PERFORMANCE

EXECUTIVE SUMMARY

This report, prepared pursuant to the Government Performance and Results Act (GPRA) of 1993, covers activities of the National Science Foundation (NSF) during Fiscal Year 2005. A summary discussion of NSF's performance results and general assessment activities also is provided in Management's Discussion and Analysis under "Performance Summary and Highlights," which begins on page I-9.

NSF's annual goals fall into two broad areas: "Strategic Outcome Goals" and "Other Performance Goals."

Strategic Outcome Goals: The NSF's Strategic Plan, adopted in the fall of 2003, included a new programmatic framework that translated into four strategic outcome goals: Ideas, Tools, People and Organizational Excellence. Ideas, Tools and People focus on the long-term results of NSF's grants and programs. These goals represent the outcomes from NSF investments in science and engineering research and education. The strategic outcome goal of Organizational Excellence focuses on the administrative and management activities of the agency, and ensures that NSF is a capable and responsive organization that supports the accomplishment of the three other strategic outcome goals.

Other Performance Goals: These goals include performance measures included in NSF's Program Assessment Rating Tool (PART) evaluation as well as award size, duration and dwell time goals related to agency effectiveness and efficiency.

FY 2005 Performance Results	
Number of Goals Achieved	
Annual Performance Outcome Goals	**4 of 4 (100%)**
Other Annual Performance Goals	**14 of 17 (82%)**
TOTAL	**18 of 21 (86%)**

FY 2005 Results: For FY 2005 NSF met 18 of our 21 goals (86%).[1]

Outcome Goals: NSF was successful for all (100%) of the four strategic outcome goals:

Ideas – Discovery across the frontier of science and engineering, connected to learning, innovation and service to society;

Tools – Broadly accessible, state-of-the-art science and engineering (S&E) facilities, tools, and other infrastructure that enable discovery, learning, and innovation;

People – A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens; and

Organizational Excellence – An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

Examples of accomplishments for each of the outcome goals are provided within the body of this chapter.

Other Performance Goals: We were successful for 14 of our other 17 performance goals (82%). Our goals in FY 2005 relative to FY 2004 goals were to:

- Increase the average annualized new award size for research grants to $140,000 (Goal I2). We achieved $144,000 in FY 2005 compared to $140,000 in FY 2004.
- Maintain the percent of Nanoscale Science and Engineering (NS&E) proposals that are multi-investigator proposals at 75% (Goal I4). We achieved 84% in FY 2005 compared to 80% in FY 2004.
- Obtain an external committee finding by ITR Committee of Visitors that the ITR Program is serving the appropriate role in ensuring that grantees meaningfully and effectively collaborate across disciplines of science and engineering (Goal I5). External experts found this to be the case.
- Maintain the percent of operational facilities that keep scheduled operating time lost to less than 10% (Goal T3). In FY 2005, the percent of facilities that achieved the goal was 100% compared to the goal of 90%.
- Maintain the number of users accessing National Nanofabrication Users Network/National Nanotechnology Infrastructure Network (NNUN/NNIN) and Network for Computational Nanotechnology (NCN) sites at 4000 (Goal T4).
- Maintain the number of nodes that comprise infrastructure (Goal T5). In FY 2005, we had 20 nodes compared to 20 in FY 2004.
- Obtain an external committee finding that there have been significant research contributions to software design and quality, scalable information infrastructure, high-end computing, workforce, and socio-economic impacts of information technology (Goal T6). External experts found this to be the case.
- Increase the number of U.S. students receiving fellowships through Graduate Research Fellowships and (GRF), Graduate Teaching Fellows in K-12 Education and Integrative Graduate Education and Research Traineeships (IGERT) (Goal P2). The number of students receiving fellowships increased from 4600 in FY 2004 to 4648 in FY 2005.

[1] IBM Business Consulting Services (IBM) provided an independent verification and validation of performance information and data. See page II-87.

- Increase the number of applicants for Graduate Research Fellowships (GRF) from groups that are underrepresented in the science and engineering workforce (Goal P3). Our number of applicants increased from 1009 in FY 2004 to 1013 in FY 2005.
- Increase the number of applications for Faculty Early Career Development Program (CAREER) awards from investigators at minority-serving institutions (Goal P4). We had 92 applications in FY 2005 compared to 82 applications in FY 2004.
- Maintain the percent of Nanoscale Science and Engineering (NS&E) proposals with at least one female PI or Co-PI to 25% (Goal P5). We achieved 31% in FY 2005 compared to 26% in FY 2004.
- For 70% of proposals, being able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later (Goal O2). In FY 2005, we achieved 76% compared to 77% in FY 2004.
- For 70% of proposals, being able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts for the Nanoscale Science and Engineering Program (Goal O3). In FY 2005 we achieved 73%.
- For 70% of proposals, being able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts for the Individuals Program (Goal O4). In FY 2005, we achieved 78%.

We were not successful for 3 of our 17 other performance goals (18%). These were:

- Increase the average duration of awards for research grants (Goal I3). In FY 2005, the average duration was 2.96 years compared to the goal of 3.0 years.
- Maintain at 90% the percentage of facilities construction, acquisition and upgrade projects with negative cost and schedule variances of less than 10% of the approved project plan (Goal T2). In FY 2005, the percent of facilities achieving the goal was 79% compared to 100% in FY 2004.
- Maintain the percent of NS&E proposals with at least one minority principal investigator (PI) or co-principal investigator (Co-PI) at the FY 2003 performance level of 13% (Goal P6). We achieved 12.9% in FY 2005 compared to 12% in FY 2004.

A more detailed discussion of each of these results begins on page II-41.

SUMMARY TABLE OF PERFORMANCE RESULTS

Overall, NSF was successful in achieving 18 of 21 (86%) of the performance goals in FY 2005. Progress towards achievement of NSF's four strategic outcome goals is measured by NSF's performance with respect to annual performance goals for Ideas (Goal I1), Tools (Goal T1), People (Goal P1) and Organizational Excellence (Goal O1).

FY 2001 – FY 2005 Performance Results
Number of Goals Achieved

	FY 2001	FY 2002	FY 2003	FY 2004	**FY 2005**
Annual Performance Outcome Goals	4 of 5 (80%)	4 of 4 (100%)	4 of 4 (100%)	4 of 4 (100%)	**4 of 4 (100%)**
Other Annual Performance Goals	11 of 18 (61%)	14 of 19 (74%)	10 of 16 (63%)	23 of 26 (88%)	**14 of 17 (82%)**
Total	15 of 23 (65%)	18 of 23 (78%)	14 of 20 (70%)	27 of 30 (90%)	**18 of 21 (86 %)**

Note: In FY 2001 through FY 2004, Other Performance Goals include goals that have been previously identified as Investment Process goals or Management Goals.

The table that follows provides a summary of NSF's FY 2005 results for our GPRA and PART goals.

Annual Performance Goals

Performance Area	FY 2005 Annual Performance Goal	Results for National Science Foundation
Ideas Strategic Outcome Goal	***Performance Goal I1:*** **NSF will demonstrate significant achievement for the majority of the following performance indicators related to the Ideas outcome goal:**	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003**: NSF successful for related goal.
Outcome Goal: Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.	**Indicators:**	**FY 2004**: NSF successful for goal I1. **FY 2005: NSF is successful for goal I1.** **Indicator Results:**
	Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering (S&E) knowledge.	Demonstrated significant achievement.
	Encourage collaborative research and education efforts – across organizations, disciplines, sectors and international boundaries.	Demonstrated significant achievement.
	Foster connections between discoveries and their use in the service of society.	Demonstrated significant achievement.
	Increase opportunities for underrepresented individuals and institutions to conduct high quality, competitive research and education activities.	Demonstrated significant achievement.
	Provide leadership in identifying and developing new research and education opportunities within and across S&E fields.	Demonstrated significant achievement.
	Accelerate progress in selected S&E areas of high priority by creating new integrative and cross-disciplinary knowledge and tools, and by providing people with new skills and perspectives.	Demonstrated significant achievement.
	FY 2005 Result: External expert assessment found that NSF has demonstrated significant achievement for each of the performance indicators associated with this goal.	G

Annual Performance Goals
(continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
Award Size	***<u>Performance Goal I2:</u>*** NSF will increase the average annualized award size for research grants to $140,000. FY 2001 Goal $110,000 FY 2001 Result $114,000 FY 2002 Goal $113,000 FY 2002 Result $116,000 FY 2003 Goal $125,000 FY 2003 Result $136,000 FY 2004 Goal $139,000 FY 2004 Result $140,000 FY 2005 Goal $140,000 <u>FY 2005 Result</u> $144,000	**FY 2001:** NSF successful **FY 2002:** NSF successful **FY 2003:** NSF successful **FY 2004:** NSF successful **FY 2005: NSF is successful for goal I2.** G
Award Duration	***<u>Performance Goal I3:</u>*** The average duration of awards for research grants will be 3.0 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 2004 Goal 3.0 years FY 2004 Result 2.96 years FY 2005 Goal 3.0 years <u>FY 2005 Result</u> 2.96 years <u>FY 2005 Result:</u> NSF is not successful for this goal: Progress on reaching 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, together with recovering from recent declines in success rates, as permitted within budget constraints. The performance goal was set at an approximate target level, and the deviation from that level is slight. There was no effect on overall program or activity performance.	**FY 2001:** NSF not successful **FY 2002:** NSF not successful **FY 2003:** NSF not successful **FY 2004:** NSF not successful **FY 2005: NSF is not successful for goal I3.** R

Annual Performance Goals
(continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
Multidisciplinary	***Performance Goal I4:*** Foster collaboration among investigators in Nanoscale Science and Engineering and track this through the percent of Nanoscale Science and Engineering (NS&E) proposals that are multi-investigator proposals. FY 2001 Result 75% FY 2002 Result 75% FY 2003 Goal 75% FY 2003 Result 73% FY 2004 Goal 75% FY 2004 Result 80% FY 2005 Goal 75% FY 2005 Result 84%	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** NSF not successful. **FY 2004:** NSF is successful for goal I4. **FY 2005: NSF is successful for goal I4.** G
Information Technology Research	***Performance Goal I5:*** Qualitative assessment by external experts that the program is serving the appropriate role in ensuring that grantees meaningfully and effectively collaborate across disciplines of science and engineering [Information Technology Research (ITR) Committee of Visitors (COV)] FY 2005 Goal Is Serving the Appropriate Role FY 2005 Result Is Serving the Appropriate Role FY 2005 Result: Based on the ITR COV report NSF is serving the appropriate role for this goal.	**(New Goal)** **FY 2005: NSF is successful for goal I5.** G

Annual Performance Goals (continued)

Performance Area	FY 2005 Annual Performance Goal	Results for National Science Foundation
Tools Strategic Outcome Goal	***<u>Performance Goal T1:</u>*** **NSF will demonstrate significant achievement for the majority of the following performance indicators related to the Tools outcome goal:**	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003**: NSF successful **FY 2004**: NSF successful **FY 2005: NSF is successful for goal T1.**
	Indicators:	**Indicator Results:**
	Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of-the-art S&E facilities, tools, databases, and other infrastructure.	Demonstrated significant achievement.
Outcome Goal: Broadly accessible state-of-the-art S&E facilities, tools, and other infrastructure that enable discovery, learning and innovation.	Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.	Demonstrated significant achievement.
	Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.	Demonstrated significant achievement.
	Provide for the collection and analysis of the scientific and technical resources of the U.S. and other nations to inform policy formulation and resource allocation.	Demonstrated significant achievement.
	Support research that advances instrument technology and leads to the development of next-generation research and education tools.	Demonstrated significant achievement.
	<u>FY 2005 Result:</u> External expert assessment found that NSF has demonstrated significant achievement for each of the performance indicators associated with this goal.	G

Annual Performance Goals
(continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
Construction and Upgrade of Facilities	***Performance Goal T2*:** Percent of construction acquisition and upgrade projects with negative cost and schedule variances of less than 10% of the approved project plan. *FY 2005 target is 90%.* FY 2003 Goal 90% FY 2003 Result 88% FY 2004 Goal 90% FY 2004 Result 100% FY 2005 Goal 90% FY 2005 Result 79 % FY 2005 Result: Data collected from Facilities Managers external to NSF indicate that 79% (15 out of 19) of facilities kept both negative cost and schedule variances to less than 10 percent of the approved project plan. The cost and schedule variances were facility specific due to unforeseen delays related to a shipyard contract and the process for soliciting bids; drilling contract delayed due to hurricanes; and delays in approval of contract because of additional testing and coordinating the procurement with international partners.	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** NSF not successful **FY 2004:** NSF is successful **FY 2005: NSF is not successful for goal T2.** R

Annual Performance Goals
(continued)

Strategic Outcome	**FY 2005 Annual Performance Goal**	**Results for National Science Foundation**
Operations and Management of Facilities	***<u>Performance Goal T3:</u>*** Percent of operational facilities that keep scheduled operating time lost to less than 10%. *FY 2004 target is 90%.* 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: Of the 30 reporting facilities, 26 (87 percent) met the goal keeping scheduled operating time lost to less than 10 percent. FY 2004 Result: Of the 29 reporting facilities, 26 (89.7 percent) met the goal keeping scheduled operating time lost to less than 10 percent. <u>FY 2005 Result:</u> Data collected from Facilities Managers external to NSF indicate that 100% (10 out of 10) facilities kept scheduled operating time lost to less than 10 percent. After several years of tracking this goal, it appears that facility managers are improving on their ability to estimate, and perhaps mitigate against, unscheduled downtime.	**FY 2001:** NSF not successful **FY 2002:** NSF not successful **FY 2003:** NSF not successful **FY 2004:** NSF not successful **FY 2005: NSF is successful.** G

Annual Performance Goals (continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
Number of Users	***Performance Goal T4:*** Number of users accessing National Nanofabrication Users Network/National Nanotechnology Infrastructure Network (NNUN/NNIN) and Network for Computational Nanotechnology (NCN) sites. FY 2001 Result 1300 FY 2002 Result 1700 FY 2003 Goal 3000 FY 2003 Result 3000 FY 2004 Goal 4000 FY 2004 Result 6350 FY 2005 Goal 4000 FY 2005 Result 12462 The use of the network far exceeded expectation due, in part, to the great interest in the field of nanotechnology.	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful. **FY 2005: NSF is successful for goal T4.** G
Number of Nodes	***Performance Goal T5:*** Number of nodes that comprise infrastructure. FY 2001 Result 5 FY 2002 Result 5 FY 2003 Goal 12 FY 2003 Result 12 FY 2004 Goal 14 FY 2004 Result 20 FY 2005 Goal 14 FY 2005 Result 20	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful. **FY 2005: NSF is successful for goal T5.** G
Information Technology Research	***Performance Goal T6:*** Qualitative assessment by external experts that there have been significant research contributions to software design and quality, scalable information infrastructure, high-end computing, workforce, and socio-economic impacts of Information Technology. FY 2005 Goal Significant Research Contributions FY 2005 Result Significant Research Contributions FY 2005 Result: Based on the Information Technology Research (ITR) Committee of Visitors (COV) report NSF is successful for this goal.	**(New Goal)** **FY 2005: NSF is successful for goal T6.** G

Annual Performance Goals
(continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
People Strategic Outcome Goal	***Performance Goal P1:*** **NSF will demonstrate significant achievement for the majority of the following performance indicators related to the People outcome goal:**	**FY 2001:** NSF successful for related goal. **FY 2002**: NSF successful for related goal. **FY 2003**: NSF successful for related goal. **FY 2004**: NSF is successful for goal P1. **FY 2005: NSF is successful for goal P1.**
Outcome Goal: A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.	**Indicators:**	**Indicator Results:**
	Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups in NSF activities.	Demonstrated significant achievement
	Support programs that attract and prepare U.S. students to be highly qualified members of the global S&E workforce, including providing opportunities for international study, collaborations and partnerships.	Demonstrated significant achievement.
	Develop the Nation's capability to provide K-12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering and mathematics.	Demonstrated significant achievement.
	Promote public understanding and appreciation of science, technology, engineering, and mathematics, and build bridges between formal and informal science education.	Demonstrated significant achievement.
	Support innovative research on learning, teaching and education that provides a scientific basis for improving science, technology, engineering and mathematics education at all levels.	Did not demonstrate significant achievement.
	<u>FY 2005 Result:</u> External expert assessment found that NSF has demonstrated significant achievement for a majority of the performance indicators associated with this goal.	G

Annual Performance Goals
(continued)

Performance Area	FY 2005 Annual Performance Goal	Results for National Science Foundation
Fellowships	***Performance Goal P2:*** Number of graduate students funded through fellowships or traineeships from Graduate Research Fellowships (GRF), Integrative Graduate Education and Research Traineeships (IGERT), or Graduate Teaching Fellows in K-12 Education (GK-12) FY 2002 Result 3011 FY 2003 Result 3328 FY 2004 Result 3681 FY 2005 Goal 4600 FY 2005 Result 4648	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004**: NSF is successful for goal P2. **FY 2005: NSF is successful for goal P2.** G
Fellowships	***Performance Goal P3:*** Number of applicants for Graduate Research Fellowships from groups that are underrepresented in the science and engineering workforce. FY 2002 Result 730 FY 2003 Result 820 FY 2004 Goal Increase FY 2004 Result 1009 FY 2005 Goal Increase FY 2005 Result 1013	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful for goal P3. **FY 2005: NSF is successful for goal P3.** G
Diversity	***Performance Goal P4:*** Number of applications for Faculty Early Career Development (CAREER) awards from investigators at minority-serving institutions. FY 2002 Result 60 FY 2003 Result 67 FY 2004 Goal Increase FY 2004 Result 82 FY 2005 Goal Increase FY 2005 Result 92	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful for goal P4. **FY 2005: NSF is successful for goal P4.** G

Annual Performance Goals
(continued)

Performance Area	FY 2005 Annual Performance Goal	Results for National Science Foundation
Diversity	***Performance Goal P5:*** Percent of Nanoscale Science and Engineering (NS&E) proposals with at least one female principal investigator (PI) or Co-PI. FY 2001 Result 25% FY 2002 Result 25% FY 2003 Result 22% FY 2004 Goal 25% FY 2004 Result 26% FY 2005 Goal 25% FY 2005 Result 31%	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful for goal P5. **FY 2005: NSF is successful for goal P5.** G
Diversity	***Performance Goal P6:*** Percent of Nanoscale Science and Engineering (NS&E) proposals with at least one minority principal investigator (PI) or Co-PI. FY 2001 Result 10% FY 2002 Result 10% FY 2003 Result 13% FY 2004 Goal 13% FY 2004 Result 12% FY 2005 Goal 13% FY 2005 Result 12.9% FY 2005 Result: NSF is not successful for this goal. We will continue our efforts to encourage minorities to submit proposals to this area. The performance goal was set at an approximate target level, and the deviation from that level is slight. There was no effect on overall program or activity performance.	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is not successful for goal P6. **FY 2005: NSF is not successful for goal P6.** R

Annual Performance Goals (continued)

Strategic Outcome	FY 2005 Annual Performance Goal	Results for National Science Foundation
Organizational Excellence Strategic Outcome Goal **Outcome Goal:** An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.	***Performance Goal O1:*** **NSF will demonstrate significant achievement for the majority of the following performance indicators related to the Organizational Excellence outcome goal:** **Indicators:** Operate a credible, efficient merit review system. Utilize and sustain broad access to new and emerging technologies for business application. Develop a diverse, capable, motivated staff that operates with efficiency and integrity. Develop and use performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.	**FY 2001:** N/A **FY 2002:** N/A **FY 2003:** N/A **FY 2004:** NSF is successful. **FY 2005: NSF is successful for goal O1.** **Indicator Results:** Demonstrated significant achievement. Demonstrated significant achievement. Demonstrated significant achievement. Demonstrated significant achievement. G
Time-to-decision	***Performance Goal O2:*** 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 or target date, or receipt date, whichever is later. 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 2004 Goal 70% FY 2004 Result 77% FY 2005 Goal 70% FY 2005 Result 76%	**FY 2000:** NSF not successful **FY 2001:** NSF not successful **FY 2002:** NSF successful **FY 2003:** NSF successful **FY 2004:** NSF successful **FY 2005: NSF is successful for goal O2.** G

Annual Performance Goals (continued)

Performance Area	FY 2005 Annual Performance Goal	Results for National Science Foundation
Nanoscale Science and Engineering Program Time-to-decision	***Performance Goal O3:*** Percent of award decisions made available to applicants within six months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system as evaluated by external experts for the Nanoscale Science and Engineering Program in FY2005. FY 2005 Goal 70% FY 2005 Result 73%	**(New Goal for GPRA Reporting)** **FY 2005: NSF is successful for goal O3.** G
Individuals Program Time-to-decision	***Performance Goal O4:*** Percent of award decisions made available to applicants within six months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system as evaluated by external experts for the Individuals Program in FY2005. FY 2005 Goal 70% FY 2005Result 78%	**(New Goal for GPRA Reporting)** **FY 2005: NSF is successful for goal O4.** G

SOME NSF ACHIEVEMENTS

Achievements Noted by the Advisory Committee for GPRA Performance Assessment

NSF is the only agency to invite an external advisory committee, the Advisory Committee for GPRA Performance Assessment (AC/GPA), to perform an analysis of its entire portfolio as part of the agency GPRA assessment process. The material in this section has been taken from the FY 2005 AC/GPA Report available at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05210. The referenced award numbers are links to the NSF web site and provide further information on the awards.

Ideas

Indicator I1. ***Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge.***

The "Biomechanics and Hydrodynamics of Fish Locomotion" research focuses on the analysis of the motion of fish fins and the resulting propulsion and positioning accuracy using techniques from fluid engineering (0316675). One goal of this research is to apply this knowledge to man made vehicles that at present have several limitations. Recent findings show that 1) fish can extract energy from high-speed turbulent flows and thus maintain position using minimal muscular energy; and 2) fish use several fins simultaneously to generate discrete vortex rings allowing them to achieve fine positional control.

After devastating earthquakes in Turkey and Taiwan, the NSF funded several reconnaissance missions including the project, "Ground Improvement Techniques Shown to Mitigate Earthquake Damage" (0085281). This work investigated the performance of sites that had been improved prior to construction to reduce the liquefaction potential of these sites. The study demonstrated that ground improvement was effective in mitigating earthquake-caused damage and in particular was the first to verify that closely spaced jet-grout columns worked well. Although these techniques have been widely used, this work is first to give evidence of the effectiveness in an actual earthquake. This work has immediate application to the design and implementation of these techniques in the U.S. and worldwide.

"How Does the Brain Overcome Obstacles to Successful Memory Performance? Insights from Studies of Prefrontal Cortex and Interference Resolution" has helped to increase our insight on neuroimaging of cognitive and mnemonic control (0401641). When we try to remember a particular piece of information – like the location of our parked car – there can be interference in the brain due to the recalling of memories having been associated with previous parking situations. This work performed several studies using functional magnetic resonance imaging that established a correlation with activity in the left ventrolateral prefrontal cortex and the interference of memory. This research is important in trying to further understand and hopefully improve memory performance.

There has been a long standing mystery in understanding the seismic data that have been collected from the layer between the outer liquid core of the Earth and the inner mantle at a distance of about 2,700 kilometers below Earth's surface. This boundary is called the D'' layer. The "Inner Earth Revealed" team supported by the NSF analyzed x-ray images of perovskite taken at the high pressure and temperature expected in the D'' layer and found a new type of structure that will explain the previous data (0135533, 0215587, and 0230319). This discovery will allow better understanding of the Earth's interior.

Researchers on "Nanotube Membrane Mimics the Functions of the Biological Cell Wall" created a working synthetic membrane made of 8 to 12 nanometer gold nanotubes deposited on a polycarbonate template (9987646). They verified that this membrane did function like cell membranes in recognizing and allowing certain DNA segments to pass more easily than others. This multidisciplinary project uses a chemical model to mimic a biological cell membrane. Such membranes could be useful for DNA separation and/or genomic research.

***Indicator I2.* Encourage collaborative research and education efforts across organizations, disciplines, sectors and international boundaries.**

One outstanding example is the project, "A Sex Pheromone Elicits Distinct Behavior in Male African Elephants," which is multidisciplinary in nature, involving the collaboration of Principal Investigators with different training from three universities across the US (0216862 and 0217062). In terms of education, this project serves not only the graduate students who are about to become professionals in their fields but also creates excellent opportunities for the succeeding group of students, the undergraduates. The project is international in nature, involving the cooperation of international organizations and governments and could not be successful without it. Additionally, this research has the potential for preservation of the African elephant, an endangered species, and therefore maintaining current levels of biodiversity.

Another excellent example is a project, "U.S./Africa Materials Institute" (0231418), in which chemists, materials scientists and biomedical researchers from US universities and organizations join with their counterparts from several African countries to conduct research on improving early cancer detection. Successful treatment of cancer depends in part on its size at detection. Current imaging techniques can resolve tumors a few millimeters in size. So far, the team of scientists working on this project is able to detect tumors that are a fraction of a millimeter. This has untold benefit for the treatment of cancer. The multidisciplinary, collaborative and international nature of the project is clear. One of the interesting (unusual) aspects of this project is that the education is not occurring at the university student level but at the level of the research scientists. And it involves a transfer of information from the African scientists to the US scientists and vice versa. More often the transfer of information is from the US to the lesser-developed region. This research provides opportunities that would be otherwise difficult for the African scientists to access and has beneficial effects on the field of health and medicine in the US and Africa (and potentially the world).

The project, "Beetles and Their Yeast Endosymbionts From Basidiocarp Habitats," is multidisciplinary and collaborative at the U.S. university level but not at the international level (0072741). Although its scientific basis is sound and interesting, it was chosen as an example of a project that has a very strong undergraduate student component, a commitment to entraining minority students, and outreach to elementary and secondary students. Undergraduate students participated in science at field sites, where they identify, collect and preserve biological specimens -- an invaluable experience. The involvement of undergraduates, minority students and students at earlier stages of their education has important long-term benefits for the students in particular and science in general.

The "Puerto Rico Collaborative for Excellence in Teacher Preparation" (PR-CETP) project is different from the mainstream. It does not focus directly on scientific research; rather, it focuses on the training of the teachers who deliver the scientific information to pre-university students (0331998). It involves the cooperation of university and K-12 teachers. This effort is notable because of its focus on improving education at the earlier stages of the learning process. Teachers are better prepared which means that students entering university would be better prepared. This bodes well for the ultimate advancement of science.

The "Children's Research Initiative" (CRI) researches routine tools used by wild Capuchin Monkeys (0125486). It meets each of the goals outlined above. It stands out from the rest of the group because it is an excellent example of research led by a female Principal Investigator and it has the potential for understanding further the links between humans and other primates. This research examines the use of tools by the wild capuchin monkeys and is an opportunity to study the development of this behavior, which was once thought to be peculiar to humans.

<u>Indicator I3.</u> Foster connections between discoveries and their use in the service of society.

The project accomplishments selected to illustrate the impacts of NSF-sponsored research in this area include:

> A Long-Term Ecological Research (LTER) grant, "Plum Island Sound Comparative Ecosystem Study (Pisces) Effects of Changing land Cover, Climate and Sea Level on Estuarine Trophic Dynamics," that involves an investigation of the contribution of dissolved organic matter from living organisms to the overall carbon cycling within deep oceans (9726921);
>
> "Intrusion Detection Techniques for Mobile Ad Hoc Networks," a project involving student participation at many levels, has led to advancements in wireless security technology that have the potential to be developed for use at very low cost (0311024);
>
> The project, "Earthquake Engineering Research Center" had direct applications in improving the ability of the critical infrastructure of the city of San Francisco to withstand significant earthquake activity (8607591);
>
> "Organic Materials of Intermediate Dimensions for Optoelectronic Technologies" is a project that has led to the discovery of new optoelectric capabilities for building sensors for the detection of individual viruses or bacteria, a technology that may prove critical in the area of homeland security (0097611); and
>
> The project, "Dynamic Employer-Household Data and the Social Data Infrastructure," is a sociological and economic analysis of means whereby low-income women, the employment rates of whom have reached all-time highs, can be encouraged by policymakers to pursue strategic job ladders that move them out of poverty (9978093).

Each of these projects has a direct impact on an area or areas that have in recent years been identified as a national and/or regional priority. Indeed, several of these illustrate the global nature and potential effects that research in the areas of critical technologies or sociological imperatives can have.

There is relevance and high risk in each of the examples cited above. The impact of the large, multidisciplinary initiatives such as LTERs and ERCs is unquestionably enhanced well beyond the individual sum of the parts involved. The marriage of life sciences with engineering expertise provides a particularly potent approach to formerly intractable problems and is yielding promising results. Moreover, in the case of the fifth example cited above, the potential impact on society at large of the novel approach of focusing on employer strategies and practices rather than on employee characteristics has the potential to transform how we craft future social policies and manage workforce and workplace issues.

<u>Indicator I4.</u> Increase opportunities for underrepresented individuals and institutions to conduct high quality, competitive research and education activities.

NSF programs such as the Louis Stokes Alliances for Minority Participation (LSAMP), Centers of Research Excellence in Science and Technology (CREST), Alliances For Graduate Education and the Professoriate (AGEP), the Minority Postdoctoral Fellowship Program, and Research Experiences for Undergraduates have historically provided a stimulus and increased opportunities for women and underrepresented minorities to participate in all stages of the research process. These programs have been successful, and now NSF's portfolio contains a number of examples of projects that involve the full participation of underrepresented individuals and institutions in the generation of ideas. Several overarching themes emerge, including: a) improved access to STEM (science, technology, engineering, and math) by disabled persons; b) culturally-based learning projects; c) CAREER awards that have provided the groundwork for highly successful careers of underrepresented minorities; and d) the coupling of outstanding science and strong mentorship.

A number of projects involved the improved access to STEM by visually and hearing-impaired persons, with a cluster of projects addressing the needs of blind persons. Involving a totally blind graduate student researcher, the project “Automated Tactilization of Graphical Images: Full Access to Math, Science, and Engineering for Blind Students” aims to automatically create tactile versions of maps, charts, graphs, diagrams, and other images that are found in math, science, and engineering textbooks (0415273). This is an important problem, as the creation of tactile representations of data is very time and labor intensive.

Another project, “Exploring New Geometry by Touching, Seeing, and Feeling,” explores new geometry by touching, seeing, and feeling has similar goals (0430730): it combines computer graphics with 3D computer haptics (which imitates the 3D sense of touch) to enable blind persons to perceive geometric shapes including self-intersecting surfaces. Finally, working under the mentorship of the PIs of the “Engineering Research Center for Biomimetic Microelectronic Systems” at the University of Southern California (0310723), a high-school student won the top prize at the 2004 Orange County Science and Engineering Fair for her project, “Intraocular Camera for Retinal Prostheses: Restoring Vision to the Blind.”

Culturally based learning projects are providing a novel approach to the inclusion of underrepresented minorities in competitive research and education activities. A new paradigm is emerging, one that involves the student in STEM by using the student’s life experience and culture as a starting point. Examples include:

A project, “Agricultural Science Summer Undergraduate Research Education and Development Project” (ASSURED) (0244179), in which the children of migrant workers, who have spent their youth harvesting onions and chili peppers in the field, are now studying these plants in a laboratory. They are looking at ways to improve yield and to understand fundamental characteristics of the plants at the genomic level. Developed in cooperation with Yup’ik Eskimo elders, another project, **“**Improving Alaska Native Elementary Students’ Math Performance” (0138920 and 9618099), produced a culturally based mathematics curriculum for elementary school students. As an example, students learned the mathematical properties of shapes that they made as bookmarks. Students participating in this curriculum had significantly higher test scores than those students in the standard curriculum.

Similarly, there is another project, “Sustainability and Stewardship in Alaska,” that addresses Alaskan Natives and is organized along lines parallel to NSF's Integrative Graduate Education and Research Traineeship (IGERT) program but is focused on undergraduate education and research (0331261). This undergraduate to graduate pipeline approach invigorates the students by infusing them with real-world research concepts. They participate in hands-on research involving the integration of natural and social sciences for natural resource conservation. The focus is on sustainability and stewardship of the land.

Women and underrepresented minorities who have received NSF CAREER awards are making significant contributions to STEM and are becoming outstanding mentors, as well. For example, Janice A. Hudgings developed a 2-D thermoreflectance microscopy technique that enables thermal measurement of optoelectronic devices on the nanoscale in the project, “High Performance Thermal Profiling of Photonic Integrated Circuits” (0321449 and 0134228). She established the first engineering and physics research lab at Mount Holyoke College, an ideal context in which to encourage a diverse group of women undergraduates to participate in science and engineering. To date, 19 women have performed independent research in her lab, nine of which are underrepresented minorities.

Kathleen Pickering is using the Pine Ridge Lakota Indian Reservation as a starting point to study how pre-industrial indigenous societies organized economic production on a "subsistence" level, based on the family and different from that of market-based industrial capitalism in “CAREER: Cash and the Social Economy of the Pine Ridge Indian Reservation: Labor Allocations, Consumption, and Economic Development on the Periphery” (0092527). Her research advances theoretical understandings of the subsistence-market distinction, trains students in research design and methods and encourages local Lakota students to consider advanced studies at the university.

CAREER awardee Kim Venn, in collaboration with researchers at University of Texas at Austin and University of Texas, El Paso, has analyzed the chemical composition of stars in a sample of local dwarf galaxies and compared them to published datasets for stars in the Milky Way in the projects, "The First Stellar Abundances in Local Group Galaxies" and "Collaborative Research: Chemical Evolution Beyond the Milky Way" (0306884, 0307534, and 9984073). They find distinctive differences; their results challenge basic ideas about the formation of galaxies.

Finally, CAREER awardee Kristi Anseth of the University of Colorado, Boulder, received the 2004 Waterman Award, which is the highest prize the NSF offers to scientists from all fields who are not more than 35 years old and seven years since their doctorate. In her pioneering work in the field of tissue engineering, "CAREER: Photocrosslinkable Polymers for Fracture Fixation" (9734236), she created polymeric scaffolds that serve as specific templates for the attachment, growth, and proliferation of cells, and has also developed novel polymeric materials for the fixation of fractured bones.

A number of projects illustrate that strong mentorship, especially by and of women and underrepresented minorities, is a very positive by-product of outstanding STEM accomplishments.

For example, Casonya Johnson is a female African-American who, after graduate and post-doctoral work at the Johns Hopkins University, returned to her alma mater, Morgan State University, where she serves as an important role model for her students. Her research involves functional characterization of a novel class of genes, discovered through analysis of the *C. elegans* genome sequence. Her project, "Genetic and Molecular Characterization of Dual HLH Domain Proteins in *C. elegans*" (0212336), supports the integration of quality research and education at a historically black university.

Two of the graduate student researchers in Frank Bates' (winner of the prestigious Turnbull Award of the Materials Research Society) laboratory at the University of Minnesota who contributed to the discovery of a totally new phase in soft matter were African Americans. The project team for "Phase Behavior and Network Morphologies in ABC Triblock Copolymers" (0220460) synthesized tri-block copolymers, in which the three molecular components segregate themselves into continuous nanoscale pathways that are intertwined in a regularly structured way. In this manner they may find unique applications as membranes, templates, or composites. These students now have outstanding careers in industry and academia.

Using nanoparticle-mediated assembly of crystals, Jennifer Lewis at the University of Illinois at Urbana-Champaign has reported, for the first time, a new directed-assembly route that allows for the creation of crack-free, single region (or domain) colloidal crystals of high quality. Her research, "Novel Colloidal Routes to Photonic Band Gap Materials" (0071645), may lead to new optical devices for chemical/biological sensing, optoelectronics, optical computing, and telecommunication networks.

***Indicator I5.* Provide leadership in identifying and developing new research and education opportunities within and across Science and Engineering fields.**

NSF supports a broad array of research projects that promote the identification and development of new research and educational opportunities in science and engineering fields. Many of the projects demonstrate leadership and novelty and represent new and ingenious ways of approaching research. Much of the work in this indicator is interdisciplinary, requiring input by a number of researchers from different areas. Further, many of the studies involved a combination of fundamental and applied research with high potential for practical outcome.

For example, NSF funded, "Renewable and Resource Efficient Composite Materials for Affordable Housing" (0229731), the research of Professor Chandrashekhara at the University of Missouri, Rolla, and his team of mostly undergraduate students to develop new fiberglass-epoxy composite materials from soy products. These materials are suitable for structural use in floors, roofs, and walls and in the form of a foam for use in insulation panels. This project delineates an innovative approach to utilizing a waste product to form low cost and environmentally friendly construction materials. This creative research involves a multidisciplinary team with backgrounds in polymer chemistry, composite manufacturing, structural mechanics and environmental engineering.

Another project, "Multiscale Virtual Reality of Diffusion-Induced Deformation Processes" (0313346), an Information Technology Research (ITR) project, shows leadership in developing a novel approach to educating today's students for tomorrow's jobs by supporting the development of joint doctoral programs between San Diego State University and the University of California, San Diego (in applied mechanics and materials science) and between San Diego State University and Claremont Graduate University (in computational materials science). These joint doctoral programs provide a link between research universities with those more oriented toward teaching and community service-based education. These programs will produce students who are well versed in the technological challenges of today while being equipped with an extensive background in the fundamental sciences. Both joint programs enhance the flow of innovative ideas that will provide San Diego's booming technology economy with a more creative and inventive workforce.

A project led by Kenneth Beard at the Carnegie Institute, "Investigating the Origin and Early Evolution of Primates in Asia" (0309800), challenges earlier interpretations whereby most or even all of the major events in primate and human evolution were thought to have occurred in Africa. The team has uncovered evidence for a broad range of early primates in Asia, including the oldest and most primitive primates and anthropoids yet to be discovered. This project has attracted a substantial amount of attention from popular media and has fostered international collaborations among American, Chinese, French, Thai, and Burmese scientists. This research demonstrates leadership because it challenges the long-held hypothesis that primate and human evolution took place only in Africa. This work has the potential to change the way we think about where the evolution of humans began.

Research by Caroline Ross and colleagues at Massachusetts Institute of Technology on controlled self-assembly of nanostructures, "Nanostructured Surfaces with Long-Range Order for Controlled Self-Assembly" (0210321), a Nanoscale Interdisciplinary Research Teams (NIRT) project, is hoped to generate a set of methods and processes to impose precise long-range order nanostructure arrays over large areas. These methods are designed to be scaleable and compatible with low-cost, high-volume manufacturing. The educational goals of this work are to contribute to the public understanding of nanotechnology and to the training of skilled researchers.

Another project that demonstrates significant leadership is one that engages diverse students in developing nuclear physics tools for unraveling the mysteries of subatomic particles, **"**Precision Measurements with Pions **"** (0354808, 0245407, and 0114343). This work is a collaboration involving three interactive projects: Research in Intermediate Energy Physics, Study of Electromagnetic Structure of Light Pseudoscalar Mesons via the Primakoff Effect, and Center for the Study of the Origin and Structure of Matter. This collaboration includes several Historically Black Colleges and Universities (North Carolina A&T and Hampton University), as well as scientists from China, Russia, Ukraine, Armenia and Brazil. Undergraduate and graduate students from five different universities have been involved in the project. This effort brings nuclear physics to students often underrepresented in this challenging area.

A team led by S. J. Yoo at UC Davis is working on a project, "Protocol Agile Optical Networking for the Next Generation Internet" (9986665), that explores new research opportunities in high-speed optical networking by creating new switching technologies. This project contributes to knowledge in the area of networking architectures by developing and demonstrating a new optical networking approach. This new networking technology can be integrated with campus networks to form the basis for future cyberinfrastructure. This research group is committed to integrating research and education and has directly trained 14 graduate students and educated 150 graduate and 250 undergraduate students.

Indicator I6. ***Accelerate progress in selected S&E areas of high priority by creating new integrative and cross-disciplinary knowledge and tools, and by providing people with new skills and perspectives.***

One extremely innovative project fosters cross-disciplinary knowledge by developing a new graduate program in astrochemistry at the University of Hawaii, "Untangling the Energetics and Dynamics of Atom-Radical and Radical-Radical Reactions" (0234461). This project is the first of its kind in the United States and has been spearheaded by Ralf Kaiser, an assistant professor and CAREER awardee. This program features a curriculum that relates chemical dynamics to astrochemistry, planetary sciences, laboratory astrophysics, astrobiology, and combustion chemistry in reaction dynamics and astrochemistry. Participating units include the Department of Chemistry, the Department of Physics & Astronomy, the Institute for Astronomy (IfA), the Hawai'ian Institute of Geophysics and Planetology (HIGP), and the Astrobiology Institute (NAI).

In the interest of fostering highly integrative knowledge exchange, NSF supported a project that utilized a series of workshops aimed at unifying the cross-disciplinary knowledge of complex networks in order to generate a text describing that nascent field, **"**First Crossdisciplinary Text on Optimal Adaptive Management of Complex Systems," (0223696 and 0224592). These workshops, organized by Jennie Si at Arizona State University, brought together experts in neural networks, control theory, operations research, artificial intelligence, electric power and fuzzy logic. The new text focuses on adaptive systems that learn to optimize performance with foresight to manage complex systems prone to unexpected disturbances like power grids, critical infrastructure and financial systems.

William Kaiser from UCLA is building a networked infomechanical systems (NIMS) robotic sensor system to operate continuously in the forest at the James San Jacinto Mountain Reserve that will provide accurate environmental (0331481). NIMS systems have generated the first three-dimensional characterization of solar radiation on the space and time scale of forests, waterways and wetlands. These new robotic sensing systems are suspended on cable infrastructure and may move, sense, draw water samples from a stream, or collect images high in the forest canopy while responding suddenly to events by moving immediately to acquire detailed imaging of compact objects at centimeter ranges. NIMS research is a convergence between the computer science and engineering fields of networked sensing and robotics along with the science application fields of biology and public health that enables fundamental investigations of ecosystem energy, water and carbon budgets critical to global change. The NIMS project includes a summer REU program involving students from universities throughout the U.S.

The Particle Engineering Research Center (PERC) at the University of Florida is developing a major new alternative drug transport technology (9402989). This involves collaboration between chemical engineers, materials scientists, and pharmaceutical researchers. This technology is designed to deliver drugs specifically to diseased cells, thereby greatly reducing doses needed by patients while providing a more effective treatment. Potential applications include drugs used to treat life-threatening human maladies such as cancer, heart disease, and AIDS. This significant new application of nanotechnology is the result of a multi-disciplinary team working in an Engineering Research Center.

NSF is taking the lead on supporting a collaborative research platform of geographically distributed infrastructure that will be connected via information technology to address pressing environmental questions on regional to continental scales. The National Ecological Observatory Network (NEON) will be a large-scale multi-disciplinary effort led by the American Institute of Biological Sciences that involves biologists, engineers, computer scientists, social scientists and educators in a collaborative effort. NEON will generate knowledge of complex environmental processes by applying emerging sensor, analytical, communication and information technologies to investigate the structure and dynamics of ecosystems and to forecast biological change, such as in the project, "Infrastructure for Biology at Regional to Continental Scales" (0229195). Example environmental questions that will be addressed include evaluating the ecological effects resulting from climate-driven changes on global water and carbon cycles and the emergence of infectious diseases and invasive species resulting from anthropogenic activities.

Tools

Indicator T1. ***Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of the-art S&E facilities, tools, databases, and other infrastructure.***

Through FabLab, which is an educational outreach component (0122419), the Center for Bits and Atoms provides outreach facilities to bring the ideas of fabrication and micro-manipulation to the US public and includes modules in Kenya and South Africa. The tools of this large center are made available to the public through these activities and the Fab Lab serves as a model for Centers that are more than the total of all the science that occurs there because the science is disseminated and brought to the public in meaningful, hands-on methods. CBA's laboratory research on technologies for personal fabrication is complemented by the field "Fab Lab" program. The FabLab brings prototype capabilities to under-served communities that have not had access to the reach of conventional and modern technology development and deployment.

"Expanding National Library of Virtual Manipulatives (NLVM) Reaches U.S. and International Audiences of K-8 Math Learners" (0352570) and "National Library of Interactive Web-based Virtual Manipulatives for K-8 Mathematics" (9819107), are projects that enhance the mathematics education in grades K-8 in both the US and abroad. This project provides on-line, web based tools and databases that have more than 1 million hits a day as students access the information on the web. Not only does the program provide state-of the art educational tools for students, but it also provides pre-service teacher training in a field where innovation on a K-8 level that is solid and rigorous is hard to come by. Accessibility will be increased as well as the team is working on creating a version in Spanish. The outreach of this activity is expanding, has free access and can help to increase mathematics literacy by providing manipulatives via the internet that are formal curriculum tools as well as informal learning environments.

Materials Science as a field has developed to the point where scientists are beginning to predict macroscopic properties from atomic or microscopic structure. However, in order to have this capability, the tools of cyberscience—algorithms and computational expertise—are needed. Researchers at the University of Illinois at Urbana Champaign have begun to address this important cyberinfrastructure need by developing software and education cyberinfrastructure (0325939). From a small group award, the seeds of this idea grew to a larger proposal in FY03 awarded through the Information Technology Research solicitation and is funded through the Division of Materials Research with co-funding from the Chemistry Division and the Division of Computing and Communications Foundations in the Computer and Information Sciences and Engineering Directorate. This program has provided software dissemination openly, developed new software tools, and hosted a workshop to promote the exchange of ideas and new advances in algorithms for computational materials research and a computational summer school to help train the next generation of computational materials researchers in state of the art computational methods. This project is an example of the cyberscience tools being developed through the NSF that will enable the forefront science of the next generation.

The Protein Data Bank (0312718) promotes international cooperation and is the authoritative, international repository for 3D structural information for biological macromolecules. Indeed, anyone in the US or abroad looking for the structure and classification of a protein can access all published information on the web. This database not only provides information, but is coupled with tools for visualizing the protein structure as well. In addition, storage of this data, archiving and backup is pushing the frontiers of international collaboration as well as the issues of permanent or long term storage and ownership/responsibility for long term maintenance. Suzanne Richman from Rutgers University writes about her work in Japan on this project "Despite our differing cultures and languages, working at PDB felt like home. We are all working on the same project, half a world apart, but with the same thoughts and feelings about it, and in an annotation room that can be just as eerily quiet, as we all work and concentrate hard." Science can bring people together and break down barriers of language, culture, and geography. The Protein Data Bank provides an excellent example of the unifying force of science.

The Cyber Defense Technology Experimental Research (DETER) Network (0335298) is a facility funded by NSF. The DETER network and test-bed serves as a center for interchange and collaboration among security researchers, and as a shared laboratory in which researchers, developers, and operators from government, industry, and academia experiment with cyber security technologies under realistic conditions. It provides an infrastructure that would not otherwise exist to both aid in the development of tools for protecting cyberinfrastructure and for training students and the next generation of cyberinfrastructure researchers. This is a unique facility with broad outreach to a diverse community involved in network security evaluation.

Microsystems Packaging is a key component of all consumer electronics, and yet as a field has not yet been developed. This innovative program has developed textbooks and innovative curricula (9402723). Students from the program at Georgia Tech have been highly sought by industry. Two of the largest professional societies, IEEE and IMAPS have helped develop 15 new courses for the Internet that are accessible internationally. This access as well as the adoption of the textbook at 47 universities shows the importance of MSP and the need for the tools and curricular databases provided by this program.

Through a joint collaboration between U.S. and Indian astronomers, a spectroscopic fingerprinting of over 1200 stars has been funded and will be provided openly to the scientific community (0114536). This is a huge undertaking as the current largest star mapping is about 200 stars. This library will include spectral data over the largest wavelength range available as well. The star library is a unique data resource for our international scientific collaborations, as for the whole astronomical community. The scientific potential of the library is that certain spectra can be used as building blocks for analyzing the evolution of galaxies. As a database, this library will be unparalleled in the astronomical community.

***Indicator T2.* Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.**

The Arctic Ocean is a crucial region determining the present and future state of the world's oceans and climate. The extreme conditions of the Arctic environment have limited scientific observations to a relatively few locations and seasons of the year. The design and implementation of an observational array for Arctic oceanographic measurements through "An Observational Array for High Resolution, Year-round Measurements of Volume, Freshwater, and Ice Flux Variability in Davis Strait" (**0230381**) will provide a highly integrated and interdisciplinary perspective on the role played by the Arctic and sub-Arctic in steering decadal scale climate variability. The observing system will provide the first year-round measurements of the total water volume, influence of freshwater, and ice fluxes across Davis Strait between Greenland and Canada. The ocean, ice, and atmospheric observations from this facility will be essential for understanding and documenting the influence of future climate variability and change on Arctic environments.

In February 2004, the Global Biodiversity Information Facility (GBIF) (0301149) went online with a prototype data portal (www.gbif.net) that provides digital access to data from the world's natural history collections, herbaria, culture collections, and observational databases. Participation in the GBIF consortium is open to any country or relevant international organization. The consortium currently consists of 72 participating institutions. This revolutionary capability for sharing a treasure of unique data collected from important ecosystems across the entire planet will promote scientific collaboration and dramatically improve fundamental understanding of the state of the world's biodiversity. Science and society stand to gain much from the GBIF data. Data mining will turn up gems of insight and understanding that cannot be predicted but are likely to lead to fruitful new directions for both research and commercial applications of natural substances. Such insights are vital to creating better futures for both people and nature.

From the Pacific coast to our nation's interior, more than 75 million Americans in 39 states live in towns and cities at risk for earthquake devastation. While scientists are digging into the origins of seismic waves, engineers are pushing the boundaries of design to create structures that remain safe when an earthquake ultimately occurs. The George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) (0126366, 0117853, and 0402490), integrates 15 experimental facilities, located at academic institutions across the United States, including shake tables, geotechnical centrifuges, a tsunami wave basin, large strong floor and reaction wall facilities with unique testing equipment and mobile and permanently installed field equipment. A NEESgrid connects these experimental facilities via the Internet2 to form the world's first prototype of a distributed "virtual instrument" for earthquake engineering research (www.nees.org). NEES also provides national resources for developing, coordinating, and sharing new educational programs and materials to excite and support future generations of the earthquake engineering workforce.

Scientists and engineers at the University of Texas at Austin, Center for Space Research (CSR), Mid-American Geospatial Information Center (MAGIC) lead the development of cyberinfrastructure that rapidly integrates and distributes crucial environmental, engineering, economic, and social data necessary to disaster mitigation, response, and recovery in their project "Extensible Terascale Facility (ETF): Enhancing the Capabilities, Scope and Impact of the Extensible Terascale Facility" (0338629). This timely and usable information is quickly provided to state and federal agencies, regional and local governments, academic institutions, and the public. This accomplishment is a stunning example of translating fundamental earth science observations and research into operational uses that will reduce the loss of life and property caused by hurricane winds, storm surges, tsunamis, floods and other disasters. This project involved collaborations with the Texas Advanced Computing Center, Oak Ridge National Laboratory, and Purdue University.

The Cyber Defense Technology Experimental Research (DETER) Network (0335298) is a new center for collaboration among information technology networking and security researchers. This facility encourages collaborative research and education efforts - across organizations and disciplines - by involving six universities and four industrial institutions in an effort that spans both networking and security issues. This project provides leadership in the future networks and computational infrastructure that will be necessary to the emerging knowledge society. This project also expands opportunities for U.S. researchers, educators, and students at all levels to access state-of-the-art network security evaluation infrastructure.

Indicator T3. ***Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.***

Cyberinfrastructure constitutes the research environments that make advanced computation, data acquisition, and collaborative services available through high-speed networks. NSF has built up the country's cyberinfrastructure through a variety of programs, notably the PACI (Partnerships for Advanced Computational Infrastructure) supercomputer centers, the Middleware Initiative, the Information Technology Research (ITR) program, and the Teragrid.

There was significant achievement in the cyberinfrastructure goal through the combination of these facilities, indicated by progress in several funded activities, falling roughly under two headings:

- Successful applications of the existing cyberinfrastructure. Several project accomplishments attest to how the recently developed infrastructure is supporting many scientific projects, from access to astronomical surveys (the National Virtual Observatory), to parallelizing existing useful software, like the Harvard CHARMM code for molecular mechanics. Two nuggets are exemplary in this regard: "Computing dark energy" and "Using Grid platforms to better understand neuro-transmission."

- Development of new tools to extend the reach of the cyberinfrastructure. We highlight two project accomplishments among the several that fall into this category: "Rocks Cluster Management Software" and "Workflow Scheduler for Distributed Computation."

The greatest concern is stable funding and management of these resources in the future.

Successful applications:

The recent conclusion that the expansion of the universe is accelerating likely due to the presence of "dark energy" was initially supported only from supernova data. Now a second line of evidence from the projects "Statistical Data Mining for Cosmology" and "Searching for Correlations in a High Dimensional Space" (0121671 and 0312498) bolsters the same conclusion, based on the so-called Sachs-Wolfe effect. The faster expansion rate of a universe that contains dark energy would leave its mark on photons that gain energy passing by gravitational potentials. This effect has been observed with the help of statistical data mining algorithms developed to search the massive astrophysical surveys.

MCell is a Monte Carlo simulator of cellular microphysiology. It simulates the dynamics of biochemical reactions in 3D microenvironments, and in particular, of neurotransmitters in synapses. Current demands are of the order of 2CPU-months of computation and 35GB of memory. The project, "Virtual Instruments: Scalable Software Instruments for the Grid" (0086092), altered MCell to MCell-K to permit it to run in parallel, distributing the work onto large Grid platforms. Clusters at the San Diego Super Computing Center, the Tokyo Institute of Technology, and the IBM BlueHorizon supercomputer, were all used for large-scale simulations previously unapproachable by serial MCell.

Development of tools:

There is a need to make stable and manageable parallel computing platforms available to a wide range of science and engineering research, as the project "National Partnership for Advanced Computational Infrastructure" (9619020) may demonstrate. An impediment has been the difficulty of setting up a cluster, and then managing it, e.g., ensuring all nodes have a consistent set of software. Rocks addresses this need by making it easy to create, manage, and upgrade a Linux cluster. The basic idea is to make complete OS installation on a node the basic management tool, which is faster and easier than determining the software synchronization of all nodes. Rocks software clusters use a MySQL database for site configuration. The software builds a cluster by installing a Linux suite of software, and provides tools for easy upgrades and extensions. Rocks has quickly developed an extensive worldwide user base, and won several awards at the 2004 Supercomputing Conference.

Scheduling the flow of work in a distributed computation is a critical issue for heterogeneous tasks, which are more challenging than tightly-coupled parallel computations. This new workflow scheduler (0331645) seeks to minimize the "makespan" (overall job completion time). It creates a task graph, and ranks each eligible resource against subtasks, incorporating information (some automatically estimated) about communication and memory costs. Optimization heuristics then choose a mapping of components to nodes. Experiments indicate significant improvement over randomized scheduling.

Indicator T4. ***Provide for the collection and analysis of the scientific and technical resources of the U.S. and other nations to inform policy formulation and resource allocation.***

NSF's SRS unit gathers a great deal of data on Research and Development (R&D) which forms the statistical basis for the familiar volume *Science and Engineering Indicators*, published every other year under the imprimatur of the National Science Board. Surveys cover such topics as Industrial R&D, Federal Funds for R&D, Federal science and engineering support to universities, colleges, and nonprofit institutions, academic R&D, and science and engineering research facilities. SRS works with other units of the Federal Government, most particularly the Census Bureau, in developing these data.

A committee, convened in 2002 by the National Academy of Sciences, reviewed the performance of SRS and issued a report in 2005. This report contains 32 separate recommendations that largely deal with ways in which SRS could improve and/or extend the kinds of data, which it does collect (Brown, Plewes, and Gerstein 2005). Given the scope of this group's review and the integrity of the National Academy review process, our subcommittee chose to simply accept the positive review by the National Academy committee at face value and did not make our own independent evaluation of SRS.

The second way that the NSF supports the development of useful policy data is to support projects that include as all or part of their mission the development of websites that either contain some data themselves or have links to websites that contain data. We cite here three examples of such projects that came to the committee's attention as being examples of particularly noteworthy endeavors.

The Math and Science Partnership program (MSP), developed in conjunction with the President's “No Child Left Behind” education initiative, has generated among other things a pooled database of successful practices that will be very useful both to people within the MSP community and beyond it, for example, in the project “Program Evaluation for the Math and Science Partnership” (0456995, 0335334, and 0445398). Exploration of one of the many websites supported by this project (http://hub.mspnet.org/) revealed that already, only a few years after the MSP projects began, there are a considerable number of papers presenting results which are of interest to practicing science teachers. The links were easy to follow and information on particular areas of interest was easy to find.

Scientists and science instructors occasionally find themselves interested in some very specific areas that suddenly come on to their radar screen. For example, a university scientist who has been asked to visit a school for deaf children would do well to visit the website of the NSF-funded project COMETS (Clearinghouse on Mathematics, Engineering, Technology, and Science). The COMETS website, developed at the National Technical Institute of the Deaf, aims to contain virtually everything ever published that is related to deaf education in STEM fields (0095948). This website (http://www.rit.edu/~comets/pages/featurespages/biblio/bibliopage.html) has information on a great deal of individual investigations, and a complete list of scientists who were deaf or hard of hearing.

Another example deals with a particular environmental niche, the cold regions of our planet. A scientist who had a need for information on the work that had been done in arctic and sub-arctic regions of the planet, and who was not already familiar with the network of literature and investigators in this area, could simply go to http://www.coldregions.org/. This website, prepared with NSF support (9909727) apparently contains links to almost everything published on these parts of the planet.

A third way that the Foundation supports policy studies is to support basic research projects which not only have significant policy implications but which seem to be influenced by the need to develop data with policy implications. For example, Dr. Robbie Luliucci at Washington & Jefferson College studies the aging of silica-reinforced polymers used in weapons systems (9909727). The materials that age are not the materials that explode, but the plastic and rubber-like materials that are equally important to the integrity of a weapon. Undergraduate students develop skills that can be used in industry, particularly as is related to homeland security. As another example, Marina Alberti of the University of Washington led an interdisciplinary study of urban development, land-cover change, and bird diversity, a study that could certainly be useful to any land-use planner who was interested in the relationship between environmental integrity and the intensity of urban or suburban development in any particular area (0120024).

***Indicator T5.* Support research that advances instrument technology and leads to the development of next-generation research and education tools.**

In evaluating the various research nuggets for 2005, it is clear that there are many NSF-funded programs producing results for putting in place new instruments that can and will provide opportunities for great advancements in the fields of biology, medicine, materials, and computer technology.

> For example, at the Center for Bits and Atoms at MIT, scientists are developing new methods that fundamentally will change the way a computer works integrating both "living" software and hardware that changes to meet the computational needs at hand. This program is innovative in that it seeks to fundamentally revisit the notion of what a computer is, and what a computation is. By taking a more

holistic approach and a radically new view of the process, the program seeks to revolutionize the computing process. If successful, this program has the potential of creating a new foundation for much more advanced computing and management of much larger amounts of information at higher speeds than ever before possible. This program expands the narrow "hardware" focus of current computational techniques and methods. The vision is to include in the computational approach "context" information. The goal is to overcome the very real scaling limits of "data crunching only" that creates an obstacle to designing and managing very large-scale data and information systems. The program is high risk, multidisciplinary, and has already achieved some positive results, one of which is a new type of analog to digital converter. Under NSF funding for "Center for Bits and Atoms" (0122419), Neil Gershenfeld and his team have produced an extremely energy-efficient version of the versatile analog-to-digital converter. Conversion of analog readings to digital signals is becoming extremely important, not only in technology advancement, but also in everyday life. This device applies new methods to increase speed of conversion and energy efficiency over previous technology. This instrument has an array of applications in the computer, automotive and communications industries.

As another example, NSF has taken a leadership role in developing nanotechnology and instrumentation. In the project "Nanotechnology Moves into Production at IBM" (0213618 and 0213695), Curtis Frank of Stanford University and Thomas Russell of University of Massachusetts Amherst have developed a new tool for high-density lithography. Collaboration with IBM scientists has led to the application of this technology to increasing the lifetime of flash memory over 100-fold, compared to previous technology. As with the analog-to-digital converter, this application of nanotechnology is important in technological research as well as improving everyday life.

Carl Wieman and Thomas Perkins, at the University of Colorado at Boulder, in their project "Watching Proteins Bend DNA with Subnanometer Resolution" (0404286 and 0096822), have created another breakthrough nano-scale instrumentation as a tool, which allows biologists to follow the motion of a single molecule. Until this advancement, scientists needed to rely on the average of a set of measurements on a group of molecules in order to study molecular behavior. Now, molecular motion can be measured with ten-fold greater resolution at times on the millisecond level. This project opens up the opportunity to measure the motion of enzymes replicating.

Another new tool in the field of biology and medicine allows for early detection of esophageal cancer. Adam Wax of Duke University in the research project, "Low Coherence Light Scattering for Biophotonics" (0348204), developed a method, which has been proven successful in experiments with rats, using the scattering of light to detect an enlarged nucleus, one of the earliest signs of pre-cancerous cells. Measurements of light scattering can be taken in 40 milliseconds, making diagnosis possible in less than a second (compared to the many minutes it takes using current methods). Time is of the essence in cancer diagnosis, so shorter diagnosis times combined with earlier detection capabilities are great strides in instrument technology for cancer treatment. Not only is this a valuable platform tool, but also extension from rats to humans, if successful, could save many lives.

At Carnegie-Mellon University, "Synchronized Transatlantic Synchrotron Research" (0079996) has yielded a new tool that can increase our ability to predict and control the properties of ceramic and metallic materials. The instrument developed in this program uses x-rays that can penetrate through centimeters of solid samples, allowing scientists to measure the shapes and orientations of grains in the material and how they change with time. An increased understanding of material structures and properties can lead to improvements in fabrication of products from bridges to microscopes to prosthetics.

The Materials Research and Science Engineering Center (0079996), as well as the previous four projects described, advances in instrument technology are creating opportunities to better understand and improve products and processes in the fields of biology, medicine, materials, and computer technology. Thus, through achieving success in Indicator T5, NSF-funded programs are enabling "discovery, learning and innovation," one of the National Science Foundation's five main goals.

People

***Indicator P1.* Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups and institutions in all NSF programs and activities.**

Within EHR, there are numerous programs that are relevant and contribute directly toward this indicator. In total, the estimation was that 134,050, 113,890, and 86,050 individuals were or will be involved in each of FY2004, 2005, and 2006 respectively. In addition, there are programs distributed across all directorates that support this indicator. Examples include selected projects in the Research Experiences for Undergraduates (REU) (0244221) and CAREER programs. The portfolio of the funded activities is broad.

> Projects such as the "Valle Imperial Project" and the "University of California Alliance for Graduate Education" range from professional development of K-6 teachers in one of the poorest counties in the country (9731274) to graduating more minority doctoral recipients in STEM fields (0450366), and from increasing ethnic minority student participation at the college level through projects in the REU and Model Institutions for Excellence (MIE) programs ("Research Experiences for Undergraduates in Environmental Sciences at Northern Arizona University," 0244221 and "University of Texas at El Paso's MIE-Supported Academic Center for Engineers and Scientists," 9550502) to reaching out to young women in middle and high schools through the Research on Gender in Science and Engineering program (0080386). Due to adverse funding trends in most of the EHR programs, the level of achievement is expected to decline unless funding in other programs is increase sufficiently to compensate for the EHR reduction.

Some of the ongoing projects address the "pipeline" issue by focusing on K-12 students.

> Consider the Valle Imperial Project in Science (9731274) conducted by the El Centro School District located in the Imperial County in southeast California. It involves 14 other school districts in the county and the Imperial Valley Campus of San Diego State University. Most of the K-12 students are underrepresented minorities and from low-income families. The project has increased the number of students taking college prep STEM classes and led to tripling the percentage of graduates eligible for enrollment in the University of California system. The Techbridge project conducted by a collaborative partnership based at the Chabot Space and Science Center (0080386), focuses entirely on encouraging more women to pursue science and engineering in a girls-only environment. The approach taken involves exposing the students to experiences and opportunities that are otherwise not available to them. The curriculum developed has been found to produce positive results and is available online (http://www.chabotspace.org/visit/programs/techbridge.asp).

At the college level, there are many projects that aim to increase participation of ethnic minorities in science and engineering. Examples include:

> The "REU: Environmental Science Summer Program at Northern Arizona University" (0244221) and the "University of Texas at El Paso's MIE-Supported Academic Center for Engineers and Scientists" (ACES) (9550502). Due to its location, Northern Arizona University is able to attract a significant number of American Indians to participate in the program. In 2003 and 2004, there were 8 and 10 students, respectively, that attended the program: among the 18 were 14 Native American and 2 Hispanic students. Likewise, the University of Texas at El Paso serves an area with a large Hispanic population. Two-thirds of the STEM students at the university are participating in the MIE-ACES program, which has contributed to a 9 percent increase in undergraduate STEM degrees.
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> Targeted at the post-baccalaureate level, the "University of California Alliance for Graduate Education and the Professoriate (AGEP) Phase II" (0450366) was initiated in 2004. It involves all 10 UC campuses. Impressive results were achieved in Phase I of this project. There was an average of 131 new minority graduate students enrolled in STEM during 1997-1999. By 2003, the number had increased to 237, yielding an 80 percent increase. Phase II of this AGEP will build upon prior success and has the potential

to pose a new model for recruiting, retaining, and graduating STEM minority doctoral degree recipients and assisting with postdoctoral placements.

Indicator P2. ***Support programs that attract and prepare U.S. students to be highly qualified members of the global science and engineering (S&E) workforce, including providing opportunities for international study, collaborations and partnerships.***

The Boulder School for Condensed Matter and Materials Physics (0437903) brings together large numbers of graduate students (60 this year) from around the world for summer coursework and lectures. Not only is the student body international, so is the team of presenters brought to the campus. This program meets students at a high level to forge new partnerships, understandings, and research agendas at the frontier juncture of optic, atomic, and condensed matter physics. Another highly interdisciplinary program, PRIME (Preparing Undergraduates for the Global Workforce in Cyberinfrastructure) of University of California, San Diego (UCSD) (0407508), brings together a smaller number of students at an earlier career stage and across a broader level of engagement. Nine students, 3 of them from the US, studied and worked together on research while immersed in the international environment generated by UCSD partners in the Cybermedia Center of Osaka University (Japan), the National Center for High-Performance Computing in Hsinchu (Taiwan), and the Department of Computer Science at Monash University (Australia). Admission to both these programs is competitive, and PRIME requires participants to return to UCSD in the fall for at least one quarter in order to continue their project work and share their experiences with potential new PRIME students.

Graduate students in the University of Alaska, Fairbanks IGERT program, "Regional Resilience and Adaptation: Planning for Change," (0114423) have done research and helped develop related international policy and legislation with scientific bodies of other governments, namely the Swedish Royal Academy of Agriculture and Forestry and the Alaska Native Science Commission. Graduate students in another University of Alaska, Fairbanks, program have participated in a U.S.-Russia International Volcanological Field School at sites in Alaska and Kamchatka, developing professional relationships with each another as they study the relationships between the two major areas of volcanic activity (0429155). And in yet another variant of this indicator theme (0096097), graduate students at the University of Kentucky and MIT have been able to carry out research in the Japanese university system known worldwide for its leadership in carbon science, as part of a U.S.-Japan collaborative research project that's paid off in numerous publications, conferences, and advancements in carbon science.

The 2002 COV report for OISE (still designated as INT at that time) stated: "INT clearly enjoys a level of impact that goes far beyond its very modest budget. It is exciting to imagine how much greater the impact could be if INT had resources more commensurate with its level of responsibility, particularly for project funding and travel for INT personnel." Given the importance of the P2 indicator in achieving the NSF's strategic People goals, we note with approval that OISE has been given a role as a crosscutting “agent of change” within NSF. OISE’s new organizational position should enhance its success in stimulating international activities across the Foundation.

Indicator P3. ***Develop the Nation’s capability to provide K-12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering and mathematics.***

Some projects connect K-12 teachers with university STEM faculty members through active research collaborations. For example:

”The Alaska Lake Ice and Snow Observatory Network (ALISON): A Statewide K-12 and University Science Education and Research Partnership” (0326631) at the University of Alaska, Fairbanks Campus, provides teachers at 17 schools around the state with a professional development experience and with researcher mentors, as well as connecting them with other teachers throughout the state of Alaska. This experience with science and professional networks can help alleviate the feelings of isolation common to teachers in rural Alaska, where teacher turnover is high and student populations are largely Alaska Native. Another approach that gives teachers opportunities to do STEM research is seen in "RET Site: Research Experience for Teachers in Areas of Innovative and Novel Technologies in Philadelphia" (RETAIN Technologies in Philadelphia) (0227700) at Drexel University. Providing K-12 teachers with hands-on research and education experiences demonstrated the power of experiential learning in science and engineering. The project also helped participants bridge the gap between technology and curriculum by providing workshops and resources to support curriculum development. Finally, the project has led to a number of other related projects throughout Philadelphia schools.

Other projects are providing a foundation for professional development opportunities.

The National Science Teachers Association (NSTA) has a conference grant (0442722) sponsored by the Teacher Professional Continuum program, that is testing a strategy that assembles experts supported by NSF to disseminate their findings that address important questions in K-12 science and mathematics education. The first prototype conference, "Linking Science and Literacy in the Classroom," was offered at the NSTA Regional Meeting in Seattle in November 2004. A total of 375 teachers, administrators and professional development providers participated. Presenters included leading scholars, researchers, and practitioners who described NSF-funded work on the multiple aspects of literacy in K-8 science classrooms. The 30 presenters were Principal Investigators (PIs) or participants in TPC, Local Systemic Change, Teacher Enhancement, Instructional Materials Development, or other related NSF programs that have been researching this high profile topic. Another approach is the Lesley/TERC Science Education Master project (9911770), a national, on-line Master's program for K-8 STEM educators that merges the expertise of scientists and educators, and is carrying out research on the effectiveness of on-line learning. Its enrichment curricula should be flexible to accommodate busy schedules and geographical challenges and must be relevant to the classroom. A total of 380 teachers from 33 states and three countries have participated in one or more courses since the program's inception in Summer 2000. The first graduates were in Spring 2003; 47 teachers have graduated from the program, and currently there are 114 M.Ed. candidates. Leadership is the focus of a third example, the Fulcrum Institute for Education in Science (0412456) at Tufts University, where teachers prepare for roles as school-based intellectual leaders in their fields and catalysts for reforming the mathematics and science programs in their schools. Their schools and districts commit to providing the time and resources commensurate with the positions of increased responsibility that the emerging teacher-leaders are expected to assume upon completion of an Institute program that deepens and updates their content knowledge, instructional strategies and leadership skills.

The Southeast Center for Networking and Information Technology Education, (0071047) located at the Daytona Beach Community College, is an example of faculty development in higher education. The center established a framework for community colleges to collaborate in the delivery of advanced technology faculty development workshops that helps colleges offer courses in the key high demand IT curriculum areas. Based on data from the Florida Community College System, the project's 105 faculty development workshops supported instruction across 557 different course titles within the system since the fall of 2000, benefiting 914 community college faculty members, who in turn teach over 20,000 students annually in the region.

Indicator P4. ***Promote public understanding and appreciation of science, technology, engineering, and mathematics, and build bridges between formal and informal science education.***

One set of channels for informal science education is popular media: television, radio, movies, and the Web. An example of using these routes effectively is the "Magic School Bus," the most successful children's science series in history, with more than 54 million books in print and 52 television episodes (9153967). NSF supported the original development of the series, and more recently funded development of associated bilingual traveling exhibits for children aged 5 to 12 (9627162). The traveling exhibit, which has visited 36 cities in a six-year tour, allows students to explore the dynamics of weather. Other examples of the broad outreach of informal science education include the "Pulse of the Planet" series (heard over 309 broadcast outlets worldwide) (0337143), TV411, for adult math education (0104712), *Under Antarctic Ice*, a program in the PBS Nature series (0000373), "Peep and the Big Wide World," a television series for 3 to

5 year olds that was rated second in viewing audience in its time slot (0104700); and web access to news from Antarctica (0000373). NSF is supporting evaluation of the effectiveness of its informal science education work. For example, visitor impact evaluation of learning outcomes from the Magic School Bus tour indicates that 80 percent of the children who tour the exhibit gain new knowledge about weather dynamics or learn a new weather concept. Follow-up telephone interviews indicated that the children stay interested in the weather several months after their visit. Likewise, evaluation has shown that children who watch *Peep* are much more likely to ask questions and solve problems than those who do not.

Museums also provide an opportunity to engage the public. For example, Martin Luther King Day at the Cleveland Museum of Natural History (0133164) was advertised broadly to 54 municipal schools, plus youth groups, church groups, and recreation facilities. NSF-supported polymer researchers, with their graduate students, put together mini-lectures, displays, demonstrations, and hands-on experiments for the more than 4,000 visitors. Attendance was up 50% from the previous year. Other examples of informal science education through museums include “Go Figure,” an exhibit at the Minnesota Children’s Museum to engage parents and children in mathematics learning, particularly in underserved communities (9725857); the CAREER program’s courses involving undergraduate students in independent historical research at science museums (0134482); engaging the public in botanical gardens through studies of the vanilla orchid (0108100); and an exhibit on “Strange Matter,” produced by materials scientists and visited by tens of thousands at New Jersey’s Liberty Science Center (0213706).

Science education goes two ways, especially when it moves into communities with special knowledge of the environment. An example is the project “Fire-Mediated Changes in the Arctic System: Inter … and Human Activities” (0328282). The community of Huslia, Alaska, has been teaching university researchers about how fire affects their community and researchers share what they know about future changes in climate and fire regime. The mutual learning workshops are turned into teaching materials, which are shared with local schools after approval by the Huslia Tribal Council. The elders view the project as one of few opportunities they have to talk to students about traditional knowledge. Other community-based mutual learning projects include the Community Collaborative Rain, Hail, and Show Network on the Great Plains (0229723); *Math in the Garden*, a set of activities that teach math to children and adults in relation to gardening topics (9909764); and a project on well water quality on the Navajo Reservation [0348873].

NSF programs also move into the classroom to spread interest and confidence in science, and move students from classrooms into the laboratory. An example is Project SERVE (Science Enrichment using Retired Volunteer Educators) (0412101), which links senior citizens with young students. A Discovery Corps Senior Fellowship supported the investigator to train senior citizens in age- and pedagogically-appropriate general chemical principles. The senior citizens then volunteer in elementary and middle school classrooms as teacher’s aides, tutors, mentors, and resource persons for under-performing students. Other classroom enrichment projects include EdGCM, a global climate model that is run on inexpensive desktop computers (0231400); glassblowing demonstrations for K-12 students at the University of Iowa (9972466); nanoscience made simple for junior-high school students in southeastern Ohio (0304314; femtosecond laser systems at Michigan State for middle school students (0135581); safe racer competitions in Baltimore that involve elementary students in engineering design (9731748); and demonstrations on nanostructured materials and interfaces for K-12 students in Wisconsin (0079983). NSF’s outreach in informal science education is even becoming international. The Fab Lab project (0122419) goes into the field to allow participants to fabricate objects at micron size and microsecond speed. This gives participants a hands-on experience with manufacturing components for information technologies, not just with using the technologies themselves. The exhibit has reached many under-served communities, including in rural India, northern Norway, Boston, and Costa Rica. In the past year, it has engaged the public in Ghana, and is working on a collaborative exhibit in South Africa. The worldwide public is also able to participate in LIGO, the Laser Interferometer Gravitational wave Observatory, searching LIGO data through Project Einstein@home (0200852) and web access to real-time Mars exploration (0104589).

Indicator P5. ***Support innovative research on learning, teaching and mentoring that provides a scientific basis for improving science, technology, engineering and mathematics education on all levels.***

As the following five projects show, activity in this indicator area is found within current NSF-sponsored programs. However, these projects were the only ones found within the set of nuggets proposed to satisfy this indicator (56 in the Primary set, 88 in the Secondary). Thus, we conclude that this does not constitute a body of work sufficient to determine that NSF has met the "significant achievement" threshold with respect to this important indicator. Though one relevant COV report (ROLE) from 2002 suggested significant achievement in this area, the paucity of current nuggets seems to contradict this. This lack of relevant nuggets may be due to confusion on the part of program directors as to what exactly this indicator means. The following programs, significant in their own right in terms of quality, relevance, and multi-disciplinarity, are involved in the study of individual learning, group/collaborative learning, the assessment of learning, the dissemination of the results of learning research, and the mentoring of STEM faculty.

> The work of Robert Sternberg of Yale University (9979843) is focused on the methods or "modalities" of individual learning through triarchic instruction and assessment. Sternberg's work suggests that individuals learn through a combination of three approaches: creative, analytic, and practical thinking. By training elementary school teachers in this "Triarchic" theory, Sternberg is helping them to recognize the learning patterns of their students and to tailor their lessons to the individual student' needs. Work is also being carried out to better understand how STEM students learn in groups. Gerry Stahl of Drexel University (0325447) is studying how math students utilize the Internet to work together to solve problems. By collecting and analyzing records of student problem-solving chat groups, Stahl hopes to develop a theory for how students best learn in such situations and to disseminate this information to mathematics teachers world wide.
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> A fundamental problem in pedagogical research is that of assessment. It is crucial to the scientific study of learning that new and innovative teaching techniques be assessed. One NSF-funded project aims to improve upon current assessment techniques. Tiffany Koszalka of Syracuse University (0335644) is leading an attempt to understand and assess how practitioners of a field move from novice toward expert-level problem solving abilities. By discerning the thinking and decision making methodologies followed by experienced practitioners, the "Enhanced Evaluation of Learning in Complex Domains" (DEEP) project hopes to improve the methods of assessing the learning of novice and intermediate-level practitioners. However, individual results from pedagogy research can only be useful to the teaching community at large if they are efficiently disseminated. This is the goal of the project, "Program Evaluation for the Math and Science Partnership" (0456995). This partnership of related programs, known as the MSP Learning Network, is developing a community of connected researchers, allowing them to quickly and easily share their results. Through the building of electronic communities and digital databases, the results of learning and pedagogy research are being made available to K-12 teachers, college faculty, and the technical/scientific community at large.
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> Lastly, it is important to the success of new pedagogical initiatives that those involved in the teaching be actively mentored. The project, "SOMAS: Support of Mentors and their Students in the Neurosciences," led by Julio Ramirez of Davidson College (0426266) has received funding to both allow junior STEM faculty to involve undergraduate students in their research activities and to bring these students together with mentors to help the mentors make the most of their pedagogical opportunities. The SOMAS project aims to assist junior faculty in integrating students into their scholarly activities thereby improving the students' oral, written, and cognitive skills and making them much more likely to succeed in their programs.

PERFORMANCE REPORTING REQUIREMENTS

To accomplish the NSF mission to promote the progress of science, NSF invests in the most capable people, supporting their creative ideas, and providing them with cutting-edge research and education tools. Within NSF, the agency strives to maintain a diverse, agile, results-oriented cadre of NSF knowledge workers and leadership in state-of-the-art business processes, tools and technologies.

NSF has four strategic outcome goals. These are:

IDEAS – *Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.*

Investments in *Ideas* are aimed at the frontiers of science and engineering. They build the intellectual capital and fundamental knowledge that drive technological innovation, spur economic growth, and increase national security and welfare. They also seek answers to the most fundamental questions about the origin and nature of the universe and humankind.

TOOLS – *Broadly accessible, state-of-the-art Science and Engineering (S&E) facilities, tools, and other infrastructure that enable discovery, learning and innovation.*

State-of-the-art tools and facilities boost the overall productivity of the research and education enterprise. NSF's strategy is to invest in a wide range of instrumentation, multi-user facilities, distributed networks, digital libraries and computational infrastructure that add unique value to research and are accessible and widely shared among researchers across the nation.

PEOPLE – *A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.*

Leadership in today's knowledge economy requires world-class scientists and engineers and a national workforce that is scientifically, technically and mathematically strong. Investments in *People* aim to improve the quality and reach of science, engineering, and mathematics education and enhance student achievement. Each year, NSF supports almost 200,000 people – teachers, students, and researchers at every educational level and across all disciplines in science and engineering. Embedded in all NSF programs are efforts to build a more inclusive, knowledgeable, and globally engaged workforce that fully reflects the strength of the nation's diverse population.

ORGANIZATIONAL EXCELLENCE – *An agile, innovative organization that fulfills its mission through leadership in state-of the-art business processes.*

Excellence in managing NSF underpins all of the agency's activities. Most importantly, this leadership depends on maintaining a diverse, agile, results-oriented NSF workforce that operates in a continuous learning environment. NSF's strategy focuses directly on the agency's leadership in core business processes, such as E-government and financial management. NSF's investments in administration and management must respond both to the growing complexity of its workload and to new requirements for accountability and transparency in its processes.

NSF also has an additional 17 performance goals associated with the Program Assessment Rating Tool (PART) developed by the Office of Management and Budget. Information concerning the PART process can be found at www.whitehouse.gov/omb/part/. The performance goals and achievement with respect to these goals are found following the strategic outcome goal with which they are most closely associated.

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[2]. 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 NSF Director regarding the Foundation's performance under the Government Performance and Results Act (GPRA) of 1993.

In FY 2004, Organizational Excellence (OE) became a specific NSF strategic outcome goal. This goal was included as a strategic outcome goal at the urging of NSF's Advisory Committee for Business and Operations (AC/B&O) since it is a key enabling tool for the outcome goals of Ideas, Tools, and People.

In its FY 2003 report, the AC/GPA recommended that NSF should consider an approach that involved a significant component of "self study." They envisioned that this would involve a greater number of NSF staff, would be based on NSF's strategic goals and indicators, would be data driven, and would provide key information at multiple levels of detail. NSF adopted this approach for the Organizational Excellence goal. Early on, it was determined that the AC/B&O would provide an assessment of three of the indicators for the OE goal: Human Capital, Technology-Enabled Business Processes, and Performance Assessment. The AC/GPA would conduct an assessment of the Merit Review indicator.

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

- An assessment of results for indicators associated with the strategic outcome goals of Ideas, Tools, and People, and with the merit review indicator for the Organizational Excellence goal. (The other three indicators for this goal were assessed by the Advisory Committee on Business and Operations – see above);
- Comments on the quality and relevance of award portfolios; and
- Comments on transformative/bold/innovative-high risk research and education.

The format of Section III is the following:

- An NSF assessment of performance with respect to each strategic outcome goal;
- Comments by the AC/GPA concerning the strategic outcome goal;
- For each indicator associated with a strategic outcome goal:
    - Comments by the AC/GPA; and
    - An NSF assessment of performance with respect to related PART performance goals.

The following AC/GPA comments concerning the quality and relevance of NSF-supported research as well as AC/GPA comments on transformative/bold/innovative-high risk research and education supported by NSF are excerpted from the AC/GPA Report. The report is available at www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05210.

[2] See Section IV for further details on these committees.

AC/GPA Comments on Quality and Relevance

The Committee concluded that the quality of the NSF portfolio was high in the three outcome goals of Ideas, Tools, and People and that the Organizational Excellence goal demonstrated quality and innovativeness in its activities. The diversity of projects in the research portfolio is remarkable, representing a spectrum of approaches, methods, ideas, and award types. This diversity enables NSF to support a wide variety of performers including individuals, teams of all sizes, and large centers as well as facilities and other infrastructure (defined broadly).

NSF continues to make important contributions toward the achievement of key national goals. It also provides important service to its constituents in the scientific community as well as serving the broader needs of science, engineering and education as human endeavors. In addition, NSF is recognized as a high-performing organization. Its focus on organizational excellence as a strategic outcome goal is a necessary complement to the other goals and will enable NSF to continue to use the nation's investments wisely and efficiently in support of science, engineering, mathematics, and education.

The Committee wants to reiterate again that the synergy of the four outcome goals is a major source of their power. Discoveries at the frontiers of knowledge are both supportive of and dependent on progress in effectively linking education and research, the development of new instrumentation, facilities, and other tools, and the education and training of a highly qualified cadre of individuals motivated and excited by science, engineering, and mathematics. Organizational excellence in people, processes, and assessment enables all three. The Committee felt that it was important to continue to make this point, as it has done previously.

The Committee concluded that the high quality, relevance, and performance of the NSF portfolio are principally due to NSF's use of a rigorous process of competitive merit review in making awards. NSF has continued to make progress in implementing its two principal review criteria – intellectual merit and broader impacts with over 90 percent of all reviews now addressing both criteria. NSF also continues to provide a heightened focus on the use of both criteria by proposers, reviewers, and program officers. The Committee notes that this will continue to be a "work in progress," that is, an ongoing effort that will require constant vigilance by the NSF program staff and further education for the proposing and reviewing community as to the importance of addressing both criteria adequately. Competitive merit review is a key process for ensuring the quality and relevance of research and in maintaining US leadership in many areas of science and technology. NSF and its external stakeholders, both within and outside the Federal government, should work together to resist the corrosive influence of forces that are inimical to merit review. The National Science Board should use its influence to advocate for expanded competitive merit review across the Federal government's research portfolio.

AC/GPA Comments on Transformative/Bold/Innovative-High Risk Research and Education

With regard to transformative/bold/innovative-high risk research and education, the Committee saw evidence of accomplishment. NSF itself has sought to clarify the definition of such research using an "operational" approach. NSF asked its program staff to identify projects they believed reflected transformative/bold/innovative-high risk research and education. The agency then attempted to organize the 150 nuggets so identified into a definitive framework with guidance or rubric. The Committee compared this rubric against the proposals and also reviewed comments in the Committees of Visitors reports on this topic. Based on that analysis, the Committee concluded that there is still work to be done in defining what constitutes transformative research. A complete discussion of this issue is found in the Organizational Excellence section of this report. The Committee appreciates the work of the National Science Board on this issue over the past year and looks forward to its efforts to initiate a dialogue with the research and education community.

No matter how much time is spent to carefully and thoughtfully craft a rubric to define transformative research, there is still no empirical way to determine what fraction of the portfolio should be the farthest out on the frontier. This difficulty is complicated by the fact that researchers (particularly academic researchers) don't typically think of their research in terms of its "riskiness" in the sense we are using that word here.

Clearly, the nation benefits and the research enterprise advances when transformative research is part of the equation. However, when COVs were asked to comment on this issue, their responses raised the very issues that we know to be the toughest to address, namely, how do you know this research when you see it?; how much should be funded in a constrained environment?; and, how should the very necessary flexibility of NSF program staff be balanced against what might appear to be a rather conservative merit review process in making investment decisions in favor of such research?

This AC/GPA process looks retrospectively at a year, or two or three, of research progress (as evidenced through the accomplishments). The determination about whether an investment in a proposal has yielded results that could fundamentally transform our understanding of the physical or natural world may take decades. All of NSF's stakeholders, internal and external, would do well to keep that in mind.

NSF GPRA PERFORMANCE GOALS – IDEAS

Ideas
Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.

Tools
Broadly accessible state-of-the-art science and engineering facilities, tools, and other infrastructure that enable discovery, learning and innovation.

People
A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.

Organizational Excellence
An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

IDEAS STRATEGIC OUTCOME GOAL: Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.

✓ Goal I1 Achieved

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. These investments enable the Foundation to meet its mission of promoting the progress of science – while at the same time helping to maintain the nation's capacity to excel in science and engineering, particularly in academic institutions. The results of NSF-funded research 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.

Annual Performance Goal I1: NSF's performance is successful when, *in the aggregate*, results reported in the period FY 2005 demonstrate significant achievement in the majority of the following indicators:

- Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge.
- Encourage collaborative research and education efforts – across organizations, disciplines, sectors and international boundaries.
- Foster connections between discoveries and their use in the service of society.
- Increase opportunities for underrepresented individuals and institutions to conduct high quality, competitive research and education activities.
- Provide leadership in identifying and developing new research and education opportunities within and across S&E fields.

- Accelerate progress in selected S&E areas of high priority by creating new integrative and cross-disciplinary knowledge and tools, and by providing people with new skills and perspectives.

RESULT: NSF achieved this goal. External experts provided examples of significant achievement during FY 2005 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators for this goal.

IMPLICATIONS FOR THE FY 2005 PERFORMANCE PLAN[3]: This goal will be continued in FY 2006.

[3] The Performance Plan has now been integrated within the Performance Budget.

IDEAS: Comments by the Advisory Committee for GPRA Performance Assessment

The following statements concerning NSF achievement with respect to the indicators 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/publications/pub_summ.jsp?ods_key=nsf05210.

The Committee concluded that there has been significant achievement in all indicators of the IDEAS strategic outcome goal, which is to foster "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society." The Committee concluded that NSF had met the goal for each indicator in making investments in discovery, collaborative research and education, connections between discoveries and their use in society, increased opportunities for underrepresented individuals and institutions, developing new research and education opportunities, and creating new integrative and cross-disciplinary knowledge and tools. It is worth noting that our determination of "significant achievement" is, in large part, a reflection of the fact that the ideas embodied in the projects in this portfolio are themselves significant – that is, of high quality and relevance.

Whether we consider engineering, life sciences, physical sciences, social sciences, or information technology, it is apparent that NSF-sponsored research is having a significant impact on our nation and world today and shows every indication of continuing this into the future. The challenge for the Committee in this strategic outcome goal was in selecting a relatively few nuggets from the vast array of very fine projects from which to choose. For each of the six indicators, the accomplishments were chosen to illustrate the breadth and depth of NSF's portfolio with special emphasis placed on the important objective of broadening participation.

IDEAS in themselves are the essence of the research and education mission of NSF. Themes emerged in the arena of IDEAS many of which involve enhanced interaction between scientists and engineers, especially across broad areas within the life sciences. For example, the potential of nanotechnology coupled with the biological sciences is generating research projects that hold significant potential for understanding and improving the human condition. Applications of engineering principles and practices to the environment are now yielding new ways in which we can temper the effects of natural forces such as earthquakes. These themes illustrate the power that multidisciplinary research can have on approaches to answer questions that could not previously be addressed.

Perhaps one of the most powerful illustrations of the potency and efficacy of NSF sponsorship comes from an analysis of funding for Nobel Prize winners. In 2004, Kydland and Prescott won the Nobel Prize in Economics. Both were beneficiaries of NSF support throughout their careers, such as "Studies in Aggregate Analyses" (0422539), and winning a Nobel Prize is further validation of the quality and relevance of NSF-sponsored research. Remarkably, within economics, the NSF has sponsored research for 32 winners of Nobel Prizes.

To broaden participation, the Foundation has supported international collaborations, often involving cross-cultural and crosscutting experiences for investigators and students in particular. For example, there are large and important societal benefits as well as scientific benefits that have been gained from NSF support to send teams of investigators to Africa to investigate ways to preserve and propagate endangered wild animal species. NSF has also significantly increased opportunities for underrepresented individuals to participate fully in the research enterprise embodied in the IDEAS portfolio. Several themes emerged, including projects to improve the access to STEM by disabled persons; culturally-based learning projects that utilize the student's life experience and culture as jumping-off points for hands-on learning; CAREER awards that provide the groundwork for highly successful careers; and the strong coupling between outstanding science and thoughtful mentorship in NSF projects.

Thus, NSF's portfolio of accomplishments in the IDEAS strategic outcome goal exhibits both exceptional quality and high relevance to important national goals. In addition, the Committee found numerous examples of "transformative/bold/innovative-high risk" research in the IDEAS portfolio. A more in-depth discussion of this topic is found in the section on the Organizational Excellence strategic outcome goal.

INDICATOR I1: Enable people who work at the forefront of discovery to make important and significant contributions to science and engineering knowledge.

RESULT: *Demonstrated significant achievement.*

The NSF was established as the "patron of pure science." Therefore, researchers who work at the forefront of discovery are the best candidates for NSF support and are the most likely to receive it. We find that NSF support has been critical to enabling researchers to be in the vanguard of those at the frontier. There are numerous examples of major results and below we summarize a few examples that give a sense of the wide breadth and significance of NSF support.

INDICATOR I2: Encourage collaborative research and education efforts – across organizations, disciplines, sectors and international boundaries.

RESULT: *Demonstrated significant achievement.*

Examples were provided by the AC/GPA.

INDICATOR I3: Foster connections between discoveries and their use in the service of society.

RESULT: *Demonstrated significant achievement.*

One of the goals of the NSF is to build and foster connections between research that leads to new discoveries and the societal benefits of these discoveries. What is truly impressive about the breadth of research sponsored by the NSF in this regard is that it is both broad and deep, from large-scale studies that examine carbon cycling in our oceans to improvement of cities at risk for massive earthquake damage.

INDICATOR I4: Increase opportunities for underrepresented individuals and institutions to conduct high quality, competitive research and education activities.

RESULT: *Demonstrated significant achievement.*

NSF programs such as the Louis Stokes Alliances for Minority Participation (LSAMP), Centers of Research Excellence in Science and Technology (CREST), Alliances For Graduate Education and the Professoriate (AGEP), the Minority Postdoctoral Fellowship Program, and Research Experiences for Undergraduates have historically provided a stimulus and increased opportunities for women and underrepresented minorities to participate in all stages of the research process. These programs have been successful, and now NSF's portfolio contains a number of examples of projects that involve the full participation of underrepresented individuals and institutions in the generation of ideas. Several overarching themes emerge, including: a) improved access to STEM (science, technology, engineering, and math) by disabled persons; b) culturally-based learning projects; c) CAREER awards that have provided the groundwork for highly successful careers of underrepresented minorities; and d) the coupling of outstanding science and strong mentorship."

INDICATOR I5: Provide leadership in identifying and developing new research and education opportunities within and across S&E fields.

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

NSF supports a broad array of research projects that promote the identification and development of new research and educational opportunities in science and engineering fields. Many of the projects demonstrate leadership and novelty and represent new and ingenious ways of approaching research. Much of the work in this indicator is interdisciplinary, requiring input by a number of researchers from different areas. Further, many of the studies involved a combination of fundamental and applied research with high potential for practical outcome.

INDICATOR I6: Accelerate progress in selected S&E areas of high priority by creating new integrative and cross-disciplinary knowledge and tools, and by providing people with new skills and perspectives.

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

The NSF supports a wide variety of projects that create new integrative and cross-disciplinary knowledge while providing researchers with new skills and multi-disciplinary perspectives.

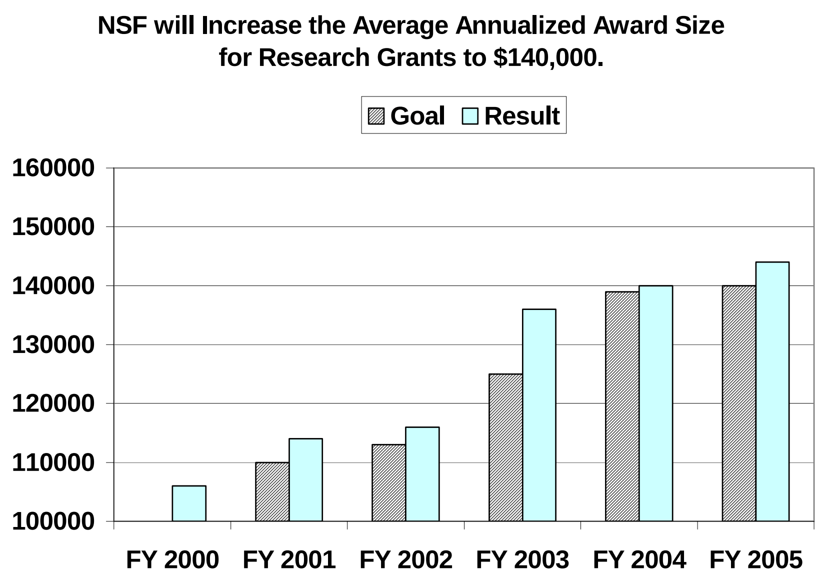
Annual Performance Goal I2: NSF will increase the average annualized award size for research grants to $140,000.

✓ Goal I2 Achieved

NSF is continuing its goal of increasing award size[4]. 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.

NSF WILL INCREASE THE AVERAGE ANNUALIZED AWARD SIZE FOR RESEARCH GRANTS to $140,000.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	$110,000	$113,000	$125,000	$139,000	$140,000	NA
Result	$114,000	$116,000	$136,000[5]	$140,000	**✓$144,000**	NA



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This will not be a goal in FY 2006 as time-to-decision with a quality measure is used as an efficiency measure across most PART programs.

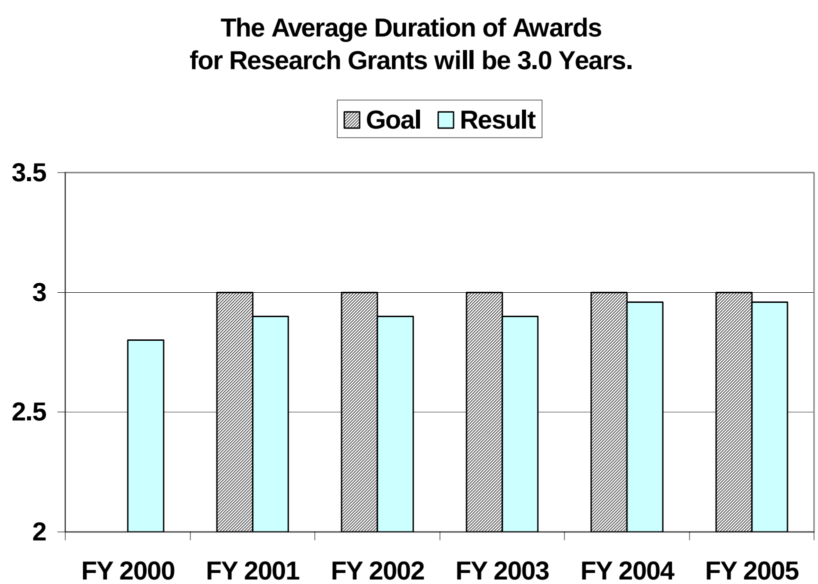
[4] The award size and duration performance goals are applicable only to competitive research grants (a subset of awards that focuses on awards to individual investigators and small groups).

[5] Beginning 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.

Annual Performance Goal I3: The average duration of awards for research grants will be 3.0 years.

✕ Goal I3 Not Achieved

THE AVERAGE DURATION OF AWARDS FOR RESEARCH GRANTS					
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**
Goal	3.0 years	3.0 years	3.0 years	3.0 years	3.0 years
Result	2.9 years	2.9 years	2.9 years	2.96 years	**✕2.96 years**



WHY WE DID NOT ACHIEVE THIS GOAL: Progress on this goal is budget dependent. The performance goal was set at an approximate target level, and the deviation from that level is slight. There was no effect on overall program or activity performance.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This will not be a goal in FY 2006 as time-to-decision with a quality measure is used as an efficiency measure across most PART programs.

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Annual Performance Goal I4: Foster collaboration among investigators in Nanoscale Science and Engineering.

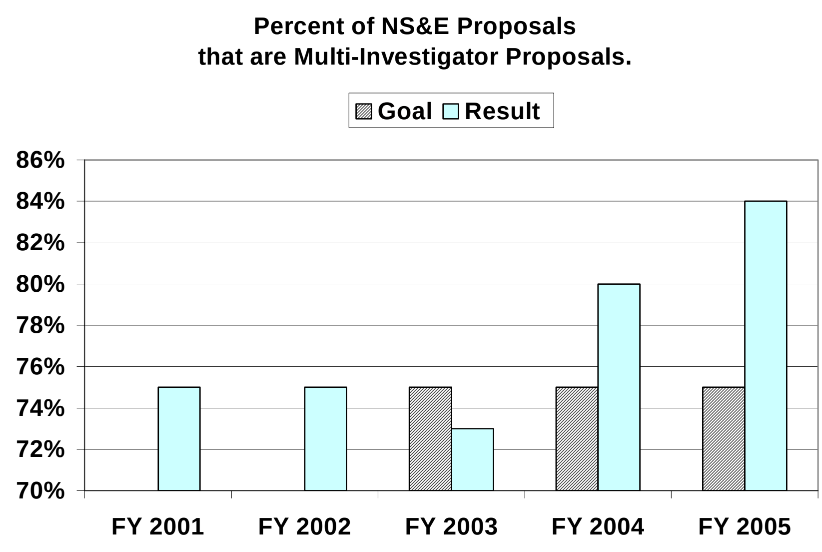
✓ Goal I4 Achieved

The Nanoscale Science and Engineering (NS&E) priority area encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – shift and expand possibilities in science, engineering and technology. A nanometer (one-billionth of a meter) is to an inch what an inch is to 400 miles. With the capacity to manipulate matter at this scale, science, engineering and technology are realizing revolutionary advances, in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for industry and order-of-magnitude faster computer chips.

Nanoscale science and engineering research promises a better understanding of nature, a new world of products beyond what it is now possible, high efficiency in manufacturing, sustainable development, better healthcare and improved human performance. The NSF NS&E priority area strives to foster collaborations among investigators that may not have otherwise occurred.

PERCENT OF NS&E PROPOSALS THAT ARE MULTI-INVESTIGATOR PROPOSALS.

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	75%	75%	75%	75%
Result	75%	75%	73%	80%	**✓84%**	



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[6]: This goal will be continued in FY 2006.

[6] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal I5: Qualitative assessment by external experts that the program is serving the appropriate role in ensuring that grantees meaningfully and effectively collaborate across disciplines of science and engineering (ITR COV).

✓ Goal I5 Successful

The following is taken from the Information Technology Research (ITR) Committee of Visitors report of their review conducted March 8-10, 2005 (Question 2[7]*, page 11). The report will be available at* www.nsf.gov/od/gpra/COV/start.htm *in early November 2005.*

"Yes, NSF did serve an appropriate role in ensuring that grantees meaningfully and effectively collaborate across disciplines of science and engineering.

One of the broadest contributions that ITR has made has been to develop interdisciplinary interactions between and across disciplines. These are partnerships that would likely not have spontaneously formed without the infusion of money that ITR brought, and many of these collaborations will last far beyond the duration of the ITR program.

Medium and large ITR grants were daunting management challenges. Large proposals were always allowed extra pages for a management plan. By 2002, NSF was encouraging investigators to provide a management plan, including their plan for coordinating across sites for both medium and large proposals. Panels were asked to assess management plans as part of their overall review."

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: The ITR initiative has been completed. The goal will not appear in FY 2006.

[7] 2. *Has the ITR program served an appropriate role in ensuring that grantees meaningfully and effectively collaborate across disciplines of science and engineering?*

NSF GPRA PERFORMANCE GOALS – TOOLS

Ideas
Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.

Tools
Broadly accessible state-of-the-art science and engineering facilities, tools, and other infrastructure that enable discovery, learning and innovation.

People
A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.

Organizational Excellence
An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

TOOLS STRATEGIC OUTCOME GOAL: Broadly accessible state-of-the-art Science and Engineering facilities, tools, and other infrastructure that enable discovery, learning and innovation.

✓ Goal T1 Achieved

As the issues researchers face increasingly involve phenomena at or beyond the limits of our measurement capabilities, their study requires the use of new generations of powerful tools. Examples of such tools include instrumentation and equipment needed by individual investigators in the conduct of their research, multi-user facilities, digital libraries, accelerators, telescopes, research vessels, and aircraft and earthquake simulators. In addition, funding devoted to the TOOLS strategic outcome area provides resources needed to support large surveys and databases as well as computational and computing infrastructures for all fields of science, engineering, and education.

NSF provides support for large multi-user facilities that meet the need for state-of-the-art, world-class research platforms vital to new discoveries and the progress of research. NSF support may include construction, upgrades, operations, maintenance, and personnel needed to assist scientists and engineers in the conduct of research at such facilities. NSF consults with other agencies and international partners to avoid duplication and optimize capabilities for American researchers.

All of these investments enable the Foundation to meet its mission of promoting the progress of science, while responding specifically to direction in the NSF Act of 1950 to foster and support the development and use of computer and other scientific and engineering methods and technologies, primarily for research and education in the sciences and engineering.

Annual Performance Goal T1: Our performance is successful when, *in the aggregate*, results reported in the period FY 2005 demonstrate significant achievement in the majority of the following indicators:

- Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of the-art S&E facilities, tools, databases, and other infrastructure.
- Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.
- Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.
- Provide for the collection and analysis of the scientific and technical resources of the U.S. and other nations to inform policy formulation and resource allocation.
- Support research that advances instrument technology and leads to the development of next-generation research and education tools.

RESULT: External experts provided examples of significant achievement during FY 2005 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators for this goal.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This goal will be continued in FY 2006.

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/publications/pub_summ.jsp?ods_key=nsf05210.

The Committee concluded that there has been significant achievement in all indicators of the TOOLS strategic outcome goal. The Committee also concluded that the projects contained in the TOOLS portfolio exhibit both high quality and high relevance to important national goals.

Innovative/High-Risk /Bold Research: A more thorough discussion of this issue is found elsewhere in this report. However, the Tools subgroup endorses the definitional efforts of the Organizational Excellence Subgroup on this topic. Additionally, we offer three observations:

- First, it may be useful to look at NIST's ATP (Advanced Technology Program) risk rating system, which has been developed over years of experience.

- Second, one of the mechanisms used by NSF to encourage "bold" research, Small Grants for Exploratory Research (SGERs) is not, in our view, effectively addressing the innovative research issue. Although program officers have considerable latitude to employ SGER grants to foster innovative research to counter what might be unwarranted caution in review panels, in fact SGERs are used relatively rarely. Foundation-wide, divisions may use up to 5 percent of their budget on SGER grants, but in reality only 0.4 percent of these budgets are used in this way. In our view, SGER grants are not a significant fraction of the overall portfolio therefore, they may not be playing a significant role in increasing the amount of highly innovative research. The reason(s) for this is (are) unclear. We encourage NSF to re-examine the purpose and use of SGER grants.

- Third, it does not appear that clear data exist which demonstrate that NSF either does or does not fund enough innovative research. With respect to the TOOLS portfolio, we found that many of our nuggets indeed reflected bold/innovative research efforts. On the other hand, some directorates that use a number of different mechanisms may not be making such awards with a full understanding of the implications for the entire portfolio, or, conversely, may not be using the full suite of mechanisms available to them to encourage and fund innovative research efforts. The bottom line is that it is important to have a clear definition in hand as the necessary precursor to collecting reliable data to form a more accurate picture of the portfolio mix with respect to innovative or transformative research.

Multidisciplinary Research Projects: More and more, forefront science sits between traditional disciplines, and some of the more innovative ideas involve investigators from very different fields collaborating on "terra incognita." NSF has a structure that, for the most part, has been established to fund single principal investigators. While many of the new, targeted solicitations and priority areas encourage or require multidisciplinary activities, these are often short-lived programs (e.g., Information Technology Research, Nanoscale Science and Engineering, and Biocomplexity in the Environment). We encourage NSF to develop ways to encourage and fund multi- and/or inter-disciplinary activities through its ongoing programs.

We point out the difficulty of parsing projects to fit into a single indicator "box". Many of the large, NSF-funded centers and networks impact many indicators not only in the TOOLS strategic goal, but sometimes including indicators from the IDEAS and PEOPLE strategic goals. The Network for Earthquake Engineering Simulation (NEES) is an example. Since we will refer to it several times, to minimize repetition in the text, we describe it here, before we turn to the individual indicators.

From the Pacific coast to our nation's interior, more than 75 million Americans in 39 states live in towns and cities at risk for earthquake devastation. While scientists are digging into the origins of seismic waves, engineers are pushing the boundaries of design to create structures that remain safe when an earthquake ultimately occurs. The George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) (0126366, 0117853, and 0402490) integrates 15 experimental facilities located at academic institutions across the United States, including shake tables, geotechnical centrifuges, a tsunami wave basin, large strong floor and reaction wall facilities with unique testing equipment, and mobile and permanently installed field equipment.

NEES is a major state-of-the-art facility and important for the discipline (Indicator T1). Indeed, it goes beyond the state of the art in developing the prototype of next-generation ways of doing science (Indicator T2). It is a distributed "virtual instrument" for earthquake engineering research (www.nees.org). It has enabled a large community of earthquake engineers, computer scientists, and other disciplinary specialties to share resources in a unique way. It provides the necessary tools for remote data acquisition, for sharing data through metadata management software, for remote simulations, virtual laboratories, even for telepresence. The interface is friendly enough to support K-12 teachers and be usable by the general public. This effort is serving as a model for other distributed scientific instrumentation. As such, it demonstrates the potential for cyberinfrastructure (Indicator T3) to transform the way that researchers do research and that teachers teach.

Other Important Issues

Expanding the NSF community beyond research-focused institutions: In the past, research-focused institutions have stood out as being the primary recipients of NSF funds. In order to meet the future needs of the nation for scientists, engineers, and technically trained people, NSF must redouble its efforts to expand its constituency to include predominantly undergraduate institutions (typically teaching-intensive) and minority-serving institutions as well as research-focused institutions. NSF has made significant progress on building infrastructure capacity at many of these other types of institutions. However, it is clear that a primary barrier to making continuing progress towards enhancing the research capacity at institutions educating a large percentage of underrepresented groups is the high teaching workload of faculty at these institutions. The NSF should examine the relative balance of its investments aimed at enhancing infrastructure, encouraging student pursuit of STEM fields, and supporting the professional development of faculty in the community colleges, predominantly undergraduate, and minority-serving institutions.

Sustainability: We continue to be concerned about the sustainability of a number of the tools developed with NSF funding. This issue was also raised by several COV reports that we reviewed. For example, databases whose collection, organization and initial presentation, often on web sites, must be maintained after the duration of the grant or upon departure of a PI, graduate student or other technical staff from the institution that hosts that database. Another example would be facilities that are funded and built to provide access to a user community, but then the funding is reduced or eliminated either due to termination of the program (for example, large projects funded by Information Technology Research) or funding cycle. The accomplishment descriptions of the various projects mentioned in our report do not provide any indication about what the institution will do when the NSF funding runs out. We suggest that merit review panels should, where appropriate, consider the quality of the proposer's plan for the long-term sustainability of the site or facility.

INDICATOR T1: Expand opportunities for U.S. researchers, educators, and students at all levels to access state-of the-art S&E facilities, tools, databases, and other infrastructure.

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

NSF supports and provides a wide variety of accessible, state-of-the-art science and education facilities, tools and infrastructure, and in most cases is the only support for such instrumentation in academia. These tools provide opportunities for researchers, educators, students, citizens and policymakers. NSF supports large state of the art facilities, and nearly all of the US's land based astrological facilities, and tools that push the forefront of science and engineering. It supports databases and acquisition/analysis software that present and synthesize large amounts of data collection by numerous researchers around the US and the world. Through a variety of funding mechanisms on different scales, NSF addresses both the needs of researchers to have and develop facilities and infrastructure that enables scientific discovery and educators to develop innovative means of disseminating science to students and the public. NSF has made a significant achievement with respect to indicator T1.

INDICATOR T2: Provide leadership in the development, construction, and operation of major, next-generation facilities and other large research and education platforms.

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

The development, construction, and operation of major, next-generation research facilitates many essential discoveries that advance fundamental knowledge and enhance the American economy. Innovative facilities and research tools often open unique opportunities for collaborative research across institutions, nations, and disciplines. Facilities and other large research and education platforms provide the long-term infrastructure for creating new knowledge that serves society. The NSF has made significant achievement in providing leadership in the development, construction, and operation of major, next-generation facilities and other large research and education facilities.

INDICATOR T3: Develop and deploy an advanced cyberinfrastructure to enable all fields of science and engineering to fully utilize state-of-the-art computation.

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

There was significant achievement in the cyberinfrastructure goal through the combination of these facilities, indicated by progress in several funded activities, falling roughly under two headings:

- Successful applications of the existing cyberinfrastructure, and
- Development of new tools to extend the reach of the cyberinfrastructure.

INDICATOR T4: Provide for the collection and analysis of the scientific and technical resources of the U.S. and other nations to inform policy formulation and resource allocation.

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

Our examination of the nuggets and other background information indicates that the NSF and its grantees contribute to a great extent to the national need for information needed to inform policies and budgets. This information is produced in three basic ways, which we will discuss in turn. First, the NSF's division of Science Resources Statistics (SRS) and its contractors collect and interpret a great deal of information themselves. Second, a variety of programs within the NSF make grants that result in a number of databases that scientists, educators, and citizens can use. Third, some grants made by the NSF either deliberately or accidentally produce policy-related information that is useful for dealing with specific issues. We find that that the NSF program merits the designation of "significant achievement" in the T4 area.

INDICATOR T5: Support research that advances instrument technology and leads to the development of next-generation research and education tools.

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

An important part of NSF's research strategy is to provide new and advanced tools as a "backbone" that can position our nation to investigate and develop "next-generation" research programs further advancing science and technology. Perhaps of equal significance is the training and development of students and academia to new methods and processes that enable us to do things tomorrow that are just being imagined today thus leading to “development of next generation research and education.” We find that the NSF efforts in this area are worth describing as ‘significant achievements.’

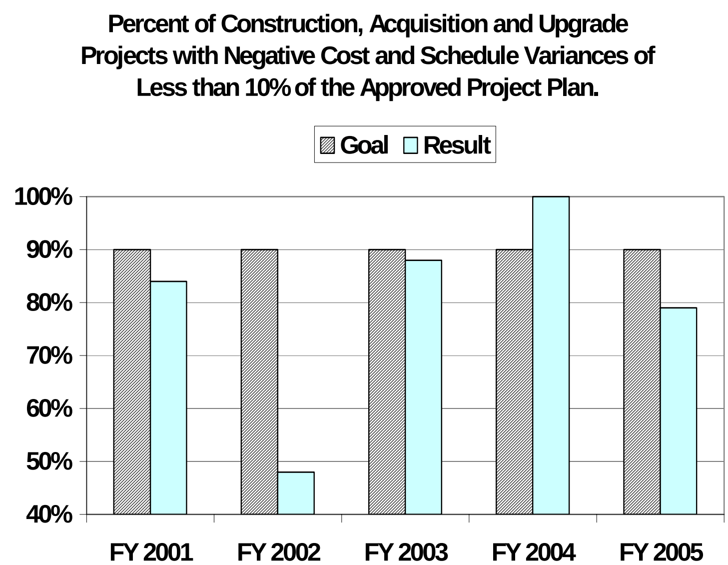
Annual Performance Goal T2: Percent of construction, acquisition and upgrade projects with negative cost and schedule variances of less than 10% of the approved project plan.

✕ Goal T2 Not Achieved

Investments in development and construction of state-of-the-art facilities and platforms are implemented consistently with planned cost and schedule. In FY 2001 and FY 2002, NSF undertook a comprehensive internal review of the facilities goals. In 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. Beginning in FY 2004, Polar facilities were included in a separate Program Assessment Rating Tool (PART) evaluation and are not included under this goal for the Facilities PART.

PERCENT OF CONSTRUCTION, ACQUISITION AND UPGRADE PROJECTS WITH NEGATIVE COST AND SCHEDULE VARIANCES OF LESS THAN 10% OF THE APPROVED PROJECT PLAN[8]

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	90%	90%	90%	90%	90%	90%
Result	84%	48%[9]	88%	100%	**✕79%**	



WHY WE DID NOT ACHIEVE THIS GOAL: The cost and schedule variances were facility specific due to unforeseen delays related to a shipyard contract and the process for soliciting bids; drilling contract delayed due to hurricanes; and delays in approval of contract because of additional testing and coordinating the procurement with international partners.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: NSF will continue to work with project managers to help avoid obstacles to successful performance by requiring all MREFC projects to provide quarterly financial reporting comparing budgeted expenditures to actual expenditures for

[8] Through FY 2002, there were three interrelated but separate GPRA goals for schedule and cost for construction/upgrade projects. For FY 2003 and beyond, these goals were combined into the single goal. While annual and total cost targets were all met in FY 2001 and FY 2002, scheduling milestones were not. The goals and actual performance shown (*) for FY 2001 and FY 2002 reflect the schedule goal only.

[9] Success in FY 2002 required all milestones within the year to also be met.

each Work Breakdown Schedule (WBS) identified in their construction project as described in the approved Project Execution Plan and also provide quarterly status reports with a graph of cumulative earned value for the construction of the overall project. NSF will include language in the Cooperative Agreement for each MREFC Awardee to be completed by end of fiscal year 2006.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This goal will be continued in FY 2006.

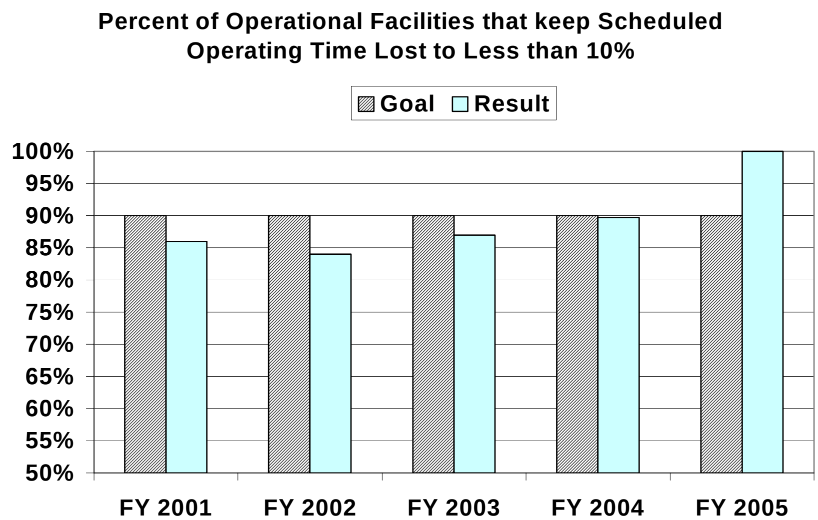
Annual Performance Goal T3: Percent of Operational Facilities that keep Scheduled Operating Time Lost to Less than 10%.

✓ Goal T3 Achieved

To provide the flexibility necessary for NSF to report realistic goals, we maintained the level deemed "successful" at 90% of the facilities. Measure in FY 2001 and 2002 was based on keeping operating time greater than 90%; results reported here are in terms of present measure. Beginning in FY 2005, the threshold for reporting was raised to $8M per year, to provide consistent definitions of "large facilities." After several years of tracking this goal, it appears that facility managers are improving on their ability to estimate, and perhaps mitigate against, unscheduled downtime.

PERCENT OF OPERATIONAL FACILITIES THAT KEEP SCHEDULED OPERATING TIME LOST TO LESS THAN 10%

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	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%.	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%.
Result	25 of 29 (86%) reporting facilities met goal.	26 of 31 (84%) reporting facilities met goal.	26 of 30 (87%) reporting facilities met goal.	26 of 29 (89.7%) reporting facilities met goal.	**✓10 of 10 (100%) reporting facilities met goal.**	



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This goal will be continued in FY 2006.

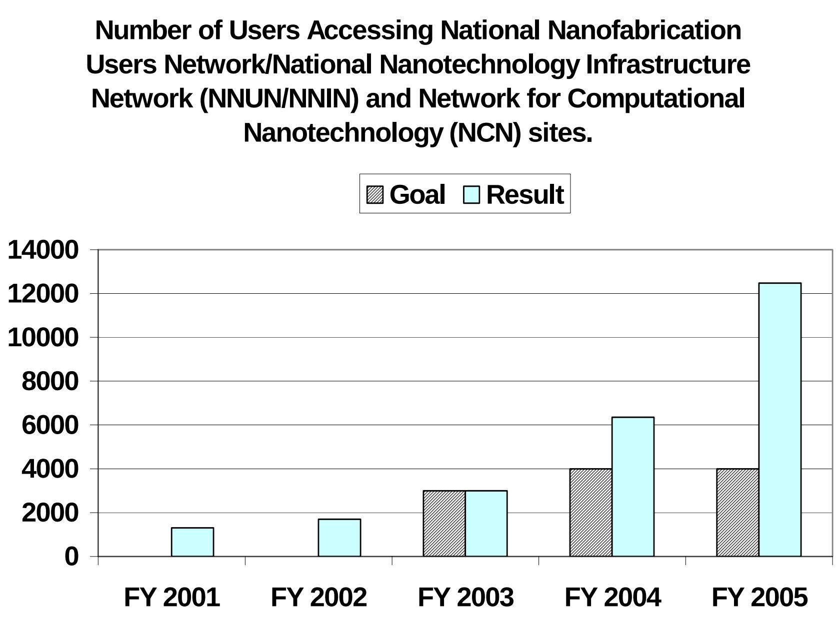
Annual Performance Goal T4: Number of users accessing National Nanofabrication Users Network/National Nanotechnology Infrastructure Network (NNUN/NNIN) and Network for Computational Nanotechnology (NCN) sites.

✓ Goal T4 Achieved

The National Nanotechnology Infrastructure Network (NNIN) is an integrated national network of user facilities that supports the future infrastructure needs for research and education in the burgeoning nanoscale science and engineering field. The facilities comprising this network are diverse in capabilities, research areas, and geographic locations, and the network will have the flexibility to grow or reconfigure as needs arise. The NNIN broadly supports nanotechnology activities outlined in the National Nanotechnology Initiative investment strategy. It provides users across the nation access to leading-edge fabrication and characterization tools and instruments in support of nanoscale science and engineering research. The NNIN supersedes the National Nanofabrication Users Network (NNUN), initiated in 1994 and for which NSF support concluded at the end of 2003. The use of the network far exceeded expectation due, in part, to the great interest in the field of nanotechnology.

NUMBER OF USERS ACCESSING NATIONAL NANOFABRICATION USERS NETWORK/NATIONAL NANOTECHNOLOGY INFRASTRUCURE NETWORK (NNUN/NNIN) AND NETWORK FOR COMPUTATIONAL NANOTECHNOLOGY (NCN) SITES

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	3000	4000	4000	12500
Result	1300	1700	3000	6350	**✓12462**	



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[10]: This goal will be continued in FY 2006.

[10] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal T5: Number of nodes that comprise infrastructure.

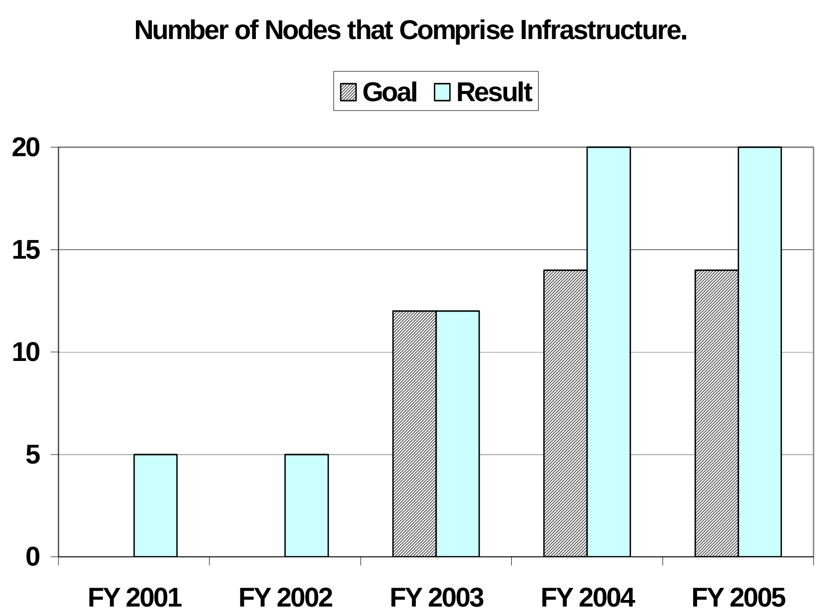
✓ Goal T5 Achieved

The National Nanotechnology Infrastructure Network (NNIN) is an integrated national network of user facilities that supports the future infrastructure needs for research and education in the burgeoning nanoscale science and engineering field. The facilities comprising this network are diverse in capabilities, research areas, and geographic locations, and the network will have the flexibility to grow or reconfigure as needs arise. The NNIN broadly supports nanotechnology activities outlined in the National Nanotechnology Initiative investment strategy. It provides users across the nation access to leading-edge fabrication and characterization tools and instruments in support of nanoscale science and engineering research. The NNIN supersedes the National Nanofabrication Users Network (NNUN), initiated in 1994 and for which NSF support concluded at the end of 2003.

NNIN nodes are defined as both large and small individual user facilities, geographically distributed and with diverse and complementary capabilities to design, create, characterize, and measure novel nanoscale structures, materials, devices, and systems.

NUMBER OF NODES THAT COMPRISE INFRASTRUCTURE.

	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	12	14	14	17
Result	5	5	12	20	✓**20**	



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[11]: This goal will be continued in FY 2006.

[11] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal T6: Qualitative assessment by external experts that there have been significant research contributions to software design and quality, scalable information infrastructure, high-end computing, workforce, and socio-economic impacts of IT (ITR COV).

✓ Goal T6 Successful

The following is taken from the Information Technology Research (ITR) Committee of Visitors report of their review conducted March 8-10, 2005 (Question 1[12], page 11). The report will be available at www.nsf.gov/od/gpra/COV/start.htm in early November.

> Yes, the ITR program has made significant research contributions to software design and quality, scalable information infrastructure, high-end computing, workforce, and socio-economic impacts of IT.
>
> It has supported innovative projects that would not otherwise be supported from the disciplinary programs. The scope of the programs was broad, and has opened up new subfields of computer science including bio-informatics, human-robot interaction and computational medicine for example.
>
> The scale of the grants enables researchers to mine, visualize and model huge datasets, to tackle large problems ranging from global warming, to economic recession, to traffic jams and encouraged faculty and students from diverse backgrounds to cross-train for new fields and positions using IT. The program has supported many projects bringing computer science and information technology to K-12 schools and to the public both through hands-on projects and through tools to assess learning and teaching.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: The ITR initiative has been completed. The goal will not appear in FY 2006.

[12] 1. *Has the ITR Program made significant research contributions to software design and quality, scalable information infrastructure, high-end computing, workforce, and socio-economic impacts of IT?*

NSF GPRA PERFORMANCE GOALS – PEOPLE

Ideas
Discovery across the frontier of science and engineering, connected to learning, innovation and service to society.

Tools
Broadly accessible state-of-the-art science and engineering facilities, tools, and other infrastructure that enable discovery, learning and innovation.

People
A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.

Organizational Excellence
An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

PEOPLE STRATEGIC OUTCOME GOAL: A diverse, competitive, and globally engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens.

✓ Goal P1 Achieved

Leadership in today’s knowledge economy requires world-class scientists and engineers and a national workforce that is scientifically, technically and mathematically strong. Investments in *People* aim to improve the quality and reach of science, engineering, and mathematics education and enhance student achievement. Each year, NSF supports almost 200,000 people – teachers, students, and researchers at every educational level and across all disciplines in science and engineering. Embedded in all NSF programs are efforts to build a more inclusive, knowledgeable, and globally engaged workforce that fully reflects the strength of the Nation’s diverse population.

Annual Performance Goal P1: Our performance for this goal is successful when, *in the aggregate*, results reported in the period FY 2005 demonstrate significant achievement in the majority of the following indicators:

- Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups and institutions in all NSF programs and activities.
- Support programs that attract and prepare U.S. students to be highly qualified members of the global S&E workforce, including providing opportunities for international study, collaborations and partnerships.
- Develop the Nation’s capability to provide K-12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering and mathematics.

- Promote public understanding and appreciation of science, technology, engineering, and mathematics, and build bridges between formal and informal science education.
- Support innovative research on learning, teaching and mentoring that provides a scientific basis for improving science, technology, engineering and mathematics education at all levels.

RESULT FOR PERFORMANCE GOAL P1: NSF achieved this goal. External experts provided examples of significant achievement during FY 2004 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 2006 Performance Plan: This goal will be continued in FY 2006.

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

The following statements concerning NSF achievement with respect to the indicators 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/publications/pub_summ.jsp?ods_key=nsf05210.

The Committee found significant achievement for PEOPLE indicators 1, 2, 3 and 4. However, based on evidence provided, the Committee did not find significant achievement for indicator P5.

Quality and relevance: Based on the review of COV reports and project accomplishments (nuggets), the overall quality of projects was determined to be high and relevant to the People strategic outcome goal. Delivery methods and application of research findings were also found to contribute to the high quality of projects reviewed. Many of the projects reviewed have high relevance to the development of a strong workforce and public understanding of science.

Transformative/Bold/High risk-Innovative projects: Projects contributing to the People goal were found across NSF as evidenced by the breadth of nuggets selected to illustrate significant achievement. Overall, the Committee found ambitious projects that we would consider "bold." One general observation was that high risk or bold projects seemed to be less likely to be funded under the PEOPLE strategic goal.

Other Comments:

Reduced funding: The Committee members reviewing this strategic goal expressed serious concern about the significant decrease in funding for programs that focus on the People Goal. Funding levels for this goal have declined from $1,146,880,000 in 2004 to the FY 2006 Request of $978,770,000. In addition, the number of people involved in or impacted by NSF activities has declined from an estimated 215,350 in 2004 to 168,280 in 2006. This trend should be monitored carefully by the AC/GPA because it could have an adverse impact on NSF's ability to demonstrate significant achievement in the future. The principal organizational unit within NSF for meeting the PEOPLE outcome goal is the Education and Human Resources (EHR) directorate. This directorate has borne the brunt of the funding reductions noted above. This may have long-term implications for meeting the objectives in the People goal. The Committee recognizes that other directorates within NSF are making major contributions to this goal. However, delegating yet more responsibility for meeting these objectives to other parts of NSF because of budgetary realignments may result in lack of experience and expertise in K-12 education, particularly in programs that sustain high-quality, high-commitment engagement of scientists and mathematicians with students and teachers in classroom settings.

Data Collection and Assessment: Effective assessment should be, at its heart, data-driven. Thus, it is very important to develop simple but effective metrics and to provide data that enable both qualitative and quantitative analyses of progress toward the People goal. This will be critical to establishing a context for future evaluations by this Committee or others of NSF's level of achievement. The Committee on Equal Opportunity in Science and Engineering (CEOSE) recommended in its 2004 report, *"Broadening Participation in America's Science and Engineering Workforce*," that NSF should expand its systematic and objective evaluation efforts by continuing to "obtain, refine and disaggregate data and factors related to the participation and advancement of persons from underrepresented groups in STEM education and careers" (Executive Summary, p. 7-8; CEOSE 04-02). We support that recommendation and urge NSF to increase its focus on this issue and to strive to identify those data elements (particularly those collected over a long period) that are the most critical to assessing program impact.

Broadening Participation: It is important for NSF to emphasize that "broadening the participation of underrepresented groups" is not an issue of simple demographics, but of increasing the diversity of *paradigms, ideas, methods, and perceptions* brought to the Foundation's programs. In particular, NSF must develop strategies to ensure that activities aimed at broadening participation are carried out with rigor and attention to high-quality research.

P5 Designation: P5, "Support innovative research on learning, teaching and mentoring that provides a scientific basis for improving science, technology, engineering and mathematics education on all levels," is a research goal that contributes to building a workforce. NSF is encouraged to review whether or not it would be more appropriate under the 'Ideas' goal.

INDICATOR P1: Promote greater diversity in the science and engineering workforce through increased participation of underrepresented groups in NSF activities.

RESULT: *Demonstrated significant achievement.*

Based on the accomplishments provided, NSF devotes a substantial amount of resources to fund projects that contribute to the attainment of the PEOPLE strategic outcome goal as articulated under Indicator P1. Collectively, the projects demonstrate significant achievement toward producing a workforce with strong representation of under-represented groups and women in science and engineering.

INDICATOR P2: Support programs that attract and prepare U.S. students to be highly qualified members of the global S&E workforce, including providing opportunities for international study, collaborations and partnerships.

RESULT: *Demonstrated significant achievement.*

The success of NSF in meeting the P2 indicator is largely due to the activities of one foundation-wide program, OISE (Office of International Science and Engineering, and its earlier incarnation INT). Of the 46 nuggets listed under "primary indicator" for P2, only 13 -- less than 30 percent -- met both the stated criteria for selection, namely that the program attract and prepare US students to science **and** that part of preparing them to be highly qualified members of the global workforce includes providing opportunities for international collaboration. Six of those were produced by OISE, with a range of other divisions represented. Exemplary activities recruited and trained students in science and offered them significant opportunities for international collaborative learning. The collaborative elements of these opportunities superseded standard international field practices of the past, in which researchers collected specimens or data abroad, brought them to the U.S., and published without consulting, conferring with, or including colleagues from the host nations.

INDICATOR P3: Develop the Nation's capability to provide K-12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering and mathematics.

RESULT: *Demonstrated significant achievement.*

NSF invests in developing the Nation's capability to provide K-12 and higher education faculty with opportunities for continuous learning and career development in science, technology, engineering and mathematics. Development opportunities are funded over a wide range of programs, and evidence from outcomes reported by projects funded in FY 2005 demonstrate significant achievement in taking a variety of approaches to engage teachers and faculty in quality development experiences across STEM disciplines. Research Experiences for Teachers (RET), the CAREER awards, and the Teacher Preparation Continuum (TPC) are examples at the program level that help achieve NSF's goals.

INDICATOR P4: Promote public understanding and appreciation of science, technology, engineering, and mathematics, and build bridges between formal and informal science education.

RESULT: *Demonstrated significant achievement.*

The range of accomplishments reported under Indicator P4 show that NSF is investing in effective informal science education materials and incorporating public outreach and dialog into many programs and projects. The accomplishments indicate that NSF-supported activities are reaching large numbers of people of all ages with insights from many fields, including biology, the earth and atmospheric sciences, engineering mathematics, and psychology. The portfolio of work shows a willingness to push the envelope, and is highly multidisciplinary. NSF has reached a level of significant achievement in this area.

INDICATOR P5: Support innovative research on learning, teaching and mentoring that provides a scientific basis for improving science, technology, engineering and mathematics education at all levels.

RESULT: *Did not demonstrate significant achievement.*

…we conclude that this does not constitute a body of work sufficient to determine that NSF has met the "significant achievement" threshold with respect to this important indicator.

Annual Performance Goal P2: Number of U.S. students receiving fellowships through Graduate Research Fellowships (GRF) and Integrative Graduate Education and Research Traineeships (IGERT) or Graduate Teaching Fellows in K-12 Education (GK-12).

✓ Goal P2 Achieved

NSF) seeks to ensure the vitality of the human resource base of science, mathematics, and engineering in the United States and to reinforce its diversity. A competition is conducted for Graduate Research Fellowships, with additional awards offered for women in engineering and computer and information science. NSF Graduate Fellowships offer recognition and three years of support for advanced study to outstanding graduate students in the mathematical, physical, biological, engineering, and behavioral and social sciences, including the history of science and the philosophy of science, and to research-based Ph.D. degrees in science education.

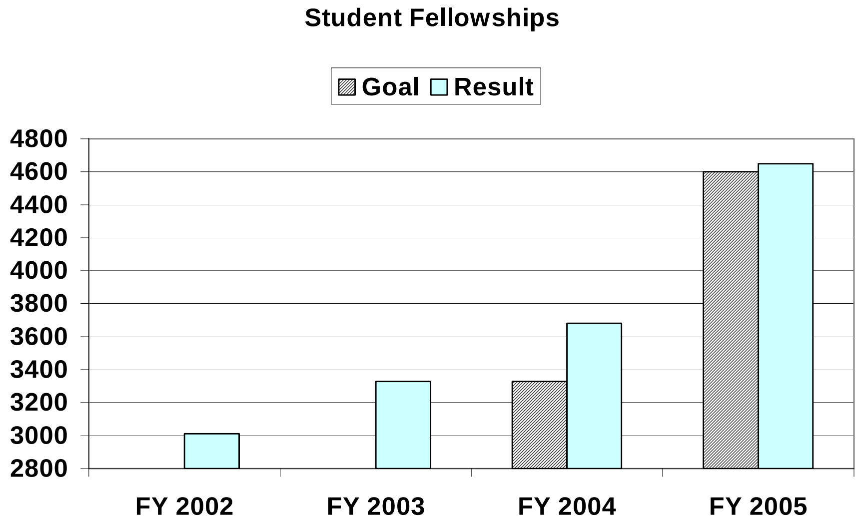
The Integrative Graduate Education and Research Traineeships (IGERT) program has been developed to meet the challenges of educating U.S. Ph.D. scientists, engineers, and educators with the interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills to become in their own careers the leaders and creative agents for change. The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries. It is also intended to facilitate greater diversity in student participation and preparation, and to contribute to the development of a diverse, globally-engaged science and engineering workforce.

The Graduate Teaching Fellows in K-12 Education (GK-12) program supports fellowships and associated training that enable graduate students in NSF- supported science, technology, engineering, and mathematics (STEM) disciplines to acquire additional skills that will broadly prepare them for professional and scientific careers in the 21st century. Through interactions with teachers in K-12 schools, graduate students can improve communication and teaching skills while enriching STEM instruction in K-12 schools. In addition, the GK-12 program provides institutions of higher education with an opportunity to make a permanent change in their graduate programs by including partnerships with K-12 schools in a manner that is of mutual benefit to their faculties and students. Expected outcomes include improved communication, teaching and team building skills for the Fellows; professional development opportunities for K-12 teachers; enriched learning for K-12 students; and strengthened partnerships between institutions of higher education and local school districts.

NUMBER OF U.S. STUDENTS RECEIVING FELLOWSHIPS THROUGH GRF AND TRAINEESHIPS THROUGH IGERT, OR THROUGH GK-12

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	increase	4600	4468
Result	3011	3328	3681[13]	**✓4648**	

[13] For FY 2002 - 2004, NSF is only including funded GRF and IGERT recipients and has revised FY 2002 and FY 2003 accordingly. Prior numbers in FY 2002 and FY 2003 had also included active students in these programs even if they were not currently funded.



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This goal will be continued in FY 2006.

Annual Performance Goal P3: Number of applicants for Graduate Research Fellowships from groups that are underrepresented in the science and engineering workforce.

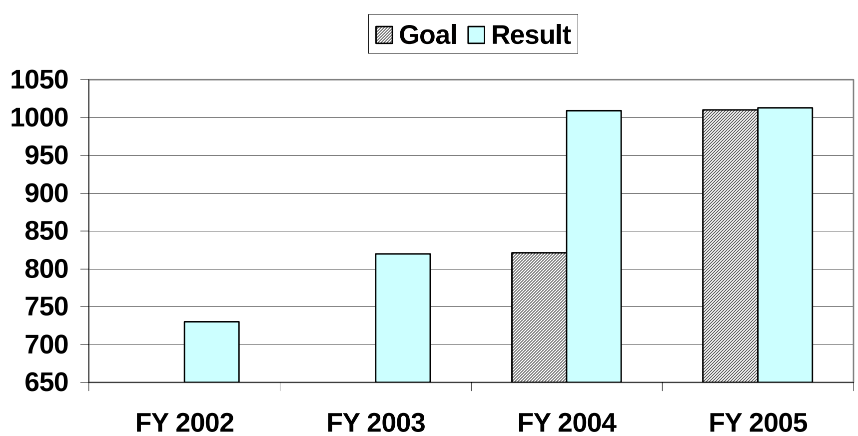
✓ Goal P3 Achieved

Graduate Research Fellowships are NSF's flagship investment in graduate education and training, and outreach efforts to increase the number of applicants from underrepresented groups are an ongoing priority. As with all demographic goals, the data come from voluntary self-reporting. Therefore, the number of applicants from underrepresented groups may actually be higher.

NUMBER OF APPLICANTS FOR GRADUATE RESEARCH FELLOWSHIPS FROM GROUPS THAT ARE UNDERREPRESENTED IN THE SCIENCE AND ENGINEERING WORKFORCE.

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	821	1010	increase
Result	730	820	1009	**✓1013**	

Number of Applicants for Graduate Research Fellowships from Groups that are Underrepresented in the Science and Engineering Workforce.



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[14]: This goal will be continued in FY 2006.

[14] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal P4: Number of applications for Faculty Early Career Development ProgCAREER) awards from investigators at minority-serving institutions.

✓ Goal P4 Achieved

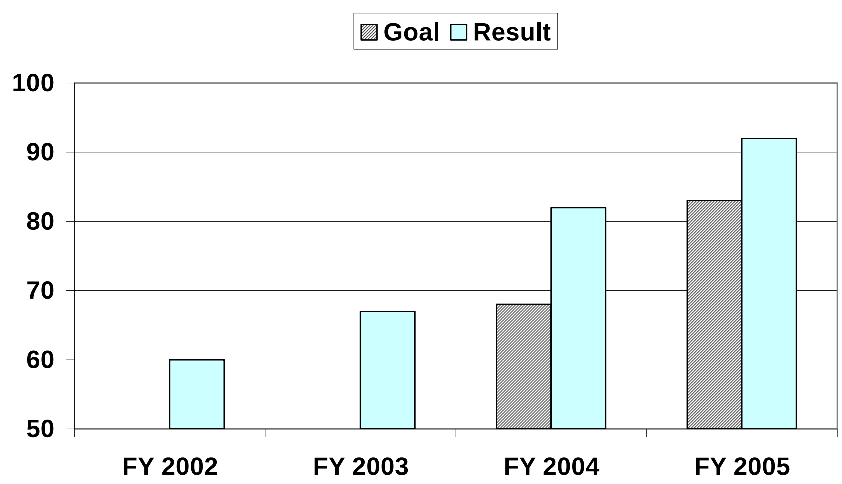
The Faculty Early Career Development (CAREER) Program is an NSF-wide activity that supports junior faculty within the context of their overall career development. It combines in a single program the support of research and education of the highest quality and in the broadest sense. This premier program emphasizes the importance the Foundation places on the early development of academic careers dedicated to stimulating the discovery process in which the excitement of research is enhanced by inspired teaching and enthusiastic learning. Each year NSF selects nominees for Presidential Early Career Awards for Scientists and Engineers (PECASE) from among the first-year awardees supported by the CAREER Program. PECASE awards recognize outstanding scientists and engineers who are in the early stages in their careers, and show exceptional potential for leadership at the frontiers of knowledge.

CAREER is NSF's flagship investment in the development of young faculty, and broadening the institutional base of applicants to the program is a continuing priority. Outreach efforts have specifically focused on attracting faculty from minority-serving institutions and from a broader geographic base.

NUMBER OF APPLICATIONS FOR CAREER AWARDS FROM INVESTIGATORS AT MINORITY-SERVING INSTITUTIONS

	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Goal	N/A	N/A	68	83	increase
Result	60	67	82	**✓92**	

Number of Applications for CAREER Awards from Investigators at Minority-Serving Institutions.



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[15]: This goal will be continued in FY 2006.

[15] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal P5: Percent of Nanoscale Science and Engineering (NS&E) proposals with at least one female PI or Co-PI.

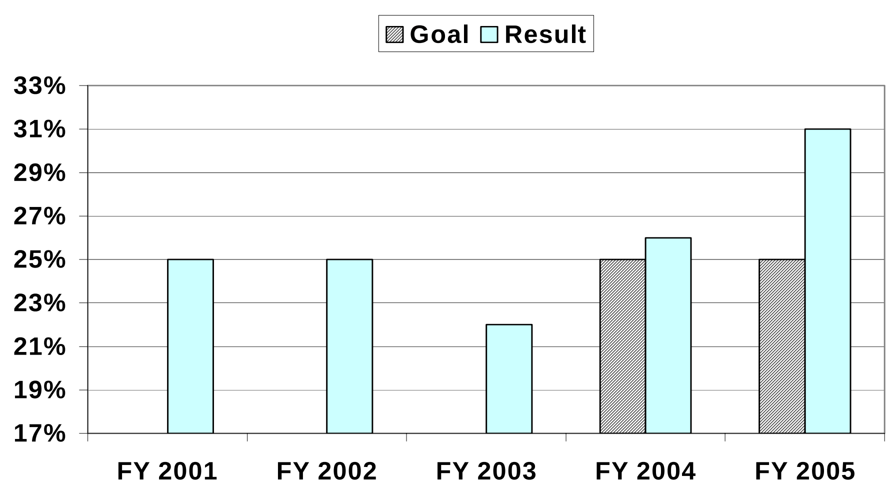
✓Goal P5 Achieved

The Nanoscale Science and Engineering (NS&E) priority area encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – shift and expand possibilities in science, engineering and technology. A nanometer (one-billionth of a meter) is to an inch what an inch is to 400 miles. With the capacity to manipulate matter at this scale, science, engineering and technology are realizing revolutionary advances, in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for industry and order-of-magnitude faster computer chips.

NS&E research promises a better understanding of nature, a new world of products beyond what is now possible, high efficiency in manufacturing, sustainable development, better healthcare, and improved human performance. NSF has a continued commitment to increasing participation of female investigators in this priority area.

PERCENT OF NS&E PROPOSALS WITH AT LEAST ONE FEMALE PI OR CO-PI.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	N/A	N/A	N/A	25%	25%	25%
Result	25%	25%	22%	26%	**✓31%**	

Percent of NS&E Proposals with at Least One Female PI or Co-PI.



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[16]: This goal will be continued in FY 2006.

[16] The Performance Plan has now been integrated within the Performance Budget.

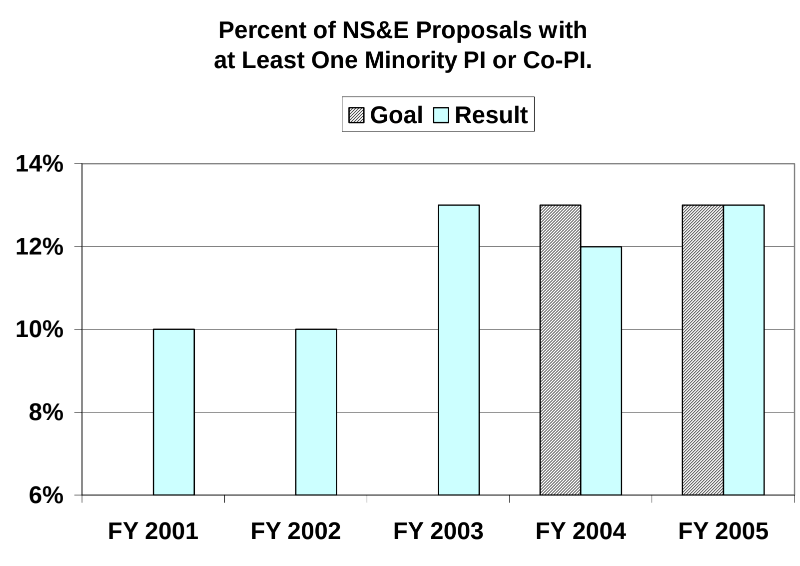
Annual Performance Goal P6: Percent of Nanoscale Science and Engineering (NS&E) proposals with at least one minority principal investigator (PI) or co-principal investigator (Co-PI).

✕ Goal P6 Not Achieved

The Nanoscale Science and Engineering (NS&E) priority area encompasses the systematic organization, manipulation and control of matter at atomic, molecular and supramolecular levels. Novel materials, devices, and systems – with their building blocks on the scale of nanometers – shift and expand possibilities in science, engineering and technology. A nanometer (one-billionth of a meter) is to an inch what an inch is to 400 miles. With the capacity to manipulate matter at this scale, science, engineering and technology are realizing revolutionary advances, in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for industry and order-of-magnitude faster computer chips.

Nanoscale science and engineering research promises a better understanding of nature, a new world of products beyond what is now possible, high efficiency in manufacturing, sustainable development, better healthcare, and improved human performance. NSF has a continued commitment to increasing participation of female investigators in this priority area.

PERCENT OF NS&E PROPOSALS WITH AT LEAST ONE MINORITY PI OR CO-PI.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	N/A	N/A	N/A	13%	13%	13%
Result	10%	10%	13%	12%	**×12.9%**	



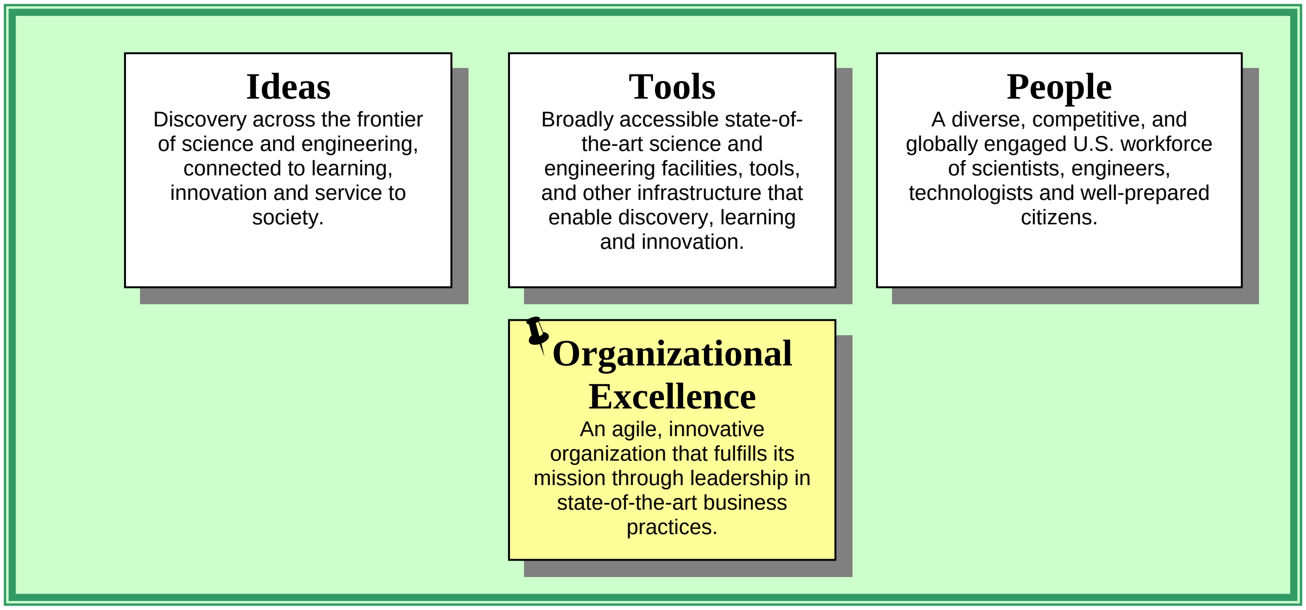
WHY WE DID NOT ACHIEVE THIS GOAL: NSF is committed to its goal of increasing participation by minorities. While there was an increase, it was not adequate to meet the goal. The performance goal was set at an approximate target level, and the deviation from that level is slight. There was no effect on overall program or activity performance.

STEPS WE WILL TAKE TO ACHIEVE THIS GOAL: We will continue our efforts to encourage minorities to submit proposals to these areas.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[17]: This goal will be continued in FY 2006.

[17] The Performance Plan has now been integrated within the Performance Budget.

NSF GPRA PERFORMANCE GOALS – ORGANIZATIONAL EXCELLENCE



ORGANIZATIONAL EXCELLENCE STRATEGIC OUTCOME GOAL: An agile, innovative organization that fulfills its mission through leadership in state-of-the-art business practices.

✓ Goal O1 Achieved

Excellence in managing NSF's activities is critical to achievement of the Foundation's mission-oriented outcome goals. Long-term investment categories include *human capital*, which produces a diverse, agile, results-oriented cadre of knowledge workers committed to enabling the agency's mission and to constantly expanding their abilities to shape the agency's future; *business processes*, which produce effective, efficient, strategically-aligned business processes that integrate and capitalize on the agency's human capital and technology resources; and *technologies and tools*, which produce flexible, reliable, state-of-the-art business tools and technologies designed to support the agency's mission, business processes, and customers.

Annual Performance Goal O1: Our performance is successful when, *in the aggregate*, results reported in the FY 2005 period demonstrate significant achievement in the majority of the following indicators:

- Operate a credible, efficient merit review system.
- Utilize and sustain broad access to new and emerging technologies for business application.
- Develop a diverse, capable, motivated staff that operates with efficiency and integrity.
- Develop and use performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.

RESULT: External experts provided examples of significant achievement during FY 2005 reporting. Comments by the AC/GPA and examples they selected are presented for each of the performance indicators for this goal.

IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN: This goal will be continued in FY 2006.

ORGANIZATIONAL EXCELLENCE: Comments by the Advisory Committee for GPRA Performance Assessment

The following statements concerning NSF achievement with respect to the Indicators for the ORGANIZATIONAL EXCELLENCE goal are excerpted from the AC/GPA Report at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05210.

> The 2005 Advisory Committee for Business and Operations (AC/B&O) assessment supports NSF's conclusion that the agency has demonstrated significant achievement for the three indicators it considered (human capital, business processes, and performance assessment). The AC/GPA agrees with this conclusion. The AC/B&O also made a number of comments to improve the approach, methodology and analysis for the assessment of performance in subsequent years. The AC/B&O report can be found in an Appendix to this report. For our part, we conclude that the Merit Review Process (MRP) is effective in the processing and reviewing of a large and increasing volume of proposals and in the engagement of a broad and diverse segment of talent in the NSF's science and engineering enterprises. While the MRP will always, in our view, require vigilance and a commitment to continuous improvement, when taken as a whole and when one looks at the results as illustrated in the Ideas, Tools, and People portfolios, clearly, the process remains a major positive force in advancing the frontiers of science, mathematics, and engineering. <u>From this review, we concluded that NSF has demonstrated significant achievement for this OE indicator.</u>

Additional comments can be found in the AC/GPA Report.

INDICATOR 1: Operate a credible, efficient merit review system.

RESULT: *Demonstrated significant achievement.*

It was the unanimous judgment of the Committee that NSF has demonstrated significant achievement for all indicators in the Ideas and Tools goals and also for the merit review indicator of the Organizational Excellence outcome goal.

For our part, we conclude that the Merit Review Process (MRP) is effective in the processing and reviewing of a large and increasing volume of proposals and in the engagement of a broad and diverse segment of talent in the NSF's science and engineering enterprises. While the MRP will always, in our view, require vigilance and a commitment to continuous improvement, when taken as a whole and when one looks at the results as illustrated in the Ideas, Tools, and People portfolios, clearly, the process remains a major positive force in advancing the frontiers of science, mathematics, and engineering. From this review, we concluded that NSF has demonstrated significant achievement for this OE indicator.

INDICATOR 2: Utilize and sustain broad access to new and emerging technologies for business application.

RESULT: *Demonstrated significant achievement.*

Evaluated by the AC/B&O.

INDICATOR 3: Develop a diverse, capable, motivated staff that operates with efficiency and integrity.

RESULT: *Demonstrated significant achievement.*

Evaluated by the AC/B&O.

INDICATOR 4: Develop and use performance assessment tools and measures to provide an environment of continuous improvement in NSF's intellectual investments as well as its management effectiveness.

RESULT: *Demonstrated significant achievement.*

Evaluated by the AC/B&O.

The 2005 AC/B&O assessment supports NSF's conclusion that the agency has demonstrated significant achievement for the three indicators it considered (human capital, business processes, and performance assessment). The AC/GPA agrees with this conclusion.

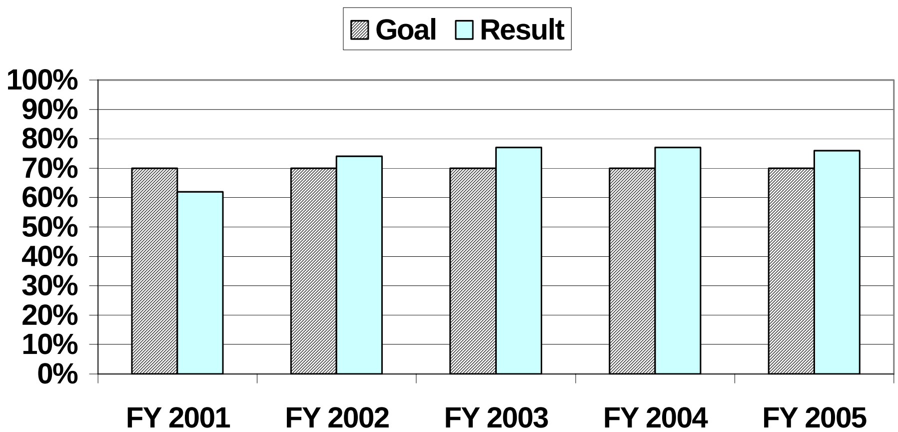
Annual Performance Goal O2: For 70 percent of proposals, be able to inform applicants whether their proposals have been declined or recommended for funding within six months of deadline or target date, or receipt date, whichever is later.

✓ Goal O2 Achieved

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.

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 OR TARGET DATE, OR RECEIPT DATE, WHICHEVER IS LATER.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	70%	70%	70%	70%	70%	70%
Result	62%	74%	77%	77%	**✓76%**	

For 70 Percent of Proposals, Make Information Available to Applicants on whether their Proposals have been Declined or Recommended for Funding within Six Months of Deadline or Receipt Date, Whichever is Later.



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[18]: This goal will be continued in FY 2006.

[18] The Performance Plan has now been integrated within the Performance Budget.

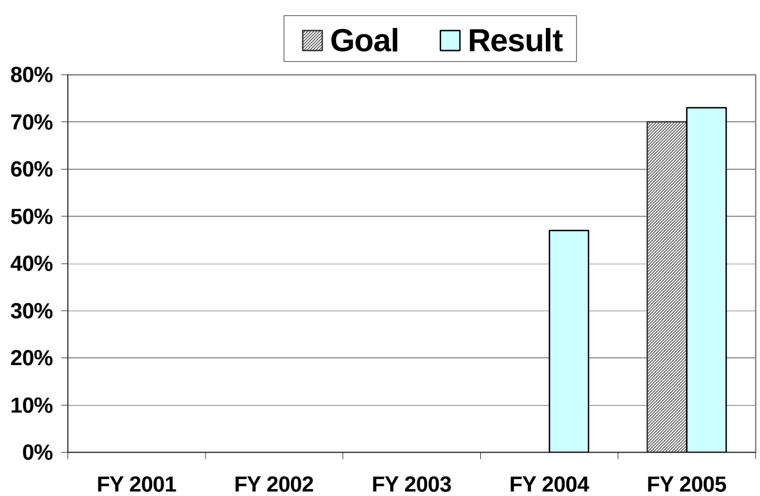
Annual Performance Goal O3: For the Nanoscale Science and Engineering Program, percent of award decisions made available to applicants within six months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts.

✓ Goal O3 Achieved

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.

FOR THE NANOSCALE SCIENCE AND ENGINEERING PROGRAM, PERCENT OF AWARD DECISIONS MADE AVAILABLE TO APPLICANTS WITHIN SIX MONTHS OF PROPOSAL RECEIPT OR DEADLINE DATE, WHILE MAINTAINING A CREDIBLE AND EFFICIENT COMPETITIVE MERIT REVIEW SYSTEM, AS EVALUATED BY EXTERNAL EXPERTS.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	N/A	N/A	N/A	N/A	70%	70%
Result	N/A	N/A	N/A	46%	**✓73%**	

Percent of Award Decisions Made Available to Applicants within Six Months of Proposal Receipt or Deadline Date for the Nanoscale Science and Engineering Program



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[19]: This goal will be continued in FY 2006.

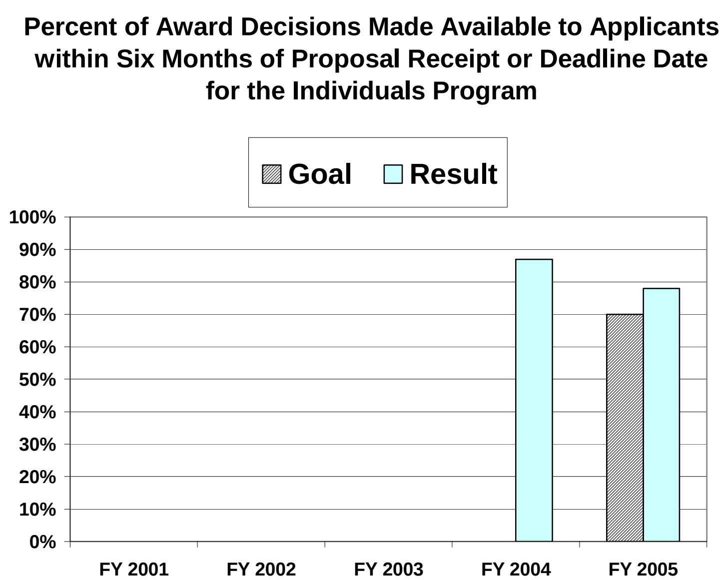
[19] The Performance Plan has now been integrated within the Performance Budget.

Annual Performance Goal O4: For the Individuals Program, percent of award decisions made available to individuals within six months of proposal receipt or deadline date, while maintaining a credible and efficient competitive merit review system, as evaluated by external experts.

✓ Goal O4 Achieved

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.

FOR THE INDIVIDUALS PROGRAM, PERCENT OF AWARD DECISIONS MADE AVAILABLE TO APPLICANTS WITHIN SIX MONTHS OF PROPOSAL RECEIPT OR DEADLINE DATE, WHILE MAINTAINING A CREDIBLE AND EFFICIENT COMPETITIVE MERIT REVIEW SYSTEM, AS EVALUATED BY EXTERNAL EXPERTS.						
	FY 2001	**FY 2002**	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**
Goal	N/A	N/A	N/A	N/A	70%	70%
Result	N/A	N/A	N/A	87%	**✓78%**	



IMPLICATIONS FOR THE FY 2006 PERFORMANCE PLAN[20]: This goal will be continued in FY 2006.

[20] The Performance Plan has now been integrated within the Performance Budget.

II-82

ASSESSMENT AND EVALUATION PROCESS

Measuring NSF's Ability to Meet Mission-Oriented Goals

The National Science Foundation's Advisory Committee for GPRA Performance Assessment (AC/GPA) was established in June 2002 to provide advice and recommendations to the NSF Director regarding the Foundation's performance under the Government Performance and Results Act (GPRA) of 1993. The Committee of 20-25 scientists, engineers and educators review NSF's broad portfolio in their analysis of annual progress toward NSF's four strategic outcome goals of Ideas, Tools, People, and Organizational Excellence.

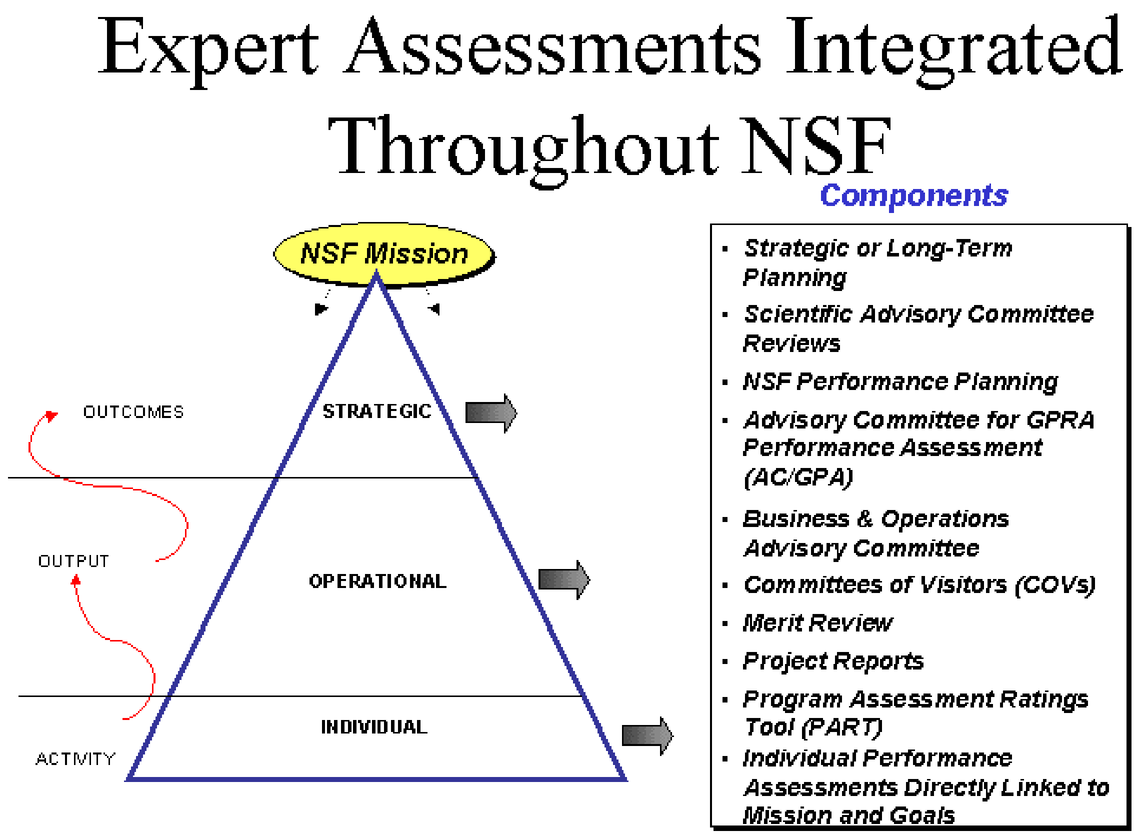
Indicators are used by the Foundation to assess annual progress toward attainment of its long-term outcome goals. For each outcome goal, NSF judges itself successful when, in the aggregate, results reported demonstrate significant achievement for the majority of associated indicators. The AC/GPA's assessment of whether NSF has demonstrated significant achievement with respect to individual performance indicators is based on the collective experience and expertise of the Committee using input from "nuggets" (exemplary outcomes from NSF-funded research), COV reports, PI project reports and input from NSF and the Business and Operations Advisory Committee regarding Organizational Excellence activities. These sources cover NSF's entire portfolio. After its meetings, the AC/GPA provides NSF with a report concerning NSF performance with respect to the indicators associated with each annual performance goal. The recommendations developed by the AC/GPA are used, along with other qualitative information and quantitative management results, to prepare NSF's Performance and Accountability Report.

Project Assessment During NSF Merit Review

Applicants provide results from previous NSF support, information about existing facilities and equipment available to conduct the proposed activity, biographical information on the Principal Investigator(s), other sources of support, federally required certifications, and certifications specific to NSF. Such information is required at the time of application, 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, from the onset, less than one-fourth of the most competitive proposals submitted for consideration are selected (down from one-third in FY 2001).

Program Officers review the annual progress of awards. The project reports include information on significant accomplishments, progress achieved in the prior year, and point 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 for continuing grants.

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



The schematic above shows the components and the value of expert evaluations performed at NSF.

Program Assessment by Committees of Visitors

NSF's Committees of Visitors (COV) provide program assessments that are used both in program management and in annual GPRA reporting. Each COV typically consists of five to 20 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. Approximately one-third of NSF activities are assessed each year.

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

The FY 2005 COVs were asked to comment on program activities as they relate to NSF's strategic outcome goals. COVs are asked to justify their assessment and provide supporting examples or statements.

COVs are subcommittees of NSF directorate advisory committees. As such, their reports, along with NSF responses to the recommendations made by the COVs, are submitted to the parent advisory committee.

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 in the respective fields who have broad experience in academia, industry, and government. ACs 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, advisory committees no longer assess directorate progress towards these goals.

Advisory Committee for Business and Operations

In FY 2001, NSF established the Advisory Committee for Business and Operations. The committee is composed of 15 members selected from the research administration, education management and business communities, including business professionals and academics in the field. The committee is charged with providing advice on issues related to NSF's business practices and operations, including innovative approaches to the achievement of NSF's strategic goals. This committee provided significant input to the formulation of NSF's Organizational Excellence strategic outcome goal and provided an assessment of NSF performance with respect to three of the four indicators associated with this goal.

Agency GPRA and PART Reporting

NSF has integrated its GPRA and PART reporting. For the third straight year, all performance goals in the Performance and Accountability Report were verified and validated by an external third party. This year, that includes both GPRA and PART goals. A discussion of our verification and validation (V&V) process can be found on page II-87.

The COV and AC/GPA reports prepared by external experts are integral to the evaluation of NSF performance and 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 Ideas, Tools, People and Organizational Excellence outcome goals.

The criterion for success for each of the annual performance goals for the strategic outcome goals of Ideas, Tools, People and Organizational Excellence can be stated:

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

NSF staff examines statements of significant accomplishment in the AC/GPA to ensure that ratings for the qualitative outcome goals and indicators are justified.

NSF plan for improving and strengthening project management, including monitoring performance against performance targets, includes annual reviews of progress and plans, including external reviewers or consultants, as well as NSF staff, site visits on mutually agreed dates and locations to review project status, technical topics critical to the success of the project, cost and schedule performance, and management. In addition, MREFC projects will provide quarterly financial reporting comparing budgeted expenditures to actual expenditures for each Work Breakdown Schedule (WBS) identified in their construction project as described in the approved Project Execution Plan and also provide quarterly status reports with a graph of cumulative earned value for the construction of the overall project. NSF will include language in the Cooperative Agreement for each MREFC Awardee to be completed by end of fiscal year 2006.

VERIFICATION AND VALIDATION

NSF used a verification and validation (V&V) process similar to the one used in FY 2004 to verify and validate all FY 2005 GPRA performance information. For FY 2004 data verification and analyses, NSF engaged IBM Business Consulting Services (IBM) to document the processes we follow to collect, process, maintain, and report all performance data. They identified relevant controls and commented on their effectiveness. Based on Government Accountability 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 2004 goals. We engaged IBM again in FY 2005. For the outcome goals, IBM reviewed the processes NSF used to obtain external assessment of NSF activities with respect to these goals. IBM also provided high-level review of NSF's information systems based on GAO standards for application controls[21].

In their October 2005 report[22], IBM states: *"Overall, we conclude that NSF continues to make a concerted effort to report its performance results accurately and has effective systems, policies, and procedures to promote data quality. NSF relies on sound business policies, internal controls, and manual checks of system queries to report performance and maintains adequate documentation of processes and data for an effective verification and validation review."*

The Foundation has both qualitative and quantitative GPRA and PART goals. Its qualitative goals include annual performance goals that support the strategic outcome goals of Ideas, Tools, People, and Organizational Excellence. These outcome goals are presented in a format that requires expert 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 provide insight into management activities, enabling assessment of progress toward goal achievement. Assessment for these goals is primarily based on data collected with NSF's central data systems.

Types and Sources of Performance Data and Information

Most of the data that underlie achievement assessments for strategic outcome goals (with the exception of the Organizational Excellence goal) originate outside the agency and are submitted to NSF 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 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.
- Information on Tools – published and disseminated results; new tools and technologies, multidisciplinary databases; software, newly-developed instrumentation, and other inventions; data,

[21] The executive summary of the IBM V&V report can be found on page II-92.

[22] Page 1 of the IBM report.

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.

- 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 Organizational Excellence – information provided by NSF on diversity initiatives, diversity statistics, the NSF Academy and the government-wide eTraining Initiative; information on performance management system improvements, employee recognition activities, innovative capital studies within NSF, the development and implementation of a human capital management plan, and eGovernment human resource initiatives; information on technology enabled business processes, government-wide grants management initiatives, the ePayroll initiative, compliance with the FY 2003 Federal Information Security Management Act (FISMA) Compliance, Greater IT Security Awareness Training Throughout Foundation, and activities associated with GPRA performance assessment.

Most of the data supporting quantitative goals can be found in NSF's central systems. These central systems include the Enterprise Information System (EIS); FastLane, with its Project Reporting System and its Facilities Performance Reporting System; the Online Document System (ODS); the Proposal 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.

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.

Judgmental Sampling

With respect to Ideas, Tools, and People outcome goals, the AC/GPA is provided with access to recent Committee of Visitor (COV) reports and program assessments conducted by external programmatic expert panels, Principal Investigator project reports, award abstracts, and, since it is impractical for an external committee to review the contributions to the associated performance goals by each of the over 25,000 active awards, NSF Program Officers provided the Committee with nearly 900 summaries of notable results relevant to the performance indicators. Collections obtained from expert sampling of outstanding accomplishments ("nuggets") from awards, together with COV reports and 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 in its Strategic Outcome Goals for Ideas, Tools and People. 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. Nevertheless, the combination of COV reports, project reports, award abstracts and notable accomplishments cover the entire NSF portfolio.

ADDITIONAL INFORMATION

Information On Use Of Non-Federal Parties

This GPRA performance report was 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.

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 AC reports that provide an independent external assessment of NSF's performance.

We engaged an independent third-party, IBM, to conduct a review of data and information used in performance reporting. IBM 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

Analysis of Tax Expenditures

None

Waivers of Administrative Requirements

None

IBM Performance Measurement Validation and Verification
FY 2005 Final Report
(Executive Summary)