NATIONAL SCIENCE FOUNDATION CENTERS

NSF supports a variety of centers programs that contribute to the Foundation's mission and vision. Centers exploit opportunities in science, engineering, and technology in which the complexity of the research problem or the resources needed to solve the problem require the advantages of scope, scale, duration, equipment, facilities, and students. Centers are a principal means by which NSF fosters interdisciplinary research.

NSF Centers Funding

(Dollars in Millions)

	Program initiation	Numbers Centers in FY 2010	FY 2010 Actual	FY 2010 Enacted/ Annualized FY 2012 CR	FY 2012 Request	Change Over FY 2010 Enacted Amount	Change Over FY 2010 Enacted Percent
Centers for Analysis & Synthesis	1995	4	$22.72	$22.72	$25.81	$3.09	13.6%
Centers for Chemical Innovation	1998	14	24.00	24.00	24.00	-	-
Engineering Research Centers	1985	15	48.60	54.91	81.00	26.09	47.5%
Materials Centers	1994	27	52.49	56.70	57.00	0.30	0.5%
Nanoscale Science & Engineering Centers	2001	19	47.99	46.26	30.27	-15.99	-34.6%
Science & Technology Centers	1987	17	57.63	57.77	50.75	-7.02	-12.2%
Science of Learning Centers	2003	6	26.58	25.80	20.37	-5.43	-21.0%
Totals		**102**	**$279.99**	**$288.16**	**$289.20**	**$1.04**	**0.4%**

Totals may not add due to rounding.

DESCRIPTION OF MAJOR CHANGES

Centers for Analysis and Synthesis (BIO)

The Centers for Analysis and Synthesis are designed to continue development of new tools and standards for management of biological information and meta-information, support data analysis capabilities with broad utility across the biological sciences, host workshops that bring together scientists from a variety of disciplines, and begin to host and curate databases. The Centers have a critical role in organizing and synthesizing biological knowledge that is useful to researchers, policy makers, government agencies, educators, and society. In FY 2012, four centers are expected to be funded.

The National Center for Environmental Synthesis will use synthetic approaches to advance the frontiers of scientific understanding of environmental complexity in order to anticipate and manage environmental challenges. This center will allow scientists from diverse disciplines to frame questions, identify resource needs to advance synthesis, reorganize how researchers carry out their research, and thus transform approaches to environmental synthesis. Workshops sponsored by this center will engage philosophers, sociologists, political scientists, psychologists, anthropologists, and environmental biologists (together with policy makers) to integrate broad disciplines from the outset and to set precedence for all subsequent activities.

The National Evolutionary Synthesis Center (NESCent) is a collaborative effort by Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill to foster a greater conceptual synthesis in biological evolution by bringing together researchers and educators, extant data, and information technology resources. NESCent will fund graduate students engaged in center activities, support activities to expand the conceptual reach of the center into targeted areas, and initiate a

formalized, three-tiered assessment of the center that includes milestones for reporting on the impact of those activities. No major changes are planned for NESCent in FY 2012

The National Institute for Mathematical and Biological Synthesis (NIMBioS), located at the University of Tennessee-Knoxville, fosters cross-disciplinary approaches in mathematics and biology to address fundamental and applied biological questions, including national needs research in modeling of infectious diseases of plants and animals. The center will design education programs aimed at the mathematics/biology interface, thereby building the capacity of mathematically competent, biologically knowledgeable, and computationally adept researchers needed to address the vast array of challenging questions in this century of biology. Although predominantly supported by the Directorate for Biological Sciences, the Directorate for Mathematical and Physical Sciences and the Department of Homeland Security also contribute. No major changes are planned for NIMBioS in FY 2012.

iPlant (formerly Plant Science Cyberinfrastructure Collaborative), led by the University of Arizona, uses new computer and information science, and cyberinfrastructure solutions to address an evolving array of grand challenges in the plant sciences. This center is a community-driven effort, involving plant biologists, computer and information scientists and engineers as well as experts from other disciplines, all working in integrated teams. No major changes are planned for iPlant in FY 2012.

Centers for Chemical Innovation (MPS)
The Centers for Chemical Innovation (CCI) are designed to support research on strategic, transformative "big questions" in basic chemical research. The program is stimulating the chemical sciences community to perform work that is high-risk and of potential high scientific and societal impact. CCIs promote the integration of research and education through the extensive involvement of students and postdoctoral fellows in all phases of the work. CCIs are expected to be agile, responding to scientific opportunities as they arise, and to creatively engage the public. Grand challenges include emulating and even surpassing the efficiency of the natural process of photosynthesis to capture the sun's energy; activating strong bonds as a means to store and use chemical energy and to lower energy costs in chemical processing; and designing self-assembling, complex structures, such as molecular computers, with emergent and useful functions not yet known or foreseen.

The program is designed as a staged competition. Several Phase I centers are supported, which then compete for larger Phase II awards. At FY 2012 Request, a total of 15 CCIs will be supported. These are:

- Six Phase II awards: Four continuing awards, as well as two new and/or renewal awards. The Center for Enabling New Transformations through Catalysis will be seeking renewal of its Phase II award and four Phase I awards are eligible to compete for Phase II support.
- Nine Phase I awards: Three new awards and six continuing awards (three initiated in FY 2010 and three initiated in FY 2011).
- Four Phase I awards initiated in FY 2009 will conclude in FY 2012.

The CCI program evaluation design is scheduled for completion in FY 2011, allowing the initiation of a resource center and data gathering in FY 2012. A Leadership Network to support the CCI program will also be implemented in FY 2012.

Engineering Research Centers (ENG)
NSF Engineering Research Centers (ERCs) enable innovation through partnerships, bridging the intellectual curiosity of discovery-focused university research and the engineered systems and technology opportunities of industry research. The centers also educate a technology-enabled workforce with hands-on, real-world experience. These characteristics catalyze the development of marketable technologies to

generate wealth and address grand challenges. ERCs are investigating intelligent electric power grid systems to provide electricity from renewable sources, devising healthcare innovations through tissue engineering and microelectronics research, creating sensing systems that improve the prediction of tornados, and demonstrating intelligent robotic systems to assist people who are elderly or disabled in daily tasks.

ERCs face two renewal reviews, one in year three to determine if they are structured effectively to deliver on ERC program goals, and another in year six to determine if they are making an impact, delivering on goals, and positioning themselves for more challenging tasks to warrant further support. The ERC program periodically commissions program-level evaluations by external evaluators such as SRI International; the Science and Technology Policy Institute (STPI); and ABT Associates to determine the effectiveness of ERC graduates in industry and the benefits of ERC membership to industry and others. A recent survey of the 33 ERCs that have graduated from NSF support after 10 years finds that 27 (83 percent) are self-sustaining with strong financial support and most ERC features in place.

In FY 2012, funding for ERCs increases by $26.09 million over FY 2010 Enacted to a total of $81.0 million. This will support the first class of three new Nanoscale Engineering Research Centers (Nanoscale ERCs), bringing the number of traditional ERCs and Nanoscale ERCs to a total of 21. Funding for the three new Nanoscale ERCs comes from a reallocation of support from the Nanoscale Science and Engineering Centers (NSECs) that graduate in 2011. The reallocated funds will enable the transition of nano-devices created at graduating NSECs to the level of nano-enabled systems created at Nanoscale ERCs.

Materials Centers (MPS)

The Materials Research Centers and Teams (MRCT) program is an interdisciplinary vehicle for increasing materials research and educating students including global research experiences. Thus, the next class of centers will be called Centers of Excellence in Materials Research and Innovation (CEMRI), while the teams will be known as Materials Interdisciplinary Research Teams (MIRT). A restructuring of the Materials Research Science and Engineering Centers (MRSEC) program was implemented with the FY 2011 competition. This new approach eliminates small centers in favor of a new team program. This change is in response to the 2007 National Academies report *The NSF's Materials Research Science and Engineering Program, Looking Back, Moving Forward*.

FY 2011 marks a competition year, which is held triennially. Eight to 10 CEMRI and 10 to 12 MIRT awards are expected in 2011, depending on funds availability.

At FY 2012 Request, funding for all Materials Centers awards, CEMRIs and ongoing MRSECS, is $57.0 million (+$300,000 over FY 2010 Enacted). Support for 14 MRSEC awards is expected through FY 2014 as the old structure is phased out. The FY 2012 Request also includes an additional $6.0 million for MIRT team awards, which will be tracked within the core programs budget line, separate from the Materials Centers line. In total, 21 to 23 centers and 10 to 12 team awards will be supported in FY 2012, compared to the roughly 27 MRSEC-only awards that have been previously funded. Funding increases will allow the newly structured program to broaden participation to institutions not previously supported and to expand participants' international collaborations, thus strengthening U.S. materials research performance and workforce.

Nanoscale Science and Engineering Centers (multi-directorate)

Nanotechnology, which addresses the smallest of scales, is projected to be one of the largest drivers of technological innovation for the next decade and beyond. This potential was recognized in the National Nanotechnology Initiative, particularly in the burgeoning area of nanomanufacturing. Research at the nanoscale through NSF-funded Nanoscale Science and Engineering Centers (NSECs) aims to advance the

development of the ultra-small technology that will transform electronics, materials, medicine, environmental science, and many other fields. Each center has an extended vision for research. Together they provide coherence and a long-term outlook to U.S. nanotechnology research and education and also address the social and ethical implications of such research. NSEC funding supports education and outreach programs from K-12 to the graduate level, which is designed to develop a highly skilled workforce, advance pre-college training, and further public understanding of nanoscale science and engineering. These centers have strong partnerships with industry, national laboratories, and international centers of excellence, which puts in place the necessary elements to bring discoveries in the laboratory to real-world, marketable innovations and technologies.

The FY 2012 Request level of $30.27 million will support 13 continuing NSECs. The first class of six NSECs, initiated in 2001, received their final year of support in FY 2010 and will complete their associated research programs in FY 2011. The decrease of $15.99 million from the FY 2010 Enacted level is principally due to redirection of funds from the NSECs to Nano Engineering Research Centers (ERCs) in FY 2012. As noted in the ERC section above, these reallocated funds will support the first class of Nanoscale ERCs.

Science and Technology Centers: Integrative Partnerships (multi-directorate)
The Science and Technology Centers: Integrative Partnerships (STC) program advances interdisciplinary discovery and innovation in science and engineering through the integration of cutting-edge research, excellence in education, targeted knowledge transfer, and the development of a diverse workforce. The STC portfolio reflects NSF-supported disciplines. Examples of investment include: engineering of biological systems; energy-efficient electronics; global and regional environmental systems -- sustainability and change; new ways of handling the extraction, manipulation, and exchange of information; cyber security; and new materials for optical and electronic applications. STCs engage the Nation's intellectual talent and collaborate with partners in academia, industry, national labs, and government. STCs strengthen the caliber of the Nation's science, technology, engineering, and mathematics (STEM) workforce through intellectually challenging research experiences for students, postdoctoral fellows, researchers, and educators and advance public scientific understanding through partnerships with K-12 and informal education communities.

A review of the STC program, initiated in FY 2009 and organized by the American Association for the Advancement of Science, is nearing completion. A final report is expected in February 2011. The review examined the performance, accomplishments, and effectiveness of 17 STCs (from the 2000, 2002, and 2005/6 cohorts) as well as envisioned the future of the STC program. As one of the general conclusions in the preliminary draft report states, "STC concept has been very effective in catalyzing and nurturing interdisciplinary and transformational science and technology."

At FY 2012 Request, $50.75 million supports eleven STCs, five from the 2010 cohort and six from the 2005-2006 cohort. This decrease of $7.02 million from FY 2010 Enacted is due to the planned sunset of six centers from the FY 2002 cohort in FY 2011.

Science of Learning Centers (multi-directorate)
The Science of Learning Centers (SLC) program supports six large-scale, long-term centers that create the intellectual, organizational, and physical infrastructure needed for the advancement of Science of Learning research. It supports research that harnesses and integrates knowledge across multiple disciplines to create a common groundwork of conceptualization, experimentation, and explanation that anchor new lines of thinking and inquiry towards a deeper understanding of learning. The SLC program goal is to advance the frontiers of all the sciences of learning through integrated research; to connect the research to specific scientific, technological, educational, and workforce challenges; to enable research communities to capitalize on new opportunities and discoveries; and to respond to new challenges. The

SLC portfolio represents synergistic, exciting research efforts that address many different dimensions of learning.

Each SLC award includes funding for an external evaluation of the center. Annual meetings of the SLC evaluators contribute to consistency across these evaluations and its usefulness for program managers. A Committee of Visitors (COV) review for the SLCs was held in 2009, and the SLCs will be part of a COV for the Directorate for Social, Behavioral, and Economic Sciences Office of Multidisciplinary Activities (SBE/OMA) in late 2011. An external evaluation of the SLC program is being planned for FY 2012.

Four awards for the first cohort of SLCs were made in FY 2004. One center was decommissioned in its second year due to its failure to develop cohesively as a center. Three awards for a second cohort were made in FY 2006. The remaining three centers in the first cohort have been approved for renewal through FY 2014, with some ramp down in funding beginning in FY 2012. In February 2011, the National Science Board will consider renewal actions for up to five years (through FY 2016) for two of the three second cohort centers. The third center in the second cohort will be extended at a reduced level of funding for four years, through FY 2015.

In FY 2012, $20.37 million (-$5.43 million from FY 2010 Enacted) will fund six SLCs. SBE/OMA will continue to oversee management of all six centers, with co-funding from the NSF Directorates for Biological Sciences, Computer and Information Science and Engineering, and Engineering.

SBE initiated external discussion on the future of the SLC program and the science it supports at its May 2010 Advisory Committee meeting. The consensus was that NSF should phase down the program as funding for individual centers comes to a close, shifting resources wherever possible to enhance support for the science of learning through non-center mechanisms. NSF will begin ramping down SLC funding in FY 2012, and as possible, redeploy some funds to activities in science of learning and brain sciences.

Estimates of Centers Participation in 2010

(Dollars in Millions)

	Number of Participating Institutions	Number of Partners	Total FY 2010 NSF Support	Total Est. Leveraged Support	Number of Participants
Centers for Analysis & Synthesis	617	116	$23	$8	2,337
Centers for Chemical Innovation	71	57	$24	$3	490
Engineering Research Centers	369	263	$49	$85	3,583
Materials Centers	365	278	$52	$50	4,500
Nanoscale Science & Engineering Centers	522	550	$48	$46	3,900
Science & Technology Centers	131	108	$58	$59	3,127
Science of Learning Centers	44	73	$27	$8	981

No. of Participating Institutions: all academic institutions participating in activities at the centers.

No. of Partners: the total number of non-academic participants, including industry, states, and other federal agencies at the centers.

Total Leveraged Support: funding for centers from sources other than NSF.

No. of Participants: the total number of people who use center facilities, not just persons directly support by NSF.

Centers Supported by NSF in FY 2010

Center	Institution	State
Centers for Analysis and Synthesis		
National Center for Ecological Analysis and Synthesis	U of California-Santa Barbara	CA
National Evolutionary Synthesis Center	Duke, NC State U, U of N. Carolina	NC
National Institute for Mathematical & Biological Synthesis	U of Tennessee- Knoxville	TN
Plant Science Cyberinfrastructure Collaborative	U of Arizona	AZ
Centers for Chemical Innovation		
Center for Chemical Evolution (phase II)	Georgia Institute of Technology	GA
Center for Enabling New Technologies through Catalysis (phase II)	U of Washington	WA
Chemistry at the Space-Time Limit (phase II)	U of California-Irvine	CA
Powering the Planet (phase II)	California Institute of Tech	CA
Center for Chemistry Effects on Climate (phase I)	U of California San Diego	CA
Center for the Chemistry of the Universe (phase I)	U of Virginia	VA
Center for Energetic Non-Equilibrium Chem. at Interfaces (phase I)	U of Chicago	IL
Center for Green Materials Chemistry (phase I)	Oregon State U	OR
Center for Molecular Interfacing (phase I)	Cornell	NY
Center for Molecular Spintronics (phase I)	North Carolina State U	NC
Center for Molecular Tools for Conjugated Polymer Analy (phase I)	U of Texas Austin	TX
Center for Nanostructured Electronic Materials (phase I)	University of Florida	FL
Center for Quantum Info & Chemistry (phase I)	Purdue U	IN
Center for Stereoselective C-H Functionalization (phase I)	Emory U	GA
Engineering Research Centers		
Biomimetic Microelectronic Systems	U of Southern California	CA
Biorenewable Chemicals	Iowa State U	IA
Collaborative Adaptive Sensing of the Atmosphere	U of Mass-Amherst	MA
Compact and Efficient Fluid Power	U of Minnesota	MN
Extreme Ultraviolet Science and Technology	Colorado State	CO
Future Renewable Electric Energy Delivery & Mgmt. Systems	North Carolina State U	NC
Integrated Access Networks	U of Arizona	AZ
Mid-IR Tech for Health and the Environment	Princeton	NJ
Quality of Life Technology	Carnegie Mellon/U of Pittsburgh	PA
Revolutionizing Metallic Biomaterials	North Carolina A&T U	NC
Smart Lighting	Rensselaer Polytechnic Institute	NY
Structured Organic Composites	Rutgers	NJ
Subsurface Sensing and Imaging Systems	Northeastern	MA
Synthetic Biology	U of California-Berkeley	CA
Wireless Integrated MicroSystems	U of Michigan	MI
Materials Centers		
Brandeis Materials Research Science and Engineering Center	Brandeis U	MA
Center for Complex Materials	Princeton	NJ
Center for Emergent Materials	Ohio State U	OH
Center for Materials Research	Cornell	NY
Center for Materials Science and Engineering	Massachusetts Institute of Tech	MA
Center for Micro- and Nanomechanics of Materials	Brown	RI
Center for Multifunctional Nanoscale Materials Structures	Northwestern	IL
Center for Nanomagnetic Structures	U of Nebraska	NE
Center for Nanoscale Science	Pennsylvania State	PA
Center for Nanostructured Interfaces	U of Wisconsin	WI
Center for Research on Interface Structures and Phenomena	Yale	CT
Center for Science and Engineering of Materials	California Institute of Tech	CA
Center for Semiconductor Physics in Nanostructures	U of Oklahoma, U of Arkansas	OK, AR
Ferroelectric Liquid Crystals Materials Research Center	U of Colorado-Boulder	CO
Genetically Engineered Materials Science and Engineering Center	U of Washington	WA

Laboratory for Research on the Structure of Matter	U of Pennsylvania	PA
Materials Research Center	U of Chicago	IL
Materials Research Science and Engineering Center	Carnegie Mellon	PA
Materials Research Science and Engineering Center	Johns Hopkins	MD
Materials Research Science and Engineering Center	Harvard	MA
Materials Research Science and Engineering Center	Georgia Institute of Tech	GA
Materials Research Science and Engineering Center	New York U	NY
Materials Research Science and Engineering Center	U of California-Santa Barbara	CA
Materials Research Science and Engineering Center	U of Maryland	MD
Materials Research Science and Engineering Center	U of Minnesota	MN
Materials Research Science and Engineering Center on Polymers	U of Massachusetts	MA
Renewable Energy Materials Science and Engineering Center	Colorado School of Mines	CO
Nanoscale Science and Engineering Centers		
Affordable Nanoengineering of Polymer Biomedical Devices	Ohio State	OH
Center for Environmental Implications of Nanotechnology (CEIN)	Duke	NC
Center for Integrated and Scalable Nanomanufacturing	U of California-Los Angeles	CA
Directed Assembly of Nanostructures	Rensselaer Polytechnic Institute	NY
Electronic Transport in Molecular Nanostructures	Columbia	NY
High Rate Nanomanufacturing	Northeastern, U of New Hampshire, U of Mass-Lowell	MA, NH
Integrated Nanomechanical Systems	U of California-Berkeley, Cal Tech, Stanford, U of California-Merced	CA
Integrated Nanopatterning and Detection Technologies	Northwestern	IL
Molecular Function at the Nano/Bio Interface	U of Pennsylvania	PA
Nanotechnology in Society Network: Center at ASU	Arizona State U	AZ
Nanotechnology in Society Network: Center at UCSB	U of California-Berkeley	CA
Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems	U of Illinois-Urbana Champaign	IL
Nanoscale Systems in Information Technologies	Cornell	NY
Nanoscience in Biological and Environmental Engineering	Rice	TX
National Nanomanufacturing Network: Center for Hierarchical Manufacturing	U of Massachusetts-Amherst	MA
Predictive Toxicology Assessment & Safe Implementation of Nanotechnology in the Environment (CEIN)	U of California-Los Angeles	CA
Probing the Nanoscale	Stanford, IBM	CA
Science of Nanoscale Systems and their Device Applications	Harvard	MA
Templated Synthesis and Assembly at the Nanoscale	U of Wisconsin-Madison	WI
Science and Technology Centers		
An NSF Center for the Study of Evolution in Action	Michigan State U	MI
Center of Adv. Materials for the Purification of H2O wth Systems	U of Illinois-Urbana Champaign	IL
Center for Biophotonics Science and Technology	U of California-Davis	CA
Center for Coastal Margin Observation and Prediction	Oregon Health and Science U	OR
Center for Dark Energy Biosphere Investigations	U of Southern California	CA
Center for Energy Efficient Electronics Science	U of California-Berkeley	CA
Center for Embedded Networked Sensing	U of California-Los Angeles	CA
Center for Integrated Space Weather Modeling	Boston U	MA
Center for Layered Polymeric Systems	Case Western Reserve U	OH
Center for Microbial Oceanography: Research and Education	U of Hawaii-Manoa	HI
Center for Multi-Scale Modeling of Atmospheric Processes	Colorado State U	CO
Center for Remote Sensing of Ice Sheets	U of Kansas	KS
Emergent Behaviors of Integrated Cellular Systems	MIT	MA
Emerging Frontiers of Science Information	Purdue U	IN
National Center for Earth Surface Dynamics	U of Minnesota-Twin Cities	MN
Center on Materials and Devices for Info. Technology Research	U of Washington	WA
Team for Research in Ubiquitous Secure Technology	U of California-Berkeley	CA

Science of Learning Centers

Center for Excellence for Learning in Education, Science, & Tech.	Boston U	MA
Pittsburgh Science of Learning Center - Studying Robust Learning with Learning Experiments in Real Classrooms	Carnegie Mellon	PA
LIFE Center - Learning in Formal and Informal Environments	U of Washington	WA
Spatial Intelligence and Learning Center	Temple	PA
The Temporal Dynamics of Learning Center	U of California-San Diego	CA
Visual Language and Visual Learning	Gallaudet	DC