

Workforce Development for Teachers and Scientists

Funding Profile by Subprogram

(dollars in thousands)

	FY 2008 Current Appropriation	FY 2009 Original Appropriation	FY 2009 Additional Appropriation ^a	FY 2010 Request
Workforce Development for Teachers and Scientists				
Student Programs	4,760	5,265	—	8,078
Educator Programs	2,664	6,311	—	5,750
Workforce Development Programs	—	—	+12,500	5,000
Program Administration and Evaluation	620	2,007	—	1,850
Total, Workforce Development for Teachers and Scientists	8,044	13,583	+12,500	20,678

Public Law Authorizations:

Public Law 95–91, “Department of Energy Organization Act”, 1977

Public Law 101–510, “DOE Science Education Enhancement Act,” 1991

Public Law 103–382, “The Albert Einstein Distinguished Educator Fellowship Act of 1994”

Public Law 109–58, “Energy Policy Act of 2005”

Public Law 110–69, “America COMPETES Act of 2007”

Program Overview

Mission

The mission of the Workforce Development for Teachers and Scientists (WDTS) program is to help ensure that DOE and the Nation have a sustained pipeline of highly trained Science, Technology, Engineering, and Mathematics (STEM) workers.

Background

The U.S. STEM workforce is part of the foundation upon which our Nation’s prosperity is built. Trillions of dollars of investments in the Nation’s 1,540 independent school districts, 1,700 community colleges, and 2,500 four-year colleges and universities have resulted in an educational system that annually produces thousands of students who are prepared for STEM careers and the emerging innovation economy.

New dynamics, however, could weaken the U.S. STEM workforce. Foreign students educated in the U.S. are increasingly going to our foreign competitors, who employ these highly trained students in their own laboratories and factories, drawing away a source of skilled workers the U.S. had captured in the past. Other nations are establishing universities and training facilities that match U.S. capabilities and are attracting students who otherwise would come to the U.S. Even though demographic shifts in the U.S. indicate that the U.S. will be a majority population of minorities by 2043, U.S. students,

^a The Additional Appropriation column reflects the planned allocation of funding from the American Recovery and Reinvestment Act of 2009, P.L. 111–5. See the Department of Energy Recovery website at <http://www.energy.gov/recovery> for up-to-date information regarding Recovery Act funding.

particularly students from under-represented populations, are not choosing STEM careers and educations.

The Nation is not in crisis, but as the National Academy of Sciences' 2005 report, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future," indicates, the warning signs are on the horizon. Without investments in U.S. STEM workforce and education, the U.S. is in danger of becoming less competitive in the increasingly innovative, knowledge-based global economy.

DOE and its predecessor organizations have been involved with STEM workforce training and education for over 60 years. These programs have produced tens of thousands of world class scientists, engineers, and technicians who have helped solve national security, energy, and environment challenges, while pursuing answers to many of the most important scientific questions in physics, biology, and other areas of basic science. DOE's STEM education programs are primarily executed through DOE national laboratories and several major research universities that work with the Department, and these programs typically involve mentor-intensive research training.

WDTS works closely with DOE national laboratory education offices to implement a range of workforce and education opportunities for STEM students and faculty. These programs include world class competitions, such as the National Science Bowl[®], which annually attracts 22,000 of the highest achieving middle and high school students in the Nation; undergraduate internship opportunities at the DOE national laboratories, which place over 750 students each year in mentor-intensive research environments; and K-12 and undergraduate faculty professional development programs that place more than 300 educators into DOE-sponsored research programs.

Subprograms

WDTS is organized into four subprograms: Students, Educators, Workforce Development, and Program Administration and Evaluation.

- The *Student* subprogram focuses on encouraging students to enter STEM careers and retaining them in the workforce. Competitions at the middle school and high school levels are designed to reward and recognize high-potential science and engineering students. At the undergraduate level, WDTS places students into world class research environments to improve their content knowledge and to help them understand how to be successful as researchers. Included within this subprogram are Science Undergraduate Laboratory Internship (SULI), Community College Institute (CCI), Pre-Service Teachers (PST), the National Science Bowl[®], and the Real World Design Challenge.
- The *Educator* subprogram provides professional development experiences for K-12 and undergraduate faculty teaching STEM subjects. Faculty are provided with two mentor-intensive experiences: one in a research setting working on a DOE research project, and another under the tutelage of a master teacher or senior laboratory staff to understand how to translate lessons learned in the laboratory into classroom practice and content. Included within this subprogram are DOE Academies Creating Teacher Scientists (ACTS), Faculty and Student Teams (FaST), and the Albert Einstein Distinguished Educator Fellowship.
- The *Workforce Development* subprogram is new for FY 2010 and is designed to bring top talent into the Nation's STEM workforce. A new graduate fellowship program will support high-potential students studying physics, biology, chemistry, mathematics, and other disciplines important to DOE's missions in energy, environment, national security, and basic discovery, and nurture the skills needed to pursue careers at universities, industry, DOE national laboratories, and in the Federal government.

- The *Program Administration and Evaluation* subprogram develops and deploys rigorous evaluation methods for all WDTS programs; sponsors longitudinal workforce studies that track student and educator participants in DOE programs; encourages partnerships with Federal agencies, industry, academic institutions, and professional associations to leverage resources and expertise in workforce development; and improves DOE outreach efforts to communicate to the broader public the role the Department plays in STEM education and the opportunities that are available to students and educators, particularly those from under-served populations. Included within this subprogram are the Laboratory Equipment Donation Program, Evaluation Studies, Technology Development and On-Line Application Systems, Outreach, Workforce Studies, and the DOE Mentor Program.

Benefits

WDTS delivers three major benefits to society, which are closely tied to the need to improve the overall STEM workforce in the U.S.

First, students and educators who otherwise might not have selected a STEM career/education are provided opportunities through WDTS competitions, internships, and other activities to make an informed choice about pursuing a STEM career. Given the need for the U.S. to increase the supply of highly technical workers, increasing the overall pool of potential students and educators is critical.

Second, students and faculty with an aptitude and desire to pursue STEM careers and education are introduced through WDTS programs to authentic research environments and mentors as a way to increase the retention of students and faculty in STEM fields. Very few educators at the K–12 level have ever worked in a laboratory setting and this prevents them from effectively conveying to their students content knowledge and the process of science. In addition, studies^a demonstrate that students and faculty who are exposed to mentor intensive research environments are much more likely to stay in the STEM system because of the support that is developed in those environments. This is important to society because there is a low retention rate of STEM students and K–12 educators, particularly those from under-represented populations.

Finally, WDTS provides students and faculty with a pathway to STEM careers at the Department, its national laboratories, and other institutions that support scientific disciplines consistent with DOE's missions in energy, environment, national security, and scientific discovery. Producing more STEM workers and educators results in considerable societal benefits, such as improvements in the performance of U.S. student academic performance, increases in the capabilities of faculty to teach STEM, the creation of a skilled scientific and technical workforce ready for high-wage job opportunities in the U.S. in emerging technical fields such as sustainable energy production, and improvements in the general public's understanding of the importance of DOE science and technology in their lives and society.

Program Planning and Management

The foundation for WDTS program planning and management efforts came through a series of stakeholder meetings in 2007–2009 that set a new direction for WDTS STEM workforce and education efforts. More than 100 representatives from other Federal agencies, the DOE national laboratories, scientific professional associations, education groups, universities, the private sector and organizations representing under-represented populations have provided WDTS with advice and comments. This

^a Bragg, D.D., *Promising Outcomes for Tech Prep Participants in Eight Local Consortia: A Summary of Initial Results*, Minneapolis, MN: National Research Center for Career and Technical Education, University of Minnesota, 2001.

resulted in the development of a strategic plan^a that serves as the blueprint that WDTS follows when setting its strategic direction. As a result of this effort, the WDTS program has been restructured to include:

- Rigorous evaluation of all WDTS programs
- Expansion of efforts to provide STEM professional development opportunities for K–12 and undergraduate faculty
- Programs for undergraduate students and educators that will fill critical skill gaps, with a premium on increasing the participation of under-represented populations and institutions in WDTS programs
- Implementation of two new initiatives consistent with recommendations from WDTS stakeholders: the Graduate Fellowship program and a dedicated mentoring program.

WDTS participates on the Education Subcommittee of the National Science and Technology Council (NSTC), which is managed by the White House Office of Science and Technology Policy (OSTP). Through the NSTC subcommittee and other venues, WDTS engages with the National Science Foundation (NSF), National Aeronautics and Space Administration (NASA), Department of Defense (DOD), National Institutes of Health (NIH), Federal Aviation Administration (FAA), and other Federal agencies to develop interagency efforts in science education. Recent examples include the creation of the Real World Design Challenge in cooperation with the FAA and co-sponsorship of Faculty and Student Teams (FaST) with NSF. In addition, WDTS has been participating in an effort within the NSTC's Education Subcommittee to outline a general interagency framework for science education.

WDTS programs have been reviewed by a panel of STEM experts and are recognized as premier opportunities offered by a Federal agency for students and faculty to become engaged in STEM fields. In addition, the review identified a number of “model” programs that other Federal agencies could adopt, for example, the National Science Bowl[®], which attracts more than 22,000 of the highest performing middle and high school students in the Nation; the Academies Creating Teacher Scientists (ACTS) program; the Faculty and Student Teams (FaST) program, which integrates under-represented faculty into mainstream SC research programs; and, the Science Undergraduate Laboratory Internship (SULI) program, which is the flagship WDTS program and annually attracts 5–10 times more applicants than there are slots available.

Coordination of Education/Workforce Development Activities

WDTS coordinates with other DOE program offices to develop workforce and science education efforts that leverage existing WDTS capabilities and resources, particularly those developed within the DOE national laboratory system. WDTS has established programs and support infrastructure (online application system, outreach efforts, financial instruments, etc.) that interest other DOE programs seeking to create dedicated STEM education/workforce efforts. As a result, other DOE programs frequently consult with WDTS as they launch new efforts or propose partnerships that leverage resources.

In FY 2008–2009, for example, WDTS worked with the Office of Energy Efficiency and Renewable Energy (EERE) as they developed a plan for an FY 2010 workforce training and education initiative; the National Nuclear Security Administration (NNSA) as they developed a Faculty and Student Teams effort; the Office of Fossil Energy on a new undergraduate internship program; and the Office of

^a DOE Office of Workforce Development, “*Future Workforce Strategy*,” 2007.

Economic Impact and Diversity on mentor/protégé agreements with Historically Black Colleges and Universities. In addition, WDTS provides significant support for K–12 educator professional development and undergraduate internship programs at all three NNSA laboratories, the National Renewable Energy Laboratory (EERE), Idaho National Laboratory (Office of Nuclear Energy), and the Savannah River Ecology Laboratory (Office of Environmental Management).

Budget Overview

WDTS programs are designed to help the U.S. maintain its competitive edge. These opportunities will help increase the pipeline of skilled scientists and engineers who can successfully pursue careers in areas that will transform the world's energy and environment future, supports our national security, and seeks to understand the fundamentals of matter and energy itself. The FY 2010 budget request continues support for all ongoing program activities, including expanded support for the ACTS, FaST, CCI, Outreach, and Workforce Studies programs, and implements the new Graduate Fellowship and DOE Mentor programs.

Significant Program Shifts

The proposed Graduate Fellowship program will create an immediate pipeline of graduate students pursuing advanced science and engineering degrees with an interest in energy, environment, and basic research. Fellowship awards will be made on a competitive basis for a period of three years contingent on the Fellow's progress.

In addition, WDTS will significantly increase funding for the Science Undergraduate Laboratory Internship and Community College Institute programs.

Student Programs

Funding Schedule by Activity

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Student Programs			
Science Undergraduate Laboratory Internship	2,583	2,800	4,000
Community College Institute of Science and Technology	319	292	800
Pre-Service Teachers	188	210	428
National Science Bowl [®]	1,670	1,963	2,350
Real World Design Challenge	—	—	500
Total, Student Programs	4,760	5,265	8,078

Description

The goals of the Student subprogram are to provide mentor-intensive research experiences at the DOE national laboratories for students to enhance their content knowledge in science and mathematics and their investigative expertise, to inspire interest in pursuing STEM careers and K–12 STEM education, and to retain these students within the STEM pipeline. By providing a wide variety of students with the opportunity to work directly with many of the world’s best scientists and use the most advanced scientific facilities available, this program expands the Nation’s supply of highly skilled scientists and engineers, especially in the physical sciences where the greatest demand lies because of a steady decline in U.S. citizens entering these fields. Through the National Science Bowl[®] and other student science and engineering competitions, DOE’s laboratories and facilities provide experiences to inspire secondary students to continue and focus on STEM education and careers.

Selected FY 2008 Accomplishments

- In FY 2008, WDTS validated, through program evaluation, that undergraduate research experiences at the DOE national laboratories significantly increased a student’s interest in pursuing a STEM career and that their content knowledge in STEM fields of importance to DOE increased as a result of the experience. These evaluation findings validated the WDTS approach to STEM workforce development, which relies heavily upon mentored research experiences.
- Peer review evaluation of more than 600 undergraduate student scientific abstracts from the research conducted by undergraduate students supported by WDTS indicates that students are participating in highly technical research projects under the close supervision of a senior laboratory scientist, which is a leading indicator that WDTS undergraduate programs are succeeding in their goal of promoting effective mentor/protégé relationships.
- WDTS teamed with the California State University (CSU) system in 2008 to create the “Student Teachers as Researchers” (STAR) program supported by CSU, which builds on the WDTS Pre-Service Teacher program and promotes life-long professional development for K–12 STEM educators. This is one example of how WDTS programs and resources can be leveraged for improving K–12 educator professional development sponsored by other organizations.
- FY 2008 marked the 18th anniversary of the DOE’s National Science Bowl[®]. More than 16,000 high school students from over 1,500 school districts (10 percent of the U.S. total) participated in 67

regional science bowl events. Saturday science seminars at the National Science Bowl[®] introduced students to many contemporary issues and findings in contemporary scientific research. More than 5,000 volunteers participated in judging, timekeeping, and other activities helped make this event possible. The Middle School Science Bowl (MSSB), initiated in FY 2002 with 8 teams, expanded to 36 regional events with each winning team traveling to the national event. In addition to the academic competition, each middle school team participated in the Hydrogen Fuel Cell Car Challenge. In total, more than 6,000 students and 2,000 volunteers participated at the regional competitions. The national event was hosted by the National Renewable Energy Laboratory at the University of Denver.

Detailed Justification

(dollars in thousands)

FY 2008	FY 2009	FY 2010
2,583	2,800	4,000

Science Undergraduate Laboratory Internship

Science Undergraduate Laboratory Internship (SULI) supports a diverse group of students at DOE’s national laboratories in individually mentored research experiences. Through these unique and highly focused experiences, students become a part of the national laboratory community and a source of talent for DOE and the Nation. Students in the program apply on a competitive basis and are matched with mentors working in the student’s fields of interest, spend an intensive 10–16 weeks working under the individual mentorship of resident scientists, produce a peer-reviewed abstract and research paper, and attend seminars that broaden their view of science careers and help them understand how to become members of the scientific community. Goals and outcomes are measured based on students’ research papers and abstracts, pre- and post-surveys, and an annual evaluation by a group of peers, both within and outside of DOE. An undergraduate student journal is produced annually that publishes selected full length peer-reviewed research papers and all abstracts of SULI students. Full research papers published in the journal are presented by the student authors at a poster competition at the annual meeting of the American Association for the Advancement of Science (AAAS). An annual competition first held in 2008, the Science and Energy Research Challenge (SERCh), recognizes the 15 best posters produced by SULI students through a rigorous and peer reviewed selection process. The abstracts of the research conducted by these students and their mentors are posted on the AAAS web site. NSF collaborates with DOE to offer students in its undergraduate programs access to individually mentored research internships that they would otherwise not have. This activity helps ensure a steady flow of students with growing interest in science careers into the Nation’s pipeline of workers at the national laboratories, academia, and industry.

In FY 2008, with DOE, NSF, and other leveraged support, 16 students participated in the fall semester program, 26 students participated in the spring semester program, and 370 students participated in the summer, with 22 from NSF programs. The DOE contribution will support an estimated 365 students in FY 2009 and 570 in FY 2010. This total includes undergraduate students who participate in the WDTS Faculty and Student Teams (FaST) program.

Community College Institute of Science and Technology

319	292	800
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The Community College Institute (CCI) of Science and Technology, which provides a 10 to 16-week (summer or semester) mentored research internship at a DOE national laboratory for highly motivated community college students, is designed to address DOE’s workforce shortages, particularly at the

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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skilled technician level for DOE mission critical areas, such as “green technology” deployment. Because community colleges account for over 40% of the entire Nation’s undergraduate enrollment and a majority of under-represented students in STEM, this is a largely untapped and clear avenue to increase participation by under-represented groups in STEM careers. CCI students apply online and are matched with mentors working in the student’s field of interest, spend an intensive 10 weeks working under the individual mentorship of resident scientists, produce an abstract and formal research paper, and, attend professional enrichment activities, workshops, and seminars that broaden their view of career options, help them understand how to become members of the scientific community, and enhance their professional skills. Goals and outcomes are measured based on students’ research papers and abstracts, pre- and post-surveys, and external evaluation. An undergraduate student journal was created to publish selected full research papers and all abstracts of students in this activity.

Through the partnership with NSF, 13 undergraduate students in NSF programs (e.g., the Louis Stokes Alliance for Minority Participation and Advanced Technology Education program) also participated in CCI in FY 2008. In FY 2008, 48 DOE-supported students directly participated in this internship. Twelve additional students were part of one of the NSF programs that provided funding for CCI. WDTS will fund an estimated 48 students in FY 2009 and 115 students in FY 2010. This total includes students participating on FaST teams.

Pre-Service Teachers **188** **210** **428**

The Pre-Service Teachers (PST) program prepares undergraduate students for a K–12 STEM education career. This effort addresses the national need to improve the content knowledge of STEM educators prior to entering the teaching workforce and to improve the retention rate of those educators once they enter the field (which has a 50% dropout rate after the first five years). The NSF has been a partner with DOE on this activity since FY 2001. This allows NSF’s undergraduate pre-service programs to include a PST internship in the opportunities they provide to students. Students in this program apply on a competitive basis and are matched with mentors working in the student’s field of interest; spend an intensive 10 weeks working under the mentorship of a master teacher and DOE laboratory scientist to help maximize the building of content knowledge and skills through the research experience; produce an abstract and an educational module related to their research and an optional research paper, poster, or oral presentation; and attend professional enrichment activities, workshops, and seminars that help students apply what they learn to their academic program and the classroom, help them understand how to become members of the scientific community, and improve their communication and other professional skills. Goals and outcomes are measured based on students’ abstracts, education modules, pre- and post-surveys, and external evaluation.

In FY 2008, 8 DOE national laboratories hosted 31 participating students (7 from NSF). In FY 2009, WDTS funding will support 35 students at 8 national laboratories. In 2010, the increase in funding will support 60 students and 6 master teachers at 10 DOE national laboratories.

National Science Bowl[®] **1,670** **1,963** **2,350**

The National Science Bowl[®] is an internationally recognized, prestigious academic event for high school and middle school students. It has attained its level of recognition and participation through a grass-roots design, which encourages the voluntary participation of professional scientists, engineers, and educators from across the Nation. Students answer questions on topics in astronomy, biology, chemistry, mathematics, and physics in a highly competitive, Jeopardy-style format. From 1991–2009,

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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nearly 200,000 students from across the Nation have participated in regional and national competitions and have been encouraged to excel in mathematics and science and to pursue careers in those fields. The National Science Bowl[®] provides students and educators with a forum to receive recognition for their talent and hard work by solving academic problems in selected fields of science and math, in addition to their participation in various hands-on science challenges. In 2009, both the high school and middle school teams that win their regional events will attend the four-day national finals held in Washington, D.C. During this time, the students participate in a day of scientific seminars and science discovery activities with the students “doing” science, with the event culminating in an academic competition. Middle school teams participate in the model hydrogen fuel cell car competition. WDTS funding provides all of the travel and lodging expenses for each winning team attending the national event, seminar speakers, trophies, awards, and items and equipment for the various hands-on and interactive science activities and events.

The number of regional events remains relatively constant from one year to the next with 67 to 70 high school and 36 to 40 middle school teams participating in recent years. A total of 22,000 middle and high school students participate at the regional and national competitions, along with more than 7,000 coaches and volunteers.

Real World Design Challenge — — **500**

The Real World Design Challenge (RWDC) originated out of the National Science Bowl[®] high school engineering competition and was funded as a pilot effort in FY 2009. The National Science Bowl[®] focuses on basic research knowledge, but for five years students also participated in an engineering challenge (typically a fuel car competition) as part of the competition. Evaluation of the program indicated that a more rigorous engineering competition was needed to attract the Nation’s best engineering students and to provide a real learning experience for the students. WDTS partnered in FY 2009 with a major computer-aided design (CAD) and computer-aided manufacturing (CAM) engineering software firm, the Federal Aviation Administration and several industry leaders to develop a pilot RWDC effort involving 10 states that culminated in a national competition held at the National Air and Space Museum in March 2009. WDTS will seek to expand the RWDC model to include participation from 15 additional states in FY 2010.

Total, Student Programs **4,760** **5,265** **8,078**

Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

Science Undergraduate Laboratory Internship

The number of students participating in this program increases by 635 in FY 2010, from 365 in FY 2009 to a total of 570 in FY 2010, with much of the growth focused on under-represented populations.

+1,200

FY 2010 vs. FY 2009 (\$000)

Community College Institute of Science and Technology

The number of students participating in this program increases by 67 in FY 2010, from 48 in FY 2009 to 115, reflecting WDTS’s effort to meet the growing demand for “green technology” workers at DOE national laboratories.

+508

Pre-Service Teachers

The number of students participating in this program will increase by 25 in FY 2010, from 35 in FY 2009 to 60 students and 6 master teachers, which support WDTS’s efforts to take the STAR K–12 educator professional development model to at least one new state.

+218

National Science Bowl®

Support is increased to provide fuel cell kits needed for the middle school competition.

+387

Real World Design Challenge

Support for travel, lodging, and associated activities.

+500

Total Funding Change, Student Programs

+2,813

Educator Programs

Funding Schedule by Activity

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Educator Programs			
DOE Academies Creating Teacher Scientists	1,849	3,768	3,750
Faculty and Student Teams	250	1,543	1,000
Albert Einstein Distinguished Educator Fellowship	565	1,000	1,000
Total, Educator Programs	2,664	6,311	5,750

Description

Improving the ability of educators at all levels to serve as mentors and teach science content is the key to increasing the size and quality of the STEM workforce. Laboratory research experiences are an effective approach to meet this goal^a. WDTS has built programs at the K–12 and undergraduate levels that focus on increasing educator knowledge of DOE science and technology programs and missions, and provides them with the resources that enable them to be successful in the classroom.

The DOE Academies Creating Teacher Scientists (DOE ACTS) program is the platform from which WDTS launches its long-term relationships with K–12 educators. DOE ACTS is a STEM educator professional development program for middle and high school teachers. The program is designed around best practices in professional development as outlined from educational research and program improvements based upon evaluation data. Through DOE ACTS, educators improve their content knowledge in areas of high importance to DOE missions and become contributing researchers in the scientific community. As highly trained leaders in STEM education, they are a key element of the effort to reform our Nation’s science education and to improve the quality of classroom educators.

The Faculty and Student Teams (FaST) program is WDTS’s premier mechanism to bring under-represented faculty and students into the mainstream of DOE’s research enterprise. FaST provides individual faculty, their students, and their respective institutions the training needed to successfully compete for Federal science research grants and to develop a deeper understanding of DOE science.

The Albert Einstein Distinguished Educator Fellowship benefits Federal agencies and Congressional offices as these outstanding educators provide their “real world” classroom expertise and advice to national policy makers. After their Fellowship, the educators return to their school districts or to education policy positions better prepared to be leaders at the local, regional, and national levels, and bring knowledge of Federal programs that provide resources to their school districts.

Selected FY 2008 Accomplishments

- In FY 2008, WDTS, partnering with the California State University (CSU) system, helped pioneer the CSU “Science Teacher and Researcher” program. This innovative program brings together the long-standing success of the WDTS Pre-Service Teachers program with CSU’s emerging K–12 STEM educator professional development program to build a life-long learning and support system

^a Gilmer, P.J.; Hahn, L.; and Spaid, M.R.; *Experiential Learning for Pre-Service Science and Mathematics Teachers: Applications to Secondary Classrooms*, Tallahassee, FL: SERVE, 2002.

for K–12 educators. Forty pre-service educators supported by CSU participated in the first year model which, through evaluation, has proven successful in its goals.

- DOE ACTS participants in FY 2008 reported in evaluation surveys that their content knowledge in physics, chemistry, and geophysics increased by more than 20 percent, on average, a key indicator that the program is succeeding in embedding key science content that is important to DOE/SC into K–12 classrooms.
- In FY 2008, approximately 50% of WDTS FaST university faculty members received competitively awarded funding for research grants from DOE and the National Science Foundation. A key indicator of success for FaST is the ability of faculty to integrate within the Nation’s research enterprise. Since the program began, more than 40 FaST faculty have submitted more than 100 research proposals to Federal institutions/agencies.

Detailed Justification

(dollars in thousands)

FY 2008	FY 2009	FY 2010
1,849	3,768	3,750

DOE Academies Creating Teacher Scientists

DOE ACTS requires a three-year commitment by educators to participate in this program. Each educator spends an intensive 4 to 8 weeks annually at DOE national laboratories working under the mentorship of master educators and laboratory scientists to build content knowledge, research skills, and a lasting connection with the scientific community through the research experience. Master educators, who are expert K–12 educators and adept in both scientific research and scientific writing, act as liaisons between the mentor scientists and the educator participants. This helps the educators transfer the research experiences to their classrooms. Follow-on support is considered critical. Participants receive an \$800 per week stipend plus travel and housing expenses while at the national laboratories.

The National Commission on Mathematics and Science Teaching indicates that professional staff development is one of the most effective ways of improving the achievement of K–12 students. The DOE national laboratories clearly are not positioned to affect the hundreds of thousands of STEM educators through direct retraining. However, the laboratories can play a pivotal role in reforming the Nation’s STEM education by creating sufficient numbers of highly trained education leaders as agents of change in STEM education. This is accomplished by providing carefully designed mentor-intensive training for science and math educators that will allow them to more effectively teach; to attract their students’ interests to science, mathematics, and technology careers; and to improve student achievement. Educators apply on a competitive basis and are matched with mentors working in their subject fields of instruction.

Evaluation includes a self-identification of science content gaps by the educator participant, pre- and post-surveys that benchmark the progress of each participant, successful development of a professional development plan by each educator, results from laboratory self-appraisals, the impact on local STEM education and student achievement; and retention of the educators in STEM K–12 education.

DOE ACTS funded 113 teachers in FY 2008 and will fund 229 educators in FY 2009 (119 continuing and 110 new). The FY 2010 request funds a total of 220 educators (110 continuing and 110 new) and provides master teachers at each participating laboratory.

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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Faculty and Student Teams

250 1,543 1,000

Faculty and Student Teams (FaST) provides an opportunity for under-represented faculty and students from colleges and universities to work on a mentor-intensive science research project at a DOE national laboratory. Faculty members are encouraged to return to the laboratory in subsequent summer terms. The program has two key components: faculty professional development designed to encourage faculty with limited research experience to develop grant proposals and participate in DOE/SC programs; and student cohorts who accompany the faculty member. During a 10-week summer research experience at the laboratory, the faculty member is introduced to new and advanced scientific techniques that contribute to their professional development and help them prepare their students for careers in science, engineering, computer sciences, and technology. FaST activities at SC laboratories are being conducted in collaboration with the NSF.

In FY 2009 WDTS launched a major increase in this program tied to the goal of increasing the participation of under-represented faculty and students in SC research programs. Surveys and other evaluation studies have revealed that faculty support of students at the national laboratories is particularly important for Minority Serving Institutions (MSIs), which are primarily teaching institutions and generally do not have the ability to support research activities at their home institutions. The FaST program enables the MSI to build faculty research capabilities, encourages cohorts of diverse students to participate in DOE research, and overall improves the retention and recruitment of under-represented populations in the DOE system.

In FY 2010, all of the undergraduate students supported on FaST teams will be supported through the SULI and CCI programs, enabling an increase in the number of faculty who are supported and maintenance of the mini-grant program. WDTS supported 10 teams in FY 2008, 50 teams in FY 2009, and will support at least 60 teams in FY 2010. Ten faculty and 30 undergraduate students were supported in FY 2008; 50 faculty and 150 undergraduate students in FY 2009; and 60 faculty and 180 students in FY 2010.

Albert Einstein Distinguished Educator Fellowship

565 1,000 1,000

The Albert Einstein Distinguished Educator Fellowship Awards for K–12 science, mathematics, and technology educators brings classroom and education expertise to Congress, DOE, and other Federal agencies' education and outreach activities. These educators provide practical insights and “real world” perspectives to policy makers and program managers. The Einstein Fellowship is a valuable professional growth opportunity for the educators because they return to the education field with knowledge of Federal resources and an understanding of national education policies. In FY 2008, WDTS completed an external review of the Einstein Program and, as a result, is making significant program improvements designed to increase the benefits of the program to DOE and to the participants.

In FY 2009, with the organizational support of DOE and other Federal agencies (including NSF, NASA, NOAA, and NIH), WDTS was able to place 15 Einstein Fellows. Of these, 3 were directly supported by WDTS and 1 was supported by an Office of Science research program (2 Fellows in Congress and 2 at DOE). The FY 2010 WDTS request will directly support 4 Fellows in Congress and 2 at DOE. The funding will also augment stipends and health insurance for the participants. NSF, NASA, NOAA, and NIH will support 16 Einstein Fellows in FY 2010.

Total, Educator Programs

2,664 6,311 5,750

Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

DOE Academies Creating Teacher Scientists

The number of educators participating in DOE ACTS will decrease by 9 in FY 2010, from 229 in FY 2009 to 220, beginning a new 3-year cohort, and providing a master teacher at each participating laboratory.

-18

Faculty and Student Teams

The number of teams supported by DOE will increase by 10 in FY 2010, from 50 in FY 2009 to 60 because WDTS will fund student participation through the SULI and CCI programs in FY 2010, allowing for an expansion of the number of faculty participants and overall teams. In addition, faculty members will be eligible to participate in a competitive mini-grant program managed by WDTS that enables them to continue DOE research at their home institution. Student participation, through support from the CCI and SULI programs in FY 2010, will increase by 30 in FY 2010 from 150 in FY 2009 to 180.

-543

Total Funding Change, Educator Programs

-561

Workforce Development Programs

Funding Schedule by Activity

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Workforce Development Programs			
Graduate Fellowships	—	—	5,000

Description

WDTS will create the Graduate Fellowship program in FY 2010 at a \$5 million level to support 50–60 U.S. students.

Graduate Fellowships fill a compelling need within the DOE workforce development pipeline. Currently, DOE does not have a coordinated fellowship program specifically designed to meet the Nation’s long-term workforce needs related to DOE’s missions in energy, environment and scientific discovery. A 2008 NSF survey found that of the 2,235 post-doctoral students working at DOE national laboratories, only 889 (40%) were U.S. citizens. This confirms recent studies by the National Academies and other organizations that the U.S. is falling behind other nations in the production of highly qualified technical workers. The Graduate Fellowship program is designed to help remedy this situation and over time will be expanded to support more U.S. Graduate Fellows per year.

Detailed Justification

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Graduate Fellowships	—	—	5,000
WDTS will implement the Graduate Fellowship program in FY 2010. The Fellowships will include support for tuition and a stipend for living expenses and travel. Applicants will be competitively selected by external review based on evaluation of each application against established criteria. Outreach will be conducted to all U.S. universities, scientific professional societies, and other organizations with student populations of interest to DOE, with an emphasis on the inclusion of under-represented populations and institutions. The Fellowships will provide up to three years of support over a maximum of five years and will pay for full tuition and fees at a U.S. university, travel associated with the student’s research, and an annual stipend. Program evaluation will include pre- and post-surveys of students, as well as longitudinal studies that indicate whether or not the students are finding employment in energy and environment fields important to DOE and the Nation.			
Total, Workforce Development Programs	—	—	5,000

Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

Graduate Fellowships

Implementation of this new Fellowship program will provide 50–60 students with tuition, monthly stipends, and other administrative costs.

+5,000

Program Administration and Evaluation

Funding Schedule by Activity

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Program Administration and Evaluation			
Laboratory Equipment Donation Program	75	75	240
Evaluation Studies	150	300	200
Technology Development & Online Application	175	400	400
Outreach	200	732	610
Workforce Studies	20	500	300
DOE Mentor Program	—	—	100
Total, Program Administration and Evaluation	620	2,007	1,850

Description

The Program Administration and Evaluation subprogram provides the data, analysis, and other resources required for effective WDTS program management and delivery. Analytical/evaluation studies are used by WDTS program managers to make efficient use of taxpayer dollars. Non-financial resources, such as laboratory equipment or on-line applications, enable WDTS performers and participants to effectively participate in WDTS programs. In addition, WDTS has initiated a number of outreach efforts with universities, professional societies, private industry, and other Federal agencies designed to fully leverage the WDTS investment in workforce development and STEM education programs.

Evaluation Studies and Workforce Studies provide the analytical resources required by WDTS to make informed judgments about the effectiveness and benefits of WDTS program investments. WDTS in FY 2007–2009 developed Evaluation Studies consistent with the recommendations of the Academic Competitiveness Council (ACC)^a and an OMB/OSTP review. These Evaluation Studies are rigorous reviews of individual performance, program effectiveness, and overall programmatic accomplishment of WDTS goals. Evaluation Studies (pre- and post-surveys, laboratory self-assessments, external expert review, and abstract reviews) focus on six leading indicators of success for WDTS: content knowledge, retention of individuals within the STEM pipeline, quality of the programs, increases in participation by under-represented groups, leveraging, and competition/reward. Workforce Studies identify the long-term STEM workforce needs of DOE and SC, and analyze the long-term success of WDTS programs. WDTS in FY 2007–2008 developed a pilot workforce study/survey methodology that will be fully implemented in FY 2009–2010. These Workforce Studies will identify the critical skill gaps, by scientific discipline, which may exist within the DOE/SC Federal and national laboratory workforces.

The Laboratory Equipment Donation program is being expanded to include middle schools and high schools (currently only universities may participate) so that educators who participate in the DOE ACTS

^a National Science and Technology Council, Subcommittee on Education, *Finding Out What Works: Agency Efforts to Strengthen the Evaluation of Federal Science, Technology, Engineering and Mathematics (STEM) Education Programs*, 2009.

program, the National Science Bowl[®], and other K–12 programs can take advantage of DOE’s excess equipment donation efforts. The Technology Development and Online Application activity provides the online resources required by students and educators to apply for resources, conduct general outreach, and manage evaluation studies (for example, the educator electronic portfolio). The Outreach activity is designed to reach under-represented populations and to form partnerships with associations, industry, and other groups to leverage WDTS investments. WDTS has developed an outreach strategy focused on the development of closer relationships with under-represented groups and institutions that it will continue to implement in FY 2010. The DOE Mentor Program, a new activity, will solidify DOE’s longstanding capacity to recruit, train, and effectively utilize the large cadre of mentor scientists who provide the foundation for WDTS’s student and educator programs. This program will develop consistent standards and training for DOE mentors and provide incentives for mentors to participate in all of the WDTS programs. Currently, mentors are recruited and trained by DOE laboratories with very little assistance from WDTS. This limits the number and utility of those mentor scientists because they are not managed as a national resource.

Selected FY 2008 Accomplishments

- WDTS initiated the first external peer review of WDTS program management and evaluation efforts in FY 2008. Results of the review were implemented throughout the WDTS portfolio during FY 2008–2009 and will continue to be implemented in FY 2010. A key result was the development of the STEM outreach strategy to under-represented populations and institutions, and greater linkages to SC and DOE R&D programs. Program managers used the results of the external review process to adjust programs and improve program efficiency/effectiveness by reallocating resources to high priority programs (such as FaST) and focusing evaluation efforts on national objectives.
- The first results of the Evaluation Studies were received in FY 2008 and were used to inform program management. One major program adjustment has been the development of competitive solicitation processes for all of WDTS’s programs and renewed efforts to improve the diversity of WDTS’s programs.
- In FY 2008, more than 568 individual pieces of surplus scientific equipment from DOE national laboratories with an original value of more than \$16,304,000 were donated to U.S. universities through the Laboratory Equipment Donation Program.

Detailed Justification

(dollars in thousands)

FY 2008	FY 2009	FY 2010
75	75	240

Laboratory Equipment Donation Program

The Laboratory Equipment Donation Program provides excess equipment to faculty at institutions of higher education for energy-related research. Through the Energy Asset Disposal System, DOE sites identify excess laboratory equipment that is then listed on the ERLE website. Colleges and universities can search for equipment of interest to them and apply via the website. DOE property managers approve or disapprove the applications. The equipment is free, but the receiving institution pays for shipping costs. WDTS intends to expand this program in FY 2010 to middle schools and high schools and will pay for shipping costs to those institutions.

(dollars in thousands)

FY 2008	FY 2009	FY 2010
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Evaluation Studies

150 300 200

WDTS will sustain rigorous and comprehensive evaluations of all WDTS programs. Funding decreases because initial efforts in FY 2009 have provided a sufficient platform for FY 2010 activities.

Technology Development and On-Line Application

175 400 400

Technology Development and Online-Application Systems provides for a new IT architecture, which is a two year endeavor, to enhance and maintain the WDTS application and electronic portfolio system. Funding in FY 2010 will support the second year of the new design of all of the websites, on-line applications, DOE ACTS education portfolios, and pre- and post-surveys that participants complete during their internship/fellowship experiences.

Outreach

200 732 610

Outreach has four components: providing information to WDTS program alumni (competitions, undergraduate research internships, educator programs, etc.) to encourage their continued participation in DOE programs; creating a common database of internship opportunities, fellowships, and other research-based educational opportunities at DOE; assisting in the coordination of outreach activities with other Federal agencies; and enhancing communication about WDTS programs to the public. A major emphasis of the outreach effort is with under-represented groups and institutions. In FY 2009 WDTS initiated the development of an outreach strategy that will be implemented in FY 2010.

Workforce Studies

20 500 300

Workforce Studies focus on the critical skill gaps, by scientific discipline, which may exist within the SC Federal and national laboratory workforces. These studies are designed to be long-term sustained efforts that will provide a baseline of data and results to effectively manage WDTS programs and set overall strategic direction. Minor funding was provided in FY 2008. Full implementation began in FY 2009 and continues in FY 2010 to provide in-depth and systematic reviews of workforce requirements and to determine the long-term benefits of WDTS program investments by tracking the progress of STEM students and workers who participate in WDTS programs.

DOE Mentor Program

— — 100

The DOE Mentor Program will be implemented in FY 2010 and has two components: a professional development effort designed to recruit and train the mentor scientists at DOE national laboratories and a recognition/rewards program that will provide incentives for mentor participation in WDTS programs. Scientist mentors are the key resource that WDTS bases its programs upon and must be nurtured in a systematic manner to ensure that a sufficient supply of mentors exist for WDTS programs.

Total, Program Administration and Evaluation

620 2,007 1,850

Explanation of Funding Changes

FY 2010 vs. FY 2009 (\$000)

Laboratory Equipment Donation Program

The increase will support expansion of this program to middle and high schools in FY 2010. Funding will support transportation of equipment to middle and high schools and for some training, as needed.

+165

Evaluation Studies

Development efforts for Evaluation Studies occurred in FY 2007–2009 and the reduction reflects the maintenance of the WDTS evaluation program at a sufficient level in FY 2010 to provide in-depth and systemic reviews of all WDTS programs.

-100

Outreach

The WDTS STEM outreach strategy identifies a number of new efforts designed to include under-represented individuals and institutions into SC STEM programs. Those include mentor/protégé agreements with Minority Serving Institutions, participation at professional society meetings, and other activities. Funding decreases because initial efforts in FY 2009 have provided a sufficient platform for steady state activities in FY 2010.

-122

Workforce Studies

Development efforts for the Workforce Studies began in FY 2008 and were funded in FY 2009 at a level needed to establish the base effort. The reduction reflects maintaining these studies at a sufficient level to provide continuity.

-200

DOE Mentor Program

This new effort will create a professional development program focused on mentor/protégé relationships and a rewards/recognition program for outstanding DOE mentors.

+100

Total Funding Change, Program Administration and Evaluation

-157

Supporting Information

SC Education Crosscut

The Office of Science (SC) through its six research Programs—Basic Energy Sciences, Advanced Scientific Computing Research, Biological and Environmental Research, High Energy Physics, Nuclear Physics, and Fusion Energy Sciences—supports the training of undergraduates, graduate students, and postdoctoral researchers as an integral part of the ongoing sponsored research activities at universities and DOE national laboratories. In addition, these six SC Programs support modest activities targeted towards undergraduate, graduate students, postdocs, and K-12 science and math educators to educate and encourage new talent into fields important to the Program-specific missions.

These activities, in addition to the activities supported within the Workforce Development for Teachers and Scientists program, provide opportunities that will draw U.S. talent into science, technology, engineering and mathematics and create the skilled scientific and technical workforce needed develop the solutions to meeting our energy challenges in the 21st century and enable the U.S. to continue to be among the leaders in science and innovation. The following table summarizes the support for science, technology, engineering, and mathematics education and training opportunities outside of ongoing sponsored research awards.

Funding Summary

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Undergraduate Programs			
Basic Energy Sciences	280	280	300
Advanced Scientific Computing Research	250	250	250
Biological and Environmental Research	100	100	100
High Energy Physics	10	10	10
Nuclear Physics	73	88	103
Fusion Energy Sciences	370	370	370
Workforce Development for Teachers and Scientists	3,090	3,334	5,228
Total, Undergraduate Programs	4,173	4,432	6,361
Graduate Programs			
Basic Energy Sciences	440	578	585
Advanced Scientific Computing Research	5,000	5,006	6,000
Biological and Environmental Research	1,694	1,703	1,710
High Energy Physics	780	780	775
Nuclear Physics	179	225	167
Fusion Energy Sciences	1,170	1,145	1,375
Workforce Development for Teachers and Scientists	—	—	5,000
Total, Graduate Programs	9,263	9,437	15,612

(dollars in thousands)

	FY 2008	FY 2009	FY 2010
Educator Programs, K–12 Students			
Biological and Environmental Research	250	250	250
High Energy Physics	750	750	750
Fusion Energy Sciences	786	850	850
Workforce Development for Teachers and Scientists	4,409	8,349	8,840
Total, Educator Programs	6,195	10,199	10,690
Office of Science			
Basic Energy Sciences	720	858	885
Advanced Scientific Computing Research	5,250	5,256	6,250
Biological and Environmental Research	2,044	2,053	2,060
High Energy Physics	1,540	1,540	1,535
Nuclear Physics	252	313	270
Fusion Energy Sciences	2,326	2,365	2,595
Workforce Development for Teachers and Scientists	7,499	11,683	19,068
Total, Office of Science	19,631	24,068	32,663