STEM Education
Co-STEM 5-year Strategic Plan + Budget Reorganization

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Federal Budget for STEM Education

- Reorganization = $176m
- Total = $3.1B
Federal programs aren’t structured to meet the needs of those who deliver STEM education: teachers, school districts, states, and post-secondary institutions.

More than 226 programs spread over 13 federal agencies.

Without a unifying strategy, Federal agencies create small programs that often replicate similar functions, are not always targeted on greatest need, and are not showing measurable impacts.

Extreme fragmentation hinders effectiveness and targeting, and results in:

- Inability to set an overall strategy and focus resources on key drivers of change.
- Difficulty in identifying and scaling up validated approaches.
- No specific mechanism for identifying and focusing on the needs of students, schools, and higher education.
Why a new strategy is needed

- States and districts are unprepared to implement the Common Core math and New Generation Science standards.
- Math and science outcomes, in particular for underrepresented students, need to improve.
- STEM workforce needs are not being met.
- STEM efforts face extreme fragmentation that limits reform and improvements.
- Many STEM programs are untested or poorly targeted and aren’t connected to the needs of students and school or to national priorities.
- New initiatives have been sprinkled across programs and don’t reflect a cohesive national strategy.
- STEM investments have stagnated – there is little willingness to increase STEM investment in a significant way without using the current investments more effectively.
Co-STEM 5-year Strategic Plan

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Goals of the Co-STEM Plan

- Improve STEM instruction (P-12 teaching and learning)
- Increase and sustain youth and public engagement in STEM
- Enhance STEM experience of undergraduate students
- Better serve groups historically underrepresented in STEM
- Design graduate education for tomorrow’s STEM workforce
## Reorganization of Federal STEM education programs: new roles

The core goal of reorganization is to reach more students, more teachers, more effectively.

### Education

**K-12 instruction:** The Department of Education will support partnerships between school districts and universities, science agencies and their labs and bases, businesses and others to transform teaching and learning at the K-12 level. ED would help organize many of our Nation’s school districts into STEM Innovation Networks that can develop, share and replicate best practices for effective teaching and provide rich and up-to-date content knowledge.

### NSF

**Undergraduate education and fellowships:** The National Science Foundation will focus on improving undergraduate STEM instruction through evidence-based reforms. They will also create a more coherent system of graduate fellowships from a range of fragmented programs.

### Smithsonian

**Develop infrastructure to support STEM instruction and engagement:** The Smithsonian Institution will work with Federal agencies and other science partners to harness their unique expertise and resources to make relevant materials, online resources, and effective delivery mechanisms available to more students.

### Federal science mission agencies

**Identify content and federal assets that can be used in the classroom:** Federal science mission agencies will play an active role in developing and implementing these initiatives to ensure they align with agency and national goals. The Innovation Networks will create a streamlined path to the classroom so that the knowledge base of our science agencies will be accessible to more districts and teachers and have a greater impact on more students.
The Department will support partnerships between school districts and universities, science agencies, museums, businesses and community partners to transform teaching and learning at the P-12 level.

Design and launch **STEM Innovation Networks**

- Support consortia of school districts in partnership with IHEs, federal mission science agencies and their facilities, non-profits, museums, business partners, etc. to provide rich STEM learning and engagement experiences.
- Develop and use evidence-based practices, leverage STEM facilities and assets, establish data systems and quick turnaround feedback mechanisms to assess student learning, inform teaching, and link formal and informal learning.
- Connect school districts to regional “hubs” (such as local NASA, NOAA, USDA, or NIH facilities) and establish STEM platform schools that have a particularly strong STEM focus.

Develop a **Virtual Learning Network** as a dissemination and technical assistance strategy to promote and help implement evidence-based practices funded through research and innovation grants at ED, NSF and other federal agencies.

Launch a STEM **Master Teacher Corps** and implement strategies to achieve the “**100K in 10**” goal of preparing and recruiting 100,000 high-quality STEM teachers.
$150 million for competitive grants to STEM Innovation Networks. Grants would be awarded to consortia of districts, colleges and other regional partners to improve STEM education in their communities, such as by –

- Increasing student engagement in the STEM subjects, or
- Improving STEM teacher preparation and professional development

$35 million to pilot a STEM Master Teacher Corps

$80 million for competitive grants to recruit and train effective STEM teachers for high-need schools and further the President’s “100K in 10” goal

$30 million for a joint mathematics education grant with NSF to improve transitions from high school → college.

(in addition to the MSP program, renamed “Effective Teaching and Learning: STEM”)
National Science Foundation: Undergraduate education and fellowships

The National Science Foundation will focus on improving undergraduate STEM instruction through evidence-based reforms. They will also create a more coherent system of graduate fellowships from a range of fragmented programs.

Undergraduate STEM education:
- Evaluate strategies and build evidence for effective STEM instruction.
- Make undergraduate education more experiential and built on effective discipline-based practices.
- Develop effective strategies to ensure success for under-represented populations in STEM fields.

National Strategy for Graduate Fellowships:
- Redirect a portfolio of fellowship funds to NSF, but include mission agency input in the design and implementation of fellowship programs.
- Establish mechanism to ensure input from science mission agencies and appropriate distribution of fellows among STEM disciplines.
- Goals:
  - Clear link to national needs
  - Streamline application process and establish a more publicly accessible fellowship program
  - Design programs to collect data and support evaluation
Smithsonian Institution and Federal Agencies: Infrastructure for Instruction and Engagement

The Smithsonian Institution will work with Federal agencies and other science partners to harness their unique expertise and resources to make relevant materials, on-line resources, and effective delivery mechanisms available to more students.

Knowledge transfer infrastructure

- Establish the Smithsonian as a “one-stop-shop” conduit between mission agencies, non-profit partners, ED, and school districts. The Smithsonian would help identify and develop material that is ripe for integration into schools and informal education, facilitate partnership-building, and help develop curriculum, materials, and professional development.

- Mission agencies that do STEM research would create a single office or point of contact to work with the Smithsonian.

- ED’s STEM Innovation Networks (partnerships of school districts, IHE’s, and regional STEM assets including mission agencies) would link to the work of the Smithsonian and facilitate knowledge transfer to and from school districts.
Strategy for a Smooth Transition

ED, NSF, and the Smithsonian Institution are working with their counterparts to identify effective activities or products that could be incorporated into the new STEM strategy, create mechanisms for ongoing input, and address transition issues such as staffing and continuation awards:

- ED is working with agencies that serve P-12 functions to identify connections with their Innovation Networks proposal and dissemination strategy, identify and continue best practices, and use agency input to help develop program priorities.
- NSF is working with agencies with graduate fellowships to establish a mechanism to insure input and meet national and agency needs.
- The Smithsonian is working with all STEM agencies to identify existing high-quality products and on-line resources, identify best practices, and establish “knowledge transfer” systems.
- Science mission agencies are making recommendations on how to best utilize and engage with the new structure for their purposes, identifying continuation award issues, and developing staffing plans to facilitate knowledge transfer.

The Committee on Science, Technology, Engineering, and Math Education (CoSTEM) will play a key role developing transition plans and in managing, monitoring, and improving these strategies.
Examples of Coordination across the Administration: MSEIP 2013 Program Design

Minority Science and Engineering Improvement Program

- *Invitational Priority 2: Improve STEM Education in the First Two Years of College.*

- This invitational priority invites applications to eliminate systemic problems and impediments that result in high failure and dropout rates within the introductory years of science and engineering programs. We invite applications for projects that are designed to improve student success and retention in the first two years with actions, including, but not limited to, one or more of the following:

(see next slide)
(a) Providing greater exposure to science and engineering real-world problems in the first two years through actions such as the appropriate sequencing of courses.
(b) Introducing recent innovations and discoveries in the first two years to make science and engineering education relevant. The students should experience real developments such as those led by nanotechnology, cell biology, and ICT (Information and Communication Technologies).
(c) Widespread integration of research courses into the introductory STEM curricula. Expand the use of scientific research and engineering design courses in the first two years.
(d) Increasing opportunities for student research and design in faculty research laboratories.
(e) Developing new curricula that integrate scientific theory with real-world applications in scientific problem-solving and engineering design, in the context of global environmental, energy, and economic problems.
(f) Adopting pedagogy for integrative teaching.
(g) Establishing programs to train faculty in evidence-based teaching practices, and catalyzing widespread adoption of empirically validated teaching practices.
(h) Seeking institutional and accreditation support for changes in curricular, pedagogical, and graduation requirements that are necessary to improve the first two years of STEM coursework.
APPENDIX

The Importance of STEM Education
The importance of STEM education: student progress, but not proficiency

**Indicators of student knowledge and skills in math and science**

- Despite small but significant gains over the years, NAEP mathematics and science assessment results show that overall, large majorities of 4th, 8th, and 12th graders did not demonstrate proficiency in the knowledge and skills taught at their grade level.

- While a majority of ninth graders reached proficiency in low-level algebra skills, few mastered higher level skills.

- On the 2011 NAEP science assessment, the average eighth-grade science score increased from 2009 to 2011. The percentages of students performing at or above the Basic and Proficient levels were higher, but there was no significant change in the percentage of students at the Advanced level from 2009 to 2011.

- Only 16% of American high school seniors are proficient in math and interested in a STEM career.
The importance of STEM education: international comparisons

International comparisons

- Students from the United States were outperformed by 17 of 33 other countries belonging to the OECD on the 2009 PISA mathematics assessment, which measures the mathematics literacy of 15-year-olds.

- America’s 15-year-old students also were outperformed by those of 12 of 33 other OECD countries on the 2009 PISA science assessment.

- On the 2011 TIMMS Science Assessment, twelve educational systems – including several states – had higher percentages of 8th-graders reaching Advanced than the U.S. national average.
The importance of STEM education: jobs

STEM and jobs:

- America is not producing enough students with STEM skills to meet demand, both in traditional STEM jobs and in other sectors that require similar skills.
- STEM occupations are projected to grow much faster than others, with 2.6 million STEM job openings projected by 2018, with about 80% of these in computer-related jobs and engineering.

*STEM is defined here to include non-medical occupations.

The importance of STEM education: equity

STEM jobs and equity:

- Only 12% of STEM jobs are held by Hispanics or Blacks, despite representing 24% of workforce. Though they constitute nearly 50% of the workforce, women hold less than 25% of all STEM jobs.

- Although pay gaps exist among demographic groups in STEM, they are smaller than in other occupations.
  The wage premium for having a STEM job is 22% for Whites, 36% for Hispanics, 39% for Blacks, and 33% for women.