COORDINATING FEDERAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION INVESTMENTS: PROGRESS REPORT

A Report from the

Federal Coordination in STEM Education Task Force

Committee on STEM Education

National Science and Technology Council

In Response to the Requirements of the America COMPETES Reauthorization Act of 2010

FEBRUARY 2012

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) advises the President on the effects of science and technology on domestic and international affairs. The office serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal government. OSTP leads an interagency effort to develop and implement sound science and technology policies and budgets. The office works with the private sector to ensure Federal investments in science and technology contribute to economic prosperity, environmental quality, and national security. For more information, visit http://www.ostp.gov.

About the National Science and Technology Council

The National Science and Technology Council (NSTC) was established by Executive Order on November 23, 1993. This Cabinet-level council is the principal body within the executive branch that coordinates science and technology policy across the diverse entities that make up the Federal research and development enterprise. Chaired by the President, the membership of the NSTC consists of the Vice President, the Director of the Office of Science and Technology Policy, Cabinet Secretaries and Agency Heads with significant science and technology responsibilities, and other White House officials.

The NSTC is organized into five primary committees: Science, Technology, Engineering, and Mathematics (STEM) Education; Science; Technology; Environment, Natural Resources and Sustainability; and Homeland and National Security. Each of these committees oversees subgroups focused on different aspects of science and technology. One of the NSTC's primary objectives is to establish clear national goals for Federal science and technology investments in an array of areas that span virtually all the mission areas of the executive branch. The Council prepares coordinated interagency research and development strategies to form investment packages that are aimed at achieving multiple national goals.

For additional information concerning the work of the National Science and Technology Council, please visit the NTSC website.

About the Committee on Science, Technology, Engineering, and Mathematics (STEM) Education

The NSTC Committee on STEM Education (CoSTEM) coordinates Federal programs and activities in support of STEM education pursuant to the requirements of Sec. 101 of the America COMPETES Reauthorization Act of 2010.[1] The CoSTEM addresses education and workforce policy issues; research and development efforts that focus on STEM education at the PreK-12, undergraduate, graduate, and lifelong learning levels; and current and projected STEM workforce needs, trends, and issues. The CoSTEM performs three functions: review and assessment of Federal STEM education activities and programs; with the Office of Management and Budget, coordination of STEM education activities and programs across Federal agencies; and development and implementation of a 5-Year Federal STEM education strategic plan through the participating agencies, to be updated every five years.

1. Pub. L. No. 111-358 (http://www.gpo.gov/fdsys/pkg/BILLS-111hr5116enr/pdf/BILLS-111hr5116enr.pdf)

About this document

This report provides a descriptive overview of the Federal STEM Education Strategic Plan that is being developed by the CoSTEM. The Federal Coordination in STEM Education Task Force (FC-STEM) was chartered to develop the Strategic Plan with oversight by the CoSTEM. The FC-STEM includes representatives from OSTP and the same 11 Federal agencies that comprise the CoSTEM. In addition, this report includes a description of the Federal STEM education portfolio and the degree of overlap and fragmentation therein. The Strategic Plan will be delivered to Congress in spring 2012.

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EXECUTIVE OFFICE OF THE PRESIDENT
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WASHINGTON, D.C. 20502

February 13, 2012

Members of Congress:

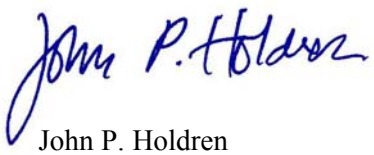
I am pleased to release this update on the status of the 5-Year Federal Science, Technology, Engineering, and Mathematics (STEM) Education Strategic Plan. The importance of Federal investments in STEM education and need for increased coordination and efficiency of these investments has been apparent for many years. However, with 13 Federal agencies investing in STEM education efforts, such long-term, meaningful coordination and efficiency has been hampered by the absence of a government-wide STEM education strategic plan. To address this issue, Congress passed and President Obama signed the America COMPETES Act Reauthorization of 2010, which calls for the formation of a National Science and Technology Council Committee on STEM Education (CoSTEM) to create a 5-year strategic plan to advance the state of American STEM education. As a first step in the development and implementation of the strategic plan, CoSTEM released the results of an inventory of all Federal investments in STEM education – *The Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio*. High-level findings from the *Portfolio* report and progress in creating the Strategic Plan are included in this report.

The Strategic Plan described in this report will be a component of the Administration's comprehensive effort to improve STEM education in America. To date, the CoSTEM has identified inter-agency STEM education goals, and defined objectives and strategies to coordinate Federal investments in STEM education to efficiently achieve those goals. In addition, this report includes a description of current Federal investments in STEM education and the level of Federal STEM education spending during the previous, current, and upcoming fiscal year. The Strategic Plan will be completed in Spring 2012, and will include annual and long-term objectives, evidence standards, each contributing agency's role in achieving the objectives, and common practices for assessing progress toward the objectives.

The connection between the Strategic Plan and the Administration's comprehensive effort to improve STEM education steps is reflected in new programs proposed in the FY 2013 President's Budget Request. For example, a joint Department of Education and National Science Foundation K-16 mathematics education program to create a knowledge-building infrastructure and a new approach to grant-making that will serve as models to be implemented more widely as part of the Strategic Plan.

I look forward to continuing to work with the Congress, agencies, the private sector, and the public to improve STEM education in America.

Sincerely,



John P. Holdren
Assistant to the President for Science and Technology
Director, Office of Science and Technology Policy

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Department and Agency Abbreviations

DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DHS	Department of Homeland Security
DOT	Department of Transportation
ED	Department of Education
EPA	Environmental Protection Agency
HHS	Department of Health and Human Services
NASA	National Aeronautics and Space Administration
NIH	National Institutes of Health (part of HHS)
NIST	National Institute of Standards and Technology (part of DOC)
NOAA	National Oceanic and Atmospheric Administration (part of DOC)
NRC	Nuclear Regulatory Commission
NSF	National Science Foundation
NSTC	National Science and Technology Council
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
USDA	United States Department of Agriculture
USGS	United States Geological Survey (part of DOI)

Executive Summary

The America COMPETES Reauthorization Act of 2010 calls for the National Science and Technology Council's (NSTC) Committee on STEM Education (CoSTEM) to create a 5-year Federal STEM education strategic plan. As required by the Act, this report includes a description of the Strategic Plan and Federal STEM education programs. The 5-Year Federal STEM Education Strategic Plan is nearing completion, and this report includes details about the components of the Strategic Plan that have been established and provides an overview of the components that are under development. The Strategic Plan will be completed and delivered to Congress in spring 2012.

The review of the Federal government's STEM education portfolio (a critical aspect of the Strategic Plan) is complete. In December 2011, the CoSTEM released the *Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio*[2] report that describes how 13 Federal agencies utilize $3.4 billion to support STEM education. The *Portfolio* report indicates that Federal expenditures on STEM-focused education represent a very small piece of the $1.1 trillion in annual U.S. spending on education. In addition, of the 252 investments funded in fiscal year 2010, the CoSTEM identified only a moderate number with similar objectives, target audiences, products, and STEM fields of focus. The CoSTEM found no investments that had the same objectives, target audiences, products, and STEM fields of focus.

The *Portfolio* report has been crucial in the development of the Strategic Plan, and makes possible a description of the common goals, desired outcomes, and strategies needed to create a coordinated portfolio of STEM education across the Federal Government. The Strategic Plan will recommend that as Federal agencies coordinate their STEM education investments by taking the necessary steps to accomplish the following objectives:

1. **Use evidence-based approaches.** Ensure Federal STEM education investments incorporate what is known about effective STEM education and evidence-based STEM education practices.
2. **Identify and share evidence-based approaches.** Conduct STEM education research and evaluation to identify evidence-based practices and assess program effectiveness. Enhance sharing of research and evaluation findings across agencies and with the public.
3. **Increase efficiency and coherence.** Ensure Federal STEM education investments are coordinated in order to utilize and leverage Federal resources efficiently.
4. **Identify and focus on priority areas.** Align a subset of the Federal STEM education investments to focus on Federal STEM education priority areas in a coordinated manner. The four priority areas identified are: Effective K-12 STEM teacher education, engagement, undergraduate STEM education, and serving groups traditionally underrepresented in STEM fields.

Annual milestones to guide the implementation of the Strategic Plan and track its outcomes are currently under development. Progress toward reaching the annual milestones will inform revisions to the Strategic Plan and relevant STEM education policy decisions.

2. NSTC (2011). The Federal STEM Education Portfolio. http://www.whitehouse.gov/sites/default/files/microsites/ostp/costem__federal_stem_education_portfolio_report.pdf

Through public input and the continued efforts of the CoSTEM, the Strategic Plan will be completed by spring 2012. It will embody work on the annual milestones; the criteria for success; a process for creating the priority area roadmaps; a tracking and accountability plan; and a process to develop the infrastructure and capacity for implementation—all of which are currently under development.

"We know that the progress and prosperity of future generations will depend on what we do now to educate the next generation. Today I'm announcing a renewed commitment to education in mathematics and science…Through this commitment, American students will move – from the middle to the top of the pack in science and math over the next decade – for we know that the nation that out-educates us today will out-compete us tomorrow."

President Obama
Remarks at the National Academy of Sciences Annual Meeting
April 27, 2009

Introduction

The America COMPETES Reauthorization Act of 2010[3] directs the Office of Science and Technology Policy (OSTP) to create an interagency committee under the National Science and Technology Council (NSTC) to develop a 5-year Federal science, technology, engineering, and mathematics (STEM) education strategic plan that includes:

- annual and long-term objectives;
- common metrics to assess progress toward achieving the objectives;
- approaches that agencies will take to assess the effectiveness of their STEM programs and activities;
- the role of each agency in achieving the objectives; and
- an inventory of Federal STEM education programs and activities.

Purpose of this Report

This report is the first of the reports that are required under the Act to be transmitted annually to Congress by the Director of OSTP at the time of the President's Budget Request. The America COMPETES Reauthorization Act of 2010 requires the report to include a description of:

- the Strategic Plan;
- Federal STEM education activities and programs;
- each agency's STEM education funding for the previous, current, and next fiscal year (FY);
- duplication and fragmentation of programs and activities; and
- a process for disseminating information about Federal STEM education research and evidence-based practices to education practitioners and stakeholders.[4]

3. Pub. L. No. 111-358 (http://www.gpo.gov/fdsys/pkg/BILLS-111hr5116enr/pdf/BILLS-111hr5116enr.pdf).
4. Congress recently reiterated the need for the Strategic Plan and the importance of dissemination of STEM education research and best practices. Conference Report on H.R. 2112, Consolidated and Further Continuing Appropriations Act, 2012 (http://www.gpo.gov/fdsys/pkg/CREC-2011-11-14/pdf/CREC-2011-11-14-pt1-PgH7433-3.pdf#page=89).

Need for a Strategic Plan

Quality STEM education is important for the nation as a whole and for individual citizens. A robust and capable STEM workforce is crucial to United States competiveness. Multiple reports link STEM education to the future security and economic success of the United States.[5] There are, however, indications that not enough citizens are being educated for careers in STEM or STEM-related fields. For example, the number of jobs at all levels that require knowledge of STEM is increasing,[6] but it is difficult in some economic sectors for employers to find job applicants with needed STEM knowledge and STEM problem solving skills.[7] In addition, the U.S. ranks in the middle of the pack internationally on assessments of K-12 students' performance in mathematics and science.[8]

The Federal government is a major employer of the U.S. STEM workforce and funder of STEM research and development. To ensure that a capable workforce is available for its own operations as well as for the broader U.S. economy, the Federal government has devoted funding and resources to STEM education and supported post-secondary students through STEM research funding.[9] It has long been apparent, however, that the efficiency and effectiveness of Federal support of STEM-focused education programs have been limited by a lack of inter-agency coordination and collaboration.[10] In addition, there have long been calls for improvements in the STEM education evaluation capacity and practices of Federal agencies.[11] Some agencies have recently increased planning and evaluation capacity and have developed agency-wide STEM education strategic plans and evaluation strategies.[12]

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5. U.S. Department of Commerce (January, 2012). The competitiveness and innovative capacity of the United States. http://www.commerce.gov/sites/default/files/documents/2012/january/competes_010511_0.pdf.

President's Council of Advisors on Science and Technology (September, 2010). Prepare and inspire: K-12 education in science, technology, engineering, and mathematics (STEM) for America's future. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf.

6. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2010). Rising above the gathering storm revisited: Rapidly approaching category 5. Washington, DC: The National Academies Press.

7. National Governors Association (2007). Innovation America: A final report. Washington DC. http://www.nga.org/files/live/sites/NGA/files/pdf/0707INNOVATIONINVEST.PDF.

8. National Science Board. 2012. *Science and Engineering Indicators 2012*. Arlington VA: National Science Foundation (NSB 12-01).

9. While Federal agencies' STEM research funding has a broad impact on the training of STEM workers through support for students who contribute to research, the focus of the Strategic Plan is on Federal programs that focus primarily on STEM education.

10. Federal Coordinating Council for Science, Engineering, and Technology, Committee on Education and Human Resources (1993). Pathways to excellence: A federal strategy for science, mathematics, engineering, and technology education. http://www.eric.ed.gov/PDFS/ED360165.pdf.

GAO (2005). Higher education: Federal STEM programs and related trends. http://www.gao.gov/assets/250/248137.pdf.

U.S. Department of Education (2007). Report of the Academic Competitiveness Council, Washington, D.C.

PCAST (September, 2010). Report to the President: Prepare and inspire: K-12 education in STEM for America's Future. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf.

11. NSTC Subcommittee on Education (2008). Finding out what works: Agency efforts to strengthen the evaluation of Federal STEM education programs. http://www.whitehouse.gov/files/documents/ostp/NSTC%20Reports/NSTC_Education_Report_Complete.pdf.

12. National Research Council. (2008). *NASA's Elementary and Secondary Education Program: Review and Critique*. Committee for the Review and Evaluation of NASA's Precollege Education Program, Helen R. Quinn, Heidi A. Schweingruber and Michael A. Feder, Editors. Board on Science Education. Washington, DC: The National Academies Press.

National Research Council. (2010). *NOAA's Education Program: Review and Critique*. Committee for the Review of the NOAA Education Program. J.W. Farrington and M.A. Feder, Editors. Board on Science Education. Washington, DC: The National Academies Press.

Development of the 5-Year Federal STEM Education Strategic Plan

In response to the America COMPETES Reauthorization Act of 2010, the Committee on STEM Education (CoSTEM) is developing the 5-Year Federal STEM Education Strategic Plan to address issues related to the coordination of Federal STEM education investments. A critical first step in creating the Strategic Plan was to document the portfolio of current Federal investments in STEM education.

The NSTC Federal Coordination in STEM Education (FC-STEM) Task Force was chartered by the CoSTEM to develop a 5-Year Federal STEM Education Strategic Plan and to prepare this report with oversight by the CoSTEM. The FC-STEM includes members from the 11 Federal agencies represented on the CoSTEM, the OSTP, and the Office of Management and Budget (OMB). The FC-STEM met 12 times between March 24, 2011 and January 11, 2012 to develop the Federal STEM Education Strategic Plan. Work on the Strategic Plan has been a collaborative process, with significant contributions made by representatives from each of the 11 agencies represented on the FC-STEM.[13] The Task Force intends to complete the Strategic Plan in the spring of 2012.

During the development of the Strategic Plan, the CoSTEM conducted an inventory of current Federal investments in STEM education. The inventory was designed and implemented by the NSTC Fast-Track Action Committee on Federal Investments in STEM (FI-STEM), a committee chartered by the CoSTEM. The inventory provides an overview of Federal STEM education investments and has guided the development of the Strategic Plan. The FI-STEM included members from OSTP and the 11 Federal agencies represented on the CoSTEM.[14] The FI-STEM met eight times between March 24, 2011 and August 30, 2011 to discuss the structure and definitions to be used for the inventory survey; set criteria for inclusion in the inventory; pilot the online data entry site; and draft this report. The *Federal STEM Portfolio* report[15] was released in December 2011 and provides the most detailed overview of the Federal STEM education portfolio to date. The *Portfolio* report reveals that the Federal government draws upon a remarkably wide range of unique assets to support STEM education. An overview of the *Portfolio* is provided herein to illustrate the context in which the Strategic Plan is being developed.

13. Members of the FC-STEM are listed on p. iii.
14. Members of the CoSTEM are listed on page iv. The same agencies were represented on the FI-STEM.
15. NSTC (2011). The Federal STEM Education Portfolio. http://www.whitehouse.gov/sites/default/files/microsites/ostp/costem__federal_stem_education_portfolio_report.pdf.

The Current Context

Federal Role in STEM Education

The Federal Government's investment in STEM-focused education programs[16] amounts to less than 1 percent of annual U.S. funding for K-12 and higher education. In addition to providing funding for STEM education initiatives, Federal agencies support STEM education with their unique assets, such as people, data, technology, and facilities. Nevertheless, the majority of education funding comes from the state and district level or from institutions of higher education. These entities are responsible for policies and practices that govern such areas as entrance requirements, teacher licensing, school staffing, content standards and curricula, and student and teacher assessment. The Federal government's STEM education efforts must interface strategically with these entities in order to support institutional, state, and local efforts.

Thirteen Federal agencies sponsor programs that focus specifically on STEM education.[17] The roles of individual agencies in supporting STEM education have evolved as a result of a combination of factors, including (1) the mission and goals of the agency; (2) Congressional and Presidential directives to engage in particular aspects of STEM education; and (3) the assets each agency can contribute to the STEM education landscape. For example, science mission agencies generally have statutory roles and responsibilities that lead these agencies to support STEM research and development in complementary disciplines in order to carry out their missions (see Appendix A). Similarly, science mission agencies support STEM education investments that target disciplines, fields, and/or audiences that are relevant to addressing their STEM workforce and STEM literacy goals.

The Role of the Department of Education and the National Science Foundation

As illustrated in the *Portfolio* report, two agencies – the Department of Education (ED) and the National Science Foundation (NSF) – in FY 2010 provided nearly two-thirds of the $3.4 billion of Federal STEM education funding. These two agencies also have the broadest STEM education missions and the largest Federal investments in STEM education research.

ED is the primary Federal agency for education at all levels and is charged with promoting student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access. The primary focus of ED's work is systemic reform for all students in all disciplines. STEM is an important part of reform, both through ED programs that focus specifically on STEM education (e.g., the Upward Bound Math-Science competition, Minority Science and Engineering Improvement Program, and the Mathematics and Science Partnerships Program), and its broader education programs that boost student achievement and close achievement gaps (e.g., the Investing in Innovation Fund, Titles I and II of the Elementary and Secondary Education Act). Beyond programmatic resources, ED also

16. Agencies also support STEM education through broad education programs that can be used to support STEM, even though STEM education is not a specific focus of the programs.

17. The 11 agencies represented on the CoSTEM along with Nuclear Regulatory Commission and the Department of Homeland Security.

collects and disseminates data that describe the state of the education system. For instance, national performance in STEM is measured by the National Assessment of Educational Progress (NAEP), and international progress is gauged by the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA). In addition, building from its statutory authority, ED cultivates strong relationships with state education agencies, local education agencies, and other key education organizations. These relationships provide ED with insights about the strengths and needs of state education systems and connections with influential state-level STEM education leaders. ED uses its relationships with States, districts, and the public to draw attention to particular needs or interests as part of its overall mission.

Under the authority of its organic legislation, the NSF supports STEM education across the agency and is the only Federal agency dedicated to the support of basic research and development across all fields of science and engineering. The NSF responds to national challenges by strategically stimulating innovative research that connects the science and engineering enterprise with potential economic, societal, and educational benefits. Underpinning all of its programmatic activities is a rigorous merit review process whereby proposals to the NSF are competitively evaluated by peers external to the agency. Presently, the NSF supports a substantial portfolio of STEM education programs that makes investments across a diverse landscape of institutions and organizations (both public and private) and across all levels of education, in both formal and informal environments, seeking to inspire and engage the next generation of scientists and engineers. NSF programs support a range of activities from basic research, progressing to multidisciplinary learning and education research and development, small-scale implementation, and building capacity in people and organizations. NSF investments support scientists and practitioners as they endeavor to create and expand the research-based evidence about quality STEM teaching and learning; build a diverse, professional and technical STEM workforce; improve student and teacher learning; and advance research to build evaluation knowledge, theory, and instruments. In addition, NSF investments utilize many of the assets that characterize the science mission agencies, including access to the scientific research workforce, large scientific instruments and facilities, and scientific data.

The Role of Science Mission Agencies

Most science mission agencies are authorized through legislation to use their assets in support of STEM education. Some agencies have also been mandated to conduct specific education activities (*see Appendix B*). The goals of science mission agencies are generally to leverage their STEM education resources to increase the STEM literacy of the United States in areas related to their missions, or to develop a highly qualified STEM workforce that can carry out their missions.

Science mission agencies possess and support assets that can improve STEM education. The National Research Council[18] identified two key resources that Federal science agencies possess: agency STEM knowledge and products, and access to STEM professionals. With respect to agency STEM knowledge and products, science mission agencies' investments and activities directly produce frontier science research and engineering advances, contributing compelling data and ideas that can be valuable

18. National Research Council. (2008). *NASA's Elementary and Secondary Education Program: Review and Critique*. Committee for the Review and Evaluation of NASA's Precollege Education Program, Helen R. Quinn, Heidi A. Schweingruber, and Michael A. Feder, Editors. Board on Science Education. Washington, DC: The National Academies Press.

resources to STEM education and educators. Agencies also have access to practicing scientists and engineers, both their own employees and the large number of researchers whom they support at universities, national laboratories, or other institutions. In addition, science mission agencies possess and support technology that can be used to illustrate the applications of science, mathematics, and engineering. Many of these agencies also manage natural environments where students, teachers, and the general public can explore STEM principles and engage in STEM practices.

By and large, the primary educational role of science mission agencies is to promote understanding of the major societal issues for which they have leadership roles and to develop the highly qualified workforce needed to address the societal issues. Agencies undertake this task through STEM education investments that connect learners to agency content, people, and facilities that are integral to their mission-driven research and development efforts. This role is often carried out through participatory and experiential learning that connects students, teachers, and the public to unique agency STEM resources and people. In addition, many STEM undergraduate and graduate students receive support through science mission agency funding of STEM research and development. This is quite different from both the role of ED (improving all levels of education and creating systemic changes) and the role of NSF (supporting research and development that leads to evidence-based STEM education models and tools). A primary focus of developing the Strategic Plan has been to identify ways to coordinate the range of STEM education initiatives across agencies with such different roles and missions.

Federal Investments in STEM Education

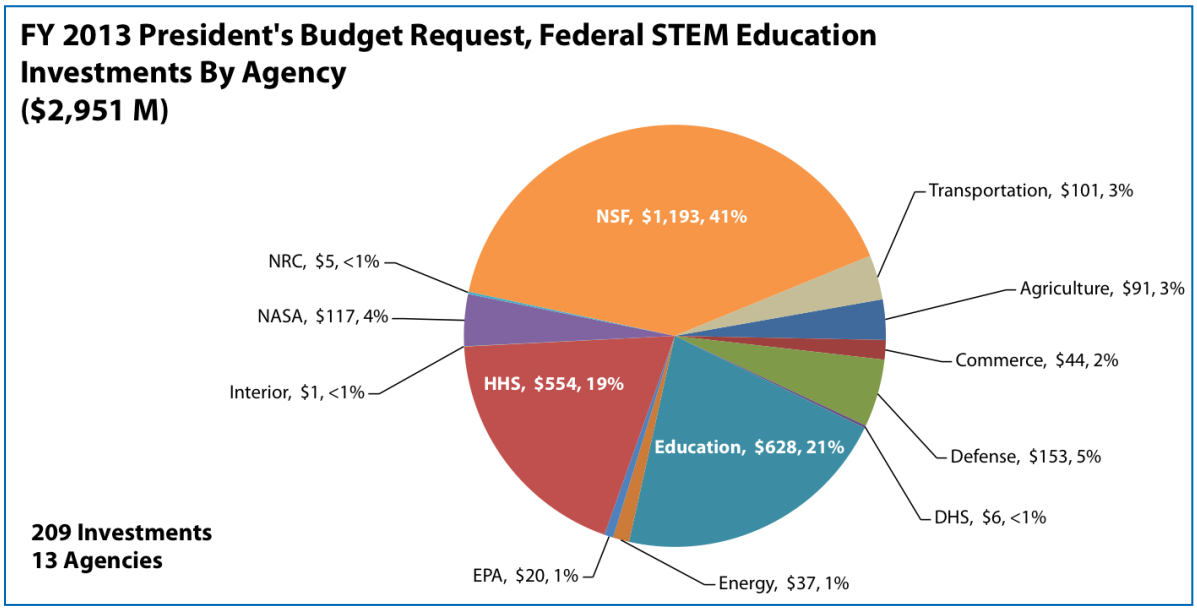
The Federal government supports a large number of STEM education programs that previous reports have described as potentially duplicative, overlapping, or uncoordinated. The *Portfolio* report provides the most detailed analysis of the claims related to duplication, overlap, and fragmentation among

Federal STEM education investments to date and has been a useful tool in developing the Strategic Plan.[19] The Portfolio report includes extensive information on 252 distinct investments in STEM education with a total budgetary commitment of $3.4 billion in FY 2010.[20] Eighty percent of the funding supported STEM education investments made by NSF, ED, and HHS. Investments from these three agencies continue to account for about 80 percent of Federal funding for STEM education in the FY 2013 President's Budget Request (see Figure 1).

19. http://www.whitehouse.gov/sites/default/files/microsites/ostp/costem__federal_stem_education_portfolio_report.pdf

20. The budget figures reported in the *Portfolio* report were tentative, because not all agency budget offices were able to verify the budget figures prior to the release of the report. Changes to ED and NSF budget figures were made after the release of the *Portfolio* report, and are reflected in Figure 1, Figure, 2, and Table 1.

Figure 1: FY 2013 President's Budget Request, Federal STEM Education Investments by Agency



As illustrated in Figure 2, STEM education funding decreased by about $500 million between FY 2010 and FY 2011, primarily due to the phasing out of ED SMART Grants ($380 million). After FY 2011, funding levels remain relatively stable through FY 2013. The most significant decreases in funding from FY 2010 through the FY 2013 President's Budget Request occurred at the Nuclear Regulatory Commission (NRC; -76%), the Department of Commerce (DOC; -39%), the Department of Energy (-41%) , ED (-36%), and the National Aeronautics and Space Administration (NASA; -34%). During the same time period the most significant increases in funding, as reflected in the President's FY 2013 Budget Request, would occur at the Department of Defense (DOD; 21%) and the Environmental Protection Agency (EPA; 21%). However, there is a consistent decrease in the overall *number* of Federal investments in STEM education between those conducted in FY 2010 and those proposed for FY 2013. The level of funding for Federal STEM education investments during the current, previous, and next fiscal year is included in Appendix C.

Figure 2: Funding of Federal STEM Education Investments from FY 2010 through FY 2013[21]

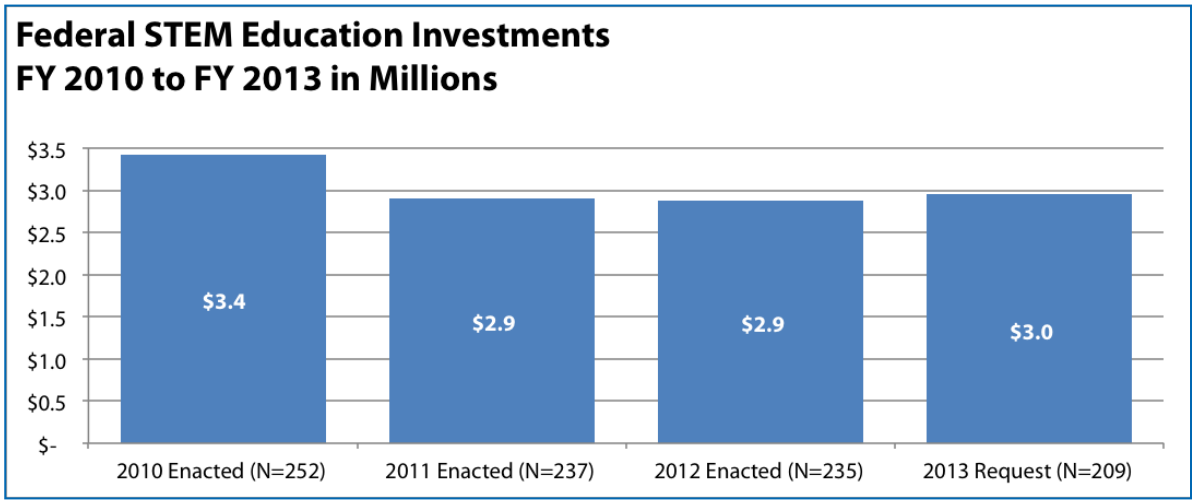


Table 1: Federal STEM Education Funding By Agency in Millions FY 2010-2013

	2010 Enacted	2011 Enacted	2012 Enacted	2013 Requested
USDA	$ 91	$ 91	$ 88	$ 91
DOC	$ 73	$ 58	$ 55	$ 44
DOD	$ 126	$ 153	$ 164	$ 153
DHS	$ 7	$ 2	$ 2	$ 6
ED[22]	$ 986	$ 561	$ 517	$ 628
DOE	$ 62	$ 49	$ 48	$ 37
EPA	$ 17	$ 20	$ 26	$ 20
HHS	$ 577	$ 560	$ 560	$ 554
DOI	$ 1	$ 1	$ 1	$ 1
NASA	$ 177	$ 157	$ 149	$ 117
NRC	$ 23	$ 10	$ 16	$ 5
NSF[23]	$ 1,175	$ 1,148	$ 1,154	$1,193
DOT	$ 104	$ 100	$ 98	$ 101
Total	$ 3,418	$ 2,910	$ 2,877	$2,951

21. The total FY2010 Federal STEM education budget is different than what was reported in the Federal STEM Education Portfolio report ($3,440 million) due to the verification of budget information provided by agency budget offices.

22. The ED FY 2010 total funding of STEM-focused investments is $15 million less than reported in the *NSTC STEM Education Portfolio* report because the ED budget office identified $15 million for the Strengthening Predominately Black Institutions program that was not obligated in FY 2010 due to a redesign of the program.

23. The NSF FY 2010 total funding for STEM-focused investments is $6 million more than reported in the *NSTC STEM Education Portfolio* report primarily due to identification of an additional investment (Transforming Undergraduate Biology Education).

Other major findings in the *Portfolio* report that have informed the development of the Strategic Plan include:

1. "Of the total of $3.4 billion spent by Federal agencies on STEM education investments, $967 million (28%) is spent on activities that target the specific workforce needs of science mission agencies. As these agencies' missions are quite different from one another, their workforce needs are also quite different – whether they are for a national workforce of biomedical researchers to fulfill the mission of the National Institutes of Health or a workforce of transportation engineers needed to fulfill the mission of the Department of Transportation. This finding does not rule out the possibility that in some cases there may be overlapping skill-set needs among disparate workforces, which could be addressed by joint training opportunities or other collaborative endeavors.
2. The remaining $2.5 billion (72%) is spent on broader STEM education, and this spending is dominated by the expenditures of the National Science Foundation (47% of that $2.5 billion, or $1.2 billion) and the Department of Education (40% of the $2.5 billion, or $1 billion).
3. The Federal government spends $1.1 billion on investments that have the primary goal of targeting groups that are underrepresented in STEM. In addition, nearly every other STEM education investment has this as a secondary goal.
4. Twenty-four investments, with a total budget of $312 million, have the primary goal of improving teacher effectiveness, with most of that funding going to teacher professional development. Improving teacher effectiveness is a secondary goal of an additional 101 investments. Together, improving teacher effectiveness is a primary or secondary objective of 49 percent (125 of 252) of all Federal STEM education investments.
5. Of the broader STEM education investments, 86 percent (119 of 139) have been evaluated since 2005 to identify how they can be improved, to test their impact, or both. Summative evaluations (evaluations of impact) have been conducted on 59 of those investments. Thirty-three of the summative evaluations were either randomized control trials (eight evaluations) or pre-post designs with matched comparison groups (25 evaluations) – evaluation designs that can illustrate causality. The other 26 summative evaluations used other designs. Agency mission-specific workforce education investments have been less thoroughly evaluated; only 40 percent (46 of 113) of these investments have been subject to any kind of outcome data collection."[24]
6. Nearly all investments focus on the multiple fields related to agency-specific workforce needs, STEM, or specific fields of science. Only one investment focused solely on mathematics education and two investments focused solely on engineering.

In addition, the *Portfolio* report provides an "unprecedented look at how much overlap and duplication there may be among these programs."[25] To accomplish this, the CoSTEM used definitions and measures of overlap, duplication, and fragmentation previously established by the U.S. Government Accountability Office (GAO).[26] Based on a series of complex analytic techniques the CoSTEM concluded that "there is

24. pp. xii-xiii.
25. p. xii.
26. GAO (March, 2011). Opportunities to reduce potential duplication in Government programs, save tax dollars,

only modest overlap in investments and no duplication among the STEM education investments."[27] This conclusion should not be interpreted to mean there are no opportunities for improving the alignment, deployment, and efficiency of Federal STEM education investments.

One reason that no duplication and only modest overlap were found is, as stated in the *Portfolio* report,

> the label 'STEM education' encompasses an enormous multidimensional landscape covering many different audiences, objectives, STEM fields, educational products, geographical regions, and funding sources. The small proportion of the overall funding for STEM education provided by Federal agencies supports investments that cover a small fraction of the STEM education landscape. To put the current investment in perspective, Federal investment in STEM education today is less than 1 percent of the $1.1 trillion spent annually on education in the United States.[28]

The *Portfolio* report also indicates that, "to maximize the impact of Federal investments in STEM education the CoSTEM will scrutinize how these resources are allocated in order to ensure Federal investments are focused on the most important needs and most effective strategies."[29] In addition, the *Portfolio* report suggests that various approaches to improve Federal investments in STEM education should be explored, including: "consolidating programs, creating joint solicitations across agencies, and developing structures and procedures for sharing program data and performance measurement and evaluation tools."[30]

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and enhance revenue. http://www.gao.gov/new.items/d11318sp.pdf

Overlapping investments share the same primary objective, and have at least one type of audience, product or service, and fields within STEM in common. Investments that share a number of audiences, products or services, and fields of STEM in common overlap more than those with fewer features in common.

Duplicative investments focus on the same primary objective, audiences, products or services, and fields within STEM.

Fragmentation of investments is where more than one agency supports investments with the same primary objective.

27. p. xii.
28. p. xii.
29. p. xii.
30. p. xii.

Description of the 5-Year Federal STEM Education Strategic Plan

Since its initial meeting in March 2011, the CoSTEM has made substantial progress in developing the Strategic Plan. While all aspects are not yet complete, the Plan's component parts, general structure, and coordination goals, objectives, and strategies have been established. A complete version of the Strategic Plan will be delivered to Congress in spring 2012.

Common STEM Education Vision, Goals, and Objectives

In order to improve the coordination and efficiency of Federal STEM education investments, the CoSTEM first identified a STEM education vision that is shared across all agencies, as well as the goals and objectives agencies have established to achieve this vision. While there are 13 Federal agencies with different roles in STEM education and different assets to support STEM education, the agencies' STEM education vision, goals, and objectives are quite similar. These similarities are encompassed and stated below as "Common Federal STEM Education Vision, Goals, and Objectives." Although the Federal agencies collectively share a set of goals and objectives, not all agencies contribute to each goal and objective to the same degree. The primary goal of the Strategic Plan is development of a shared pathway toward more effective and efficient Federal investments for achieving the Common Vision, Goals, and Objectives.

Common Federal STEM Education Vision

A portfolio of Federal STEM education investments and assets that helps prepare a diverse and internationally competitive workforce and a society that understands STEM practices and concepts so that all citizens are prepared to succeed in the current and future economy.

Common Federal Agency STEM Education Goals and Objectives

The shared STEM education goals of Federal agencies focus primarily on issues of (1) STEM workforce development and (2) STEM literacy:

Agency STEM Workforce Goal:

Provide the STEM education and training opportunities needed to prepare a diverse, well-qualified workforce that is able to address the mission needs of the Federal agencies and lead in innovation across the broad spectrum of industries and occupations related to the missions of Federal agencies.

> *Agency Mission Workforce Objective 1:* Ensure that a well-qualified pool of candidates is prepared to meet the current and future STEM workforce needs of Federal agencies and related industries.
>
> *Agency Mission Workforce Objective 2:* Ensure that a well-qualified pool of candidates for Federal agencies and related industries reflects the diversity of the Nation.

Agency STEM Literacy and Proficiency Goal:

Increase access to and improve the quality of PreK-12, postsecondary, and informal STEM education.

Literacy and Proficiency Objective 1: Increase interest and engagement in STEM among children and adults, especially those from groups traditionally underrepresented in STEM, so that learners are motivated to explore and participate in STEM throughout their lives.

Literacy and Proficiency Objective 2: Increase opportunities for children and adults, especially for members of groups traditionally underrepresented in STEM, to develop deeper STEM knowledge, skills, and abilities.

Literacy and Proficiency Objective 3: Improve STEM educator and leader preparation, induction, and professional development programs, especially for those individuals from groups traditionally underrepresented in STEM, to improve the quality of STEM instruction.

Literacy and Proficiency Objective 4: Improve the capacity of U.S. education institutions to support effective STEM education and learning programs.

Literacy and Proficiency Objective 5: Increase the STEM learning research base and widespread use of evidence-based STEM education practices to improve STEM education in formal and informal learning environments.

Limiting Factors

Identifying the external factors that are beyond the control of Federal agencies but can significantly affect achievement of strategic goals is a critical component of any Federal strategic plan.[31] There are a number of external factors that limit the ability of agencies to achieve the Common Federal Agency STEM Education Goals and Objectives above, including:

- The Federal government does not have the authority to create a national STEM education curriculum or set of standards.
- Overall agency budget fluctuations and changing views of an agency's role in STEM education make long-term planning difficult.
- Some agencies and subagencies are barred by their authorizing language from targeting underrepresented groups.
- Limited funding to support coordination and collaboration across agencies leads to ad hoc coordination of STEM education investments and makes coordination difficult to sustain.
- Challenges associated with collecting and sharing student data can limit STEM education program evaluation strategies.

31. GAO (September, 1997). Managing for results: Critical issues for improving Federal agencies strategic plans. http://www.gao.gov/assets/230/224825.pdf.

Additionally, some agencies generally lack infrastructure for their STEM education investments and are challenged by internal factors, including:

- Some agency missions and priorities do not have a STEM education focus.
- Solicitation, review, and award processes for STEM education grants are inconsistent.
- Some agencies have limited STEM education and evaluation expertise.
- STEM education investments *within* some agencies are distinct and decoupled.
- Creating joint solicitations, memoranda of understanding (MOU), and other agreements that support inter-agency coordination and resource-sharing can be time-consuming and costly.

Federal STEM Education Coordination Goal and Objectives

To enable the Federal government to collaboratively and efficiently accomplish the Common STEM Education Vision, Goals, and Objectives listed above, the CoSTEM developed the following coordination goal and objectives.

Strategic Federal STEM Education Coordination Goal:

Establish a coordinated portfolio of STEM education investments across the Federal government so that all Federal STEM education efforts and assets are effectively and efficiently deployed to achieve the Common Federal STEM Education Goals and Objectives.

Coordination of Federal STEM education investments can be supported in a number of ways, including the creation of common evidence standards and evaluation practices, complementary programmatic goals, and a shared understanding of evidence-based STEM education practices. Based on the condition of Federal STEM education (see the *Portfolio* report for details) and the capacity of Federal agencies, the CoSTEM identified the following objectives to reach the Strategic Federal STEM Education Coordination Goal:

> *Strategic Federal Coordination Objective 1:* **Use evidence-based approaches.** Ensure Federal STEM investments incorporate what is known about effective STEM education and evidence-based practices in STEM education.
>
> *Strategic Federal Coordination Objective 2:* **Identify and share evidence-based approaches.** Conduct STEM education research and evaluation to identify evidence-based practices and assess program effectiveness. Enhance sharing of research and evaluation findings across agencies and with the public.
>
> *Strategic Federal Coordination Objective 3:* **Increase efficiency and coherence.** Ensure Federal STEM education investments are coordinated in order to utilize and leverage Federal resources efficiently.
>
> *Strategic Federal Coordination Objective 4:* **Identify and focus on priority areas.** Align a subset of the Federal STEM education investments to focus on Federal STEM education priority areas in a coordinated manner. The four priority areas identified are: Effective K-12 STEM teacher education, engagement, undergraduate STEM education, and serving groups traditionally underrepresented in STEM fields.

To accomplish the four Coordination Objectives, the Strategic Plan will include:

- criteria for investments to be successful (Coordination Objective 1);
- syntheses of evidence-based STEM education practices (Coordination Objective 1);
- a strategy to disseminate evidence-based practices (Coordination Objective 2);
- evaluation guidance (Coordination Objective 2);
- specific roles and responsibilities for each agency (Coordination Objectives 3 and 4);
- common metrics (Coordination Objectives 3 and 4); and
- annual milestones to guide the implementation and track the impact of the Strategic Plan (Coordination Objectives 1, 2, 3, and 4).

The process for developing each of these components in relationship to the four Coordination Objectives is described below.

The Strategic Plan will also establish a procedure for the CoSTEM to review progress toward annual milestones in order to guide revisions to the Strategic Plan and make relevant policy decisions. Annual appropriations decisions by Congress will have a direct impact on the development of the components and tracking progress toward meeting the annual milestones because both will require significant capacity building and financial commitments from OSTP and the Federal agencies.

Strategic Federal Coordination Objective 1: Use Evidence-Based Approaches

To increase their impact, Federal STEM education investments will be expected to meet a set of criteria for success and align with identified evidence-based practices in STEM education. Criteria for success and evidence-based practices will be developed for each type of STEM education investment that Federal agencies support.

The criteria for success will focus on program management, evaluation, and implementation strategies that are necessary, but not currently sufficient, for programs to be successful. A preliminary draft of these criteria is included in Appendix D. Prior to completing the Strategic Plan, public input will be solicited to refine and improve the criteria for success. Additionally, a process will be developed to identify areas where STEM education investments need support and to review how well investments align with the criteria for success. Annual funding requests by the Administration will reflect the extent to which each agency demonstrates that its STEM education investments are aligned with the criteria for success.

Evidence-based STEM education practices identified through research studies and evaluations will also guide Federal investments in STEM education. These evidence-based practices will differ from the criteria for success in that they are related to the program substance. They will be more fine-grained strategies and will be derived from sound theory and empirical evidence. Agencies will be expected to update the design of STEM education investments to align with evidence-based practices in STEM education. This may require building capacity of staff and principal investigators within particular investments or across entire agencies. A comprehensive review of literature to identify evidence-based practices related to the aspects of STEM education that are funded by the Federal government will require contracting with experts or other mechanisms. As with the criteria for success, a process to identify areas where STEM education investments need additional empirical support and a process to review how well investments

align with the evidence-based practices will be developed. Annual Administration funding requests will be tied to each agency's ability to demonstrate that its STEM education investments are aligned with or are generating more evidence-based practices.

The criteria for success and the evidence-based practices will be living documents that are annually updated based on lessons learned from program management and research. A formal process for keeping the criteria and evidence-based practices updated, including the capacity and resources needed to do so, will be part of the Strategic Plan's implementation.

Strategic Federal Coordination Objective 2: Identify and Share Evidence-Based Approaches

It is important to increase understanding about improving STEM education, and to act on the 2008 NSTC evaluation recommendations.[32] The Strategic Plan, therefore, will recomend processes to develop strong STEM education evaluation strategies within each agency to create performance measurement and evaluation guidance. In addition, the Strategic Plan will suggest the development and implement ation of a robust process for disseminating results and lessons learned.

A strong evaluation strategy is needed to guide and coordinate such efforts within agencies and ensure continual improvement in the evaluation, of individual investments, and of agency STEM education portfolios. Agencies are at different stages in developing and implementing systems of evaluation. The lessons learned from these efforts, along with existing evaluation guiding principles,[33] will be used to outline how all agencies can develop similar systems and the capacity needed to implement them. An evaluation interagency working group will be created to support agency efforts to develop and carry out evaluation strategies.

In addition, CoSTEM will recommend mechanisms to develop and disseminate evaluation evidence standards that can be applied to different types of STEM education investments and evaluation guidance regarding metrics, evaluation design, and other important aspects of program evaluation. The evidence standards will describe evaluation designs suitable for different types of investments and provide information for improving programs and identifying effective evaluation practices. The evaluation guidance will provide agencies with the needed information to conduct cost-efficient and appropriate evaluations.

Agencies that will lead the development of the evaluation guidance will be identified in FY 2012. Progress in FY 2012 will partially depend on available agency capacity and funding. A process for providing technical assistance may be established to support the use of these evidence standards and the evaluation guidance. The evidence standards and evaluation guidance will be refined and expanded on an ongoing basis.

Improvements to agency evaluations of STEM education investments will be coupled with a strategy to address Congressional direction to improve the dissemination of STEM education research and evidence-based practices. Currently, Federal agencies use a variety of strategies to disseminate findings

32. NSTC Subcommittee on Education (2008). Finding out what works: Agency efforts to strengthen the evaluation of Federal STEM education programs. http://www.whitehouse.gov/files/documents/ostp/NSTC%20Reports/NSTC_Education_Report_Complete.pdf.

33. Various groups including the American Evaluation Association, the American Education Research Association, the What Works Clearinghouse, and the Campbell Collaboration have created evaluation guidelines.

from STEM education evaluations and research. A sample of current strategies and policies to promote dissemination are included in Appendix E. A coordinated and robust strategy for dissemination will be developed based on a review of strategies currently used by agencies and other successful strategies used by non-Federal stakeholders.

Strategic Federal Coordination Objective 3: Increase Efficiency and Coherence

Efficient and effective use of funding and resources remains a priority for all Federal investments, including those in STEM education. The Strategic Plan will encourage efficiency across agencies through inter-agency coordination and collaboration. The Strategic Plan will encourage efficiency within agencies through alignment of agency investments with agency capabilities, roles, missions, and mandates.

Information from the STEM education inventory is being used to identify investments across agencies that have similar objectives, audiences, geographic targets, partners, and products that could potentially become more coherent and efficient. Agencies will be encouraged to utilize a range of strategies to bring coherence and efficiency into STEM education programs with similar goals, including aligning programmatic goals, developing joint solicitations or MOUs, and consolidating programs. An online tool is being developed that will allow agency staff to search the current inventory data, identify staff contact information, and extract relevant data files. A similar tool will be developed for the general public.

The implementation of the Strategic Plan will include outlining a process for establishing annual efficiency goals and the specific contributions of each agency. Identifying specific roles for each agency will help increase efficiency in the Federal STEM education portfolio by ensuring that each agency understands the particular contribution it can make and how that contribution fits into the Government-wide effort.

Strategic Federal Coordination Objective 4: Identify and Focus Attention on Priority Areas

The *Portfolio* report illustrated that, for Federal investments in STEM education to have a measurable impact on the "multi-dimensional" STEM landscape, investments across the Federal government need to be coordinated around specific aspects of the landscape. Determining priority areas of STEM education for coordinated Federal initiatives has been a complex and challenging task. From teacher education, to research on how people learn STEM inside and outside of school, to undergraduate STEM attrition rates, to access to engaging outdoor STEM experiences, there is an ever-expanding list of STEM education issues on which the Federal government might focus. Strong arguments can be made for prioritizing many of these issues.

It is important to realize that some investments must continue to focus on areas that are not included in the priority areas for coordinated Federal initiatives described below. For example, the Common Federal Workforce Goal highlights the fact that Federal agencies have a significant and crucial role in supporting the development of the future STEM workforce through investments in graduate students, including fellowships, traineeships, and research assistantships. Agency mission-specific workforce needs were not considered to be a viable area for a coordinated Federal initiative because each agency requires different mission-related STEM expertise. Although agency mission-specific workforce development is not one of the priority areas for coordinated Federal initiatives, it is clearly a crucial component of the the Federal portfolio of STEM education investments, and should continue to be a significant portion

of that portfolio. The Strategic Plan will recommend improvements in agency mission-specific workforce investments and other important STEM education goals not explicitly prioritized in this objective through the three objectives described above.

To determine which areas of STEM education deserve the coordinated focus of the Federal government, areas where national needs, Presidential priorities, and Federal assets converge were identified. The CoSTEM believes that the Federal government, through coordinated and collaborative interagency efforts, can achieve significant, measurable impacts on the following four priority areas:

1. *Effective K-12 STEM Teacher Education* – Increase the number and proportion of individuals, particularly from groups that are traditionally underrepresented in STEM fields, who complete teacher pre-service and in-service programs with an ability to increase students' understanding of STEM.
2. *Engagement*[34] *in STEM* – Expand the availability and coherence of investments that increase interest in, involvement in, or value placed on STEM by PreK-12 aged individuals (especially those from traditionally underrepresented groups).
3. *Undergraduate STEM Education* – Improve retention rates, including among groups traditionally underrepresented, in STEM majors during the first two years of undergraduate education.
4. *Serving Groups Traditionally Underrepresented in STEM Fields* – Increase the number of individuals from underrepresented groups that graduate with STEM degrees.

To implement this Strategic Plan, it will be recommended that the Federal agencies assess their STEM education investments to identify potential changes in some of their investments that could be made to enable an overall shift in the Federal STEM education portfolio. Investments that currently address the four priority areas will be coordinated to achieve to a coherent interagency effort.

Agencies will not be expected to redirect all of their funding or realign all existing investments to address these four areas. Whether an agency shifts the focus of particular STEM investments toward these areas will depend on its statutory requirements, authorizing legislation, Congressional and Administration priorities as directed through annual appropriations, and available expertise and resources. In addition, agencies that have mission-critical workforce development needs will need to maintain their support of mission-driven workforce investments. In such cases, it may be difficult or inappropriate to redirect or shift existing workforce development programs. Some agency mission-driven workforce investments, however, may have the capability to be more supportive of undergraduate STEM education and/or groups underrepresented in STEM fields and still meet their workforce development goals.

For each priority area, the Strategic Plan will recommend that agencies assess the steps that can be taken: to align programmatic goals and objectives; create clear and connected mechanisms for aligning investment dollars; implement joint communication and outreach strategies; identify investments that can be adjusted to focus on a priority area; and align program evaluation and management mechanisms and practices. A roadmap for addressing each of the priority areas will be developed. The roadmaps

34. As defined in the NSTC Federal STEM Inventory, investments that focus on engagement are designed to increase learners' involvement and interest in STEM, inform their views of STEM's value in their lives, or positively influence the perception of their ability to participate in STEM.

will identify specific actions needed to address the priority areas and describe how specific investments fit within the roadmap. In addition, the roadmap will identify a multi-agency "network" of core investments that will make the initial changes needed to address the priority areas. The roadmaps will include implementation timelines with annual actions and milestones. Milestones will provide guideposts for progress related to capacity building and expected outputs and outcomes. Common metrics will also be developed to track progress related to outputs and outcomes.

To support the development of the roadmaps, agencies will conduct a needs and/or knowledge assessment of each of these priority areas. This will enable agencies to better understand the current state of knowledge related to each issue and create an agenda for connecting and advancing research, program implementation, and evaluation of the four priority areas. One possible method to conduct the assessments is for agencies to collectively identify, in a public forum, priority areas that merit strategic investment, relevant research done to date, and the research questions that should be addressed through future grants. This and other methodologies are under consideration. The ability of agencies to implement the roadmaps (including the needs and/or knowledge assessment) and create common metrics will be dependent on agency capacity and may require significant financial commitments.

Next Steps

In the coming months, the FC-STEM, with oversight from the CoSTEM, will complete the 5-Year Federal STEM Education Strategic Plan. Priority will be placed on finalizing the annual milestones,[35] the criteria for success, a process for creating the priority area roadmaps, a tracking and accountability plan, plans for gathering public input, and recommendations for developing the infrastructure and capacity needed to implement all four Federal STEM coordination strategies in FY 2013. Progress in each of these areas will be enhanced by public feedback as well as input from stakeholders and STEM education experts. While the Strategic Plan is being finalized, the CoSTEM will work with agencies to plan the development of capacity, processes, and mechanisms needed to fully implement the Strategic Plan in FY 2013. In addition, the FI-STEM will update the *Federal STEM Education Portfolio* report with FY 2011 data.

35. A draft of the annual milestones is included in Appendix F.

Appendix A: Overarching and STEM-Specific Agency Missions

Agency Missions
Department of Agriculture
Overarching Mission: Provide leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management. STEM Education Mission: Support the development of the next generation of food and agricultural scientists, leaders, and workforce; work with higher-education institutions to develop education and training programs with strong science, technology, engineering, and math curriculums, increase enrollment in secondary and two-year post-secondary education programs and promote Agriculture literacy.
Department of Commerce
DOC Overarching Mission: The U.S. Department of Commerce promotes job creation, economic growth, sustainable development and improved standards of living for all Americans by working in partnership with businesses, universities, communities, and our Nation's workers. *NOAA Overarching Mission:* To understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others; and to conserve and manage coastal and marine ecosystems and resources. *NOAA STEM Education Mission:* To advance environmental literacy and promote a diverse workforce in ocean, coastal, Great Lakes, weather, and climate sciences, encouraging stewardship and increasing informed decision making for the Nation. *NIST Overarching Mission:* To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. *NIST STEM Education Mission:* To promote STEM education, particularly in areas that relate to measurement science and standards, and to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Department of Defense

Overarching Mission:
Provide the military forces needed to deter war and to protect the security of our country.

STEM Education Mission:
Inspire, develop, and attract the STEM talent essential to deliver innovative solutions for the Nation's current and future challenges.

Department of Education

Overarching Mission:
Promote student achievement and preparation for global competitiveness by fostering educational excellence and ensuring equal access.

STEM Education Mission:
Restore and sustain America's lead in the modern knowledge economy by seeking to improve the participation and performance of America's students in STEM subjects and fields so that America will once again lead the world as the country with the highest proportion adults who are of college graduates.

Department of Energy

Overarching Mission:
Ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.

STEM Education Mission:
Maintain a vibrant and talented science and engineering workforce that will address DOE's current and future challenges in energy, the environment, national security, and discovery science, and train the workforce we need to ensure that the U.S. remains a driver of innovation in the 21st century.

Department Health and Human Services

Overarching Mission:
Enhance the health and well-being of Americans by providing for effective health and human services and by fostering sound, sustained advances in the sciences underlying medicine, public health, and social services.

STEM Education Mission:
Conduct biomedical and behavioral research that affords the opportunities to educate students, teachers, and the public about National Institutes of Health discoveries to improve health and save lives. These research experiences also engage students in the pursuit of science and prepare the next generation of exceptional scientists from diverse backgrounds to conduct the research that will continue to advance the health of our Nation and the world.

Department of the Interior

Overarching Mission:
Protect and manage the Nation's natural resources and cultural heritage; provide scientific and other information about those resources; and honor its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

STEM Education Mission:
Connect the American people with the Nation's natural and cultural resources; advance the science, engineering, and technology that inform natural resource management and decision-making on critical issues impacting our planet; provide outdoor developmental experiences; and provide long-term engagement, service, education, and employment on and in support of our public lands.

Department of Transportation

Overarching Mission:
Serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

STEM Education Mission:
Ensure the supply of a highly skilled workforce that will anticipate transportation challenges and create innovative solutions.

Environmental Protection Agency

Overarching Mission:
Protect human health and the environment.

STEM Education Mission:
Ensure that environmental education, based on sound science and effective education practices, is used as a tool to promote and protect human health and the environment and to encourage student academic achievement.

National Science Foundation

Overarching Mission:
Promote the progress of science to advance the national health, prosperity, and welfare, and to secure the national defense.

STEM Education Mission:
Possible replacement: Through its portfolio of STEM education programs, the NSF builds capacity among scientists, engineers, and the institutions where important research and development takes place in order to: build a globally competitive and diverse STEM workforce, inspire and engage the public as science learners, advance the understanding and anticipate the form and value of tomorrow's learning, and innovate to meet societal challenges.

National Aeronautics and Space Administration

Overarching Mission:

Drive advances in science, technology, and exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth.

STEM Education Vision:

Provide high quality STEM education using NASA's unique capabilities.

Appendix B: Legislative and Other Authority for Federal Engagement in STEM Education

Examples of Legislative and Other Authority for Federal Engagement in STEM Education

Authority for NASA

The National Aeronautics and Space Act of 1958 (P.L. 85-568): NASA's mandate to conduct STEM education activities can be traced back to the Agency's originating legislation – The National Aeronautics and Space Act of 1958 (P.L. 85-568). Section 102(d) of the Act directs that the "aeronautical and space activities of the United States shall be conducted so as to contribute materially" to "the expansion of human knowledge of the Earth and of phenomena in the atmosphere and space."

Title II of the NASA Authorization Act of 1988 (P.L. 100-147): This act established the National Space Grant College and Fellowship Program, and contains significant details on the Program's purposes, authorities, and requirements.

NASA Authorization Act of 2005 (P.L. 109-155): Section 431 of the Act directs the NASA Administrator to establish a scholarship program for graduate students enrolled in programs in aeronautical engineering or equivalent programs that includes cooperative training opportunities at NASA Aeronautics Research Centers. Section 612 of the Act directs NASA to "develop or expand programs to extend science and space educational outreach to rural communities and schools," with priority given to existing programs that utilize community-based partnerships, build and maintain video conferencing and exhibit capacity, travel to rural communities, serve low-income populations, and place special emphasis on increasing the number of women and minorities in the science and engineering professions. Section 615 of the Act directs that the NASA Administrator shall "strive to ensure equal access for minority and economically disadvantaged students to NASA's education programs." Section 616 of the Act provides the authority that NASA continues to rely upon to award grants and cooperative agreements with museums and planetariums for the enhancement of programs "related to space exploration, aeronautics, space science, earth science, or microgravity."

NASA Authorization Act of 2008 (P.L. 110-422): Section 703 of the Act expresses the sense of Congress that "NASA's educational programs are important sources of inspiration and hands-on learning for the next generation of engineers and scientists which should be supported." This section goes on to identify EarthKAM – a project that enables students to take photographs of Earth from Space – as well as student robotics competitions as "worthy undertakings" that NASA should support. Section 704(a) of the Act expresses the sense of Congress that the ISS "offers a unique opportunity" for Federal agencies to engage students in STEM education, and encourages NASA to include other Federal agencies

in its planning efforts to use the ISS National Laboratory for STEM education activities. Regarding the National Space Grant College and Fellowship Program, Section 704(c) of the Act directs that "NASA shall continue its emphasis on the importance of education to expand opportunities for Americans to understand and participate in NASA's aeronautics and space projects by supporting and enhancing science and engineering education, research, and public outreach efforts."

NASA Authorization Act of 2010 (P.L. 111-267): Section 202(3) of the NASA Authorization Act of 2010 (P.L. 111-256) lists "inspiring young people in their educational pursuits" among the key objectives for the United States for human expansion into space. Section 504(6) of the Act directs that NASA provide initial financial assistance to the organizations managing the International Space Station (ISS) National Laboratory to enable it to initiate the "development and implementation of scientific outreach and education activities designed to ensure effective utilization of ISS research capabilities… and the development of educational programs…including student-focused research opportunities for conduct of research in ISS national laboratory facilities."

America COMPETES Reauthorization Act of 2010 (P.L. 111-358): Section 202 of the Act expresses the sense of Congress that "NASA is uniquely positioned to interest students in STEM, not only by the example it sets, but through its education programs." This section further directs that NASA "shall develop and maintain educational programs to: [c]arry out and support research based programs and activities designed to increase student interest and participation in STEM, including students from minority and underrepresented groups; [i]mprove public literacy in STEM; [e]mploy proven strategies and methods for improving student learning and teaching in STEM; [p]rovide curriculum support materials and other resources. . .[and] create and support opportunities for enhanced and ongoing professional development for teachers…" Section 204 of the Act expresses the sense of Congress that "the ISS" represents a valuable and unique national asset which can be utilized to increase educational opportunities and scientific and technological innovation," and directs that NASA "evaluate and, where possible, expand efforts to maximize NASA's contribution to interagency efforts to enhance [STEM] education capabilities. . ." Similar direction is found in the America COMPETES Act of 2007 (P.L. 110-69).

Authority for NOAA

America COMPETES 2010 Reauthorization Act (P.L . 111-358): Section 4002 of the Act directs NOAA to "carry out and support research based programs and activities designed to increase student interest and participation in STEM." The section also calls for NOAA to, among other things, "create and support opportunities for enhanced and ongoing professional development for teachers." Similar direction is found in the America COMPETES Act of 2007 (P.L. 110-69).

Coral Reef Conservation Act (P.L. 106-562): Section 207 of the act encourages NOAA to enhance "public awareness, education, understanding, and appreciation of coral reefs and coral reef ecosystems."

Coastal Zone Management Act (P.L. 109-58): & Section 1461, National Estuarine Research Reserve System: These Acts require NOAA to provide opportunities for public costal and marine education and interpretation.

National Marine Sanctuaries Act (P.L. 106-513, Sections 1431 et seq.): The Act established that the National Marine Sanctuary system includes "areas of the marine environment which have special conservation, recreational, ecological, historical, cultural, archeological, scientific, educational, or esthetic qualities." The Act calls for the National Marine Sanctuary system to "support, promote, and coordinate efforts to enhance public awareness, understanding, and appreciation of the national marine sanctuaries." Education for the general public, teachers, students, national marine sanctuaries users, and ocean and costal resource managers is approved under this Act.

Magnuson-Stevens Fishery Conservation and Management Act (P.L. 109-479): The Act calls for the National Marine Fisheries Service to engage in conservation and sustainability education, and provide educational experiences related to marine professions. In addition, the Act creates the Western Pacific and Northern Pacific Regional Marine Education and Training program.

National Sea Grant College Program Act (P.L. 107-299): The Act encourages National Sea Grant Colleges to engage in research, education, and outreach programs. The Act calls for the National Sea Grant College Program to provide equal access to fellowships provided through the National Sea Grant College Program.

Omnibus Public Land Management Act of 2009 (P.L. 111-11); Title XII – Oceans

Subtitle A–Ocean Exploration; The Act calls for NOAA to create a National Ocean Exploration program that includes, among other things, education and outreach activities to improve public understanding of the Ocean and costal resources.

Subtitle B–Ocean and Coastal Mapping Integration Act; The Act calls for NOAA to create up to three joint Coastal and Mapping Centers, which should provide graduate education and training in ocean and costal mapping sciences.

Subtitle C–Integrated Coastal and Ocean Observation System Act of 2009; The Act calls for NOAA to create at National ocean, coastal, and Great Lakes observing system that includes, among other things, public outreach and education activities.

Subtitle D–Federal Ocean Acidification Research and Monitoring Act of 2009; The Act calls for NOAA to conduct ocean acidification research and provide educational opportunities that encourage an interdisciplinary and international approach to exploring the impacts of ocean acidification.

Executive Orders and other White House Mandates:

Executive Order: Stewardship of the Ocean, Our Coasts, and the Great Lakes, July 19, 2010; The Executive Order encourages NOAA to foster public understanding of the value of the ocean, costal resources, and the Great Lakes.

Presidential Memorandum: America's Great Outdoors, April, 16, 2010; The Memorandum calls for NOAA, along with other agencies, to create opportunities for the public to engage in environmental conservation activities and engage in educational experiences in outdoor environments managed by the Federal government.

Authority for EPA

National Environmental Education Act of 1990 (P.L. 101-619): The Act calls for the EPA Office of Environmental Education to (1) develop and support programs and related efforts to improve understanding of the natural and built environment, and the relationships between humans and their environment, (2) support development and the widest possible dissemination of model curricula, educational materials, and training programs for elementary and secondary students and other interested groups, and (3) manage Federal grant assistance provided to local education agencies, institutions of higher education, and other not-for-profit organizations. The Act also establishes an Environmental Education and Training Program to train educational professionals in the development and delivery of environmental education and training programs and studies. Finally, the Act calls for EPA to provide for internships to postsecondary students and fellowships for in-service teachers with agencies of the Federal Government.

Appendix C:
STEM Education Funding in Millions by Agency[36,37]

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Agriculture	NIFA	1890 Facilities Grant Program	19.7	19.7	19.7
Agriculture	NIFA	1890 Institutions Capacity Building Grants Program: Extension	6.4	6.4	6.4
Agriculture	NIFA	1890 Institutions Capacity Building Grants Program: Teaching	6.4	6.4	6.4
Agriculture	NIFA	4-H Science, 4-H Youth Development Program	24.0	24.0	23.9
Agriculture	APHIS	AgDiscovery	0.5	0.5	0.5
Agriculture	NIFA	Agriculture in the Classroom	0.6	0.6	0.6
Agriculture	NIFA	AITC Secondary Postsecondary Agriculture Education Challenge Grants (SPECA)	1.0	0.9	1.0
Agriculture	NIFA	Alaska Native-Serving and Native Hawaiian-Serving Institutions Education Competitive Grants Program	3.2	3.2	3.2
Agriculture	NIFA	Distance Education Grants for Institutions of Higher Education in Insular Areas (DEG)	0.7	0.8	0.7
Agriculture	NIFA	Food and Agricultural Sciences National Needs Graduate and Postgraduate Fellowship Grant Program	3.9	3.2	3.9
Agriculture	NIFA	Higher Education Challenge Grants (HEC)	5.6	4.8	5.6
Agriculture	NIFA	Higher Education Multicultural Scholars Program (MSP)	1.2	1.0	1.2
Agriculture	NIFA	Hispanic Serving Institutions Education Grants Program	9.2	9.2	9.2
Agriculture	NIFA	New Era Rural Technology Competitive Grants Program (RTP)	0.9	*	*
Agriculture	NIFA	NIFA Fellowship Grants Program	6.1	6.1	7.5
Agriculture	NIFA	Resident Instruction Grants Program for Institutions of Higher Education in Insular Areas	0.9	0.9	0.9
Agriculture	NIFA	Women and Minorities in Science, Technology, Engineering and Mathematics Fields Program (WAMS)	0.4	0.4	0.4

36. Only investments with a budget of $300k or greater in at least one year from FY 2010 to FY 2013 are included in the table. Basic information on investments with a budget consistently below $300k was and will continue to be collected as part of the annual NSTC Federal STEM Education Inventory.

37. '*' = Previously appropriated investment that has been eliminated; "+" = Previously appropriate investment that is proposed for elimination in FY 2013

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Agriculture Total			**$ 90.8**	**$ 88.1**	**$ 91.2**
Commerce	NOAA	Climate Communications and Education	1.6	1.6	1.6
Commerce	NOAA	Coral Reef Conservation Program	0.5	0.5	0.5
Commerce	NOAA	Dr. Nancy Foster Scholarship Program	0.5	0.5	0.5
Commerce	NOAA	Educational Partnership Program with Minority Serving Institutions	14.5	11.3	11.0
Commerce	NOAA	Environmental Literacy Grants program	6.3	5.0	+
Commerce	NOAA	Ernest F. Hollings Undergraduate Scholarship Program	4.3	4.3	4.3
Commerce	NOAA	Global Learning and Observations to Benefit the Environment (GLOBE)	*	*	*
Commerce	NOAA	National Estuarine Research Reserve System	4.0	4.0	4.0
Commerce	NOAA	National Ocean Service Education	0.6	0.6	0.6
Commerce	NOAA	National Sea Grant College Program	9.4	9.4	9.4
Commerce	NIST	NIST Summer Institute for Middle School Teachers	0.3	0.3	0.3
Commerce	NOAA	NOAA Bay Watershed Education and Training (B-WET)	4.2	4.5	+
Commerce	NOAA	NOAA Fisheries Education Program	2.3	2.3	2.3
Commerce	NOAA	NOAA Office of Ocean Exploration and Research (Education Only)	0.9	0.9	+
Commerce	NOAA	NOAA Teacher at Sea Program	0.6	0.6	+
Commerce	NOAA	NWS Outreach Program	2.7	2.7	2.7
Commerce	NOAA	Office of National Marine Sanctuaries Education Program	1.5	1.5	1.5
Commerce	NOAA	Satellite and Information Service	3.2	3.2	3.2
Commerce	NIST	STEM Pipeline for the Next Generation Scientists and Engineers	-	1.0	1.0
Commerce	NIST	Summer Undergraduate Research Fellowship (SURF)	0.6	0.6	0.6
Commerce Total			**$ 58.0**	**$ 54.8**	**$ 43.5**
Defense	Army, Acquisition, Logistics and Technology (ASA/ ALT)	Army Educational Outreach Program (AEOP)	7.9	8.2	9.3
Defense	Air Force, Office of Scientific Research	Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE)	4.5	4.5	4.5
Defense	Office of the Secretary of Defense, Under Secretary of Defense, Personnel & Readiness	DOD STARBASE Program	28.0	25.0	20.0

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Defense	Navy, Office of Naval Research	Historically Black Colleges and Universities/Minority Institutions Research and Education Partnership	1.5	1.4	1.5
Defense	Navy, Office of Naval Research	Iridescent Learning	0.9	2.5	2.7
Defense	Office of the Secretary of Defense, Undersecretary of Defense for Acquisition, Technology & Logistics (AT&L)	National Defense Education Program K-12 component	11.2	17.3	15.2
Defense	Office of the Secretary of Defense, Under Secretary of Defense for Acquisition, Technology & Logistics (AT&L)	National Defense Education Program Science, Mathematics And Research for Transformation (SMART)	48.8	53.3	46.9
Defense	Air Force Office of Scientific Research	National Defense Science and Engineering Graduate (NDSEG) Fellowship Program	38.3	39.7	40.7
Defense	Army, G-1	National Science Center (NSC)	1.8	1.9	2.8
Defense	Navy, Office of Naval Research	Science and Engineering Apprenticeship Program (SEAP)	0.8	0.8	0.8
Defense	Navy, Office of Naval Research	SeaPerch	1.5	1.5	1.5
Defense	Under Secretary of Defense Intelligence, National Security Agency	Stokes Educational Scholarship Program	2.2	2.0	1.8
Defense	Navy, Office of Naval Research	The Naval Research Enterprise Intern Program (NREIP)	1.2	1.3	1.3
Defense	Office of the Secretary of Defense	Uniformed Services University of the Health Sciences (USUHS)	0.5	0.5	0.5
Defense	Navy, Office of Naval Research	University Laboratory Initiative (ULI)	2.3	2.2	2.2
Defense	Air Force, Office of Scientific Research	University Nano Satellite Program	1.6	1.6	1.6

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Defense Total			**$ 152.9**	**$ 163.7**	**$ 153.1**
Homeland Security	S&T Office of University Programs	Homeland Security STEM Career Development Grant Program	1.0	1.0	2.6
Homeland Security	S&T Office of University Programs	Homeland Security STEM Summer Intern Program	-	-	0.6
Homeland Security	S&T Office of University Programs	Scientific Leadership Awards Program	1.0	1.0	2.4
Homeland Security	S&T Office of University Programs	Summer Research Team Program	-	-	0.4
DHS Total			**$ 2.0**	**$ 2.0**	**$ 6.0**
Education	OPE	Developing Hispanic Serving Institutions STEM and articulation programs	100.0	100.0	100.0
Education	OII	Fund for the Improvement of Education (FIE)	-	-	30.0
Education	OPE	Fund for the Improvement of Postsecondary Education (FIPSE)	*	*	*
Education	OPE	Graduate Assistance in Areas of National Need (GAANN)	31.0	30.9	30.9
Education	IES	High School Longitudinal Study of 2009	6.5	6.5	5.5
Education	OESE	Improving Teacher Quality State Grants/Effective Teacher and Leader State Grants	-	-	80.0
Education	OII	Investing in Innovation	74.0	45.0	45.0
Education	OESE	Mathematics and Science Partnerships/Effective Teaching and Learning for a Complete Education	175.1	149.7	149.7
Education	OPE	Minority Science and Engineering Improvement Program	9.5	9.5	9.5
Education	IES	Research in Special Education	11.4	11.4	11.4
Education	IES	Research, Development, and Dissemination	45.5	45.5	45.5
Education	OPE	SMART Grants	*	*	*
Education	OPE	Strengthening Predominantly Black Institutions	5.8	5.7	5.7
Education	OPE	Teacher Loan Forgiveness	68.7	79.2	81.3
Education	OPE	Teachers for a Competitive Tomorrow: Programs for Baccalaureate Degrees in STEM or Critical Foreign Languages, with Concurrent Teacher Certification	*	*	*
Education	OPE	Teachers for a Competitive Tomorrow: Programs for Master's Degrees STEM or Critical Foreign Language Education (TCT-M)	*	*	*
Education	OPE	Upward Bound Math and Science Program	33.9	33.8	33.8
Education Total			**$ 561.4**	**$ 517.2**	**$ 628.3**

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Energy	Office of Energy Efficiency and Renewable Energy, Vehicle Technologies	Advanced Vehicle Competitions	2.0	2.0	2.0
Energy	Office of Science, Office of Fusion Energy Sciences	American Chemical Society Summer School in Nuclear and Radiochemistry	0.5	0.2	0.6
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	Community College Institute of Science and Technology	0.7	0.7	0.8
Energy	Office of Science, Office of Fusion Energy Sciences	Computational Science Graduate Fellowship	6.0	6.0	1.6
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	DOE Academies Creating Teacher Scientists (DOE ACTS)	*	*	*
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	Faculty and Student Teams	1.2	1.2	1.2
Energy	Office of Science, Office of Fusion Energy Sciences	Fusion Energy Sciences Graduate Fellowship Program	0.2	*	*
Energy	Office of Science, Office of Fusion Energy Sciences	Global Change Education Program	0.9	0.9	+
Energy	Office of Energy Efficiency and Renewable Energy, Vehicle Technologies	Graduate Automotive Technology Education	1.0	1.0	1.0
Energy	Office of Environmental Management	HBCU Mathematics, Science & Technology, Engineering and Research Workforce Development Program	8.3	8.3	8.3

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Energy	Office of Energy Efficiency and Renewable Energy, Water	Hydro Research Fellowships	0.9	*	*
Energy	Office of Energy Efficiency and Renewable Energy, Industrial Technologies	Industrial Assessment Centers	4.1	4.1	4.1
Energy	Office of Nuclear Energy	Integrated University Program	*	*	*
Energy	Office of Economic Impact and Diversity	Minority Educational Institution Student Partnership Program	1.5	1.2	0.6
Energy	Office of Energy Efficiency and Renewable Energy, Solar	Minority University Research Associates Program (MURA)	0.5	0.5	0.5
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	National Science Bowl	2.4	2.2	2.8
Energy	Office of Science, Office of Fusion Energy Sciences	National Undergraduate Fellowship Program in Plasma Physics and Fusion Energy Sciences	*	*	*
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	Office of Science Graduate Fellowship (SCGF) program	5.0	5.0	+
Energy	Office of Science, Office of Fusion Energy Sciences	Plasma/Fusion Science Educator Programs	0.8	0.6	0.7
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	Pre-Service Teacher Program	-	0.4	+

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
Energy	Office of Science, High Energy Physics	QuarkNet	0.8	0.8	0.8
Energy	Office of Science, Office of Workforce Development for Teachers and Scientists	Science Undergraduate Laboratory Internships	6.0	6.0	6.0
Energy	Office of Energy Efficiency and Renewable Energy, Building Technologies	Solar Decathlon	5.0	5.0	5.0
Energy	Office of Fossil Energy	Special Recruitment Programs	0.7	0.7	0.7
Energy	Office of Energy Efficiency and Renewable Energy, Wind	Wind for Schools	0.6	0.9	+
Energy Total			**$ 49.0**	**$ 47.7**	**$ 36.7**
EPA	ORD	Cooperative Training Partnership in Environmental Sciences Research	0.5	0.5	0.5
EPA	OEE	Environmental Education Grants	3.7	3.5	+
EPA	NCER	Greater Research Opportunities (GRO) Fellowships for Undergraduate Environmental Study	2.0	2.1	2.1
EPA	OEE	National Environmental Education and Training Partnership	2.4	2.0	+
EPA	OSPI	National Network for Environmental Management Studies Fellowship Program	-	0.1	0.1
EPA	ORD	People, Prosperity & the Planet-Award (P3): A National Student Design Competition for Sustainability	1.6	3.1	3.0
EPA	NCER	Science to Achieve Results (STAR) Graduate Fellowship Program	9.5	14.0	14.0
EPA	ORD	University of Cincinnati/EPA Research Training Grant	0.6	0.6	0.6
EPA Total			**$ 20.3**	**$ 25.9**	**$ 20.3**
HHS	NIH/NIDA	Blueprint for Neuroscience Research Science Education Award	0.4	0.4	0.4
HHS	NIH/NIGMS	Bridges to the Baccalaureate Program	6.7	6.8	6.6
HHS	NIH/NIGMS	Bridges to the Doctorate	3.2	3.2	3.1
HHS	NIH/NCI	Cancer Education Grants Program	5.7	5.7	5.6

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
HHS	NIH/NCI	CCR/JHU Master of Science in Biotechnology Concentration in Molecular Targets and Drug Discovery Technologies	0.2	0.2	0.2
HHS	NIH/Clinical Center/ Office of Clinical Research Training and Medical Education	Clinical Research Training Program	0.9	0.9	1.1
HHS	NIH/Office of the Director/Office of Science Education	Curriculum Supplement Series	0.3	0.3	0.5
HHS	NIH/Office of the Director/Office of Intramural Training and Education	Graduate Program Partnerships	16.0	16.0	16.7
HHS	NIH/NIGMS	Initiative for Maximizing Student Development	22.3	22.3	21.8
HHS	NIH/NIGMS	MARC U-STAR NRSA Program	20.9	20.9	20.6
HHS	NIH/NICHD	Mathematics and Science Cognition and Learning (MSCL) Program	9.2	9.2	9.2
HHS	NIH/NCI	National Cancer Institute Cancer Education and Career Development Program	18.4	18.4	18.2
HHS	NIH/NCRR	NCRR Science Education Partnership Award	18.9	18.9	19.6
HHS	NIH/NIDA	Neuroimaging Training	1.2	1.2	1.2
HHS	NIH/NHLBI	NHLBI HBCU Research Scientist Award	*	*	*
HHS	NIH/NHLBI	NHLBI Minority Undergraduate Biomedical Education Program	*	*	*
HHS	NIH/NIAID	NIAID Science Education Awards	0.6	0.6	0.6
HHS	NIH/NINDS	NINDS Diversity Research Education Grants in Neuroscience	1.0	1.0	0.9
HHS	NIH/NLM	NLM Institutional Grants for Research Training in Biomedical Informatics	12.2	12.2	13.6
HHS	NIH/ Office of the Director /Office of Science Education	Office of Science Education K-12 Program	2.2	2.2	2.2
HHS	NIH/ Office of the Director/Office of Intramural Training and Education	Post-baccalaureate Intramural Research Training Award Program	23.5	23.5	22.5
HHS	NIH/NIGMS	Postbaccalaureate Research Education Program (PREP)	7.7	7.7	7.6
HHS	NIH	Research Supplements to Promote Diversity in Health-Related Research	66.2	66.2	65.4
HHS	NIH/NIGMS	RISE (Research Initiative for Scientific Enhancement)	26.2	26.2	25.7

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
HHS	NIH	Ruth L. Kirschstein National Research Service Award Institutional Research Training Grants (T32, T35)	219.4	219.4	217.0
HHS	NIH	Ruth L. Kirschstein NRSA for Individual Predoctoral Fellows, including Underrepresented Racial/Ethnic Groups, Students from Disadvantaged Backgrounds, and Predoctoral Students with Disabilities	54.1	54.1	53.2
HHS	NIH/NIDA	Science Education Drug Abuse Partnership Award	1.9	1.9	1.9
HHS	NIH/NIGMS	Short Courses in Integrative and Organ Systems Pharmacology	0.7	0.7	+
HHS	NIH/NICHD	Short Courses in Population Research (Education Programs for Population Research R25)	0.8	0.8	0.8
HHS	NIH/NIGMS	Short Courses on Mathematical, Statistical, and Computational Tools for Studying Biological Systems	0.9	0.9	0.9
HHS	NIH/NIEHS	Short Term Educational Experiences for Research (STEER) in the Environmental health Sciences for Undergraduates and High School Students	0.5	0.5	+
HHS	NIH/NHLBI	Short-Term Research Education Program to Increase Diversity in Health-Related Research	4.0	4.0	3.1
HHS	NIH/NIDA	Small Business Innovation Research Grants	0.7	0.7	0.7
HHS	NIH/ Office of the Director/Office of Intramural Training and Education	Student Intramural Research Training Award Program	5.4	5.4	4.8
HHS	NIH/NHLBI	Summer Institute for Training in Biostatistics	1.5	1.5	1.5
HHS	NIH/ Office of the Director/Office of Intramural Training and Education	Technical Intramural Research Training Award	2.2	2.2	2.3
HHS	NIH/NIDA	Training in Computational Neuroscience: From Biology to Model and Back Again	1.8	1.8	1.8
HHS	NIH/ Office of the Director/Office of Intramural Training and Education	Undergraduate Scholarship Program for Individuals from Disadvantaged Backgrounds	2.5	2.5	2.5
HHS Total			**$ 560.3**	**$ 560.4**	**$ 553.8**
Interior	USGS	EDMAP	0.6	0.6	0.6
Interior Total			**$ 0.6**	**$ 0.6**	**$ 0.6**

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NASA	HEOMD	21st Century Explorer	*	*	*
NASA	ARMD	Aeronautics Content–Smart Skies/Product Content Upgrade	-	0.8	0.8
NASA	ARMD	Aeronautics Scholarship	1.6	1.8	1.8
NASA	Education Office	Aerospace Education Services Project	3.9	3.1	N/A[38]
NASA	SMD	Aqua	0.4	0.3	0.3
NASA	SMD	Astrophysics Forum	1.0	1.0	1.0
NASA	SMD	Aura	0.5	0.3	0.3
NASA	SMD	Cassini	1.3	0.9	0.9
NASA	Center JSC	Career Exploration Project	1.2	1.1	1.3
NASA	SMD	Chandra	1.8	0.5	0.5
NASA	Education Office	Competitive Program for Science Museums and Planetariums	*	*	*
NASA	Center JPL	Curriculum Improvement Partnership Award for the Integration of Research into the Undergraduate Curriculum (CIPAIR)	0.6	1.6	N/A
NASA	SMD	DAWN	0.5	0.3	0.3
NASA	SMD	Earth Science E/PO Forum	0.9	0.9	0.9
NASA	Center MSFC	eEducation Small Projects/Central Operation of Resources for Educators	0.7	0.7	0.1
NASA	Center JSC	Education Flight Projects	2.7	2.2	N/A
NASA	SMD	EPOESS	7.0	6.6	4.4[39]
NASA	HEOMD	ESMD Space Grant Project	*[40]	*	*
NASA	Education Office	Global Climate Change Education	3.5	3.2	N/A
NASA	SMD	GLOBE Program	5.0	4.5	4.5
NASA	SMD	GRAIL	0.5	0.4	0.2
NASA	Education Office	Graduate Student Researchers Program	3.3	2.8	N/A
NASA	SMD	Heliophysics E/PO Forum	0.8	0.7	0.8
NASA	HEOMD	Goldstone Apple Valley Radio Telescope (GAVRT) Project	0.5	0.5	0.5
NASA	HEOMD	NASA's Beginning Engineering, Science and Technology (BEST) Students (NBS)	0.3	0.4	0.4
NASA	HEOMD	Space Grant–Senior design projects and faculty activities	0.3	0.5	0.5
NASA	HEOMD	HEOMD-University Student Launch Initiative	0.3	0.3	0.3
NASA	SMD	Hinode	0.2	0.1	0.1

38. N/A = The Office of Education is currently rebuilding its entire portfolio; the exact amount for this activity in 2013 not determined at this time.
39. No new starts in 2012, covers current on-going agreements.
40. Merged with Space Grant – Senior design projects and faculty activities.

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NASA	SMD	HST	1.3	1.6	1.6
NASA	Education Office	Informal STEM Education		10.0[41]	5.0
NASA	ARMD	Innovation in Aeronautics Instruction Competition	0.5	0.1	-[42]
NASA	Education Office	Innovation in Higher Education STEM Education	4.7	0.5	N/A
NASA	Education Office	Interdisciplinary National Science Program Incorporating Research and Education Experience	3.2	0.7	N/A
NASA	Education Office	JPFP–Jenkins Pre-Doctoral Fellowship Program	3.4	2.6	N/A
NASA	SMD	Juno	1.3	0.6	0.4
NASA	Center GSFC	K-12 Competitive Grants Opportunity	-	-	N/A
NASA	SMD	Kepler	0.2	0.2	0.1
NASA	Center LaRC	NASA Langley Aerospace Research Summer Scholars Program	0.6	0.6	0.6
NASA	SMD	LDCM	0.7	0.6	0.4
NASA	Education Office	Learning Environment and Research Network	2.7	3.0	N/A
NASA	Center GRC	Lewis Educational Research Collaborative Internship Project	0.6	0.1	0.1
NASA	Education Office	Learning Technologies Project	0.5	0.5	N/A
NASA	SMD	Mars E/PO Formal Ed	1.1	1.1	1.1
NASA	SMD	Mars E/PO Informal Ed	1.0	1.0	1.0
NASA	SMD	MESSENGER	0.4	0.3	0.1
NASA	Education Office	MOD/SIM Summer Fellowships for Middle School Teachers	0.4	*	*
NASA	Education Office	MSP–MUREP Small Projects	1.8	1.0	N/A
NASA	Education Office	MUREP			30.0[43]
NASA	Center GRC	MUST–Motivating Undergraduates in Science and Technology	1.6	2.3	N/A
NASA	Education Office	NAFP–NASA Administrator's Fellowship Project	0.1	*	*
NASA	Center JSC	NAS–NASA Aerospace Scholars	0.3	0.3	0.3
NASA	Education Office	NES–NASA Explorer Schools	3.1	3.8	N/A
NASA	Center MSFC	NETS–NASA Education Technologies Services	0.5	1.0	N/A

41. Funding for previous FY is broken out into the investments that make up the Informal Education Program: Visitor Center Activities, and the Competitive Program for Science Museums and Planetariums. FY 2012 and FY 2013 funding for the Informal STEM Education STEM is not yet broken out for separate investments.

42. The competition ends in FY 2012.

43. Funding for previous FY is broken out into the investments that make up MUREP. Funding for MUREP will be broken out into separate investments once Congress passes the FY2013 budget.

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NASA	Education Office	NIEO–NASA Informal Education Opportunities	0.5	*	*
NASA	HEOMD	NSBRI Higher Education Activities–National Space Biomedical Research Institute	0.8	0.8	0.8
NASA	Education Office	NSTI-MI–NASA Science and Technology Institute for Minority Institutions	1.8	0.6	N/A
NASA	SMD	Planetary Science E/PO Forum	0.9	0.9	0.9
NASA	HEOMD	Reduced Gravity Student Flight Opportunity Project	0.3	0.3	0.3
NASA	Education Office	Research Cluster	3.7	1.4	N/A
NASA	HEOMD	SEED–Systems Engineering Educational Discovery	*	*	*
NASA	Center GRC	SEMAA–Science Engineering Mathematics and Aerospace Academy/FIRST Buckeye	2.1	1.0	N/A
NASA	SMD	SOFIA (Stratospheric Observatory for Infrared Astronomy) Education and Public Outreach	0.6	0.6	0.7
NASA	Education Office	SOI–Summer of Innovation/NASA IV&V Engineering Apprenticeship Program	10.1	5.9	0.1
NASA	Education Office	Space Grant–National Space Grant College and Fellowship Program	45.5	40.0	24.0
NASA	OCT-ST	Space Technology Research Fellowships	7.0	12.0	15.0
NASA	CMO/ARC	Spaceward Bound	-	0.4	0.4
NASA	Education Office	STEM Education & Accountability Project	-	-	14.0[44]
NASA	Center JPL	SURF–Summer Undergraduate Research Fellowships Program	*	*	*
NASA	Education Office	TCUP–NASA Tribal College and University Project	1.5	1.2	N/A
NASA	SMD	Terra	0.3	0.3	0.3
NASA	Education Office	URC–University Research Centers	10.4	16.0	N/A
NASA	Education Office	USRP–Undergraduate Student Research Project	3.3	0.3	N/A
NASA	Education Office	Visitor Centers–NASA Visitor Centers	-	-	N/A
NASA Total			**$ 157.5**	**$ 149.0**	**$117.3**
NRC	Office of Human Resources	Integrated University Program	5.0	15	+
NRC	Small Business and Civil Rights Office	Minority Serving Institutions Program (MSIP)	0.7	0.7	0.7
NRC	Office of Human Resources	Nuclear Education Curriculum Development Program	4.7	0.0	4.7
NRC Total			**$ 10.4**	**$ 15.7**	**$ 5.4**

44. Funding for previous FY is broken out into the investments that make up the STEM Education and Accountability Projects. Funding will be broken out into separate investments once Congress passes the FY2013 budget.

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NSF	Directorate for Education and Human Resources	Advanced Technological Education (ATE)	64.0	64.0	64.0
NSF	Directorate for Education and Human Resources	Alliances for Graduate Education and the Professoriate (AGEP)	16.7	7.8	7.8
NSF	Directorate for Computer & Information Science & Engineering	Broadening Participation in Computing (BPC)	14.0	*	*
NSF	Directorate for Geosciences	Centers for Ocean Sciences Education Excellence	5.2	4.2	3.2
NSF	Directorate for Computer & Information Science & Engineering	CISE Pathways to Revitalized Undergraduate Computing Education (CPATH)	1.5	*	*
NSF	Directorate for Education and Human Resources	Climate Change Education (CCE)	10.0	10.0	7.8
NSF	Directorate for Computer & Information Science & Engineering	Computing Education for the 21st Century (CE21)	5.5	15.0	16.0
NSF	Office of Cyberinfrastructure	Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM)	5.0	4.0	+
NSF	Directorate for Education and Human Resources	Discovery Research K-12 (DR-K12)	119.9	99.2	114.2
NSF	Office of International Science and Engineering	East Asia & Pacific Summer Institutes for U.S. Graduate Students (EAPSI)	2.4	2.4	2.4
NSF	Directorate for Engineering	Engineering Education (EE)	10.9	11.1	11.1
NSF	Directorate for Math and Physical Sciences	Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21)	16.5	11.8	13.8
NSF	Directorate for Education and Human Resources	Excellence Awards in Science and Engineering (EASE)	5.2	5.2	5.2

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NSF	Directorate for Education and Human Resources	Federal Cyber Service: Scholarship for Service (SFS)	15.0	45.0	25.0
NSF	Directorate for Geosciences	Geoscience Education	1.5	1.5	1.5
NSF	Directorate for Geosciences	Geoscience Teacher Training (GEO-Teach)	2.0	2.0	2.0
NSF	Directorate for Geosciences	Global Learning and Observations to Benefit the Environment (GLOBE)	1.1	1.1	1.1
NSF	Directorate for Education and Human Resources	Graduate Research Fellowship Program (GRFP)	137.7	198.1	243.0
NSF	Directorate for Education and Human Resources	Graduate Teaching Fellows in K-12 Education (GK-12)	53.0	27.0	27.0
NSF	Directorate for Education and Human Resources	Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)	31.9	31.9	31.9
NSF	Directorate for Education and Human Resources	Informal Science Education (ISE)	64.2	61.4	47.8
NSF	Directorate for Education and Human Resources	Innovative Technology Experiences for Students and Teachers (ITEST)	25.0	25.0	25.0
NSF	Directorate for Education and Human Resources	Integrative Graduate Education and Research Traineeship (IGERT) Program	60.8	59.8	51.7
NSF	Directorate for Math and Physical Sciences	Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM)	2.1	*	*
NSF	Office of International Science and Engineering	International Research Experiences for Students (IRES)	3.2	3.2	2.3
NSF	Directorate for Education and Human Resources	Louis Stokes Alliances for Minority Participation (LSAMP)	45.6	45.6	45.6

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NSF	Directorate for Education and Human Resources	Math and Science Partnership (MSP)	57.1	57.1	57.1
NSF	Directorate for Engineering	Nanotechnology Undergraduate Education in Engineering	1.5	1.5	1.5
NSF	Directorate for Education and Human Resources	NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)	75.0	75.0	75.0
NSF	Directorate for Geosciences	Opportunities for Enhancing Diversity in the Geosciences	3.6	3.6	3.6
NSF	Office of Polar Programs	Polar Research and Education	*	*	*
NSF	Directorate for Education and Human Resources	Research and Evaluation on Education in Science and Engineering (REESE)	45.6	37.7	42.4
NSF	Directorate for Engineering	Research Experiences for Teachers (RET) in Engineering and Computer Science	4.0	5.5	5.5
NSF	Directorate for Education and Human Resources	Research Experiences for Undergraduates (REU)	63.6	66.0	68.4
NSF	Directorate for Education and Human Resources	Research in Disabilities Education (RDE)	6.5	6.5	6.5
NSF	Directorate for Education and Human Resources	Research on Gender in Science and Engineering (GSE)	10.5	10.5	10.5
NSF	Directorate for Education and Human Resources	Robert Noyce Scholarship Program	54.9	54.9	54.9
NSF	Directorate for Education and Human Resources	Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP)	33.4	25.3	17.3
NSF	Directorate for Education and Human Resources	Transforming Undergrad Education in STEM (TUES)	40.9	39.5	61.5
NSF	Directorate for Biological Sciences	Transforming Undergraduate Biology Education (TUBE)	15.0	13.0	6.5
NSF	Directorate for Education and Human Resources	Tribal Colleges and Universities Program (TCUP)	13.3	13.3	13.3

Agency	Sub-Agency	Investment	FY 11 Enacted	FY 12 Enacted	FY 13 Requested
NSF	Directorate for Biological Sciences	Undergraduate Research and Mentoring in the Biological Sciences (URM)	3.0	*	*
NSF	Directorate for Education and Human Resources	Widening Implementation and Demonstration of Evidence-based Reforms (WIDER)	-	8.0	20.0
NSF Total			**$ 1,147.6**	**$ 1,153.7**	**$ 1,193.4**
DOT	Federal Aviation Administration	Air Transportation Centers of Excellence	12.5	12.5	12.5
DOT	Research and Innovative Technology Administration	Dwight David Eisenhower Transportation Fellowship Program	2.0	1.6	3.0
DOT	Research and Innovative Technology Administration	Garrett A. Morgan Technology and Transportation Education Program	1.1	0.9	1.3
DOT	Research and Innovative Technology Administration	Summer Transportation Institute Program for Diverse Groups (STIPDG)	3.9	3.2	3.9
DOT	Research and Innovative Technology Administration	University Transportation Centers Program	80.0	80.0	80.0
DOT Total			**$ 99.5**	**$98.3**	**$ 100.7**
Federal Total			**$2,910.1**	**$ 2,877.0**	**$ 2,950.8**

Appendix D: Draft Criteria for Success

Preliminary Draft of Criteria for Success

The draft criteria below represent a preliminary attempt to capture the characteristics that STEM education investments need to have if they are to reach their primary objective. This initial draft was developed by reviewing research related to STEM education and by consulting with staff who manage Federal STEM education investments. **The criteria will be further developed and refined through public and expert input**. Major changes to the draft criteria are expected based on the input that will be gathered.

Federal STEM education investments will be expected to meet both general program management criteria and the specific criteria related to the primary objective individual investments. In addition, investments that aim to support underrepresented groups in STEM education should meet the criteria for serving underrepresented groups. For example, an investment with the primary objective to provide higher quality education opportunities to individuals from underrepresented groups for the purpose of increasing representation of these groups in STEM fields would be expected to meet general program management criteria, STEM careers criteria, and criteria for serving underrepresented groups. The CoSTEM anticipates that some agencies will need to consult with other agencies or non-Federal STEM education experts to meet the criteria for success.

The degree to which an investment meets the relevant criteria will be assessed through a CoSTEM review. Investments will not be held accountable for meeting specific general management or primary objective criteria if a clearly articulated, valid rationale is provided. A detailed description of the process to review alignment with the general management and primary objective criteria will be included in the implementation chapter of the Strategic Plan.

General Management Criteria—Draft

CoSTEM will propose that, agencies should create a management plan for each investment, which includes the following:

- Clear **goals** of the investment and the desired outcomes
- A description of how the investment **aligns with effective and/or evidence-based practices** related to its objectives
- A **logic model** and/or theory of action connecting the investment to the desired outcomes
- A description of how the investment **capitalizes on agency education assets** (e.g., STEM and education expertise and resources)
- A description of the **needs among the target population** that the investment is addressing

- An **evaluation strategy** that promotes continual improvement
- A **staffing plan** that ensures suitable expertise and assigns accountability for outcomes
- A description of **strategic partnering** within the agency, and with other Federal agencies, education organizations, or other stakeholders

The **evaluation plan** for each investment should:

- Align with the agency's broader STEM education evaluation strategy or performance plan
- Align with common evidence standards (under development)
- Make evaluation an integral part of planning, developing, managing, and implementing the investment by
  - Ensuring the investment has measureable goals and links any unmeasureable goals to outcomes that can be measured
  - Identifying and sharing issues and promising approaches that emerge during implementation with STEM education stakeholders
  - Ensuring periodic examination of select investment features to assess their effectiveness and efficiency
- Align with the theory of action/logic model for the investment
- Assure that program evaluation methods are appropriate for the questions to be addressed, the type of investment, its implementation status, and other relevant factors
- Account for ongoing funding needs to support evaluation
- Establish formal mechanisms by which evaluation findings inform changes to drive improvements in investments

STEM Education for Underrepresented Groups Criteria—Draft

Investments should:

- Be designed and implemented with input from underrepresented groups, local community stakeholders, and other stakeholders as appropriate
- Draw upon and relate to the interests, knowledge, practices, and culturally relevant STEM experiences of underrepresented groups
- Where appropriate, take advantage of place-based learning opportunities and agency STEM professionals, facilities, technology, and data
- Be designed to build sustained relationships between participants and STEM partners and build capacity

Criteria by Primary Objective

Educator Quality Investment Criteria

Pre-Service Teacher Education Criteria

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

In-service Teacher Education Criteria

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

STEM Engagement[45] Investment Criteria

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

Learning Investment Criteria

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

Postsecondary STEM Degree Investment Criteria

Non-scholarship investments

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

Scholarship investments

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

STEM Careers Criteria

Investments should:
PRELIMINARY DRAFT UNDER DEVELOPMENT

45. As defined in the NSTC Federal STEM Inventory, investments that focus on engagement are designed to increase learners' involvement and interest in STEM, inform their view of STEM's value in their lives, or positively influence the perception their ability to participate in STEM.

Appendix E: Dissemination of Evidence and Education Activities

Overview of Dissemination of Evidence and STEM Education Activities

Federal agencies utilize a wide-range of strategies to distribute information about their education activities and their education research findings to relevant audiences. A sample of dissemination efforts underway at NSF, NOAA, and NASA is presented below.

NSF Dissemination Efforts

NSF utilizes a variety of strategies to synthesize information about its work and the results of efforts it supports. Below is a sample of the synthesis and dissemination efforts currently underway in select NSF programs.

The *Division of Graduate Education,* within the Directorate for Education and Human Resources (EHR), has consistently disseminated information about the Graduate STEM Fellows in K-12 Education (GK-12) program (terminated in FY2012) and the Integrative Graduate Education and Research Traineeship (IGERT) program.

GK-12 program dissemination efforts have been diverse. There is a GK-12 program website (http://www.gk12.org/) with general information about the program, meetings, and resources. An annual meeting is held in Washington, DC, attracting nearly 700 participants, and regional events are sponsored by coalitions of individual GK-12 projects to share their STEM products and best practices. To date, over 1,000 peer-reviewed documents have been published as a result of GK-12. Most recently, GK-12 has initiated the production of the GK-12 "How-to Manual." The manual will feature best practices and lessons learned from the GK-12 model over the past 11 years, and is expected to be disseminated widely throughout the STEM community, including other NSF programs.

The IGERT program has an annual reporting system; principal investigators (PIs) are required to report up to three promising or "best" practices in interdisciplinary education and evidence that the practices work. The PIs are asked to voluntarily give NSF permission to disseminate the information. The IGERT team disseminates the information to the community at large through an externally managed website (www.igert.org). The findings are also presented in a summary report. The best practices are annually communicated at the new PI meetings so that they can take advantage of known educational tactics and devise innovative ideas of their own. In addition, the IGERT program conducts independent program evaluation through an external contractor (Abt Associates, Inc). At annual IGERT PI meetings, the program hosts sessions on novel STEM educational tools and methods to bring new ideas to the community.

The *Division on Research on Learning in Formal and Informal Settings* (DRL) in EHR has supported several research syntheses conducted by the National Research Council around issues of interest in the DRL portfolio. While this work does not draw exclusively from NSF-funded projects, it draws heavily from them and embeds the findings from NSF projects into a larger national context. Some recent examples include:

- *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics;*
- *Learning Science in Informal Environments: People, Places, and Pursuits;*
- *Taking Science to School: Learning and Teaching Science in Grades K-8;*
- *Learning and Understanding: Improving Advanced Study of Mathematics and Science in U.S. High Schools; and*
- *America's Lab Report: Investigations in High School Science.*

The DRL programs have funded resource networks that work with each of the Division's programs: Research and Evaluation on Education in Science and Engineering, Discovery Research K-12, Informal Science Education, and Innovative Technology Experiences for Students and Teachers. These resource networks have organized abstracts or descriptions of the current projects in the portfolio and are searchable through the use of key words.

The *Division of Undergraduate Education* (DUE) in EHR also uses multiple dissemination strategies. A majority of DUE programs hold annual or bi-annual PI Conferences, host webinars on DUE programs, and convene review panels that serve as professional development for participating reviewers. The PI conferences showcase best practices and research findings, and attendees include not only PIs but also other interested stakeholders (e.g. Foundations, Professional Societies, and other Federal agencies).

Some other specific examples that target dissemination broadly are the Central Resource Projects in the Transforming Undergraduate Education in Science (TUES) program and the Advanced Technology Education (ATE) Centers website, ATE Central.

For example, the TUES Central Resource Projects:

- Help those engaged in improving STEM education to synthesize knowledge produced through NSF investments through a web-based knowledge mining and interactive visualization platform
- Allow users (e.g., current and potential principle investigators, NSF/TUES program staff, and administrators at academic institutions) to interactively mine, synthesize, and visualize data at a scale that is not possible with currently available tools
- Help TUES PIs and others engaged in improving STEM education to increase the propagation of their work among undergraduate instructors in STEM and STEM departments

ATE Central (www.atecentral.net) is a freely available online portal and collection of materials and services that highlight the work of the ATE projects and centers. These National Science Foundation-funded initiatives work with educators from two-year colleges to develop and implement ideas for improving the skills of technicians and the educators who teach them. ATE Central is designed to help educators, students, and the general public to learn about, and use materials from, the entire depth and breadth of the ATE program.

The Division of Human Resource Development (HRD) in EHR provides knowledge dissemination and diffusion grants, disseminates information at PI and professional meetings, and supports public synthesis reports. For example:

- The Research on Disabilities Education Collaborative Dissemination site[46] is designed to increase awareness of how persons with disabilities can be successful in STEM, as well as how other programs can make their web and print resources, courses, and activities more welcoming and accessible to people with disabilities.
- The Emerging Researchers National Conference in STEM[47] targets college and university undergraduate and graduate students who participate in programs funded by the NSF HRD Unit, including underrepresented minorities and persons with disabilities. The objectives of the conference are to help undergraduate and graduate students to enhance their science communication skills and to better understand how to prepare for science careers in a global workforce.
- The partially NSF-funded National Academy of Sciences report *Expanding Underrepresented Minority Participation*[48] analyzes the rate of change and the challenges the nation currently faces in developing a strong and diverse workforce. It identifies best practices and offers a roadmap for increasing involvement of underrepresented minorities and improving the quality of their education. In addition, the book offers recommendations that focus on academic and social support, institutional roles, teacher preparation, affordability and program development.

NOAA Dissemination Efforts

NOAA uses many tools to distribute its educational information to relevant audiences. NOAA monitors the Earth's environment around the clock and around the world. This information is carefully analyzed and made into valuable educational products and services. It is made available through a number of national networks. NOAA's largest and best known information dissemination network is the National Weather Service (NWS), which provides weather, hydrologic and climate data, forecasts and warnings. NWS operates 122 Weather Forecast Offices (staffed 24X7), 13 River Forecast Centers and National Centers. An average of 9,000 data products are produced per hour, ranging from text-based products, to large model sets, to hourly observations. These products are disseminated through satellite systems, internet services and the NOAA Weather Radio. This information is used widely by educators to understand and investigate the Earth's environment on a local, regional and/or global scale. NOAA supports other national information networks, such as the National Sea Grant Program, the National Estuarine Research Reserves System, and the National Marine Sanctuaries, which devote significant resources to disseminating educational information.

NOAA education materials are made available through education.noaa.gov, an education portal designed to assist educators in finding quality education materials. The portal content includes a sampling of NOAA's education resources with links to additional materials. Materials selected for the site are aligned with common teaching topics and expressed needs of educators. Linked resources are organized into collections which provide the user with a toolkit of materials and activities suitable for integration

46. http://www.washington.edu/doit/RDE/
47. http://www.emerging-researchers.org/
48. http://www.nap.edu/catalog.php?record_id=12984

into a variety of educational settings. While collections are not grade-specific, resources are labeled for grade appropriateness where applicable. Additional NOAA resources that support educator professional development, academic scholarship, career exploration, and education grants are also available.

NOAA has created a number of tools, in partnership with informal education institutions, to disseminate educational information. For example, the Ocean Today Kiosk is a dynamic and visitor-friendly experience that uses video from around the globe to inform viewers about the health of the world's ocean and the beauty and mystery of the ocean realm. Ocean Today visitors learn about the ocean's influence on them and their influence on the ocean. The Ocean Today Kiosk is installed in twenty-four science museums and aquariums across the United States and in Canada, Japan and Mexico.

NOAA is an eager adopter of best education practices. NOAA's Education Council is a major driver of this process. The process by which NOAA developed its education monitoring and evaluation framework is a good example of how this process is undertaken. The Education Council identified as a priority the need to improve its ability to monitor and evaluate its education investments. A working group was formed to develop a framework for action. The working group began by conducting a literature review to understand the state of the research. The working group then looked at how other Federal agencies were dealing with monitoring and assessment to see what best practices could be identified. A draft Monitoring and Evaluation Framework was then developed to adapt the existing research and best practices to NOAA's specific needs. With assistance from the National Research Council's Board on Science Education, NOAA's Monitoring and Evaluation Framework was vetted through a panel of experts. Once the Framework was appropriately revised, NOAA hired an educator to develop and implement a Monitoring and Evaluation Plan.

In some cases NOAA actively promotes the development of best practices. For example, NOAA developed the Science On a Sphere®, an animated 68 inch-diameter globe, designed to show dynamic images and data of the atmosphere, ocean, or surface of a planet or moon. Science on a Sphere® exhibits reach over 11 million viewers per year. NOAA formed the Science on a Sphere® Users Collaborative Network, consisting of institutions dedicated to increasing the effectiveness of the Science On a Sphere® as a public exhibit. Key education objectives of this network are: (1) to improve the understanding of how spherical display systems can be used to enhance informal science education learning, and (2) to build environmental literacy among the general public through increased use of NOAA data and NOAA-related data in informal education institutions. The network conducts meetings in person and over the phone. Discussion topics include the Science on a Sphere® system and software, creation and cataloging of content, related exhibits, and new methods for delivering content. The network has also undertaken a major initiative to assess the education impact of Science on a Sphere® exhibits. By working together the network members are advancing their collective ability to teach science with the Science on a Sphere®.

NASA Dissemination Efforts

NASA.gov plays a key role in disseminating information about NASA Education's best practices, research and evaluation findings, as well as the programs and resources available to education stakeholders. The main page of the website includes links "For Educators" and "For Students" that contain a wealth of features, articles, teaching materials, and listings of current opportunities. In addition, evaluations such as *A Descriptive Analysis of NASA's Informal Education Portfolio: Preliminary Case Studies and The National Evaluation of NASA's Science, Engineering, Mathematics and Aerospace Academy (SEMAA)* are published on NASA.gov.

The National Space Grant College and Fellowship Program (Space Grant) provides broad dissemination of STEM knowledge and techniques throughout the country through its national network composed of 52 consortia in 50 states, the District of Columbia, and the Commonwealth of Puerto Rico. These consortia consist of colleges, universities, and other academic institutions, as well as state and local government entities and aerospace industry representatives.

Additionally, for the past two years, the NASA Office of Education has convened an Education Stakeholders' Summit designed to bring together hundreds of stakeholders from academia, the Federal Government, and industry to exchange ideas focused on building an infrastructure to attract, retain and develop the future STEM workforce.

Appendix F: Draft Federal STEM Education Annual Milestones

Overview of Draft Federal STEM Education Annual Milestones

The table below provides a preliminary overview of the implementation of what the CoSTEM will strive to accomplish in FY 2012 and during the first two years of the Strategic Plan. The Strategic Plan will include metrics that tie the milestones to annual quantifiable shifts in the Federal STEM education portfolio. This will allow the CoSTEM and others to track whether the milestones are being met. In addition, milestones for FY 2015-2018 will be included.

Annual milestones are still under development and should be viewed as an incomplete draft that will be completed and refined in the final Strategic Plan. Of primary concern is that many of the draft milestones include creating guiding documents, databases, technical assistance networks, and other resources that will require agency staff capacity and financial commitments in FY 2012. The amount of resources, funding, and staff of agencies in FY 2013 and beyond is unclear at this time. Thus, appropriation decisions related to agency STEM education investments may lead to significant changes to the draft milestones.

As illustrated by the milestone table below, agencies will begin to take action to implement the Strategic Plan prior to FY 2013 (the first year of the Strategic Plan). By taking steps toward creating the needed capacity and infrastructure to implement the Strategic Plan during FY 2012, substantive changes to the Federal STEM education portfolio can take place in FY 2013, the impacts of which will be measurable as early as the second year of the Strategic Plan (FY 2014).

The milestones for FY 2012-2014 broadly focus on three stages of the Strategic Plan implementation that will reshape Federal investments in STEM education into a coordinated network of programs. In FY 2012, agencies are focusing on building the capacity, infrastructure, and guiding documents needed to implement the four strategies for improving the impact and effectiveness of the Federal STEM portfolio. In addition, agencies will identify barriers to inter-agency collaboration and develop strategies to minimize those barriers. In FY 2013, agencies will utilize the newly created capacity, infrastructure, and guiding documents to begin the process of aligning investments with the Strategic Plan. The CoSTEM will also measure the degree of alignment between agency STEM education investments and the Strategic Plan in order to set a baseline for future comparison. In FY 2014, agencies will continue to align their programs with the Strategic Plan. Increases in alignment with the Strategic Plan along with other related outcomes will be measured using the NSTC Federal STEM Education Inventory process and other measurement tools and procedures that may be developed.

Draft Annual Implementation Milestones

	FY2012 Building Capacity	FY2013 Creating Benchmarks	FY2014 Measuring Impacts
Use Evidence-Based Approaches	1. Finalize the criteria for success 2. Fund syntheses of evidence-based STEM education practices, if resources are available 3. Create a central database for STEM education evidence-based practices and an updating process 4. Create a technical assistance network for agencies	1. Establish baseline alignment with criteria for success 2. Establish baseline alignment with evidence-based practices 3. Increase use of the technical assistance network	1. Increase alignment with criteria for success 2. Increase alignment with evidence-based practices 3. Increase use of the technical assistance network
Identify and Share Evidence-Based Approaches	1. Develop common evidence standards for program evaluation 2. Develop evaluation and research guidance 3. Create baseline alignment metrics 4. Design a strategy to disseminate evidence-based approaches	1. Establish baseline measure and annual goals for common evidence standards 2. Provide technical assistance to implement the evaluation and research guidance, if resources are available 3. Update central database with emerging evidence-based practices	1. Increase use of common evidence standards 2. Increase use of the evaluation and research guidance 3. Increase use of the technical assistance network 4. Update central database with emerging evidence-based practices 5. Assess implementation and impact of the dissemination strategy
Increase Efficiency and Coherence	1. Identify efficiency opportunities 2. Establish efficiency metrics 3. Develop a data collection strategy 4. Identify barriers to collaboration and strategies to overcome the barriers	1. Benchmark measures and annual goals for efficiency 2. Refine efficiency goals 3. Communicate successes and opportunities for improvement 4. Formalize agency partnerships	1. Increase efficiency and productivity 2. Refine efficiency and productivity goals 3. Communicate successes and opportunities for improvement
Identify and Focus on Priority Areas	1. Create roadmaps for each priority area 2. Initiate needs/knowledge assessment in each priority area 3. Inform the budget process 4. Review public input	1. Revise roadmaps 2. Create a multi-agency "network" of core programs 3. Update needs/knowledge assessment 4. Establish priority baseline and benchmark for progress on priority areas	1. Revise roadmaps 2. Expand multi-agency "network" 3. Establish roles for new investments included in the "network" 4. Track progress on priority roadmaps

National Science and Technology Council
Committee on STEM Education