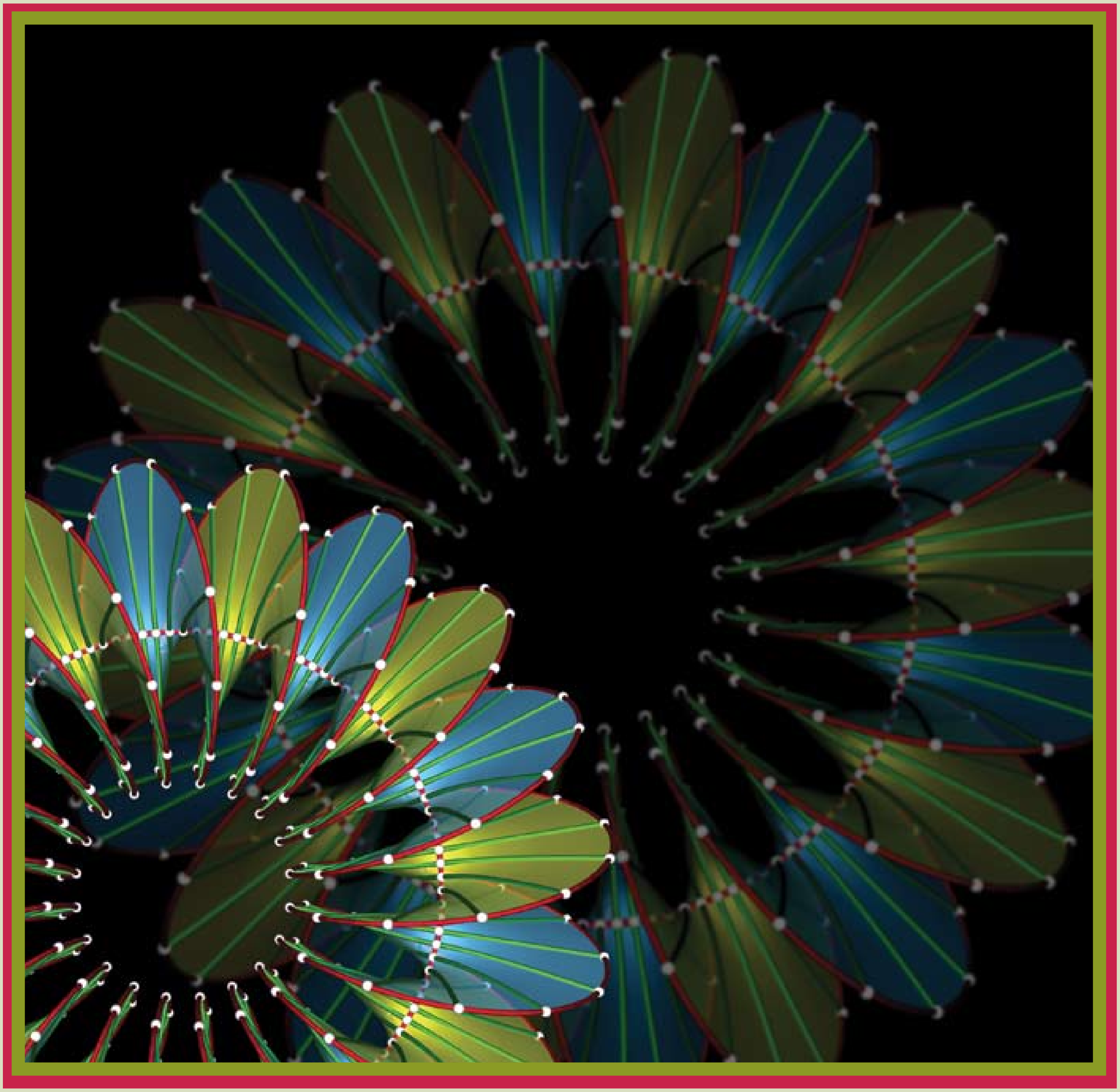
National Science Foundation

# INVESTING IN AMERICA'S FUTURE

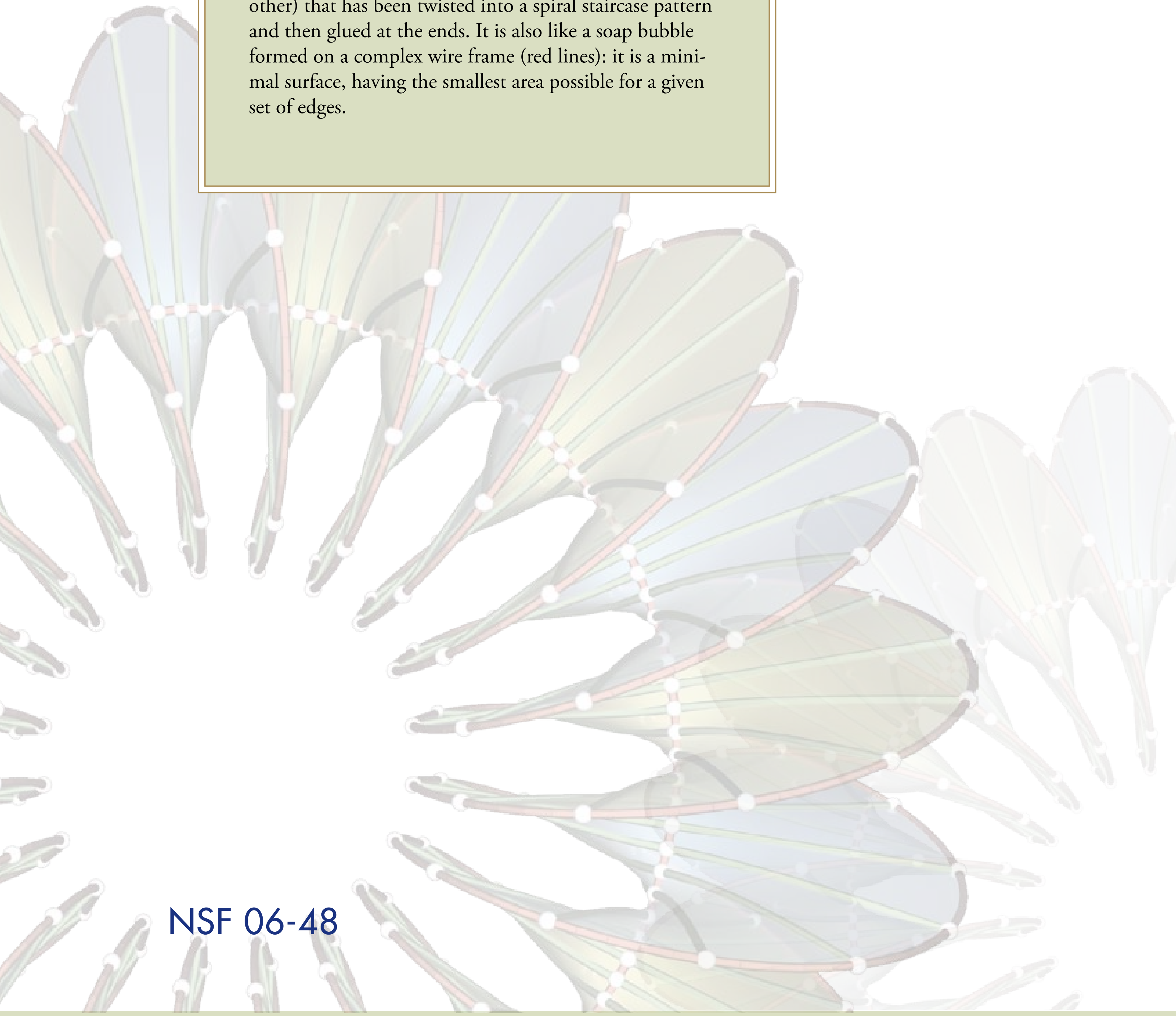


## STRATEGIC PLAN

FY 2006-2011

# ABOUT THE COVER

The cover graphic shows two views of a "circular bent helicoid," a new type of mathematical object discovered by NSF-funded researchers in 2005. The helicoid surface resembles a flat ribbon (blue on one side, green on the other) that has been twisted into a spiral staircase pattern and then glued at the ends. It is also like a soap bubble formed on a complex wire frame (red lines): it is a minimal surface, having the smallest area possible for a given set of edges.



NSF 06-48

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# I. INTRODUCTION: STRATEGIC PLANNING IN A CHANGING LANDSCAPE

The National Science Foundation (NSF), created over 50 years ago, is the premier Federal agency supporting basic research at the frontiers of discovery, across all fields, and science and engineering education at all levels. Research supported by NSF—selected through competitive, merit-based review—has fueled many important innovations, stimulating economic growth and improving quality of life and health for all Americans. NSF actively participates in shaping an increasingly dynamic and vigorous science and engineering enterprise. Today, the President's American Competitiveness Initiative (ACI) has provided new vision for sustaining our nation's competitive edge through innovation, exploration, and ingenuity. The NSF Strategic Plan addresses this changing landscape and new vision, and will ensure our continued leadership in this new era.

## A. Increasing Pace, Scope and Impact

Scientific discoveries are emerging at an accelerating pace in virtually every field, transforming the science and engineering landscape and opening entirely new territory for exploration. The generation of knowledge—requiring fresh ideas and creative people—takes place in a dynamic, complex, and competitive international environment.

Already visible on the horizon are path-breaking new avenues for investigation that were unimaginable only a few years ago. Building on decades of fundamental research, investigators are creating models of increasingly complex systems across multiple disciplines and scales. A deeper understanding of complex systems may help explain how networks of cells communicate, how species interactions create the biosphere, how simple human interactions collectively yield complex social behavior, and how basic physical forces power atmospheric and oceanic movements.

Science and engineering increasingly address global questions of significant societal importance. Today's research requires globally-engaged investigators working collaboratively across agencies and international organizations to apply the results of basic research to long-standing global challenges such as epidemics, natural disasters and the search for alternative energy sources.

### Responsibilities

The National Science Foundation Act of 1950, as amended, authorizes and directs NSF to initiate and support:

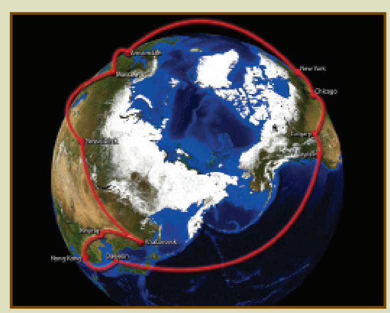
- Basic scientific research and research fundamental to the engineering process;
- Programs to strengthen scientific and engineering research potential;
- Science and engineering education programs at all levels and in all fields of science and engineering; and
- An information base on science and engineering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

*NSF supports innovative and stimulating education initiatives from pre-kindergarten to postdoctoral levels.*

### Additional Responsibilities

Legislation and Presidential Directives added new requirements for NSF over time, including:

- Fostering the interchange of scientific and engineering information nationally and internationally;
- Maintaining facilities in the Antarctic and promoting the U.S. presence through supporting and managing a vigorous U.S. national research program in the Arctic;
- Supporting the development of computer and other methodologies; and
- Addressing issues of equal opportunity in engineering.



*The Global Ring Network for Advanced Applications Development (GLORIAD) provides data exchange for scientists around the world.*

### B. New Modes of Investigation

The conduct of science and engineering is changing and evolving. This is due, in large part, to the expansion of networked cyberinfrastructure and to new techniques and technologies that enable observations of unprecedented quality, detail and scope. Today's science employs revolutionary sensor systems and involves massive, accessible databases, digital libraries, unique visualization environments, and complex computational models. Emerging areas of research exploit exciting new tools such as genomic sequencing, materials processing at nanoscales, and single-molecule chemistry. These advances have not only made it possible to reach the frontier faster; they have also increased by orders of magnitude the levels of complexity open to exploration and experimentation. Understanding complexity and learning how best to harness these new capabilities are both a challenge and a responsibility. The path is now open to address age-old questions that could not be approached before. Despite the unprecedented nature of these transformations, change of even greater magnitude is likely as understanding, tools and technologies continue to progress.

Discovery increasingly requires the expertise of individuals with different perspectives—from different disciplines and often from different nations—working together to accommodate the extraordinary complexity of today's science and engineering challenges. The convergence of disciplines and the cross-fertilization that characterizes contemporary science and engineering have made collaboration a centerpiece of the science and engineering enterprise. The Internet has clearly demonstrated, on local to global scales, that an integrated cyberinfrastructure will be of ever-increasing significance for any nation that aspires to reap the benefits of new knowledge and innovation in the future.

The changes brought about by revolutionary discoveries and technologies are also altering global economic and social landscapes. Frontier research, innovation, technological infrastructure and an educated population are powerful forces for economic growth and social prosperity. This recognition is raising national aspirations and shifting science, engineering and technology from the periphery into the mainstream of policy attention and action. To maintain the U.S. position at the forefront of discovery and innovation, the ACI includes a commitment to double investment over 10 years in key Federal agencies—including NSF—that support basic research in the physical sciences and engineering.

### C. Improving Education and Workforce Development

Scientists and educators are working collaboratively to increase the effectiveness of math and science education. Discovery-based learning—from hands-on activities in kindergarten to public participation in research sample collection—is becoming an integral feature of formal and informal education at all levels. As new practices take root, they are transforming education research and practice in ways that are not yet well understood. Science, technology, engineering and mathematics (STEM) education at all levels continues to benefit from information, communications and other new technologies, with their potential for more engaging and inclusive learning and discovery. Access to interactive data sets, simulations, and up-to-date research results, as well as the opportunity to interact with researchers, has increased rapidly in K-12 classrooms and in complementary informal science education venues.

The current science and engineering workforce is aging. To meet continuing, strong demand, it will be important that every American has an opportunity to achieve in mathematics and science. Women, minorities and persons with disabilities remain underrepresented in STEM professions while they are an increasing percentage of the overall U.S. workforce. Alternative and diverse approaches to excellence in education and mentoring

#### NSF Proposals and Awards

Each year, NSF oversees about 35,000 active awards directly supporting more than 175,000 people—teachers, students and researchers at every education level and across all disciplines in science and engineering. Merit review results in about 10,000 new awards each year from over 40,000 proposals submitted by the research and education communities.

*NSF supports a wide range of research and education in dozens of disciplines throughout the nation and the world.*

create opportunities to tap America's potential. Additionally, some regions of the country are still building the critical mass of research and innovation capacity that can propel them into the mainstream of the knowledge economy.

The U.S. has long benefited from an open-door policy that welcomes science and engineering talent from abroad. Other nations are now adopting this policy, as well as providing incentives for students to pursue their education at home or to return from abroad. Increasing international competition and workforce mobility, combined with a surge in international collaboration in science and engineering research, continue to alter the science and engineering landscape worldwide. To lead within this broader global context, the U.S. science and engineering workforce must build greater capacity for productive international collaboration.

## D. Taking Action

The National Science Foundation's Strategic Plan takes a focused approach to meeting the opportunities and challenges presented by key factors on the science and engineering horizon. NSF acts as a change agent to shape this dynamic environment positively. We will support transformational research and promote excellence in science and engineering education in ways that will fuel innovation, stimulate the economy, and improve quality of life. We will also nurture the vibrant and innovative science and engineering enterprise necessary to achieve these goals and stimulate broader participation in this enterprise throughout the nation. Working to broaden participation in science and engineering reinforces NSF's mandate to fund the best ideas from the most capable researchers and educators, now and in the future.

The strategic goals in this plan look toward and beyond today's horizons. They provide an overarching framework for progress in fundamental research and education that leaves ample room to experiment and adapt to changing circumstances. A set of programs, derived from our strategic goals, will be evaluated by the Office of Management and Budget (OMB) Program Assessment Rating Tool (PART[1]) process. NSF is committed to the highest standards of accountability, and takes responsibility for sustaining the highest degree of public trust.

1. See www.expectmore.gov

### Materials World Network

As the world's economies grow increasingly interdependent, international research partnerships are growing in importance. The ability to develop collaborations that create new value for the partners is often the limiting factor for progress in critical areas of science, engineering and technology. NSF supports international partnerships that foster cooperation, build global research capacity, and advance the frontiers of science for the benefit of all.

A case in point is the Materials World Network, a global community of researchers and educators working across borders and disciplines, in developed and developing countries, to accelerate materials discovery and design. From the first alloying of bronze to the plastics revolution to the advent of biomaterials, the design of materials to fit our needs has transformed society. Now, materials scientists are on the brink of another revolution—designing and engineering materials by building in special properties, atom by atom. Such new materials may help to increase energy efficiency, promote green manufacturing, improve health care, develop information and communications systems, and provide modern and reliable transportation and civil infrastructure. To maximize the global benefits, NSF together with partners from abroad established the Network, which now reaches nearly every region of the world. The Network brings together a diverse community to address global challenges through materials research, technology, and education. Strategic project areas include research, education, facilities, and cyber-infrastructure.


*NSF sponsors and encourages many international collaborations such as this 2005 meeting in Morocco.*

# II. MISSION AND CORE VALUES

NSF invests in the best ideas generated by scientists, engineers and educators working at the frontiers of knowledge, and across all fields of research and education. Our mission, vision and goals are designed to maintain and strengthen the vitality of the U.S. science and engineering enterprise.

## A. Mission

***To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense (NSF Act of 1950)***

This mandate to support American science and engineering, first articulated in *Science, the Endless Frontier*[2], continues to guide and inspire us to advance the frontiers of science and engineering knowledge.

## B. Core Values

The NSF core values are essential and enduring tenets that influence everyone in the organization and support our mission. The distinctive culture they generate gives NSF integrity and unique character. At NSF, we are

- ***Visionary:*** imagining the future, working at the frontier, realizing the full potential of people, furthering promising ideas wherever and whenever they arise, and encouraging creativity and initiative.
- ***Dedicated to Excellence:*** continually improving our ability to identify opportunities; investing optimally the resources entrusted to us; managing a diverse, capable, motivating organization; rewarding accomplishment; and sharing our best insights with others.
- ***Broadly Inclusive:*** seeking and accommodating contributions from all sources while reaching out especially to groups that have been underrepresented; serving scientists, engineers, educators, students and the public across the nation; and exploring every opportunity for partnerships, both nationally and internationally.
- ***Accountable:*** operating with integrity and transparency, maintaining quality and relevance in administration, management and oversight.

2. Bush, V. (1945). http://www.nsf.gov/about/history/vbush1945.htm.

### Our Partners

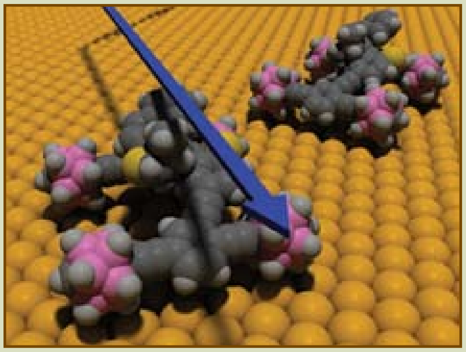
NSF draws on the vision of the research and education community for creativity and for innovative ideas that move science and engineering across new frontiers. Equally dedicated to excellence, we work together to review thousands of proposals and identify the exceptional ones that will become part of the NSF investment portfolio. We ask the community to include diverse perspectives as they explore new opportunities and partnerships, while we attempt to broaden our own.

### Nanoscience and Nanotechnology

Research advances at the nanoscale continue to inspire new technologies that will have a profound impact on society and will enhance U.S. economic competitiveness, as called for in the ACI. Increasing control of matter and energy at the molecular level is already leading to revolutionary breakthroughs in such critical fields as advanced computing, communications, materials development and medicine:

- The nanofabrication of miniature electronic components may revolutionize information processing. From nanowire circuits to quantum dots to single-molecule transistors, recent advances promise a new generation of computing devices far smaller than today's, and with lower power requirements.
- In communications, nanostructures are dramatically reducing the size of signal-processing components and have led to unanticipated new abilities to control light beams for the next wave of photonic equipment.
- In medicine and biology, ultra-miniaturized sensors and fluid channels are ushering in a new era of tiny diagnostic and detection devices that can determine the presence of target compounds, and function as artificial taste and smell organs. Other devices use nanoscale structures to detect specific DNA strands or reagents, producing "laboratories on a chip."

As the lead federal agency for the National Nanotechnology Initiative, NSF provides critical support for efforts in fundamental nanoscale science and engineering, as well as research to understand the likely impacts of nanotechnology on society. The integration of education with research at this nanoscale frontier—whether in relation to the fundamental physical sciences, materials science, engineering, biological sciences, information science or social sciences—will be essential for developing the full cadre of researchers, technologists, engineers and skilled workers necessary for realizing the maximum benefit from this new field of knowledge.



*Rice University's "nanocars," only a few atoms wide, roll across a gold surface on single-molecule wheels.*

# III. VISION AND GOALS

Through our vision and leadership, NSF stays true to our core values as we move forward to realize our mission.

### A. VISION

***Advancing discovery, innovation and education beyond the frontiers of current knowledge, and empowering future generations in science and engineering.***

### B. STRATEGIC OUTCOME GOALS

The four interrelated goals—*Discovery, Learning, Research Infrastructure and Stewardship*—adopted by the National Science Foundation establish an integrated strategy to deliver new knowledge at the frontiers, meet vital national needs and work to achieve the NSF vision. Although these goals are similar to the previous Strategic Plan's goals of *Ideas, People, Tools and Organizational Excellence,* we have aligned the first three goals directly with the three strategic priorities recently established in the *National Science Board 2020 Vision for the National Science Foundation*[3], and have added the internally focused goal of *Stewardship.*

*3. NSB 05-142. http://www.nsf.gov/pubs/2006/nsb05142/nsb05142.pdf*

#### *DISCOVERY*

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

#### *LEARNING*

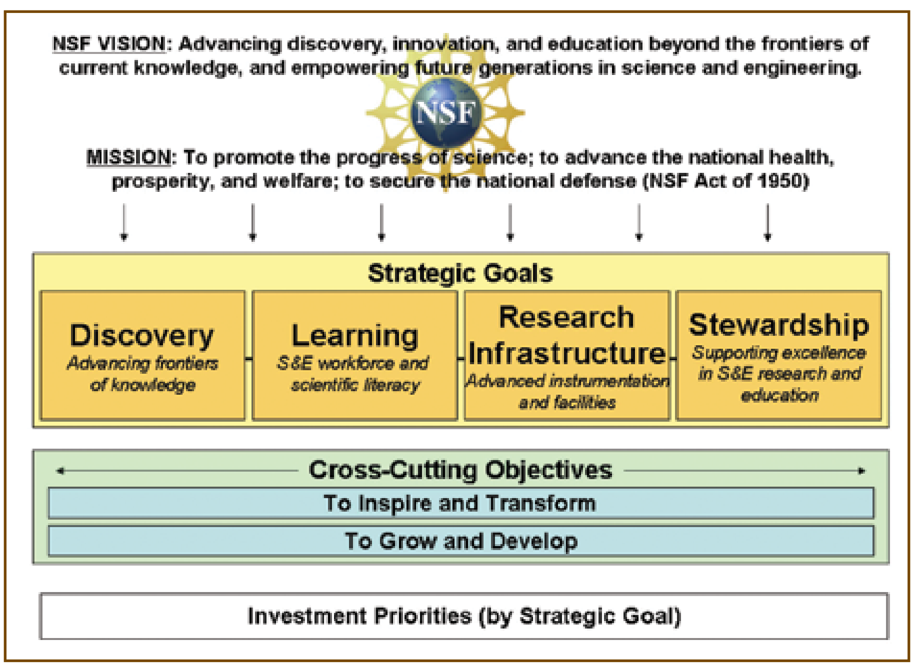
Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

#### *RESEARCH INFRASTRUCTURE*

Build the nation's research capability through critical investments in advanced instrumentation, facilities, cyberinfrastructure and experimental tools.

#### *STEWARDSHIP*

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



# IV. INVESTMENT PRIORITIES

NSF establishes well-defined priorities to allocate investment funds and internal resources effectively. The priority-setting process draws upon contributions from a broad cross section of the science and engineering community, including NSF Advisory Committees. The resulting priorities, along with NSF's investments supporting basic research across all fields, are central to maintaining the vitality of the U.S. research and education enterprise and demonstrate our commitment to eminence as a steward of the nation's resources.

Our ongoing portfolio of investments and continuing priorities are outlined in our annual budget submission. In addition, we list here a number of investment priorities, associated with our strategic goals, which NSF has identified for increased emphasis or additional funding during 2006-2011.

### A. Discovery

- ***Promote transformational, multidisciplinary research.*** NSF will emphasize investigations that cross disciplinary boundaries and require a systems approach to address complex problems (e.g., the neural basis of behavior, natural hazards and grid technologies) at the frontiers of discovery.
- ***Investigate the human and social dimensions of new knowledge and technology.*** NSF will integrate research on ethics, safety considerations and virtual communities from the outset in new research and in the applications of emerging technologies.
- ***Further U.S. economic competitiveness.*** NSF has a major role in the ACI. We will invest in basic research and in the tools of science to focus on fundamental discoveries that could have the potential to produce economically important technologies, processes, and techniques.
- ***Foster research that improves our ability to live sustainably on Earth.*** To strengthen our understanding of the links between human behavior and natural processes, research may range from investigations of deep oceans to urban centers and from basic energy science to climate science.
- ***Advance fundamental research in computational science and engineering, and in fundamental, applied and interdisciplinary mathematics and statistics.*** Beyond accelerating disciplinary progress, investments in these fields are needed to drive discovery in every science and engineering discipline and to power

#### East Asia and Pacific Summer Institutes

The frontier challenges of science and engineering are increasingly global. Future generations of the U.S. science and engineering workforce will need to collaborate across national boundaries and cultural backgrounds, as well as across disciplines. NSF's East Asia and Pacific Summer Institutes (EAPSI) program provides graduate students with a hands-on international research experience and an advantage in developing the problem-solving, teamwork and communication skills necessary to succeed in the global research arena. The EAPSI program prepares future U.S. scientists and engineers to competently engage in the rapidly expanding science and technology frontier of the East Asia and Pacific region.

Each year, the EAPSI program sends hundreds of U.S. science and engineering graduate students to Australia, China, Japan, Korea, New Zealand and Taiwan, where they work side by side with professors and peers from leading universities and laboratories on science and engineering challenges in those locations. The cross-cultural experience exposes EAPSI students to the diversity of ideas that drives innovation, and it prepares them for leadership roles in the global research enterprise. In recent years, participants have conducted research in areas ranging from humanoid robotics, nanofabrication and earthquake engineering to evolutionary biology, sensory integration, bionanomaterials and science and technology education.

For example, a behavioral biology student from Texas A&M University established a live Web "panda cam," at China's Wolong Nature Reserve, and completed a preliminary study on the ability of giant pandas to recognize their kin. Through the EAPSI, she opened a door for researchers and the broader public around the globe to observe the behavior of pandas in their natural habitat.

*A recent EAPSI project produced a novel Web-based surveillance system for studying panda behavior.*

the use of next-generation cyberinfrastructure and networking.

### B. Learning

- ***Build strong foundations and foster innovation to improve K-12 teaching, learning and evaluation in science and mathematics.*** NSF will support education research, develop model programs and effective assessment methodologies, and disseminate best practices towards helping students achieve and demonstrate proficiency in math and science. NSF will broaden partnerships with others, especially among federal and state agencies.
- ***Advance the fundamental knowledge base on learning, spanning a broad spectrum from animals and humans to machines.*** Fundamental knowledge—from neuroscience to socio-cultural dimensions—will permit researchers to address a wide range of societal challenges, including understanding how people learn, establishing best educational practices, improving workforce preparation, and facilitating the adoption and integration of new technologies in society.
- ***Develop methods to effectively bridge critical junctures in STEM education pathways.*** Methods will focus on junctures between K-12 and undergraduate scientific and technical education and will support continuous pathways to a variety of career options.
- ***Prepare a diverse, globally engaged STEM workforce.*** NSF will focus on broadening participation in STEM disciplines. We will work with academic and industry partners to ensure that STEM education and workforce preparation are broadly available, for the technical workforce as well as for future scientists and engineers, and provide the skills and knowledge needed to flourish in a global knowledge economy.
- ***Integrate research with education, and build***

#### International Polar Year (IPY)

NSF continually seeks out research opportunities with the potential to transform entire areas of science and engineering, and to propel understanding far beyond current frontiers. One highly visible example is the International Polar Year (IPY). From March of 2007 to March of 2009, NSF will lead an interagency effort to comprehend the Earth's extreme latitudes at scales from the global to the molecular, to train new researchers for careers in science and engineering, and to communicate to the public about the importance of the polar regions.

In the process, researchers will begin to answer some of the most profound questions in geoscience and biology. Among them:

- What is the history of the planet's vast ice sheets? How did they form, how did they respond to past climate patterns, how are they changing, and what is the prospect for rapid alteration?
- How does life adapt itself to extreme cold and prolonged darkness? How are those adaptations manifested in cellular structure and genome?
- What is happening in the Arctic? How are the region's physical, chemical, biological and human components interrelated? And how can we create a comprehensive, long-term observational network to supplant the scattered and uncoordinated record of measurements that now exists?

The International Geophysical Year 1957-1958 ushered in a new era of global science and international cooperation, witnessed the creation of more than 50 research stations, and paved the way for the Antarctic Treaty. Half a century later, the IPY will enable an even greater expansion in the depth and breadth of knowledge through multi- and interdisciplinary projects, the creation of long-awaited infrastructure, the collection of unprecedented datasets, and the creation of new, more expansive international collaborations.

*NSF's new South Pole Station will support IPY science initiatives from astrophysics to zoology.*

*The NSF-funded research station at Toolik Lake, Alaska will play a key role in the International Polar Year.*

***capacity.*** NSF will develop research and education capacity across the full spectrum of the nation's educational institutions, and utilize advanced cyberinfrastructure to transform the way we learn, teach and prepare an IT-literate workforce. NSF will renew a focus on 2- and 4-year colleges and minority-serving institutions, and will promote faculty enrichment programs, curricular improvements and access to research instrumentation. NSF will enhance opportunities for partnerships among community and technical colleges, 4-year colleges, and research-intensive universities.

- ***Engage and inform the public in science and engineering through informal education.*** NSF will improve STEM literacy by developing new strategies that explicitly encompass both formal and informal education, with a focus on strategies that have an impact on the nation's critical need for a citizenry literate in science and technology, a skilled workforce, and a vibrant research community. To have the greatest impact, NSF will encourage awardees, especially Centers, to broaden collaborations in order to leverage resources for outreach efforts.

## C. Research Infrastructure

- ***Fill the gaps in our ability to provide enabling research infrastructure.*** NSF will raise current limits on instrumentation funding opportunities, where appropriate, to allow for funding of needed mid-sized instrumentation.

### Informal Education

By the time our children reach the age of 18, they have spent approximately 12% of their lives in school, approximately 33% sleeping, and perhaps10-12% eating, bathing, and performing other daily routines. This leaves over 40% of time that is likely spent in informal or unstructured activity. It is safe to say that as much, if not more, actual learning takes place in this 40% as occurs in their formal education. This is why NSF invests heavily in informal math, science and engineering education, in addition to investments in curriculum development, teacher enrichment and formal education. If these subjects can be presented in ways that children (and adults) enjoy and choose for entertainment, the impact can be enormous.

Film is an entertainment medium of choice for most Americans, and athletes are our heroes. NSF partnered with the Partners Health Care, National Geographic and others to take viewers on a spellbinding ride through the Tour de France, and simultaneously through the human brain. The movie combines spectacular big-screen footage of the race with state-of-the-art computer animations of the human brain and describes how each new experience stimulates brain growth and adaptation, and how the brain responds to experience and challenge in ways we are only just beginning to understand.

Museums also play a major role in informal education, stimulating interest in science and technology through their exhibitions and programs. An example is the NSF-funded *Star Wars: Where Science Meets Imagination* developed by Boston's Museum of Science. Based on a collaboration with Lucasfilm Ltd., the exhibition takes advantage of popular culture to draw new audiences into learning about current scientific research and emerging technologies that relate to robotics and modes of transportation portrayed in science fiction. It stimulates interest and promotes technology literacy through interactive and immersive experiences, such as engineering "labs" where visitors can build and test their designs. Innovative hand-held multimedia devices allow visitors to bookmark content and e-mail it to themselves. This major traveling exhibition is on national tour, accompanied by educational programming for the public, students and teachers.

*"Star Wars: Where Science Meets Imagination," a traveling NSF-supported museum exhibition, prompts curiosity wherever it goes.*

*NSF funds educational film projects such as "Wired to Win," which combines neuroscience and the Tour de France.*

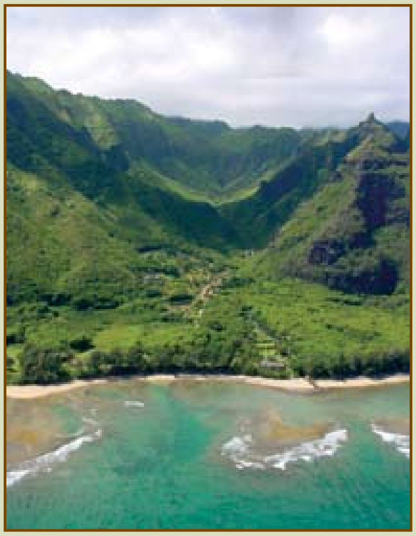
- ***Identify and support the next generation of large research facilities.*** NSF will work with the science and engineering community to identify the next generation of major equipment and facilities to enable transformational research. We will also fund the development of new capabilities, technologies, and instrumentation that could lead to the establishment of next-generation facilities.
- ***Develop a comprehensive, integrated cyberinfrastructure to drive discovery in all fields of science and engineering.*** NSF will initiate the first steps toward the development of a petascale computing facility; investigate the development of a next-generation Internet; and advance a wide variety of generic and domain specific cyberinfrastructure projects to further innovation in the field and to support global-scale research and education.
- ***Strengthen the nation's collaborative advantage by developing unique networks and innovative partnerships.*** NSF will connect science and engineering researchers and educators in academic organizations, industry and informal science institutions, both nationally and internationally, to leverage intellectual capabilities.

### D. Stewardship

- ***Strengthen our traditional partnerships and develop new collaborations with other agencies, organizations and corporations, identifying common goals that can unite and focus partnerships.***
- ***Expand efforts to broaden participation from underrepresented groups and diverse institutions in all NSF activities.*** NSF will continue to enforce its merit review policy and increase the diversity of reviewers; increase its competi-

#### Experimental Program to Stimulate Competitive Research (EPSCoR)

Our future prosperity depends on a continuous supply of knowledge and innovation—discoveries that will solve the challenges of today, and will tomorrow bring a better quality of life, new technologies and even completely new industries. But discovery doesn't just happen. It requires effective, interactive networks of scientists, engineers and educators to elaborate ideas; equipment and infrastructure to test those ideas; and diverse sources of support to help turn ideas into reality. A robust national network will have distributed capacity, employ the talents of a broad segment of the population, and sustain itself through excellence in education and infrastructure.



*In Hawaii, NSF-supported EPSCoR programs are enabling innovative research and education in ecology.*

Creating and sustaining those conditions is a major goal of NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). EPSCoR is a joint program of NSF and several U.S. states and territories that promotes the development of the states' science and technology resources through partnerships involving universities, industry, state and local government, and the Federal research and development enterprise. EPSCoR operates on the principle that aiding researchers and institutions in developing research capacity and infrastructure will maximize the potential for the state's research efforts to contribute solutions for society's challenges and advance economic growth.

A new West Virginia EPSCoR award will create a world-class research capacity in molecular recognition for biometric applications involving West Virginia University, Marshall University and West Virginia State University. The research could lead to robust, low-cost instruments with multiple applications in homeland security, health, forensic science and other fields. The program's partnership with West Virginia State University, a historically black university, will also target the integration of research with education and the recruitment of under-represented students and faculty into the state's science and technology enterprise.

*West Virginia students have sophisticated new resources and programs thanks to EPSCoR projects.*

Another recent EPSCoR award will exploit the unique environment of the Hawaiian Islands, a natural laboratory for investigating ecological and genetic factors that govern ecosystem evolution adaptation to environmental change. The award will fund cyberinfrastructure and advanced environmental sensor technology, evolutionary genetics and ecosystems research, educational outreach, and recruitment and retention activities focused on Hawaii's diverse population. It promotes exciting science; responsible stewardship of Hawaii's ecosystems; and the development of technologically literate, critically thinking citizens for Hawaii's 21st Century workforce.

tive awards investments in the participation of groups, types of institutions, and geographic regions underrepresented in STEM; and continue to increase the diversity of NSF's STEM workforce.

- ***Improve our processes to recruit and select highly qualified reviewers and panelists.*** NSF will recruit potential reviewers and automatically add new investigators to an integrated, Foundation-wide database of reviewers, establishing an increasingly diverse pool of highly qualified reviewers for future selection. Reviewers and panelists will reflect the diversity in our community.
- ***Recruit, hire and empower highly qualified professional staff members who reflect the diversity of our community.*** Program Officers, Division Directors and other science and engineering professional staff are the principal means by which NSF projects values and receives ideas from the science, engineering and education research communities. We must continue to attract and, for permanent staff, retain scientists, engineers and educators with the necessary expertise, experience and impeccable reputations to act as stewards of national research and education programs.
- ***Develop mechanisms to improve training and mentoring for Program Officers.*** NSF will increase efforts to identify and disseminate best program management practices. Training and development are particularly important for "rotators" who bring valuable expertise and new ideas to the organization but stay for a limited amount of time, normally less than two years. We expect program officers to exercise their professional judgment.
- ***Implement the NSF Human Capital Management Plan.*** This plan was developed to strengthen management of the NSF workforce. It includes measures to increase the timeliness of recruitment activities, to improve retention

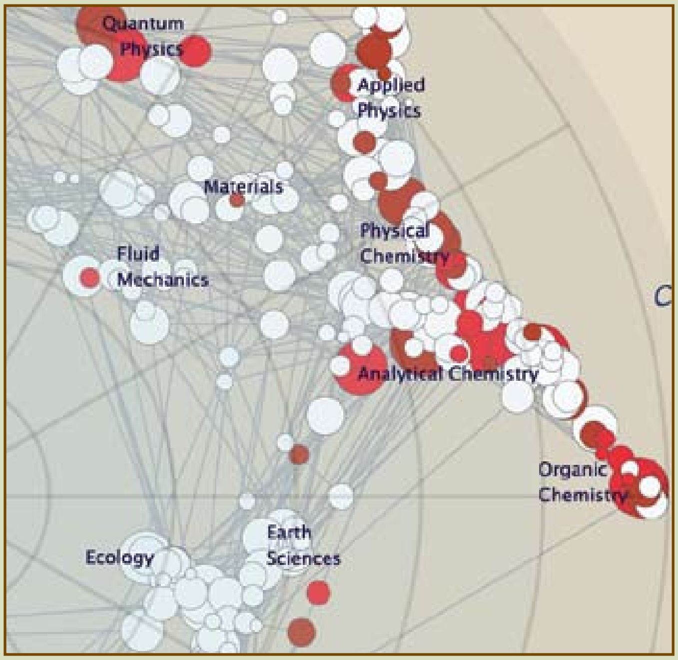
### SCIENCE OF SCIENCE POLICY

To maintain our nation's global competitiveness, as called for in the ACI, we need a better understanding of society's ability to generate and harness the latest in scientific and technological developments. NSF has begun a wide-ranging inquiry into the social science of science policy, investigating how the national research and development systems work, how to nurture innovation, how to measure science and technology indicators, and how to direct our investments. The long-term goal is to provide science policy makers with the same kinds of analyses and advice that economists now provide for the makers of fiscal and monetary policy. The NSF effort, which has two main components, will be coordinated with similar efforts in several other federal research agencies:

The measurement component seeks to develop a more scientifically rigorous, evidence-based approach to prioritizing research investments, and then monitoring the return on those investments. Research in this area will build upon NSF's already substantial effort in science and engineering statistics—by developing new kinds of measurements and analytical tools, and by forging easy-to navigate links among the databases that already exist, whether in the private sector, in local, state and federal agencies, or internationally.

The research component will seek to achieve an integrated understanding of national and global research and development systems and the process of innovation itself. The intent is to take as broad a view of the process as possible, bringing in perspectives from behavioral science, engineering, economics and virtually every other discipline supported by NSF.

Meanwhile, NSF-funded researchers are developing tools to help individual investigators and science managers navigate through a global knowledge store that is doubling every 18 months or so. A prime example is the fast-emerging field of "mapping science," in which advanced algorithms are used to correlate data from science and engineering databases such as publications, grants, patents and conferences, and to display the information as a two-dimensional map of a scientific area. This approach allows users to drill down to specific information on individual publications. But it also gives them vivid insight into rapidly evolving research areas and the relationships among them.




*Detail from a "map" of topics in the 820,000 most-referenced journal articles of 2003 reveals converging interests and connections.*

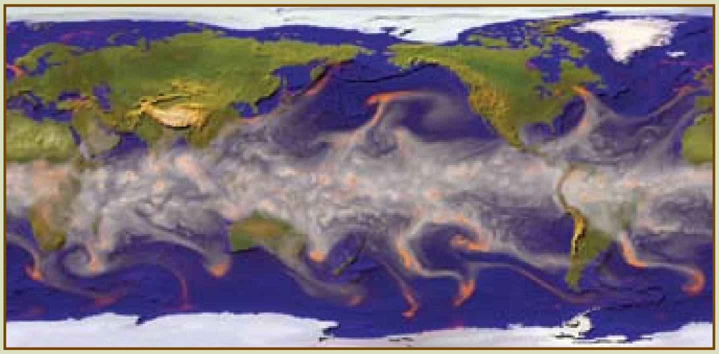
of employees, to enhance recognition of their achievements, and to provide employees with career development opportunities to meet future workforce requirements and challenges.

- ***Enhance NSF as a learning organization.*** NSF will provide continuing education, process enhancements, and opportunities to share best practices to enable continuous improvement. NSF will continue to be a great place to work and a model Equal Employment Opportunity (EEO) agency.
- ***Continue as an exemplar in science ethics.*** NSF will utilize standards, establish best practices, and implement institutional changes that maintain and further build public trust in this area.
- ***Improve the transparency, consistency and uniformity of the merit review process.*** NSF will ensure that ad hoc reviewers and panelists have the breadth and expertise for the set of proposals under their consideration, with special attention to the appropriate review of interdisciplinary and multidisciplinary proposals. Successful technologies and techniques will be expanded to aid in assigning proposals to the most appropriate panels. NSF will promote ways to boost the identification and funding of projects with the potential to transform fields of science and engineering research.
- ***Promote award balance and flexibility.*** NSF will identify and implement programmatic process improvements to achieve appropriate balance among proposal success rate, award size and award duration. NSF will encourage proposals with transformational potential, and will provide flexibility to respond to emerging opportunities and needs.
- ***Enhance processes for management and oversight of large facilities.*** NSF will improve its practices in the development, construction and operations of major research equipment and large facilities projects by implementing the revised guidelines outlined in our *Large Facilities Manual.*
- ***Reach out to the various communities we serve, especially through the use of cyberinfrastructure-enabled communications.*** NSF will utilize new information and communications technologies as they become available to achieve our mission and to communicate mission outcomes. NSF will be open and transparent in communications with the public.

### Climate Modeling

Understanding climate variability and change is of increasing importance as input for a wide range of national and international decision making. Knowing current and future trends in rainfall, temperature, storm frequency and intensity, snow cover and wind patterns—to name only a few—is critical to a host of social and economic activities, from insurance rates and agricultural production to the availability of drinking water and the spread of infectious disease. Recent advances in understanding the enormously complex interactions among the myriad components of the climate system have given researchers unprecedented insight into weather patterns and their causes. But numerous uncertainties persist. Dozens of possible cause-and-effect relations remain unconfirmed, and important connections between major components of the climate system (for example, the effect of ocean currents on terrestrial wind patterns, or airborne aerosols on cloud reflectivity) are insufficiently understood.

We cannot experiment on the weather; but through simulations with numerical models, scientists can test theories of the relationships between variables. NSF supports sophisticated climate models run on supercomputers that allow researchers to simulate and predict global and regional climate patterns. One of the most ambitious is the Community Climate System Model (CCSM)—a fully coupled, global climate model that provides state-of-the-art computer simulations of the Earth's past, present, and future climate states. The model is funded by NSF with additional support from the Department of Energy, NASA, and NOAA. It is housed at the National Center for Atmospheric Research (NCAR) and serves the broader climate science community. The model's underlying computer code and simulations data are freely available on the Web. As a result, hundreds of specialists at various institutions in the United States and overseas can use CCSM for their climate experiments.



*State-of-the-art climate models help researchers to understand and predict global weather patterns and to explore how variables are related.*

# V. TRANSLATING THE PLAN INTO ACTION

NSF welcomes the exciting opportunity to translate this plan into action. The Strategic Plan guides Directorate planning, the annual performance budget, and individual performance plans that link directly to NSF's mission, vision, goals and objectives. Implementation of this plan is the responsibility of the Assistant Directors, Office Heads and internal groups responsible for planning and performance. Individual performance appraisals will measure staff accountability. Annual metrics that track our progress will appear in the budget.

## A. Future Investment Considerations

The overall strategic goals and objectives are set by the National Science Board and NSF senior management in consultation with the science and engineering community and with additional guidance from the Office of Management and Budget, the Office of Science and Technology Policy, and Congress. Based on our strategic goals, NSF identifies key areas for future investment by balancing a variety of concurrent and equally important factors. These areas may reflect emerging opportunities of great promise, address pressing challenges, or respond to critical national needs. They may involve NSF-wide activities and require sustained levels of investment over many years, or they may be more narrowly focused and change from year to year as promising opportunities arise. Proposed investments will be evaluated against this matrix of considerations. (Individual projects are evaluated using the merit review criteria described in the Appendix.)

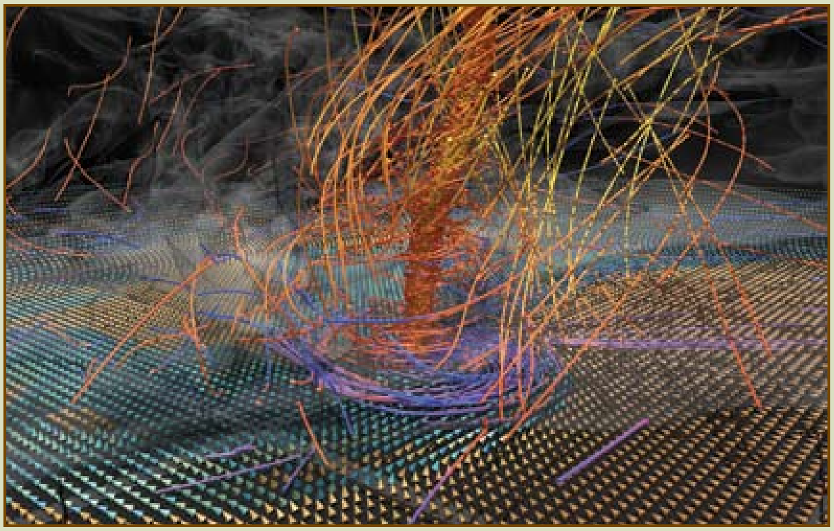
- ***Alignment:*** Align with NSF's mission, vision, goals, and objectives. Deciding factors include whether investments lie within the bounds established by the NSF Strategic Plan, effectively address multiple goals, and do not duplicate the efforts of other agencies or institutions.
- ***Budget:*** Balance investments with funding levels. Deciding factors include whether the proposed level of investment is commensurate

### Complexity and Emergence

Nature abounds with examples of complex systems that show emergent phenomena, patterns of structure or behavior seen at one scale of a system that arise from interactions among system components at other scales of length, time, or number of components. Examples include the beating of a heart, the biological origin of a thought, the evolution of weather patterns, and the dynamics of some economic phenomena.

- Complex systems are ubiquitous and to understand them requires contributions from multiple disciplines. Recent mathematical achievements have advanced the study of complex problems in geospace. These problems couple phenomena occurring at atomic scales with those occurring at astronomical scales, for example through the study of electromagnetic processes that control plasmas.
- The cross-fertilization of ideas and methods from biology and chemistry with those from the physics of complex systems has led to new approaches to a variety of critical issues including the evolution and functioning of genetic regulatory networks, the specificity of protein-protein interactions, the dynamic control of cell motility, and the neural synaptic mechanisms underlying learning.
- Analogies from the life sciences are motivating the design of self-assembling and self-repairing materials.
- Communities of researchers—spanning engineering and geosciences to behavioral science—are working together to forecast, prepare for, and respond to natural and human-induced disasters.

NSF funding to improve understanding, modeling, and harnessing of complex systems will have far-reaching consequences across the entire spectrum of science and engineering.



*Computer visualization techniques improve comprehension of complex phenomena such as the formation of tornadoes.*

with the opportunity, level of risk, relevance, and potential impact.

- ***Integration of Research with Education:*** Strengthen connections between learning and inquiry. Deciding factors include whether investments present a rich environment for encouraging future scientists, engineers and educators, and whether they provide opportunities for teachers and students to participate in research activities at the K-12, undergraduate, graduate and postdoctoral levels.
- ***Leveraging Collaborations:*** Create a variety of opportunities for national and international collaboration. Deciding factors include whether investments augment other NSF activities; leverage other community, industry, federal agency or international investments in research, education and infrastructure; and broaden participation in science and engineering.
- ***Potential for Impact and Transformation:*** Promote ideas that are intellectually compelling, innovative and imaginative. Deciding factors include the extent to which investments may transform a field of science or engineering; are broadly significant or of great interest to the community; position the U.S. at the forefront of an emerging field; promote teaching, learning, mentoring, training and outreach; contribute to national research and development priorities; sustain economic competitiveness; or enable socially important outcomes.
- ***Urgency and Readiness:*** Capture timely opportunities. Deciding factors include whether timing is critical to achieve optimum results, or investment is necessary to maintain long-term stability and progress in critical areas.

## B. Objectives

NSF has identified two crosscutting objectives—*To Inspire and Transform* and *To Grow and Develop*—that apply to each goal and are essential to advancing the mission and vision. Expert evaluations, described in the Appendix, will periodically assess the progress in working toward these two objectives for each of the four strategic outcome goals.

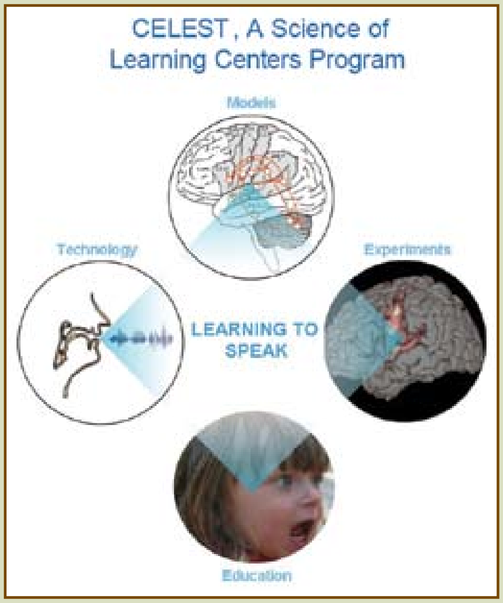
### *To Inspire and Transform*

NSF advances scientific discovery by supporting transformational and distinctive new capabili-

### NSF Centers

NSF Centers, (e.g., Science and Technology Centers, Engineering Research Centers, Science of Learning Centers) support interdisciplinary research of a scope, scale and complexity beyond the resources of any individual investigator or small group. Centers also provide rich environments for the multidisciplinary training and mentoring of undergraduate students, graduate students and postdoctoral fellows, as well as K-12 educational partnerships and public outreach. The Center model promotes opportunities for cross-fertilizations of ideas between and among theoretical and experimental scientists and students, as well as between the scientists and students and the educators and technologists who turn their results into real-world applications. One example is Boston University's Center of Excellence for Learning in Education, Science, and Technology (CELEST), a Science of Learning Center.

A Science of Learning Center seeks to advance our knowledge of learning in all its forms, from the digital to the societal, over as broad a range as possible. This may include the chemical and biological basis of learning; the psychological, social, organizational and pedagogical aspects of learning; machine learning; mathematical analyses and models of learning; and more. At CELEST, researchers study and model how the brain learns to adapt in real time to complex and changing environments. CELEST scientists address this question across multiple levels of analysis, from single neurons, to neural networks, to whole brain and behavior. To truly understand the linkages between brain and behavior, one must study each in conjunction with the other, from neurons and synapses, to sensory perception, to learning and memory, to complex behaviors. The development of new algorithms, based on knowledge of these processes, can then be used to solve outstanding technological problems presented by uncertain and ever-changing data. CELEST scientists also work with educators to bring models of how mind and brain work into math and science curricula at all instructional levels.




*NSF-supported centers bring together researchers from diverse fields to investigate phenomena such as language acquisition.*

ties—those innovations in research and education that move discovery well beyond the boundaries of current knowledge. NSF encourages this potential by emphasizing areas of greatest scientific opportunity, identified through input from the science and engineering community, and by igniting the creative spark that leads to revolutionary advances.

NSF cultivates the same creative spark in young people. We develop innovative pathways to engage them at the frontiers of discovery, facilitate their entry into the science and engineering workforce, and advance their early careers. NSF will inspire the next generation by promoting excellent science education, including timely access to exhilarating discoveries in classrooms, and by partnering with museums and other organizations that use informal science education to bridge the gulf between scientific advances and public understanding.

NSF supports the development and construction of infrastructure that gives researchers access to new territory impossible to explore without it, including multiple-use and distributed instruments and facilities, and comprehensive, next-generation cyberinfrastructure. We also support research on advanced tools and technologies to enable future generations of instrumentation and infrastructure.

NSF-funded centers enable academic institutions and their partners to integrate discovery, learning and innovation on scales that are large enough to transform important science and engineering fields and cross-disciplinary areas. Centers also provide unique opportunities for students to broaden their research horizons and industrial partners to interact with top academic researchers.

NSF seeks to be a trailblazer in its own administration and management, with organizational structures, learning environments, business practices and merit review processes that serve as models for research agencies around the world.

In all our activities, NSF endeavors to communicate the wonder of exploration and the excite-

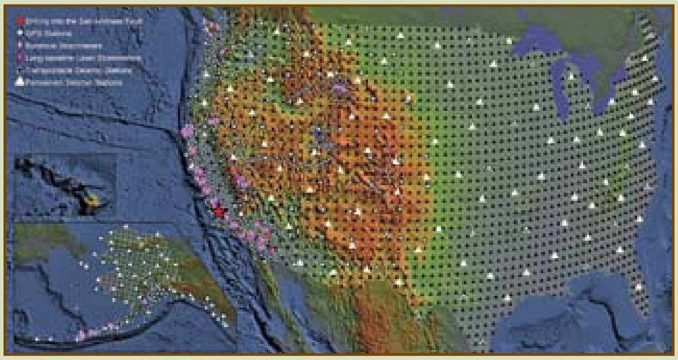
### Earthquake Science and Engineering

Earthquakes are among the most complex terrestrial phenomena. Taken from end to end, the challenge comprises understanding the loading and failure of tectonic faults, the generation and propagation of seismic waves, the response of surface sites and, in application to seismic risk, the damage caused by earthquakes to the built environment and the preparation and response of communities and disaster managers. Building on decades of funding earthquake-related science and engineering and seismic measurements, NSF is now poised to contribute to great new advances in our knowledge of the structure and evolution of the North American continent and understanding of earthquakes and seismic systems.

With NSF funding, the Southern California Earthquake Center (SCEC) has developed a community modeling environment for simulating earthquake processes using terascale computing facilities. Already, simulations have delivered new predictions about seismic hazards from California's San Andreas Fault system. During its next phase, SCEC will focus on three demanding science objectives: extending simulations of ground motions to investigate the limits of ground-motion prediction; improving the resolution of dynamic rupture simulations; and computing and validating seismic hazard maps.

The Network for Earthquake Engineering Simulation (NEES) is NSF's first distributed network cyberinfrastructure research facility. It is a national, shared-use experimental resource linking together 15 facilities located at universities across the U.S. The network enables collaboration and advanced research and education based on experimentation and computational simulations of earthquakes and how buildings, infrastructure, coastal regions and geologic materials perform during seismic events. NEES will advance understanding and improve the design and performance of the Nation's constructed civil and mechanical infrastructure when subjected to earthquake excitation and tsunamis.

The EarthScope Facility, a distributed, multipurpose geophysical instrument array, will provide the next-generation web of interrelated measurements required to fuel these and other earthquake-related research activities. The three major foci of EarthScope include a heavily instrumented drill hole that crosses the San Andreas Fault and will return unprecedented records of conditions within the seismogenic zone. Another is a dense array of permanent GPS stations and strainmeters in the western U.S. that will record deformation in and around earthquake prone regions. The third EarthScope component is the USArray, a combination of portable and permanent seismograph stations that will provide unprecedented images of the active earthquake regions throughout the continent. USArray instrumentation is expected to inhabit nearly every county within the U.S. over the lifespan of the program. Partners include USGS, NASA, the Department of Energy, and the International Continental Scientific Drilling Programme, and may also include state and local governments, geological and engineering firms, and Canadian and Mexican agencies. Over 3,000 earth scientists and students are expected to use the facility annually.



*The EarthScope program's USArray will provide a comprehensive network of interconnected sensors to explore seismic activity.*

ment of discovery and learning.

### *To Grow and Develop*

NSF will continue to strengthen fundamental research across the full spectrum of science and engineering. The majority of our research funding supports individual investigators and small groups of researchers. NSF support is particularly important in fields that are critical to the U.S. science and engineering enterprise but receive little support from other sources. NSF ensures the health of core science and engineering fields as they grow, develop and ultimately produce results that may refashion a discipline or lead to completely new fields of enquiry. We help support the underlying research enterprise that mission agencies and industry draw upon to accomplish their objectives.

NSF provides leadership within an extended network of research organizations and agencies; educational institutions, predominantly undergraduate institutions and universities; museums; professional societies; and small and large businesses—all engaged in science and engineering research and education. We encourage this broad array of institutions, in all locations throughout the nation and from every sector, to participate fully in the nation's science and engineering enterprise. NSF also broadens participation by drawing on all of the nation's talent and reaching out especially to underrepresented groups as we support programs that attract U.S. students and prepare them to be highly productive members of the global S&E workforce.

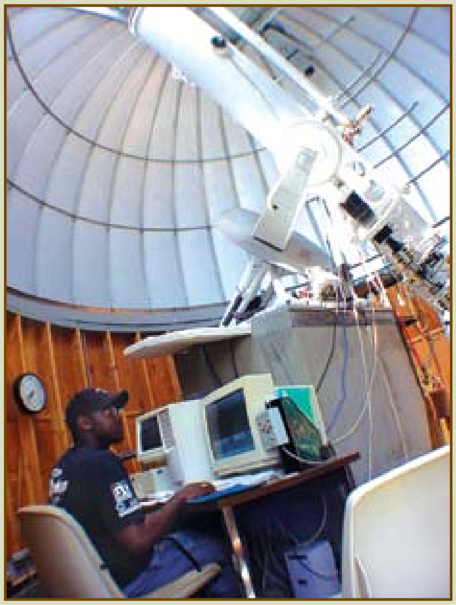
NSF is the principal source of support for investigations to improve science and engineering education from early childhood through undergraduate, graduate and postdoctoral studies, including public outreach, and for research that develops successful models for teaching and learning. Recognizing their essential partnership in this effort, NSF also supports science centers, aquaria, museums, and other organization that provide informal science education. NSF supports educational programming provided by a variety of media outlets through which many Americans acquire science information and additional learning. These efforts increase interest, engagement and understanding of science, engineering and tech-

#### Building Science and Engineering Capacity

NSF is exploring new models and new partnerships for encouraging the nation's young people to study science and engineering and broadening their participation in these fields. One critical time period for students considering science and engineering careers is the undergraduate years. NSF's Research Experiences for Undergraduates (REU) and Undergraduate Research Collaboratives (URC) reach out to a diverse range of science and engineering undergraduates. The excitement of participating in meaningful research can crystallize a career direction and provide the essential motivation for continued study. REU and URC awards particularly target students who might otherwise have no opportunity to participate in research during their critical undergraduate years.

The URC Program combines a focus on first- and second-year college students with striving to improve the research capacity, infrastructure and culture of participating institutions. Projects allow students to create new knowledge that is potentially publishable by providing exposure to research of contemporary scientific interest that is addressed with modern research tools and methods. The participation of two-year institutions that traditionally have been outside the research mainstream has been especially noteworthy. Nearly half of all undergraduate students attend community colleges. Without such programs, those students might otherwise overlook promising, productive careers in science and technology. Sample themes from projects already underway include biodiesel fuels; solar-energy conversion; chip-based chemical analyses; nanoscale materials; and molecular characterization of air, water and soil samples.

The REU program funds both sites and grant supplements. Supplements typically provide support for one or two undergraduate students to participate in research, as part of a new or ongoing NSF-funded research project. REU sites have a well-defined common focus that enables a cohort experience for students. One REU site is located at Prairie View A&M University in Texas, a historically black university. The students participate in frontier space weather and space physics research at the Prairie View Solar Observatory (PVSO), a one-of-a-kind facility. Undergraduates in the program have the opportunity for hands-on experience processing and analyzing data, producing professional reports, and working with multiple solar telescopes, as well as learning computer programming and computer simulation. PVSO faculty and research staff members mentor students in individual research experiences.



*Students at the Prairie View Solar Observatory get first-hand experience in gathering and analyzing research data.*

nology by individuals of all ages and backgrounds within a variety of different educational settings.

NSF will expand opportunities for U.S. researchers, educators and students at all levels to access state-of-the-art science and engineering facilities, laboratory instrumentation and equipment, databases, advanced computing resources, research networks and other infrastructure. We will ensure that large facilities supported by NSF, including observatories, research vessels and aircraft, large laboratories, polar facilities, distributed instrumentation networks and arrays, and other types of critical infrastructure, operate efficiently and effectively.

NSF aspires to be a learning organization that encourages, rewards and values the contributions of its talented staff. NSF leads and adapts to the changing nature of research as proposals become increasingly complex and interdisciplinary. Through constant attention, we combine business processes, human capital and information technology to continue to find and support excellence in science and engineering research and education. We promote professional integrity in this work and in the research and education we support.

## C. Communication

An essential part of communicating is listening. In developing the NSF Strategic Plan, we have listened carefully to the public, the science, engineering and education community, and our staff as they have given us comments on the previous plan and on drafts of the new plan. We developed the plan in consultation with the Office of Management and Budget and Congress, and coordinated the planning process with the development of the *National Science Board 2020 Vision for the National Science Foundation.* After the release of the plan, communication with NSF staff, the National Science Board and the larger community will continue through a variety of mechanisms. We will post the plan on the NSF website and disseminate it broadly to staff and the external community. We will present the plan to the Board and our Advisory Committees at their regular meetings, and discuss it throughout NSF in staff meetings and special presentations.

NSF will use a variety of approaches to achieve our goals and, under law, evaluate our progress against a set of yearly goals and performance metrics specified in the annual budget. Basic research presents special challenges for evaluation because outcomes from basic research often take years, sometimes decades, to understand and fully appreciate. NSF supports research on fundamental questions where directions and outcomes may be unexpected. This makes retrospective assessments of portfolios by experts (see Appendix for details) valuable, particularly when combined with the prospective assessments of projects inherent in the merit review process.

Strategic planning is an ongoing process. In concert with evaluating our progress against this plan, we will continue to solicit feedback from our staff, our advisors and the broad science, engineering and education communities to inform our next plan. As the world of science and engineering continues to change, NSF will always strive to achieve the same excellence in planning, execution and evaluation that we expect from the programs we fund.

### Fab Labs

Around the world, from high-school students to rural farmers, people are now being given the opportunity to design and fabricate sophisticated devices from scratch, thanks to an NSF-supported program called "Fab Lab." Short for "fabrication laboratory," a Fab Lab is a portable, dishwasher-sized array of equipment that combines highly flexible, user-friendly CAD/CAM and modeling software with a suite of industrial-grade tools including a laser cutter and milling machine. For less than the price of a compact car, it gives users the technology to describe, design and build just about anything from inexpensive and readily available materials. The goal is to help people who traditionally have lacked access to sophisticated resources use advanced information technologies to develop and produce solutions to local problems.

The idea for Fab Lab arose at MIT's Center for Bits and Atoms, launched by NSF funding to explore the interface between computer science and physical science. Fab Labs have been tested around the world. In Ghana, users have devised antennas and radios for wireless networks, and solar-powered machinery for cooking, cooling and cutting. In Norway, the units have produced wireless networks and animal radio collars to aid herding of livestock. In India, users are making agricultural instrumentation, testing milk for quality and safety, and tuning diesel engines to run more efficiently, particularly with local biofuels. And, in Boston, Fab Lab users make jewelry, toys and crafts using recycled materials from the community.

*In Norway, a Fab Lab unit was used to create components of a wireless tracking system for various kinds of livestock.*

# APPENDIX: EXPERT EVALUATIONS AND ASSESSMENTS

Excellence in management and fiscal responsibility are essential to sustain and enhance NSF's global leadership. NSF uses a variety of methods to determine the quality and effectiveness of our investments throughout their lifetime. Multiple levels of expert review and external evaluation provide guidance for continuous improvement in decision-making and management.

## A. Merit review

NSF's merit review system is recognized internationally as the best practice for review, assessment, and selection of projects, based upon proposals that are evaluated using two criteria: the intellectual merit of the proposed activity and its broader impacts. Intellectual merit encompasses the potential of the research to advance knowledge, qualifications of researchers, organizational capacity, and the originality and creativity of the proposed activity. Broader impacts include aspects of teaching and learning, integration of research and education, technology transfer, societal benefits, technological innovation, infrastructure development, and opportunities to include a diversity of participants, particularly from underrepresented groups in science. Proposals may also be evaluated according to additional criteria that are specific to the funding opportunity.

The merit review process helps assure that awards made by NSF are of the highest quality, are relevant to NSF goals and objectives, and have an appropriate balance for the resulting portfolio. The quality of the merit review process and its effectiveness in achieving NSF's strategic goals are evaluated through two additional levels of review: Committees of Visitors (COVs) and Advisory Committees (ACs).

## B. Committees of Visitors (COVs)

Each COV consists of external experts who review actions taken on proposals for one or more programs. These experts are selected to ensure independence, programmatic coverage, and balanced representation. They most often represent academe, industry, government and the public sector. COVs conduct detailed reviews of the materials associated with individual proposal actions. They assess the integrity and efficiency of the system for proposal review and the accomplishments of the awardees. COV members are asked to justify their assessments and provide supporting examples or highlights that illustrate performance and progress toward performance goals.

*NSF staff and external review panels continuously evaluate programs and proposals to ensure that meritorious research is supported.*

COVs assess approximately one-third of NSF's programs each year (see schedule within the annual NSF Performance and Accountability Report[4]) with a major focus on evaluating the merit review process. NSF Assistant Directors (ADs) respond to each COV report with plans for improvement covering the next three years. COV reports and AD responses are publicly available on the NSF Web site[5]. This transparency is essential for accountability and to maintain public confidence in NSF's polices and practices. These COV program evaluations were one input into the development of this plan.

## C. Advisory committees (ACs)

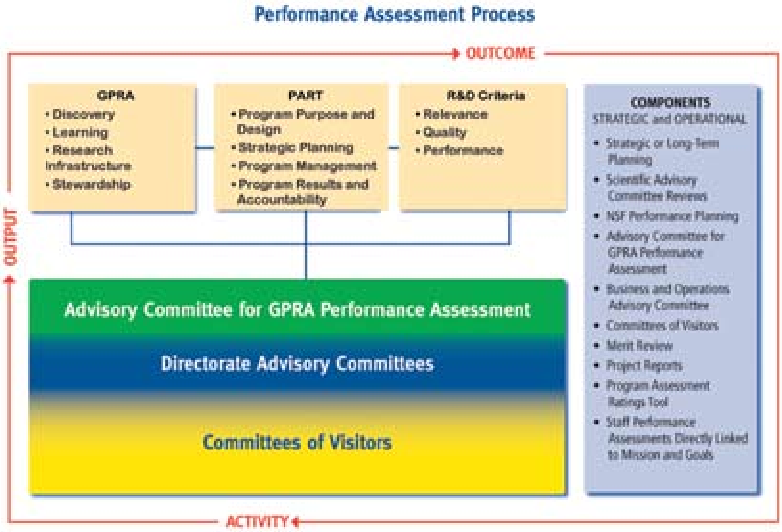
Directorates, Offices and some Foundation-wide programs have Advisory Committees composed of external experts. ACs not only review COV reports and examine Directorate and Office responses to COV recommendations, but also provide advice on priorities and program effectiveness.

The Advisory Committee for GPRA (Government Performance and Results Act) Performance Assessment, AC/GPA, provides advice and recommendations on NSF's performance in accomplishing our goals and objectives. This external com-

4. http://www.nsf.gov/publications/pub_summ.jsp?ods_key=par
5. http://www.nsf.gov/od/oia/activities/cov/

mittee primarily reviews accomplishments from NSF-funded research together with COV reports and management's responses. Their review identifies potential systemic issues and helps to assure that the COV process is of consistently high quality across Directorates and Offices.

The Advisory Committee for Business and Operations, AC/B&O, includes members from the research administration, education management and business communities, including business professionals and academics in the fields of interest. The committee provides advice related to NSF's business practices and operations, including innovative approaches to the achievement of excellence in internal operations and stewardship.




GPRA: The Government Performance and Results Act of 1993
PART: Program Assessment Rating Tool
R&D: Research and Development

## D. Additional Assessments

NSF values the opinion of the science, engineering and education community. We pay careful attention to the advice offered in reports by the National Academies, including National Research Council reports, national and international science organizations, professional societies, workshops, interagency working groups and advisory committees. We use this input to inform strategic planning and to assess management practices.

A variety of other assessment tools are used to evaluate management excellence. NSF's performance record includes eight continuous years of "clean" audit opinions. NSF has also achieved the highest ratings in the President's Management Agenda[6] for Human Capital, Financial Performance, Electronic Government and Budget-Performance Integration, and received the highest rating of "Effective" in all programs rated by OMB in its Program Assessment Rating Tool (PART) evaluations[7]. The most important PART measures, together with other annual goals, are included in NSF's annual performance budget and the agency Performance and Accountability Report (PAR). ACs, COVs and other ongoing assessment processes are valuable in ensuring continued success in PART evaluations and annual progress toward the long-term strategic goals.

Beyond setting agency-wide annual goals in the budget, NSF takes the additional step of obtaining independent verification and validation of our performance results each year before reporting them to the Office of Management and Budget, Congress and the public through the PAR. One example of an annual goal and an indicator of efficient, effective management of the merit review process is dwell time, the time from proposal submission to the time a funding decision is available to the investigator submitting the proposal. The quantitative measure for dwell time is balanced by also ensuring a high-quality review process. Timely responses to Principal Investigators are critical but must not adversely impact review quality. Results from this and other quantitative goals are available to NSF management and staff through an online Enterprise Information System that shows performance at NSF-wide, Directorate, Division and program levels.

Finally, in addition to the extensive annual PAR, NSF will report on annual Foundation performance through a concise Performance Highlights document. Over the next five years, NSF will continue to improve management excellence, with a continuing emphasis on linking together information technology, human capital and financial management to support outcomes resulting from the core processes of merit review, award management and oversight, performance assessment and accountability, resource allocation, knowledge management, and internal and external communication strategies.

*6. NSF was the first agency across government to achieve "green" (highest rating) in Financial Performance and also the first for "green" in Electronic Government (see www.results.gov). NSF remains "red" (lowest rating) for status on Competitive Sourcing, public-private job competitions.*

*7. As of the FY2007 PART evaluations, NSF is the only agency with multiple PART programs to earn the highest rating across-the-board in all programs.*

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4201 WILSON BOULEVARD
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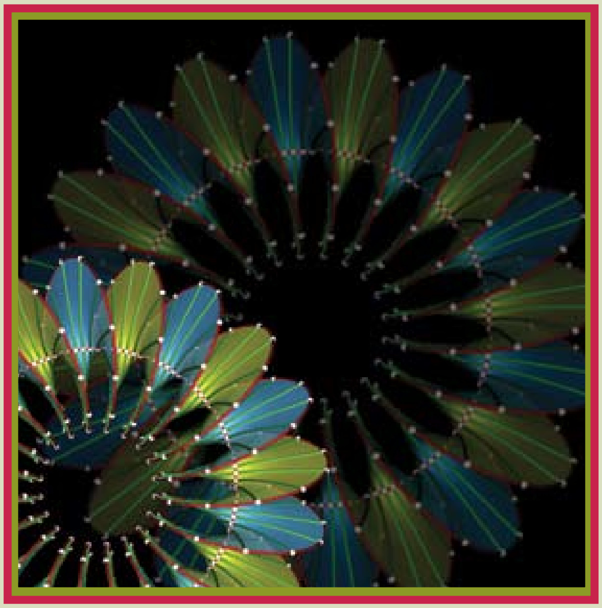

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