NSF FY 2016 Budget Request to Congress

*The National Science Foundation Act of 1950 (Public Law 81-507) sets forth our mission: "**To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."***

*The National Science Foundation Strategic Plan for 2014-2018, "Investing in Science, Engineering, and Education for the Nation's Future," defines our vision: "**A Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education."***

This FY 2016 Budget Request for the National Science Foundation (NSF) continues NSF's longstanding commitment to making investments in learning and discovery that will grow our economy, sustain our competitive advantage, and enable America to remain the world leader in innovation. It embraces the challenge of ensuring that scientific discovery and technological breakthroughs remain engines for expanding the frontiers of human knowledge and responding to the challenges of the 21st century.

NSF's FY 2016 Budget Request is $7.724 billion, an increase of $379.34 million (5.2 percent) over the FY 2015 Estimate. This reflects a strong commitment from the Administration to support science and engineering broadly, as well as the people that keep our Nation's scientific enterprise at the forefront of knowledge and discovery.

FY 2016 Budget Request

Total: $7.724 billion

Increase: $379.34 million

5.2% over FY 2015

In turn, NSF is committed to a careful and continuous evaluation of its portfolio to maximize efficiency, effectiveness, and return on investment. This ensures that the agency establishes clear priorities, and it also fosters the development of innovative mechanisms for achieving its investment goals. NSF also works to leverage resources, infrastructure, networks, and data across the federal government and invest in promising collaborative international opportunities.

FY 2016 Cross-Foundation Investments

NSF continues to bring together researchers from all fields of science and engineering to address today's cross-disciplinary questions and challenges through Foundation-wide activities. In FY 2016, four priority investments address issues of major scientific, national, and societal importance.

Funding for FY 2016 Cross-Foundation Investments

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	FY 2016 Request Change Over FY 2015 Estimate Amount	FY 2016 Request Change Over FY 2015 Estimate Percent
Understanding The Brain (UtB)	$92.62	$106.44	$143.93	$37.49	35.2%
Risk and Resilience	-	20.00	58.00	38.00	190.0%
Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS)	-	-	74.96	74.96	N/A
Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (NSF INCLUDES)	-	-	15.00	15.00	N/A

Understanding the Brain (encompasses ongoing cognitive science and neuroscience research and NSF's contributions to the Administration's Brain Research through Advancing Innovation and Neurotechnologies (BRAIN) Initiative. The goal of the Understanding the Brain investment is to enable scientific understanding of the full complexity of the brain in action and in context. Priorities include: development of innovative technologies, tools and instrumentation, computational infrastructure, theory, and models to understand the brain; increased understanding of relationships between neuronal activity, cognitive processes, and behavior; exploration of links between environment, behavior, and brain function; and training for the next generation of neuroscientists and neuroengineers. Improved understanding of the brain will promote brain health; enable engineered solutions that enhance, replace or compensate for lost function; improve the effectiveness of formal and informal educational approaches; and lead to brain-inspired smarter technologies for improved quality of life. Basic research in these areas can provide novel insights into how cognitive abilities develop and can be maintained and improved throughout the lifespan.

NSF In Action

The Center for Brains, Minds, and Machines (CBMM) at the Massachusetts Institute of Technology supports both NSF's cognitive science and neuroscience investments, as well as the BRAIN Initiative, through cross-disciplinary efforts to build more human-like machines, with the goal of establishing a theory of intelligence. CBMM will also help train the next generation of scientists and engineers through a variety of workshops and courses, an activity directly aligned with one of the goals of Understanding the Brain.

NSF In Action

How can we better predict and respond to natural hazards, as well as develop the resilient infrastructure critical for bouncing back from extreme events? NSF-funded researchers are working on topics such as the integration of natural, human and infrastructure systems for hurricane evacuation and sheltering; volcanic crises in the United States; next-generation warning systems for tornadoes and flash floods; and magnitude 9 earthquake scenarios: modeling, warnings and responses. In addition, researchers are also investigating innovative ways to bolster the resilience of the electrical grid, water systems, and other lifelines and services by exploring interactions between natural gas and electricity systems, power and communication networks, healthcare, and cyber infrastructure. These activities are funded through the Resilient Interdependent Infrastructure Processes and Systems pilot program and the Hazards and Disasters component of Science, Engineering, and Education for Sustainability (SEES), and are examples of the types of research efforts that the new Risk and Resilience investment will be based upon.

Risk and Resilience investments aim to improve predictability and risk assessment and increase resilience to extreme natural and man-made events in order to reduce their impact on quality of life, society, and the economy. NSF is uniquely positioned to support such improvements that require multidisciplinary expertise in science, engineering, and education, such as understanding the dynamic processes that produce extreme events, how people respond to extreme events, and how to engineer resilient infrastructure. One supporting program is Critical Resilient Interdependent Infrastructure Systems and Processes, which directly addresses the need for the resilient and reliable infrastructure that is critical to U.S. economic competitiveness and national security. Another is Prediction of and Resilience against Extreme Events, which aims to enhance the understanding and prediction of, as well as resilience and sustainable responses to, extreme events and geohazards, as well as their impact on natural and human systems.

Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS) is an NSF-wide investment that aims to understand, design, and model the interconnected food, energy, and water system through an interdisciplinary research effort that incorporates all areas of science and engineering and addresses the natural, social, and human-built factors involved. Throughout NSF, activities address food, energy, or water, such as the SEES portfolio, particularly Water Sustainability and Climate and Hazards SEES; Coupled Natural and Human Systems; and Basic Research to Enable Agricultural Development. INFEWS, however, will be the first program to study the interconnected food-energy-water nexus. The need for this program is increasingly urgent, as growing U.S. and global populations, changes in land use, and increasing geographic and seasonal variability in precipitation patterns are placing an ever-increasing stress on these

NSF In Action

The Great Lakes are a vital freshwater resource with chronic water quality problems. A team of investigators led by Stanford and the University of Michigan is looking at eutrophication (a process whereby water bodies receive excess nutrients that stimulate excessive plant growth) and nutrient loading, specifically phosphorus, in the Great Lakes. This research addresses the effects of modern agricultural practices and weather-related events on water quality and freshwater ecology (including fisheries), with a goal of informing effective management strategies for fertilizer application. This activity is funded through NSF's Water Sustainability and Climate program, and is an example of the type of water research that INFEWS will build upon to address the larger food-energy-water nexus.

critical resources. NSF, through INFEWS, is uniquely poised to focus not only on the fundamental science and engineering questions at this nexus, but to train the next generation of researchers in this interdisciplinary area.

NSF in Action

With NSF support, The Council on Undergraduate Research (CUR) has engaged in a systematic effort to enhance the capacity of community colleges to support faculty sponsorship of undergraduate research across all STEM disciplines. Following the development of a curriculum aimed at community college faculty and creation of a cadre of faculty leaders, CUR conducted thirteen workshops bringing together teams of faculty from community colleges to learn about creating and sustaining undergraduate research activity. Over 100 community colleges have participated in these workshops followed by a national conference to enable participants to share results of initial successes at their local campuses. A monograph, Tapping the Potential of All: Undergraduate Research at Community Colleges, was produced with chapters from participants in the project that has been widely shared across the nation's community colleges.

A new approach, **NSF INCLUDES (Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science)**, is an integrated, national initiative to increase the preparation, participation, advancement, and potential contributions of those who have been traditionally underserved and/or underrepresented in the science, technology, engineering, and mathematics (STEM) enterprise. Following wide community engagement in FY 2015, FY 2016 efforts will focus on the development of a set of new scalable concepts that will provide focus for collaborative action. Our investments are intended to produce rapid progress on changing the balance of diversity in S&E, have significant national impact for the participation of underrepresented groups, stimulate the community, forge new partnerships, and catalyze new approaches. NSF INCLUDES will build on and amplify NSF's nearly $800 million investment portfolio in broadening participation.

FY 2016 Ongoing NSF-Wide Priorities

NSF addresses many of the complex issues that face the Nation today through interdisciplinary science, engineering, and educational activities. Foundation-wide programs and priorities bring together researchers from all fields of science and engineering to focus on these challenges from a myriad of perspectives, methodologies, and knowledge bases. These interdisciplinary investments are carefully balanced with a longstanding commitment to the fundamental research that addresses grand challenges and furthers basic scientific knowledge.

FY 2016 Funding for Ongoing NSF-Wide Priorities

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	FY 2016 Request Change Over FY 2015 Estimate Amount	Percent
Clean Energy Technology	$351.07	$370.00	$377.22	$7.22	2.0%
Cyber-Enabled Materials, Manufacturing and Smart Systems (CEMMSS)	255.94	231.46	256.95	25.49	11.0%
Advanced Manufacturing	*188.30*	*164.73*	*176.57*	*11.84*	7.2%
Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)	156.75	128.96	143.06	$14.10	10.9%
Innovation Corps (I-Corps™)	20.49	26.23	30.00	$3.77	14.4%
NSF Research Traineeship (NRT)[1]	33.40	61.55	62.01	$0.46	0.7%
Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS)	37.47	29.27	32.81	$3.54	12.1%
Science, Engineering, and Education for Sustainability (SEES)	164.49	139.00	80.50	-58.50	-42.1%
Secure and Trustworthy Cyberspace (SaTC)	126.00	122.75	124.25	1.50	1.2%

[1] Outyear commitments for Integrative Graduate Education and Research Traineeship (IGERT) are included in the NRT line and are $32.81 million in FY 2014, $12.12 million in FY 2015, and $10.33 million in FY 2016.

- **Clean Energy Technology** ($377.22 million) investments are driven by the fundamental research questions that underlie future energy pathways. NSF's clean energy investments support research and education in alternative energy for electricity (solar, wind, wave, geothermal) and fuels (chemical and biofuels). NSF funding also addresses the collection, conversion, storage, and distribution of energy from diverse power sources, including smart grids; the science and engineering of energy materials; energy use; and energy efficiency. Clean energy research addresses our advancement toward reliable and sustainable energy resources and systems that preserve essential ecosystems and environmental services, promote positive social and economic outcomes, and prepare society to responsibly adopt them.

- **Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)** ($256.95 million) aims to integrate a number of science and engineering activities across the Foundation – breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems. It will address pressing technological challenges facing the Nation and promote U.S. manufacturing competitiveness. In FY 2016, CEMMSS continues to leverage key interagency activities, including the Administration's Materials Genome Initiative, Advanced Manufacturing Partnership, and the National Robotics Initiative. Through CEMMSS, NSF also invests in Advanced Manufacturing ($176.57 million).

- **Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)** ($143.06 million) accelerates and transforms the process of scientific discovery and innovation by providing advanced cyberinfrastructure and new capabilities in computational and data-enabled science and engineering. In FY 2016, NSF will continue to lead the Big Data/National Data Infrastructure program, a joint solicitation with the National Institutes of Health that strives to enable breakthrough discoveries and innovation in science, engineering, medicine, commerce, education, and national security.

- **Innovation Corps (I-Corps™)** ($30.0 million) improves NSF-funded researchers' access to resources that can assist in bridging the gap between discoveries and downstream technological applications. In FY 2016, NSF will continue to support I-Corps™ Nodes and I-Corps™ Sites to further build, utilize, and sustain a national innovation ecosystem that augments the development of technologies, products, and processes that benefit the Nation.

- **NSF Research Traineeships (NRT)** ($62.01 million) in its third year, continues to identify priority research themes that both align with NSF priority research activities and have strong potential in areas of national need where innovative practices in graduate education can be developed. NRT investments aim to advance the research agenda of these themes, as well as develop and conduct research on new approaches and models for educating the next generation of scientists and engineers.

- **Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS)** ($32.81 million) involves the Directorates for Biological Sciences, Mathematical and Physical Sciences, and Engineering, and it seeks to advance discovery at the intersections of these established disciplines. Research includes activities such as development of models, informed by statistical physics that establish the mechanisms linking the biological function of chromosomes to their cellular structure.

- **Science, Engineering, and Education for Sustainability (SEES)** ($80.50 million) aims to increase understanding of the integrated system of supply chains, society, the natural world, and alterations humans bring to Earth, in order to create a sustainable world. In FY 2016, SEES continues to ramp down in anticipation of a planned FY 2017 sunsetting; however, SEES continues to support important scientific and societal contributions during the phase-down period and will make significant progress towards achieving programmatic goals through projects currently underway. The success of several SEES research programs motivates new FY 2016 investments in INFEWS and Risk and Resilience.

- The **Secure and Trustworthy Cyberspace (SaTC)** investment ($124.25 million) aims to build the knowledge base in cybersecurity that enables discovery, learning and innovation, and leads to a more secure and trustworthy cyberspace. Through a focus on long-term, foundational research, SaTC will develop the scientific foundations for cybersecurity research for years to come. SaTC aligns NSF's cybersecurity investments with the four thrusts outlined in the national cybersecurity strategy, *Trustworthy Cyberspace: Strategic Plan for the Federal Cybersecurity Research and Development Program.*

Additional Priorities and Highlights

In FY 2016, NSF continues to emphasize investments in important or emerging areas that have been developed in recent years, including:

- **Synthetic Biology** (approximately $60 million) investments support the design and construction of new biological components as well as the redesign of existing natural biological systems for tailored purposes (e.g., improving the efficiency of photosynthesis for clean energy generation, or introducing the ability of economically important crop plants to fix nitrogen thereby eliminating dependence on

environmentally damaging fertilizers). Also included are investments in the basic biological, physical, and computational sciences and engineering that will enable the construction of a rule set and design tools for synthetic biology (i.e., the rules that govern the construction and function of new biological parts). This portfolio, which promises to develop rapidly emerging technology for new applications and disruptive technology for long-standing problems in food, energy, biomanufacturing, and other areas of national need, spans several NSF directorates as the synthetic biology approach integrates engineering and computer assisted design with biological research. There are also a number of potential partnerships with industry, other federal agencies, and other countries that will be further explored.

- **Urban Science** ($7.50 million) investments will focus on the research and development of critical infrastructure and applications, which address pressing urban challenges, such as sustainability, livability, and equity, through both fundamental research and translational research that is supported via partnerships. Multidisciplinary Urban Science research efforts at NSF and other agencies will address the question of how we can intelligently and effectively design, adapt, and manage cities to maximize their positive potential. It will enable the integration of networked computing systems, physical devices, data sources, and infrastructure leading to smart cities.

- NSF aims to increase the operational efficiency of **U.S. activities in the Antarctic** ($18.50 million) by continuing progress on a multi-year commitment toward more efficient and cost-effective science support as recommended by the U.S. Antarctic Program Blue Ribbon Panel report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*. Emphases include safety and health improvements, and facilities renewal at McMurdo and Palmer stations. Additionally, NSF aims to plan and execute more effective observational approaches to the Antarctic science community, as outlined in the 2011 National Research Council report, *Future Science Opportunities in Antarctica and the Southern Ocean*.

STEM Education

To ensure lasting capabilities to address these disciplinary and interdisciplinary challenges, NSF's educational programs and activities integrate research and education in all fields to engage tomorrow's workforce. These programs target all educational levels and emphasize broadening participation, so that STEM fields become more accessible to all whose imagination has been sparked by science and engineering.

NSF's STEM education investment, centered in the Directorate for Education and Human Resources (EHR), funds activities that support students, teachers, researchers, and the public. In keeping with the Administration's priorities and the strategic goals for STEM education as described in the 2013 National Science and Technology Council report, *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan*, NSF's key investments for FY 2016 focus on areas where NSF is the identified lead in STEM education, notably graduate education and undergraduate education, and they also emphasize the need to strengthen foundational STEM education research.

- **Improving Undergraduate STEM Education (IUSE)** ($134.58 million) aims to accelerate the quality and effectiveness of the education of undergraduates in all STEM fields by using decades of research on STEM learning and best practices in education to address challenges across fields as well as within specific disciplines. IUSE priorities are aligned with the four strategic objectives for undergraduate education identified in the federal STEM education strategic plan: increase use of evidence-based practices; increase authentic research experiences for students; improve the recruitment, retention, and STEM degree completion for students in two-year colleges; and address the high rates of failure in introductory college mathematics.

- **EHR Core Research (ECR)** ($103.84 million) remains a top priority. In FY 2016, ECR strengthens investments in and impact on the improvement of STEM learning, teaching, and workforce development, through three key areas: learning and learning environments, broadening participation and institutional capacity, and development of the STEM professional workforce.

- The **CyberCorps®: Scholarships for Service (SFS)** program ($45.0 million) supports cybersecurity education and research at higher education institutions. SFS also focuses on workforce development by increasing the number of qualified students entering the fields of information assurance and cybersecurity, which enhances the capacity of the United States higher education enterprise to continue to produce professionals in these fields to secure the Nation's cyberinfrastructure.

Major Research Equipment and Facilities Construction

In FY 2016, NSF requests funding to continue construction of three projects: the Daniel K. Inouye Solar Telescope, the Large Synoptic Survey Telescope, and the National Ecological Observatory Network. Funding concluded in FY 2014 for two projects, the Advanced Laser Interferometer Gravitational-wave Observatory and the Ocean Observatories Initiative.

- The **Daniel K. Inouye Solar Telescope** ($20.0 million) will enable the study of magneto-hydrodynamic phenomena in the solar photosphere, chromosphere, and corona at unprecedented spatial, temporal, and wavelength resolution to gain information on the creation, interaction, and ultimate annihilation of solar magnetic fields. Determining the role of magnetic fields in the outer regions of the Sun is crucial to understanding the solar dynamo, solar variability, and solar activity, including flares and coronal mass ejections. These can affect civil life on Earth through the phenomena generally described as "space weather" and may have impact on the terrestrial climate. FY 2016 is year eight of an eleven year construction process. By the end of FY 2016, the adjacent Support and Operations building will be completed, site testing of the telescope Enclosure will be finished, and the Coudé Rotator Lab will be installed in the pier. In addition, the Telescope Mount Assembly base erection will begin inside the weathertight Enclosure, along with the start of the electrical installation.

- The **Large Synoptic Survey Telescope** ($99.67 million) will be an 8-meter-class wide-field optical telescope designed to carry out surveys of the entire sky available from its site. LSST will collect nearly 40 terabytes of multi-color imaging data every night for ten years and will produce the deepest, widest-field sky image ever. It will image the entire visible sky twice per week, as well as issue alerts for moving and transient objects within 60 seconds of their discovery. The LSST surveys will result in a comprehensive data set that will enable hundreds of other fundamental astrophysical studies by the entire research community. FY 2016 is year three of a nine year construction process. In FY 2016, work on the lower enclosure will be complete at the LSST site, making it ready for construction of the telescope dome atop that enclosure. Following conclusion of a full bid-and-propose process, the contract for construction of the base facility will be awarded. The first components of the sensor will be delivered to the camera team, with production of the first "raft" of sensors (12K by 12K pixels) nearing completion.

- The **National Ecological Observatory Network** ($80.64 million) will consist of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research. NEON is the first research platform and the only national experimental facility specifically designed to collect consistent and standardized sensor and biological measurements across 106 sites nationwide in close to real-time, enabling basic research on complex phenomena driving ecological change and at the scales appropriate for studying many grand challenge questions in ecology. NEON allows researchers to expand the scale of their research to understand large-scale dynamics affecting ecosystems. FY 2016 is the final year of construction, and this will allow the project to complete civil construction, continue sensor deployment at terrestrial and aquatic locations, expand biological sampling, continue cyberinfrastructure hardware and software deployments in support of sites and domain Support Facilities acceptance, expand operational support systems, and ongoing development of data algorithms and related data release via NEON's web portal.

Major Research Equipment and Facilities Construction Funding

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request
Ongoing Projects:			
Daniel K. Inouye Solar Telescope (DKIST)	$36.88	$25.12	$20.00
Large Synoptic Survey Telescope (LSST)	27.50	79.64	99.67
National Ecological Observatory Network (NEON)	93.20	96.00	80.64
Funding Complete:			
Advanced LIGO (AdvLIGO)	14.92	-	-
Ocean Observatories Initiative (OOI)	27.50	-	-
Total, MREFC	**$200.00**	**$200.76**	**$200.31**

Totals may not add due to rounding.

Organizational Excellence

NSF seeks to integrate mission, vision, and core values to efficiently and effectively execute our activities and provide the flexibility and agility required for all aspects of its operations. This goal incorporates a culture of continuous improvement to ensure effective, inclusive, and accountable programs and merit review processes that provide the greatest value for taxpayer dollars.

Staffing

In FY 2016, NSF will work towards full utilization of its established FTE allocations, which are increased from the FY 2015 request to a total of 1,367 to accommodate additional staffing for a Digital Service team and requirements of the DATA Act as noted below. The Foundation recognizes that maintaining staffing levels is vital for managing increasing numbers of proposals and the subsequent increase in workload.

FY 2016 Priorities

In FY 2016, the primary drivers of the increase for the Agency Operations and Award Management (AOAM) account are the headquarters relocation and the 1.3 percent cost-of-living adjustment and related salary and benefit increases. AOAM also supports operational activities to ensure the Foundation has sufficient resources to fully fund ongoing operational requirements and maintain essential services as we approach the transition to the new NSF headquarters. These include strengthening capabilities in human resource management, consistent with the opportunities for action or improvement identified in the FY 2014 Strategic Review. FY 2016 funding also includes equipment and technology costs related to NSF's Headquarters relocation.

In addition, $2.85 million will support NSF's efforts to implement the Digital Accountability and Transparency Act (DATA Act; P.L. 113–101) to include changes in business processes, workforce, or information technology to support high quality, transparent Federal spending information. Further, $1.0 million will fund staffing costs to build a Digital Service team that will focus on transforming the agency's digital services with the greatest impact to citizens and businesses so they are easier to use and more cost-effective to build and maintain. For more information on these activities, see the AOAM chapter.

Organizational Excellence by Appropriations Account

(Dollars in Millions)

	FY 2014 Actual	FY 2015 Estimate	FY 2016 Request	FY 2016 Request Change Over FY 2015 Estimate Amount	FY 2016 Request Change Over FY 2015 Estimate Percent
Agency Operations and Award Management	$305.95	$325.00	$354.84	$29.84	9.2%
Office of Inspector General	13.84	14.43	15.16	0.73	5.1%
National Science Board	4.25	4.37	4.37	-	-
Program Support:					
Research & Related Activities	100.70	105.91	109.75	3.84	3.6%
Education and Human Resources	14.44	15.71	16.67	0.96	6.1%
Subtotal, Program Support	115.14	121.62	126.42	4.80	3.9%
Total	**$439.18**	**$465.42**	**$500.79**	**$35.37**	**7.6%**

Totals may not add due to rounding.

2014-2018 Strategic Plan and Performance

2014-2018 Strategic Plan

Integral to this submission is the NSF Strategic Plan for 2014-2018: *Investing in Science, Engineering, and Education for the Nation's Future*. The goals and strategies outlined in the plan build on lessons learned from NSF's past successes and continue to uphold NSF's mission: "To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense...."

The plan presents the following goals, which guide the FY 2016 Budget Request:

- "Transform the Frontiers of Science and Engineering" aims to expand and explore the frontiers of human knowledge to enhance the power of the Nation to meet its challenges, and to create new paradigms and capabilities for scientific, technological, and economic leadership in an increasingly fast-paced, competitive world.

- "Stimulate Innovation and Address Societal Needs through Research and Education" strives to focus NSF's research communities on opening up new avenues to address high priority national challenges, as well as encourages formation of partnerships with industry, other agencies, and international counterparts to leverage resources and build capacity.

- "Excel as a Federal Science Agency" focuses on efficiently and effectively executing the agency's responsibilities and achieving the flexibility and agility required to meet the quickly evolving challenges associated with the first two strategic goals.

Performance Plan

NSF embraces the use of goals to drive performance improvements. For FY 2016, NSF has set seven performance goals so that NSF can strategically monitor and oversee progress being made towards its larger aims. NSF also assesses progress through an annual process of Strategic Reviews of the Objectives in its Strategic Plan. In FY 2016, NSF will perform Strategic Reviews, as well as monitor the following annual goals:

- **Ensure that Key Program Investments are on track:** Progress on investments in NSF INCLUDES, INFEWS, and Understanding the Brain will be monitored using a set of common milestones and indicators.

- **Ensure that Infrastructure Investments are on track:** Ensure program integrity and responsible stewardship of major research facilities at varying stages of their lifecycle. In FY 2016, this involves monitoring the performance of construction projects.

- **Use Evidence to Guide Decisions:** The Foundation will use evidence-based reviews to guide management investments.

- **Make Timely Award Decisions:** NSF aims to inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months of deadline, target, or receipt date, whichever is later.

- **Foster an Environment of Diversity and Inclusion:** The Foundation seeks to foster an environment of diversity and inclusion while ensuring compliance with the agency's civil rights programs.

- **Evaluate NSF Investments:** Enable consistent evaluation of the impact of NSF investments with a high degree of rigor and independence.

- **Increase the Percentage of Wholly Virtual Panels:** Increase the percentage of proposal review panels that are conducted wholly virtually while maintaining the quality of the merit review process.

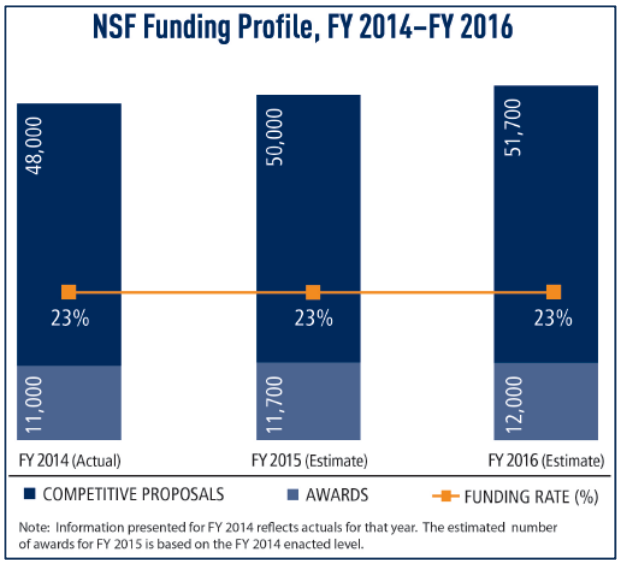
Please refer to performance.gov for information on NSF's agency Priority Goals and NSF's contributions to the federal Cross-Agency Priority (CAP) goals. Agency Priority Goals for FY 2016-FY 2017 will be set as part of the FY 2017 budget process.

NSF's FY 2016 Budget Request includes a change in the per diem compensation for individuals participating virtually in NSF meetings. Per diem compensation will be decreased from the current $280 per day to a new level of $200 per day. For more information on FY 2016 Agency Priority Goals, see the Performance Information chapter.

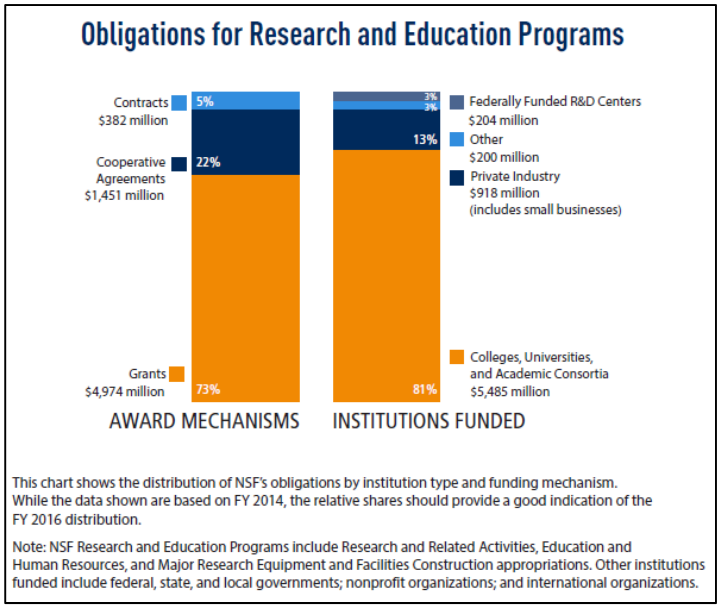
In addition, the Administration is seeking Presidential reorganization authority from the Congress. Under this authority, the President would propose to reorganize Federal business and trade programs, consolidating NSF's National Center for Science and Engineering Statistics and industry partnership programs with related programs in a new department.

NSF by the Numbers

NSF by The Numbers: In FY 2016, NSF expects to evaluate over 51,700 proposals through a competitive merit review process and make over 12,000 new awards. This will require over 225,000 proposal reviews, engaging on the order of 35,000 members of the science and engineering community participating as panelists and proposal reviewers. In a given year, NSF awards reach over 1,800 colleges, universities, and other public and private institutions in 50 states, the District of Columbia, and Puerto Rico. In FY 2016, NSF support is expected to reach approximately 356,000 researchers, postdoctoral fellows, trainees, teachers, and students.



The chart on the right shows the distribution of NSF's obligations by institution type and funding mechanism. While the data are based on FY 2014, the relative shares should provide a good indication of the FY 2016 distribution. As shown on the graph, 95 percent of NSF's FY 2014 projects were funded using grants or cooperative agreements. Grants can be funded either as standard awards, in which funding for the full duration of the project is provided in a single fiscal year, or as continuing awards, in which funding for a multi-year project is provided in increments. Cooperative agreements are used when the project requires substantial agency involvement during the project performance period (e.g., research centers, multi-user facilities, etc.). Contracts are used to acquire products, services, and studies (e.g., program evaluations) required primarily for NSF or other government use.

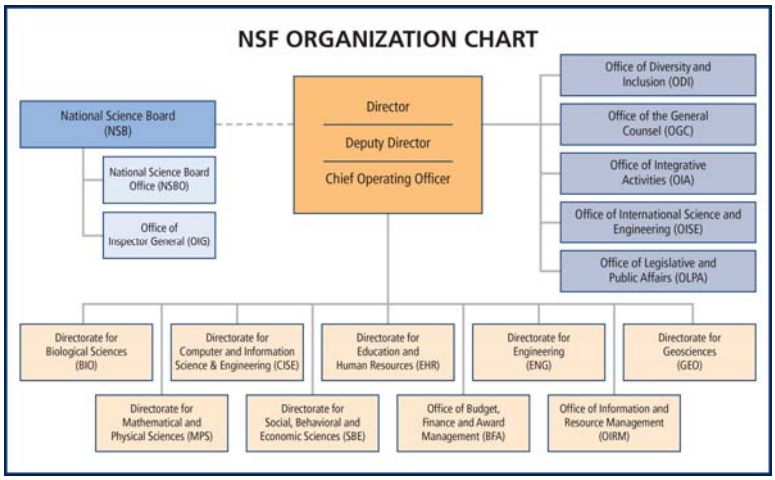


Most NSF awards are to academic institutions. Nonprofit organizations include state and local governments and international organizations. For-profit businesses include private and small businesses. Federal agencies and laboratories include funding for Federally Funded Research & Development Centers.

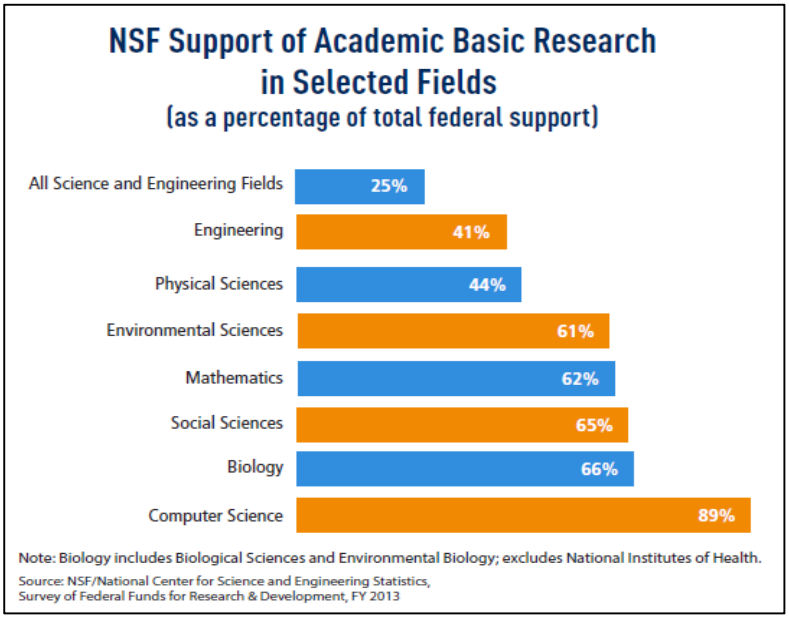
Organization and Role in the Federal Research Enterprise

NSF's comprehensive and flexible support of meritorious projects enables the Foundation to identify and foster both fundamental and transformative discoveries and broader impacts within and among fields of inquiry. NSF has the latitude to support emerging fields, high-risk ideas, interdisciplinary collaborations, and research that pushes – and even creates – the very frontiers of knowledge. In these ways, NSF's discoveries inspire the American public – and the world.

NSF's organization represents the major science and engineering fields, including: biological sciences; computer and information science and engineering; engineering; geosciences; mathematical and physical sciences; and social, behavioral, and economic sciences. NSF also carries out specific responsibilities for education and human resources, cyberinfrastructure, integrative activities, international science and engineering, and polar programs. The 25-member National Science Board sets the overall policies of the Foundation.



This chart reflects the realignment, expected in FY 2015, of the Office of International Science and Engineering (OISE) and Integrative Activities (IA) as separate budget activities.

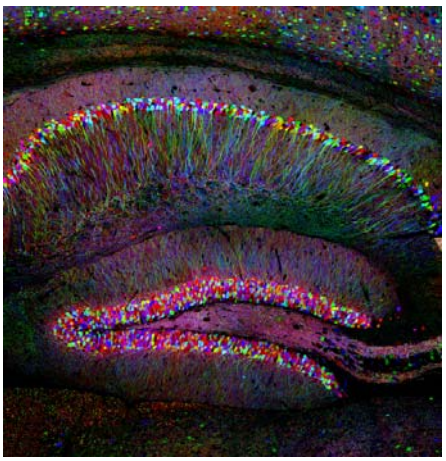


NSF's annual budget represents 25 percent of the total federal budget for basic research conducted at U.S. colleges and universities, and this share increases to 60 percent when medical research supported by the National Institutes of Health is excluded. In many fields NSF is the primary source of federal academic support.

Highlights

For over 60 years, NSF has pursued investments in fundamental research and education to fulfill its mission of promoting the progress of science and engineering. In doing so, NSF supported research has connected the discovery and advancement of knowledge with the potential societal, economic, and educational benefits that are critical for continued U.S. prosperity. Below are just a few of the important recent advances that NSF funding continues to enable.

Memory Making and Protein



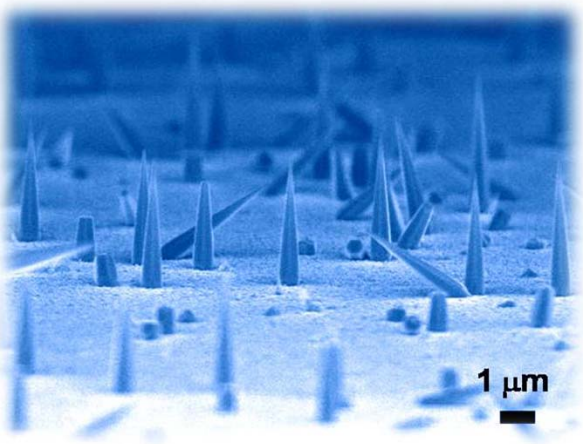
Researchers discovered that the Arc gene and its protein product, also called Arc, play an essential role in memory formation. One of tens of thousands of proteins in the brain, Arc is found in the brain's hippocampus region (the area involved in many forms of learning), and activates as memories form. Knowing how a healthy brain forms memories is an important step to understanding what goes wrong in a range of memory disorders including Alzheimer's disease and stroke.

A fluorescent imaging agent lights up the brain's hippocampus.

Credit: Jean Livet, Institut de la Vision, Paris; Jeff Lichtman and Joshua Sanes, Harvard University

Nanolasers on Silicon

Researchers developed a method to integrate nanolasers on silicon -- a crucial step toward marrying electronic devices and photonic devices (which operate using light). Photonic devices can perform in ways that silicon electronics cannot. For example, optical signals allow computer chips to carry and transmit more data, improving computing speed and efficiency. The miniature lasers could lead to new technologies for signal processing and biochemical sensors as well as cost-effective silicon-based lighting and screens.

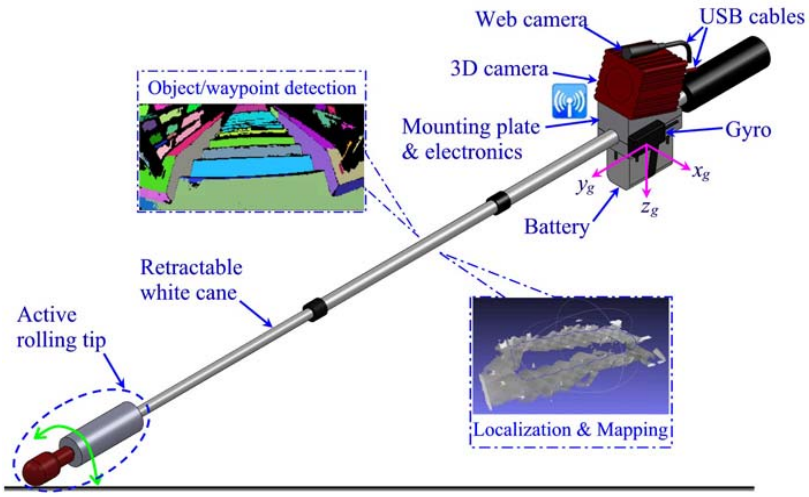


Nanolasers grown on a silicon substrate integrate easily into integrated circuits. Scale: 1 micron.

Credit: Connie Chang-Hasnain, UC Berkeley

Highlights

Seeing-Eye Robot



The co-robotic cane has a rolling tip that points the cane to the desired direction of travel. It is designed to detect the user's intent as well as 3-D objects and to build a working map for the user.

Credit: Dr. Cang Ye, University of Arkansas at Little Rock

At the University of Arkansas at Little Rock, researchers prototyped a robotic walking stick for the blind. It has cameras to detect objects in the way such as chairs and stairs, an audio system that communicates to the user, and a computer that remembers recent pathways and objects in them. Developed under the National Robotics Initiative, a multi-agency program partnership that includes NSF.

New Media Model

"Plum Landing," created by WGBH in Boston, uses animations, games, a mobile app, videos and hands-on activities to increase children's understanding of science and nature. Designed for kids aged 6 to 9, it introduces core science concepts and models key habits of mind scientists use when exploring the natural world. Since its debut last April, the website has garnered 8 million+ page views. Children also are exploring their environments — to date, they've submitted 70,000 photos and drawings.

A girl takes a picture of a plant with the "Plum's Photo Hunt" app on her mobile phone.

Credit: Copyright Bill Shribman

Highlights

Bionic Suit

The 2014 World Cup kickoff was like no other. A paraplegic volunteer did the ceremonial first kick, wearing an exoskeleton that took cues from his brain activity. The exoskeleton used computer algorithms to detect the brain signals of the kicker, who was wearing an electroencephalography (EEG) cap. The research began nearly two decades ago with an NSF grant to Duke University neurobiologist Miguel Nicolelis for research into how neurons in the cerebral cortex are involved in motor learning.

The exoskeleton's hydraulic pumps power the kicker forward.

Credit: National Science Foundation

Autonomous Underwater Vehicle Ice Study

SeaBED was deployed from the British research vessel James Clark Ross.

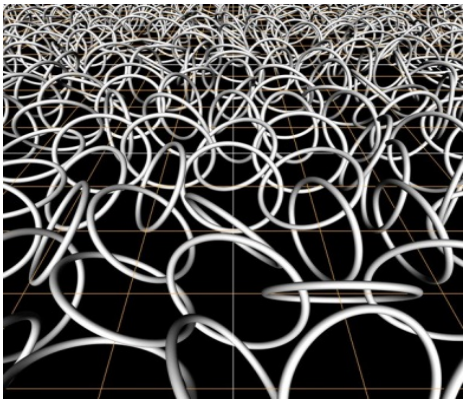
Credit: Hanumant Singh, Woods Hole Oceanographic Institution

Researchers tested an autonomous underwater vehicle, called SeaBED, which can produce high-resolution, 3-D maps of Antarctic sea ice. SeaBED measured and mapped the underside of sea-ice floes in three previously inaccessible areas off the Antarctic Peninsula. The deployment was a big step toward making the routine underwater measurements needed to help monitor and understand changes in sea ice. While satellite observations can tell us about large-scale thickness, interpreting the data can be difficult due to snow cover on the ice. Drilling, as well as visual observations from ships, help fill out the picture, but difficulties getting to thicker areas of sea ice leave gaps in the data. SeaBED is an invaluable tool to fill this gap.

Highlights

Math and Mitochondria

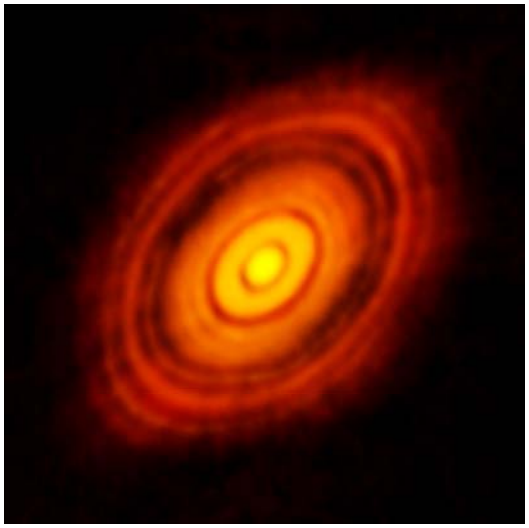
A team of mathematicians used mathematical modeling to uncover new clues to the three-dimensional organization of mitochondrial DNA in trypanosomes. Trypanosomes are microscopic, unicellular parasites responsible for widespread, fatal diseases including sleeping sickness. This neglected disease, transmitted by the tse-tse fly, threatens millions of people in sub-Saharan Africa. Its western counterpart, Chagas disease, affects an estimated 8 to 11 million people across North and South America. Unveiling the intricate organization of DNA in trypanosomes opens new avenues for the design of drugs to prevent and treat these and other diseases.



Network of oriented flat minicircles on a square grid. A tightly packed grid yields high levels of interlocking to form a large network of minicircles. This provides a model for the organization of DNA minicircles in the mitochondria of trypanosomes.

Credit: Javier Arsuaga, San Francisco State University

Atacama Large Millimeter/Submillimeter Array Shows a Planetary System in Formation



Caption: ALMA image of the young star HL Tau and its protoplanetary disk.

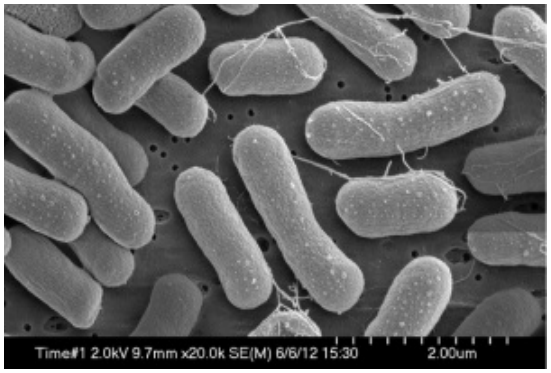
Credit: ALMA (NRAO/ESO/NAOJ); C. Brogan, B. Saxton (NRAO/AUI/NSF)

This image, taken recently with the Atacama Large Millimeter/Submillimeter Array (ALMA), shows a planetary system in the process of formation around a nearby young star called HL Tau. The multiple concentric rings are separated by dark gaps that herald the presence of emerging planets as they sweep their orbits clear of dust and gas. The existence of such well-delineated structures so early in the star's life is challenging our theories of star and planet formation. The image was obtained using only a 30-element subset of the full 66-antenna array as part of early science tests. With the relocatable antennas deployed at almost their maximum separation (15km apart), the spatial resolution is 5 au (1 au is the Earth-Sun distance) at the observing wavelength of 1.3mm.

Highlights

Biodegradable Plastic from Methane

Scientists at Stanford University and a Palo Alto, Calif.-based start-up company called Mango Materials have come up with a new way to make PHA (poly-hydroxyalkanoate) from waste methane gas. PHA is a biodegradable polymer similar to the polypropylene used to make plastic packaging. With funding from the U.S. National Science Foundation, Mango Materials is advancing the process toward commercialization.



Mango Materials is using bacteria like these to create biodegradable plastics.

Credit: Image courtesy of Mango Materials

Tide Data

Hurricane Sandy flooding Avenue C at East 6th Street in Manhattan's East Village.

Credit: David Shankbone/Wikimedia Commons

When 'Superstorm' Sandy blew ashore in 2012, New York City's South Manhattan Seawall protected the island from the storm surge. After analyzing historical tide data, researchers found that the likelihood of water overtopping the seawall is now at least 20 times greater than it was 170 years ago. The findings suggest that the changes in storm tides are related to changes in climate, as well as effects from human activity such as modifying natural channels and limiting peak river flows. This work and similar findings in coastal cities around the U.S. could help municipalities plan for the impact of major storms.

Non-contact detection of explosive materials

In research relevant to homeland security and antiterrorism efforts, Cornell University researchers created an ultrasensitive polymer that uses fluorescence to detect explosives not only on surfaces but in the air. Currently, to identify explosive ingredients, airport security officers run a swab over a suspected object prior to analysis.

Glowing polymer goes dark when exposed to explosive vapors.

Credit: Deepti Gopalakrishnan and William Dichtel