STEM and STEAM Education Overview
Dr. Brene’ Bradley
Coordinator, STEM Support Team

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).
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 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


<table>
<thead>
<tr>
<th>Education Level</th>
<th>STEM Jobs (hourly)</th>
<th>Non-STEM Jobs (hourly)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school diploma or less</td>
<td>$24.82</td>
<td>$15.55</td>
<td>+59.6%</td>
</tr>
<tr>
<td>Associates degree or some college</td>
<td>$26.63</td>
<td>$19.02</td>
<td>+40.0%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>$35.81</td>
<td>$28.27</td>
<td>+26.7%</td>
</tr>
<tr>
<td>Graduate degree</td>
<td>$40.69</td>
<td>$36.22</td>
<td>+12.3%</td>
</tr>
</tbody>
</table>

Why STEM Education?

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

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)

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**Whole School Model - Elementary**

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>350</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional STEM teachers (1 math/1 sci.)</td>
<td>2</td>
</tr>
<tr>
<td>Salaries/benefits</td>
<td>$165,400</td>
</tr>
<tr>
<td>Software (inc. DefineSTEM)</td>
<td>$3500</td>
</tr>
<tr>
<td>Equipment/Computers (inc. 24 laptops)</td>
<td>$28,700</td>
</tr>
<tr>
<td>Furniture (inc. desks, worktables, cabinets)</td>
<td>$10,000</td>
</tr>
<tr>
<td>Supplies (inc. Lego kits)</td>
<td>$14,000</td>
</tr>
<tr>
<td>Textbooks/Instructional Materials</td>
<td>$5000</td>
</tr>
<tr>
<td>Professional learning (e.g. Buck Institute)</td>
<td>$10,000</td>
</tr>
<tr>
<td>STEM-related conferences</td>
<td>$5420</td>
</tr>
<tr>
<td>Competitive Events and STEM fieldtrips</td>
<td>$1,260</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$243,280</strong></td>
</tr>
</tbody>
</table>

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**Program Model – Middle or high School**

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

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](http://stemgeorgia.org)

For APS STEM resources visit the STEM Initiatives SharePoint site under Curriculum & Instruction *(internal stakeholders)*
Atlanta Public Schools STEM Education

For more information contact:
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