NSF FY 2015 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."***

The FY 2015 Budget Request for the National Science Foundation (NSF) continues the tradition of a thoughtful and strategic balance between core research activities both within and across disciplinary boundaries and activities that address emerging areas and clearly identified national priorities. Bolstering and advancing the types of core investments that have been central to the agency's past success reflects a wise stewardship of NSF's federal funding and ensures a strong return on taxpayer investment. In addition, specific investments identified for FY 2015 align NSF's portfolio with overarching challenges and opportunities facing the Nation. This balanced approach ensures that NSF will continue to foster research that catalyzes the development of scientific discovery, promotes creation of new knowledge, and builds human capacity for the workforce of tomorrow.

NSF's FY 2015 Budget Request is $7.255 billion, an increase of $83.08 million (1.2 percent) over the FY 2014 Estimate. An additional $552.0 million is proposed through the Opportunity, Growth, and Security Initiative (OGSI). At NSF, OGSI will ensure strong support for core activities that transform the frontiers of learning and discovery. OGSI will add to NSF's progress in many areas, including clean energy, cognitive science and neuroscience, cyber-enabled smart systems, graduate education, and secure cyberspace. For more information on OGSI, see the Opportunity, Growth, and Security Initiative chapter.

NSF Funding by Account
(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	FY 2015 Request Change Over FY 2014 Estimate Amount	Percent
Research & Related Activities	$5,558.88	$5,808.92	$5,807.46	-$1.46	-0.03%
Education & Human Resources	834.62	846.50	889.75	43.25	5.1%
Major Research Equipment & Facilities Construction	196.49	200.00	200.76	0.76	0.4%
Agency Operations & Award Management	293.50	298.00	338.23	40.23	13.5%
National Science Board	4.10	4.30	4.37	0.07	1.6%
Office of Inspector General[1]	14.33	14.20	14.43	0.23	1.6%
Total, NSF	**$6,901.91**	**$7,171.92**	**$7,255.00**	**$83.08**	**1.2%**

Totals may not add due to rounding.

[1] FY 2013 Actual includes $1.16 million of obligations funded through the American Recovery and Reinvestment Act of 2009 (ARRA).

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 this FY 2015 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's FY 2015 performance plan aligns with the Strategic Plan: each performance goal is associated with one or more strategic objectives in the Strategic Plan and will be reviewed annually in the new Strategic Reviews. NSF has three Agency Priority Goals for FY 2015:

- Increase Public Access to NSF Funded Peer-reviewed Publications: By the end of FY 2015, NSF-funded investigators will be able to deposit versions of their peer-reviewed articles in a repository that will make them available to the public.

- Improve the Nation's Capacity in Data Science: NSF strives to improve the Nation's capacity in data science by investing in the development of human capital and infrastructure.

- Optimize the Award Process to Level Workload: By the end of FY 2015, NSF will meet targets to level distribution of awards across the fiscal year and subsequently improve awardee capacity to effectively manage research funding.

For more information on FY 2015 Agency Priority Goals, see the Performance Information chapter.

FY 2015 Cross-Foundation Investments

Funding for Selected FY 2015 Priorities

(Dollars in Millions)

Investment Priority	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	FY 2015 Request Change Over FY 2014 Estimate Amount	FY 2015 Request Change Over FY 2014 Estimate Percent
Cognitive Science and Neuroscience	$1.00	$13.85	$29.00	$15.15	109.4%
Cyber-Enabled Materials, Manufacturing and Smart Systems (CEMMSS)	181.43	230.05	213.20	-16.85	-7.3%
Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)	109.13	145.41	124.75	-20.66	-14.2%
Science, Engineering, and Education for Sustainability (SEES)	183.67	161.75	139.00	-22.75	-14.1%
Secure and Trustworthy Cyberspace (SaTC)	108.01	124.75	99.75	-25.00	-20.0%

Investments may have funding overlap and thus should not be summed.

The emergence of NSF's major cross-Foundation investments is the result of years of NSF support for fundamental research across all fields of science and engineering. This enduring base of knowledge and discovery positions NSF to contribute to areas of vital national importance.

- **Cognitive Science and Neuroscience** ($29.0 million) in FY 2015 draws together under one framework ongoing cognitive science and neuroscience research and NSF's contributions to the Administration's Brain Research through Advancing Innovation and Neurotechnologies (BRAIN) Initiative. 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.

- **Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)** ($213.20 million) aims to integrate a number of science and engineering activities across the Foundation – breakthrough materials, advanced manufacturing, robotics, and cyber-physical systems. It addresses pressing technological challenges facing the Nation and promotes U.S. manufacturing competiveness. CEMMSS is aligned with key interagency activities, including the Administration's Materials Genome Initiative, Advanced Manufacturing Partnership, and the National Robotics Initiative. While funding declines from the previous year, NSF maintains a strong overall investment in CEMMSS.

- **Cyberinfrastructure Framework for 21st Century Science, Engineering, and Education (CIF21)** ($124.75 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 (CDS&E). In FY 2015, NSF will continue to lead the Big Data/National Data Infrastructure program, a joint solicitation with the National Institutes of Health (NIH) that strives to enable breakthrough discoveries and innovation in science, engineering, medicine, commerce, education, and national security. Decreases in CIF21 in FY 2015 are primarily a result of

shifting investments in the cross-directorate Computational and Data-Enabled Science and Engineering program to other targeted programs.

- **Science, Engineering, and Education for Sustainability (SEES)** ($139.0 million) aims to increase understanding of the integrated system of supply chains, society, the natural world, and alternations humans bring to Earth, in order to create a sustainable world. In FY 2015, SEES enters a transition period toward sunsetting in FY 2017. 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 **Secure and Trustworthy Cyberspace (SaTC)** investment ($99.75 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.* Funding for SaTC declines in FY 2015, principally because a component program, the CyberCorps: Scholarships for Service (SFS), decreases by $20.0 million.

Priorities and Highlights

- **Advanced Manufacturing** research ($150.70 million) holds tremendous potential for significant short-term and long-term economic impact by promising entirely new classes and families of products that were previously unattainable. In FY 2015, NSF's investment emphasizes several emerging opportunities including cyber–physical systems, advanced robotics research, scalable nanomanufacturing, sensor and model-based smart manufacturing, educational activities to support training the next generation of product designers and engineers, and industry-university cooperation.

- **Clean Energy** investments ($361.95 million) that will lead to future clean energy and energy efficient technologies are seen throughout the NSF portfolio, both in core research programs and targeted investments such as BioMaPS and SEES. Specific activities include research related to sustainability science and engineering, such as the conversion, storage, and distribution of diverse power sources (including smart grids), and the science and engineering of energy materials, energy use, and energy efficiency.

- **Innovation Corps (I-Corps)** ($24.85 million) improves NSF-funded researchers' access to resources that can assist in bridging the gap between discoveries and downstream technological applications. In FY 2015, 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.

- **National Robotics Initiative (NRI)** ($28.50 million) is a concerted program to provide U.S. leadership in science and engineering research and education aimed at the development of next generation robotics, conceived as robots that work beside, or cooperatively, with people in areas such as manufacturing, space and undersea exploration, healthcare and rehabilitation, military and homeland surveillance and security, education and training, and safe driving. NRI is an interagency effort supported by NSF, the National Aeronautics and Space Administration (NASA), the National Institutes of Health (NIH), and the U.S. Department of Agriculture (USDA).

- **Research at the Interface of Biological, Mathematical, and Physical Sciences (BioMaPS)** ($29.27 million) is a collaboration among the Directorates for Biological Sciences, Mathematical and Physical

Sciences, and Engineering that seeks to discover fundamental knowledge at the intersections of these established disciplines. This activity will produce critical knowledge needed to catalyze the development of new technologies essential to the Nation's prosperity and economic competitiveness and will advance emerging areas of the bioeconomy, as described in the Administration's *National Bioeconomy Blueprint*.

- 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 (USAP) Blue Ribbon Panel (BRP) report, *More and Better Science in Antarctica through Increased Logistical Effectiveness*. Emphases include safety and health improvements, investments with positive net present value, 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*.

Science, Technology, Engineering, and Mathematics (STEM) Education

NSF's STEM education investment, centered in the Directorate for Education and Human Resources (EHR), supports bold programs and innovative projects that lead to impact by meeting the needs of end-users – students, teachers, researchers, and the public. This request continues the trajectory of those investments and furthers NSF's key role as an innovator and a leading funder of STEM education within the federal portfolio.

In keeping with the Administration's priorities and the strategic goals for STEM education as described in the National Science and Technology Council's Committee on STEM Education Strategic Plan, NSF's key investments for FY 2015 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. Four key activities in FY 2015 include:

- The **Graduate Research Fellowship (GRF)** program ($333.44 million) is a national-level competition that supports the outstanding scientists, engineers, educators, and entrepreneurs of the future. The ranks of NSF Fellows include numerous individuals who have made transformative breakthroughs in science and engineering research, with 30 Fellows having been honored as Nobel laureates. In FY 2015, 2,000 new awards will be made and the stipend level will be increased from $32,000 to $34,000. The development of additional targeted opportunities for Fellows to enrich their professional growth will continue.

- **NSF Research Traineeships (NRT)** ($58.20 million) enters its second year in FY 2015. NRT identifies 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. NRT funding also includes $7.0 million for a new track that will invite proposals for design, innovation, and research in graduate student training and professional development. Funding level shown above includes $20.32 million for continuing grant increments for the Integrative Graduate Education and Research Traineeship Program (IGERT), which transitioned to NRT in FY 2014.

- The **Improving Undergraduate STEM Education (IUSE)** program ($118.48 million) is a more extensive coordination of NSF's undergraduate STEM education investments within a framework

designed to accelerate improvement and measurable impact in undergraduate STEM education. IUSE is built upon a knowledge base accumulated from decades of research, development, and best practices across the Nation in STEM undergraduate education, and it integrates theories and findings from education research with attention to the needs and directions of frontier science and engineering research.

- **Research Experiences for Undergraduates (REU) Sites and Supplements** ($75.13 million total) will continue to provide early opportunities to conduct research for students in their first two years of college, as recommended by the President's Council of Advisors on Science and Technology (PCAST) in their report, *Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics.*

Major Research Equipment and Facilities Construction

In FY 2015, 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 concludes in FY 2014 for two projects, the Advanced Laser Interferometer Gravitational-wave Observatory and the Ocean Observatories Initiative.

- The **Daniel K. Inouye Solar Telescope,** formerly known as the Advanced Technology Solar Telescope, will enable study of the sun's magnetic fields, which is crucial to our understanding of the types of solar variability and activity that affect Earth's civil life and may impact its climate.
- The **Large Synoptic Survey Telescope** will produce an unprecedented wide-field astronomical survey of our universe, including the deepest, widest-field sky image ever. This survey will change every field of astronomical study, from the inner solar system to the large scale structure of the universe.
- The **National Ecological Observatory Network** will consist of geographically distributed field and lab infrastructure networked via cybertechnology into an integrated research platform for regional to continental scale ecological research.

Major Research Equipment and Facilities Construction Funding

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request
Funding Complete:			
Advanced LIGO	$15.18	$14.92	-
Atacama Large Millimeter Array	0.51	-	-
Ocean Observatories Initiative	65.00	27.50	-
Ongoing Projects:			
Daniel K. Inouye Solar Telescope	25.00	36.88	25.12
Large Synoptic Survey Telescope	-	27.50	79.64
National Ecological Observatory Network	90.80	93.20	96.00
Total, MREFC	**$196.49**	**$200.00**	**$200.76**

Totals may not add due to rounding.

Organizational Excellence

To "Excel as a Federal Science Agency" is an internally focused strategic goal that 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. It entails blending strong scientific leadership with robust organizational leadership, both characterized by vision and flexibility, and also supporting the staff with the information and other resources that are essential to carry out the agency's activities. 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 2015, NSF will work towards full utilization of its established FTE allocations, which remain unchanged from the FY 2014 Request at 1,352 FTE. The additional FTE will be utilized to address the agency's highest priority workforce needs.

Future NSF

The Agency Operations and Award Management (AOAM) account includes $30.04 million for Future NSF, a multi-year effort associated with NSF's upcoming headquarters relocation. This includes funding for the project management office, IT requirements (including wiring, IT set-up, and infrastructure), and build-out related items such as furniture and filing systems.

Organizational Excellence by Appropriations Account

(Dollars in Millions)

	FY 2013 Actual	FY 2014 Estimate	FY 2015 Request	FY 2015 Request Change Over FY 2014 Estimate Amount	FY 2015 Request Change Over FY 2014 Estimate Percent
Agency Operations and Award Management	$293.50	$298.00	$338.23	$40.23	13.5%
Office of Inspector General[1]	14.33	14.20	14.43	0.23	1.6%
National Science Board	4.10	4.30	4.37	0.07	1.6%
Program Support:					
Research & Related Activities	88.37	100.95	110.98	10.03	9.9%
Education and Human Resources	13.64	16.19	16.71	0.52	3.2%
Subtotal, Program Support	102.01	117.14	127.69	10.55	9.0%
Total	**$413.94**	**$433.64**	**$484.72**	**$51.08**	**11.8%**

Totals may not add due to rounding.

[1] FY 2013 Actual includes $1.16 million of obligations funded through the American Recovery and Reinvestment Act of 2009 (ARRA).

Cuts, Consolidations, Savings, and Lower Priority Programs

NSF's FY 2015 Request follows a thorough examination of programs and investments across NSF to determine where the potential exists for more innovative investments. In addition to last year's proposals, this Request includes three terminations, one reduction, and one lower-priority program elimination, totaling $26.49 million.

Science of Learning Centers (-$11.99 million)**:** the SLC program has been a ten year cross-foundation activity, supported by the Directorates for Social, Behavioral and Economic Sciences; Biological Sciences; Computer and Information Science and Engineering; and Engineering. The program supported six large-scale, long term centers that created the intellectual, organizational, and physical infrastructure needed for the advancement of Science of Learning research. Four of the six existing centers reached the end of their ten-year funding cycle at the end of FY 2014; the remaining two centers reach a planned sunset at the end of FY 2015. Funding for Science of Learning research will continue within SBE through a program of the same name which is not center-based.

Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21) (-$4.31 million) is a Division of Mathematical Sciences (DMS) workforce program offering that has accomplished its original goals. A replacement program is currently in development to better meet current national needs for the training of the next generation of researchers in the mathematical and statistical sciences.

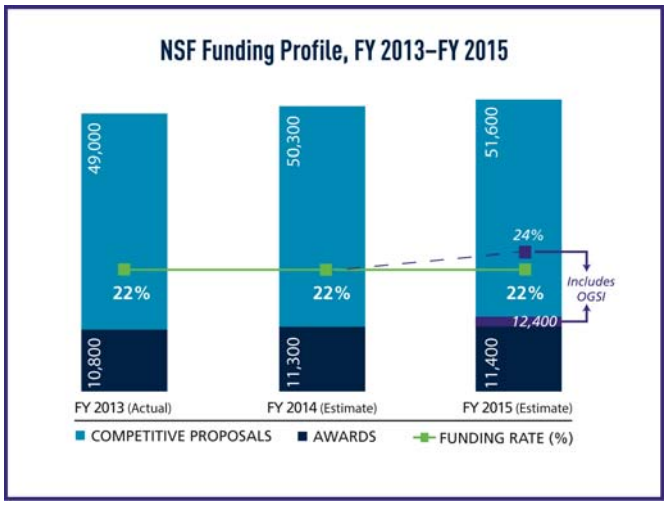
University Radio Observatories (URO) (-$1.19 million) has been superseded scientifically by the Atacama Large Millimeter/submillimeter Array (ALMA), and thus the MPS/AST Portfolio Review recommended terminating this program. Individual university-based observatories will have opportunities for funding through the Mid-Scale Innovations Program in MPS/AST.

The **Network for Earthquake Engineering Simulation (NEES)** program (-$8.0 million) is reduced because two NSF-supported studies recommended support for a smaller "second generation NEES" instead, which will allow additional investments to be made in research that addresses engineering strategies to design for and mitigate against multiple hazards. This rebalancing of facilities and research programs provides a more efficient and effective strategy to meet the needs of the civil and earthquake engineering-related research communities.

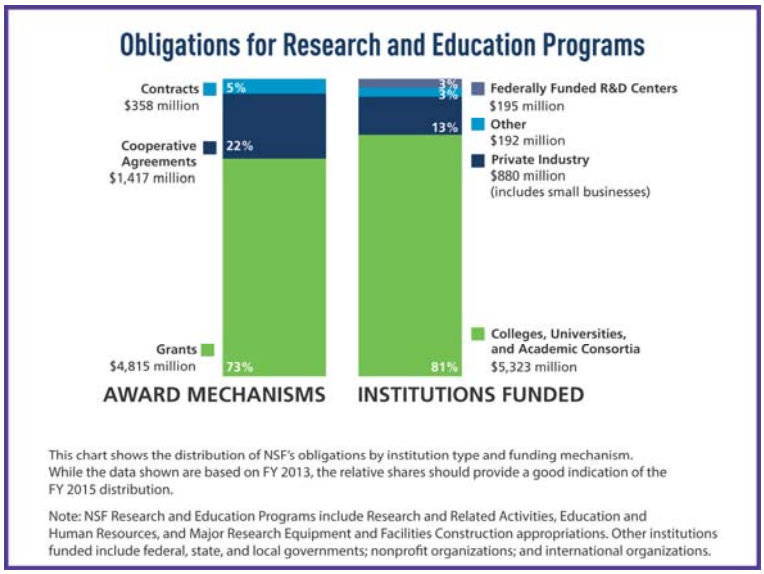
The **Virtual Astronomical Observatory (VAO)** (-$1.0 million) is a lower priority program for NSF. VAO will be transitioned to a new joint NSF/NASA program as operational reviews have shown that the current activity is not meeting the needs of the community in an efficient and cost-effective manner.

NSF by the Numbers

NSF by The Numbers: In FY 2015 NSF expects to evaluate over 51,600 proposals through a competitive merit review process and make over 11,400 new awards. This will require over 233,000 proposal reviews, engaging on the order of 40,000 to 50,000 members of the science and engineering community participating as panelists and proposal reviewers. In a given year, NSF awards reach over 1,900 colleges, universities, and other public and private institutions in 50 states, the District of Columbia, and Puerto Rico. In FY 2015, NSF support is expected to reach approximately 299,000 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 2013, the relative shares should provide a good indication of the FY 2015 distribution. As shown on the graph, 95 percent of NSF's FY 2013 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.

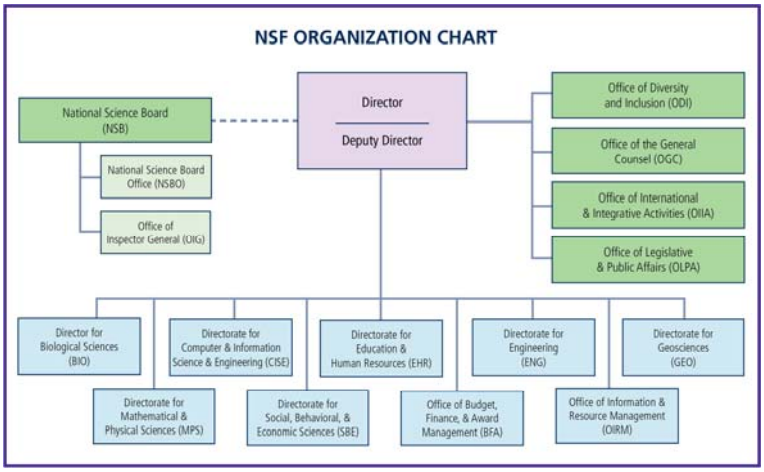


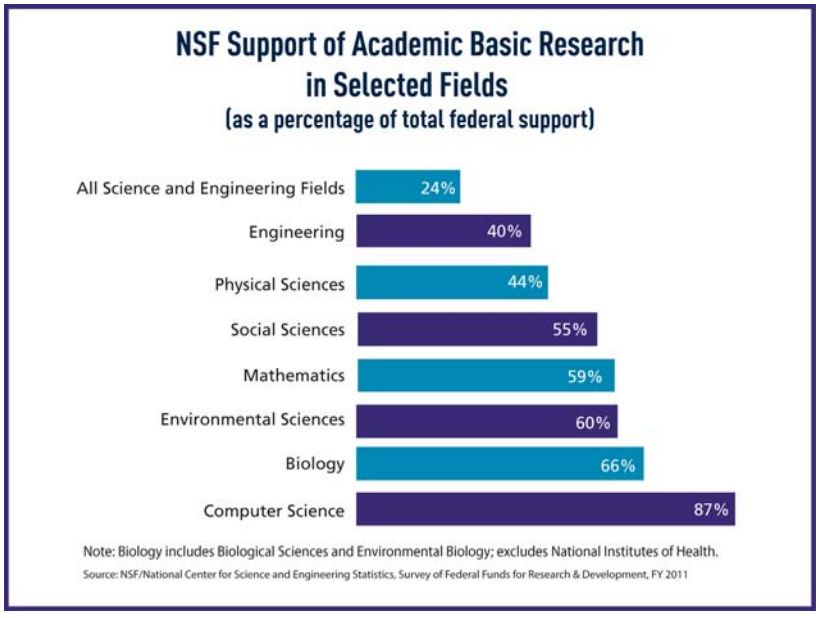
Most NSF awards are to academic institutions. Nonprofit organizations include state and local governments and international organizations. For-profit businesses include private and small businesses. Federal agencies and laboratories include funding for Federally Funded Research & Development Centers.

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 transforms – 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.





NSF's annual budget represents 24 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

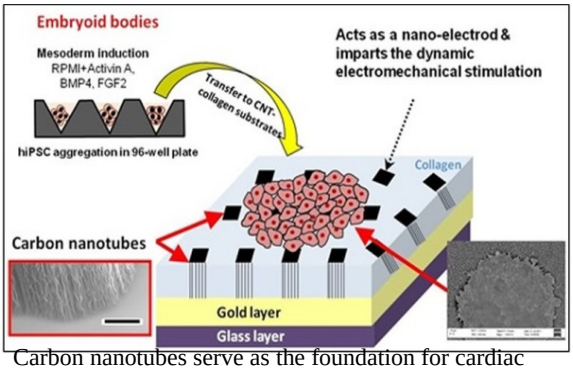
Desert Dwellers and Bots Reveal Physics of Movement

Physicist Daniel Goldman and his fellow researchers at the Georgia Institute of Technology shed light on a relatively unexplored subject - how organisms such as sea turtles and lizards move on (or within) sand. If you've ever struggled to walk with even a modicum of grace on a soft, sandy beach, you may appreciate the question. The answers that Goldman's CRAB lab (Complex Rheology and Biomechanics Laboratory) uncovers - with the help of living animals and biologically inspired robots - deepen our understanding not only of animal survival, evolution and ecology, but also, potentially, the evolution of complex life forms on Earth. The lab's research also assists the design and engineering of robots that must traverse unstable, uneven terrain - those used in search and rescue operations at disaster sites, for example.

After climbing out of their nests, hatchling loggerhead sea turtles make their way to the sea.
Credit: GSTC Turtle Patrol

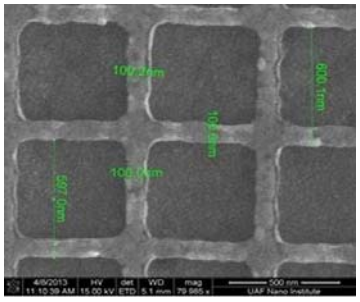
Nanotubes Help Repair Cardiac Tissue

Tissues in the adult human body are limited in their ability to regenerate. Stem cells may offer one option to aid this regrowth; however, a major challenge to using these cells is keeping large quantities of them alive when they are transferred from cell cultures to live hosts. To remedy this issue, researchers with South Carolina's Experimental Program to Stimulate Competitive Research (EPSCoR) have constructed a platform made of carbon nanotubes that stimulates cell survival, proliferation, and contractibility. This environment more closely mimics the cell's native environment, and promotes differentiation to specific types of cells such as cardiac or muscle, as well as cell propagation.



Carbon nanotubes serve as the foundation for cardiac tissue repair platform. *Credit: Ehsan Jabbarzadeh, University of South Carolina*

Improving Solar Cell Light Absorption



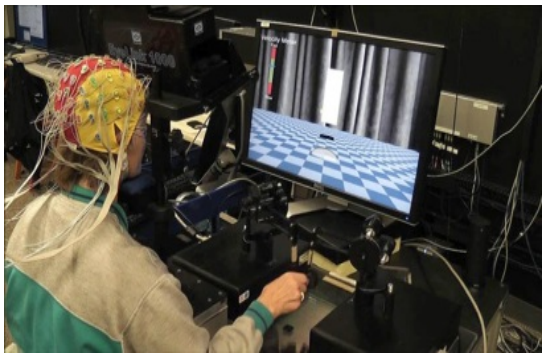
Arkansas researchers have developed a technique that increases light absorption and improves the energy output of solar cells. Working collaboratively, researchers from four Arkansas universities created the approach, which improves solar cell efficiency and lowers production costs, which will make renewable energy more accessible to the general public. Increasing consumption of sustainable solar energy will positively impact the environment, reduce dependence on foreign oil, and stimulate economic growth through job creation at various stages of solar cell production.

Fishnet nanostructure improves solar cell absorption. *Credit: Vinay Budhraja and Sayan Seal, University of Arkansas*

Highlights

Temporal Dynamics of Learning Center

How do humans learn, and how is the element of time critical for learning? The Temporal Dynamics of Learning Center, headquartered at UC San Diego, aims to find out. Its interdisciplinary team of scientists and educators includes over 40 individuals at 17 partner research institutions in three countries and several San Diego schools. The center's projects are diverse and cutting-edge. Researchers delve into topics that include: How does our brain change over time as we become experts? How does musical training affect brain development, and can music interventions improve language and cognitive development? Can we train kids with autism to become "face experts" to improve their social skills? Answers to these questions and more could have far-reaching consequences.



Researchers aim to create an innovative, non-invasive approach for rehabilitation of Parkinson's disease patients.
Credit: Howard Poizner, Institute for Neural Computation, University of California, San Diego

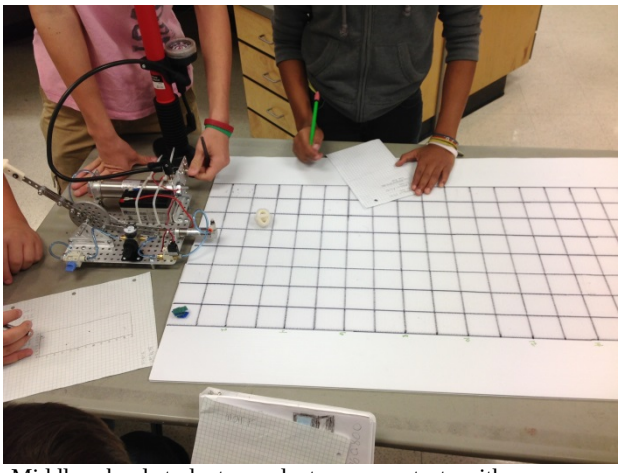
NEON Begins Operations

NEON will be a revolutionary, nationwide ecological sensing instrument.
Credit: NASA and Thinkstock (design by NSF))

The National Ecological Observatory Network (NEON) is a precedent-setting, nationwide, multidisciplinary infrastructure that will generate snapshots of ecosystem health by measuring ecological activity from strategic locations throughout the U.S. At each NEON location, ecological variables - such as air quality levels, land use, diversity of plant and animal species, health of vegetation, soil conditions, and air temperature and humidity - will be captured through 539 unique measurements, which will be recorded through calibrated instruments. Because of its standardized design, data produced by NEON will enable the scientific community to generate the first apples-to-apples comparisons of ecosystem health throughout the U.S. over multiple decades. Some of NEON's data collection and educational operations have already begun, and others will begin incrementally until NEON becomes fully functional in 2017.

Highlights

Students Practice Hands-on STEM Activities to Define Problems and Determine Solutions

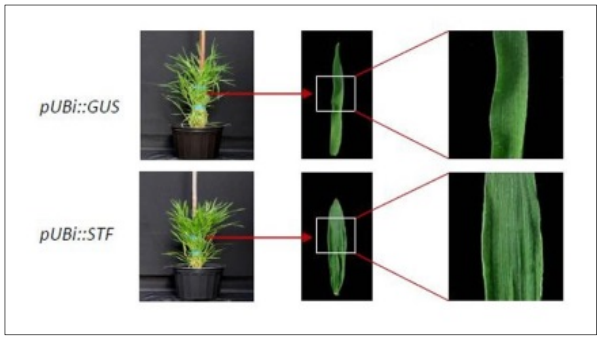


Middle school students conduct accuracy tests with a pneumatic catapult.
Credit: Georgia Institute of Technology

AMP-IT-UP is among more than 100 currently active projects supported by NSF's STEM-C Partnerships program designed to improve math, science, computer science and engineering learning at the K-12 level, through local school district partnerships with higher education institutions. AMP-IT-UP, a partnership between the Georgia Institute of Technology and the Griffin-Spalding County School system, is using a novel approach to encourage student creativity and make science and math courses come alive. The new courses integrate basic science and math content with hands-on engineering design and construction. The idea is to get youngsters to think about engineering, and to better understand engineering concepts, by using math and science to actually design and build projects, often with a specific "client" in mind.

Bigger Blades of Grass

Leaves are the energy powerhouse of plants - the place where solar energy from the sun and carbon dioxide from the atmosphere combine to make sugars. By expanding leaf size, plants can grow more vigorously. Now researchers, funded by the Oklahoma Experimental Program to Stimulate Competitive Research (EPSCoR), have discovered a gene that can increase the leaf size of an important biofuel plant. These findings could be used to increase leaf size and total biomass in grasses through a genetic transformation strategy. This approach could also improve biomass feedstock yield in the most important energy crops - switchgrass and sorghum - in Oklahoma.



Plant models *Brachypodium disachyon* (top) and *Medicago truncatula* (bottom).
Credit: Million Tadege, Oklahoma State University

Highlights

Building Stronger U.S. Businesses

Management performance by country.
Credit: Nicholas Bloom, Stanford University

Using scientific measurements of worldwide management practices and their relationship to success, a team of researchers has identified key management practices that could help U.S. firms increase profits and save jobs. The team is working with firms to help them adopt these practices. This research provides the first global database on management practices, providing the ability to pinpoint the practices that drive economic success. Having identified the essential basic management practices, the research team has shared their knowledge with U.S. firms by working directly with them as well as consulting companies, offering self-evaluation tools and winning media coverage in outlets like the *New York Times*, the *Wall Street Journal* and *BusinessWeek.*

Security Risks in Automotive Computers and Networks

Modern automobiles are no longer mere mechanical devices. Dozens of digital computers monitor and control them through internal networks and those connected to the outside world through a variety of physical and wireless interfaces. This transformation has driven major advancements in efficiency and safety, but it has also introduced a range of new potential risks. A team of university scientists has identified security issues in the design of modern automobiles. They demonstrated that cyber thieves can overtake key components within a car's computer, allowing remote control of the brakes, engine, and lights as well as tracking of the driver's current location, speed, and audio conversations. Through this work the researchers have identified vulnerabilities - and ways to fix them - in advance of any known attacks. The automotive industry is responding swiftly to fix both the particular problems identified and, through standards organizations, to improve the general level of assurance in automotive platforms.

Modern cars are vulnerable to computer attacks.
Credit: Franziska Roesner, Karl Koscher, and Alexei Czeskis, University of Washington

Highlights

Climbing Robot Builds Ships

A new remote-controlled robot can weld while maneuvering over uneven surfaces, climbing walls or even hanging upside down. Developed by researchers at Robotic Technologies of Tennessee (RTT), in collaboration with Tennessee Tech University, the mobile welding robot assists with difficult and dangerous shipbuilding work. The robot enhances worker productivity and safety, and helps to ease the debilitating ergonomic challenges currently faced by welding professionals. Robotics and automation are common in "structured" environments like auto assembly plants, but lacking in less predictable environments. Designed as an assistive technology, RTT's mobile welding robot is light, mobile and easy to use at a worksite. To create the robot, the researchers combined climbing robot technology - developed for remote inspection tasks in the electric power industry - with automated welding equipment.

A worker uses the robotic welder.
Credit: Jack Leustig, Steve Glovksy, and Mike Nutter, Bath Iron Works Photographer

Novel Coatings Clear the Fog on Glass and Plastic Surfaces

Testing anti-fog face mask.
Credit: InnoSense LLC

Few people can avoid fogging while driving a car or engaging in sports that require protective eyewear. Fogging happens when warm, moist air condenses on a cold surface to form water droplets. Water droplets cause light to scatter, affecting visibility. This can be a safety hazard. Researchers have developed coatings to prevent fogging on glass and plastic surfaces. The new coatings shed the water droplets from the surface or form a film. This prevents visibility from being affected during foggy conditions. The coatings also protect the glass or plastic surface from wear and tear, and their performance does not degrade over time. The durable anti-fog coatings can enhance visibility for motorists and pilots, potentially saving lives on the road and in the air. They could make high-speed sports such as skiing and auto racing safer for participants. Continued development of these coatings will create U.S. manufacturing jobs.