

Description of NSF Centers

Engineering Research Centers

The Engineering Research Centers (ERC) program stands as a landmark in federal support for university research and education in partnership with industry. These centers provide an environment where academe and industry can focus together on advances in the complex engineered systems that transform industrial processing systems and product lines most important for the Nation's future. ERCs bring diverse engineering and scientific disciplines together to address fundamental research issues at the interface between the discovery-driven culture of science and the innovation-driven culture of engineering. They provide the intellectual foundation for industry collaboration with faculty and students to resolve generic, long-range challenges, producing the knowledge needed to ensure steady advances in technology, speed their transition to the marketplace, and train graduates who are effective in applying them in industry.

ERCs are also devoted to the integration of research and education by creating team environments for learning and research and producing curricula and course materials for bioengineering, multimedia information systems, manufacturing, electronic packaging, and particle science and technology, among others. In addition, all ERCs have active programs to stimulate interest in engineering with pre-college students and their teachers and several have sites at local museums to educate the general public about engineering and technology.

NSF support of \$63 million in FY 2001 was leveraged by an additional \$140 million in support from industry, other federal agencies, the universities, and ten states. These 515 firms involved partnerships and collaborations in research with faculty from 147 institutions in the U.S. and abroad. In FY 2003, NSF will provide a total of approximately \$62 million, level funding with FY 2002, to support 19 centers across a broad range of technologies, including three Nanoscale Science and Engineering Centers and up to two new ERCs.

Science and Technology Centers

The Science and Technology Centers (STC) Integrative Partnerships Program supports innovation in the integrated conduct of research, education, and knowledge transfer in fields of basic science, mathematics, and engineering. STCs foster partnerships that build a new collaborative culture among researchers and educators at all levels in academia, industry, government laboratories, and other public and private organizations. The Centers provide opportunities to explore challenging and complex research problems that often require interdisciplinary expertise and high-risk approaches, access to state-of-the-art instrumentation and facilities, and a commitment of high levels of support for sustained periods of time. It is estimated that STC funding from other sources totaled approximately \$44.9 million in FY 2001.

STCs have an impressive record of research accomplishments, research training, contributions to K-12 education, and timely transfer of knowledge and technology from the laboratory to industry and other sectors. Traditional barriers among disciplines and among university, governmental, and industrial laboratories have been reduced, creating a new mode of leadership and management in research and education. STCs have engaged the nation's intellectual talent, robustly drawn from its full human diversity, in the conduct of research and education activities; enabled the training of undergraduate students, graduate students, and postdoctoral fellows; involved scores of industrial researchers in basic research; and spawned new companies, products, and jobs.

STCs also create partnerships and programs that transfer knowledge in service to society with respect to new research areas, promising new instrumentation, and potential new technologies. For example, adaptive optics

technology is being developed to investigate how far the correction of visual aberrations can extend the limits of human vision through customized contact lenses and improved laser refractive surgical procedures. NSF's FY 2003 support for the STC program is approximately \$45 million.

Industry/University Cooperative Research Centers and State/Industry/University Cooperative Research Centers

Industry depends on the Industry/University Cooperative Research Centers (I/UCRCs) and State I/UCRCs to provide a steady stream of enabling technologies critical to advancing their manufacturing processes, information technology support systems, and new product lines. In FY 2001, there were 56 of these highly-leveraged centers, representing a total NSF investment about \$6 million. NSF's investment generated \$69 million in additional cash and substantial "in-kind" contributions for the centers. Another indication of high payoff from the supporters of the I/UCRCs is that they have invested over \$160 million per year to fund follow-up internal research and implementation activities in their organizations as a result of the centers' research results.

In FY 2003, NSF will provide approximately \$6 million for the Industry/University Cooperative Research Centers program, providing support to 54 traditional I/UCRCs and the three remaining State I/UCRCs.

Centers of Research Excellence in Science and Technology

The Centers of Research Excellence in Science and Technology (CREST) program upgrades the research capabilities of the most productive minority institutions. Through strong alliances with other universities and laboratories, the Centers produce new knowledge and increase student presence in science, technology, engineering, and mathematics in their region. NSF will provide about \$9 million for CREST in FY 2003. This funding level will support nine Centers and an additional special research Center to help faculty participate more fully in NSF's other research programs.

Plant Genome Virtual Centers

The Plant Genome Research subactivity supported twenty-two Plant Genome Collaboratories or Virtual Centers in FY 2001 at a total investment of \$31 million. These are multi-institutional networks where coordinated, multi-disciplinary investigator teams pursue comprehensive, interdisciplinary research on the structure, organization and function of plant genomes relevant to economically important plants or plant processes. NSF support for Plant Genome Virtual Centers in FY 2003 will total \$31 million.

Of 22 Centers supported in FY 2001, 16 are continuations of awards made earlier; 4 are successful renewals of virtual centers initiated in FY 1998; and 2 are newly established centers. The 22 Centers involve 222 scientists as key personnel with a large number of postdoctoral fellows, graduate students, undergraduate students, technical personnel, and others involved. Key participants are located at 70 institutions in 27 States. International collaborators are involved in a number of areas of center research including the potato, wheat, and model legume projects.

One of the two new awards will investigate the genetic control of form and function in flowers, from flowering to seed production. The objective is to characterize the genes controlling the differentiation of flower cells and examine genes that play a central role in development of plant features. The project takes full advantage of data, information, technologies and research resources produced by the recipients of the Plant Genome Research Program during the last four years.

Materials Centers

The Materials Centers program supports interdisciplinary materials research addressing fundamental problems of intellectual and strategic importance. The centers have strong links to industry and other sectors, and support educational partnerships with other institutions. There were 29 Materials Research Science and Engineering Centers within this program in FY 2001, and an open competition for new and re-competing centers is underway in FY 2002. Annual NSF support for individual centers ranges from less than \$1.0 million to more than \$4.0 million. Additional support from non-NSF sources for these centers totaled \$68 million in FY 2001. NSF's FY 2003 support for the program is approximately \$53 million. Support will be continued for up to three new International Materials Institutes established in FY 2002 to foster and enhance interaction in materials research and education between U.S. and foreign investigators.

Materials Centers include broad-based centers with diverse research agendas as well as those which are more focused. The centers feature cutting-edge materials research in areas such as polymers, biomimetic and biomolecular materials, nanostructured materials, electronic and photonic materials, superconducting and superhard materials, oxide surfaces and magnetic systems, micromechanical systems, magnetic materials, sensors, deformation and fracture, materials synthesis and processing, and fundamental condensed-matter phenomena.

Center For Ecological Analysis and Synthesis

The Center for Ecological Analysis and Synthesis (CEAS) at the University of California at Santa Barbara promotes integrative studies of complex ecological questions and serves as a locus for the synthesis of large data sets. The goals of the Center are to advance the state of ecological knowledge through the search for universal patterns and principles and to organize and synthesize ecological information so that it will be useful to researchers, policy makers and resource managers addressing important environmental problems. NSF's FY 2003 support for the CEAS program is about \$3 million.

Long Term Ecological Research Program

The Long Term Ecological Research (LTER) program supports long-term analysis of ecological phenomena, both natural and human influenced; comparisons of observations across diverse ecosystems; integration of information from multiple sites and multidisciplinary projects through cross-site syntheses; and provision of large, secure, ecologically diverse sites with well-developed support capabilities. Extensive computer networking allows regional, national and international synthesis efforts.

In FY 2002 NSF is supporting 24 LTER sites that are representative of major ecosystems, including two sites in Antarctica and two in Alaska, one in Arctic Alaska. The LTER Program has taken the lead in establishing a worldwide ecological research network by electronically linking the U.S. LTER network with research sites in Europe, Latin America, and the Asia/Pacific region.

NSF's FY 2003 support for the LTER program is approximately \$19 million.

Earthquake Engineering Research Centers

The three Earthquake Engineering Research Centers (EERCs) focus at the systems level, integrate research and education, and develop partnerships with industry and the public agencies responsible for earthquake hazard mitigation at the local, state and federal levels.

The EERCs link geological information about the nature of earthquake hazards in different regions of the country with geotechnical and structural engineering knowledge to provide state-of-the-art structural design methodologies. They provide the knowledge and technology base for industry and public agencies to build and retrofit buildings, bridges, and other infrastructure to better withstand the impacts of earthquakes. Because these centers involve partnerships among social scientists and engineers, they are developing a new generation of decision tools to improve public service agencies' planning for earthquake hazard mitigation and their responses during earthquake emergencies.

EERCs are rapidly becoming major contributors in the field both in the U.S. and internationally. In FY 2001, NSF provided a total of approximately \$6 million to three EERCs, which leveraged this support with \$14.0 million from universities, three states, and industry. FY 2003 support is maintained at \$6 million.

Chemistry Centers

Chemistry Centers include the Environmental Molecular Sciences Institutes, the Collaborative Research Activities in Environmental Molecular Sciences, Collaborative Research in Chemistry, and the Center for Molecular Sciences. These centers support a wide range of activities from developing a molecular understanding of the environment to investigation of fundamental steps in chemical reactions. In FY 2003, NSF will provide approximately \$10 million to support these centers.

Mathematical Sciences Research Institutes

The institutes provide a national resource for in-depth research in the mathematical sciences and for exciting multidisciplinary research between mathematical scientists and other scientists and engineers from academia, industry, and government laboratories. Significant postdoctoral experiences are nurtured through mentoring with world-class mathematical scientists and through opportunities with partner universities, industries, and government laboratories. In FY 2003, NSF will provide about \$14 million for up to three new institutes in interdisciplinary mathematical sciences.

Information Technology Centers

As part of the Information Technology Research (ITR) program begun in FY 2000, NSF began support for 33 new center projects. These focus on major challenges for information technology research and often address interdisciplinary themes. In FY 2001, the number of center projects increased by about 100 percent. In FY 2002, 3-5 new centers will be initiated. In support of their long-term mission, some centers will develop testbeds and may include education and outreach components. Other centers will be virtual centers that join geographically separate investigators with individualized expertise or instrumentation linked by high-performance networks. Some of these virtual centers will foster research on distributed computing and applications. In FY 2003, NSF will fund the Information Technology Research Centers at the level of approximately \$70 million.

Nanoscale Science and Engineering Centers

As part of the multiagency National Nanotechnology Initiative, NSF awarded six new centers in FY 2001. Research and education are focused on a scale ranging from the size of individual atoms to that of large molecules. Research at the nanoscale aims to advance the development of the ultra-small technology that will transform electronics, materials, medicine, environment and many other fields. Each center has a long-term vision for research, and together they will provide coherence and a long-term outlook to U.S. nanotechnology research and education. Support will be provided for education and outreach programs from the graduate to the K-12 level designed to develop a highly skilled workforce, advance pre-college training,

and to advance the public understanding of nanoscale science and engineering. The centers have strong partnerships with industry, national laboratories and international centers of excellence. In FY 2003, NSF will provide continuing support to the six centers at approximately \$14 million.

Physics Frontiers Centers

The Physics Frontiers Centers program was initiated in FY 2001. These centers provide critical resources and needed infrastructure to exceptionally promising new areas of physics. They serve as focal points to help catalyze new fields, with the resources and infrastructure to enable development of the new tools and techniques needed, and to facilitate exploration of new directions in a way that is not practical in individual investigator awards. Areas such as atom lasers, quantum information science, computational physics, biological physics, and astrophysics are particularly promising for such an investment. Interdisciplinary research will be a key element of this program, and each center will have a significant outreach and infrastructure component. In FY 2003, NSF will provide a total of \$13.0 million, an increase of \$1.0 million, for support of seven Centers. The program is expected to grow in subsequent years through additional competitions, in which existing Centers will periodically be required to recompete.

Science of Learning Centers

NSF's investment in Science of Learning Centers (SLC), set to begin in FY 2003, will build on the Foundation's support for learning research in multiple disciplines including biology, psychology, education, neuroscience, cognitive science, linguistics, computer and information science, robotics, mathematics and statistics, engineering, the physical sciences, and the social and behavioral sciences. SLCs will be organized around a unifying research focus and an effective implementation strategy that will achieve all three of the SLC principal goals: (1) advancing the understanding of learning, through research on the learning process, the context of learning, and/or learning technologies; (2) strengthening the connections between science of learning research and educational and workforce development, in a manner that mutually advances both; and (3) building effective collaborative research communities with sufficient resources and organizational capacity to respond to new educational and workforce challenges, and capitalize on new research opportunities and discoveries. FY 2003 support for the SLCs totals \$20.0 million.

Research Centers on the Human Dimensions of Global Change

NSF has supported a consortium of Research Centers on the Human Dimensions of Global Change since FY 1995. The goals of these centers are to facilitate the progress of Human Dimensions of Global Change (HDGC) research; promote the education and training of researchers ranging from undergraduate to postdoctoral levels; and foster interdisciplinary and multidisciplinary research collaborations on HDGC issues. NSF's FY 2003 support for the two HDGC centers totals \$2.30 million, a \$1.0 million reduction from FY 2002. This reduction is part of a planned phase-down in core support for these centers.

National Consortium on Violence Research

NSF supports the National Consortium on Violence Research (NCOVR), which is engaged in a program of capacity building in the violence research community. The Consortium's activities focus on training the next generation of researchers in interdisciplinary approaches to understanding interpersonal violence and to increase the participation of underrepresented groups in research on violence. NCOVR also seeks to facilitate collaborative methodological research and the promotion of intellectual exchange that cuts across disciplines. NSF expects to provide about \$1.0 million in support for the Consortium in FY 2002. Support for FY 2003, contingent on review of a renewal proposal in 2003, will be \$1.0 million.

Children's Research Centers

The Children's Research Initiative (CRI) received new emphasis in FY 2001 to support a variety of research activities in areas of human sciences. Most prominent under CRI are three research centers that are funded at \$500,000 each for 5 years. Together, these centers represent a new thrust in the field of integrative developmental science. Individually, the centers represent leading edge research about children and media, developmental science, and the integration and dissemination of developmental science to inform both research and policy. Centers are located at the University of North Carolina and Cornell University. A third center is a collaboration among four universities: Georgetown University, Northwestern University, University of Texas-Austin, and University of California-Los Angeles.