal organizational structure to perform effective and efficient post-award management.

I would like to thank the OIG and KPMG staff for working in such a professional and dedicated manner with my staff to accomplish our accelerated reporting goals. Together, through coordinated planning and the diligence of our staffs, we were able to complete the audit process two and half months earlier this year—an achievement we can all be proud of.

NSF management appreciates the cooperation extended by both the OIG and KPMG LLP throughout the audit process. We will continue with our collaborative efforts to maintain the high levels of internal controls and effective and efficient practices at NSF.

cc: Dr. Warren M. Washington

Attachment 1

Attachment 1

Management's Responses to Auditors Report

Management's Response to 03-01 Post-Award Management

We have reviewed the Notification of Findings and Recommendations with regard to post-award monitoring and we are in general agreement with them. We are pleased that the Office of the Inspector General and the KPMG Audit Staff have recognized our progress and the significant effort we have put toward developing a sound program, based on pilot testing, results assessment, and continued enhancements.

We have developed a strategic program, our Award Monitoring and Business Assistance Program (AMBAP), that balances risk mitigation and cost-benefit. This program incorporates our post-award management monitoring and those complementary activities that support its effective implementation. This program includes:

- A dynamic risk assessment framework that integrates institutional and award risks. The data elements that describe our risk factors are incorporated into our database, allowing for electronic analysis.

- A site selection process that uses data from the above as a first level of identification. Our comprehensive site selection process supplements the outputs from the implementation of the risk assessment framework, with specific program office referrals and requests; institution- initiated requests; reverse site visits; and audit resolution visits.

- The AMBAP Guide that includes: core review areas, preparation protocols; site visit tools; post visit follow-up with NSF program staff and NSF grantees; and reporting and documentation requirements for which timeliness will be improved as resources increase.

- A BFA award monitoring training program that integrates a core curriculum and hands on training during on-site visits.

- For additional validation we have contracted with IBM Consultants to conduct an independent assessment of NSF's post-award management system to validate and verify the framework for assessing award risks and attendant award monitoring and management plans.

With respect to resources:

- We have increased the resources devoted to this effort over the last two years and this is demonstrated by the fact that we conducted visits to 32 awardee institutions with 1,351 active awards representing over $700 million in assistance funding. We have continued to invest in staff training.

- We have expanded our outreach activities to include targeted business assistance to grantees by type and/or risk factor. For example, we host reverse site visits for recipients of the Math and Science Partnership awards.

- We are seeking both additional resources and the optimal organizational structure to perform effective and efficient post-award management.

We will continue to develop this activity, informed by the IBM assessment, feedback from the awardee community, and the analysis of the results of the ongoing on-site monitoring itself. A key outcome from the implementation of the FY03 post-award monitoring activity is that nowhere did we find fraud, waste, abuse, or misuse of the NSF funding we reviewed.

Ultimately, the National Science Foundation will make the determination as to the appropriate level of resources to be devoted to this activity, within the context of the accomplishment of our overall mission.

IV. OTHER REPORTING REQUIREMENTS

OTHER REPORTING REQUIREMENTS

Debt Collection Improvement Act of 1996

Net Accounts Receivable totaled $18,448,637 at September 30, 2003. Of that amount, $18,246,756 is receivable from other federal agencies. The remaining $201,881 is receivable from the public. NSF fully participates in the Department of the Treasury Cross-Servicing Program. In accordance with the Debt Collection Improvement Act, this program allows NSF to refer debts that are delinquent more than 180 days to the Department of the Treasury for appropriate action to collect those accounts. Additionally, NSF seeks Department of Justice concurrence for action on items over $100,000.

Civil Monetary Penalty Act

There were no Civil Monetary Penalties assessed by NSF during the relevant financial statement reporting period.

Prompt Payment Act

NSF continues to strive for the highest levels of electronic fund transfers (EFT) payments required by the Prompt Payment Act. Payroll, vendor and grantee payment transactions are made by EFT. Only payments made to foreign banks are made by paper check. Our FastLane system utilized for grants enables grantees to draw cash as required for execution of the grant. Interest payments for commercial vendors under the Prompt Payment Act in FY 2003 is $5,191.

Cash Management Improvement Act

In FY 2003, NSF had no Treasury-State Agreement covered under the Act. NSF's FastLane system with grantee draws of cash make the timeliness of payments issue under the Act essentially not applicable to the agency. No interest payments were made in FY 2003.

Patents and Inventions Resulting From NSF Support

The following information about inventions is being reported in compliance with Section 3(f) of the National Science Foundation Act of 1950, as amended [42 U.S.C. 1862(f)]. In FY 2003, the Foundation received 870 invention disclosures. Rights to these inventions were allocated in accordance with Chapter 18 of Title 35 of the United States Code, commonly called the "Bayh-Dole Act."

Inspector General's Memorandum on Management Challenges and the Director's Response

As required by the Reports Consolidation Act of 2000, the following is the Inspector General's memorandum addressing NSF's management challenges in 2004. It is followed by the Director's response.

NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
ARLINGTON, VIRGINIA 22230

OFFICE OF
INSPECTOR GENERAL

October 17, 2003

MEMORANDUM

To: Dr. Warren Washington
Chair, National Science Board

Dr. Rita R. Colwell
Director, National Science Foundation

From: Dr. Christine C. Boesz
Inspector General, National Science Foundation

Subject: Management Challenges for NSF in FY 2004

As required by 31 U.S.C. § 3516(d), I am pleased to submit our annual statement summarizing what the Office of Inspector General (OIG) considers to be the most serious management and performance challenges facing the National Science Foundation (NSF). We have compiled this list based on our audit work, general knowledge of the agency's operations, and the evaluative reports of others, such as GAO and NSF's various advisory committees, contractors, and staff.

Because of this year's accelerated financial and performance reporting schedule, we are providing the list in October rather than December. There has been no fundamental change in the challenges this year. I should note, however, that NSF has made progress in addressing the challenges OIG has identified. The 11 specific challenges fall into five general categories, the first four of which are linked to the President's Management Agenda: 1) strategic management of agency resources, 2) improved financial performance, 3) expanded electronic government, 4) budget and performance integration, and 5) program-specific challenges.

1. Strategic Management of Agency Resources

Workforce Planning and Training

Planning for NSF's future workforce needs and training large numbers of temporary staff remains a serious problem. The workload of the agency, as reflected by the number of proposals forwarded to NSF for review, has increased by 36% over the past three years, while the agency's permanent workforce has increased just 3.6% over the past 20 years. Although advancements in

technology have enhanced productivity across the board, NSF's rapidly increasing workload has forced the agency to become increasingly dependent on temporary staff and contractors to handle the additional work. For the second year in a row, NSF's Management Controls Committee has cited the grim assessments submitted by the directorates and called human capital "a significant concern."

In addition, we consider NSF's reliance on temporary personnel, particularly in management positions, to be an area of program risk. According to NSF, 59% of the agency's program officers are in a temporary status, such as rotators from research institutions. Managers who serve at NSF on a short-term basis frequently lack institutional knowledge and are less likely to make long-term workforce planning a priority.

NSF's efforts to justify an increase in staff have been impeded by the lack of a comprehensive workforce plan that identifies workforce gaps and outlines specific actions for addressing them. Without such a plan, NSF cannot determine whether it has the appropriate number of people and competencies to accomplish its strategic goals. It was partly for this reason that NSF contracted in FY 2002 for a "business analysis," a multi-year review of its core business processes that will include a human capital management plan. As the business analysis approaches its mid-point, the preliminary assessment provided by the contractor confirms that NSF's current workforce planning activities are limited and identifies opportunities for improvement.

The first draft of the human capital management plan is expected to be only a blueprint for developing a process for managing human capital, containing few specific recommendations that will have near-term impact. According to the project schedule, it will be two more years before the plan will identify the specific gaps that NSF needs for justifying budget requests for additional staff resources. We believe that NSF cannot afford to wait that long to address its workforce issues.

Administrative Infrastructure

NSF's directorates again reported as part of their annual certification of the agency's management controls that some of the resources necessary to administer their responsibilities are inadequate. Travel funds and office space remain scarce, and these shortages impede the ability of staff to properly oversee existing awards. Adequate travel funds are necessary to conduct on-site inspections and monitor large infrastructure projects and other awards. The lack of office space adversely affects staff morale, the recruitment of new staff, and the agency's ability to store sensitive documents. If office space is inadequate at current workforce levels, it will severely constrain the agency's ability to add the staff needed to keep pace with its growing workload and budget.

The agency states that it is addressing these shortages through budget analyses and planning, assessments of space management and allocation, and increased emphasis on innovative approaches. However, 7 of the 10 directorates cited administrative resource shortages as undermining effective management controls and creating significant concern.

2. Improved Financial Performance

Management of Large Infrastructure Projects

Our audit of the Gemini Project in FY 2001 recommended that NSF improve its oversight and management of large infrastructure projects by, among other things, updating and expanding existing policies and procedures. In FY 2002, we released an audit report of the financial management of NSF's large facility projects that raised additional concerns about their management. The audit, which was conducted at the request of Congress, found that NSF's policies failed to ensure 1) that the projects remained within authorized funding levels and 2) that accurate and complete information on the total costs of major research equipment and facilities was available to decision makers. NSF responded that it would combine corrective actions recommended by this audit with those initiated as a result of the earlier Gemini audit.

During the past year NSF has continued to make gradual progress toward completing the corrective action plans. Thus far, the agency has implemented approximately half of the original recommendations, including providing guidance to staff for charging expenditures to the proper appropriations account. In June 2003, NSF hired a new Deputy Director for Large Facility Projects, and in July the agency issued a *Facilities Management and Oversight Guide*. NSF has also begun to offer Project Management Certificate Programs through the NSF Academy to help program officers improve their skills in managing large facility projects.

Nonetheless, key actions remain incomplete. Although the agency is planning supplements to the *Facilities Management and Oversight Guide*, it does not yet address the problem of recording and tracking the full cost of large facility projects, and it needs to contain more practical guidance for staff who perform the day-to-day work. A systematic process for reporting and tracking both the operational milestones and the associated financial transactions that occur during a project's lifecycle, particularly those pertaining to changes in scope, is still needed. Finally, staff involved with large facility projects need to be trained on the revised policies and procedures that affect funding, accounting, and monitoring.

Post-Award Administration

While NSF has a proven system for administering its pre-award and award disbursement responsibilities, the agency still lacks a comprehensive, risk-based program for monitoring its grants once the money has been awarded. As a result, there is little assurance that NSF award funds are adequately protected from fraud, waste, abuse and mismanagement. Recent audits of high-risk awardees, such as foreign organizations and recipients of Urban Systemic Initiative (USI) grants, confirm that in the absence of an effective post-award monitoring program, problems with certain types of grants tend to recur.

In FY 2002, NSF reviewed 35,165 proposals in order to fund 10,406 grants and cooperative agreements. Given the amount of work required to process an award, NSF is challenged to monitor its $18.7 billion award portfolio (including all active multi-year awards) for both scientific accomplishment and financial compliance. Booz-Allen and Hamilton

estimates that program officers spend just 23% of their time on award management and oversight activities and that program directors commit only 12% of their time to these efforts. During the FY 2001 and 2002 audits of NSF's financial statements, weaknesses in the agency's internal controls over the financial, administrative, and compliance aspects of post-award management were cited as a reportable condition.

NSF management has recognized these concerns and is taking steps to improve its award administration and monitoring activities. The agency has developed a risk assessment and award-monitoring document to provide guidance to staff responsible for tracking the financial aspects of awards. Using this guidance, NSF has begun to identify awardees requiring a higher level of oversight and to perform on-site evaluations of their activities. NSF has also included award management and oversight as a core business process to be evaluated in its agency-wide business analysis.

While these actions are encouraging, more needs to be done. NSF should provide more detail in its Risk Assessment and Award Monitoring Guide to ensure both comprehensive and consistent award monitoring activities. In addition, NSF's current practices should be strengthened by increasing the application of simple, cost-effective monitoring tools, such as periodic telephone calls to monitor performance and provide technical assistance, random desk reviews to ensure compliance with reporting requirements, and comparisons of financial and progress reports to proactively locate potential problems. Finally, NSF would benefit from better oversight coordination between its program officers and financial and grants managers to ensure effective sharing of information and action to address compliance issues.

Cost Sharing

Cost sharing refers to the contribution of financial or in-kind support by recipients of federal grants to the cost of their research projects. In the past, NSF program officers have usually requested cost sharing to help determine an awardee's commitment to a project and to leverage federal support of research. Federal guidelines require that the accounting of cost-shared expenses be treated in a manner consistent with federal expenditures. However, our past audit work indicates that many awardees do not adequately account for or substantiate the value of cost-shared expenditures, raising questions about whether required contributions are actually being made.

During the past year NSF has employed a dual strategy for dealing with this challenge. First, NSF has changed its policy to require cost sharing above the statutory requirement *only when there is tangible benefit to the awardee*, such as a facility that will outlast the life of the research project or income derived by the awardee as a result of the research. The agency also states that it is providing greater oversight in the risk assessment protocol and site reviews. It is too early to determine whether the change in policy is having the intended effect -- reducing cost-sharing not required by statute or program solicitation -- or to assess the effectiveness of the new risk assessment protocol. However, increased funding for travel will be needed to implement the site reviews associated with the new risk protocol, and several NSF directorates recently reported that the resources available for travel were inadequate (see Administrative Infrastructure).

3. Expanded Electronic Government

Information Security

The challenge for NSF is to implement a security program that protects key information and information systems against unauthorized access, misuse, and corruption, while maintaining the open and collaborative working environment necessary to carry out NSF's mission. Despite having made significant progress strengthening information security over the past few years, the recent hacking of the U.S. Antarctic Program's operations center in a high-profile but unsuccessful extortion attempt is a dramatic example of how vulnerable some parts of NSF's network remain to this persistent threat.

NSF's Management Controls Committee describes IT security as a significant concern in the wake of recent regional electrical blackouts, disruptions to NSF's computer network, and the demand for improved systems integration from NSF staff. Our FY 2003 review of NSF's information security program identified three significant deficiencies: lack of certification and accreditation of major systems, vulnerabilities in the United States Antarctic Program information systems, and inadequate development and implementation of agency-wide security policies. Although NSF management disagreed with our assessment of the severity of these problems, it agreed with our recommendations and is taking action to correct the problems.

The agency deserves credit for the improvements made to its security program in recent years, including implementation of a mandatory security awareness training program, establishment of an intrusion detection system, formal assignment of security responsibilities and authorities, restructuring of key security positions, appointment of an agency-wide security officer, updated security policies and procedures, and certification and accreditation of most major systems. These accomplishments are evidence of the agency's commitment to information security. However, as information security threats become more aggressive and potentially more destructive, the challenge to NSF's security program will be to provide increasing vigilance, continuous system improvement, and support at all organizational levels to ensure the integrity, confidentiality, and availability of mission critical information and information systems.

4. Budget and Performance Integration

GPRA Reporting

The Government Performance and Results Act (GPRA) was enacted by Congress in 1993 and requires each agency to produce a strategic plan that establishes specific goals against which its performance can be objectively evaluated. Building on the foundation of GPRA, the President's Management Agenda has sought to link program performance with budget decisions about agency funding. To accomplish this goal, the Office of Management and Budget (OMB) has introduced the Program Assessment Rating Tool as a means of integrating an agency's performance and budget.

But for agencies engaged in funding scientific research, GPRA poses a challenge because the benefits of basic research are not easy to measure and may not be evident for years to come. NSF relies in part on Committees of Visitors (COV) to do the difficult work of evaluating its award decisions and providing qualitative data about its performance that is used in GPRA reporting. In the past we have expressed concerns about the lack of validation for the COV information used in NSF's GPRA reports. A recent OIG audit of the COV process found that some COVs do not provide complete responses to questions regarding NSF's strategic goals and indicators. While NSF acknowledges in its performance report that limitations may exist, it does not discuss the exact nature of the data limitations. OIG recommends that these data limitations be fully disclosed so that users of the information will not misinterpret the data.

The OIG report also notes that NSF has changed how it collects and reviews data for its GPRA performance reporting in ways that raise new concerns about the objectivity of the data collection process. Beginning with FY 2002, NSF established an external Advisory Committee for GPRA Performance Assessment that reviews and assesses NSF's performance in achieving its strategic goals and related performance indicators. The Committee relies heavily on COV reports, and NSF selected "*nuggets*," i.e., research, engineering, and education highlights, to make its assessments. Since the nuggets are judgmentally selected success stories and do not represent the performance of the entire research portfolio, we believe that their usefulness as a primary assessment tool is limited. If NSF continues to use judgmental sampling, it should clearly disclose and discuss its data collection methodology in order to better inform decision makers and to comply with GPRA's reporting requirements for a complete, balanced, and objective assessment of an agency's performance. Without either a change in its data gathering process or adequate disclosure of the method's limitations, the credibility of NSF's performance reporting is compromised.

Cost Accounting

The requirement to maintain managerial cost information has gained increasing recognition over the years as an important element of an agency's reporting system. It appears in the CFO Act of 1990, and has been a federal accounting standard since 1998. Most recently, the President's Management Agenda requires an effective accounting and reporting system in order to successfully integrate budget and performance information. The measurement and comparison of inputs to outputs is fundamental to any meaningful organizational evaluation. However, at present, NSF's information systems do not readily provide basic cost accounting information needed to link its costs to its program performance. The agency is only just beginning to focus on developing a cost accounting system that will enhance its management information systems and GPRA reporting.

The FY 2002 Management Letter Report notes that NSF's financial and award systems do not track or maintain cost data for its programs and projects, and costs incurred under different funding sources are not linked to provide program officers with information to monitor the full cost of a program or project. The FY 2000, 2001 and 2002 Management Letter Reports accompanying the annual financial statement audit reports recommended that NSF identify management cost information needs for its programs, activities and projects; establish output and outcome goals for each; and develop and report cost efficiency measures that align costs with

output and outcome goals. Although NSF management plans to institute cost-measurement practices, they have stated that they must first work with the Office of Management and Budget to define NSF programs in order to establish a system for identifying and measuring the cost of these programs.

5. NSF Program-Specific Challenges

Management of U. S. Antarctic Program

The U.S. Antarctic Program provides the means by which American scientists are able to conduct polar research. Last year, the USAP sponsored nearly 700 researchers conducting 141 projects. Through its contractors, the USAP also operates the three U.S. year-round stations in Antarctica at McMurdo, Amunsden-Scott South Pole, and Palmer, as well as two research vessels. Two thousand civilian contract employees and U.S. military personnel support the work of the Antarctic scientists. NSF's contract for Antarctic support is both costly and complex. The contractor must have technical expertise in a variety of disciplines (medical, environmental engineering, etc.) and is responsible for managing a number of subcontractors in the U.S. and overseas. Therefore, it is important that NSF closely monitor the programmatic and financial performance of this large contract.

The oversight of the United States Antarctica Program remains an ongoing challenge for NSF in part because of its responsibility for the safety and good health of the more than 1000 scientists and contractors that work there during the year. When Antarctic-based personnel become ill questions are raised about whether additional measures can be taken to protect workers in Antarctica from being subjected to unnecessary risks. To address these questions, our office performed an audit of the occupational health and safety, and medical programs established by the USAP contractor.

We found that in general these programs are effective in protecting the health of Antarctic scientists and support staff. However, the audit report notes that facilities and infrastructure at the Antarctic research stations are deteriorating from age and use, and it recommends developing a life-cycle oriented capital asset management program that would serve as support for a dedicated line item (funding source) in its Research and Related Activities budget request. Also, the aged condition of the USAP's physical infrastructure was mentioned by two external committees charged with reviewing the USAP since 1997, and poses a potential health and safety hazard to the men and women who work in the harsh polar environment.

Broadening Participation in the Merit Review Process

A key NSF strategy is to broaden participation and enhance diversity in all NSF activities involving researchers, educators, and students. NSF reported both successes and frustrations in achieving their objectives over the past year. Significant gains have been made in attracting more proposals from women and minorities. Proposals from female PIs increased by 13% in 2002, while proposals from minority PIs have gone up by 29% over the past two years. NSF reported that they have expanded the use of seminars and workshops, focusing on underrepresented minorities, minority serving institutions, and geographic regions that have not

in the past received major research support from the government.

However, the number of minority awards remains a relatively small percentage of the total number of awards (5%), and the percentage has only increased slightly over the past 8 years. In addition, NSF continues to lag in its attempts to track diversity among reviewers participating in the merit review process. Increasing the number of minority reviewers is considered an effective means of promoting increases in the number of proposals from and awards to minority PIs. Demographic information was volunteered for only 3,507 out of a total of 37,943 distinct reviewers. NSF intends to continue its efforts to identify new reviewers from underrepresented groups, but states that it cannot require reviewers to provide demographic information.

Math and Science Partnership

In spite of the significant amount of money invested by the federal government in programs to improve K-12 education, the Nation's Report Card and other evaluations of math and science education continue to indicate that achievement gaps still exist between American schoolchildren and their foreign counterparts. The Math and Science Partnership Program was established to promote partnerships between state and local school districts, and colleges and universities to improve math and science education at the K-12 level. NSF made 23 multi-year awards worth approximately $230 million in FY 2002, and 12 multi-year awards worth approximately $203 million in FY 2003. NSF will fund many of these projects for up to five years.

To be successful, NSF will need to resolve difficult issues such as how best to facilitate partnerships between parties that are not used to working together (e.g., university math and science departments, and local school systems), determining how the success of the projects will be evaluated, and the challenge of monitoring awardees with limited experience in handling federal funds. Although NSF has developed a 6-pronged plan for the oversight and management of MSP awards that includes site and reverse site visits to awardees, use of cooperative agreements for the larger more complex awards, and a contract to develop a substantial overall program evaluation, the plan will be difficult to implement given resource and technical constraints. An audit of specific issues associated with the administration of the program is planned for the fall.

NATIONAL SCIENCE FOUNDATION
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OFFICE OF
THE DIRECTOR

November 3, 2003

MEMORANDUM

From: Director, NSF

To: Inspector General, NSF

Subject: Response to the Inspector General's Memorandum on Management Challenges for NSF in 2004

Thank you for your memorandum of October 17, 2003 on the management and performance challenges facing the National Science Foundation, as authorized by the Reports Consolidation Act of 2000.

The Foundation is recognized as an effective, efficient agency, and we build continuously on our legacy of excellence. NSF's achievements are acknowledged in the President's management scorecard, where we receive "green lights" in financial management and electronic government. In addition, the recent report from the Foundation's external Advisory Committee for GPRA Performance Assessment finds that accomplishments from NSF programs demonstrate that our investments in research and education are well made.

As the rapidly changing character of research and the increasing workload have placed new demands on NSF staff and systems, the Foundation continues to hold the agency's business process to the same high standards as its investments in science and engineering. Our new strategic goal for organizational excellence reflects our commitment to innovation in the administration and management of NSF's activities as they grow in size and complexity.

NSF has a vigorous process to identify and address the management challenges that accompany change. Your memorandum notes many of the same areas. We continue to act on these challenges. Steps taken in FY 2003 include:

- *Development of a revised NSF Strategic Plan.* The Plan aligns NSF's strategic goals with investments, and provides a framework for budget, cost and performance integration. Based on continued steady progress, NSF's score on the President's Management Agenda scorecard for Budget and Performance Integration rose from "red" to "yellow" in the scorecard for the fourth quarter of FY 2003.

- *Strengthened information security*. A security management structure is now fully in place. Significant time and resources were invested in certification and accreditation of

systems: eighteen of nineteen major systems were completed by the end of FY 2003. An NSF-wide Security Working Group has been established addressing both physical and IT security, and 95 percent of NSF staff and contractors received IT security training. Also, the agency developed and tested a Continuity of Operations Plan that covers people, facilities and business processes, to enable resumption of NSF functions in case of disruption. This plan is closely linked to the agency's Disaster Recovery Plan focused on IT.

- *Progress in strategic business analysis*. The first iteration of an NSF human capital management plan is completed and under review. The plan provides the basis both for near-term improvements and, as it is refined, for longer term changes drawing on findings over the course of the five-year strategic business analysis. A pilot restructuring process has been initiated in the Directorate for Computer and Information Science and Engineering.

- *Establishment of a formal Award Monitoring and Business Assistance Program*. The program is documented in an Award Monitoring and Business Assistance Program Guide, including a training program, a framework for risk assessment and asset management, and an award monitoring site visit review module. Cost sharing is identified as a high-risk factor and is a focus of the risk assessment protocol.

- *Proactive approach for Math and Science Partnerships*. Awards recommended in FY 2003 for Comprehensive Partnerships were subjected to more intensive review, including early analysis of the prospective awardees' experience/ability to handle federal funds. Based on the analysis, a prospective awardee was provided with additional technical assistance by NSF business operations staff. A coordinated post-award effort is underway as well, including outreach, site visits and an administrative workshop for all awardees.

- *Implementation of the Facilities Management and Oversight Guide.* The Guide is a “living document,” to be updated over time to reflect policy changes and lessons learned as NSF continues to create and operate facilities at the research frontiers. Within the comprehensive framework of the Guide, modules are under development to allow users to drill down in areas where they seek greater detail. Work is also underway to enhance NSF’s financial management systems to facilitate tracking of life cycle costs.

- *Validation of GPRA performance assessment process*. NSF management and external experts gave careful consideration to the Foundation's use of collections of outstanding accomplishments and examples ("nuggets") as part of the GPRA assessment process. The Advisory Committee for GPRA Performance Assessment reported that this approach is appropriate, reasonable and useful for GPRA reporting purposes, and an external contractor undertaking GPRA performance measurement verification and validation concurred with this assessment.

We will continue to take strategic steps to address the challenges before us and to seek additional resources to keep pace with our increasing, and increasingly complex, workload. We take pride in the commitment of NSF staff to the agency’s mission, and in our efforts to maximize the Foundation’s effectiveness and performance.

Rita R. Colwell

V. APPENDIXES

DESCRIPTION OF NSF DIRECTORATES AND MANAGEMENT OFFICES

The **Directorate for Biological Sciences (BIO)** supports research programs ranging from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, through cells, organs and organisms, to studies of populations and ecosystems. It encompasses processes that are internal to the organism as well as those that are external, and includes temporal frameworks ranging from measurements in real time through individual life spans, to the full scope of evolutionary times. Among the research programs BIO supports is fundamental academic research on biodiversity, environmental biology, and plant biology, including providing leadership for the Multinational Coordinated *Arabidopsis* Genome Project.

The **Directorate for Computer and Information Science and Engineering (CISE)** supports research on the foundations of computing and communications devices and their usage, research on computing and networking technologies and software, and research to increase the capabilities of humans and machines to create, discover, and reason with knowledge by advancing the ability to represent, collect, store, organize, locate, visualize, and communicate information. CISE also supports planning and operations of centers and facilities that provide national cyberinfrastructure supporting science and engineering research and education. CISE supports a range of activities in education and workforce that complement these efforts.

The **Directorate for Education and Human Resources (EHR)** supports activities that promote excellence in U.S. science, technology, engineering, mathematics (STEM) education at all levels and in all settings (both formal and informal). The goal of these activities is to develop a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians, and educators, as well as a well-informed citizenry with access to the ideas and tools of science and engineering. Support is provided for individuals to pursue advanced study, for institutions to build their capacity to provide excellent STEM education, and for collaborations to strengthen STEM education at all levels by fostering partnerships among colleges, universities, school districts, and other institutions in the public and private sectors.

The **Directorate for Engineering (ENG)** supports research and education activities contributing to technological innovation that is vital to the nation's economic strength, security, and quality of life. ENG invests in fundamental research on engineering systems, devices, and materials, and the underpinning processes and methodologies that support them. Emerging technologies—nanotechnology, information technology and biotechnology—comprise a major focus of ENG research investments. ENG also makes critical investments in facilities, networks and people to assure diversity and quality in the nation's infrastructure for engineering education and research.

The **Directorate for Geosciences (GEO)** supports research in the atmospheric, earth and ocean sciences. Basic research in the Geosciences advances our scientific knowledge of the Earth and advances our ability to predict natural phenomena of economic and human significance, such as climate change, weather, earthquakes, fish-stock fluctuations, and disruptive events in the solar-terrestrial environment. GEO also supports the operation of national user facilities.

The **Directorate for Mathematical and Physical Sciences (MPS)** supports research and education in astronomical sciences, chemistry, materials research, mathematical sciences and physics. Major equipment and instrumentation such as telescopes and particle accelerators are provided to support the needs of individual investigators. MPS also supports state-of-the-art facilities that enable research at the cutting edge of science and research opportunities in totally new directions.

The **Directorate for Social, Behavioral and Economic Sciences (SBE)** supports research to build fundamental scientific knowledge about human behavior, interaction, and social and economic systems, organizations and institutions. SBE also facilitates NSF's international activities by promoting partnerships between U.S. and foreign researchers, enhancing access to critical research conducted outside the U.S. and increasing knowledge of mutually beneficial research opportunities abroad. To improve understanding of the science and engineering enterprise, SBE also supports science resources studies that are the nation's primary source of data on the science and engineering enterprise.

The **Office of Polar Programs (OPP)**, which includes the U.S. Polar Research Programs and U.S. Antarctic Logistical Support Activities, supports multidisciplinary research in the Arctic and Antarctic regions. These geographic frontiers—premier natural laboratories—are the areas predicted to be the first affected by global change. They are vital to understanding past, present, and future responses of Earth systems to natural and man-made changes. Polar Programs support provides unique research opportunities ranging from studies of Earth's ice and oceans to research in atmospheric sciences and astronomy.

The **Office of International Science and Engineering (OISE)** serves as the focal point, both inside and outside NSF, for international science and engineering activities and manages international programs that are innovative, catalytic and responsive to the broad range of NSF interests. The Office supports international collaborative research that provides U.S. scientists and engineers access to the world's top researchers, institutions and facilities. The Office also supports several programs that provide international research experiences to students and young investigators, preparing them for full participation in the global research enterprise.

The **Office of Budget, Finance and Award Management (BFA)** is headed by the Chief Financial Officer who has responsibility for budget, financial management, grants administration and procurement operations and related policy. Budget responsibilities include the development of the Foundation's annual budget, long range planning and budget operations and control. BFA's financial, grants and other administrative management systems ensure that the Foundation's resources are well managed and that efficient, streamlined business and management practices are in place. NSF has been acknowledged as a leader in the federal research administration community, especially in its pursuit of a paperless environment that provides more timely, efficient awards administration.

The **Office of Information and Resource Management (OIRM)** provides information systems, human resource management, and general administrative and logistical support functions to the NSF community of scientists, engineers, and educators as well as to the general public. OIRM is responsible for staffing and personnel service requirements for staff members including visiting scientists; NSF's physical infrastructure; dissemination of information about NSF programs to the external community; and administration of NSF's sophisticated technological infrastructure, providing the hardware, software and support systems necessary to manage the Foundation's grant-making process and to maintain advance financial and accounting systems.

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Executive Officer
National Science Board

[1] From July 28, 2003

MANAGEMENT CHALLENGES AND REFORMS

This appendix contains a discussion of management issues presented in the President's Management Agenda or identified for NSF and other federal agencies by OMB or GAO, in NSF's annual review of financial and administrative systems as required by the Federal Managers' Financial Integrity Act, or by the NSF Office of Inspector General. The OIG issues addressed are those included in a December 23, 2002 memorandum on NSF's management and performance challenges.

Many of the issues discussed also fall within the purview of the internal NSF Management Controls Committee (MCC), chaired by the Chief Financial Officer. That committee provides continuing and long-term senior executive attention to NSF's management challenges and reforms.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Broadening Participation in the Merit Review Process (OIG)	
NSF's OIG (December 2002*) noted "Increasing the participation of minority scientists as proposers, reviewers, and investigators, while maintaining the integrity of the award process, remains an important priority and challenge for NSF." The OIG notes that the NAPA study on the Foundation's criteria for project selection, which focused on the impact of the "broader impacts" criterion recommended "broader-based review panels with participants drawn from a wider range of institutions, disciplines and underrepresented minorities" but also noted that low participation in voluntary data disclosure has hampered accurate data tracking.	NSF considers its merit review process the keystone for award selection. The agency evaluates proposals using two criteria – the intellectual merit of the proposed activity and its broader impacts. NSF staff rely on expert evaluation by selected peers when evaluating proposals and making funding decisions. Each year, more than 250,000 merit reviews are provided to assist NSF with the evaluation of proposals. NSF focuses its management activities on a wide variety of issues related to merit review – including use of both merit review criteria by reviewers and program officers, broadening participation, and enhancing customer service. NSF also makes use of Directorate Advisory Committees for research and education programmatic guidance, and Committees of Visitors for an independent assessment of the processes used for award selection and the outcomes obtained. As a result of NSF guidance to proposers in the *Grant Proposal Guide* (GPG) that each project summary must address both review criteria, proposals were returned without review in FY 2003 for non-compliance if they failed to address both criteria. Also in FY 2003 the quantitative GPRA goal was achieved for usage of both criteria by reviewers. A similar goal for usage by NSF program officers was not met. In FY 2002 and FY 2003 NSF continued to expand the use of seminars and proposal writing workshops for broadening participation purposes, focusing on underrepresented minorities, minority serving institutions (Tribal Colleges, Historically Black Colleges and Universities, and Hispanic Serving Institutions), and regions of the country that normally do not receive major research support from the federal government. While obtaining data about the gender and ethnicity of individual reviewers has remained a challenge, NSF has moved to the strategy of employing NSF's science and engineering staff for diversity. The Foundation met its FY 2003 GPRA goal to initiate development of an NSF science and engineering diversity plan. Although the Foundation increased the number of minority women appointed to its science, engineering and management staff, NSF did not meet its overall GPRA goal to increase such appointments from underrepresented groups. Still, NSF has demonstrated great progress by infusing diversity in its review panels, Directorate Advisory Committees, and it's Committees of Visitors.

*The December 2002 OIG reference that appears throughout this section refers to the NSF Inspector General's statement concerning NSF's Management and Performance Challenges. See the NSF FY 2002 Performance and Accountability Report to view a copy.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
	Over 10 years, awards going to minority serving institutions have increased from about 2.7% to 4% in 2002. Moreover, underrepresented minority investigators, women and majority men have about the same success rate for proposals submitted to NSF, 29%, 30%, and 30% respectively. While the number of proposals continue to increase for the following groups, women received (in FY 2002) about 20% of all awards going to NSF researchers, and underrepresented minorities received about 5% of all awards.

Management of Large Infrastructure Projects (OMB, OIG)

In response to OMB concerns related to NSF's capability to manage proposed multi-year, large facility projects given their magnitude and costs NSF was asked to develop and submit a plan to OMB that documents its costing, approval, and oversight of major facility projects. The NSF OIG (December 2002) noted concern about the management of NSF's large infrastructure projects, stating "In particular, fund control and the accurate accounting for infrastructure projects have been cited as a problem in recent audit reports." Concerns were noted that policies and procedures allowed the use of multiple appropriation accounts to fund projects; that NSF's accounting only captured costs funded from the MREFC account; and that "…NSF could not ensure it stayed within its authorized funding limits or that it provided accurate and complete information about project costs to key decision makers." The OIG also noted that "…NSF has made progress toward correcting the types of problems identified" in audits and that "the agency recently issued its current draft of the Facilities Management and Oversight Guide and instructed staff to begin using it." The OIG also recognized that NSF "will continue to make needed improvements to the Guide over time."	NSF continues its efforts to improve management and oversight of its large facility projects. In June 2003, a new Deputy Director for Large Facility Projects came onboard, within BFA, to strengthen NSF's ability to effectively manage large facility projects. On July 31, 2003, the *Facilities Management & Oversight Guide* was released after addressing and incorporating both internal and external review and comment. The Guide will be a *living document* to be updated over time, to reflect policy changes and lessons learned, as the Foundation continues to create and operate facilities at the research frontiers. Additional supporting material is being developed in modular form that will provide more detailed information and instruction. The purposes of the Guide are as follows: • Provide requirements and guidance to NSF staff and Awardees to strengthen project management and oversight of large facilities. • State clearly the policies, procedures and requirements that come into play at each stage of the facility project – throughout its lifecycle. • Document the experience, knowledge and best practices gained over many years in order to facilitate a process of continuous improvement, based upon the learning of best practices. The Facilities Management and Oversight Guide is available on the Web at http://www.nsf.gov/pubsys/ods/getpub.cfm?nsf03049 Regarding fund control and accounting, NSF has strengthened its procedures for large facility projects through issuance of standard operating guidance for handling funds for projects funded through the MREFC account (July 2001) and with sections on Budgeting and Funding in the Guide. NSF is also working with a contractor to enhance the financial system to facilitate tracking of life cycle costs for MREFC projects. The Foundation has provided complete and detailed information about project costs through special reports to Congress (February 2002, July 2002) and such information is now routinely included in NSF's annual budget request to Congress.

Award Administration (OIG)

Award administration is a broad term used to describe the award and program monitoring directed toward scientific progress and the oversight exercised by BFA (Office of Budget, Finance, and Award Management) over grantees' financial management of NSF awards. The NSF OIG (December 2002) noted that "NSF	In FY 2002, BFA initiated a pilot program of risk based award monitoring site visits to strengthen its stewardship of federal funds by augmenting NSF existing award management and oversight activities. The program set forth a strategic framework for assessing and managing awardee risks and assets focusing on financial and administrative monitoring and was designed to test the proposed site visit methodology and tools. During FY 2002, NSF and BFA staff conducted award monitoring site visits at 19 awardee institutions with 1,360 active awards representing $2.3 billion in NSF support.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
lacks a comprehensive, risk-based management program to monitor its grants during the post-award phase" and that this challenge will be a reportable condition again in the FY 2002 Management Letter Report. The OIG noted that NSF should establish policies for award monitoring "including 1) implementing a comprehensive risk-based program that describes when and how monitoring will occur; and 2) establishing a system of risk assessment of awardees to ensure that each receives the appropriate level of oversight." The OIG also noted that "NSF recently issued a draft version of a Risk Assessment and Award Monitoring Guide and has been working closely with the OIG to address this challenge. The Guide is generally responsive to the recommendations outlined in the FY 2001 Management Letter Report and represents an important first step to improving NSF's post-award administration practices" but encouraged more detail and more emphasis on lower risk awardees.	Informed from its experience with the pilot program, BFA established a formal Award Monitoring and Business Assistance Program (AMBAP) in FY 2003. Using the new AMBAP procedures and guidelines, BFA site visited 32 awardee institutions with 1,351 active awards representing $700 million in NSF support. The new award monitoring program is documented in the *Award Monitoring and Business Assistance Program Guide*. It includes the following major components: • An *Award Monitoring Training Program* that consists of a core curriculum and hands on training for BFA staff members during on-site monitoring visits. • An awardee review selection process based on an established framework for risk assessment and asset management. • An annual plan that is resource dependent and is flexible to accommodate programmatic and/or awardee assistance requests that may arise throughout the year. • *An Award Monitoring Site Visit Review Module* that is prepared at the trainee level to provide detailed instructions on how to plan, conduct, and report on award monitoring and business assistance site visits. The Award Monitoring and Business Assistance Program Guide is available on the Web at http://www.inside.nsf.gov/bfa/dga/. The Foundation continues to disagree with the categorization of this issue as a reportable condition, and sees this ongoing activity as a management challenge for the foreseeable future.
GPRA Data Quality (OIG)	
The NSF OIG (December 2002) noted, "We continue to have concerns about the validity and quality of NSF's Government Performance and Results Act (GPRA) data and outcome measures." Particular concerns were expressed about the perception of too many GPRA goals, the need for more agency level data capture to support programs, and the need for clarity in the priority setting process.	Since the FY 2000 GPRA reporting cycle, NSF has engaged an external party to provide an independent verification and validation (V&V) of selected GPRA goals. The V&V focused on reliability of data, on processes to collect, process, maintain, and report the data, and on program reports prepared by external experts. The V&V report maps out NSF procedures against GAO guidance for polices and procedures that underlie GPRA performance reporting. The annual V&V assessments for FY 2000 - 2003 were positive and constructive and have helped NSF be in compliance with standards set forth in OMB Circular A-11. For example, the report on FY 2003 results concluded that "NSF has made a concerted effort to assure that it reports its performance results accurately and has effective systems, policies and procedures to promote data quality. Overall, we verify that NSF relies on sound business practices, internal controls, and manual checks of system queries to report performance. NSF maintains adequate documentation of its processes and data to allow for an effective verification and validation review. Further, we validate the reliability of NSF's third and fourth quarter results through our successful recalculation and reconfirmation of these results based on processes, data and systems." Regarding the "perception of too many GPRA goals", the addition of program-specific goals from the Performance Assessment Rating Tool (PART) process may exacerbate this issue. To alleviate the situation, NSF is aligning program-specific PART goals to agency-wide goals, where possible. There will also be a reduction in the number of agency-wide goals , limiting these goals to the ones most critical to NSF's mission. NSF reassessed its GPRA outcome measures during preparation of the updated and revised 2003-2008 Strategic Plan, finalized in September 2003. The agency

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
	also engaged the services of an external management-consulting firm to conduct an integrated performance, cost, and budget strategy assessment, with the intent of obtaining different scenarios to meet our growing requirements in this arena. This assessment was completed in August 2002. Information derived from this assessment was used to develop an action plan for integrating budget, cost and performance activities. The plan was submitted to OMB to formalize NSF actions for implementing the PMA. Copies of the action plan have also been provided to the OIG and NSF's Business and Operations Advisory Committee. This plan was updated to reflect the framework outlined in the new NSF Strategic Plan and to incorporate new guidance in OMB Circular A-11.
Management of U.S. Antarctic Program (OIG)	
The NSF OIG (December 2002) has stated that "The successful operation of the USAP requires unique management and administrative skills combined with knowledge of the special needs of Antarctic researchers." They also note that "One issue that has been raised in Committee of Visitors (COV) reports, as well as our audit work, is the need to improve long-range capital planning and budgeting for repairing and maintaining the Antarctic infrastructure, including facilities, transportation, and communications.	NSF agrees with the OIG that the safety of scientists and workers, environmental concerns, and the national interests of the U.S. Government require unique management and administrative skills that are responsive to the special needs of Antarctic scientific research. In order to meet these challenges, NSF staff utilize their special expertise to: • Implement next steps in long-range plan for renovating/updating McMurdo Station infrastructure. • Coordinate Department of Defense, NASA, USGS and DOE activities; • Oversee environmental, health, safety, and medical activities; • Oversee construction and maintenance of all infrastructure at three U.S. stations in Antarctica (roads, fire stations, clinics, power stations, heating, communications, ground stations, air traffic control, ground vehicles, food services, sewage treatment, water supplies, etc.); • Coordinate support of scientists in Antarctica, construction of specialized science instrumentation, etc.; • Plan and budget for the above activities; and • Select science projects for deployment on the basis of merit review and ability to meet logistics requirements.
The Math and Science Partnership Program (OIG)	
NSF's OIG notes in December 2002, "The sustained involvement of NSF remains essential. NSF program officers now need to provide extensive coaching of the new projects …[and] will also need to assist project partners in building a shared sense of purpose and in coordinating efforts. Also, those projects involving awardees with limited experience in handling federal funds will require close monitoring of all aspects of their projects, including financial and administrative matters. Therefore, NSF staff will need to help coordinate the efforts of the various parties, monitor the progress of the projects, and ensure that federal funds are handled properly, while at the same time administering the subsequent program solicitation of approximately $200 million.	NSF has developed a comprehensive award oversight and management plan for all Math and Science Partnership (MSP) awards. NSF made 24 MSP awards in FY 2002. Larger, more complex awards were made as cooperative agreements. These cooperative agreements describe the post-award management and oversight that will support the work of MSP partnerships in realization of their goals; management and oversight activities will draw upon NSF's strong, community-based site visit processes. The lead partners responsible for both fiscal and project management of MSP-supported projects will, for the most part, be institutions with significant experience handling federal funds. In FY 2003, the 14 most highly rated Comprehensive projects were invited for reverse site visits. Prior to the reverse site visits, these 14 Partnerships were sent questions to elicit additional information emanating from questions and concerns identified by reviewers and NSF staff. At the reverse site visits, an external panel of experts engaged in discussion with each Partnership and then prepared a written summary of the panel's evaluation and engaged in final debriefing with NSF program staff. Thus, the Comprehensive Partnerships being recommended for award in FY 2003 have already been subjected to an increased and more intensive level of review, and this review has included an early analysis of the prospective awardee's experience/ability to handle federal funds. In this pre-

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
	award review and analysis, one prospective Partnership was identified as potentially needing additional technical assistance, and the Partnership (including its SRO/financial personnel) traveled to NSF for a workshop with staff from the Office of Budget, Finance and Award Management (BFA), the Division of Grants and Agreements (DGA) and the Cost Analysis/Audit Resolution Branch (CAAR), prior to recommendation for an award. DGA has developed a coordinated post-award effort, working in collaboration with CAAR and MSP Program Officers and awardees. The effort includes site visits, outreach visits and meetings with individual awardees to discuss specific issues, as well as an administrative workshop all MSP awardees. Ongoing Management and Oversight. MSP will employ a six-pronged approach to project management and oversight: (1) site and reverse site visits to awardees; (2) Program Officer review of annual progress reports and project-specific formative evaluations; (3) use of co-operative agreements for Comprehensive Partnerships and other mechanisms, such as carefully formulated "conditions of award" in grants, that enable focused oversight; (4) technical assistance, especially for new awardees; (5) an information management system; and (6) a substantial overall program evaluation, whose task order and statement of work are to be released for bid soon.
Electronic Government (PMA, OMB, GAO)	
Expanded electronic government is one of the government-wide initiatives presented in the *President's Management Agenda for 2002*. That document states that "the administration's goal is to champion citizen-centered electronic government." Specifics were delineated in the February 27, 2002 E-government Strategy Document, http://www.whitehouse.gov/omb/inforeg/egovstrategy.pdf, which includes E-grants, E-travel and E-payroll/HR projects of relevance to NSF.	The NSF Administration and Management Strategic Plan provides the framework for agency activities that address the President's Management Agenda E-government initiative. The results of NSF's E-government initiatives are significant and earned NSF the only E-government "green light," in the July 2002 scorecard from OMB. NSF has maintained green status in E-government from FY 2002 Quarter 2 to the present. The OMB mid-session review reports that NSF is a "model for successful E-Government." In FY 2002, NSF received 99.99% of proposals through electronic systems. In FY 2003, we duplicated this achievement. NSF's FastLane system, which handles virtually all business transactions with proposers and awardees, exemplifies what can be accomplished in E-government information system design, development, and implementation. NSF continues to be an active leader in interagency E-government efforts through the government-wide E-grants initiative as well as actively participating in E-travel and E-payroll/HR activities.
Data/Information (IT) Security (GAO, OMB, OIG)	
The NSF OIG (December 2002) stated "The challenge for management is to implement security controls to protect … key information systems against unauthorized access and misuse, while maintaining the open and collaborative working environment needed to achieve NSF's mission." The FY 2002 review "identified three significant deficiencies related to weaknesses in access controls, the security management structure, and the certification and accreditation of major systems. Although NSF management disagreed with our assessment of	The NSF Information Technology Security (ITS) Program remains focused on ensuring that NSF infrastructure and critical assets are appropriately protected while maintaining an open and collaborative environment for science and engineering research and education. NSF has strengthened all areas of its information security program in FY 2003, and has invested significant time and resources to certification and accreditation of all major systems. To address Foundation concerns regarding agency computer systems that might be vulnerable to attack, NSF embarked on an ambitious endeavor to identify and certify and accredit the major applications and general support systems critical to fulfill the organization's mission. NSF ultimately identified 19 systems; 18 of those systems were certified and accredited by September 30, 2003. NSF has

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
the severity of these problems, it agreed with our recommendations and is taking action to correct the problems." The OIG also noted "The agency is to be commended for the improvements in its security program made in the past year, including implementation of a mandatory security awareness training program, formal assignment of security responsibilities and authorities, restructuring of key security positions, appointment of an agency-wide security officer, and establishment of updated security policies and procedures. These accomplishments help build a foundation for a comprehensive security program and demonstrate the agency's commitment to information security." Nevertheless, concern was expressed that "more improvements are needed." GAO (01-758) noted that recent audits continue to show that federal computer systems are riddled with weaknesses that make them highly vulnerable to computer-based attacks and place a broad range of critical operations and assets at risk of fraud, misuse and disruption.	also implemented policies and processes to monitor and protect against intrusion attempts. Periodic penetration testing began FY 2003. Documentation in accordance with OMB Circular A-130, "Management of Federal Information Resources" of risk assessments and commensurate security plans for major systems is prepared and independently reviewed. NSF has a comprehensive disaster recovery and continuity of operations plan, which are tested at least annually at a remote location. In accordance with the Federal Information Security Management Act of 2002 (FISMA) and the Computer Security Act, NSF has again in FY 2003 required IT security training for all NSF staff and contractors who use NSF computer systems. Based on the FY 2003 OIG audit and security program review, the OIG closed out the three findings noted by the OIG in December 2002.

Erroneous Payments to Recipients of Government Funds (PMA, OMB)

OMB guidance and the *President's Management Agenda for 2002* addresses improved financial performance for federal agencies, including erroneous payments. In addition, the General Accounting Office (GAO) recently issued an executive guidance, which outlines strategies for agencies to effectively manage improper payments.	NSF has always understood its fiduciary responsibility to ensure taxpayer funds entrusted to it are properly controlled and disbursed. Consequently, NSF has a culture of high operating efficiencies and sophisticated systems, which results in few improper payments as part of pre-award internal controls. NSF will further expand its review of improper payments as part of NSF's annual post-award monitoring and oversight processes. NSF uses a well defined risk monitoring program to apply tools for conducting on-site reviews of NSF awardees that are deemed to have the most significant risk, and we plan to expand this to address improper payments beginning in FY 2004. This expanded approach will assist NSF as we continue to monitor improper payments and to implement those strategies that are appropriate to guard against improper payments.

Cost-Sharing (OIG)

The NSF OIG (December 2002) noted, "… audit work indicates that NSF grantees continue to experience significant problems in accounting for cost sharing, raising questions about whether required contributions are actually being made. The issues cited in our reports are primarily related to the commingling of reimbursable and cost-shared expenses, time and effort reporting, and cost-sharing certification."	During FY 2003, BFA established an Award Monitoring and Business Assistance Program which provides the strategic framework for assessing and managing awardee risks and assets. Cost sharing is identified as a high-risk factor and is a focus of the risk assessment protocol. Our increased use of on-site review provides important business and managerial assistance to awardees in this area. In addition, BFA has continued to assess issues that have surfaced since implementation of Important Notice 124, *Implementation of the New Cost Sharing Policy*. At the November 2002 meeting, the NSB approved clarifications to Important Notice 124 that are expected to improve cost sharing negotiations. Since November 2002, NSF has taken the following steps to implement the revised policy for use by NSF staff and the awardee community:

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
	• Issued Important Notice 128, *Revision of the NSF Cost Sharing Policy*, dated January 24, 2003, which addressed: - continued existence of the statutory cost sharing requirement; - restatement of the principal components of the policy including the concept of "tangible benefit"; - guidance to proposers that if cost sharing is not required by program solicitation, it should not be reflected on Line M; and - guidance to proposers that if the program solicitation did require cost sharing, the proposal should not include cost sharing in excess of the required level. • Revised NSF policy documents, e.g., *Grant Proposal Guide* and the NSF *Proposal and Award Manual* to ensure consistency with the revised cost sharing policy; • Increased emphasis to cost sharing requirements stated in solicitations to ensure clarity of understanding by all parties. • BFA has worked with DIS to develop an electronic capability in FastLane to submit the required certifications for awards that contain cost sharing in excess of $500,000. This new capability is anticipated to be available in September 2003. Overall, NSF is pursuing a two-pronged approach: 1) limit cost sharing requirements consistent with the NSB policy, and 2) provide greater oversight of cost-sharing in the risk assessment protocol and site reviews.

Competitive Sourcing [A-76 Competitions and FAIR Act Inventories] (PMA, OMB)

The *President's Management Agenda* proposes to increase competition for commercial activities performed by the government as listed on agency Federal Activities Inventory Reform (FAIR) Act inventories. OMB guidance "Conducting Public-Private Competition in a Reasoned and Responsible Manner" (July 2003) calls for agency customized competition plans built around (i) a reasoned classification of their workforce, (ii) careful consideration of where competitive sourcing can best help their mission and workforce, and (iii) collaborative reviews with OMB. OMB has also recently released a revision to its Circular A-76 (May 29, 2003), and NSF will monitor the impact of these changes.	The National Science Foundation is conducting a multi-year, comprehensive, integrated analysis of its business processes and workforce and technology management. This analysis began in July 2002, and is expected to continue through the end of FY 2005. NSF expects to dramatically improve the effectiveness and efficiency of its business processes, human capital management, and technology and tools management through this effort. In the area of human capital management, NSF is developing a strategic approach to workforce planning and deployment that: • Evaluates mission needs, customer expectations, and workload; • Identifies competencies; • Develops strategies to obtain, develop, and retain skills; and • Reduces excess organizational layers and redundancies. Clearly, this effort is likely to suggest significant changes to NSF's organizational structure and staff composition over time. Initial results from the Human Capital Planning effort were available internally by the end of September 2003. NSF will begin to develop a competitive sourcing plan or an alternative strategy for implementing the competitive sourcing initiative in FY 2004. The Human Capital Planning effort, along with other findings from the business analysis, will inform possible structural or functional realignments across the agency, and will, therefore inform the overall competitive sourcing strategy. In July 2003 the Foundation appointed a Competitive Sourcing Official (CSO) in accordance with the requirements of OMB Circular A-76 (Revised), who exercises agency-wide responsibility for implementing the circular.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Budget and Performance Integration (OIG, PMA)	
NSF's OIG noted in December 2002 that "managerial (cost) accounting information is used to assess operational effectiveness and efficiency. Cost information not only adds significant value to activities such as budgeting, cost control, and performance measurement, but also is useful in informing capital investment decisions such as prioritizing the funding of large infrastructure projects…. NSF should use its accounting systems to capture total project or outcome costs and supply information useful to the Congress, OMB, the National Science Board and NSF management." In addition, NSF is rated "red" on the Budget-Performance Integration initiative of the President's Management Agenda in part because the NSF Budget does not charge the full budgetary cost to individual activities.	NSF has made steady progress toward Budget, Cost, and Performance Integration (BCPI). Its score on the President's Management Agenda scorecard for Budget & Performance Integration rose from "red" to "yellow" on the most recent scorecard (issued 10/2003). This improvement was driven largely by the update of NSF's Strategic Plan, as the plan now aligns NSF's strategic outcome goals (People, Ideas, Tools, and Organizational Excellence) with 10 "investment categories." These investment categories provide the framework both for completing the PART (Program Assessment Rating Tool) and for the linkage of full budgetary and proprietary cost accounting. NSF is now in the process of aligning its Financial Accounting System with these investment categories, so that budgeted cost, actual cost, and performance can be tracked in tandem for NSF's investments. In addition, the agency's FY 2005 Budget submission to OMB incorporated the new alignment and included a presentation of the request with full budgetary costing.
Workforce Planning and Training (Human Capital) (PMA, OMB, GAO, OIG)	
GAO *(GAO-01-236, April 2001)* has identified shortcomings of many agencies involving key elements of modern strategic human capital management, including (1) strategic planning and organizational alignment; (2) leadership continuity and succession planning; and (3) acquiring and developing staff whose size, skills, and deployment meet agency needs. The NSF OIG (December 2002) notes, "planning for NSF's future workforce needs and training the large number of temporary staff continue to be serious concerns." Personnel records also indicate that since 1996, NSF's reliance on temporary staff has increased in tandem with the size of its appropriation … [and that the increase in temporary staff places a greater burden on the agency, particularly Human Resource Management, to continually recruit and train these personnel and find them suitable office space. Additionally, the *President's Management Agenda (2002)* includes strategic management of human capital as a government-wide initiative.	NSF is one year into a multi-year strategic business analysis, which will examine organizational alignment, workforce size, skill mix, and deployment necessary to ensure mission accomplishment. This analysis began in July 2002, and is expected to continue through the end of FY 2005. As part of this effort, NSF will develop and implement human capital strategies, which will address both the needs of the organization and the overall concerns of the President's Management Agenda. In FY 2003, NSF completed the first iteration of its Human Capital Management Plan. This plan integrates and links Human Capital activities to the NSF business plan and to the Human Capital Assessment and Accountability Framework as provided by the Office of Personnel Management. Using this outline, a cross-functional, cross-organizational, Human Capital Management Planning Team developed a working draft of the NSF Human Capital Management Plan. At the same time, NSF completed an inventory of business functions and activities for an NSF-wide workload analysis and defined competencies for all key occupations. These competencies are the basis for operationalizing the various components of the Human Capital Management Plan.

MAJOR MANAGEMENT CHALLENGE	STEPS TO ADDRESS CHALLENGE
Efficiency of the Research Process (OMB)	
In discussions with OMB, NSF has asserted that the current size of its grants and their duration might result in inefficiency at U.S. academic institutions if scientists and engineers devote a greater proportion of their time to preparing proposals than to conducting research. OMB has asked the agency to develop metrics to measure the efficiency of the research process and determine the "right" grant size for the types of proposals that the Foundation funds.	NSF surveyed the community and established an average annualized award size goal of $250,000 and average award duration goal of 5.0 years. When achieved this will improve efficiency by reducing the number of awards required to conduct research. Improving award size and duration remains among the top priorities of the Foundation, and NSF increased its award size to $136,000 in FY 2003. Award size and duration are two of the key NSF investment goals in its annual GPRA plan. Therefore, this activity will be dropped as a management challenge and retained as an annual goal for the foreseeable future.
Federal Funding of Astronomy and Astrophysics (OMB)	
NSF and NASA provide more than 90 percent of Federal funds for academic astronomy research and facilities. Historically, NASA has funded space-based astronomy and NSF has funded ground-based astronomy as well as unsolicited astronomy research proposals. Recent changes (e.g., the share of grants funding and the need for more integration of ground and space-based facilities) suggest that the Federal government's management and organization of astronomical research should be assessed.	Following the recommendations in September 2001 of the National Research Council (NRC) Committee on the Organization and Management of Research in Astronomy and Astrophysics (COMRAA) and the implementation called for in the NSF Authorization Act of 2002, NSF and NASA have established the joint Astronomy and Astrophysics Advisory Committee (AAAC). The AAAC is responsible for assessing and providing advice to both NSF and NASA on the coordination of the two agencies' astronomy and astrophysics programs and the development of strategic plans to meet community recommendations in NRC reports such as the "Astronomy and Astrophysics in the New Millennium" and "Connecting Quarks with the Cosmos". The Committee meets four times annually. Its reports are currently available at <http://www.aas.org/naaac/index.html>. This management challenge is considered closed.
Budget for Administration and Management (OIG)	
In December 2002, the OIG noted that: "It is increasingly apparent that NSF's staff is in need of two basic resources to do its job: office space and travel funds. This year's management certification of the agency's internal controls contains multiple cautionary statements from senior managers about these two issues and their impact on operations." In particular they noted that "the agency cannot afford to wait for the results of its Business Analysis, which is not expected to conclude until 2006, to begin planning for and acquiring new offices." They further note that "the shortage of travel funds affects NSF's ability to successfully address several of the management challenges identified here" and that "NSF should seek to maximize the effectiveness of staff by allocating more funding for these two essential resources."	This resource challenge is being addressed through budget analyses and planning; ongoing assessments of space management and allocation; increased emphasis on innovative and creative approaches such as telecommuting; exploring cost efficiencies that can be gained in the move to E-travel and in the use of video conferencing. NSF is also leasing additional space in Stafford II to help alleviate the current space issues. The travel budget increased in FY 2003 and a further increase is requested in the FY 2004 Budget Request for the Salaries and Expenses account.

NSF ASSESSMENT ACTIVITIES

Assessment is fundamental to the mission of the NSF, permeating all NSF processes. Using mail merit review, panel merit review, and site visits, agency personnel are continually engaged with assessment activities through the review of research and education proposals. These assessments guide the NSF investment in individual investigator proposals, centers and institutes, and major facilities[1]. Programs, divisions, directorates and other units within the agency periodically undertake assessments of the current state and future directions of science, engineering and education[2]. Both the NSF and the NSB commission assessments to determine how best the agency can serve investigators or the public[3] and to determine the effectiveness and vitality of the NSF's internal management processes[4]. In FY 1999, as part of government-wide performance assessment, NSF began reporting on the agency's annual GPRA (Government's Performance and Results Act of 1993) performance goals. In FY 2002, NSF began participation in a new assessment tool – the Program Assessment Rating Tool (PART). PART is an evaluative questionnaire developed by the White House Office of Management and Budget (OMB) for rating federal programs. In a report issued March 2003 by the U.S. General Accounting Office (GAO), NSF was identified as one of five exemplary federal agencies successfully conducting evaluative activities[5].

Committees of Visitors (COVs) and Advisory Committees (AC) are two types of review panels that the Foundation has used for over 20 years to conduct independent assessments of the quality and integrity of NSF's programmatic investments.

The following provides a more detailed description of NSF Committee of Visitors and Advisory Committees. For information about NSF's COV meeting schedule, see Appendix 6. For a schedule of the external evaluations that were completed in FY 2003, see Appendix 7.

Committees of Visitors: NSF convenes panels composed of qualified external evaluators from academia, industry, government and the public sector to review NSF's awards, declinations, and other management issues of each NSF program. These panels are known as Committee of Visitors (COV). Each program is reviewed by a COV approximately once each three years. These experts assess the integrity and efficiency of the processes for proposal review and recommendation and provide an assessment of NSF's programmatic investments. The COV process has been carefully refined and improved with specific definitions and requirements for all steps of the process, from the selection of the committee, to documentation given to the committee, to the exact task of the review, to the form and content of the report, to the

[1] *Report to the National Science Board on the National Science Foundation's Merit Review Process*, Fiscal Year 2002. NSB-03-2-66.
[2] For example, *Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure 2003* (http://www.communitytechnology.org/nsf_ci_report/) or *Assessing the Impact and Effectiveness of the Advanced Technological Education (ATE) Program Survey 2002: The Status of ATE Projects and Centers*, by Arlen Gullickson, Frances Lawrenz, and Nanette Keiser (http://www.wmich.edu/evalctr/ate/survey2002/sr2002esfinal.pdf)
[3] For example, *NSF Report on Efficiency of Grant Size and Duration.* (http://www.nsf.gov/od/gpra/grantsize/contents.htm?gpraplan97)
[4] For example, *Business Analysis*, Booz, Allen, Hamilton (ongoing)
[5] GAO-03-454, GAO Report to Congressional Committees: *Program Evaluation: An Evaluation Culture and Collaborative Partnerships Help Build Agency Capacity*, May 2003.

responsibility and actions required throughout the Foundation responding to and using the findings and recommendations of the report. COV reports are reviewed by Directorate/Office Advisory Committees before submission to the NSF Director. On behalf of the Director, NSF's Office of Integrated Activities (OIA) oversees the COV process and schedule. COVs address questions contained on a template that is modified and updated by OIA. For FY 2001, the template had two sections: The first section addressed the integrity and efficiency of the programs management and processes; the second section addressed the outcomes of investments and the extent these outcomes reflected the strategic goals of NSF.

Directorate/Office Advisory Committees (AC), whose membership parallels that of the COVs (but AC members normally serve three years), advise the seven directorates, the Office of Polar Programs, the Offices of Information and Resource Management, and the Office of Business, Finance and Award Management. The ACs provide advice on priority setting, address program effectiveness, review COV reports, examine directorate/office responses to COV recommendations, and occasionally undertake studies. For example, the Biology Advisory Committee describes its mission as advising the Directorate for Biological Sciences (BIO) on such issues as:

- How BIO's mission, programs, and goals can best serve the scientific community
- Important issues in institutional administration and policy
- How BIO can promote quality graduate and undergraduate education in the biological sciences
- Priority investment areas in biological research
- Government Performance and Results Act, including Committees of Visitors

In FY 2001 and in prior years, directorate/office advisory committees assessed directorate/office progress in achieving NSF-wide GPRA goals. With the establishment of the Advisory Committee for GPRA Performance Assessment (AC/GPA), Directorate/Office Advisory Committees no longer assess directorate progress toward these goals, although AC reports are source material used by the AC/GPA.

SCHEDULE OF PROGRAM EVALUATIONS

The following table provides information on the scheduling of meetings for Committees of Visitors (COVs) for NSF programs. The table lists the fiscal year of the most recent COV meeting for the program and the fiscal year for the next COV review of the program. The COV meetings that were held in FY 2003 are highlighted in bold.

Committee of Visitors Meetings by Directorate

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
BIOLOGICAL SCIENCES		
Biological Infrastructure	2000	2004
Instrument Related Activities	2002	2004
Research Resources	**2003**	2004
Training	**2003**	2004
Plant Genome	2001	2004
Environmental Biology	**2003**	2006
Ecological Studies	2002	2006
Thematic Review	2001	2006
Systematic and Population Biology	2000	2006
Integrative Biology and Neuroscience	2001	2005
Neuroscience	**2003**	2005
Developmental Mechanisms	2000	2005
Physiology and Ethnology	2002	2005
Molecular and Cellular Biosciences	2002	2005
Biomolecular Structure and Function	2000	2005
Biomolecular Processes	2000	2005
Cell Biology	2001	2005
Genetics	**2003**	2005
Emerging Frontiers (new in 2003)	N/A	2006

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
COMPUTER AND INFORMATION SCIENCE AND ENGINEERING		
Advanced Computational Infrastructure and Research		
Advanced Computational Research	2001	2004
PACI	2002	2004
Computer-Communications Research		
Communications	**2003**	2006
Computer Systems Architecture	**2003**	2006
Design Automation	**2003**	2006
Hybrid and Embedded Systems (new in ’02)	N/A	2006
Numeric, Symbolic and Geometric Computation	**2003**	2006
Operating Systems and Compilers	**2003**	2006
Signal Processing Systems	**2003**	2006
Software Engineering and Languages	**2003**	2006
Theory of Computing	**2003**	2006
Trusted Computing (new in ’02)	N/A	2006
Information and Intelligent Systems		
Computation and Social Systems	**2003**	2006
Human Computer Interaction	**2003**	2006
Knowledge and Cognitive Systems	**2003**	2006
Robotics and Human Augmentation	**2003**	2006
Information and Data Management	**2003**	2006
Advanced Networking Infrastructure and Research		
Networking Research	**2003**	2006
Special Projects in Networking Research	**2003**	2006
Advanced Networking Infrastructure	**2003**	2006
Information Technology Research (ITR) (new in ’00)	2004	2007
Experimental and Integrative Activities	2001	2004
-Instrumentation Infrastructure Cluster		
Research Infrastructure	2001	2004
Research Resources (new in ‘02)	N/A	2004
-Multidisciplinary Research Cluster		
Biological Information Technology and Systems (new in ’02)	N/A	2004
Quantum and Biologically Inspired Computing (new in ’02)	N/A	2004
Digital Government	2001	2004
Next Generation Software	2001	2004
-Education Workforce Cluster		
Information Technology Workforce (new in ’02)	N/A	2004
Minority Institutions Infrastructure	2001	2004
CISE Educational Innovation	2001	2004

**CISE Postdoctoral Research Associates	2001	
-EIA Special Projects Cluster		
Special Projects (new in '02)	N/A	2004
**NSF-CONACyT Collaborative Research	2001	
**NSF-CNPq Collaborative Research	2001	
**EIA monitored, managed/reviewed by Division in Partnership with Engineering		

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
EDUCATION AND HUMAN RESOURCES		
Educational Systemic Reform		
Statewide Systemic Initiatives	2001	2004
Urban Systemic Initiatives	2001	2004
Rural Systemic Initiatives	2001	2004
Office of Innovation Partnerships		
EPSCoR	2000	2005
Elementary, Secondary and Informal Education		
Informal Science Education	2001	2005
Teacher Enhancement	**2003**	2006
Instructional Materials Development	2002	2005
Centers for Learning and Teaching (new in '01)	N/A	2004
Undergraduate Education		
Teacher Preparation	2000	2004
Advanced Technological Education	**2003**	2006
NSF Computer, Science, Engineering and Mathematics Scholarships (new in '01)	**2003**	2006
Distinguished Teaching Scholars (new in '02)	N/A	2004
Scholarship for Service (new in '01)	N/A	2005
National SMETE Digital Library (new in '01)	2002	2005
Course, Curriculum, and Laboratory Improvement	**2003**	2006
Undergraduate Assessment (new in '02)	N/A	2004
The STEM Talent Expansion Program (STEP)	N/A	2005
Graduate Education		
Graduate Research Fellowships	**2003**	2006
NATO Postdoctorate Fellowships	2001	2004
IGERT (new in '97)	2002	2005
GK-12 Fellows (new in '99)	2002	2005
Human Resource Development		
The Louis Stokes Alliances for Minority Participation	2001	2005
Centers for Research Excellence In Science and Technology (CREST)	2001	2005
Programs for Gender Equity (PGE)	**2003**	2006
Programs for Persons with Disabilities (PPD)	**2003**	2006

Alliances for Graduate Education and the Professoriate (AGEP)	2001	2005
Tribal Colleges Program (TCP) (new in '01)	N/A	2005
Historically Black Colleges and Universities (HBCU)	2001	2005
Research, Evaluation & Communications		
REPP/ROLE (new in '96)	2002	2005
Evaluation	**2003**	2006
Interagency Education Research Initiative (IERI) (new in '01)	2002	2005
Other		
H-IB VISA K-12	N/A	2004
Math and Science Partnership (MSP) (new in '02)	N/A	2005

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
ENGINEERING		
Bioengineering and Environmental Systems	2002	2005
Biochemical Engineering	2002	2005
Biotechnology	2002	2005
Biomedical Engineering	2002	2005
Research to Aid the Disabled	2002	2005
Environmental Engineering	2002	2005
Environmental Technology	2002	2005
Civil and Mechanical Systems	2001	2004
Dynamic System Modeling, Sensing and Control	2001	2004
Geotechnical and GeoHazard Systems	2001	2004
Infrastructure and Information Systems	2001	2004
Solid Mechanics and Materials Engineering	2001	2004
Structural Systems and Engineering	2001	2004
Network for Earthquake Engineering Simulation	2001	2004
Chemical and Transport Systems		2006
Chemical Reaction Processes	**2003**	2006
Interfacial, Transport and Separation Processes	**2003**	2006
Fluid and Particle Processes	**2003**	2006
Thermal Systems	**2003**	2006
Design, Manufacture and Industrial Innovation		
-Engineering Decision Systems Programs (new in '02)	**2003**	2006
Engineering Design	**2003**	2006
Manufacturing Enterprise Systems (new in '02)	**2003**	2006
Service Enterprise Systems (new in '02)	**2003**	2006
Operations Research	**2003**	2006

-Manufacturing Processes and Equipment Systems	**2003**	2006
Materials Processing and Manufacturing	**2003**	2006
Manufacturing Machines and Equipment	**2003**	2006
Nanomanufacturing (new in '02)	**2003**	2006
-Industrial Innovation Programs Cluster		
Small Business Innovation Research (SBIR)	2001	2004
Innovation and Organizational Change	**2003**	2006
Grant Opportunities for Academic Liaison with Industry	**2003**	2006
Small Business Technology Transfer	2001	2004
Electrical and Communications Systems		
Electronics, Photonics and Device Technologies	2002	2005
Control, Networks, and Computational Intelligence	2002	2005
Integrative Systems (new in '02)	2002	2005
Engineering, Education and Centers	2001	2004
Engineering Education	2001	2004
Engineering Research Centers	2001	2004
Earthquake Engineering Research Centers	2001	2004
Human Resource Development	2001	2004
State/Industry/University Cooperative Research Centers	2001	2004
Industry/Univ. Cooperative Research Centers	2001	2004
Innovation Partnership Activities (new in '01)	N/A	2004

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
GEOSCIENCES		
Atmospheric Sciences		
-Lower Atmosphere Research Section		
Atmospheric Chemistry	2001	2004
Climate Dynamics	2001	2004
Mesoscale Dynamic Meteorology	2001	2004
Large-scale Dynamic Meteorology	2001	2004
Physical Meteorology	2001	2004
Paleoclimate	2001	2004
-Upper Atmosphere Research Section		
Magnetospheric Physics	2002	2005
Aeronomy	2002	2005
Upper Atmospheric Research Facilities	2002	2005
Solar Terrestrial Research	2002	2005
-UCAR and Lower Atmospheric Facilities Oversight Section		
Lower Atmospheric Observing Facilities	**2003**	2006
UNIDATA	**2003**	2006
NCAR/UCAR	**2003**	2006

Earth Sciences		
Instrumentation and Facilities	2001	2004
-Research Support		
Tectonics	2002	2005
Geology and Paleontology	2002	2005
Hydrological Sciences	2002	2005
Petrology and Geochemistry	2002	2005
Geophysics	2002	2005
Continental Dynamics	2002	2005
Ocean Sciences		
-Integrative Programs Section		
Oceanographic Technical Services	2002	2005
Ship Operations	2002	2005
Oceanographic Instrumentation	2002	2005
Ship Acquisitions and Upgrades (new in '02)	2002	2005
Shipboard Scientific Support Equipment (new in '02)	2002	2005
Oceanographic Tech and Interdisciplinary Coordination	**2003**	2006
Ocean Science Education and Human Resources	**2003**	2006
-Marine Geosciences Section		
Marine Geology and Geophysics	**2003**	2006
Ocean Drilling	**2003**	2006
-Ocean Section		
Chemical Oceanography	**2003**	2006
Physical Oceanography	**2003**	2006
Biological Oceanography	**2003**	2006
Other Programs		
Global Learning and Observation to Benefit the Environment	**2003**	2006
Opportunities to Enhance Diversity in the Geosciences	**2003**	2006
Geoscience Education	**2003**	2006

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
MATHEMATICAL AND PHYSICAL SCIENCES		
Astronomical Sciences	2002	2005
Planetary Astronomy	2002	2005
Stellar Astronomy and Astrophysics	2002	2005
Galactic Astronomy	2002	2005
Education, Human Resources and Special Programs	2002	2005
Advanced Technologies and Instrumentation	2002	2005
Electromagnetic Spectrum Management	2002	2005
Extragalactic Astronomy and Cosmology	2002	2005

-Facilities Cluster		
Gemini Observatory	2002	2005
National Radio Astronomy Observatory (NRAO)	2002	2005
National Optical Astronomy Observatory (NOAO)	2002	2005
National Solar Observatory (NSO)	2002	2005
National Astronomy and Ionosphere Center (NAIC)	2002	2005
Atacama Large Millimeter Array (ALMA)	N/A	2005
Chemistry	2001	2004
Office of Special Projects	2001	2004
Chemistry Research Instrumentation and Facilities (CRIF)	2001	2004
Organic Chemical Dynamics	2001	2004
Organic Synthesis	2001	2004
Chemistry of Materials	2001	2004
Theoretical and Computational Chemistry	2001	2004
Experimental Physical Chemistry	2001	2004
Inorganic, Bioinorganic and Organometallic Chemistry	2001	2004
Analytical and Surface Chemistry	2001	2004
Materials Research	2002	2005
-Base Science Cluster		
Condensed Matter Physics	2002	2005
Solid-State Chemistry	2002	2005
Polymers	2002	2005
-Advanced Materials and Processing Cluster		
Metals	2002	2005
Ceramics	2002	2005
Electronic Materials	2002	2005
-Materials Research and Technology Enabling Cluster		
Materials Theory	2002	2005
Instrumentation for Materials Research	2002	2005
National Facilities	2002	2005
Materials Research Science and Engineering Centers	2002	2005
-Office for Special Programs (new in 2003)	N/A	2005
Mathematical Sciences	2001	2004
Applied Mathematics	2001	2004
Topology and Foundations	2001	2004
Computational Mathematics	2001	2004
Infrastructure	2001	2004
Geometric Analysis	2001	2004
Analysis	2001	2004
Algebra, Number Theory, and Combinatorics	2001	2004
Statistics and Probability	2001	2004
Physics	**2003**	
Atomic, Molecular, Optical and Plasma Physics	**2003**	2006
Elementary Particle Physics	**2003**	2006

Theoretical Physics	**2003**	2006
Particle and Nuclear Astrophysics (new in ’00)	**2003**	2006
Nuclear Physics	**2003**	2006
Education and Interdisciplinary Research (new in ’00)	**2003**	2006
Gravitational Physics	**2003**	2006
Office of Multidisciplinary Research	**2003**	2006

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
SOCIAL, BEHAVIORAL, AND ECONOMIC SCIENCES		
Office of International Science and Engineering (INT)	2002	2005
Science Resource Statistics (SRS)	2000	
Human Resources Statistics	2002	
Research and Development Statistics	2000	2004
Behavioral and Cognitive Sciences (BCS)		
Cultural Anthropology	**2003**	2006
Linguistics	**2003**	2006
Social Psychology	**2003**	2006
Physical Anthropology	**2003**	2006
Geography and Regional Sciences	**2003**	2006
Cognitive Neuroscience (new if FY2001)	**2003**	2006
Developmental and Learning Sciences (formally Child Learning & Development)	**2003**	2006
Perception, Action, and Cognition (formally Human Cognition and Perception)	**2003**	2006
Archaeology	**2003**	2006
Archaeometry (formally part of Archaeology)	**2003**	2006
Environmental Social and Behavioral Science (new in FY1999)	**2003**	2006
Social and Economic Sciences (SES)		
Decision, Risk, and Management Sciences	2000	2004
Political Science	2000	2004
Law and Social Science	2000	2004
Innovation and Organizational Change	2000	2004
Methodology, Measurement and Statistics	2000	2004
Science and Technology Studies	2000	2004
Societal Dimensions of Engineering, Science, and Technology	2000	2004
Economics	2000	2004
Sociology	2000	2004
ADVANCE (Cross-Directorate Program, new in FY01/FY02)		2005
Science of Learning Centers (New in FY03/04)		2007

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
OFFICE OF POLAR PROGRAMS		
Polar Research Support	2001	2004
Antarctic Sciences	**2003**	2006
Antarctic Aeronomy and Astrophysics	**2003**	2006
Antarctic Biology and Medicine	**2003**	2006
Antarctic Geology and Geophysics	**2003**	2006
Antarctic Glaciology	**2003**	2006
Antarctic Ocean and Climate Systems	**2003**	2006
Arctic Sciences	**2003**	2006
Arctic Research Opportunities	**2003**	2006
Arctic Research and Policy	**2003**	2006
Arctic System Sciences	**2003**	2006
Arctic Natural Sciences	**2003**	2006
Arctic Social Sciences	**2003**	2006

DIRECTORATE *Division* Program	Fiscal Year of Most Recent COV	Fiscal Year of Next COV
OFFICE OF INTEGRATIVE ACTIVITIES		
Major Research Instrumentation (MRI)	2000*	
Science and Technology Centers (STC)	1996*	2007
NSF PRIORITY AREAS		
NSF Nanoscale Science and Engineering Priority Area	N/A	2004
*External evaluations		

TABLE OF EXTERNAL EVALUATIONS

The Table on the following pages provides information on program assessments and evaluations other than Committee of Visitor and Advisory Committee assessments.

The Table lists other types of evaluations not used in GPRA performance assessment that were completed in FY 2003. These reports, studies, and evaluations are frequently used in setting new priorities in a field or in documenting progress in a particular area. The reader is encouraged to review the reports for additional information on findings and recommendations that are beyond the scope of this report.

Reports (other than COV reports) produced by NSF are available online at http://www.nsf.gov/pubs/start.htm using the NSF's online document system and the publication number indicated.

Information on obtaining reports produced by the National Research Council or National Academy of Sciences can be found online by searching www.nap.edu or from the National Academy Press, 2101 Constitution Avenue, N.W., Lockbox 285, Washington, D.C. 20055 (1.800.642.6242).

Evaluations Completed in FY 2003

	Directorate for Biological Sciences (BIO)
Infrastructure for Biology at Regional to Continental Scales Working Group of the American Institute of Biological Sciences White Paper on the National Ecological Observatory Network	**Findings:** IBRCS White Paper *Rationale, Blueprint, and Expectations for the National Ecological Observatory Network*, explains the scientific rationale behind the need for NEON, how NEON will operate to meet that need, and the results that NEON is expected to produce. The IBRCS white paper is a summary and evaluation of past NEON and BON workshops on relevant infrastructure and data-networks and a synthesis of the current scientific communities perspective on networks and infrastructure needed to address biological research at over large geographical regions, and highlights the need for coordinated scientific infrastructure that is itself spread over large regions. Ongoing advances in our technical capability permit the development of networks of people and tools that can meet that need. NEON has been designed by the scientific community to capitalize on such capabilities and to enable discoveries about our nation's ecosystems that until now have been impossible to address. By fostering collaboration, the development of new tools and technologies, and the study of regional- and continental-scale questions, NEON will produce new perspectives in ecosystem science and thus public benefits, both anticipated and unforeseeable. **Recommendations:** 1. NEON should provide a research platform that will apply experimental, observational, analytical, communication, and information technologies to investigate the structure, dynamics, and evolution of ecosystems in the United States, to measure the pace of biological change resulting from natural and human influences at local to continental scales, and to forecast the consequences of that change. 2. Each observatory will provide state-of-the-art infrastructure to support interdisciplinary, integrated research at regional to continental scales. Collectively, the network of observatories will allow scientists to conduct comprehensive, local to continental-scale experiments on ecological systems. 3. NEON should be designed to provide an integrated network of regionally distributed, extensively-instrumented, shared use research observatories with teleobservation and teleoperation capabilities; next generation laboratory instrumentation, field-based sensors, and computational infrastructure; curated repository system; and information technology to facilitate collaboration in biological sciences and education. 4. NEON should be administered and governed through a national-level coordinating agency. **Availability:** **http://ibrcs.aibs.org/reports/pdf/IBRCSWhitePaper_NEON.pdf**

Microbial Research: Progress and Potential	**Findings:** NSF Microbial Observatories (MO)/Life in Extreme Environments (LExEn) PI Workshop to discuss recent accomplishments and point to future directions in microbial diversity research. The MO and LExEn programs have fostered significant advances in microbial diversity research, discovering novel microbial lineages, describing the complexity of natural microbial communities, and linking microbial taxa to critical ecosystem functions. The LExEn program has now run its course. Despite the success of the MO program in addressing a critical research need in site-based microbial discovery and activity, significant funding gaps remain in areas such as: • Microbial discovery that is not site-based; • Microbe-microbe interactions; • Microbial community interactions (physiological, biochemical, genetic); • Natural patterns of microbial distribution; • Environmental proteomics and functional genomics. **Recommendations:** 1. Continue the MO program, broadening its scope to include smaller microbial diversity projects that need not be site-based, and are geared more to individual investigators. Consider establishing this or a similar activity as a core program for integrative microbial diversity research. 2. Increase NSF funding opportunities and resources to support continued advances in areas such as: i) environmental microbial genomics, metagenomics and proteomics; ii) environmental sequence databasing and informatics; iii) microbial cultivation-based approaches that take advantage of recent advances in micro- and nanotechnologies; iv) environmental sample and culture collection archiving and v) improved micro- and nanosensor techniques to identify and quantify metabolites in situ, as well as follow reactant sources and products in real time. **Accessibility:** http://www.simo.marsci.uga.edu/MainWeb/pages/MOLExEnWorkshop.pdf

Frontiers in Polar Biology in the Genomic Era	**Findings:** The new era of genomics is opening doors to an unparalleled realm of research questions, and polar scientists are poised to make great advances. The application of new genomic technologies has the potential to be a unifying paradigm for polar biological sciences. However, to facilitate the advancement of polar genome sciences, coordination of research efforts will be required to ensure efficient transfer of technologies, provide guidance to researchers on choosing organisms for genome analyses, and help in the development of new scientific initiatives. Although genomic technologies are applicable to some of the key questions in polar biology, the technical demands of genome science often transcend the resources of any individual researcher. The development of enabling technologies is critical to the successful application of genomic technologies to polar studies. There is a need for enhanced flow of information about polar biology to a wide audience of scientists, policymakers and the general public, because of the important role that polar systems play in global-scale phenomena. A number of impediments to conducting multidisciplinary integrated polar science exist, including administrative, fiscal and infrastructure issues. **Recommendations:** NSF should develop a major new initiative in polar genome sciences emphasizing collaborative multidisciplinary research. The initiative could: Facilitate genome analyses of polar organisms and support the relevant research on their physiology, biochemistry, ecosystem function, and biotechnological applications. Capitalize on data from existing LTER and Microbial Observatory sites, and enable research conducted at sites with comparable conditions at both poles. NSF should form a scientific standing committee to establish priorities and coordinate large-scale efforts for genome-enabled polar science. NSF should support some mechanism to facilitate gene sequencing and related genomic activities beyond the budget of an individual principal investigator, such as virtual genome science centers. Ancillary technologies such as observatories, ice drilling, remote sensing, mooring and autonomous sensors, and isotope approaches should be developed to support application of genomic technologies to polar studies. NSF should continue its efforts to make information about polar regions available to teachers, schools, and the public. Short- and long-term plans should be developed for increasing public awareness of polar biology, encouraging the entry of young scientists into the field, and incorporating polar biology in college and K-12 curricula. To address impediments to conducting multidisciplinary integrated polar science, NSF should: Remove impediments to cross-directorate funding, and should form interagency partnerships with the National Aeronautics and Space Administration and others as relevant. Establish international research partnerships or memoranda of understanding (addressing stipends, travel; visas, education, ship time, aircraft use and other logistical issues) to facilitate and enhance international collaborative efforts. Conduct a brief survey of researchers and research groups who would potentially work in both poles to identify impediments to bipolar research and then take steps to address them. Improve biological laboratories and research vessels, and develop ice-drilling resources in the polar regions, to facilitate integrated, multidisciplinary biological research at both poles. Opportunities to allow year-round access to, and operation of, field sites should be pursued. **Availability:** http://www.nap.edu/books/0309087279/html/

	Directorate for Computer & Information Sciences & Engineering (CISE)
Revolutionizing Science and Engineering through Cyberinfrastructure: Report of the National Science Foundation Advisory Panel on Cyberinfrastructure.	**Scope:** The committee assessed NSF's Partnerships for Advanced Computational Infrastructure (PACI) program and and recommended new areas of emphasis for cyberinfrastructure. **Findings:** "Following the guidelines of the original PACI solicitation, the activities of the PACI partnerships have addressed multiple needs and served multiple purposes, some of which we highlight: • During the five years of the current program [PACI], the two PACI partnerships have fulfilled their mission of providing high-end computing cycles. This conclusion is based on systematic, regularly conducted user surveys that are reported to NSF, and on the survey conducted as part of this panel's information-gathering process … • The PACIs have supported, engendered, and supplied software tools to help users take advantage of architecturally diverse, increasingly complex, and distributed hardware. … • Through a joint Education, Outreach and Training activity, the PACIs have broadened access to computational science and engineering by encouraging the participation of women and underrepresented groups at all educational levels. • Many successes in domain science and engineering have been enabled as well as supported in part by PACI funding. In particular some PACI-enabled collaborations have been exemplars of interdisciplinary interactions in which information technology becomes a creative, close partner with science. …" On planning for a new generation of cyberinfrastructure, the committee notes "a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information and communication technology, and pulled by the expanding complexity, scope, and scale of today's challenges. The capacity of this technology has crossed thresholds that now make possible a comprehensive "cyberinfrastructure" on which to build new types of scientific and engineering knowledge environments and organizations and to pursue research in new ways and with increased efficiency." **Availability:** http://www.cise.nsf.gov/news/cybr/cybr.htm

Preliminary Study of Information Technology Research (ITR).	**Scope:** The committee examined the extent to which the ITR program is responsive to the Presidential Information Technology Advisory Committee Report (PITAC Report) and made recommendations for issues to be examined by a committee of visitors. **Findings:** The subcommittee found that NSF is not slavishly adhering to topic area recommendations of the PITAC report and has appropriately moved into new areas where appropriate. With respect to outcomes, the subcommittee found that all the sampled (sample size of 10 projects) large and medium ITR awards promised some sort of interdisciplinary or cross-institutional activity, although several did not give evidence of accomplishing that in their annual reports. They noted that all of the projects promised educational activities to complement their research and all but one gave evidence in annual reports of accomplishing that. Examining decisions, they found evidence that NSF staff were making awards to high risk projects and judged this to be correct handling of high-risk proposals. The subcommittee also looked at questions of how focus areas are identified and what the purpose is; these were called out for additional study by a full COV.
"Who Goes There? Authentication through the Lens of Privacy"	**Scope:** The study examined authentication systems that capture identity information about information system users and the implications for privacy in the use of these systems Findings: Issues such as the need for identification, the type of identification, security of captured information, linking information across multiple resources, and other matters were discussed as areas for needed research. **Availability:** Computer Science and Telecommunications Board, part of the NRC.
NSF ANIR Workshop on Experimental Infostructure Networks	**Scope:** The workshop was asked if the computer and telecommunications industry sector agreed on a need for experimental infostructure networks. If so recommended, they were asked to recommend what sorts of experimental networks were needed and what roles should industry, government and academia play. **Findings:** The group, with emphasis on industry participation, recommended that NSF support a program for experimental networks (i.e., networks that support research and experimentation rather than production networks). Recommendation included maintaining an applications-driven focus with vertical integration (from network to middleware to application to user interface), emphasis on innovation rather than geographic scope, emphasis on delivered end-t0-end connections of all resources involved in each experiment, and demonstrations of controls of network capabilities that facilitate applications. **Availability:** http://www.calit2.net/events/2002/nsf/index.html

"IT Roadmap to a Geospatial Future"	**Scope:** The study examined directions for research that would enhance the performance, accessibility and usability of geospatial information. **Findings:** The group recommended an integrative, interdisciplinary approach; more coordination in government support; accessible location-sensing infrastructure; and research in several areas including mobile envorinments; geospatial data models and algorithms; geospatial data ontologies; data mining for geospatial data; geospatial interaction technologies; improved access technologies; and collaborative interaction with geoinformation. **Availability:** Science and Telecommunications Board, part of the NRC.

	Directorate for Education and Human Resources (EHR)
Teaching Mathematics in Seven Countries: Results From the TIMSS 1999 Video Study. (March 2003)	**Scope:** The 1998-2000 Third International Mathematics and Science Study Video Study (TIMSS 1999 Video Study) builds on the Third International Mathematics & Science Study (TIMSS). It seeks to deepen understanding of classroom mathematics teaching; to deepen understanding of how teaching methods can be increasingly aligned with student learning goals; and to develop communication strategies to reach research and professional development communities. Countries: Australia, Czech Republic, Hong Kong, Japan, Netherlands, Switzerland, and the US. Of these, in 1995, Japan top performer (581) -- US (492) lowest; in 1999, Hong Kong top (582) – US lowest (502). **Findings:** Provides documentation that the prevalent instructional activity internationally is problem solving. All countries devoted at least 80 percent of time on solving problems and less time on presenting new content. U.S. and Czech Republic place more emphasis on reviewing materials; Hong Kong and Japan emphasize new content. Japan is distinguished by devoting lesson time to relatively few problems with higher procedural complexity, that include proofs more often, and that relate to each other in mathematically significant ways. In Japan, 74% of problems require students to decide how to use procedures (not just execute them); in US, 34% (lowest reported number). High achieving countries do not employ one single method of mathematics teaching; teaching practice must be aligned with learning goals. **Availability:** Available from U.S. DoED, National Center for Education Statistics. See http://www.ed.gov/index.jsp.
Studying Classroom Teaching as a Medium for Professional Development: Proceedings of a U.S.-Japan Workshop	**Scope:** Draws on elementary mathematics expertise from Japan and the U.S. in order to understand better the knowledge needed to teach mathematics well and determine how to help teachers gain this knowledge. Focus was on Japanese "lesson study," and U.S. use of classroom documentation and written cases. **Findings:** Helps define research agenda for improving the study of mathematics: • How are the practice of teaching learned & what things are instrumental to that learning? • What do teachers need to learn to effectively engage in mathematics teaching? • How do teachers learn to know mathematics in ways that enable them to organize content and to create and adjust activities to address lesson goals and student interests, needs, problems, difficulties, etc.? • "Teacher Mathematics" is an applied field, covering both pure and applied mathematics, algorithms and proof, concepts and representations. What would constitute a coherent field of study? Important ideas include: phenomenology of mathematical concepts, extended analyses of related problems, and connects and generalizations within/among diverse branches of mathematics. **Availability:** Available from U.S. National Commission on Mathematics Instruction and Mathematical Sciences Education Board, National Research Council. See: http://www/nap.edu.

Mathematical Proficiency for All Students: Toward a Strategic Research & Development Program in Mathematics Education (2003)	**Scope:** Report proposes long-term, strategic research and development in mathematics education. The effort would develop knowledge, materials, and programs to help educators raise the level of mathematical proficiency and eliminate differences in levels of proficiency among students from different social, cultural, and ethnic groups. **Findings:** Limited resources leads to recommendation of three foci to generate immediate progress: • Develop teachers' mathematics knowledge in ways that are directly useful for teaching; • Teaching & learning skills used in mathematical thinking and problem solving; • Teaching and learning algebra from kindergarten through 12th grade. The effort requires use of effective scientific practices; use of methods appropriate to the goals of component project; building knowledge over time, and rigorously testing and revising of interventions through cycles of design and trial. Research and development initiatives must be solidly informed and guided by practice; partnerships are required among research institutions and schools/school districts. Requires greater collaboration and interdisciplinary action in planning; willingness of researchers to develop common measures; and attention to building both knowledge and practice. The effort also requires research on competing views over proficiency standards, curricular designs, pedagogical styles, and assessment methods. **Availability:** RAND Mathematics Study Panel, the RAND Corporation. See: http://www.rand.org.

Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the U.S. (May 2003)	**Scope:** Study provides education research and policy communities with snapshots of mathematics and science education from U.S. classrooms across a variety of contexts. Uses systematic sampling and implicit stratification to ensure representativeness of sample with respect to teacher backgrounds, instructional objectives, and classroom activities. Uses classroom observation instrument developed by HRI for the NSF Local Systemic Change initiative to assess quality of design and implementation of science and mathematics lessons. Sample includes 31 schools and nearly 400 classrooms. **Findings:** Study findings have implications for preparation and continuing education of teachers of science and mathematics, and for other support provided to teachers. • No one pedagogical style should be advocated. • High-quality instruction must emphasize developmentally appropriate learning goals; instructional activities engaging students in content; learning environments that support and challenge students; and helping students make sense of mathematics and science concepts. • Teachers need to analyze role of teacher questioning and sense-making focused on conceptual understanding. • Support materials accompanying textbooks and other instructional materials should provide targeted assistance for teachers, articulating learning goals for activities; research on student thinking in content areas; strategies for monitoring student understanding; and outlining points to help students make sense of concepts. • Professional development needs to reflect elements of high-quality instruction; content knowledge alone is not sufficient. • Further exploration is needed to mitigate equities in high-quality instruction. • Administrators/policymakers need to ensure that teachers get coherent messages. Need alignment of preservice, K-12 curriculum, student assessment, professional development, and teacher evaluation policies at state, district, and school levels to achieve excellence and equity. **Availability:** Horizon Research, Inc., See http://www.horizon-research.com.

Local Systemic Change through Teacher Enhancement: Year Eight Cross-Site Report	**Scope:** An evaluative study of the 52 Local Systemic Change projects active during the 2001–02 academic year. **Findings**: Questionnaire data collected from a random sample of targeted teachers suggest that LSC professional development has had a significant impact on teachers' attitudes and beliefs about mathematics/science education. In addition, participants were becoming more confident in their knowledge of mathematics and science content, and more likely to use standards-based instructional strategies. Both mathematics and science participants reported making greater use of strategies that facilitate exploration and investigation by students, such as using open ended questions and requiring students to supply evidence to support their claims, than did non-participants. Science participants were also more likely than other science teachers to use reform-oriented teaching practices such as having students engage in hands-on activities, work on extended investigations, and write reflections in notebooks or journals. Data from a random sample of classroom observations show that teachers who participated in LSC professional development were more likely to be using the designated instructional materials, and that the quality of the lessons taught improved with increased participation in LSC activities. Furthermore, lessons taught by teachers who had participated in at least 20 hours of LSC professional development and were using the designated materials were more likely to receive high ratings for their lessons, lending support to the program's focus on professional development aimed at implementing exemplary instructional materials. **Availability:** Available from EHR Directorate, NSF.
Progress and Pitfalls: A Cross-Site Look at Local Systemic Change through Teacher Enhancement	**Scope**: A program evaluation study of the efforts and lessons learned of 61 Local Systemic Change projects based on data collected from 1998 to 2001. **Findings**: LSC projects have demonstrated important successes in a number of areas. Overall, LSCs have had a positive impact on teachers' attitudes toward teaching mathematics and science, and their perceptions of preparedness in content and pedagogy. With increased participation in LSC professional development, teachers are more likely to use designated instructional materials, and the quality of their instruction improves. LSC projects have developed a core of teacher leaders, many of whom have played integral roles in planning, designing, and implementing professional development, policy alignment efforts, and community outreach. Many LSCs reported considerable success in moving mathematics and science to the forefront of district priorities, in securing a supportive policy environment for reforms, and in increasing stakeholder support over the course of the project. Projects also faced a number of key challenges in their work with teachers and school systems: building capacity for and consistency of high quality professional development, attracting teachers and sustaining their involvement, focusing professional development for a teaching population with diverse needs, securing administrative support, and dealing with the constraints of a district context (e.g., teacher/administrative turnover, making time for teachers to attend professional development, and poorly aligned assessments). **Availability:** Available from EHR Directorate, NSF.

Instructional Materials Development (IMD) Dissemination and Implementation Site Evaluation	**Scope:** A program evaluation of the impact and effectiveness of seven IMD Dissemination and Implementation projects and their satellite sites. **Findings:** The IMD Dissemination and Implementation Centers contributed to the dissemination and use of standards-based mathematics and science materials by exposing districts and schools to standards-based reform, providing districts with greater accessibility to standards-based materials, encouraging a systematic selection process for materials, and substantially increasing the capacity of well-qualified staff to provide professional development to districts and schools. Each center adopted either a process- or product-oriented theory of action to guide project structures and activities. In the process model, both the Center and its satellites focused on school or district conditions that fostered appropriate selection and full implementation of curricula, such as leadership, professional development, and teacher content knowledge. In the product-oriented model, the Centers focused on raising awareness of multiple curricula and providing technical assistance in making choices. In the product-oriented projects, the satellites provided technical assistance in implementation of the curriculum itself. Both process- and product-focused satellites relied on building a network of staff developers experienced with teaching and/or the curricula. The evaluation concluded that the center with the least impact at the district and school levels is one that focuses primarily on public awareness and planning, rather than on issues of implementation. Overall, the Dissemination and Implementation sites provide high quality professional development and other services to support adoption and implementation of IMD materials. **Availability:** Available from EHR Directorate, NSF
Protecting Information: The Role of Community Colleges in Cybersecurity	**Scope:** Focus on how community college resources could be utilized and further developed to help educate a cybersecurity workforce. **Findings:** The Report includes recommendations in the following areas: • Role of certification and skill standards • Establishment and maintenance of cybersecurity programs at community colleges • Specification of topics, courses, curricula, and programs • Preparation for cybersecurity positions • Advancement of the role of community colleges in cybersecurity education Key Areas: **Availability:** Community College Press, American Association of Community Colleges, One Dupont Circle, Suite 410, Washington, DC 20036-1176

The Advanced Technological Education) Evaluation Project	**Scope:** Assess the impact and effectiveness of the NSF Advanced Technological Education (ATE) Program. **Findings:** The project is ongoing, but has provided primary findings for each category of work that will serve as a baseline from which future actions can be tracked and ultimately judged. Findings include: • The projects are actively addressing the goals of the ATE program • The ATE projects have established a large number of collaborative arrangements. The collaborations serve multiple purposes and provide monetary support as well as other kinds of assistance for materials development, academic programs, and professional development efforts • ATE projects are developing many materials to support the preparation of technicians. These materials include full courses, adaptations of courses, and modules that can be incorporated into coursework • Projects and centers are improving their technician-based programs by constructing new courses, modifying existing courses, and taking steps to better serve students in matters of recruitment, retention, placement, and diversity. • Projects conduct large numbers of professional development activities. These activities are well attended and well received. Where follow-up has occurred, reportedly about half the participants try out materials and a third implement them **Availability:** http://www.wmich.edu/evalctr/ate

	Directorate for Geosciences (GEO)
The Sun to the Earth—and Beyond: A Decadal Research Strategy in Solar and Space Physics	**Scope:** A study to assess the current status and future directions of U.S. ground- and space-based programs in solar and space physics research. **Findings:** The report summarizes the state of knowledge about the total heliospheric system, poses key scientific questions for further research, and presents an integrated research strategy, with priorities, for the next decade. The report emphasizes the importance of understanding the Sun, the heliosphere, and planetary magnetospheres and ionospheres as astrophysical objects and as laboratories for the investigation of fundamental plasma physics phenomena. **Availability:** National Academy of Sciences www.nas.edu
EarthLab: A subterranean Laboratory and Observatory to Study Microbial Life, Fluid Flow, and Rock Deformation	**Scope:** EarthLab is an initiative to build a laboratory in the deep subsurface to study the biological, geomechanical, hydrological and geochemical processes that modify Earth from its surface to the limit of habitable depths. **Findings:** At a joint conference between the physics and Earth science communities, *Neutrinos and Subterranean Science 2002* (September 2002), the concept and goals of EarthLab were established. To carry out needed experiments and observe changes over the long term, EarthLab requires a large-scale underground excavation where drilling, coring, and tunneling can access a variety of structural, hydrological, biological, and geochemical environments. Such a facility will be a unique resource for multidisciplinary and multi-institution investigations for the international geological and biological science and engineering communities. **Availability:** EarthLab, http://www.earthlab.org/
Ocean Boise and Marine Mammals	**Scope:** Reviews sources of noise in the ocean environment, what is known of the responses of marine mammals to acoustic disturbance, and what models exist for describing ocean noise and marine mammal response. **Findings:** Recommendations are made for future data gathering efforts, studies of marine mammal behavior and physiology, and modeling efforts necessary to determine what the long- and short-term impacts of ocean noise on marine mammals. **Availability:** National Academy of Sciences www.nas.edu

Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering	**Scope:** This Committee on Challenges for the Chemical Sciences in the 21st Century, National Research Council study, brings together research, discovery, and invention across the entire spectrum of the chemical sciences—from fundamental, molecular-level chemistry to large-scale chemical processing technology. This reflects the way the field has evolved, the synergy at academic institutions between research and education in chemistry and chemical engineering, and the way chemists and chemical engineers work together in industry. **Findings:** The study identifies the key opportunities and challenges for the chemical sciences, from basic research to societal needs, and from terrorism defense to environmental protection. It looks at the ways in which chemists and chemical engineers can work together to contribute to an improved future. **Availability:** National Academy Press, http://www.nap.edu/catalog/10633.html
Materials Science and Technology: Challenges for the Chemical Sciences in the 21st Century	**Scope:** This Organizing Committee for the Workshop on Materials and Manufacturing, Committee on Challenges for the Chemical Sciences in the 21st Century, National Research Council workshop report, outlines the role that the chemical sciences has played in past and future developments in the design, creation and understanding of new materials. **Findings:** Numerous findings are listed in the categories of Discovery, Interfaces, Challenges, and Infrastructure. **Availability:** National Academy Press, http://www.nap.edu/catalog/10694.html
National Security and Homeland Defense: Challenges for the Chemical Sciences in the 21st Century	**Scope:** This Committee on Challenges for the Chemical Sciences in the 21st Century, National Research Council workshop report outlines the role that the chemical sciences can play in national security and homeland defense. **Findings:** Numerous findings are listed in the categories of Discovery, Interfaces, Challenges, and Infrastructure **Availability:** National Academy Press, http://www.nap.edu/catalog/10543.html

Exploring the Concept of Undergraduate Research Centers	**Scope:** On March 31 – April 1, 2003 a workshop was held at the NSF. The hypothesis motivating this workshop was that by providing research opportunities to young students in their first or second year of college through the creation of undergraduate research centers (URCs), we would attract a larger and more diverse student body to chemistry. Projects conducted at the URCs could be more broadly defined from traditional norms, and they could be "titrated" to the skills of students as well as available instrumentation. The types of projects could be faculty-initiated research projects or carefully designed discovery-based laboratory exercises, or others. **Findings:** Workshop participants agreed that URCs should bring institutions with divergent missions together to their mutual benefit. A second strong theme that emerged was that, as often as possible, students should be involved in real research and actively contribute to the production of new knowledge. The utility of community-based research experiences in attracting students to the sciences, particularly at urban and nonresidential institutions, was recognized in this context. While it was agreed that URCs should focus initially on expanding research opportunities for freshmen and sophomores, participants articulated an expansive vision in which URCs support research-based learning "from cradle to grave," from elementary school to civic involvement within the local community. Finally, the themes of institutionalization of the culture of research as the cornerstone of scientific literacy for all students and curricular reform necessary to successfully support such a vision of URCs were also emphasized. Despite its focus on a seemingly limited problem—improving research opportunities for undergraduates early in their academic experience—the concept of URCs clearly represents the kernel of a comprehensive vision for undergraduate education, one with the potential to transform it from an exclusive "ivory tower" into a vigorous and dynamic forum of inclusiveness and engagement for a larger group of students than we currently serve. **Availability:** http://urc.arizona.edu/
Postdoctoral Appointments: Roles and Opportunities	**Scope:** On May 11-13, 2003 an NSF-supported workshop was held to discuss new postdoctoral and professional development models that combine research expertise with professional service. These models would combine professional development and research and education activities addressing needs. **Findings:** Numerous recommendations and observations will appear in the report for both enhancing traditional postdoctoral appointments supported by NSF and new models. **Availability:** To appear at http://www.merrimackllc.com/2003/postdoc-workshop.html

Workshop on New Mechanisms for Support Of High-Risk and Unconventional Research in Chemistry	**Scope**: A group of academic scientists and engineers met at the NSF on May 17-18, 2003 to discuss mechanisms for funding "high-risk" and unconventional research in the chemical sciences. Specifically, this group considered whether it would be desirable to develop an experimental program designed to support highly innovative research (which might be high-risk, in areas relatively unfamiliar to chemistry, or unconventional in focus or structure of the programs); that is, research of types that would be difficult or impossible to support within existing structures. **Findings:** The committee concluded that there were a number of opportunities to provide funding mechanisms that would be more responsive to unconventional ideas, and more proactive in helping the community to develop and shape new ideas. It developed the concept of a program that would support Centers (either real or virtual), having a number of key features: • A Focus on a Big Problem, and a Common Vision. • Three to Six Highly Talented Investigators and a Strong Leader. • Representation from a Range of Skills and Approaches. • A Critical Mass in Financial and Human Resources. • Local Autonomy with accountability, in Allocation of Resources, in Personnel, and in Direction. • A Culture of Innovation and Risk-Taking. **Availability:** The report is available at http://www.mrl.uiuc.edu/NSFGMWFinal.pdf
Reducing the Time from Basic Research to Innovation in the Chemical Sciences: A Workshop Report to the Chemical Sciences Roundtable	**Scope:** This report, supported by the Chemical Sciences Roundtable, National Research Council, focused on factors such as work processes, systems, and technologies that could enable and accelerate the pace of innovation and increase the yield of major innovations from work in basic chemical sciences. **Findings:** Numerous recommendations and observations appear in the report. **Availability:** http://www.nap.edu/catalog/10676.html
Minorities in the Chemical Workforce: Diversity Models that Work - A Workshop Report to the Chemical Sciences Roundtable	**Scope:** This report, supported by the Chemical Sciences Roundtable, National Research Council, was organized to explore how the chemical science community could respond to the challenge of increasing the diversity of the workforce. Sessions were organized on why diversity is important, pipeline issues beginning at the undergraduate level through graduate school, and successful activities in industry to attract and retain minorities in the workforce. **Findings:** Numerous recommendations and observations appear in the report. **Availability:** http://doe-hep.hep.net/lrp_panel/

Statistics: Challenges and Opportunities for the 21st Century	**Scope:** On May 6-8, 2002 a workshop was held at the NSF to identify the future challenges and opportunities for the statistics profession. The report that will be available in the early part of 2003 identifies major opportunities and challenges for the field of Statistics and formulates recommendations. The organizing committee of the workshop that is responsible in producing this report decided that the entire domain of statistics should be covered, both as a core science and in its scientific application areas, except for the health sciences, which is a very large and thriving specialty deserving of its own report. The report, in addition to discussing scientific opportunities and the challenges associated with those, discusses the role of education and training in statistics. **Findings:** Three high-priority opportunities are identified; analysis of massive data sets, modeling complex systems and understanding uncertainty. An in- depth discussion of each of these areas is provided in the report. Four major challenges were also identified; challenge of recognition, challenge of multidisciplinary activity, challenges in core research areas, and challenges in education and training. Five recommendations are made and discussed in the report: promote recognition of the unique identity of statistics, strengthen the core research areas; strengthen multidisciplinary research activities; develop new models for statistical education and accelerate the recruitment of the next generation of statisticians. **Availability:** The latest version of the report is available on the website of the American Statistical Association at http://www.amstat.org. It is expected that the final version will be available in early fall 2003.
Computational Opportunities in Algebra, Number Theory, and Combinatorics (ANTC)	**Scope:** The Workshop on Computational Opportunities in Algebra, Number Theory, and Combinatorics (ANTC) was held in September 2002 at the NSF. The purpose of the workshop was to bring together members of the ANTC community with extensive computing expertise to discuss the role of computation in ANTC research, future needs in computing support and new research opportunities for this area. **Findings:** Numerous recommendations and observations appear in the report. The report includes sections on the role of computation in ANTC research, research problems where computation is likely to have a significant impact, hardware and software issues, web databases, the role of computers in proofs, and education and outreach. A set of recommendations may be found in the report. **Availability:** The report is now available on the website of the American Institute of Mathematics at http://www.aimath.org/ResearchService.

Current and Emerging Research Opportunities in Probability	**Scope:** The Workshop on Current and Emerging Research Opportunities in Probability was held on May 29-31, 2002 at the NSF. The report identifies the strengths of the discipline, both internally and in its applications. It describes some of the exciting areas of current research. While it does not quantify the needs of the community, it does demonstrate the need for a larger community trained in probability and probabilistic reasoning. It further points to the responsibilities of the funding agencies, the academic institutions, and the community itself, to meet the growing demands for the discipline. **Findings:** Probability is both a fundamental way of viewing the world, and a core mathematical discipline, alongside geometry, algebra, and analysis. In recent years, the evident power and utility of probabilistic reasoning as a distinctive method of scientific inquiry has led to an explosive growth in the importance of probability theory in scientific research. Central to statistics and commonplace in physics, genetics, and information theory for many decades, the probabilistic approach to science has more recently become indispensable in many other disciplines, including finance, geosciences, neuroscience, artificial intelligence and communication networks. **Availability:** The report is now available at http://www.math.cornell.edu/~durrett/probrep/probrep.html
Accelerating Mathematical-Biological Linkages: Report of a Joint NSF-NIH Workshop	**Scope:** On February 12-13, 2003, a workshop was held at the National Institutes of Health in order to highlight the opportunities and challenges present at the mathematical-biological interface, and to challenge the institutional, cultural, and educational barriers to these essential and fruitful partnerships. The workshop consisted of a day-long symposium followed by a half day in which small working groups identified key needs to move mathematical-biological linkages forward. Linkages are broadly defined to include collaborations among mathematicians and biologists, educational and training opportunities, new research initiatives, as well as other activities. **Findings:** Three working groups were formed to discuss (1) institutional issues, (2) education and training, and (3) strengthening ties among researchers. Each group was charged with developing and articulating critical actions needed to enhance mathematical-biological linkages. The report contains the recommendations of these groups, some of which are directed at the NSF and NIH, while others are directed at scientists and mathematicians or at academic and research institutions. **Availability:** The report is now available at: http://www.palmerlab.umd.edu/report.pdf

Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century	**Scope:** This report from the National Research Council's "Committee on the Physics of the Universe" was commissioned jointly by NASA, NSF, and DOE, in recognition of the deep connections that exist between quarks and the cosmos. It identifies eleven science questions that focus on the interface between physics and astrophysics, connecting physics at the most microscopic scales to the properties of the universe and its contents on the largest physical scales. Further, it recommends research and research coordination needed to address the 11 science questions. **Findings:** The report recommends that NASA, NSF, and DOE work together to carry out an extensive program of experiments, including: measure polarization of the cosmic microwave background; determine properties of the dark matter; determine the neutrino masses, the constituents of dark matter, and the lifetime of the proton; use space to probe the basic laws of physics; determine the origin of the highest energy gamma rays, neutrinos, and cosmic rays; discern physical principles of extreme astrophysical environments through laboratory study of high-energy-density physics; and realize the scientific opportunities at the intersection of physics and astronomy. **Availability:** Ordering information and Executive Summary available at: http://www.nap.edu/catalog/10079.html
Neutrinos and Beyond: New Windows on Nature	**Scope:** The National Research Council's "Neutrino Facilities Assessment Committee" was charged by OSTP with providing scientific assessments of: (1) IceCube, a very large volume detector of high-energy neutrinos proposed for the South Pole and (2) a possible deep underground science facility to be developed in the U.S. to pursue a broad range of fundamental questions in physics and astronomy. The assessments were to be in the context of current and planned neutrino capabilities throughout the world. **Findings:** The NRC committee reported its assessments that: (1) The planned IceCube experiment can open a new window on the universe by detecting very high-energy neutrinos from objects across the universe. The science is well motivated and exciting, the detection technique is proven, and the experiment appears ready for construction. (2) A deep underground laboratory can house a new generation of experiments that will advance understanding of the fundamental properties of neutrinos and the forces that govern elementary particles, as well as shed light on the nature of the dark matter that holds the universe together. Recent ideas about neutrinos, new ideas and technologies, and the scientific leadership in the U.S. make the time ripe to build such a unique facility. **Availability:** http://www.nap.edu/catalog/10583.html

NeSS 2002: International Workshop on Neutrinos and Subterranean Science	**Scope:** This workshop, requested by the executive branch of the U.S. government, was held September 19 - 21, 2002 and was tasked to develop a roadmap to guide neutrino and subterranean science investigations worldwide over the next few years. The interdisciplinary meeting was structured around working groups that covered double-beta decay, proton decay, neutrino oscillations, dark matter, solar neutrinos, astrophysical and cosmological neutrinos, and geosciences; as well as topics of national security, and education and outreach. This activity coordinated with the NRC's Neutrino Facilities Assessment Committee and vice versa. **Findings:** A principal conclusion of the workshop was that the goals of IceCube and a national underground laboratory are two separate research endeavors. IceCube will be a high-energy neutrino observatory that instruments a large volume of ice at the South Pole to detect neutrinos from distant regions of the universe. In contrast, there is a group of detectors designed to measure rare, low-energy processes of a fundamental nature that require the low background environment of a deep underground location. There was considerable excitement from the physicists about the science proposed by the geosciences working groups. **Availability:** http://www.physics.umd.edu/events/spevents/NeSS02/
Frontiers in High Energy Density Physics: The X-Games of Contemporary Science	**Scope:** The NRC Committee on High Energy Density Plasma Physics was charged to: (a) review recent advances in the field of high energy density plasma phenomena, on both the laboratory scale and the astrophysical scale; (b) provide a scientific assessment of the field, identifying compelling research opportunities and intellectual challenges; (c) develop a unifying framework for diverse aspects of the field; (d) outline a strategy for extending the forefronts of the field through scientific experiments at various facilities where high energy density plasmas can be created; and (e) discuss the roles of the national laboratories, universities, and industry in achieving these objectives. **Findings:** High energy density physics (HEDP) includes a wide variety of physical phenomena at energy densities exceeding 10**11 J/m**3. Their principal findings are: (a) HEDP is a rapidly growing field with exciting research opportunities; (b) a new generation of sophisticated laboratory facilities exist or are planned; (c) advances in computing have made numerical modeling of nonlinear dynamics and astrophysical hydrodynamics possible; (d) instruments for measuring astrophysical processes under HEDP conditions are unprecedented in their sensitivity and detail; (e) the NNSA has recently established a program to fund research at universities in HEDP S&T relevant to stockpile stewardship; (f) increased support of HEDP research by DOE, NSF, DOD, and NASA is recommended; (g) upgrade opportunities exist at current experimental facilities; and (h) partnerships between industry and universities and laboratories are mutually beneficial. **Availability:** Ordering information and Executive Summary available at: http://www.nap.edu/catalog/10544.html

The Science and Applications of Ultrafast, Ultraintense Lasers (SAUUL)	**Scope:** This report is the result of a workshop held June 17 - 19, 2002 in Washington, DC to assess the potential national impact of ultra-fast, ultra-high intensity lasers (UUL). It was supported by DOE, NNSA and NSF. The report isolates five areas where opportunities for major breakthroughs exist with UULs: fusion energy; compact, high gradient particle accelerators; ultrafast x-ray generation; creation of extreme states of matter, and the generation of attosecond bursts of radiation. **Findings:** Their four central conclusions are: (1) science studied with UULs is a fast growing field in the U.S., Europe, and Japan; (2) applications of UULs are much broader and more interdisciplinary than in the 1980s; (3) state-of-the-art lasers are more complex and expensive than in the past; and (4) a new mode of organization (a network of institutions) is needed to maintain the vitality of the field in the U.S. **Availability:** The report is available at: **http://www.ph.utexas.edu/~utlasers/papers/SAUUL_report.pdf**

	Directorate for Social, Behavioral and Economic Sciences
National Research Council's Committee to Review the 2000 Decade Design of the Scientists and Engineers Statistical Data System (SESTAT)	**Scope:** The review and assessment of three proposed design options for the 2000 decade being considered by NSF staff for SESTAT (the Scientists and Engineers Statistical Data System, a system of surveys that provide information about the numbers and characteristics of scientists and engineers in the United States). **Findings:** The committee's report presents their understanding of the purposes and characteristics of the SESTAT, applies the criteria important for assessing design options for the database, provides recommendations for the best approach to adopt in the 2000 decade, and offers encouragement to NSF to pursue opportunities to improve the understanding of the numbers and characteristics of scientists and engineers in the United States. The report presents the following recommendations: 1. Almost all of the resources allocated to the SESTAT data collection effort in 2003 should be devoted to drawing a new National Survey of College Graduates from the 2000 census and supplementing this panel with the National Survey of Recent College Graduates. 2. If Division of Science Resources Statistics (SRS) staff confirm that a targeted sample could be useful for the purpose of adjustment, SRS should consider surveying in 2003 a very small, carefully targeted subset of the current panel to study biases in the current sample, possibly to use for the purpose of adjustment. 3. A cost-benefit analysis should be conducted to optimize the relative allocation of resources between the National Survey of College Graduates and the National Survey of Recent College Graduates. Also, additional oversampling should be applied to capture adequate numbers for small domains for which increased interest has become apparent since the last design. 4. The Division of Science Resources Statistics should make every effort to achieve a response rate of 85 percent or higher for the recommended new sample and to retain the sample over time.

Genomics of Human Origins Workshop	**Scope:** To assess the contributions that comparative genomics can make to the study of human origins research. **Findings:** The participants concluded that tremendous opportunities exist to apply innovations in genomics, developmental biology and neuroscience to specific questions of human evolution. While a large number of differences can be noted that separate humans from non-human primates, many of these are not understood in detail. Precise definition of these differences requires collaborative efforts by researchers in numerous sciences. The definitions can then lead to a more thorough understanding of the mechanisms underlying human origins. Key questions relate to the tension between the high degree of observed similarity between human and non-human primate DNA sequences and the obvious anatomical, phenotypic and cognitive differences between the species. A deep understanding of (2) rests in part on deciphering the evolution of human ontogeny. This will require the development of new analytical techniques. Continued progress in the reconstruction of primate phylogeny, relying on DNA analysis, is necessary to draw the framework for interpreting phenotypic data. The broader impacts of a concerted effort in this area are great, e.g. leading to a clearer understanding of the workings of the human mind and advancing our understanding of human learning capabilities. Information on comparative primate genomics can be used to assist in pharmaceutical development. Few, if any, scientific topics are as compelling to the general public as the ancestry of our species. While the basic questions posed by the participants have been part of biological anthropology for years, opportunities for major advances now arise through the application of state-of-the-art genomic, neuroscience and computer technology. An infusion of resources beyond those of the core programs is necessary to support this exciting expansion of human origins research.

LIST OF ACRONYMS

AAAC	Astronomy and Astrophysics Advisory Committee
AAAS	American Association for the Advancement of Science
AC	Advisory Committee
ACBAR	Arcminute Cosmology Bolometer Array Receiver
AC/GPA	Advisory Committee for GPRA Performance Assessment
ACS	American Chemical Society
ADVANCE	Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers
AGEP	Alliances for Graduate Education and the Professoriate
AKRSI	Alaska Rural Systemic Initiative
ALMA	Atacama Large Millimeter Array
AMANDA	Antarctic Muon and Neutrino Detector Array
AMBAP	Award Monitoring and Business Assistance Program
ANIR	Advanced Networking Infrastructure and Research
ANSC	Alaska Native Science Commission
ANTC	Algebra, Number Theory, Combinatorics
ARCUS	Arctic Research Consortium
ATE	Advance Technological Education
AUI	Associated Universities, Inc.
AURA	Association of Universities for Research in Astronomy
BCPI	Budget, Cost, and Performance Integration
BCS	Behavioral and Cognitive Sciences
BFA	Division of Budget, Finance, and Award Management
BI	Burning Index
BIO	Directorate for Biological Sciences
BIRN	Biomedical Informatics Research Network
BCPI	Budget, Cost and Performance Integration
BPI	Budget Performance Integration
CA	California
CAAR	Cost Analysis/Audit Resolution Branch
CBI	Cosmic Background Imager
CBS	Columbia Broadcasting System
CCD	Charge-Coupled Device
CCLI	Course, Curriculum, and Laboratory Improvement
CeBASE	Center for Empirically Based Software Engineering
CFO	Chief Financial Officer
CIP	Construction in Progress
CISE	Directorate for Computer and Information Science and Engineering
CLT	Centers for Learning and Teaching
CMB	Cosmic Microwave Background
CMU	Carnegie Mellon University
CNN	Cable Network News
COMRAA	Committee on the Organization and Management of Research in Astronomy and Astrophysics
COSMIC	Constellation Observing System for Meteorology, Ionosphere, and Climate
COTS	Commercial Off-The-Shelf
COV	Committee of Visitors
CREST	Centers for Research Excellence In Science and Technology
CRIF	Chemistry Research Instrumentation and Facilities
CSDT	Culturally Situated Design Tools
CSLA	California School Leadership Academy
CSO	Competitive Source Official
CSRS	Civil Service Retirement System
CT	Connecticut
CURE	Consortium for Undergraduate Research Experience
DAPCEP	Detroit Area Pre-College Engineering Program
DC	District of Columbia
DGA	Division of Grants and Agreements
DIS	Division of Information Systems
DMFT	Dynamical Mean Field Theory
DNA	Deoxyribonucleic Acid
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DOL	Department of Labor
DPOSS	Digital Palomar Observatory Sky Survey
EC	European Community
EFT	Electronic Fund Transfer
EHR	Directorate for Education and Human Resources
EIA	Division of Experimental and Integrative Activities
EIS	Enterprise Information System
ENG	Directorate for Engineering
ERC	Engineering Research Center
ESO	European Southern Observatory
ET-S	E-Travel Solution
FACA	Federal Advisory Committee Act

FAIR	Federal Activities Inventory Reform
FAS	Financial Accounting System
FASAB	Federal Accounting Standards Advisory Board
FCTR	Federal Cash Transaction Report
FECA	Federal Employees Compensation Act
FERS	Federal Employees Retirement System
FFMIA	Federal Financial Management Improvement Act of 1996
FISMA	Federal Information Security Management Act
FMFIA	Federal Managers' Financial Integrity Act of 1982
FTS	Fischer-Tropsch Synthesis
FY	Fiscal Year
FY1999	Fiscal Year 1999
FY2001	Fiscal Year 2001
GAPP	Generally Accepted Accounting Principles
GAO	General Accounting Office
GEO	Directorate for Geosciences
GISRA	Government Information Security Reform Act
GMRA	Government Management Reform Act
GPG	Grant Proposal Guide
GPRA	Government Performance and Results Act
GPS	Global Positioning System
GSA	Government Services Administration
HIAPER	High-Performance Instrumented Airborne Platform for Environmental Research
H1-B	Nonimmigrant Petitioner Visa
H_2O	Water
HBCU	Historically Black Colleges and Universities
HE	Hamburg/European Southern Observatory Survey
HEDP	High Energy Density Physics
HIV	Human Immune Deficiency Virus
HLT	Human Language Technology
HRM	Division of Human Resources Management
HR	Human Resources
HRI	Horizon Research, Inc.
IBMBCS	IBM Business Consulting Services
IBRCS	Infrastructure for Biology at Regional to Continental Scales
ID	Identification
IERI	Interagency Education Research Initiative
IGERT	Integrative Graduate Education and Research Traineeship
IHOP	International H_2O Project
IMD	Instructional Materials Development
INT	Office of International Science and Engineering
IP	Intellectual Property
IPERS	Integrated Personnel System
IS	Information Security
ISP	Integrated and Sustained Program
IT	Information Technology
ITR	Information Technology Research
ITRD	Information Technology Research and Development
ITS	Information Technology Security
IVET	Immersive Virtual Environment Technology
JPL	Jet Propulsion Laboratory
KITP	Kavli Institute of Theoretical Physics
KY	Kentucky
LA	Los Angeles
LEO	Low Earth Orbiting
LSAMP	Louis Stokes Alliances for Minority Participation
LSC	Local Systemic Change
LTER	Long-Term Ecological Research
MAC	Minority Affairs Committee
MATLAB	Matrix Laboratory
MCC	Management Controls Committee
MD&A	Management's Discussion and Analysis
MLIAM	Multilingual Information Access and Management
MN	Minnesota
MPS	Directorate for Mathematical and Physical Sciences
MREFC	Major Research Equipment and Facilities Construction (account)
MRI	Major Research Instrumentation (program)
MIT	Massachusetts Institute of Technology
MO	Microbial Observatories
MPS	Directorate for Mathematical and Physical Sciences
MSP	Math and Science Partnerships
MTS	Measurement Tracking System
NA	Not Applicable or Not Available (see context)
NAIC	National Astronomy and Ionosphere Center
NAPA	National Academy of Public Administration
NAS	National Academy of Sciences

NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NC	North Carolina
NCAR	National Center for Atmospheric Research
NCMIR	National Center for Microscopy and Imaging Research
NEON	National Ecological Observatory Network
NESPOLE	Negotiating Through SPOken Language in E-Commerce
NHMFL	National High Magnetic Field Laboratory
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NMR	Nuclear Magnetic Resonance
NNUN	National Nanofabrication Users Network
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NOAO	National Optical Astronomy Observatory
NOPP	National Oceanographic Partnership Program
NPACI	National Partnership for Advanced Computational Infrastructure
NRAO	National Radio Astronomy Observatories
NRC	National Research Council
NSB	National Science Board
NSF	National Science Foundation
NSO	National Solar Observatory
NVO	National Virtual Observatory
NY	New York
ODS	Online Document System
OEOP	Office of Equal Opportunity Programs
OFRG	Oligonucleotide Fingerprinting of Ribosomal RNA Genes
OIG	Office of the Inspector General
OIRM	Office of Information and Resource Management
OISE	Office of International Science and Engineering
OMB	Office of Management and Budget
ONR	Office of Naval Research
OPM	United States Office of Personnel Management
OPP	Office of Polar Programs
OSTP	Office of Science and Technology Policy
PA	Pennsylvania
PACI	Partnerships for Advanced Computational Infrastructure
PAR	Performance and Accountability Reports
PARS	Proposal, PI and Reviewer System
PART	Performance Assessment Rating Tool
PBS	Public Broadcasting System
PGE	Programs for Gender Equity
PI	Principal Investigator
PIT	People, Ideas, Tools
PITAC	Presidential Information Technology Advisory Committee
PMA	President's Management Agenda
PO	Program Officer
PPD	Programs for Persons with Disabilities
PP&E	Property, Plant and Equipment
PRAGMA	Pacific Rim Applications and Grid Middleware Assembly
PSID	Panel Study of Income Dynamics
PUMS	Public Use Microdata Sample
Q3	Third Quarter
Q4	Fourth Quarter
QSAR	Quantitative Structure Activity Relationships
R&RA	Research and Related Activities
REPP	Research in Education Policy and Practice
REU	Research Experiences for Undergraduates
RNA	Ribonucleic Acid
RO	Radio Occultation
RPI	Rensselaer Polytechnic Institute
S&E	Salaries and Expenses
SARS	Severe Accute Respitory Syndrome
SAL	Speech Assisted Learning
SAUUL	Science and Applications of Ultrafast, Ultraintense Lasers
SBE	Directorate for Social, Behavioral and Economic Sciences
SBIR	Small Business Innovation Research
SDSC	San Diego Supercomputing Center
SEM	Science, Engineering, and Mathematics
SES	Division of Social and Economic Sciences
SESTAT	Scientists and Engineers Statistical Data System
SFFAS	Statement of Federal Financial Accounting Standards
SGER	Small Grant for Exploratory Research
SMETE	Science, Mathematics, Engineering and Technology Education

SPSS	Statistical Program for Social Sciences
SRB	Storage Resource Broker
SRS	Division of Science Resources Statistics
STC	Science and Technology Center
STEM	Science, Technology, Engineering and Mathematics
STEP	Systemic Teacher Excellence Preparation
STTR	Small Business Technology Transfer Program
TCP	Tribal Colleges Program
TIMSS	Third International Mathematics and Science Study
TX	Texas
TV	Television
UA	University of Arizona
UAF	University of Alaska, Fairbanks
UCAR	University Corporation for Atmospheric Research
UCLA	University of California, Los Angeles
UCSB	University of California, Santa Barbara
U.S.	United States of America
USAID	U.S. Agency for International Development
USAP	U.S. Antarctic Program
USGS	U.S. Geological Survey
USI	Urban Systemic Initiative
USWRP	U.S. Weather Research Program
UUL	Ultra-Fast, Ultra-High Intensity Lasers
VIGRE	Vertical Integration of Graduate Research and Education
VIPS	Valle Imperial Project in Science
VT	Vermont
WIMS	Center for Wireless Integrated MicroSystems

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