SOUTHEAST COMPREHENSIVE CENTER
Briefing Paper

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Engaging Diverse Learners Through the Provision of STEM Education Opportunities

Summary

Due to state and federal education priorities, funding requirements, and other factors, a number of states are exploring ways to improve access to STEM education opportunities for diverse learners and others.

Key Points

Findings from the literature suggest that decision makers should consider

- Increasing children's early exposure to math and science learning opportunities (in and out of school), which may help to attract more individuals to STEM careers
- Modifying teacher preparation programs to provide deep content knowledge and requisite pedagogical skills to help increase the number of high quality teachers in math and science
- Utilizing professional learning communities to enhance teacher instructional practice and improve student learning achievement in math and science
- Employing strategies to increase exposure and access to STEM education opportunities for groups that are underrepresented in STEM fields and careers

Introduction

Science, technology, engineering, and mathematics (STEM) are viewed as fundamental elements in the preparation of our next generation. This is evidenced by President Obama's goal of "moving our nation from the middle to the top of the pack in math and science education" and his focus on (a) hiring additional STEM teachers; (b) enhancing STEM literacy so students can think critically in key subjects; (c) improving the quality of instruction to help U.S. students perform competitively with those in other nations; and (d) expanding STEM education and career opportunities for women, minorities, and other underrepresented groups (The White House, 2010).

To begin laying this foundation for students as they compete in the 21st century economy, educators and decision makers must continue to increase their understanding of various STEM education opportunities. They must also realize the need to establish support systems for diverse learners as they relate to STEM education, while at the same time recognize the economic impact of not moving in this direction. However, before this journey can begin, a deeper understanding of STEM and a workable definition must be established. The components of STEM are discussed below following descriptions of the procedure by which resources were selected for this paper and the limitations of this paper.

Procedure

To identify literature for studies and other resources on STEM education, staff at the Southeast Comprehensive Center (SECC) conducted searches of EBSCO's Academic Search Elite database, the Education Resources Information Center (ERIC), and several online search engines (i.e., Bing, Google, Google Scholar, and Yahoo). They used combinations of terms that included science, technology, engineering, mathematics, effective STEM initiatives, innovative STEM programs, STEM education, STEM education and diverse learners, STEM and minority populations, STEM opportunities for underserved populations, STEM and gender, and STEM and student achievement. The literature searches focused on research completed within the last 10 years.

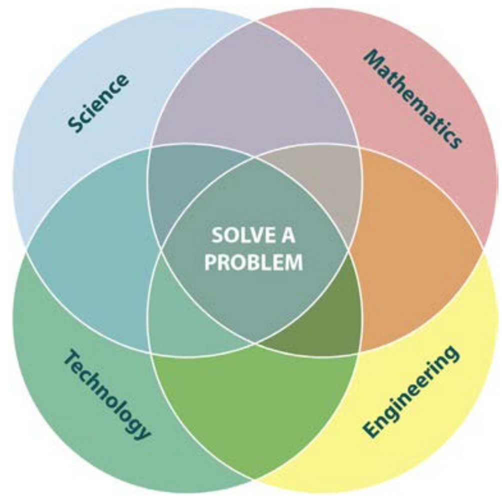
In addition to the literature searches, SECC staff contacted the states served by SEDL's Southeast and Texas Comprehensive Centers—Alabama, Georgia, Louisiana, Mississippi, South Carolina, and Texas—to obtain information on their STEM programs and initiatives. Refer to the State Highlights section of this paper for information that was obtained on state-specific STEM education efforts.

Limitations

It is important to note that a limited number of the resources summarized in this report were from peer-reviewed journals. Since the information on this topic was provided to illustrate strategies and approaches for increasing access to STEM education for diverse students, empirical support regarding the efficacy of any specific strategies or programs was included if it was available.

SECC staff provided the above limitations to assist clients and other stakeholders in making informed decisions with respect to the information presented. SECC does not endorse any strategies or programs featured in this paper.

What is STEM?



The term STEM was coined at the National Science Foundation (NSF) as a way to encompass a new "meta-discipline" that combined science, technology, engineering, and mathematics subject areas. This new discipline was meant to transform traditional classrooms from teacher-centered instruction into inquiry-based, problem solving, discovery zones where children engage with content to find solutions to problems (Fioriello, 2010). It is a way of looking at and solving a problem in a holistic way, seeing how the components of STEM interact with each other. Put simply, it is the intersection of science, technology, engineering, and mathematics. It is problem based. It is student-centered. It is the applied convergence of these disciplines used to solve a problem.

As competition in the global marketplace grows for a highly skilled, highly educated workforce that has the ability to work independently and creatively, the STEM approach seeks to meet the challenge. By giving students the opportunity to solve real-world problems in context, students grasp a deeper understanding of the content and how to apply their knowledge in a meaningful way.

In addition to viewing STEM as a meta-discipline, several key factors are important in this discussion—early exposure of children to STEM education; strategies for engaging populations that are underrepresented in STEM fields; specialized training, preparation, and support for teachers of STEM subjects; STEM afterschool and summer opportunities for students; the economic impact of STEM in the U.S.; and recommendations for improving STEM education.

Early Exposure to STEM Education

A key theme running through much of the recent science education literature has been the increasing reluctance of young people in many parts of the world to participate in STEM education (Boe et al., 2011). Several recommendations have been presented on how to best attract students into this widely growing field through various STEM education opportunities. Research suggests the need to expose children to appropriate STEM opportunities early in their education (Bagiati et al., 2010; Boe et al., 2011).

Early exposure to STEM supports children's overall academic growth, develops early critical thinking and reasoning skills, and enhances later interest in STEM study and careers (National Research Council, 2011). More than three-quarters (77%) of female and underrepresented minority chemists and chemical engineers polled say significant numbers of women and underrepresented minorities are missing from the U.S. STEM workforce today because they were not identified, encouraged, or nurtured to pursue STEM studies early on (Bayer, 2010). To help address this issue, the Sesame Street television show has focused season 42 on STEM education—encouraging children to think about science, technology, engineering, and math. Despite this recent initiative, efforts to increase children's awareness of STEM have been limited.

Purdue University conducted a study involving the review of Internet open resources containing engineering educational material intended for young children in preschool through grade 3 as part of the landscape of such resources available for use with prekindergarten through grade 12 (Bagiati et al., 2010). In their review of over 600 online documents, the researchers found that fewer than 4% of the resources had been developed specifically for PK–3 students. They also found that to introduce engineering in the early years one must recognize the need to ensure teacher understanding of the subject content and to prepare teachers to incorporate it into their practice. There are several obstacles to accomplishing these goals. First, some elementary teachers face constraints in teaching STEM that include insufficient content knowledge, lack of confidence, lack of materials and facilities, and lack of support from their schools (President's Council of Advisors on Science and Technology [PCAST], 2011). Second, most elementary teachers are generalists and are not trained specifically in STEM fields; hence, the subjects can be a source of anxiety and lead to avoidance of approaching the topics. The U.S. must address these issues if it hopes to engage students at a young age in STEM education, especially since the literature indicates that a crucial part of fostering this engagement is teacher preparation and training in STEM.

Teacher Preparation, Training, and Support

The most important factor in ensuring excellence is great STEM teachers with both deep content knowledge in STEM subjects and mastery of the pedagogical skills required to teach these subjects well (PCAST, 2011). Seventy-five percent of chemists surveyed said a lack of high quality science and math classes in lower-income school districts is the top reason why minorities and women are underrepresented in STEM fields (Bayer, 2010). Also, minority students are less likely to have highly qualified math and science teachers. In 2004, the National Science Foundation (2011) found that only 39% of African American and 42% of Hispanic fifth-graders were taught math by a teacher with a master's or advanced degree in the subject. That compares to more than half for Caucasian students. Eighth-grade students from low-income families were less likely to have science teachers with regular or advanced teacher certificates, a degree in science, and more than 3 years of experience in teaching science (NSF, 2011).

Teacher preparation programs must also be considered in developing a new generation of STEM educators. To aid teachers as they meet the challenge of teaching in the field of STEM, the U.S. must begin to rework its teacher preparation programs and how they address professional development.

The research suggests STEM teacher preparation programs need to provide the following:

1. More math or reading courses required for entry or exit into a student's chosen content area;
2. A required capstone project (for example a portfolio of work done in classrooms with students or a research paper);
3. Careful oversight of student-teaching experiences;
4. A focus on providing candidates with practical coursework to learn specific practices;
5. More opportunities for candidates to learn about local district curriculums; and
6. Focused student-teaching experiences that address the congruence between the context of student teaching in terms of grade level and subject area and later teaching assignments.

(Wilson, 2011)

Another support option to enhance teacher preparation is the utilization of professional learning communities (PLCs). STEM teaching is more effective and student achievement increases when teachers join forces to develop strong PLCs in their schools (Fulton & Britton, 2011). This finding is supported by a 2-year NSF funded study, *STEM Teachers in Professional Learning Communities: A Knowledge Synthesis*, conducted by the National Commission on Teaching and America's Future and WestEd, based on an analysis of nearly 200 STEM education research articles and reports.

Findings from the NSF knowledge synthesis on STEM teaching in PLCs are summarized below.

STEM PLCs had the following effects on teacher knowledge, beliefs/attitudes, and focus:

- Engaged teachers in discussion about content knowledge or knowledge about how to teach it (pedagogical content knowledge) and/or enhanced their understanding of content knowledge and pedagogical strategies;
- Advanced teachers' preparedness to teach content or attitudes toward teaching methods; and
- Increased teacher focus on students' mathematics or science thinking.

STEM PLCs had the following effects on teacher instructional practice:

- Teaching practices became more "reform oriented";
- Teachers' attention to students' reasoning and understanding increased; and
- Teachers engaged students in more diverse modes of problem solving.

STEM PLCs had the following effects on students' science and math achievement:

- Math PLCs led to enhanced student learning or achievement in math; however, there were no studies examining student outcomes in science.

- The expert panel reported increased science and math achievement outcomes for students based on unpublished results from PLCs that the panel had led or independently examined.

Universal support for PLCs exists across STEM education professional organizations. Forty organizations in STEM education, professional development, or education policy had position statements and/or policy recommendations for PLCs that were universally positive (Fulton & Britton, 2011). Online tools are increasingly being used to support STEM PLCs; however, research is limited but promising on how these tools are extending the reach and resources of these learning communities. Finally, all professional development for STEM educators does not have to take place in a formal setting. Though rarely acknowledged at policy levels, there is a vastly growing network of other education outlets for educator training: museums, zoos, aquariums, nature centers, national parks, and increasingly the Internet, podcasts, and other social networking media (Dierking, 2010). If taken advantage of, all these resources would strengthen teachers' STEM capacity and the programs that they are creating.

STEM Afterschool and Summer Opportunities

To help prepare youth for careers in STEM fields, decision makers and educators are encouraged to consider STEM learning opportunities beyond the school day. Afterschool programs are currently serving more than 1.3 million middle school students, with many programs providing engaging STEM content (Afterschool Alliance, 2010). The literature indicates that students can benefit greatly from experiences held after school and during the summer.

The Afterschool Alliance (2011) found in a recent evaluation report of STEM programs across the U.S. that attending high quality STEM afterschool programs for middle school youth yields STEM-specific benefits that can be organized under three broad categories (a) improved attitudes toward STEM fields and careers, (b) increased STEM knowledge and skills, and (c) higher likelihood of graduating and pursuing a STEM career.

Below is a list of these three types of outcomes, followed by specific findings that were common across a number of the evaluations:

1. Improved attitudes toward STEM fields and careers
   a) Increased enrollment and interest in STEM-related courses in school
   b) Continued participation in STEM programs
   c) Increased self-confidence in tackling science classes and projects
   d) Shift in attitude about careers in STEM

2. Increased STEM knowledge and skills
   a) Increased test scores as compared to nonparticipants
   b) Gains in knowledge about STEM careers
   c) Gains in computer and technology skills
   d) Increased general knowledge of science
   e) Gains in 21st century skills, including communication, teamwork, and analytical thinking

3. Higher likelihood of graduation and pursuing a STEM career
   a) High rate of high school graduation among participants
   b) Pursuit of college and intention of majoring in STEM fields

(Afterschool Alliance, 2011)

If America is to succeed in an innovation-powered global economy, boosting math and science skills will be critical (Atkinson, Hugo, & Lundgren, 2007). In *Rising Above the Gathering Storm*, the U.S. system of public education was charged with laying the foundation for developing a workforce that is literate in mathematics and science. STEM opportunities for all students become a powerful requirement as a component of this charge. Nevertheless, all populations are not equally supported when it comes to STEM education. Racial/ethnic groups, women, and persons with disabilities are underrepresented in STEM fields, not by choice, but sometimes due to a lack of appropriate supports.

Diverse Learners and STEM

Women, persons with disabilities, and three racial/ethnic groups—African Americans, Hispanics, and Native Americans—are considered underrepresented in science and engineering because they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do in the American population (U.S. Commission on Civil

Rights, 2010). Addressing this underrepresentation in STEM fields has been an initiative of the U.S. Congress for the past 30 years, but the challenge still remains unresolved. Diverse learners are capable of becoming talented professionals in STEM, but they need opportunities to develop (Roberts, 2010). Alvarez, Edwards, and Harris (2010) suggest exploring programs that allow underrepresented students to overcome issues linked to educational underachievement, including socioeconomic status, cultural trends, and lack of awareness of STEM opportunities and career fields.

One of the first barriers that should be addressed is access. Diverse learners initially need to have exposure to various STEM opportunities. For example, the Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics (AccessSTEM) (http://www.washington.edu/doit/Stem/) serves to increase the number of people with disabilities in STEM careers by encouraging students with disabilities to pursue STEM fields and then supporting those who show an interest and aptitude in STEM. The National Girls Collaborative Project (http://www.ngcproject.org) is working to bring together organizations that are committed to informing and encouraging girls to pursue careers in STEM.

Another barrier to participation in STEM education opportunities is a lack of connection with diverse learners. In a recent study, 12 recommendations (http://www.eric.ed.gov/PDFS/EJ930655.pdf) were made to strengthen math and science programs for diverse learners (Kaser, 2010). Two of the recommendations focused on hiring leadership and staff members that have an understanding of the various cultures and backgrounds of the students that they are serving. Many of the opportunities needed for diverse learners to become successful in the area of STEM require connections through their cultural beliefs and practices. STEM experiences need to relate to the actual lives of the students, their ages, and their interests. In addition to connecting to students' culture, diverse learners are also in need of high quality curriculums, classroom practices that foster equity, and connections to real-world experiences (Kaser, 2010; PCAST, 2011). These robust STEM learning opportunities are only possible when all stakeholders become involved in the improvement of STEM education for all. With continued support and encouragement, diverse learners will break the access barrier to STEM opportunities.

Over the past 10 years, there has been an upsurge in the number of STEM focus schools and programs. While STEM schools historically have tended to target the top math and science students in a state or district, the new wave appears to have a broader reach, with many of the schools aimed especially at serving groups underrepresented in the STEM fields, such as African Americans, Hispanics, women, and students from low-income environments (Education Week, 2011). In addition, STEM Out-of-School-Time (OST) programs demonstrate a number of positive outcomes for girls (and in some instances, boys) related to academic achievement and school functioning, youth development, and workforce development (Chun & Harris, 2011). The next section highlights additional strategies for girls that may help to increase their interest and engagement in STEM education and careers.

STEM Strategies for Girls

Several strategies from evaluations of STEM programs emerged as particularly successful for STEM programming for girls:

- Establish measurable goals specific to the STEM objectives. It is important to articulate goals that are clear, achievable, aligned with STEM programming, and have specific progress indicators. In particular, program goals should: (a) translate into measurable objectives related to STEM; (b) use outcome-based guidelines to obtain baseline data in order to establish targets; and (c) be tied to a long-term evaluation plan.
- Appoint a leader to oversee STEM programming. Having someone to champion STEM education from within the program can be a major determining factor in whether it is valued or neglected, especially when programs include a variety of non-STEM components.
- Customize STEM experiences for a specific demographic of the target population. OST programs may be better able to engage girls when they try to relate STEM activities to the girls' lives in terms of their age, interest in particular STEM subjects, preferred mode of learning (e.g., discussion or hands-on learning), and ability level. Tailoring this experience can be especially helpful in engaging girls who otherwise might not be inclined to engage with STEM subject matter.
- Build personal connections with girls to help sustain their engagement. Once girls join a STEM OST program, the goal then becomes to maintain their interest over time, which can be facilitated through staff's efforts to build strong relationships with the girls.
- Make STEM activities accessible to all, to prevent against a self-selecting process. OST programs should have an inclusive approach to ensure that girls feel welcomed and comfortable with the materials. Both boys and girls may see STEM activities as overly technical and intimidating, but girls often do not receive the same encouragement that boys do to get involved (or may need some extra encouragement). As part of this inclusive approach, programs can increase outreach efforts through such means as partnering with schools to disseminate information and gauge interest from schoolwide populations instead of just self-referred youth.

(Chun & Harris, 2011)

In addition to the issues and challenges related to STEM education discussed above, the economic impact of STEM is gaining increasing attention as the U.S. strives to remain competitive in a global marketplace.

Economic Impact of STEM

> "A number of economic analyses suggest that if the United States is to maintain its historic preeminence in the fields of science, technology, engineering, and mathematics (STEM)—and gain the social, economic, and national security benefits that come with such preeminence—then it must produce approximately 1 million more STEM professionals over the next decade than are projected to graduate at current rates. To meet this goal, the United States will need to increase the number of students who receive undergraduate STEM degrees by about 34% annually over current rates."
>
> (President's Council of Advisors on Science and Technology, February 7, 2012, p. 1)

In understanding how the production of STEM educated-students affects the American economy, it is important to consider the needs of current and future employers. Too often, the complaint from industry is that traditional students arrive at the workplace lacking the ability to apply knowledge in a real-world environment. As the world becomes more science and technology driven, the only way for the U.S. to compete is to rise to the challenge. The literature suggests that science and technology jobs will feed the nation's economy, and those jobs can only be filled by people who have a strong foundation in math and science. While STEM fields are not for all, those with the talent and inclination must be given the environment in which to thrive (Atkinson, 2010).

Currently, STEM workers in the U.S. consist of about 70% Non-Hispanic Caucasians, which is in line with their share in the overall workforce (Beede & Khan, 2011). This statistic more importantly points to the disparity in STEM education opportunities. The author finds that regardless of race or ethnicity, higher education graduation rates correlate with increased presence in the STEM fields.

As the data illustrates in Figure 1. Projected Demand for STEM Jobs for SECC and TXCC States by 2018, the number of STEM jobs is expected to increase in the states served by the Southeast and Texas Comprehensive Centers. From 2008 to 2018, this increase will range from 8% (in Louisiana) to 22% (in Texas), with a strong majority of STEM jobs requiring postgraduate education and training (Georgetown University Center on Education and the Workforce, n.d.a–f).

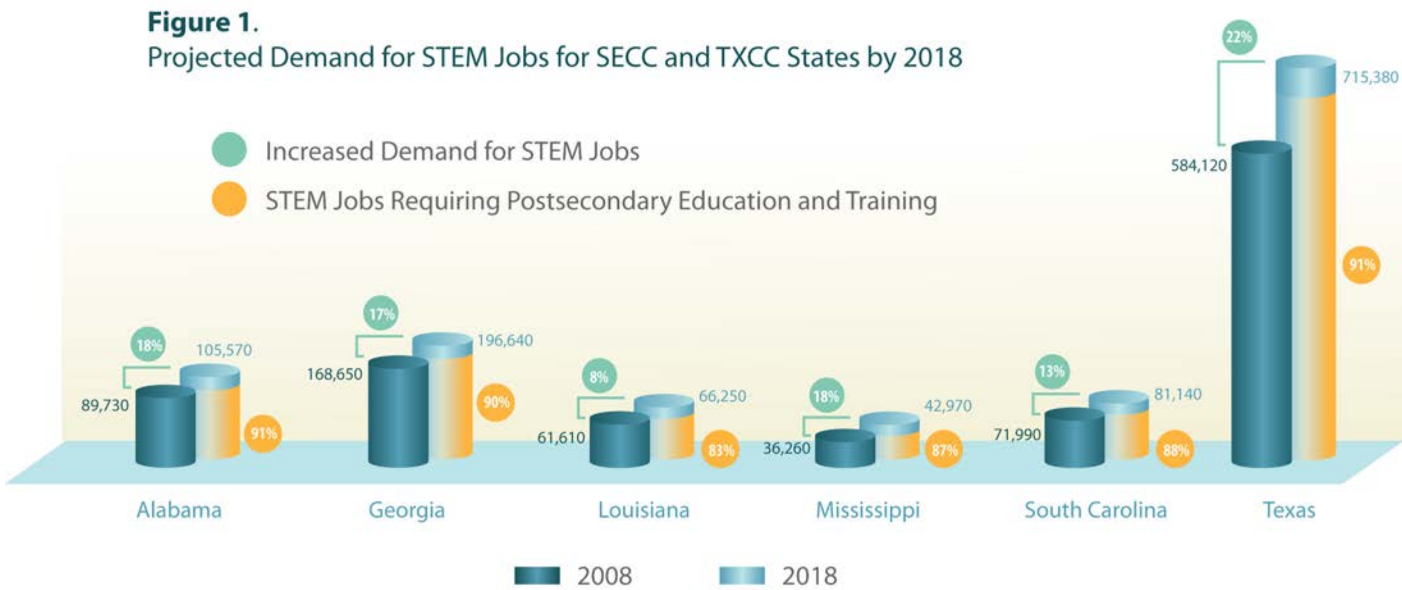


Figure 1.
Projected Demand for STEM Jobs for SECC and TXCC States by 2018

Source: STEM State-Level Analysis, State Pages. (n.d.a–f). Georgetown University Center on Education and the Workforce.

In addition to increases in the number of STEM jobs that will be needed nationwide in coming years, Carnevale, Smith, and Melton (2011, p. 24) indicate that the top three industries for jobs in 2018 will be professional and business services (37%), manufacturing (19%), and government and public education services (13%). It is apparent from the foregoing discussion that the need for increasing the number of individuals in STEM fields and careers is crucial to a thriving U.S. economy.

Despite multiple challenges associated with improving access to and participation in STEM education opportunities, the literature suggests that there are a number of things that can be done to help the U.S. achieve these goals.

Recommendations For Improving STEM Education

According to the National Research Council (2011), policymakers and education leaders at all levels can take the following actions to bring STEM K–12 education closer to fulfilling the goals that the country expects:

- Policymakers at the national, state, and local levels should elevate science to the same level of importance as reading and mathematics.
- Districts should devote adequate instructional time and resources to science in grades K–5.
- Districts should ensure that their STEM curricula are focused on the most important topics in each discipline, are rigorous, and are articulated as a sequence of topics and performances.
- Districts need to enhance the capacity of K–12 teachers to teach STEM. National and state policymakers should invest in a coherent, focused, and sustained set of supports for STEM teachers to help them teach in effective ways.
- Districts should provide instructional leaders with professional development that helps them to create the school conditions that appear to support student achievement (e.g., professional learning communities, Response to Intervention, extended learning opportunities, differentiation, etc.).
- States and national organizations should develop effective systems of assessment that are aligned with the next generation of science standards and that emphasize science practices.
- Federal agencies should support research that disentangles the effects of school practice from student selection, recognizes the importance of contextual variables, and allows for longitudinal assessments of student outcomes.

Conclusion

STEM is a meta-discipline—a convergence of science, technology, engineering, and math—that offers a student-centered, inquiry-based method of addressing and solving problems. A curriculum that is dedicated to a STEM approach can provide many opportunities for students. It can deepen the understanding of concepts by presenting them in a real-world context. It can engage a student who is good with hands-on tasks, but struggles with math. It can bring the excitement of science, engineering, and technology to the math whiz, while connecting students from around the globe. Most importantly, it can provide an avenue to higher education and ultimately to the jobs needed to shape the future of this country and fuel its economy.

States across the nation are taking steps to meet the challenges associated with improving STEM education. A few in the regions served by SEDL are establishing STEM academies, labs, and centers; offering STEM pre-service teacher preparation programs; providing professional learning opportunities for teachers; and offering courses and programs in aerospace, rocketry, and robotics. Details on these and other initiatives in the states of Georgia, South Carolina, and Texas are provided in the State Highlights section of this paper.

Resources

Note. Open hyperlinks using Adobe Reader. If a hyperlink does not open after it is clicked, copy and paste the entire hyperlink into the Internet browser window to access the resource.

AccessSTEM: The Alliance for Students with Disabilities in Science, Technology, Engineering, and Mathematics

http://www.washington.edu/doit/Stem/index.html

Funded by the National Science Foundation, the University of Washington's AccessSTEM Knowledge Base helps K–12 teachers, postsecondary educators, and employers make classroom and employment opportunities in STEM accessible to individuals with disabilities.

K–12 Resources for Science, Technology, Engineering, and Mathematics Education

http://www.nsfresources.org/home.cfm

Resources and findings generated through educational research and development projects funded in part by NSF can help inform states and school systems that are developing strategies for improving K–12 STEM education.

PBS Teachers STEM Education Resource Center

http://www.pbs.org/teachers/stem/

PBS offers visitors to this site the opportunity to explore new ideas and new worlds related to STEM learning through television and online content.

Siemens STEM Academy

http://www.siemensstemacademy.com/

The Siemens Foundation, in partnership with Discovery Education, produced a national STEM education program for teachers. Designed to support educators in increasing student achievement, the National Teacher Academy is an online shared repository of STEM best teaching practices, which brings together science educators from around the country and provides an ongoing webinar series featuring leading scientists and experts in their field.

STEM Education Coalition

http://www.stemedcoalition.org/

The STEM Education Coalition works to support STEM programs for teachers and students at the U.S. Department of Education, the National Science Foundation, and other agencies that offer STEM related programs.

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State Highlights

Below are summaries of STEM education initiatives for the states of Georgia, South Carolina, and Texas as well as contact information for individuals in the state departments of education that may provide additional information.

Georgia

Juan-Carlos Aguilar, program manager, science, Georgia Department of Education, provided the information below. He may be reached at jaguilar@doe.k12.ga.us or 404- 657-9072.

Georgia K–12 STEM Initiatives

STEM Vision

The Georgia Department of Education (GaDOE) is dedicated to preparing students for 21st century workplace careers by providing high quality educational opportunities in STEM fields. STEM represents the fields of science, technology, engineering, and mathematics. STEM education encourages a curriculum that is driven by problem solving, discovery, exploratory learning, and student-centered development of ideas and solutions.

STEM Initiative Goals

Empower students to become innovators and technologically proficient problem solvers:

- Ensure that all students have access to the appropriate technology conducive to enhancing their learning experiences both in and outside the traditional classroom
- Increase student 21st century skills and technological literacy by providing students with opportunities to use the technical tools of the STEM industry
- Guide community understanding of the importance of STEM education and build capacity to sustain a viable STEM educational program to prepare students for work and life in the 21st century
- Increase Georgia's capacity to provide high quality K–12 STEM professional learning opportunities
- Nurture partnerships that allow schools and the business sector to join efforts to improve students' STEM career opportunities
- Increase the number of students pursuing careers in STEM-related fields and/or postsecondary STEM related education and training

STEM Projects

Georgia STEM Institute

The GaDOE hosted the first Georgia STEM Institute on July 6–15, 2011. The purpose of the institute was to have teachers use the institute's experiences to develop classroom instruction that integrates core content knowledge and CTAE applications.

- Participating schools sent teams of CTAE and core content teachers to Atlanta for a 10-day immersion experience in STEM.
- Teachers attending the institute interacted with members of different STEM industries and visited STEM sites.

Georgia Alliance of STEM Teachers

The GaDOE has formed the Georgia Alliance of STEM Teachers. Teachers that join this group receive direct information about STEM projects in Georgia and share some of their own projects with other teachers via listservs, webinar sessions, Skype videoconferences, school visits, Twitter, e-mail, etc. Participants in this group share

- a desire to incorporate STEM initiatives into the classroom;
- experiences with project-based learning and STEM programs;
- interest in learning and trying STEM experiences with students; and
- a desire to fully implement STEM initiatives by establishing collaborations with and/or mentoring other teachers.

Georgia STEM Festivals

The Georgia STEM Festivals are hosted by high schools across the state. The festivals propose to foster public understanding of STEM and the relevance of STEM fields to everyday life. They also serve to inspire and motivate students to consider a STEM career by creating an awareness of STEM possibilities for parents and students. STEM competitions, experiments, investigations, and design challenges available during the festival plant seeds of possibility in the minds of students who may otherwise have never considered a STEM career. Universities and colleges of Georgia join the festival by displaying their STEM programs.

The STEM Festivals for 2011 were held at Gwinnett School of Mathematics, Science, and Technology, Ware County High School, and Houston County High School. A fourth festival was held in Savannah in conjunction with the Savannah Chatham County School's Student Success Expo on February 5, 2012. Attendance at the three inaugural festivals exceeded 2,400 parents, students, and teachers. Over 90 STEM exhibitors conducted interactive activities related to STEM education and careers.

STEM Georgia Web Page

The GaDOE has created a STEM Georgia Web page (http://stemgeorgia.org/) that includes links to teacher resource materials, STEM schools in Georgia, and integrated project lesson plans.

Georgia Department of Education STEM School Designation

Schools in Georgia may apply for official GaDOE STEM School Designation via an application process where specific criteria indicative of STEM schools are met.

STEM Classroom Feedback Rubric

A rubric for providing feedback to STEM teachers in order to move instruction toward exemplary status has been developed and is being tested on different sites.

21st Century STEM Labs

The goals of the 21st Century STEM Labs Grant are to

- Increase community understanding of STEM education to prepare students for work and life in the 21st century
- Develop model technology enabled STEM labs emphasizing, interdisciplinary, hands-on, inquiry-based (guided discovery) learning
- Increase Georgia's capacity to provide high quality K–12 STEM professional learning opportunities
- Increase student engagement and interest in STEM studies
- Increase student 21st century skills and technology literacy by providing use of the technical tools of the STEM industry
- Increase the number of students pursuing careers in STEM-related fields and/or postsecondary STEM-related education/training

This project is funded by a Title II, Part D, American Recovery and Reinvestment Act of 2009 grant (refer to Table 1., Local Education Agency Grant Awards for Middle and High Schools, below for the figures).

Table 1. Local Education Agency Grant Awards for Middle and High Schools (Grant Award for Each LEA = $691,109, Total Grant Award = $8,984,417)

LEA	High School	Middle School	Concentration
Carrollton City	Carrollton High	Carrollton Jr. High	Engineering and Robotics
Chattooga County	Chattooga High	Summerville Middle	Forensics and Robotics
Decatur County	Bainbridge High	Bainbridge Middle	Agriculture
DeKalb County	Avondale High	Avondale Middle	Engineering
DeKalb County	Cedar Grove High	Cedar Grove Middle	Biotech/Health Science
DeKalb County	DeKalb School of Arts	Chamblee Middle	Robotics and Graphics
DeKalb County	Dunwoody High	Peachtree Middle	Robotics and Biotech
Jenkins County	Jenkins County High	Jenkins County Middle	Agriculture

Table 2. Local Education Agency Grant Awards for Middle and High Schools (continued)			
LEA	High School	Middle School	Concentration
Laurens County	East Laurens High	East Laurens Middle	Engineering
Madison County	Madison County High	Madison County Middle	Agriculture
Social Circle City	Social Circle High	Social Circle Middle	Biotech/Health Science
Telfair County	Telfair County High	Telfair County Middle	Agriculture and Engineering
Walker County	Ridgeland High	Rossville Middle	Engineering and Broadcasting

Source: Georgia Department of Education.

Senate Resolution 68

Senate Resolution 68 mandated the formation of the Science and Technology Strategic Initiative Joint Study Commission. One of the purposes of the commission is to develop specific recommendations with regard to the scope and content of a strategic plan for science and technology in Georgia. The commission identified seven specific targets:

1. Increase performance on K–12 science and math test indicators (CRCT, EOCT, SAT, ACT)
2. Increase the number of secondary students enrolled in STEM pathways and/or matriculating to STEM postsecondary options
3. Increase the number of STEM certified teachers
4. Expand STEM business/education partnerships statewide
5. Develop communication channels to educate Georgia citizens of the importance of STEM education so they recognize the role of STEM education to a vibrant economy and high quality lifestyle
6. Integrate advanced technology into classroom instruction statewide and provide access to content for all Georgia students
7. Increase the number of STEM graduates from postsecondary institutions in Georgia (University System of Georgia [USG], Technical College System of Georgia [TCSG], and private institutions)

Race to the Top
Center for Education Integrating Science, Mathematics, and Computing (CEISMC)

The GaDOE in partnership with CEISMC is developing STEM-related courses in robotics, problem-based inquiry science, statistics, and online learning. These online courses will include teacher preparation in areas such as genetics/ biotechnology, climate science, instructional technology, and nanochemistry. Through funds received from the Race to the Top grant, CEISMC will expand the Georgia Intern-Fellowships for Teachers (GIFT) program, which places STEM teachers in mentored, challenging STEM summer internships in industry and university research laboratories to deepen their knowledge of content application. Additionally, CEISMC is working on developing a technology tool kit that will provide teachers with professional learning opportunities to better incorporate technology into their daily lessons.

UTeach

The GaDOE has partnered with UTeach to increase the pipeline of effective teachers in high-need schools and hard-to-staff subject areas. Georgia has committed to the creation of three UTeach sites statewide.

South Carolina

John Holton, education associate, South Carolina Department of Education, provided the information below. He may be reached at jholton@ed.sc.gov or 803-734-8311.

Activities Supporting STEM in South Carolina

There is a widely held agreement that for South Carolina to have a role in the global economy it must have a "reliable Science, Technology, Engineering, and Mathematics (STEM) talent pipeline producing qualified STEM-competent workers." (http://www.citadel.edu/stemcollaborative/)

Creating such a pipeline requires the cooperative effort from a variety of different stakeholders. The Lowcountry STEM Collaborative has been working since late 2010 to bring together individuals and groups from schools, higher education, and businesses and industries in the Lowcountry of South Carolina.

At a meeting in November 2011, the group of stakeholders formed themselves into six working groups to develop a strategic plan. The working groups (asset mapping, communications and marketing, governance and leadership, K–20 programs, resource development, and volunteers) held a working meeting and developed a strategic plan, which was completed by February. The strategic plan will ensure that there is a robust structure for the organization so that it can continue to effectively develop robust collaborations among the stakeholders.

The principle goal of the organization is to "impact to advance STEM literacy in the tri-county region." While the focus of the work begins in the Lowcountry, the goal is to work with similar organizations across the state.

There is clearly much important work to be done if South Carolina is to have a secure future in the global marketplace. Organizations such as the Lowcountry STEM Collaborative help this happen by advocating for strong STEM education. Strong STEM education requires that more of the best and brightest students, especially those from traditionally underrepresented groups, elect to study in STEM disciplines. It also requires that the content and pedagogical knowledge of South Carolina teachers be steadily improved and that highly skilled STEM educators are recruited and retained in South Carolina schools. Resources must be available to support learning the STEM subjects.

South Carolina already has lots of very smart people, community oriented businesses and industries, and school teachers and administrators who already understand the importance of STEM education to develop and maintain a "reliable pipeline," but it will take organizations like the Lowcountry STEM Collaborative to bring these people, businesses, industries, and educators together into effective cooperation to make the vision into a day-to-day reality.

The information in this section was drawn from the Lowcountry STEM Collaborative Web site (http://www.citadel.edu/stemcollaborative/) from an update on the LSC activities by Carolyn Kelley, STEM Center director at The Citadel, and from participation in the November 2011 meeting.

Texas

Stacy Avery, program manager, department of state initiatives, Texas Education Agency, provided the following information. She may be reached at stacy.avery@tea.state.tx.us or 512-936-6060.

Texas Science, Technology, Engineering, and Mathematics (T-STEM) Initiative
Introduction

In these times of rapid economic and technological change, a widespread command of the science, technology, engineering, and mathematics disciplines is essential to personal, state, and national prosperity. In Texas, economic growth has been steady; however, the number of Texas students who graduate with degrees in math and science is low and has been flat for years. These numbers are significantly lower among minority and economically disadvantaged students. As a result, employers in Texas are forced to look outside the state for much of their science-, technology-, engineering-, and math-skilled workforce. To continue its economic growth and increase the prosperity of its citizens, Texas must revitalize the educational pipeline by dramatically upgrading math and science instruction, especially in underserved communities, and by aligning high school, postsecondary education, and economic development activities.

The $120 million Texas Science, Technology, Engineering, and Mathematics (T-STEM) Initiative is designed to improve instruction and academic performance in science- and math-related subjects in Texas secondary schools. T-STEM promotes education strategies that challenge students to innovate and invent; coursework requires students to demonstrate their understanding of these disciplines in an environment that models real-world contexts for postsecondary learning and work. Students participating in a T-STEM education graduate from high school prepared to pursue postsecondary coursework and careers in STEM.

Among the original goals of the T-STEM Initiative is the establishment of 35 T-STEM Academies in high-need areas throughout the state. Annually, each T-STEM Academy is tasked with graduating 100 students from diverse backgrounds, all prepared either for postsecondary study or careers in STEM fields.

STEM Projects

T-STEM Academies

T-STEM Academies are rigorous secondary schools focusing on improving instruction and academic performance in science- and mathematics-related subjects and increasing the number of students who study and enter STEM careers. The cornerstone of T-STEM Academy learning is student engagement and exposure to innovation and design in STEM-focused instruction and learning that models real-world contexts. The T-STEM Academies use the T-STEM Design Blueprint, Rubric, and Glossary as a guidepost to build and sustain STEM schools that address the seven benchmarks (a) mission driven leadership; (b) school culture and design; (c) student outreach, recruitment, and retention; (d) teacher selection, development and retention; (e) curriculum, instruction, and assessment; (f) strategic alliances; and (g) academy advancement and sustainability.

Additionally, T-STEM Academies serve as demonstration schools and learning labs that develop innovative methods to improve science and mathematics instruction and serve students in grades 6–12 or 9–12.

In the 2011-2012 school year there are

- Fifty-nine Designated T-STEM Academies
    - ◊ Thirty-six campuses serving students in grades 6–12
    - ◊ Twenty-three campuses serving students in grades 9–12
- Serving over 20,000 students
- Focusing on underrepresented populations in higher education and economically disadvantaged students

T-STEM Centers

The T-STEM Centers develop partnerships with universities, regional service centers, local education agencies, businesses, and nonprofit organizations to create and deliver high quality, innovative, and relevant STEM-focused professional development. The seven T-STEM Centers are listed below.

- University of Texas Medical Branch-Galveston
- Education Service Center, Region 1
- Education Service Center, Region 12
- University of Texas, Tyler
- Texas Tech University
- University of Texas, Dallas
- Texas A&M University

T-STEM Robotics

The T-STEM Robotics Program provides hands-on experience in solving real-world challenges and exposing students to physics, mechanics, electronics, programming, business, financial management, teamwork, and leadership. This program serves as a model for all Texas high schools to increase students' interest in STEM areas, particularly among low-income and minority students.

T-STEM Aerospace/Rocketry Program

The T-STEM Aerospace/Rocketry program provides professional development and support to teachers to implement upper level courses in high schools. The program enables students to participate in a hands-on, project based engineering and technology program and competitions. Eighty percent of students participating in aerospace/rocketry programs continue on to study engineering in college, with many starting careers at major space-related organizations such as NASA and the United Space Alliance.

T-STEM Teacher Pre-Service Preparation Program (UTeach)

With over a decade of proven results, UTeach offers degree programs that allow students to graduate in 4 years, completing a math, science, or computer science degree and all the requirements for secondary teacher certification.

The T-STEM Pre-Service Teacher Preparation Program funds the replication of a successful teacher preparation program, UTeach, which is based at the University of Texas at Austin. The five replication sites are listed below.

- University of Texas, Tyler
- University of Texas, Dallas
- University of Texas, Arlington
- University of North Texas
- University of Houston

Briefing Papers are prepared to provide information to the departments of education of the states served by SEDL's comprehensive centers. They address topics on education issues related to the requirements and implementation of the Elementary and Secondary Education Act (ESEA).

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