NATIONAL SCIENCE FOUNDATION

FY 2008 Budget Request to Congress

February 5, 2007

On the cover: ***North Pole Midnight Sun.*** The sun skirts the horizon at the top of the world. In early springtime, the sun at the North Pole is on its way to its highest point in the sky, the period when it will not set for several weeks.

Cover image courtesy of Peter West, National Science Foundation

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FY 2008 BUDGET REQUEST TO CONGRESS

Budget Request

The National Science Foundation proposes a FY 2008 investment of $6.43 billion to advance the frontiers of research and education in science and engineering. The NSF FY 2008 Budget Request includes an increase of $408.79 million (6.8 percent) over the FY 2007 Budget Request. At this level, NSF will build on recent advances and support promising initiatives to strengthen the Nation's capacity for discovery and innovation.

The President's American Competitiveness Initiative (ACI) sets a bold challenge, calling for expanded federal investment to drive innovation and sharpen the Nation's competitive edge. To maintain the U.S. position at the forefront of discovery, learning, and innovation, the American Competitiveness Initiative commits to doubling investments over 10 years in NSF and other principal sources of federal support for the physical sciences and engineering. NSF's task in this ambitious undertaking is to uphold the leadership and excellence in fundamental research and education that keeps America at the leading edge of science, engineering, and technology.

To meet the challenges posed by the ACI, the new NSF Strategic Plan for FY 2006 to FY 2011 underscores the Foundation's role as a focal point in the Nation's innovation enterprise. The plan charts an ambitious course for the future, stressing investment opportunities that promise to stimulate innovation, contribute to economic growth, and provide exceptional returns on America's investment in frontier research and education.

The four strategic outcome goals established in the plan shape the overall investment strategy for this Request:

- Discovery – Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the Nation as a global leader in fundamental and transformational science and engineering.

- Learning – Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

- Research Infrastructure – Build the Nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure, and experimental tools.

- Stewardship – Support excellence in science and engineering research and education through a capable and responsive organization.

To implement these strategies in FY 2008, this Request addresses five priorities:

- Discovery Research for Innovation
- Preparing the Workforce of the 21st Century

- Transformational Facilities & Infrastructure
- International Polar Year Leadership
- Stewardship

Each priority targets investments in concrete scientific, engineering, and educational challenges of major significance to the Nation and the world. Rapid progress in these areas will generate new concepts and tools with far-reaching applications, lay the foundations for next-generation tools and technologies, and develop educational strategies to engage students and prepare them to excel in a fast-changing, global environment. The Request also reflects the Foundation's continued commitment to efficient and effective management of public resources.

NSF Funding by Account
(Dollars in Millions)

				Change over FY 2007 Request	
	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Amount	Percent
Research and Related Activities[1/]	$4,449.25	$4,765.95	$5,131.69	$365.74	7.7%
Education and Human Resources	700.26	716.22	750.60	34.38	4.8%
Major Research Equipment and Facilities Construction	233.81	240.45	244.74	4.29	1.8%
Agency Operations and Award Management	247.06	281.82	285.59	3.77	1.3%
National Science Board	3.94	3.91	4.03	0.12	3.1%
Office of Inspector General	11.47	11.86	12.35	0.49	4.1%
Total, NSF	$5,645.79	$6,020.21	$6,429.00	$408.79	6.8%

Totals may not add due to rounding.

[1/] In FY 2008, funding for EPSCoR is requested within the Research and Related Activities appropriation. Prior to FY 2008, EPSCoR was funded within the Education and Human Resources appropriation. EPSCoR is included here in Research and Related Activities for all years for comparability.

Why Frontier Research Matters

America faces new challenges in this era of global transformation and integration. Discovery and innovation – the forces driving U.S. economic growth and providing a steady stream of benefits to society – now take place in a dynamic, complex, and competitive international environment. Other nations are emulating the strategies that have sustained U.S. leadership in science, engineering, and education. Many nations are investing in frontier research and developing well-honed talent, fueling the lightning-quick pace of discovery and innovation worldwide, and driving fierce competition for knowledge and talent.

> *"America's economic strength and global leadership depend in large measure on our Nation's ability to generate and harness the latest in scientific and technological developments and to apply these developments to real world applications."*
>
> – American Competitiveness Initiative

At the same time, opportunities to make significant progress in meeting pressing national needs – in energy, health, security, and environment – and resolve longstanding dilemmas of global scope are now more plentiful than ever before. Thanks to past federal investments in research and education, the Nation

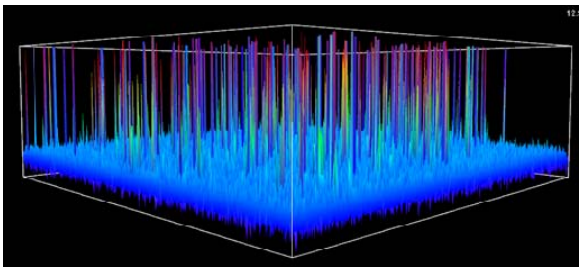
is well-equipped to tackle the most complex and challenging questions of our times. The result is that we stand poised on the threshold of a new era of exceptional scientific and technological promise.

As a leader in the global science and engineering enterprise, America has always been a valued partner in the global arena – maintaining excellence in research and education at home and attracting talent and investment from abroad. Changing global circumstances demand that we take vigorous steps to demonstrate our continued leadership, and to ensure that Americans reap not only the benefits we enjoy today, but also the revolutionary technologies of tomorrow that will lift the Nation and the world.

Research that Benefits the Nation

The ingenuity of America's researchers – and the relentless quest of business and industry for new concepts – puts American innovation to work rapidly, for the benefit of society and the economy. Today, valuable knowledge and marketable technologies are emerging at breathtaking speed. Just this past year, researchers funded by NSF reported significant results and launched new initiatives that will keep benefits flowing to the American people. Examples include:

► **Nanotechnology Powered by Your Body:** Medical devices implanted in the human body are normally battery operated. But a promising new approach may enable humans to tap into the body's own energy via a "nanogenerator." Developed by NSF-funded researchers at the Georgia Institute of Technology, nanogenerators convert mechanical energy into electrical energy from body movement, muscle stretching, or water flow into electrical energy. This technique could open up tremendous possibilities for self-powered, implantable biomedical devices, as well as wireless sensors, portable electronics, and other applications. The nanogenerators produce electricity by bending and then releasing zinc oxide nanowires. By creating interconnected groups of arrays containing millions of wires, researchers can potentially produce enough current to power nanoscale devices, eliminating the need for bulky power sources.



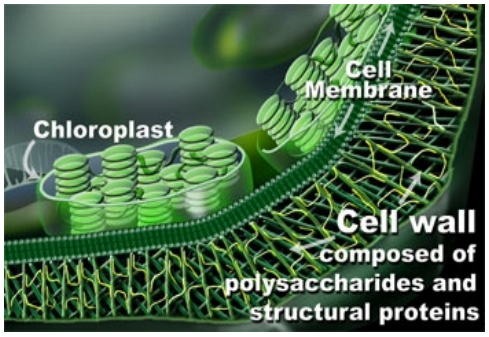
Output voltage (vertical scale) of a nano-wire array. Researchers are using nano-wire arrays to create nanogenerators to power implantable medical devices. *Credit: Z.L. Wang, Georgia Tech.*

The Bureau of Economic Analysis used NSF data to determine the impact of research and development on the economy. Research and development contributed 6.5 percent to U.S. economic growth between 1995 and 2002.

► **Research Adds to Economic Growth:** New calculations from the U.S. Bureau of Economic Analysis suggest research and development (R&D) accounted for a substantial share of the resurgence in U.S. economic growth in recent years. Using data from the NSF's annual surveys of government, academic, industry, and non-profit R&D expenditures, the bureau determined that R&D contributed 6.5 percent to economic growth between 1995 and 2002. NSF and agencies in many other nations collect extensive R&D expenditure data because R&D is vital to economic growth and social welfare and often results in unimagined benefits. The resources that organizations devote to R&D influence both economic growth and international competitiveness.

► **Untangling Traffic with Cell Phones:** Engineers have developed a system that takes anonymous cell-phone location information and turns it into an illuminated traffic map that identifies congestion in real time. The system takes advantage of the steady stream of positioning cues, untraced signals all cell phones produce whether in use or not, as they seek towers. It is the first traffic-solution technology that monitors patterns on rural roads and city streets as easily as on highways. Developed by IntelliOne of Atlanta, Ga., with a Small Business Innovation Research grant from NSF, the TrafficAid system could not only help guide drivers around tie-ups, but also tell emergency responders where accidents are or how effectively an evacuation is unfolding by pinpointing clusters of cell phones. Unlike sensors and other equipment along major freeways that are expensive and take years to deploy, this system takes advantage of existing cellular networks in which wireless carriers have already invested billions of dollars, according to NSF awardee and IntelliOne CEO Ron Herman.

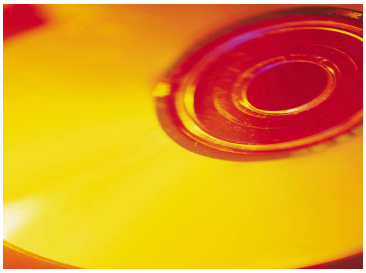
The IntelliOne Roadway Speed Measurement System uses cell phone signals to map roadway speeds for all highways and surface streets where mobile phone coverage exists. The blue dots represent a snapshot of all active mobile phones from a single carrier's network in Tampa, Fla. *Credit: IntelliOne Technologies Corporation.*



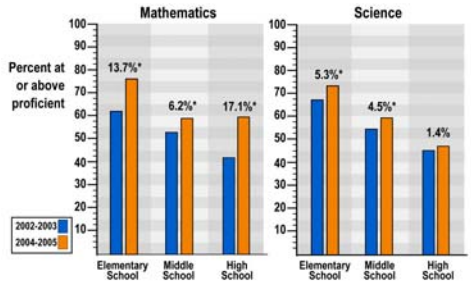
Researchers have recently identified plant genes responsible for the production of cell-wall carbohydrates. Cell walls are the protective sheaths that give plant cells shape and protect them from disease and dehydration. *Credit: Nicolle Rager Fuller, NSF.*

► **How Does Your Garden Grow?:** In a finding that could make it cheaper and easier to convert plant fibers into ethanol bio-fuels and other products, scientists have taken another step toward understanding how plants synthesize the fibrous carbohydrates that make up their cell walls. Cell-wall carbohydrates constitute a major source of dietary fiber and have numerous commercial applications. However, identifying the molecular machinery that plants use to make these critical components of their cell walls has been a major challenge – until now. With support from NSF's Plant Genome Research Program, Michigan State University scientists were able to study plant proteins in a background free of other competing plant enzymes and to identify genes critical to the production of cell wall carbohydrates. This insight brings scientists closer to developing plants that provide increased nutrition, cheaper food additives, and improved digestibility.

► **Biodegradable Plastics from Carbon Dioxide:** NSF-funded researchers from Texas A&M University have pioneered a method to accelerate the conversion of carbon dioxide (CO_2) gas into the biodegradable thermoplastics used in eyeglass lenses, shatterproof glass, baby bottles, CDs, and DVDs. Current methods for making thermoplastics generally require petroleum. However, researchers have pioneered a method to produce biodegradable plastic products using atmospheric CO_2 – a productive use for the greenhouse gas. Researchers are now working to develop effective non-toxic metal catalysts for producing another extremely useful plastic, polycarbonate, from CO_2 and other compounds. This plastic can be made into biodegradable rubber-like substances that have potential biomedical applications, such as surgical sutures, drug delivery devices, and body or dental implants.

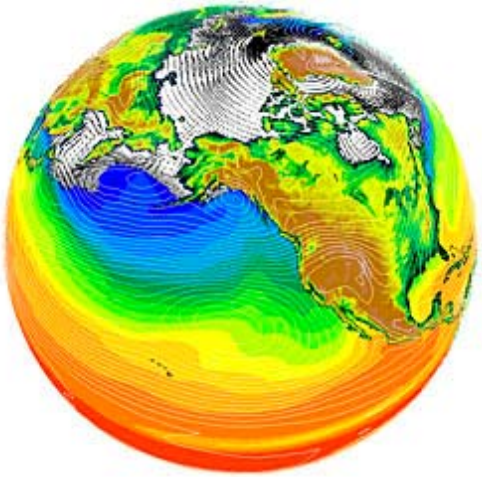


Researchers have pioneered a method to speed the up production of biodegradable plastic products manufactured using atmospheric CO_2, providing a productive use for the greenhouse gas. *Credit: Paul Spyropoulos, NSF.*



► **Math and Science Partnership Students Leap Ahead:** Elementary, middle- and high-school students participating in the NSF Math and Science Partnership (MSP) program continued to show improvement in mathematics and science proficiency over the three year time period from 2002-2003 to 2004-2005, according to an analysis of data gathered by NSF-funded researchers. Elementary students achieved the most dramatic increases in mathematics, where 7.2 percent more students achieved or exceeded proficiency from 2002-03 to 2003-04, followed by an increase of another 6.5 percent from 2003-04 to 2004-05. Students at all levels showed significant improvements in mathematics proficiency for the three-year period. Scores in science also showed gains from the first to third years at all grade spans. Over the three-year period, the MSP Program provided professional development opportunities to 30,000 K-12 teachers in 550 school districts nationwide. Projects in the current MSP portfolio are expected to impact more than 141,000 science and mathematics teachers and 4.2 million students over 550 local school districts.

► **Expanding the Computational Grid Frontier:** The Globus Toolkit – an open-source library of gridding middleware and software used to integrate geographically distributed computing systems – is the de facto standard for building grids, and Globus development is in part supported by NSF. IBM promotes Globus as its standard open source grid platform. Several prominent companies also rely on Globus-related applications, e.g., Intel for internal grids and Cisco for network management. The National Cancer Institute's $100-million Globus-based Cancer Bioinformatics Grid program engages companies at multiple levels. Globus' indirect impacts are also significant. Virtually every major computer vendor has a "grid product," and most of the Fortune 500 have a "grid strategy." All are influenced by the work on Globus even if they do not use Globus software directly.



Scientists in the Earth System Grid – who use Globus software for security, data movement, and system monitoring – are providing access to climate data. This image shows sea ice extent (white/gray), sea ice motion, sea surface temperatures (colors), and atmospheric sea level pressure (contours). *Credit: UCAR.*

Credit: Photos.com

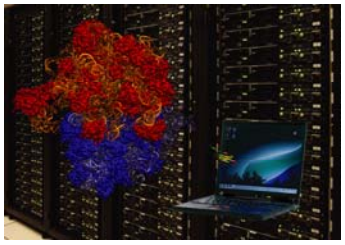
► **Using the Sun to Heat and Cool:** Researchers are developing a thin-film technology that adheres both solar cells and heat pumps onto surfaces, ultimately turning walls and windows into climate control systems -- and harvesting the sun's energy to both heat and cool. NSF-funded researchers at Rensselaer Polytechnic Institute have built a prototype Active Building Envelope system. Made of solar panels, thermo-electric heat pumps, and a storage device to provide energy on rainy days, the system silently cools and heats with no moving parts.

Investment Priorities

Discovery Research for Innovation

NSF works at the frontiers of knowledge where new ideas are born, nurtured, and in time bear fruit in economic and social returns. High-risk, high-reward research at the frontier can lay the foundation for revolutionary technologies, tackle extremely difficult challenges of enormous social and economic significance, and expand the transformational power of science, engineering, and education. To address priorities identified in the ACI and to promote research that will drive innovation, NSF will target programs in cyberinfrastructure, engineering, mathematics, and the computing and physical sciences, as well as programs that promise to have a substantial impact on quality of life. Some highlights of these investments follow.

Cyber-enabled Discovery and Innovation (CDI) **$52 million**



This Request includes an important new NSF-wide investment to broaden the Nation's capability for innovation by developing a new generation of computationally based discovery concepts and tools to deal with complex, data-rich, and interacting systems. The rapidly emerging world of peta-scale computers, massive data flows, and databases pose exceptional challenges that require capabilities well beyond those available today. Cyber-enabled Discovery and Innovation aims to explore radically new concepts, approaches, and tools at the intersection of computational and physical or biological worlds to address such challenges. New means of computational discovery will augment the traditional discovery-innovation loop with novel computational concepts to aid knowledge discovery, analysis, and experimentation. This will accelerate the discovery of knowledge buried in massive datasets, creation of models to understand complex phenomenon, and understanding of rare events. CDI includes five distinct themes: knowledge extraction, interacting elements, computational experimentation, virtual environments, and education for computational discovery.

National Nanotechnology Initiative **$390 million**

NSF is increasing its investment in the interagency National Nanotechnology Initiative by nearly $17 million in FY 2008. Increased funding amounts are requested for fundamental nanoscale research, development of nanomaterials, and for research directed at environmental, health, and safety impacts of nanotechnology development. This includes a new multidisciplinary focus on fundamental research on the environmental, health, and safety impacts of nanomaterials. This research will explore the interactions between particles and materials at the nanoscale and the living world with development of innovative methods of investigation and instrumentation an essential focus.

Ocean Research Priorities Plan **$17 million**

Understanding the interactions between society and the ocean is of vital importance for ensuring a clean, healthy, and stable ocean environment. The Ocean Research Priorities Plan (ORPP), developed by the Joint Subcommittee on Ocean Science and Technology of the National Science and Technology Council (NSTC), identifies significant research challenges needed to understand ocean dynamics, forecast ocean events, and manage ocean resources. This new investment of $17 million in FY 2008 will support research in four areas identified in the Plan as critical near-term priorities: the complex dynamics that control and regulate marine ecosystem processes; the variability of the Atlantic Meridional Overturning Circulation; the response of coastal ecosystems to extreme and abrupt events; and the development of new sensors to improve ocean observations. Research in these areas will provide the scientific foundation to improve society's stewardship and use of the ocean and ocean resources.

Cybersecurity Research and Development **$107 million**

Networked computers reside at the heart of systems on which people now rely, both in critical national infrastructures and in homes, cars, and offices. Today, many of these systems are far too vulnerable to cyber attacks. With a focus on activities that address threats to the Nation's critical infrastructure, NSF will increase its investment in cybersecurity research in FY 2008 by $10 million, In addition, the NSF Cyber Trust program will support research to make networked computer systems more predictable, more accountable, and less vulnerable to attack and abuse. Cyber Trust also includes educational programs to ensure that networked computer systems are developed, configured, operated, and evaluated by a well-trained and diverse workforce, and used by a public educated in their secure and ethical operation.

EPSCoR **$107 million**

NSF will increase support by $7 million for the Experimental Program to Stimulate Competitive Research (EPSCoR). EPSCoR investments provide strategic programs and opportunities for participants – jurisdictions and states that have historically received less federal R&D funding – to make sustainable improvements in research capacity and national research competitiveness. The EPSCoR program strengthens knowledge-based prosperity for participants and also contributes substantially to the Nation's overall ability to compete globally. Beginning in FY 2008, funding for the NSF EPSCoR program will be included in the Research and Related Activities account.

International Science and Engineering **$45 million**

NSF will continue to support the participation of U.S. scientists and engineers in international programs that are innovative and responsive to a broad range of NSF and national interests. The locus for these investments is the Office of International Science and Engineering, which increases nearly 11 percent in FY 2008 to a total of $45 million. These include opportunities for U.S. undergraduate and graduate students to engage in international activities, an increasingly important part of a student's training in this era of globalization. International partnerships, now an abiding feature of the global science and engineering enterprise, provide U.S. scientists and engineers with the opportunity to keep up-to-date on new concepts and technologies emerging

around the world, and provide the experience needed to operate effectively in teams comprised of partners from different nations and cultural backgrounds.

Preparing the Workforce of the 21st Century

Creating a strong science and engineering workforce for the future is vital to maintaining the Nation's competitive edge. NSF will continue to fund a broad spectrum of successful programs that contribute to this goal. CAREER is an NSF-wide program that supports outstanding junior faculty in all disciplines supported by the Foundation, and is often a vital link to establishing a successful academic research record. Efforts to train an efficient, effective, and agile IT workforce are also central in a number of NSF programs, such as Broadening Participation in Computing and Advanced Technological Education. In addition, NSF provides support for development of a world-class teaching corps through programs such as the Noyce Scholarship program. Other programs – including the STEM Talent Expansion Program (STEP) and the Centers for Research Excellence in Science and Technology (CREST) program – will strengthen efforts to promote innovation and develop a strong science and engineering workforce by broadening participation of underrepresented groups and types of institutions, two objectives of vital importance to maintaining America's global competitiveness.

NSF educational support will be closely coordinated with other agencies, consistent with the Academic Competitiveness Council (ACC). Working with the Department of Education and other agencies active in STEM education, NSF will continue to develop and apply rigorous evaluation criteria to our portfolio of education programs in order to ensure U.S. students receive the highest quality STEM education.

In coordination with the Department of Education, NSF will continue funding for the Math and Science Partnership program, aimed at improving K-12 science and math education and teaching. The budget request also includes funding for an additional 200 Graduate Research Fellowships (GRF), bringing the total number of GRFs supported to about 2,950.

Transformational Facilities and Infrastructure

NSF supports the conceptualization, design, and development of innovative facilities and instruments that provide vital momentum to advance the frontiers of discovery, including large-scale, broadly accessible facilities, mid-scale instruments, and cyberinfrastructure.

- For FY 2008, NSF proposes one new start in the Major Research Equipment and Facilities Construction account (MREFC): Advanced LIGO (AdvLIGO), a gravitational wave observatory that will improve by a factor of 10 the sensitivity of current earth-based facilities.
- In addition, NSF will raise the maximum level of funding within the Major Research Instrumentation (MRI) program from $2.0 million to $4.0 million to provide for the acquisition and development of mid-size instruments, such as e-beam lithography and nanofabrication tools, large-scale petawatt lasers, and spectroscopy instruments. Funding for the MRI program increases by $24.44 million in FY 2008, to a total of $114.44 million.
- NSF will continue support for the development of a petascale computing capability widely accessible to the science and engineering community. The development of cyberinfrastructure, which significantly augments computational and networking capabilities available to scientists and engineers in all disciplines, will remain a significant focus of NSF investment.

International Polar Year Leadership

Credit: Shawn Marshall

As the lead agency supporting Polar research, NSF will provide U.S. leadership for International Polar Year (IPY) activities through support for an intense research and public education effort among grantees, in coordination with other agencies, and in cooperation with other nations. NSF's Request for supporting these activities is nearly $59 million for FY 2008. A major focus for NSF IPY activities will be climate change research and environmental observations. Much of the research supported under IPY will support the goals of the U.S. Climate Change Science Program. Work will include observations, data analysis, models, and basic and social science research to strengthen our ability to understand and respond to global environmental issues. In most instances, U.S. scientists' efforts will be leveraged by the related efforts of international scientists. Another major focus will be research that explores how life adapts to and survives in the polar dark, with emphasis on the cellular and genomic levels but reaching to human impacts as well. A third focus of IPY will be maintaining existing standardized data sets, creating new scientific collections, and ensuring their availability to current and future generations of researchers. IPY offers a fine opportunity for outreach and education to raise public understanding of science and engineering, and NSF will continue to support such efforts.

Stewardship

NSF's FY 2006 - FY 2011 Strategic Plan defines the Stewardship strategic goal as the support of "excellence in science and engineering research and education through a capable and responsive organization." As a direct result of the strategic planning process, NSF has established eight new multi-year stewardship objectives, including strengthening our traditional partnerships and developing new collaborations with other agencies and organizations, expanding efforts to broaden participation from underrepresented groups and institutions in all NSF activities, and improving the transparency, consistency, and uniformity of the merit review process. A major objective in FY 2008 is establishing the Research.gov portal site, which will provide an updated suite of services aimed at the grantee community and share grants management solutions among research agencies as part of the Grants Management Line of Business.

NSF proposes to change the name of the *Salaries and Expenses* account to *Agency Operations and Award Management*. The proposed name is a straightforward description that reflects both the content of the activity and its overall purpose.

Interagency R&D Priorities

NSF plays a significant role in several interagency R&D priorities including the Networking and Information Technology R&D (NITRD) program, the National Nanotechnology Initiative (NNI), the U.S. Climate Change Science Program (CCSP) and Homeland Security.

INTERAGENCY R&D PRIORITIES
(Dollars in Millions)

	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Change over FY 2007 Request Amount	Change over FY 2007 Request Percent
National Nanotechnology Initiative	$359.71	$373.18	$389.90	$16.72	4.5%
Climate Change Science Program	196.88	205.25	208.25	3.00	1.5%
Networking and Information Technology R&D	811.53	903.74	993.69	89.95	10.0%
Homeland Security	342.10	385.91	375.36	-10.55	-2.7%

The Foundation will continue as a major participant in each of these areas in FY 2008, with increases for NNI, NITRD, and CCSP. The change for Homeland Security funding reflects the fact that FY 2007 included a one-time investment of $20 million for research relevant to the detection of explosives and related threats. Additional information on NITRD, NNI, and CCSP can be found in the NSF-wide Investments section. For Homeland Security, additional information is available in the Summary Tables and Charts section.

Delivering Results

NSF's FY 2008 Budget Request incorporates the Research and Development Investment Criteria outlined in the President's Management Agenda. The three sections below describe NSF's approach to ensuring that its investments address Relevance, Quality, and Performance. More specific information on the criteria is integrated throughout this document in discussions of investments by each of NSF's directorates and major program offices.

The nature of NSF's programming gives the agency an invaluable level of flexibility and agility. NSF has proven time and again that it can respond decisively and proactively to emerging opportunities and challenges. These qualities are especially valuable in maintaining a dynamic and productive portfolio in the current funding environment. With only five to six percent of the agency's budget spent on internal operations – the remaining supports other organizations working at the frontiers of learning and discovery – NSF also maintains a high level of efficiency.

Relevance: R&D programs must be able to articulate *why* this investment is important, relevant, and appropriate.

NSF is the only federal agency with a mandate to strengthen the health and vitality of U.S. science and engineering and support fundamental research and education in all scientific and engineering disciplines. NSF-sponsored activities result in new knowledge and technologies and educate a world-class workforce of scientists, engineers, mathematicians, educators, and other technically trained professionals.

Although NSF investments account for only four percent of total federal funding for research and development, the agency provides 45 percent of federal support to academic institutions for non-medical basic research. NSF investments are especially vital in non-medical fields and disciplines. For over two decades, NSF has been a principal source of federal support for basic research at colleges and universities

in such areas as computer science, mathematics, the physical sciences, the social sciences, the environmental sciences, engineering, and non-medical areas of the life sciences. Furthermore, while NSF does not directly support medical research, its investments benefit the medical sciences and related industries, leading to advances in diagnosis, regenerative medicine, drug delivery, and the design and processing of pharmaceuticals.

The NSF Strategic Plan for FY 2006-2011 acknowledges and responds to the changing context that is transforming science and education research and education today. Researchers operate in an increasingly complex environment, in which science and engineering cross the boundaries of disciplines, organizations, and nations. The frontier changes quickly, and discovery requires ever-more-sophisticated skills and methods, as well as technology and instrumentation. Global competition for technical workers and science and education professionals has intensified, and so have the skills expected in today's changing workplace. Leadership and excellence in discovery, innovation, and learning are the most effective means to meet and surpass these new challenges. The Plan establishes a framework for investment strategies for research and education that directly addresses these issues.

Quality: R&D programs must justify *how* funds will be allocated to ensure quality R&D.

NSF leads federal agencies in funding research and education activities based on competitive merit review, with over 88 percent of its research and education funding going to awards selected through a competitive merit review process. In FY 2006, the last year for which complete data exist, NSF awarded more than 10,400 new grants from over 42,300 competitive proposals.

All proposals for research and education projects are evaluated using two criteria: the *intellectual merit* of the proposed activity and its *broader impacts*, ranging from effects on teaching, training, and learning to improvements in cybersecurity. Reviewers also consider how well the proposed activity fosters the integration of research and education and broadens opportunities to include a diversity of participants, particularly from underrepresented groups.

Further, to ensure the highest quality in processing and recommending proposals for awards, NSF also convenes Committees of Visitors, composed of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments. In addition, NSF directorates also utilize Advisory Committees to offer recommendations on such issues as: the mission, programs, and goals that can best serve the scientific community; how to promote quality graduate and undergraduate education; and priority investment areas for NSF-funded research.

Perhaps the most dramatic indicator of the level of competition for NSF funding is the quality of the proposals that go unfunded every year. In FY 2006, for example, proposals totaling $1.8 billion were declined due to funding constraints even though they were rated as highly as the proposals that received funding. These declined proposals represent a rich portfolio of highly regarded yet unfunded opportunities to advance research and education.

Performance: R&D programs must be able to monitor and document *how well* the investment is performing.

Strategic investments intended to achieve long-term outcomes are the target of performance assessments at NSF. Specific measures of organizational effectiveness relate to the internal practices, operations, and processes that support the NSF mission. Historically, NSF has relied upon external committees of experts

to evaluate the long-term outcomes from research and education. This is appropriate given the broad scope of science and engineering covered by NSF, and the critical and extensive use of merit review for selecting new awards. Over the past several years, these external evaluations have provided integral information for the assessments conducted using the Program Assessment Rating Tool (PART).

External Evaluations. The NSF Advisory Committee for GPRA Performance Assessment (AC/GPA) leads the annual evaluation of NSF's performance. In FY 2006, the Advisory Committee for Business and Operations (AC/BO) assisted the AC/GPA in the evaluation of the Organizational Excellence goal. The AC/GPA summarized its findings as follows:

> Based on the extensive review of numerous materials provided by the NSF, **the Committee was unanimous in its conclusion that NSF has demonstrated significant achievement for all indicators in the Ideas, Tools, and People goals and as well as the indicators of the Organizational Excellence goal. There was also agreement that NSF has demonstrated quality and relevance on Ideas, Tools, and People. The Committee also found demonstrated quality in all indicators of the Organizational Excellence goal (the evaluation criterion "relevance" is not applicable to Organizational Excellence).**
>
> The NSF portfolio is deep and rich in IDEAS. From novel discoveries in the basic sciences and engineering to educational advancements across the STEM disciplines, the NSF has demonstrated continued commitment to its basic goals of pursuing the highest quality research, in novel and transformative ways, while broadening the participation in science and engineering of people from all parts of society. The R&D programs under the TOOLS performance indicator are important investments and appropriate and deemed to be of high quality. Many of the projects reviewed related to the PEOPLE performance indicators have high relevance to the development of a strong workforce and to public understanding of science. Projects were found to include goals and accomplishments considered to be bold and at the frontiers of science, engineering, and education. The ORGANIZATIONAL EXCELLENCE review found the merit review system to be highly effective, trusted, and respected by participants within the science community. The process is thorough and has well-designed contingencies for handling nonprocedural issues and allows for continuous improvement.

Program Assessment Rating Tool. The PART process has also become a central component of NSF's performance framework. Since its inception, only 15 percent of the PART programs evaluated across federal agencies received the highest rating of "Effective." All NSF programs have been evaluated over the past several years, and each one has received the highest rating of effective. NSF is now exploring the appropriate PART framework for advancing the goals and priorities of the new Strategic Plan.

FY 2008 Budget Request by Strategic Goal

NSF invests in a rich mix of programs, platforms, and partnerships developed by the research and education community. Funding levels for these programs and activities in the FY 2008 Budget Request link directly with the Strategic Outcome Goals established in the NSF Strategic Plan for FY 2006-2011. These four interrelated strategic outcome goals – Discovery, Learning, Research Infrastructure, and Stewardship – establish an integrated strategy to deliver new knowledge at the frontiers, meet vital national needs, and work to achieve the NSF vision. Although these goals are similar to the previous Strategic Plan's goals of Ideas, People, Tools, and Organizational Excellence, the first three are aligned

directly with the three strategic priorities recently established in the *National Science Board 2020 Vision for the National Science Foundation*, while the fourth acknowledges NSF's responsibilities as a steward of the taxpayer's investment in science and engineering.

NSF Budget by Strategic Outcome Goal

(Dollars in Millions)

	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Change over FY 2007 Request Amount	Change over FY 2007 Request Percent
Discovery	$2,942.82	$3,086.93	$3,312.96	$226.03	7.3%
Learning	878.99	898.51	938.22	39.71	4.4%
Research Infrastructure	1,508.17	1,685.24	1,813.99	128.75	7.6%
Stewardship	315.82	349.53	363.83	14.30	4.1%
Total, NSF	**$5,645.79**	**$6,020.21**	**$6,429.00**	**$408.79**	**6.8%**

Totals may not add due to rounding.