

STEM and STEAM Education Overview

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What are STEM and STEAM?

- STEM is the acronym for **Science, Technology, Engineering** and **Mathematics** (STEM). **STEAM** denotes the inclusion of the **Arts**
- Arts programs must demonstrate the infusion of math and/or science concepts and principles
- In Georgia, a STEM education program may include curriculum from career clusters other than engineering and computer science (i.e. **healthcare** science, **agricultural** science, **biotechnology**, and **food and nutrition** science)



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What is STEM Education?

- STEM education is based on rigorous curriculum that **integrates subjects** as opposed to teaching them separately
- STEM education in elementary grades creates in students an **interest** in mathematics and science that provides a foundation for middle school, high school and beyond...
- STEM education's integration of hands-on, real-world learning tasks, coupled with academic theory, helps students **master rigorous math and science concepts**
- STEM education builds greater capacity in teachers through content specific, **rigorous** and ongoing professional development and training

What is STEM Education?

- STEM education incorporates several researched-based best practices proven to improve student achievement:
 - ✓ Inter-disciplinary instruction
 - ✓ Problem and project-based learning
 - ✓ Inquiry-based learning
 - ✓ Collaborative learning
 - ✓ Laboratory investigations
 - ✓ Research projects
 - ✓ Real-world experiences via work-based learning opportunities
 - ✓ Advanced Placement (AP), International Baccalaureate (IB), college Dual Enrollment Programs, and Career, Technical and Agricultural Education (CTAE)

Source: International Center for Leadership in Education

Why STEM Education?

“Everyone has a stake in in improving STEM education. Inspiring all our students to be capable in math and science will help them contribute in an increasingly technology-based economy, and will also help America prepare the next generation of STEM professionals – scientists, engineering, architects, and technology professionals – to ensure our competitiveness.”

U.S. Secretary of Education, Arne Duncan

Source: Connections Learning



Why STEM Education?

- In addition to fostering **in-depth knowledge of math and science**, a STEM education increases achievement by equipping students with:
 - ✓ Critical and analytical thinking skills
 - ✓ Proficiency at solving non-routine problems
 - ✓ High-level communication abilities
 - ✓ Project management experience
 - ✓ Teamwork and leadership skills



These skills are required to be successful in college and the world of work!



Why STEM Education?

- STEM education enables students to earn high wages in high demand occupations and encourages self-sufficiency and financial independence
- By 2018, America will be short 1,000,000 nurses, 200,000 doctors, and 400,000 engineers
- Over the past 10 years, growth in STEM jobs was 3 times as fast as growth in non-STEM jobs
- STEM occupations are projected to grow by 17% from 2008 – 2018, compared to 9.8% growth for non-STEM occupations
- STEM workers command higher wages, earning 26% more than non-STEM counterparts

Source: US Bureau of Labor Statistics



Why STEM Education?

Education Level	STEM Jobs (hourly)	Non-STEM Jobs (hourly)	Difference
High school diploma or less	\$24.82	\$15.55	+59.6%
Associates degree or some college	\$26.63	\$19.02	+40.0%
Bachelor's degree	\$35.81	\$28.27	+26.7%
Graduate degree	\$40.69	\$36.22	+12.3%

Source: US Bureau of Labor Statistics



Why STEM Education?

Occupation	Projected Jobs by 2022	Median Annual Wage (May 2013)	Typical entry-level education
Environmental Science Technicians	38,900	\$41,700	Associate's degree
Computer Support Specialist	658,500	\$46,420	Some college, no degree
Web Developer	169,900	\$63,160	Associate's degree
Sales, technical and scientific products	419,500	\$74,520	Bachelor's degree
Statistician	34,900	\$79,290	Master's degree
Civil Engineer	326,600	\$80,770	Bachelor's degree
Software Developer	752,900	\$92,660	Bachelor's degree
Information Systems Manager	383,600	\$123,950	Bachelor's degree

Source: US Occupational Outlook



Local STEM Results

- DeKalb County Schools:
 - ✓ Started with 2 schools in 2010, now **89 schools** (out of 143) **are pursuing STEM** certification
 - ✓ Elementary science scores: non-STEM 66%...STEM 80%
 - ✓ Elementary math scores: non-STEM 71%...STEM 84%
 - ✓ Middle school science scores: non-STEM 64.5%...STEM 73%
 - ✓ Middle school math scores: non-STEM 71%...75%
 - ✓ Five (5) IB schools now pursuing STEM certification
 - ✓ Two (2) language immersion now schools pursuing STEM



What is the cost of STEM?

- Costs to implement STEM in a school vary dependent upon existing resources
- There are no registration or membership fees associated with STEM
- GADOE provides some professional development at no charge to schools
- Associated costs include:
 - ✓ STEM specific professional development for teachers
 - ✓ Technology (computer hardware and software)
 - ✓ Equipment (cost varies greatly depending on program focus)
 - ✓ Supplies (Annual costs vary based on types of projects)
 - ✓ Creating and maintaining a “wet” lab (if not already in place)

What is the cost of STEM?

Whole School Model - Elementary Sample Start-up Budget

Number of Students	350
Additional STEM teachers (1 math/1 sci.)	2
Salaries/benefits	\$165,400
Software (inc. DefineSTEM)	\$3500
Equipment/Computers (inc. 24 laptops)	\$28,700
Furniture (inc. desks, worktables, cabinets)	\$10,000
Supplies (inc. Lego kits)	\$14,000
Textbooks/Instructional Materials	\$5000
Professional learning (e.g. Buck Institute)	\$10,000
STEM-related conferences	\$5420
Competitive Events and STEM fieldtrips	\$1260
TOTAL	\$243,280

Program Model – Middle or high School Sample Start-up Budget w/Engineering Focus

Number of Students	250
Additional STEM teachers (1 math/1 sci.)	2
Salaries/benefits	\$165,400
Software (Includes DefineSTEM, ADOBE)	\$5000
Equipment/Computers (Inc. 28 desktops)	\$79,595
Furniture (inc. modular desks, worktables)	\$43,000
Supplies (inc. VEX robotics)	\$36,600
Textbooks/Instructional Materials	\$13,900
Professional learning (e.g. Buck Institute)	\$18,780
STEM-related conferences	\$5420
Competitive Events and STEM fieldtrips	\$7680
TOTAL	\$375,375

Georgia's STEM Certification Process

- STEM certification may be for the **whole school** (all students participate in the STEM program), or for a **program** within the school (cohorts of students are taught by STEM teachers)
- STEM certification is available for all grade levels: elementary, middle and high school
- The State provides a framework for STEM, but does not mandate curriculum or specific professional development for teachers
- Preparation for STEM certification usually takes 2 – 3 years

Georgia STEM Certification Steps

1. School leadership meets with math and science teachers (and CTAE where applicable) to determine capacity
2. School community (e.g. staff, parents, business partners) meets to determine commitment to STEM
3. School leadership meets with district STEM Support Team for guidance on the STEM guidelines
4. School leadership submits a proposal to Associate Superintendent for approval to pursue STEM certification

Georgia STEM Certification Steps

5. School works with district STEM Support Team to request the DOE pre-application visit where input and feedback is provided by the STEM Coordinator
6. School submits STEM application to the state
7. School implements STEM or STEAM according to guidelines
8. Several visits are made by the district team and state STEM Coordinator to monitor progress
9. Official certification visit is scheduled and on-site evaluation conducted

STEM Certification Criteria

- Students must apply for the STEM program and be **identified** as part of the STEM population (Program model only)
- Students from **all backgrounds** must be allowed and encouraged to participate (e.g. minorities, females, economically disadvantaged, and special needs students)
- **100% of STEM teachers** should be certified in a STEM content area (i.e. mathematics, science, technology or a career cluster)

STEM Certification Criteria

- STEM teachers must collaborate and integrate lessons in science and mathematics, utilizing instructional technology and real world projects
- Teacher professional learning must be on-going and in content areas (i.e. mathematics, science, technology, or a career cluster)
- At the high school level, STEM education should incorporate a state-approved career cluster (i.e. agricultural science, biotechnology, computer science, engineering & technology, healthcare science, or food & nutrition science)

STEM Certification Criteria

- Time for **collaboration** must be allocated regularly for STEM teachers to develop lessons, create projects, and evaluate student work
- High school students should complete a **STEM related pathway** (i.e. math, science or CTAE), and an internship or capstone project before graduation
- High school students should be enrolled in STEM related **advance-level courses** (e.g. AP, IB, or college dual enrollment math and science courses)

STEM Certification Criteria

- Business, industry, and post-secondary partners must be integrally involved in the instructional program
- Students at all levels must routinely participate in math, science, and CTAE **competitions** (e.g. science fair, robotics, Math Challenge, Science Olympiad, Healthcare Occupations Student Association , Technology Student Association)
- Performance assessments must go beyond paper/pencil tests to include: portfolios, formal presentations, research projects, demonstration of skills

STEM Certification Criteria

- All STEM programs must have a **lab with running water** and up-to-date technology
- A wide-range of **technology** must be utilized for instruction and learning by teachers and students (e.g. 3D printers, computers, scientific/graphing calculators, smart boards, iPads, ADOBE software, autoCAD software)
- **Accountability** must be documented with schools meeting state identified performance standards; student achievement data must show increases over time

Georgia DOE Annual State-wide STEM Activities

- Georgia STEM Festival
- Georgia STEM Institutes
- Girls Adventures in STEM
- Georgia STEM Day



APS Annual STEM Activities

- Annual Technology Fair
- Annual Science Fair
- CTAE Healthcare Science Symposium
- CTAE Engineering Expo



Department of Instructional Technology



- Dedicated Instructional Technology Support at each STEM school (Educational Technology Specialist)
 - Collaborate with school to meet goals within the STEM rubric
 - Job Embedded Professional Learning
 - Direct support for students around 21st Century skills needed to support STEM
- Digital Learning Specialists in Mathematics and Science
 - Customize digital resources for each STEM School
 - Provide direct instructional support for STEM schools

STEM Resources

For Georgia STEM resources, materials, links to STEM schools, grants, competitions, lesson plans,

visit: <http://stemgeorgia.org>

For APS STEM resources visit the STEM Initiatives SharePoint site under Curriculum & Instruction

(internal stakeholders)

Atlanta Public Schools STEM Education

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