Enclosure 1

NSF GPRA Strategic Plan
FY 2001 – 2006

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National Science Foundation
Where Discovery Begins

GPRA Strategic Plan FY 2001 – 2006

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About the NSF

Created in 1950, NSF is an independent U.S. government agency responsible for advancing science and engineering in the United States across a broad and expanding frontier. Operating no laboratories itself, NSF makes merit-based grants and cooperative agreements and provides other forms of support to educators and researchers in all fifty states and in the U.S. territories.

NSF supports education and training at all levels, from pre-kindergarten through career development; promotes public understanding of science, mathematics, engineering, and technology; and helps ensure that the United States has world-class scientists, mathematicians and engineers. Together with NSF's support for leading edge research, its educational activities are critical to sustaining the Nation's economic strength and ensuring the well being of all Americans in the 21st century.

NSF invests in the best ideas from the most capable people, determined by competitive merit review. NSF evaluates proposals for research and education projects using two criteria: the intellectual merit of the proposed activity and the broader impacts of the activity on society.

Competition for NSF support is intense. Each year, NSF receives about 30,000 proposals for research and education projects and about one-third of them are funded. Awards typically go to universities, colleges, academic consortia, nonprofit institutions, and small businesses. NSF also supports collaborative projects between universities and industry and U.S. participation in international cooperative research and education efforts.

Numerous advisors from the science and engineering community assist NSF staff members in identifying areas of promise with maximum opportunity for breakthroughs. Reliance on the science and engineering research and education community enables NSF to be both intellectually decisive and cost-efficient.

The National Science Foundation is governed by the National Science Board (NSB). The Board is composed of 24 part-time members, appointed by the President and confirmed by the Senate. The NSF Director serves on the Board, ex officio. The Board has dual responsibilities: as a national science policy advisor to the President and the Congress, and as the governing body for NSF.

NSF's Role

NSF provides the funding that sustains many research fields as advances in these fields expand the boundaries of knowledge. Equally important, the agency provides seed capital to catalyze emerging opportunities in research and education. It supports a portfolio of investments that reflects the interdependence among fields, promoting disciplinary strength while embracing interdisciplinary activities. Its investments promote the emergence of new disciplines, fields, and technologies.

Academic institutions, working in partnership with the public and private sectors, are crucibles for expanding the frontiers of science and engineering knowledge, and educating the next generation of scientists and engineers. Consequently, NSF plays a critical role in supporting fundamental research and education at colleges and universities throughout the country.

NSF does not operate laboratories, but instead brings together diverse elements of the larger science and engineering community to achieve our mission. This places the agency in a unique position to provide leadership, working with its partners to chart new paths for research and education. In this leadership role, NSF fosters strategic collaborations with key national and international counterparts that address global science and engineering priorities and promote the betterment of humankind.

NSF coordinates agency plans with the activities of other Federal agencies, creating partnerships when there are shared interests and taking complementary approaches where appropriate. Senior managers at NSF and other agencies maintain the close connections that provide a productive framework for program-level coordination and permit formal cooperation among agencies.

Given the extraordinary importance of science and technology at the dawn of the 21st century, there is a growing need for timely, accurate, relevant information on the status of the domestic and foreign science and engineering enterprise that informs science policy and priority setting.

The National Science Board has been responsible, by law, for developing on a biennial basis a report "…on indicators of the state of science and engineering in the United States." This report, which the Board submits to the President for transmission to Congress, provides not only a domestic perspective, but international comparisons as well. It serves as a basis for decision-making on major policy issues related to science and engineering.

I. Introduction

The Government Performance and Results Act of 1993 (GPRA) provides a mandate to Federal agencies to account for program results through the integration of strategic planning, budgeting, and performance measurement.

According to GPRA, each agency must prepare a strategic plan that addresses its mission and major functions over a six-year period (the current fiscal year and five years into the future). Agencies are required to update their strategic plans every three years for submission to the Office of Management and Budget (OMB) and the Congress.

The *NSF GPRA Strategic Plan FY 2001-2006* integrates previous strategic planning activities that resulted in 1995's *NSF in a Changing World*, the 1997 GPRA Strategic Plan, and the *National Science Board (NSB) Strategic Plan*, 1998. In integrating those plans, NSF seeks to clearly communicate our vision, ideals, and “corporate personality,” and to provide a framework for the future. This framework is informed by NSF's mission, as set out by Congress in the National Science Foundation Act of 1950, and by the Foundation's unique role as the only federal agency charged with strengthening the overall health of U.S. science and engineering across a broad and expanding frontier.

The plan emphasizes outcome goals for NSF’s investments in people, ideas and tools, and describes the three core strategies -- developing intellectual capital, integrating research and education, and promoting partnerships -- that, together with our core values, guide NSF in pursuing these goals. The plan also sets forth NSF’s implementation strategy, and introduces four emerging areas that will benefit from increased attention in the next several years -- information technology research, biocomplexity in the environment, twenty-first century workforce, and nanoscale science and engineering.

In developing this strategic plan, NSF efforts were greatly enhanced by the science and engineering community and others, such as the Office of Management and Budget and the various congressional committees, who are concerned about the vitality of U.S. science and engineering. Their input is reflected throughout this document.

II. NSF's Vision and Mission

VISION

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

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

MISSION

NSF's mission, set out in the NSF Act of 1950 (Public Law 810507) is:

To promote the progress of science; to advance the National health, prosperity, and welfare; to secure the National defense; and for other purposes.

The Act authorizes and directs NSF to initiate and support:

- Basic scientific research and research fundamental to the engineering process,
- Programs to strengthen scientific and engineering research potential,
- Science and engineering education programs at all levels and in all fields of science and engineering, and
- An information base on science and engineering appropriate for development of national and international policy.

The NSF Act conferred on the presidentially appointed National Science Board the responsibility for establishing the policies of the Foundation and serving as its governing board. The Act also directs the Board to advise the President and Congress to assure the productivity and excellence of the Nation's science and engineering enterprise.

Over time, the following additional responsibilities were added to the agency's mission: (1) foster the interchange of scientific and engineering information nationally and internationally; (2) support the development of computer and other methodologies; (3) maintain facilities in the Antarctic and promote the US presence through research conducted there, and (4) address issues of equal opportunity in science and engineering.

III. NSF's Outcome Goals: *Investing in today's promise for tomorrow's achievement*

In pursuit of its historic mission, NSF invests in:

- PEOPLE to develop a diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens. This goal supports the parts of NSF's mission that are directed at (1) programs to strengthen scientific and engineering research potential; and (2) science and engineering education programs at all levels and in all fields of science and engineering.

- IDEAS to provide a deep and broad fundamental science and engineering knowledge base. These goal supports the parts of NSF's mission directed at basic scientific research and research fundamental to the engineering process.

- TOOLS to provide widely accessible, state-of-the-art science and engineering infrastructure. This goal supports the parts of NSF's mission directed at (1)) programs to strengthen scientific and engineering research potential; and (2) an information base on science and engineering appropriate for development of national and international policy.

Issues of equal opportunity in science and engineering are addressed by all three of the outcome goals.

In Appendix 5, *Resource Utilization*, NSF's FY 2001 budget request is distributed across the three outcome goals and Administration and Management (A&M), with a total request of $4.572 billion.

In Appendix 7: *Crosswalk of NSF Goals and Programs,* all NSF programs are classified according to the outcome goal on which they are primarily focused. However, is should be noted that there is considerable synergy among the goals.

For example, a grant supporting materials research at a university may focus on producing new knowledge (Ideas) but also may help train the next generation of scientists and engineers (People), and provide new research equipment (Tools). The ability of NSF-supported projects to simultaneously address multiple outcome goals increases the effectiveness and productivity of NSF's investments.

A. PEOPLE: A diverse, internationally competitive and globally-engaged workforce of scientists, engineers and well-prepared citizens.

> *NSF Statutory Authority:*
>
> *"The Foundation is authorized and directed to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels . . ." (NSF Act of 1950)*
>
> *"The Foundation is authorized to support activities designed to . . encourage women to consider and prepare for careers in science and engineering. . " (Science & Engineering Equal Opportunities Act; 42USC 1885)*
>
> *"The Foundation is authorized to undertake and support a comprehensive science and engineering education program to increase the participation of minorities in science and engineering . . ." (Science & Engineering Equal Opportunities Act; 42USC 1885)*
>
> *"The Foundation is authorized to undertake and support programs and activities to encourage the participation of persons with disabilities in the science and engineering professions." (Science & Engineering Equal Opportunities Act; 42USC 1885)*

NSF is committed to ensuring that the United States has world-class scientists and engineers, a national workforce that is scientifically, technically and mathematically strong, and a citizenry that understands and can take full advantage of basic concepts of science, mathematics, engineering, and technology.

Every dollar NSF spends is an investment in people. The agency supports nearly 200,000 people – teachers, students, researchers, postdoctoral researchers, and many others. NSF supports formal and informal science, mathematics, engineering, and technology (SMET) education at all levels.

NSF employs three core strategies that guide the entire agency in establishing priorities, identifying opportunities, and designing new programs and activities: (1) Develop Intellectual Capital; (2) Integrate Research and Education; and (3) Promote Partnerships. (These strategies are more fully described in Section IV.) Each of these strategies is critical to accomplishing the People goal. In addition, there are implementation strategies that are specific to this goal:

- Use all aspects of NSF activity to enhance diversity in the science and engineering workforce, with particular attention to the development of people who are beginning careers in science and engineering.

- Invigorate research-informed, standards-based SMET education at all levels through partnerships that draw deeply from the research and education community, Federal, state, and local education agencies, civic groups, business and industry, and parents.

- Increase the Nation's capacity to educate teachers and faculty in SMET areas and provide them with career-long professional development.

- Foster innovative research on learning, teaching, and organizational effectiveness, with special interest in determining the most effective use of information and computer technologies.

- Further the engagement of the U.S. scientific and engineering community in the global community by providing opportunities for international study, collaborations and partnerships.

- Promote greater public understanding of science, mathematics, and technology, and build bridges between formal and informal science education.

The following long-term outcomes of the People Goal provide the basis for development of more specific and time-dependent annual performance goals:

- Improved mathematics, science and technology understanding and skills for U.S. students at the K-12 level and for all citizens of all ages, so that they can be competitive in a technological society.

- A science and technology workforce that draws on the strengths of America's diversity and has global career perspectives and opportunities.

- Globally-engaged science and engineering professionals who are among the best in the world.

- A public that understands the processes and benefits that accrue from science and engineering.

Appendix 1 describes the critical factors for success that are identified for the outcome goals. In particular, Factor 1, *operating a credible, efficient merit review system*, is critical because it is at the very heart of NSF's selection of the projects through which its outcome goals are achieved. Factor 2*, maintaining a diverse, capable, motivated staff that operates with efficiency and integrity* is also critically important because it is the program staff that makes the final selection of projects to be supported, and then monitors performance.

Appendix 2 describes the external factors that must be considered in developing goal achievement strategies. With regard to the People Goal, characteristics of the workforce of scientists and engineers are highly dependent on the systems through which they are educated and trained. NSF programs influence educational systems and the public that supports them, but are only one influence among many factors.

As described in Appendix 3, *Assessing NSF Performance*, NSF performance is successful if the outcomes of NSF investments for a given period of time are judged to have achieved or to have made significant progress in achieving the specific performance goals. These assessments are made by independent external panels of experts, who use their collective experienced-based norms in determining the level of "significance" necessary for a rating of successful.

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

NSF Statutory Authority:

"The Foundation is authorized and directed to initiate and support basic scientific research and ... research fundamental to the engineering process . . ." (NSF Act of 1950)

". . . The Foundation is authorized to initiate and support specific scientific and engineering activities in connection with matters relating to scientific and engineering applications upon society. . ." (NSF Act of 1950)

Investments aimed at discovery fund cutting edge research projects proposed by individuals and groups of scientists and engineers. Because no one can predict every discovery or anticipate all of the opportunities that fresh discoveries will produce, NSF's portfolio must be large and diverse, addressing many fields and activities, ranging from single investigator grants to small groups of investigators to large multi-purpose research centers.

NSF-funded research projects also provide a rich foundation for broad and useful applications of knowledge and the development of new technologies. NSF is committed to fostering connections between discoveries and their use in the service to society. A key strategy for accomplishing this is by promoting partnerships at all levels.

As described in Section IV, NSF employs three core strategies that guide the entire agency in establishing priorities, identifying opportunities, and designing new programs and activities. Each of these strategies is critical to accomplishing the Ideas goal.

In addition, there are some implementation strategies that are specific to this goal. NSF will:

- Support the most promising ideas as selected through merit review of competitive proposals.

- Take informed risks when scientific consensus is lacking or just beginning to form.

- Identify and provide long-term support for new and emerging opportunities within and across all fields of science and engineering.

- Encourage cooperative research and education efforts – among disciplines and organizations, where partners work at different locations, in different sectors, or across international boundaries.

- Foster connections between discoveries and their use in the service of society.

The following long-term outcomes for the Ideas goal provide the basis for development of more specific and time-dependent annual performance goals:

- A robust and growing fundamental knowledge base that enhances progress in all science and engineering areas.

- Discoveries that advance the frontiers of science, engineering, and technology.

- Partnerships connecting discovery to innovation, learning, and societal advancement.

- Research and education processes that are synergistic.

Appendix 1 describes the critical factors for success that are identified for the outcome goals

Appendix 2 describes the external factors that should be considered in developing goal achievement strategies. The work that results in the achievement of the IDEAS outcome goals is performed largely outside the agency; thus, external factors have a significant impact on NSF's performance. In general, these factors result from changes (social, political, physical, etc.) in the environment for the conduct of research and education activities in the federal sector, the private sector, and in academe. They stem largely from the fact that NSF does not conduct the research and education activities directly and, therefore, influences outcomes rather than controls them.

As described in Appendix 3, *Assessing NSF Performance*, NSF performance is successful if the outcomes of NSF investments for a given period of time are judged to have achieved or to have made significant progress in achieving the specific performance goals. These assessments are made by independent external panels of experts, who use their collective experienced-based norms in determining the level of “significance” necessary for a rating of successful.

C. **TOOLS:** Broadly accessible, state-of-the-art and shared research and education tools

NSF Statutory Authority

"The Foundation is authorized and directed to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels . . ." (NSF Act of 1950)

"The Foundation is authorized and directed 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; . . ." (NSF Act of 1950)

NSF investments provide state-of-the art tools for research and education, such as instrumentation and equipment, multi-user facilities, accelerators, telescopes, research vessels and aircraft, and earthquake simulators. In addition, investments in Internet-based and distributed user facilities, advanced computing resources, research networks, digital libraries, and large databases are increasing, as a result of rapid advances in computer, information, and communication technologies. NSF's investments are coordinated with those of other organizations, agencies and countries to provide complementarity and integration.

As described in Section IV, NSF employs three core strategies that guide the entire agency in establishing priorities, identifying opportunities, and designing new programs and activities. Each of these strategies is critical to accomplishing the Tools goal. In addition, there are some implementation strategies that are specific to this goal:

- Stimulate and support the development, modernization, maintenance, operation and dissemination of next-generation instrumentation, multi-user facilities, databases, and other shared research and education platforms;

- Upgrade the computation and computing infrastructures for all fields of science, engineering, and education that NSF supports; and

- Provide information on the status of the domestic and foreign science and engineering enterprise to inform science policy and priority setting, and help identify current and emerging opportunities and needs in science and engineering.

The following long-term outcomes for the Tools goal provide the basis for development of more specific and time-dependent annual performance goals:

- Shared-use platforms, facilities, instruments, and databases that enable discovery and enhance the productivity and effectiveness of the science and engineering workforce.

- Networking and connectivity that take full advantage of the Internet and make science and technology information available to all citizens.

- Information and policy analyses that contribute to the effective use of science and engineering resources.

Appendix 1 describes the critical factors for success that are identified for the outcome goals.

Appendix 2 describes the external factors that must be considered in developing goal achievement strategies. For example, NSF relies on the academic research facilities and platforms available at colleges and universities across the country to provide a base upon which grantees can build their research programs. Although NSF support enhances this infrastructure, it does not control its current condition and quality. Failing to maintain a state-of-the-art research infrastructure will slow the pace of discovery and limit the research options available to researchers.

As described in Appendix 3, *Assessing NSF Performance*, NSF performance is successful if the outcomes of NSF investments for a given period of time are judged to have achieved or to have made significant progress in achieving the specific performance goals. These assessments are made by independent external panels of experts, who use their collective experienced-based norms in determining the level of "significance" necessary for a rating of successful.

IV. Strategy

A. Core Strategies

NSF employs the following three *core strategies* that guide the entire agency in establishing priorities, identifying opportunities, and designing new programs and activities. They cut across all NSF programs and activities, and each is critical to accomplishing NSF's three outcome goals.

(1) Develop Intellectual Capital

NSF invests in projects that enhance individual and collective capacity to perform, i.e. to discover, learn, create, identify problems and formulate solutions. It seeks investments that tap into the potential evident in previously underutilized groups of the Nation's human resource pool.

(2) Integrate Research and Education

NSF invests in activities that integrate research and education, and that develop reward systems that support teaching, mentoring and outreach. Effective integration of research and education at all levels infuses learning with the excitement of discovery. Joining together research and education also assures that the findings and methods of research are quickly and effectively communicated in a broader context and to a larger audience.

(3) Promote Partnerships

Collaboration and partnerships between disciplines and institutions and among academe, industry and government enable the movement of people, ideas and tools throughout the public and private sectors. Furthermore, these partnerships optimize the impact of people, ideas and tools on the economy and on society.

International partnerships are vital to achieving NSF's goals. The very nature of the science and engineering enterprise is global, often requiring access to geographically dispersed materials, phenomena, and expertise. It also requires open and timely communication, sharing, and validation of findings.

B. Five-year Strategies

NSF's mission cannot be accomplished without the U.S. science and engineering community providing significant intellectual leadership in critical, emerging and newly developing fields of research and education. The following five-year strategies help NSF to identify opportunities and make the investments that foster intellectual leadership within science and engineering community. These strategies cut across NSF programs and activities and are critical to accomplishing NSF's three outcome goals.

(1) Support competitive investigator-initiated research along a broad and expanding frontier of science and engineering.

Because no one can predict every discovery or anticipate all of the opportunities that fresh discoveries will produce, NSF's portfolio must be large and diverse, addressing many fields and activities, ranging from single investigator grants to small groups of investigators to large multi-purpose research centers. Over one half of NSF's research budget supports unsolicited, investigator-initiated research proposals. These proposals are supported in expectation that their results will broadly contribute to advances and seed new concepts and opportunities.

This element of NSF's strategy is primarily aimed at progress toward the Ideas goal. Our support of competitive investigator-initiated research opens the door for discovery. However such activities contribute to NSF's goals for People and Tools as well, by providing venues for students and postdoctoral researchers to participate and also settings for the development and innovative use of tools.

The escalating complexity of science and engineering is moving research toward a collaborative mode with greater focus on intellectual integration. NSF grants must be of sufficient size and duration to enable this collaboration and permit complex issues to be addressed. In addition, writing and reviewing proposals takes valuable time that researchers and educators could better spend in carrying their agendas forward. Larger, longer-term grants will increase productivity by minimizing the time they must spend writing proposals and managing administrative tasks.

Increasing the average size of research grants to an enabling level of at least $150,000 will greatly enchance the effectiveness and efficiency of researchers. Likewise, increasing the duration of grants from a minimum of three years to four years will facilitate collaborations and provide added stability to the support of graduate students through completion of their graduate activities. Reaching these target levels will require both judicious uses of existing resources and additional new resources.

(2) Identify and support "unmet opportunities" that strengthen and cross-fertilize the S&E disciplines and promise significant future payoffs for the Nation.

NSF's commitment to funding basic research assures the Nation a deep reservoir of knowledge and provides flexibility and choices for identifying and addressing future opportunities. Working with broad segments of the research and education community, we identify unmet opportunities that arise in the disciplines we support. These are areas where activity in the community already exists, usually with modest support from the agency. In these areas, the people and tools are available to do the work, but a greater NSF investment now will have a very large future payoff for the Nation

As a case in point, the mathematical sciences increasingly underpin and enable advances in all areas of science, engineering, and technology. Mathematics is most effective when it brings to bear varied approaches – discrete, continuous, geometric, analytic, algebraic, probabilistic, and statistical – that reflect its multifaceted character. For example, mathematics expands the impact of digitalization afforded by powerful computational tools, increasing the ability to analyze massive data collections, increasing the richness of simulation models, and providing powerful new ways to handle probability and uncertainty issues.

A multi-year investment by NSF will advance: (1) mathematics and statistics in partnership with science and engineering across a broad spectrum of research; (2) information technology based on the study of massive graphs, random graphs, combinatorial optimization, coding theory and cryptology, and discrete and computational geometry; (3) mathematical biology, building on preliminary successes in simulation of organ functions, mathematical ecology, and neuroscience; (4) nanoscale science and engineering by modeling, simulation, and control of molecular processes; and (5) the education and training of a mathematically literate workforce to meet future challenges.

Similar opportunities exist throughout every field of science and engineering. Discoveries in physical science, for example, have created unprecedented opportunities to understand the origins of our universe and the role of quantum mechanics in the development of new chemical and materials systems. These discoveries also promise opportunities in laser science, computing, and medical instrumentation. Molecular science studies are also leading to important new ideas about environmentally benign processes and more efficient energy generation that should be developed more quickly and more deeply.

It is now possible to study an enormous spectrum of the earth's dynamic processes. New knowledge and technological innovations, such as satellite communications, electronic connectivity, remote sensing and autonomous instruments, are also opening up new windows to the most remote regions on earth, enabling studies of the origin of the universe from the South Pole, the formation of earth's crust beneath the Arctic ice cap, and the evolution of biological species in extreme and isolated environments.

Additional investments may revolutionize our ability to understand and predict nonlinear geophysical systems, such as climate changes and their impacts on the environment, and natural disasters, such as earthquakes and floods.

The convergence of biotechnology and information technology is revolutionizing the biological sciences and their impacts on society. For example, sequencing the genomes of selected organisms, including plant-associated microbes, plant pathogens, and plant-associated insect pests, will provide insights into fundamental biological processes.

Research in the psychological, cognitive, neural, and language sciences will help provide a sharper picture of how human language is acquired and how it is used, both for thought and communication. This will lay the foundation for progress in many areas of national importance, from teaching children how to read and understanding learning processes in science and mathematics to building computers that can talk.

New developments in information technology also provide unprecedented opportunities for social and behavioral researchers to collect, access, and analyze the huge amounts of data necessary to reliably and validly inform policy makers about the complex processes by which we live, learn, and work. Improved efficiency and performance will be gained through an investment in shared infrastructure of web-based databases, research tools, archives, and collaboratories.

Bringing our understanding of learning processes together with advances in information technology creates new opportunities for education, both formal and informal. Such research should stimulate the design of new curricula that integrate technology and learning, contributing to an educational environment in which a high level of competence in information technology would be a natural consequence of all course work.

In the future, additional opportunities will be identified and discussed in NSF's strategic and performance plans.

(3) Emphasize several "transcendent" areas of emerging opportunity that enable research and education across a broad frontier of science and engineering.

As NSF and other agencies invest broadly in science and engineering opportunities, a few breakthroughs emerge that are revolutionary and encompassing. As these breakthroughs coalesce and merge with other ideas and technologies, they promise to reshape science and engineering, and change the way we think and live.

NSF works with other government agencies and with National Science and Technology Council (NSTC) to identify and support these areas. This interagency process allows agencies to create a comprehensive program of complementary activities. The goal is to accelerate scientific and technical progress by identifying gaps in knowledge and barriers that prevent progress, and developing methods of addressing gaps and overcoming barriers. This activity means more than a redistribution of dollars - - more money alone does not necessarily accelerate progress or solve problems. Recruiting new talent, inviting scientists in allied fields to "look across the fence," training new investigators to work in new areas will produce better results.

NSF has selected the following areas for increased attention during the next several years.

Information Technology

Sustained U.S. leadership in information technology requires an aggressive Federal program to create new knowledge in a variety of areas. The U.S. economy's robust growth is in part due to new ideas that become the basis for new products. For example, NSF contributed greatly to the development of today's Internet. NSF's investments – in People, Ideas and Tools– have benefited greatly from the application of information technology. So, NSF itself has a strongly vested interest in furthering research in information technology as rapidly and as effectively as possible.

NSF faces two major challenges and opportunities with respect to information technology. One is to support the people, ideas and tools that will create and advance knowledge in all areas of information science and engineering. This includes the creation of wholly new computation approaches to problems arising from the science and engineering disciplines, and the development of new learning technologies for use in education.

The second challenge is to support upgrading the computational and computing infrastructures for all fields that NSF supports. Researchers and educators in many areas need to incorporate information technology and, in some cases, revolutionize their experimental and collaborative processes to attain new effectiveness and greater efficiency. Finally, the United States must address a range of access and workforce issues. The digital divide won't disappear on its own. Overcoming inequity will require innovative educational technologies, such as highly interactive computer science courseware that is multicultural and multimedia.

NSF is the lead agency for a multi-agency, five-year research initiative in information technology. Each agency participating in the initiative will define specific programs in keeping with that agency's mission. NSF is primarily responsible for basic research to advance knowledge, and for education and workforce development activities. The multi-year Information Technology Initiative investment by NSF will lead to the following outcomes:

- Advancement of fundamental knowledge in techniques for computation; the representation of information; the manipulation and visualization of information; and the transmission and communication of information.

- Enhanced knowledge about how to design, build, and maintain large, complex software systems that are reliable, predictable, secure, and scalable.

- New knowledge about distributed and networked systems, and interactions among component parts, as well as systems' interaction with both individuals and cooperating groups of users.

- Development of a significantly advanced high-end computing capability needed to solve myriad important science and engineering problems.

- Increased understanding of the societal, ethical, and workforce implications of the information revolution.

- A strong information technology workforce and a citizenry capable of using information technology effectively.

Biocomplexity in the Environment

The environment is a subject of profound national and international importance, as well as scientific interest; hence, it is a strategic priority for the Foundation. In fact, the significance of environmental study was recently affirmed by the National Science Board in its report *Environmental Science and Engineering for the 21st Century: The Role of the National Science Foundation* (NSB 00-22).

The goals of NSF's increasing investment in this area are to enhance environmental research in all relevant disciplines including interdisciplinary and long-term research, create educational opportunities that enhance scientific and technological capacity, enable an increased portfolio of scientific assessments, and support enhanced physical, technological and information infrastructure.

As an initial step, NSF has begun intensive study of biocomplexity in the environment. Biocomplexity refers to phenomena that result from dynamic interactions among biological, physical and social components of the Earth's diverse systems.

Studying biocomplexity will provide a more complete understanding of natural processes, the effects of human actions on the natural world, and ways to use new technology effectively. A strategic multi-year investment by NSF will lead to the following outcomes:

- More comprehensive understanding of environmental systems including the processes that mediate energy and material flows among systems over space and time; the relationship among genetic information, biodiversity and the functioning of ecosystems; and the social and economic factors affecting the environment.

- Development of new theories, mathematical methods, and computational strategies for modeling complex systems. This may improve the capability to forecast environmental changes and their impacts including long-term climatic change, earthquakes, floods, land-use changes, the ecology of infectious diseases, and introductions of non-native species.

- Development of advanced technologies and approaches including functional genomics and other genetic and nano/molecular level capabilities.

- Utilization of biocomplexity-inspired design strategies for discovery of new materials, measurement technologies and sensors, process engineering and other technologies, especially those that are environmentally beneficial.

- Improved platforms for research such as networked observational systems, physical and digital natural history collections, and digital libraries.

Twenty-First Century Workforce

U.S. leadership in the concept-based, innovation-led global economy of the next century will depend on success in building and sustaining a competent and diverse scientific, mathematics, engineering, and technology (SMET) workforce, drawing on all elements of the Nation's rich human resources.

The SMET education continuum reaches from pre-kindergarten through elementary and secondary to undergraduate, graduate, and continuing professional education. The level, quality, and accessibility of SMET education depend upon 1) understanding the nature of learning, 2) strategically enabling an improved, science- and technology-based educational enterprise, and 3) building an infrastructure to broaden participation of all members of our society.

Across the Foundation, organizations will provide disciplinary and interdisciplinary support for educational linkages to the research community and new tools and models for K-12, undergraduate, and graduate education. These activities recognize the importance of the SMET content of educational programs for K-12 students and for the instructional workforce.

A National Digital Library for SMET Education will provide ready access to the highest quality educational materials, pedagogy, and research on learning, and enhance the quality of graduate, undergraduate, K-12, and public science education.

The outcomes of NSF's sustained investment in research, education, training and human resource programs will be:

- Enhanced knowledge about how humans learn;
- Enhanced practices throughout the SMET educational enterprise, especially at the K-12 level, leading to improved teacher performance and student achievement; and
- A more inclusive and globally engaged SMET enterprise that fully reflects the strength of America's diverse population.

Nanoscale Science and Engineering

Nanoscale science and engineering is likely to yield several prominent technologies for the 21^{st} century. Control of matter at the nanoscale underpins innovation in critical areas from information and medicine to manufacturing and the environment.

One nanometer (one billionth of a meter) is a magical point on the dimensional scale. Nanostructures are at the confluence of the smallest of human-made devices and the large molecules of living systems. Biological cells, like red blood cells, have diameters in the range of thousands of nanometers. Micro-electrical mechanical systems are now approaching this same scale. This means we are now at the point of connecting machines to individual cells.

Nanoscale science and engineering is the NSF contribution to the interagency National Nanotechnology Initiative (NNI). A multi-year investment by NSF will lead to the following outcomes:

- Discovery of novel phenomena, processes and tools.

- Enhanced methods for the synthesis and processing of engineered, nanometer-scale building blocks for materials and system components,

- New device concepts and system architecture appropriate to the unique features and demands of nanoscale engineering, and

- Development of a new generation of skilled workers who have the multidisciplinary perspective necessary for rapid progress in nanotechnology.

(4) Broaden participation and enhance diversity in NSF programs.

NSF emphasizes improving achievement for all students in science, mathematics, engineering, and technology and building capacity for research in these areas across the Nation. These activities enable NSF to set the stage for a concerted effort to broaden and diversify the workforce.

At present, several groups, including underrepresented minorities, women, certain types of institutions, and some geographic areas, perceive barriers to their full participation in the science and engineering enterprise. NSF is committed to leading the way to an enterprise that fully captures the strength of America's diversity.

All NSF's research and education programs must be directly involved in broadening participation. Hence, NSF will promote diversity by embedding it throughout the investment portfolio. A key element of NSF's strategy includes the use of information technology and connectivity to engage under-served individuals, groups, and communities in science and engineering.

For groups and individuals at the collegiate, graduate, and professional levels, NSF aims at new strategies for improving diversity, while maintaining the current suite of focused programs that achieves results.

NSF will build on the cumulative experience of the Experimental Program to Stimulate Competitive Research (EPSCoR) and programs involving, for example, undergraduate and minority serving institutions, to strengthen and broaden the education and research capability and competitiveness of states, regions, institutions, and groups.

NSF GPRA Strategic Plan
FY 2001 – 2006

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APPENDIX 1: CRITICAL FACTORS FOR SUCCESS

Excellence in managing the agency's activities underpins all of NSF's goals. Four factors are especially critical to NSF's goal achievement.

Factor 1: Operating a credible, efficient merit review system.

NSF's merit review process is the keystone for award selection. All proposals for research and education projects are evaluated using two criteria: the intellectual merit of the proposed activity and the broader impacts of the activity on society. Specifically addressed in these criteria are the creativity and originality of the idea, the development of human resources, and the potential impact on the research and education infrastructure.

The merit review system is at the very heart of NSF's selection of the projects through which its outcome goals are achieved. Ensuring a credible, efficient system requires constant attention and openness to change.

Implementation Strategies

- Regularly assess performance of all aspects of the merit review system, comparing its efficiency, effectiveness, customer satisfaction and integrity against similar processes run by other organizations.
- Promote the use of both merit review criteria (i.e. *intellectual merit* and *broader impacts*) in the evaluation of proposals.
- Develop alternative mechanisms for obtaining and reviewing proposals and evaluating their potential for use in determining NSF's investments.
- Reduce the burden on proposers and reviewers while maintaining the quality of decision processes, by increasing award size and duration.

Factor 2: Exemplary use of and broad access to new and emerging technologies for business application.

NSF has moved aggressively to adopt new technologies in our business processes. NSF must sustain and further develop exemplary mechanisms to streamline business interactions, enhance organizational productivity, ensure accessibility to a broadened group of participants, and maintain financial integrity and internal controls.

Implementation Strategies

- Implement full electronic proposal receipt, review, processing and award, to reduce the administrative burden on staff and partner institutions, and eliminate paper materials wherever possible.
- Implement a high-quality communications infrastructure and state-of-the-art technological tools to enhance organizational productivity.
- Maintain financial and award system integrity through rigorous systems standards and controls and continual system improvements.

Factor 3: A diverse, capable, motivated staff that operates with efficiency and integrity.

NSF is dependent on the capability and integrity of its staff. Innovative methods of recruitment, development, and employee recognition will be needed to meet the challenges of the future.

Implementation Strategies

- Provide a learning environment where the ideas and opinions of program officers and support staff are highly valued by management.
- Sustain a recruitment and retention policy that enables personnel searches that focus on excellence and diversity in the workplace.
- Invest in staff development and provide training on continuing issues of importance such as avoiding conflicts of interest and on new directions such as electronic proposal submission.
- Improve the participation of underrepresented groups in both career and temporary positions.
- Explore new mechanisms for the recruitment and employment of scientists, engineers, and educators at NSF.
- Use flextime, flexplace, telecommuting, independent research and development plans, and related tools of the work environment to maximize staff productivity and growth.

Factor 4: Implementation of mandated performance assessment and management reforms in line with agency needs.

An organization that is dependent on public funds must be accountable to the public. The development and use of effective indicators of agency performance -- measuring NSF's ability to meet mission-oriented goals, our competent use of resources in the investment process, and our efficiency and effectiveness as a reliable partner to others -- are needed to better explain the agency's role to the public.

Implementation Strategies

- Assess the reliability, completeness, appropriateness and usability of NSF's management data systems as they support GPRA and the CFO Act.
- Work with academic institutions and other grantees to assure reliable, valid collection of project reporting information.
- Align individual performance plans with agency and organizational plans and with the changing technologies and needs of the workplace.
- Continue to develop appropriate standards and indicators of success for reporting systems.

APPENDIX 2: EXTERNAL FACTORS AFFECTING SUCCESS

The work of research and education that results in the achievement of NSF's outcome goals is performed largely outside the agency; thus, external factors have a significant impact on NSF's performance. In particular, the circumstances of our institutional partners in academe, the private sector, and the government affect how individuals and groups are able to respond in both proposing and conducting research and education activities.

For example, NSF relies on the academic research facilities and platforms available at colleges and universities across the country to provide a base upon which grantees can build their research programs. Although NSF support enhances this infrastructure, we do not control its current condition and quality. Failing to maintain a state-of-the-art research infrastructure will slow the pace of discovery and limit the research options available to researchers.

With regard to the "people" goal, characteristics of the workforce of scientists and engineers are highly dependent on the systems through which they are educated and trained. NSF programs influence educational systems and the public that supports them, but are only one influence among many.

Other factors that exist beyond NSF's control include: (1) appropriations; (2) indirect cost rates; (3) government-wide policies; (4) inflation; (5) budgets and plans of other R&D agencies; (6) uncertainty and risk inherent in research; (7) availability and pace of technology; and (8) private sector capacity to use new knowledge.

However, NSF's influence and leadership extend well beyond our budget, and we can do much to minimize the negative impacts of factors beyond the agency's control. Given our unique role, NSF brings together diverse elements of the larger science and engineering community to achieve our mission. This positions the agency to: (1) establish partnerships that leverage funds beyond our budget and (2) provide leadership that catalyzes new directions for research and education.

APPENDIX 3: ASSESSING NSF's PERFORMANCE

The challenge of performance assessment for NSF is that both the substance and the timing of outcomes from research and education activities are largely unpredictable. NSF staff members do not conduct the research and education projects. They provide support for others to undertake these activities based on proposals for the work to be done, the best information available as to the likely outputs and outcomes, and their knowledge of NSF's outcome goals and the strategies for achieving them. They influence rather than control the outputs and outcomes.

OMB authorized NSF to use alternative format performance goals for NSF's outcomes in research and education. This approach allows for expert judgment to consider both quantitative and qualitative information on performance and to weigh that information in a balanced assessment. NSF uses the descriptive performance goals in our management process through a combination of internal self-assessment and review by independent external panels of experts and peers.

For the three outcome goals, NSF performance is successful if the outcomes of NSF investments for a given period of time are judged to have achieved or to have made significant progress in achieving the specific performance goals. These assessments are made by independent external panels of experts, who use their collective experienced-based norms in determining the level of "significance" necessary for a rating of successful.

Assessment of goal achievement, by external groups of peers and experts will take into account such factors as (1) identified performance indicators for each performance goal, (2) the success to which NSF strategies and plans are implemented; (3) the level of resources invested; (4) external events beyond control of the agency; and (5) the agency's capability to be flexible and respond rapidly to emerging opportunities. NSF makes use of the following stages in the grant award cycle to assess performance:

- Applicant and Grantee Information/Merit Review

All applicants and grantees provide results from previous NSF support, information about existing facilities and equipment available to conduct the proposed research, where the research is to be conducted, biographical information on the primary investigators, other sources of support, and certifications specific to NSF. Information is required at the time of application, at the time of an award, and in annual and final project reports. Awards are made based on merit review by peers who are experts in the field using NSF's merit review criteria, and availability of resources.

- Program Evaluation by Committees of Visitors (COVs)

To ensure the highest quality in processing and recommending proposals for award, qualified external experts review each program every three years. COVs report on the integrity and efficiency of the processes for proposal review and the quality of results of NSF's programs in the form of outputs and outcomes that appear over time. COVs report on the noteworthy achievements of each year, ways in which projects have collectively affected progress, and expectations for future performance. The recommendations of COVs are reviewed by management and taken into consideration by NSF when evaluating existing programs and future directions for the Foundation.

- Directorate Assessment by Advisory Committees

Directorate advisory committees review internal self-assessments, COV reports, available external evaluations, and annual directorate performance reports, judging program effectiveness, and describing strengths and weaknesses. The advisory committees' reports are reviewed by NSF management, which then integrates committee recommendations into the NSF Annual Performance Report.

Much of this performance assessment is retrospective, addressing investments made at some point in the past. In order to tie this effectively to current issues in management of the programs, the assessments must also address the quality of the set of awards made in the fiscal year under consideration. The focus of this portfolio assessment is the likelihood that the package of awards will produce strong results in the future. Special emphases within the plans for the fiscal year merit special attention in the assessment process.

NSF staff has control over budget allocations and the decision processes that determine the set of awards. NSF performance goals for investment processes, along with those for management of the agency, are generally quantitative. They refer to processes conducted during the fiscal year that are generally captured in NSF systems.

Data Collection, Verification, and Validation for NSF's Results Goals

Two types of data are used to assess goal performance: (a) non-quantitative output and outcome information, collected and reported using the alternative format, which are used to assess the Outcome Goals and the implementation of the new merit review criteria; and (b) quantitative data collected through systems for the performance target levels of the Investment Process and Management Goals.

NSF sources of data include central databases such as the electronic Project Reporting System, the Enterprise Information System, the FastLane system, the Proposal system, the Awards system, the Reviewer System, the Integrated Personnel System, the Finance System, Online Document System, and the Performance Reporting System; distributed sources such as scientific publications, press releases, independent assessments including Committee of Visitor (COV) and Advisory Committee (AC) reports, program and division annual reports, directorate annual reports, and internally maintained local databases. In a few cases, NSF makes use of externally maintained contractor databases.

Through these sources, output indicators such as the following will be available to program staff, third party evaluators, and advisory committees:

- *Related to Ideas*: Results, published and disseminated: journal publications, books, software, audio or video products; 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; role of NSF-sponsored activities in stimulating innovation and policy development.

- *Related to People*: student participants; 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; number and quality of teachers trained; student outcomes including enrollments in mathematics and science courses, retention, achievement, and science and mathematics degrees received.

- *Related to Tools*: new tools and technologies, multidisciplinary databases; software, newly-developed instrumentation, and other inventions; data, samples, specimens, germ lines, and related products of awards placed in shared repositories; facilities construction and upgrade costs and schedules; operating efficiency of shared-use facilities.

NSF's electronic Project Reporting System permits organized reporting of aggregate information. We anticipate that the reliability of the information in the system will improve over time, as investigators and institutions become comfortable with its use. FY 1999 was the first year of its full implementation. Electronic submission of project reports is required in FY 2000.

The scientific data from the reporting system will be tested for plausibility as a natural part of the external assessment process. In addition, data from the reporting system will be used to address progress under prior support when investigators reapply to NSF. Thus, the investigators have a strong incentive to provide accurate information that reviewers may rely upon.

<u>Issues Specific to NSF:</u>

Because it is difficult to predict or quantify research results, or to report them in a timely way, NSF's Outcome goals are expressed in an OMB-approved alternative format. Research results cannot be predicted beforehand, and the time frame for reporting outcomes is typically long after the fiscal year in which an award was made. For example, a grant provided in one fiscal year might not produce a reportable outcome for five years or more, if at all.

It should be noted that while NSF made use of the alternative format using the two standard approach required by the Act ("successful" or "minimally effective"), it was found that there was little to be gained in defining the use of "minimally effective," and that in many instances it was confusing to the evaluators.

Therefore, for FY 2000 and beyond, NSF will define one standard only: the "successful" standard. The programs will be evaluated on whether they succeed in achieving the target goals and their impact.

Collection of data for all goals takes place throughout the year, and is completed near the end of the fiscal year. Depending on the specific type of data, data are collected into a report for a given goal by the group responsible for that goal, and then organized for reporting. The data obtained are reviewed on a continuing basis by senior NSF management throughout the year, to observe whether the results are as expected, or need to be improved, or whether the information being obtained is useful to the agency. Data collection systems are also under constant observance and refinement, as in the case of the new FastLane reporting system.

During FY 1999, NSF staff began to implement a Data Quality Project for the quantitative Investment Process and Management goals. This project is currently underway with the first priority placed on the central data systems used to support the performance plan.

In addition, NSF staff implemented new guidelines and reporting procedures for collecting data for the qualitative Outcome goals. The Committee of Visitor (COV) guidelines were revised in FY 1999 to incorporate the GPRA related reporting requirements. Reporting templates were developed for the COVs to address the performance of programs in a systematic way to allow for aggregating information across NSF. COVs address a common set of questions for all programs reviewed in a fiscal year.

Reporting guidelines were also developed for Advisory Committees to allow for a systematic aggregation of information. The results of using the new procedures have identified areas for improvement that are being incorporated into the FY 2000 reporting guidelines. Many of the results learned while conducting these assessments have been used in revising the FY 2000 performance goals, and the revised strategic plan.

NSF Program Assessment/Evaluation Schedule

Assessed Activity	Frequency	Conducted by	Used in Strategic Planning
Program level assessment[1]	30% per year	External Committee of Visitors	Yes
Directorate level assessment[2]	100% per year	External Advisory Committees	Yes
Special programs (NSF-wide activities such as MRI, CAREER, STC, PFF, GRF, GRT, IGERT)[3]	Varies annually	External Committee of Visitors or external contractor	Yes
All agency GPRA related activities[4]	Weekly	Internal senior management DPG, GIIC, GIIC WG	Yes

[1] One-third of NSF programs assessed annually; assessments take place throughout the fiscal year. All programs assessed on a three-year cycle. COVs address management of programs and achievement of outcome goals; information used by senior management and in aggregate for performance reporting.

[2] Advisory committees review directorate activities annually and approve COV reports; assess contributions of directorate in achieving NSFs goals; provide reports for use by NSF management and in aggregating NSF performance results. Schedule: meet twice annually with assessment at end of fiscal year. Advisory committees use COV reports as basis for strategic planning discussions with directorates.

[3] NSF-wide programs evaluated by external contractors to assess impact of programs. Schedule varies depending on program. MRI= Major Research Instrumentation program external contractor reviewed in FY 2000; CAREER =Faculty Early Career Development program external contractor review being organized in FY 2000 for evaluation in FY 2001; STC= Science and Technology Centers; PFF=Presidential Faculty Fellows; GRF=Graduate Research Fellowships program; GRT=Graduate Research Traineeships program evaluation completed in FY 2000; IGERT= Integrative Graduate Education and Research Training program evaluation ongoing in FY 2000.

[4] Internal staff meetings to review GPRA activities across NSF and make recommendations for implementation of GPRA. DPG = Director's Policy Group, GIIC= GPRA Infrastructure Implementation Council, GIIC WG= GPRA Infrastructure Implementation Council Working Group.

<u>APPENDIX 4:</u> INTEGRATION OF NSF PLANS WITH THOSE OF OTHER AGENCIES

Many other agencies support or conduct research and education activities in science and engineering in support of their missions. Frequently they will define outcome and performance goals that are similar to those NSF has defined. However, an agency's mission will have an impact on the nature of the outcome and performance goals, so, in general, they are distinct. NSF's general approach is to work with other agencies to ensure complementary sets of activities. Certain interagency interactions are particularly important for NSF support of fundamental research:

- National Institutes of Health (NIH): biosciences, genomics, biomedical research, chemistry, behavioral sciences, cognitive development;
- Department of Energy (DOE): high energy and nuclear physics, materials, high end computing, genomics;
- Department of Defense (DOD): engineering, computer and information science and engineering, mathematics;
- Department of Commerce (DOC): ocean and atmospheric sciences, global climate change, meteorology, atomic and molecular physics;
- National Aeronautics and Space Administration (NASA): astronomical sciences, global climate change;
- Department of Agriculture (USDA): biosciences, genomics;
- Department of Education (ED): education research; and,
- Environmental Protection Agency (EPA): environmental research.

Each of these agencies addresses fundamental research in a somewhat different way with an interdependent mix of intramural research, funding for extramural research, and construction and operation of facilities. For example, in some areas, NSF's support of extramural research is critically dependent on an investigator's access to user facilities provided by other agencies. Likewise, results of NSF-supported research may be used in intramural research activities of other agencies.

Many investigators work on several projects simultaneously, seeking support for complementary activities from different agencies. Senior managers at NSF and other agencies maintain the close connections that provide a productive framework for program-level coordination and permit formal cooperation among agencies when working toward similar objectives.

NSF actively participates in many interagency initiatives and planning activities coordinated through the National Science and Technology Council (NSTC). These activities include the following:

- Information Technology Research (ITR),
- National Nanotechnology Initiative (NNI),

- U.S. Global Change Research Program,
- High Performance Computing and Communications,
- Partnership for a New Generation of Vehicles (PNGV),
- Education Research,
- Integrated Science for Ecosystems Challenges,
- Children's Research,
- Plant Genome Research,
- National Oceanographic Partnership Program,
- Interagency Arctic Research Policy Committee.

In all of these activities, NSF's role is at the fundamental end of the research and development spectrum. These interagency planning efforts are coordinated among agencies to reap optimal benefit from the Federal investment.

NSF has been designated the lead Federal agency for an initiative on Information Technology Research (ITR) – a six agency initiative which includes the Departments of Energy and Defense, the National Aeronautics and Space Administration, the National Institutes of Health, and the National Oceanic and Atmospheric Administration. ITR grew from the efforts of several agencies and responds to recommendations made by the President's Information Technology Advisory Committee (PITAC). NSF's FY 2001 investment includes a substantial increase for research in software systems, scaleable information infrastructure, high-end computing, and socioeconomic and workforce impacts of IT.

In FY 1999 and 2000, NSF continued to work in partnership with other Federal agencies in planning nanoscale science and engineering activities. NSF chairs the interagency working group on Nanoscience, Engineering and Technology, under the guidance of the NSTC, in cooperation with DOD, DOC, National Institute for Science and Technology, Air Force Office of Scientific Research (AFOSR), DOE, Department of Transportation/Volpe Center, Department of Treasury, NASA, and NIH.

NSF also has a number of partnerships with individual agencies or small groups of agencies. Some grow out of formal interagency processes; for example, NSF partners with four other agencies in development of the Next Generation Internet. Other collaborations reflect the particular interests of the partnering agencies. Examples include NSF's partnership with EPA and DOI in areas such as water and watersheds, ecological and environmental technologies, and risk assessment and evaluation, and also our work with the Department of Energy and NASA in the interagency program of research on Human Origins. These and similar partnerships are designed to make efficient, effective use of Federal resources in support of research.

NSF is involved with numerous agencies in support of research in the biological sciences, including:

- Interagency Arabidopsis Genome Project (USDA/DOE/NIH/NSF as lead agency) which has a goal of understanding biological processes underlying plant growth and development;
- NSF/NIH/USDA International Cooperative Biodiversity Groups;
- NSF/NASA Neurolab which also involves NIH, the Office of Naval Research and international partners to support ground based research leading to experiments flown on the NASA space shuttle;
- The Human Brain Project (NIH/NSF/DOD/DOE/NASA), which is a broad Federal research initiative to support research in the neurosciences and the new field of neuroinformatics;
- Ecology of Emerging Infectious Diseases (NSF/NIH/USDA/NASA/DOI).

NSF is one of twelve federal agencies supporting Arctic research and logistics. NSF provides interagency leadership for research planning as directed by the Arctic Research Policy Act of 1984. NSF is charged with managing all U.S. activities in the Antarctic as a single, integrated program. The U.S. Antarctic Program (USAP) implements national policy to maintain Antarctica as an area of international cooperation reserved for peaceful purposes, to preserve and pursue unique opportunities for scientific research, to understand Antarctica and its role in global environmental systems, to protect the environment, and to assure the conservation and sustainable management of the living resources in the surrounding oceans.

NSF is one of many public and private agencies with responsibilities for obtaining statistical information on areas of important national interest. NSF and other agencies share information on statistical information technology, and other methods and resources through the Federal Committee on Statistical Methodology and related groups.

APPENDIX 5: RESOURCE UTILIZATION

The resources at NSF's disposal include: (1) a staff of approximately 1,200 government employees, an additional 126 scientists and engineers on various types of visiting appointments, and 192 contractors that support the agency's work; (2) outstanding information management systems that help the agency process approximately 30,000 competitive proposals, 10,000 new awards and 10,000 continuing awards per year; and (3) members of the science and engineering community who donate tens of thousands of hours each year to the review of proposals for research and education.

NSF recognizes the need to secure a workforce that is skilled, flexible, and performance-oriented with a customer focus. It will increase its use of workforce planning and other strategies that align human resources with the fulfillment of its mission and goals.

Proposals and awards are managed through eight programmatic organizations -- the seven directorates and the Office of Polar Programs -- and a ninth organization that focuses on multidisciplinary programs, the Office of Integrative Activities.

- The **Biological Sciences** (BIO) directorate supports research ranging from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, through cells, organs, and organisms, to studies of populations and ecosystems. (FY 2001 Request: $511.14 million)

- The **Computer and Information Science and Engineering** (CISE) directorate supports research on the theory and foundations of computing, system software and computer system design, and human-computer interactions, as well as prototyping, testing and development of cutting-edge computing and communications systems. (FY 2001 Request: $529.10 million)

- The **Engineering** (ENG) directorate supports research in bioengineering and environmental systems; chemical and transport systems; civil and mechanical systems; electrical and communications systems; design, manufacture, and industrial innovation; and engineering education activities. (FY 2001 Request: $456.50 million)

- The **Geosciences** (GEO) directorate supports research in the atmospheric, earth, and ocean sciences. (FY 2001 Request: $583.0 million)

- The **Mathematical and Physical Sciences** (MPS) directorate supports research in mathematics, astronomy, physics, chemistry, and materials science. (FY 2001 Request: $881.16 million)

- The **Social, Behavioral and Economic Sciences** (SBE) directorate supports research on human characteristics and behavior, including research on economic systems; supports the NSF's international activities; and provides informational tools for tracking the resources that make up the nation's science and engineering infrastructure. (FY 2001 Request: $175.14 million)

- The **Office of Polar Programs** (OPP) supports multidisciplinary research in Arctic and Antarctic regions. (FY 2001 Request: $285.41 million)

- The **Education and Human Resources** directorate (EHR) supports education and training activities at every level, informal education, research on teaching and learning, human resource development, and development of research capabilities. EHR is the focal point for NSF efforts to promote diversity. (FY 2001 Request: $729.01 million)

- The **Integrative Activities** (IA) budget activity funds selected Foundation-wide activities such as the Opportunity Fund and the Major Research Instrumentation (MRI) program. (FY 2001 Request: $119.23 million)

Approximately 95% of NSF's budget goes directly to investments in NSF's three outcome goals. A fourth function, administration and management, provides operating support for the immediate activities of the agency. The FY 2001 Request leads to the following distribution of NSF budget resources across the three strategic goal and the Administration and Management (A&M) account, with a total Request of $4.572 billion. Dollar estimates are made at a programmatic level based on the principal objectives of the activity.

Crosswalk of Resources with Strategic Goals: FY 2001

(Estimated Millions of Dollars)

	Staff	Strategic Goal				Total
	Number of FTE's & IPA's[1]	Ideas	People	Tools	Administration & Management	
BIO	125	391	50	64	6	511
CISE	84	363	38	121	7	529
ENG	141	373	73	4	7	457
GEO	109	343	18	217	4	583
MPS	140	579	106	190	6	881
SBE	146	132	9	29	5	175
OPP	54	79	1	202	3	285
IA	0	52	13	54	0	119
EHR	172	112	578	25	14	729
Other[2]	439	0	0	139	164	303
Total[3]	1,410	$2,425	$886	$1,045	$217	$4,572

[1] FTE's funded through the S&E and OIG accounts. IPA's are funded through the EHR and R&RA accounts.

[2] Other staff includes all central administration and management. Other budget items include Major Research Equipment ($139 million, Tools); Salaries and Expenses ($158 million, Administration and Management); and Office of Inspector General ($6 million, Administration and Management)

[3] Numbers may not add due to rounding.

Working closely with the National Science Board, NSF advisory committees, and other groups, NSF will periodically re-examine the distribution of resources across these goals.

<u>APPENDIX 6:</u> LINKING THE GPRA STRATEGIC PLAN TO THE PERFORMANCE PLAN

NSF will develop annual performance plans under the Government Performance and Results Act (GPRA) with performance goals that provide strong accountability and management tools. These annual plans will also reflect the reality that the results of NSF's investment in research and education appear over long time scales and at uneven, unpredictable intervals, arising from the nature of science and technology.

The outcome goals, core strategies, and five-year plans will be used as a basis for organizing both the annual performance plan and the agency's corresponding annual budget request. These comprise the principal directions of agency action and the bulk of NSF funding.

While the three broad goals in this strategic plan are not described in a way that permits assessment of their achievement, the long-term outcomes identified for each of these goals will provide the basis for results-oriented performance goals that can be assessed. (This is permissible under Circular A-11, Part 2, OMB.)

Performance plans for an upcoming fiscal year will be developed in light of the analysis of past performance, assessment of how recent or projected changes in the investment portfolio will influence future performance, and fit to the outcome goals and strategies identified in this strategic plan. Given the expected lag between investment and outcomes, NSF will always be operating with only partial information in developing its program strategies.

Annual performance goals for NSF management will derive from the key strategies under *Critical Factors for Success* in the body of this GPRA strategic plan, with selected areas highlighted in a given year as it becomes particularly timely. Specific performance goals for each year will be determined by assessing past performance and making reasonable projections for levels of performance that can be expected.

APPENDIX 7: CROSSWALK OF NSF GOALS AND PROGRAMS

All NSF programs are classified according to the outcome goal on which they are primarily focused. However, is should be noted that there is considerable synergy among the goals. For example, a grant supporting materials research at a university may focus on producing new knowledge (Ideas) but also may help train the next generation of scientists and engineers (People), and provide new research equipment (Tools). The ability of NSF-supported projects to simultaneously address multiple outcome goals increases the effectiveness and productivity of NSF's investments.

PEOPLE – A diverse, internationally-competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens.

K-12 Support

Educational System Reform (ESR) – ESR programs implement large-scale reform of science, mathematics, and technology (SMT) education, particularly at the preK-12 level, across the nation. Systemic reform projects provide access to high-quality science and mathematics educational resources for the nation's children, and expand professional development opportunities for the instructional workforce

Rural Systemic Initiatives (RSI) – systemic reform program to promote systemic improvements in math, science and technology education for students in rural and economically disadvantaged regions of the nation.

Statewide Systemic Initiatives (SSI) – systemic reform program to encourage improvements in science, math and engineering education through comprehensive systemic changes in the education systems of the states.

Urban Systemic Program (USP) – a new program that includes innovative options calling for K-12 districts to collaborate with (1) two-year colleges in developing exemplary improvements in technical education and (2) four-year colleges and universities in improving existing teacher preparation programs and developing research enrichment opportunities for K-12 students. Program and site-specific research is encouraged across projects to increase understanding of the reform process.

Instructional Materials, Teachers & Students

Centers for Teaching and Learning program (CLT) – CLTs will address teacher competencies and will build the SMT educational infrastructure across diverse areas of specialization and geographic regions. Local Systemic Change (LSC) projects will continue to couple sustained professional development with appropriate instructional materials and will build an infrastructure for future CLTs in all regions of the country.

Instructional Materials Development – supports the development of materials and strategies to promote the improvement of science, math and technology instruction at all levels so students can acquire sophisticated content knowledge, higher order thinking abilities and problem solving skills.

Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST) – provides career recognition for outstanding K-12 math and science teachers.

Teacher Enhancement / Student Development – supports professional development projects to broaden and deepen the content and pedagogical knowledge of teachers; also promotes teacher and student development through research experiences.
Teacher Preparation – responds to a national need to attract, develop and retain well-qualified teachers of science and mathematics; aims to reform PreK-12 teacher education with the intent to strengthen the content and pedagogical skills needed for delivery of standards-based science and mathematics education.

Undergraduate Support

<u>Broadening Participation</u>

Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) – provides funds to improve the quality of undergraduate science, mathematics, engineering and technology programs through curricular reform and enhancement, faculty development, research experiences for undergraduates, upgrading of scientific instrumentation, and improvement of research infrastructure. A program goal is to increase the number of baccalaureate recipients.
Louis Stokes Alliances for Minority Participation (LSAMP) – a program to increase the number of minority and other students who successfully complete baccalaureates in science, math, engineering and technology.
Model Institutions of Excellence (MIE) – collaborative support for several minority mathematics institutions that have strong track records for producing minority students with baccalaureate degrees in science, math or engineering disciplines and who go on to graduate school in these fields.
Tribal Colleges Program (TCP) – a program for Tribal Colleges that encourages Native Americans to pursue information technology and other science and technology fields of study, as well as increases the capacity of tribal colleges to offer relevant courses and enhance K-12 education in feeder school systems.

<u>Curriculum, Laboratory & Faculty</u>

Advanced Technological Education (ATE) – promotes improvements in science and mathematics curricula and instruction, intended to benefit students who plan to become technicians in the high-performance workplace in the near-term. ATE provides opportunities for development of the workforce for technological positions that do not require full undergraduate programs of study. New emphases will be on information technology, manufacturing and teacher development in related areas.
Course, Curriculum & Laboratory Improvement – supports adaptation and implementation of proven curricula and laboratory instructional models, and development of educational materials.
Distinguished Teaching Scholars – recognizes and rewards undergraduate faculty whose integration of research and education enhances the quality of the future workforce and the scientific knowledge of the general public.
Engineering Education Reform – promotes systemic reform in undergraduate engineering education. For example, the program supports development of innovative curricula in nanotechnology and other areas of emerging technology. Special attention is given to

institutionalizing successful innovations that have resulted from this program. It also supports smaller scale projects to integrate advanced technology research into the curriculum.
Research Experiences for Undergraduates (REU) – an NSF-wide program that provides opportunities for undergraduate students to experience hands-on participation in research or related scholarly activities in areas of science, math and engineering.

Scholarships for Service – a program that awards scholarships for the study of information security in return for a commitment to work for a specified time for the federal government.

Graduate and Professional Development Support

Graduate

Graduate Research Fellowships (GRF) – provide recognition and three years of support for advanced study to outstanding graduate students in all fields of science, mathematics, and engineering.
Graduate Research Traineeships (GRT) – continuing **–** program that preceded the IGERT program. This funding is for continuing awards made under the original program.
Graduate Teaching Fellows in K-12 Education program (GK-12) – initiated in FY 1999 to support graduate and advanced undergraduate science, math, engineering and technology majors as content resources for K-12 teachers. These Fellows assist teachers in the science and mathematics content to be used in instruction, demonstrate key science and mathematics concepts, and connect elementary and secondary learning to the habits and skills required for collegiate study.
Integrative Graduate Education and Research Training (IGERT) – an agency-wide program that sponsors the development of innovative, research-based graduate education and training programs in Ph.D. granting institutions.
Minority Graduate Education (MGE) – continues awards for increasing the number of underrepresented minority SME doctorates and their representation in the professorate.
Research Training Grants (RTGs) – grants in the biological sciences designed to give students research experience with trained researchers. Funds being redirected to IGERT.
Vertical Integration of Research and Education in the Mathematical Sciences (VIGRE) – a program designed to broaden educational content and opportunities for students (at the undergraduate level) by the integration of research and education in the mathematical sciences.

Professional Development

ADVANCE/Professional Opportunities for Women in Research in Education (POWRE) – an NSF-wide effort aimed at increasing the prominence of women in science, engineering research and education. POWRE is being replaced by a new program called ADVANCE, created to advance professional opportunities for women.
The Faculty Early Career Development Program (CAREER) – an NSF-wide activity that supports junior faculty within the context of their overall career development.
Postdoctoral Fellowships in Science, Mathematics, Engineering and Technology Education (PFSMETE) – encourages Ph.D. graduates in these fields to attain the skills needed to assume leadership roles in education reform at all levels. They offer the opportunity and

challenge of complementing disciplinary science and engineering expertise with skills in education, thus opening new career options to the fellowship recipients.

Presidential Faculty Fellows (PFF)/NSF Young Investigators (NYI)/ Presidential Young Investigators (PYI) – programs devoted to increasing the participation and experience of young researchers. PFF is being re-directed into CAREER. NYI and PYI are currently being phased out and replaced by CAREER.

Other Programs

Evaluation – a continuum of accountability activities such as monitoring, databases, impact studies, and program evaluations with an orientation to the measurement, data collection, and reporting requirements necessary to support the Government Performance and Results Act (GPRA).

Grant Opportunities for Academic Liaison with Industry (GOALI) – a program that brings university and industry collaborators together at the conceptual phase of a research and education endeavor.

Informal Science Education (ISE) – incorporates projects that provide opportunities outside a formal school setting where K-12 individuals of all interests and backgrounds can increase their appreciation and understanding of science, math, engineering and technology.

Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM) – administered on behalf of the White House by the National Science Foundation, this program seeks to identify outstanding mentoring efforts/programs designed to enhance the participation of groups underrepresented in science, mathematics and engineering.

Programs for Gender Equity (PGE) – supports education and research activities that foster increased participation of women and girls in science, mathematics, engineering and technology.

Programs for Persons with Disabilities (PPD) – supports efforts to increase the participation and achievement in SMET education and research of individuals with disabilities. Emphasis is placed on projects building and strengthening alliances among higher education, K-12 educational systems, and business and industry.

H-1B Nonimmigrant Petitioner Account – established by Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277); requires that a prescribed percentage of funds in the Account be made available to NSF for the following activities:

Computer Science, Engineering, and Mathematics Scholarships (CSEMS) – merit-based scholarships are to be provided for new or continued enrollment at institutions of higher education by eligible low-income individuals pursuing associate, undergraduate, or graduate degrees in the disciplines specified.

Grants for Mathematics, Engineering, or Science Enrichment Courses – are intended to provide opportunities to students for enrollment in year-round academic enrichment courses in mathematics, engineering, or science.

Systemic Reform Activities – are intended to supplement systemic reform activities administered under the Educational System Reform (ESR) Subactivity.

IDEAS – Discovery at and across the frontier of science and engineering, and connections to its use in society.

Centers of Research Excellence in Science and Technology (CREST) – aims to increase the number of underrepresented minorities in science, math, engineering and technology by making substantial resources available to upgrade the capabilities of the most research-productive minority institutions.
National Consortium for Violence Research – supports research on the causes of violent behavior; encourages young researchers, especially underrepresented minorities, to enter this field; and disseminates research results to research and policy communities.
Chemistry Centers – includes the Environmental Molecular Sciences Institutes and the Center for Molecular Sciences, which advance understanding and control at the level of fundamental molecular science.
Climate Change Technology Initiative (CCTI) [1] – an interagency initiative which promotes research aimed at technologies, such as products and production methods that reduce greenhouse gas emissions and increase the efficiency of energy and materials used in transportation, buildings and manufacturing, for reducing U.S. carbon emissions at the lowest possible cost.
Partnerships for Advanced Tech in Housing (PATH) [1] – an interagency program to develop and promote the adoption of advanced housing technologies that will reduce energy consumption in building, heating/cooling and maintenance of the nation's residential housing.
Critical Infrastructure Protection (CIP) [1] – cross-disciplinary research on improved performance and sustainability of critical infrastructure systems, i.e. communication, housing, transportation.
Cyber Security for the 21st Century [1] – a program sponsored by the Office of Personnel Management and NSF that will offer college scholarships to students with concentrations in information security in exchange for their public service after graduation. This program will create a new generation of computer security specialists who will work to defend our nation's computer systems and networks.
Earthquake Engineering Research Centers – centers that bring together multi-institutional teams of investigators to provide the knowledge and technology base for industry and public agencies to build and retrofit structures and other infrastructure to prevent damage from earthquakes. These centers take a systems approach, integrate research and education, and develop partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the local level.
Engineering Research Centers and Groups (ERCs) – university-based centers that facilitate the development of new knowledge and technology. These centers share several important characteristics: a unifying long-term, coordinated approach to complex engineering problems, an emphasis on partnerships and knowledge transfer linkages with industry, and significant educational and outreach programs aimed at integrating education and research. The ERCs link cross-disciplinary teams of investigators across institutional boundaries to advance fundamental knowledge in nanoscale science and engineering, develop a wide range of new technologies, and prepare model curricula to educate new generations for this emerging field.
Experimental Program to Stimulate Competitive Research (EPSCoR) – established in 1978, EPSCoR participation is limited to states that have historically received lesser amounts of federal funding for academic research and development and have demonstrated a commitment to develop their research bases and to improve the quality of science, mathematics, and engineering research conducted at their universities and colleges. Current participants include the Commonwealth of Puerto Rico and 19 states – Alabama, Alaska, Arkansas, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, North Dakota, Oklahoma, South Carolina, South Dakota, Vermont, West Virginia and Wyoming.
Food Safety [1] – an interagency initiative to address food-borne microbial hazards, supported by the Engineering directorate.

Global Learning and Observations to Benefit the Environment (GLOBE) – an interagency program which brings together K-12 students, teachers, and scientists from around the world who work together to help us learn more about the environment. By participating in GLOBE, teachers guide their students through daily, weekly, and seasonal environmental observations, such as air temperature and precipitation. Using the Internet, students send their data to the GLOBE Student Data Archive. Scientists and other students use this data for their research.

High-Performance Computing, Information and Communications (HPCCIT) [1, 2] – an NSTC crosscut whose programs invest in long-term R&D to advance computing, information, and communications in the U.S. This includes information technology research (ITR) listed under the NSF Information Technology initiative.

Next Generation Internet (NGI) [1] – the focus is on high performance connectivity between academic research institutions, contributing to basic infrastructure for high-end research applications, and taking a major role in developing the national scalable high-performance network infrastructure for the U.S. research and education community. NGI is part of the HPCCIT crosscut.

Human Dimensions of Global Change – comprised of two centers supported by SBE: Indiana University-Bloomington Center focuses on how humans and institutions affect forest clearance and reforestation; Center at Carnegie Mellon University employs an integrated, multi-disciplinary, model-based approach to the analysis of complex global change problems.

Industry/University Cooperative Research Centers (I/UCRC) – centers to develop long-term partnerships among industry, academe and government. They provide a steady stream of enabling technologies critical to advancing industrial manufacturing processes, information technology support systems, and new product lines.

Information Technology Centers – supports fundamental research in information technology that incorporates scientific applications or addresses social, ethical and workforce issues; part of the Information Technology Research initiative.

Innovation Partnerships – The Office of Innovation Partnerships, initiated in FY 2000 as a result of Congressional action, stimulates the innovation process and strengthens economic development in diverse research and education settings, with emphasis on geographic areas that are not currently participating fully in NSF programs. Academic institutions, non-profit organizations, and private sector organizations are encouraged to develop partnership arrangements to build infrastructure and bring together human resources across institutions and sectors.

Integrated Science for Ecosystems Challenges (ISEC) [1] – an interagency initiative designed to develop the knowledge base, information infrastructure and modeling framework to help resource managers predict/assess environmental and economic impacts of stress on vulnerable terrestrial and marine ecosystems.

Interagency Education Research Initiative (IERI) – initiated in FY 1999 in partnership with the Department of Education and the National Institute for Child Health and Human Development to support research efforts in areas including: school readiness for learning, reading, and mathematics; K-3 learning in reading and mathematics; and K-12 teacher education in reading, mathematics, and science. Special emphasis is placed on application of educational technologies to K-12 education.

Long-Term Ecological Research (LTER) – promotes investigations of whole ecosystems and their component organisms and processes at sites that represent major biomes. The 24 LTER sites include coastal ecosystems; human-dominated, urban ecosystems; the Arctic tundra of Alaska; the deserts of New Mexico; the rainforests of Puerto Rico; and the Dry Valleys of Antarctica. Projects are multidisciplinary and actively encourage collaborative research with non-ecological investigators.

Materials Research Science and Engineering Centers (MRSEC)– formerly known as Materials Research Laboratories (MRL), support interdisciplinary and multidisciplinary materials research and education while addressing fundamental problems in science and engineering that are important to society.

Mathematical Sciences Research Institutes – centers to stimulate research in the mathematical sciences, bringing together in a programmatically focused scientific environment, top people in a given research subject, where new ideas can be developed and exploited.

National Center for Ecological Analysis and Synthesis (NCEAS) – located in downtown Santa Barbara, CA, scientists at NCEAS conduct collaborative research on major fundamental and applied problems in ecology. The goal is to identify major ecological patterns and understand the processes that generate them – NCEAS provides the atmosphere, facilities, equipment, and staff to help reach this goal. The National Science Foundation, the State of California, and the University of California at Santa Barbara provide funding for NCEAS.

National Center for Geographic Information and Analysis – center that supports research to advance the theory, methods and techniques of geographic analysis based on geographic information systems (GIS) and other spatial analysis tools that are integral to large-scale research, planning and management.

National Earthquake Hazards Reduction Program (NEHRP) – seeks to advance fundamental engineering and related scientific knowledge to mitigate the impacts of earthquakes, including support for fundamental research that leads to more earthquake-resistant buildings and facilities.

Partnership for a New Generation of Vehicles (PNGV) [1] – a federal program to reduce manufacturing cost and time for all vehicles; to increase fuel efficiency and reduce vehicle emissions; and to develop a new class of vehicles with three times the fuel efficiency of today's autos and comparable performance and cost of ownership. NSF does not maintain a focused PNGV program, but rather supports PNGV-related efforts through its disciplinary and other established programs.

Physics Frontiers Centers (formerly Physics Centers) – a new program planned for FY 2001, these centers will provide critical resources and needed infrastructure to exceptionally promising new areas of physics such as atom lasers, quantum information science, computational physics, biological physics, and astrophysics.

Plant Genome Centers – portion of the Plant Genome Research initiative that is devoted to supporting virtual centers (centers without walls) or collaboratories where coordinated, multi-investigator teams pursue comprehensive plant genome research programs relevant to economically important plants and plant processes. Currently active centers range in size and scope, some with a focus on functional genomics and others with a focus on developing tools and resources for plant genomics studies for the scientific community.

Plant Genome Research – research that advances our understanding of the structure, organization and function of plant genomics, and that accelerates utilization of new knowledge and innovative technologies toward a more complete understanding of basic biological processes in plants. This fundamental research has application to agriculture, forestry, energy, and the environment, as well as the production of plant-based industrial materials and chemicals.

Research Opportunity Awards (ROA) – a component of the Research at Undergraduate Institutions (RUI) program, ROAs provide opportunities for faculty at institutions with limited research opportunities to participate in NSF-funded research at other institutions.

Research at Undergraduate Institutions (RUI) – NSF-wide research program designed to support new multidisciplinary collaborative research groups at primarily undergraduate institutions. Each group is composed of faculty members representing at least two disciplinary areas and includes up to 10 undergraduates.

Science and Technology Centers (STCs) – NSF program that serves as an innovative vehicle for the conduct of world-class research by bringing together a critical mass of facilities and expertise from

academia, national laboratories and industry, involving multiple partners and bringing key strengths to the national research enterprise. Classes 1 and 2 are phasing out; a new third class of STCs will begin in 2000.
Small Business Innovation Research program (SBIR) – a federal program to stimulate small business participation in research across the science and engineering disciplines, with a goal of creating new technologies, industries, businesses and jobs. The program also works to promote effective linkages among small businesses, university experts, and state agencies to provide technical business expertise in talented entrepreneurs.
Small Business Technology Transfer program (STTR) – a federal program that links entrepreneurs to the academic research community, encouraging commercialization of government-funded research by the private sector to promote industrial innovation.
State/Industry/University Cooperative Research Centers (State/I/UCRC) – an extension of the I/UCRC model, focusing more actively on state or regional local economic development; currently being phased out.
U.S. Global Change Research Program [1] – an interagency federal effort that provides the foundation for increasing the skill of predictions of seasonal-to-interannual climate fluctuations (which can bring excessively wet and dry periods) and long-term climate change. The USGCRP also sponsors research to understand the vulnerabilities to changes in important environmental factors, including changes in climate, ultraviolet (UV) radiation at the Earth's surface, and land cover. The scientific knowledge gained is used to inform decision making on environmental issues and to ensure the social and economic health of future generations.

TOOLS – Broadly accessible, state-of-the-art information bases and shared research and education tools.

Academic Research Fleet – a fleet of large ships for ocean-wide investigations, intermediate size ships for regional investigations, small ships for coastal and estuarine work, and platforms with special capabilities such as the submersible *Alvin*. The ships are both privately and federally owned and are operated by academic institutions. NSF provides a majority of the support for the operation, maintenance, and upgrade of the fleet.
Advanced Networking Infrastructure – enables and expands scholarly communication and collaboration by providing network access for researchers and educators to high performance, remote scientific facilities including supercomputer facilities and information resources.
Antarctic Facilities and Operations – Antarctic infrastructure, operations and science support for the three U.S. Antarctic research stations: McMurdo Station on Ross Island, Palmer Station on Anvers Island, and Amundsen-Scott South Pole Station. In addition, necessary facilities include ski-equipped and fixed-wing aircraft, helicopters, research vessels (including a specially constructed ice-breaking research vessel), and an ice-strengthened supply and support ship. Over 650 researchers and students utilize the Antarctic facilities each year.
Antarctic Logistics – Antarctic logistics support is supplied in part by the Department of Defense, including: flight activity and aircraft maintenance carried out by military personnel in the 109th Airlift Wing (AW) of the New York Air National Guard; support for air traffic control, weather forecasting, and electronic equipment maintenance; use of DOD satellites for communications.
Arctic Logistics – Arctic research support and logistics funds; includes facilities, operations and research support. Arctic facilities include camps and sites for studies of greenhouse gases, monitoring stations for research on ultraviolet radiation, ice coring sites for studies of global climate history, high latitude radar observatories and magnetometers for upper atmospheric research, use of the U.S. Coast

Guard Cutter Healy, and the use of a vessel from the academic research fleet for oceanographic research in the Arctic Ocean.

Cornell Electron-positron Storage Ring (CESR) – a physics facility that produces electron and positron colliding beams that allow detailed studies of physics, including research on the matter-antimatter asymmetry in the universe as well as a fundamental asymmetry of nature called CP violation.

EarthScope: US Array and San Andreas Fault Observatory at Depth (SAFOD) [2] – a distributed, multi-purpose geophysical instrument array that will allow scientists to make major advances in our knowledge and understanding of the structure and dynamics of the North American continent. These observational facilities provide a framework for broad integrated studies across the earth sciences, including research on earthquakes and seismic hazards, magmatic systems and volcanic hazards, lithospheric dynamics, regional tectonics, continental structure and evolution, and fluids in the crust. EarthScope investigations will be done in close partnership with local and state governments, federal agencies such as the U.S. Geological Survey, and with Canada and Mexico when investigations border on those countries.

GEMINI – an international collaboration that is building 8-meter telescopes in both the Northern and Southern Hemispheres. Observatories are located in Mauna Kea, Hawaii and Cerro Pachon, Chile. Gemini will offer world-class and unique opportunities to the scientific community both in the infrared optimization of the telescope and in the use of adaptive optics.

High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER) [2] **–** a medium sized jet aircraft capable of operating in the upper troposphere to lower stratosphere and associated next-generation instrumentation, which will allow research on many of the outstanding issues in the atmosphere, biosphere, hydrosphere and cryosphere.

Incorporated Research Institutions for Seismology (IRIS) – facility to provide rapid analysis of earthquakes, aid in monitoring nuclear proliferation, permit imaging of the internal physical structure of the Earth, and make data on seismic events available to researchers worldwide.

Large Hadron Collider (LHC) [2] – an international project housed at the CERN laboratory in Switzerland, the LHC will be the world's highest energy accelerator facility. The LHC will enable a search for the Higgs particle, the existence and properties of which will provide a deeper understanding of the origin of mass of the known elementary particles. It will also enable a search for particles predicted by a powerful theoretical tool framework known as supersymmetry which will provide clues as to how the four known forces evolved from different aspects of the same "unified" force in the early universe.

Laser Interferometer Gravitational Wave Observatory (LIGO) – The LIGO construction project began in FY 1992 as a collaboration between physicists and engineers at the California Institute of Technology and the Massachusetts Institute of Technology to test the dynamical features of Einstein's theory of gravitation and to study the properties of intense gravitational fields from their radiation. Today, several other institutions are also involved. LIGO consists of identical, but widely separated detectors, one in Hanford, Washington, and the other in Livingston, Louisiana, that will be used for fundamental physics experiments to directly detect gravitational waves and gather data on their sources.

Millimeter Array [2] – a memorandum of understanding merging U.S. and European design and development efforts for an expanded array to be called the Atacama Large Millimeter Array (ALMA) was signed between the National Science Foundation and a consortium of European institutions and funding agencies. ALMA will be the world's most sensitive, highest resolution millimeter-wavelength telescope, operating in the wavelength range from 3 to 0.4 mm. It will combine an angular resolution comparable to that of the Hubble Space Telescope with the sensitivity of a single antenna nearly 100 meters in diameter. The array will provide a testing ground for theories of star birth and stellar evolution, galaxy formation and evolution, and the evolution of the universe itself. It will reveal the inner workings of the central black hole "engines" which power quasars, and will make possible a search for earth-like planets around hundreds of nearby stars.

Major Research Instrumentation program (MRI) – designed to improve the condition of scientific and engineering equipment for research and research training in our nation's academic institutions. This program seeks to improve the quality and expand the scope of research and research training in science and engineering, and to foster the integration of research and education by providing instrumentation for research-intensive learning environments.

National Superconducting Cyclotron Laboratory (NSCL) – located at Michigan State University, this facility provides important research opportunities to the community with particular emphasis on nuclear astrophysics.

Nanofabrication – a network of five university user facilities that offer advanced nano- and micro-fabrication capabilities to researchers in all fields.

National Astronomy and Ionosphere Center (NAIC) – the 305-meter-diameter radio and radar telescope located at Arecibo, Puerto Rico. NAIC is a visitor-oriented national research center devoted to scientific investigations in radio and radar astronomy and atmospheric sciences. NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters, movable line feeds, and digital data acquisition and processing equipment.

National Science, Mathematics, Engineering and Technology Education Digital Library (NSDL) – NSDL's goal is to advance the methods used to collect, store, organize and use widely distributed knowledge resources that contain diverse types of information and content stored in a variety of electronic forms.

National Center for Atmospheric Research (NCAR) – serves the entire atmospheric sciences research community and part of the ocean sciences community. Facilities available to university, NCAR, and other researchers include an advanced computational center providing resources and services well suited for the development and execution of large models and for the archiving and manipulation of large data sets. NCAR also provides research aircraft that can be equipped with sensors to measure dynamic, physical, and chemical states of the atmosphere. In addition, one airborne and one portable ground-based radar and other surface sensing systems are available for atmospheric research.

National Ecological Observatory Network (NEON) [2] – 10 observatories nationwide that will serve as national research platforms for integrated, cutting-edge, interdisciplinary research in field biology. Collectively, the network will form a large array that will allow scientists to conduct experiments on ecological systems at all levels of biological organization from molecular genetics to whole ecosystems and across scales ranging from seconds to geological time and from microns to regions and continents. Part of the Biocomplexity in the Environment Initiative.

National High Field Fourier Transform Ion Cyclotron Resonance (FT-ICR) Mass Spectrometry Center – a chemistry facility used to measure the atomic composition of complex molecular systems; part of the National High Magnetic Field Laboratory.

Network for Earthquake Engineering Simulation (NEES) [2] – a project funded through the MRE account that will upgrade, modernize, expand and network major facilities including: (a) shake tables used for earthquake simulations; (b) large reaction walls for pseudo-dynamic testing; (c) centrifuges for testing soils under earthquake loading; and (d) field testing facilities.

National High Magnetic Field Laboratory (NHMFL) – supports the research needs of materials scientists and other researchers in broad-spectrum science and technology. A team of researchers from the National High Magnetic Field Laboratory (NHMFL) has conducted the first experiments in continuous magnetic fields of 45 tesla (one million times the Earth's magnetic field) in a new hybrid magnet. This new magnetic field strength gives scientists a new scale of magnetic energy to create new states of matter and probe deeper into electronic and magnetic materials than ever before.

National Optical Astronomy Observatory (NOAO) – a national center for research in ground-based optical and infrared astronomy and solar physics. NOAO includes Kitt Peak National Observatory outside Tucson, Arizona; Cerro Tololo Inter-American Observatory in Chile; and the National Solar Observatory in Arizona and New Mexico. Large optical telescopes, observing equipment, and research support services are made available to qualified scientists.

National Radio Astronomy Observatory (NRAO) – headquartered at Charlottesville, Virginia, and operates radio telescopes at sites in Arizona, New Mexico, and West Virginia. NRAO makes radio astronomy facilities available to qualified visiting scientists and provides staff support for use of the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from astronomical objects.

Ocean Drilling Program (ODP) Facilities – infrastructure associated with the Ocean Drilling Program (ODP). ODP activities are an international exploration of Earth's crust beneath the ocean revealing the composition, structure, and history of the submerged portion of Earth's surface. Ocean drilling involves logging and collecting geologic samples from the floor of the deep ocean basins through rotary coring and hydraulic piston coring.

Partnerships for Advanced Computational Infrastructure (PACI) – provides access to, and support for, high-end computing for the national scientific and engineering community, and the development and application of the necessary software, tools and algorithms for their use on scalable, widely distributed resources. Emphasis will be on scaling applications codes to be ready for transitions to the Terascale Computing Systems and access and visualization techniques for very large data resources to support research in disciplinary areas. The education, outreach and training component of PACI will continue to broaden and accelerate the capability of the nation to utilize the advanced computational capabilities being developed.

Polar Aircraft Modernization (LC-130s) [2] – funding to upgrade ski-equipped aircraft to meet Air Force standards. These aircraft are part of Antarctic and Arctic logistical support.

Research Resources – focuses on the infrastructural tools necessary to perform state-of-the-art scientific research. It includes databases and the informatics tools and techniques needed to manage them, multi-user instrumentation, development of instrumentation and new technologies, living stock centers, and marine laboratories and terrestrial field stations.

Science & Technology Policy Institute (STPI) (formerly CTI) – a federally funded R&D center established by Congress to support devising and implementing science and technology policy.

Science Resources Studies (SRS) – a division within the Social, Behavioral and Economic Sciences directorate (SBE), responsible for collecting, analyzing and disseminating data on the science and engineering (S&E) enterprise.

South Pole Station [2] – modernization of the existing South Pole Station. Costs include materials, labor, logistics for transportation of all materials and personnel to the South Pole, construction support, inspection and equipment, as well as demolition and disposal. The goals of the modernization are to maintain a U.S. presence in accord with national policy, provide a safe working and living environment, provide a platform for science, and to achieve a 25-year station life.

Terascale Computing Systems [2] – provides access to scalable, balanced, terascale computing resources for the broad-based academic science and engineering community served by NSF; part of the Information Technology Research Initiative

<u>Other Facilities</u>

Geosciences (GEO) Facilities – include multi-user accelerator-based mass spectrometers and synchrotron beamlines, and facilities to support the scientific use of the Global Positioning System.

Materials Research Facilities – include the National High Field Mass Spectrometry Center, NIST Neutron Scattering Facility, Cornell High-Energy Synchrotron Source (CHESS), and Wisconsin Synchrotron Radiation Center.
Physics Facilities – include the Indiana University Cyclotron Facility (IUCF) and the Cornell High-Energy Synchrotron Source (CHESS).

INITIATIVES — In addition to support for core research, education and tools, NSF emphasizes priority investments in interdependent areas which cut across the People, Ideas and Tools goals. These areas combine exciting opportunities in research and education with immense potential to generate important benefits to society. The FY 2001 Budget Initiatives are:

- Information Technology Research (ITR)
- Biocomplexity in the Environment (BE)
- 21st Century Workforce
- Nanoscale Science and Engineering

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1 National Science and Technology Council Crosscuts

2 Major Research Equipment Programs – The Major Research Equipment account provides funding for the construction and acquisition of major research facilities that provide unique capabilities at the cutting edge of science and engineering. Projects supported by this account are intended to expand the boundaries of technology and will offer significant new research opportunities, frequently in totally new directions, for the science and engineering community. Operations and maintenance costs of the facilities are provided through the Research and Related Activities (R&RA) account.

HOW WE OPERATE

We enable *people to perform by investing in their creative ideas, providing them with cutting-edge research and education tools, and supporting an infrastructure for education and learning.*

We partner *with a dynamic and diverse education and research community, working in a close trusting partnership while maintaining an independent perspective. We encourage partnerships among agencies, industry, academe, the states, and other nations when collaborative efforts further our goals.*

We integrate *and synergize the knowledge and skills of diverse disciplines and constituencies. We promote the mutual sharing of knowledge and resources. We integrate the processes of discovery, innovation and learning, and connect them to societal use.*

We embrace *competitiveness in all of our programs and activities. We optimize the efficiency and effectiveness of our investments through the use of the competitive merit review process and peer evaluation of programs and activities.*

We manage and communicate *in a professional and effective manner. We listen intently to our customers, valuing their ideas and opinions. We effectively build consensus for new ideas and directions. We clearly articulate and communicate our values, plans, and activities so that customers and constituencies know what to expect of us. We provide the very best service possible to our customers.*

We include *all citizens, groups and constituencies, and promote equal opportunity for all. We work to ensure that the scientific and engineering workforce is as extensive and diverse as possible in order to create a more inclusive and robust enterprise.*

OUR ATTRIBUTES

We continually refresh our plans and strategies to assure that the agency will be:

Open **-** *NSF is committed to the sharing of information and a free marketplace of ideas. It demonstrates an openness and facility for relating to all key constituents within and outside the organization.*

Inclusive *– NSF takes a holistic view of opportunities and challenges, embracing diversity in all activities and at all levels.*

Inspiring *– Through leadership and creative flair, NSF inspires agency staff and the community it serves to strive for the greatest levels of accomplishment. The community seeks out NSF for its quality and reliable perspective, insights and offerings. NSF has earned an international reputation that makes the agency a benchmark for other science and engineering agencies throughout the world.*

Pace-setting *– In identifying and supporting ideas with the greatest creativity, embracing new thinking, and using information technologies in innovative ways, NSF helps chart new paths for the science and engineering community.*

Influential *– In both the global community and the corridors of science and technology policymakers, NSF is viewed as a creative catalyst – credible, relevant and timely – as well as an excellent, statesperson-like organization that brings together other high-level decision makers.*

Agile *– NSF quickly and effectively responds to changing needs and opportunities. It embraces change through effective systems-thinking and appropriate feedback mechanisms. NSF is a learning organization that is committed to self-improvement.*

Accountable *– NSF builds public trust by being professional, practical and orderly in its operating standards and how it manages its business. NSF and its staff are committed to excellence as a personal and an organizational standard.*

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Enclosure (2):

Consultation and Outreach Process

In developing the NSF GPRA Strategic Plan for FY 2001-2006, NSF consulted broadly with the science and engineering community and others who are concerned about the vitality of U.S. science and engineering. Specific comments were solicited from the following groups:

National Science Board
House Committee on Science
Senate Committee on Governmental Affairs
Office of Management and Budget
NSF Staff Members
NSF Advisory Committees

In addition, NSF solicited the comments of the broad science and engineering community and the public through press coverage and through direct contacts among staff, universities, and professional associations. In December 1999, the draft strategic plan was posted for several months on the NSF Website, with a response form to facilitate suggestions and reactions.

As a result of the input from these groups, NSF made many changes to the document - - most were editorial but many were substantive. This input greatly improved the document itself and its value to NSF and the community.

The National Science Board, NSF's governing body, had a dual role in developing this plan. First, the 24 members of the Board provided a great depth and breadth of expertise in providing individual comments. Secondly, the full Board approved the final document.

OMB Circular No. A-11 (2000) requires agencies to discuss contrary views. Early in the process of developing the document, NSF did receive a number of contrary views. However, it was able to resolve almost all of these views in ways that improved the plan.

The only comment that was not completely resolved had to do with the specificity of the strategic outcome goals. Some people considered the outcome goals too broad; they said they would like to see some long-range (ten year-type) goals with measurable indicators.

While NSF's broad goals don't specify time periods for completion. OMB Circular A-11 states "that when general goals are defined in the strategic plan in a way that precludes direct future determination of achievement, the performance goals and indicators in the annual plan should provide the basis for such determination." Hence, we intend to develop more specific performance goals in the annual performance plan.