

13. STEM Education

First published as a blog post on March 17, 2017

CAP Goal Statement: *Improve science, technology, engineering, and mathematics (STEM) education by implementing The Federal STEM Education 5-Year Strategic Plan announced in May 2013, and specifically seek to:*

- *improve STEM instruction;*
 - *increase and sustain youth and public engagement in STEM;*
 - *enhance STEM experience of undergraduate students;*
 - *better serve groups historically under-represented in STEM fields;*
 - *design graduate education for tomorrow's STEM workforce;*
 - *build new models for leveraging assets and expertise; and*
 - *build and use evidence-based approaches.*
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President Trump signed a bipartisan bill in his first weeks in office to promote mentoring programs to encourage girls and women to enter the aerospace field. These programs are part of a broader ecosystem of existing federal programs to bolster careers in science, technology, engineering and math (STEM).

The [new legislation](#) adds to a loosely organized network of continuing federal efforts to boost Americans' engagement in STEM education. In fact, President George W. Bush placed a governmentwide emphasis on STEM education in his State of the Union address in 2006 as a part of his [national competitiveness agenda](#).

Background: STEM career fields in the U.S. jobs market have tripled in recent years and the White House Office of Science and Technology (OSTP) projected in 2013 that the demand for these skills will outstrip the supply by at least one million jobs if STEM education trends do not change.

A [2010 law](#) required OSTP to develop a plan to better coordinate the federal government's STEM education investments. In May 2013, it released the first-ever governmentwide [5-year STEM education strategic plan](#). The plan highlights five investment areas, such as improving STEM instruction by preparing 100,000 highly-qualified STEM teachers in grades K-12. Another targets the closing of the one-million-person skills gap by increasing the number of STEM-educated college graduates.

A Network of STEM Education Programs. The federal government has encouraged STEM education since the 1950s, in part as a reaction to the Russian's launch of Sputnik to the surprise of Americans. Out of self-interest, many science-based agencies such as the Department of Energy have created programs to serve as pipelines of technical talent needed to meet their missions. Other agencies, such as NASA, have sponsored STEM programs to infuse science skills into the broader economy. In fact, there is even an [advocacy group](#) promoting STEM education!

These programs evolved largely independent of each other. But in the mid-2000s, the Office of Management and Budget (OMB) and the Government Accountability Office (GAO) stood

back and took a more strategic view, voicing concern over the effectiveness of the investments in myriad federal programs; these concerns contributed to the requirement for a plan in the 2010 law.

In 2013, GAO [inventoried existing programs and found](#): “In fiscal year 2010, 13 federal agencies invested over \$3 billion in 209 programs designed to increase knowledge of science, technology, engineering and mathematics (STEM) fields and attainment of STEM degrees. The number of programs within agencies ranged from 3 to 46, with the Department of Health and Human Services, Department of Energy and the National Science Foundation administering more than half of the 209 programs. Almost one third of all programs had obligations of \$1 million or less, while some had obligations of over \$100 million.... Eighty-three percent of the programs GAO identified overlapped to some degree with at least one other program in that they offered similar services to similar target groups in similar STEM fields to achieve similar objectives.”

That same year, the newly-released 5-year STEM plan was a first step in rationalizing the many programs and the creation of a more formal coordination network among them.

The STEM Education CAP Goal. The 2014 [STEM Education Cross-Agency Priority \(CAP\) Goal](#) is one of 15 such goals created by OMB in response to [a separate 2010 law](#) requiring the establishment of such goals. This CAP Goal outlines a multi-prong strategy with sub-goals to implement key elements in the [STEM Education 5-Year Strategic Plan](#). The eight sub-goals include initiatives to improve STEM instruction; increase and sustain youth and public engagement in STEM and build and use evidence-based approaches. Milestones and metrics were developed to assess the progress of each strategy.

Governance Structure. Leaders from OSTP and the National Science Foundation were designated as the co-leads for the STEM Education CAP Goal. In developing a broader governance structure, the co-leads leveraged an existing OSTP advisory group, the Subcommittee on Federal Coordination in STEM Education (FC-STEM), whose membership is drawn from the 14 federal agencies involved in STEM education programs.

To manage across the breadth of this CAP Goal, FC-STEM established seven interagency working groups, responsible for implementing the eight sub-goals. These working groups provide quarterly progress reports to FC-STEM, which compiles them into the quarterly progress reports required by law. According to an interagency staff that coordinates the efforts of the working groups, the designation of these efforts as a CAP Goal has led to greater coordination of funding and helps ensure there are not gaps in, or duplication of, programs to targeted groups.

For example, the interagency working group on Undergraduate STEM Education identified the high failure rate in introductory math for undergraduates as a barrier to students completing a STEM-related degree. In response, they’ve developed a focus on improving high school math instruction and measuring improvements through national testing scores. The ultimate key indicator will be the number of STEM bachelor’s degrees earned annually. While there are historical measures for this indicator, the data lag does not allow an assessment of progress since 2013.

The subcommittee, the interagency working groups and the interagency coordinating staff all predated the 2010 law, the 5-year plan and the CAP Goal. However, they were seen as policy discussion forums, without an emphasis on implementation. The CAP Goal designation in 2014 created a new mechanism for coordination, implementation and reporting progress that helped agencies “get credit” for diffuse activities occurring across myriad STEM education pro-

grams in multiple agencies. The CAP Goal framework of high-level quarterly progress meetings gave the community more visible and encouraged a greater degree of voluntary coordination. In the eyes of some observers, the CAP Goal serves as a catalyst for a shift from information sharing to joint action to meet common objectives, such as increase the number of STEM graduates.

Progress to Date. In comparison to many of the other CAP Goals, the STEM Education CAP Goal was initially seen as one of the least mature in terms of a pre-existing network of participants focused on cross-agency implementation of initiatives. However, [when GAO examined](#) its progress in 2016, it was positive about how this network evolved in a relatively short period of time.

For example, GAO said that the STEM Education CAP Goal leader from OSTP: "found contributing agencies to be more receptive to directives and efforts for implementing the CAP goal because they come jointly from the National Science Foundation (NSF) and are not solely based on OSTP's policy perspective. They also told us that NSF's leadership of CAP goal activities and its ability to secure agency buy-in, among other things, makes it an effective CAP goal leader."

But GAO also noted that the STEM CAP Goal coordinating staff "did not identify a target—expressing both magnitude and direction—for 12 of its 15 performance measures. The most recent data available for these measures is from 2013, prior to the start of the current CAP goal period."

Nevertheless, one of the more concrete cross-agency successes was the creation of a [one-stop portal](#) that the Department of Energy hosts on its [science.gov](#) "gateway to U.S. federal science" website. This portal inventories opportunities for federally-funded undergraduate and graduate STEM education programs. The STEM Education CAP Goal team helped enable the cross-agency coordination needed to make this initiative go "live."

Examples of Results. OSTP in late 2016 catalogued numerous examples of different STEM initiatives underway, for example:

- **TechHire.** In 2015, the White House launched an initiative to expand local tech sectors by building tech talent pipelines across the country, supported by grants from the Labor Department and other agencies. A year later, more than 1,000 employers in 70 communities across the country were working with new training programs, such as coding boot camps, that resulted in "thousands of new hires."
- **Computer Science for All.** An early 2016 White House initiative launched "a nationwide effort to give every student the opportunity to learn computer science." The effort, co-sponsored by the National Science Foundation (NSF) and the Corporation for National and Community Service, engaged selected states, school districts and non-profit organizations in providing computer science learning experiences. Grants were also provided to ensure availability of the tools needed, such as high-speed broadband, tech infrastructure and Wi-Fi.
- **Teaching Computer Science.** NSF announced in late 2016 that it will invest \$20 million in the coming year to "help K-12 teachers expand opportunities for teaching computer science and computational thinking for students across the United States." This funding is part of a five-year initiative to develop support materials for teachers.

Next Steps. This initiative has created enough momentum among its network of partners that existing STEM Education programs are carrying forward, pending designation of new leaders.