MARYLAND STATE DEPARTMENT OF EDUCATION
Preparing World-Class Students

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TO: Members of the State Board of Education

FROM: Bernard J. Sadusky, Ed.D.

DATE: April 24, 2012

SUBJECT: STEM Standards of Practice and STEM Education Definition

PURPOSE:

To provide the State Board with a definition of STEM Education and Maryland's STEM Standards of Practice, and to request acceptance of these draft documents.

HISTORICAL BACKGROUND:

In September 2008, Governor Martin O'Malley convened a P-20 STEM Task Force to discuss the state of STEM education in Maryland. As a result of the task force work, specific recommendations were made aimed at establishing Maryland as a global leader in the development of its workforce of the future, STEM-based research, and economic development infrastructure. The Governor's STEM Task Force report - Investing in STEM to Secure Maryland's Future can be obtained at www.governor.maryland.gov/documents/090806stemReport.pdf.
The task force's recommendations were included in Maryland's application for a Race to the Top Grant. The grant describes twelve STEM-related projects, including developing STEM-based curriculum. In order to develop STEM-based curriculum documents, STEM education must be defined. The STEM Education design team, comprised of Maryland State Department of Education members from the Office of STEM Initiatives and the Division of Career and College Readiness, developed a definition of STEM education and STEM Standards of Practice that describes the essential skills and processes in science, technology, engineering, and mathematics. This developmental work is the foundation for curriculum development.

EXECUTIVE SUMMARY:

The definition of STEM Education and the STEM Standards of Practice reflect the skills and knowledge students must master to be prepared to meet the increasing demand of the workplace where STEM skills are required. The Common Core State Standards for English Language Arts/Literacy and Mathematics, the Next Generation Science Frameworks, the Maryland Technology Literacy Standards, the Maryland Career Development Framework, and the International Technology and Engineering Education Association Content Standards were reviewed in preparation for developing STEM curriculum documents. The draft document of the STEM Standards of Practice was shared with over 250 stakeholders in face-to-face meeting. Based on their input, the draft was revised. The revised document was shared in an online survey. 711 participants responded to the online survey.

The document being presented has been revised based on the results of this survey. The purpose of the Standards of Practice will be to guide curriculum development, professional develop, and teacher preparation and certification.

ACTION:

Information and Discussion
Acceptance

ATTACHMENTS:

STEM Definition
STEM Standards of Practice
Stakeholder Data

STEM Education Definition

STEM education is an approach to teaching and learning that integrates the content and skills of science, technology, engineering, and mathematics. STEM Standards of Practice guide STEM instruction by defining the combination of behaviors, integrated with STEM content, which is expected of a proficient STEM student. These behaviors include engagement in inquiry, logical reasoning, collaboration, and investigation. The goal of STEM education is to prepare students for post-secondary study and the 21st century workforce.

STEM Standards of Practice – Draft

1. **Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content**

   STEM proficient students will learn and apply rigorous content within science, technology, engineering, and mathematics disciplines to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

   A. Demonstrate an understanding of science, technology, engineering, and mathematics content.

   B. Apply science, technology, engineering, or mathematics content to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

2. **Integrate Science, Technology, Engineering and Mathematics Content**

   STEM proficient students will integrate content from science, technology, engineering, and mathematics disciplines as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

   A. Analyze interdisciplinary connections that exist within science, technology, engineering, and mathematics disciplines and other disciplines.

   B. Apply integrated science, technology, engineering, mathematics content, and other content as appropriate to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

3. Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics

STEM proficient students will interpret and communicate information from science, technology, engineering, and mathematics to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify, analyze, and synthesize appropriate science, technology, engineering, and mathematics information (text, visual, audio, etc.).

B. Apply appropriate domain-specific vocabulary when communicating science, technology, engineering, and mathematics content.

C. Engage in critical reading and writing of technical information.

D. Evaluate and integrate multiple sources of information (e.g.: quantitative data, video and multimedia) presented in diverse formats.

E. Develop an evidence-based opinion or argument.

F. Communicate effectively and precisely with others.

4. Engage in Inquiry

STEM proficient students will engage in inquiry to investigate global issues, challenges, and real world problems.

A. Ask questions to identify and define global issues, challenges, and real world problems.

B. Conduct research to refine questions and develop new questions.

5. Engage in Logical Reasoning

STEM proficient students will engage in logical reasoning to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Engage in critical thinking.

B. Evaluate, select, and apply appropriate systematic approaches (scientific and engineering practices, engineering design process, and/or mathematical practices).

C. Apply science, technology, engineering, and mathematics content to construct creative and innovative ideas.

D. Analyze the impact of global issues and real world problems at the local, state, national, and international levels.

6. Collaborate as a STEM team

STEM proficient students will collaborate as a STEM team to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify, analyze, and perform a STEM specific subject matter expert (SME) role.

B. Share ideas and work effectively with a STEM focused multidisciplinary team to achieve a common goal.

C. Listen and be receptive to ideas of others.

D. Analyze career opportunities that exist in a variety of STEM fields relevant to the STEM focused multidisciplinary team's goal.

7. Apply Technology Strategically

STEM proficient students will apply technology appropriately to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.

A. Identify and understand technologies needed to develop solutions to problems or construct answers to complex questions.

B. Analyze the limits, risks, and impacts of technology.

C. Engage in responsible/ethical use of technology.

D. Improve or create new technologies that extend human capability.

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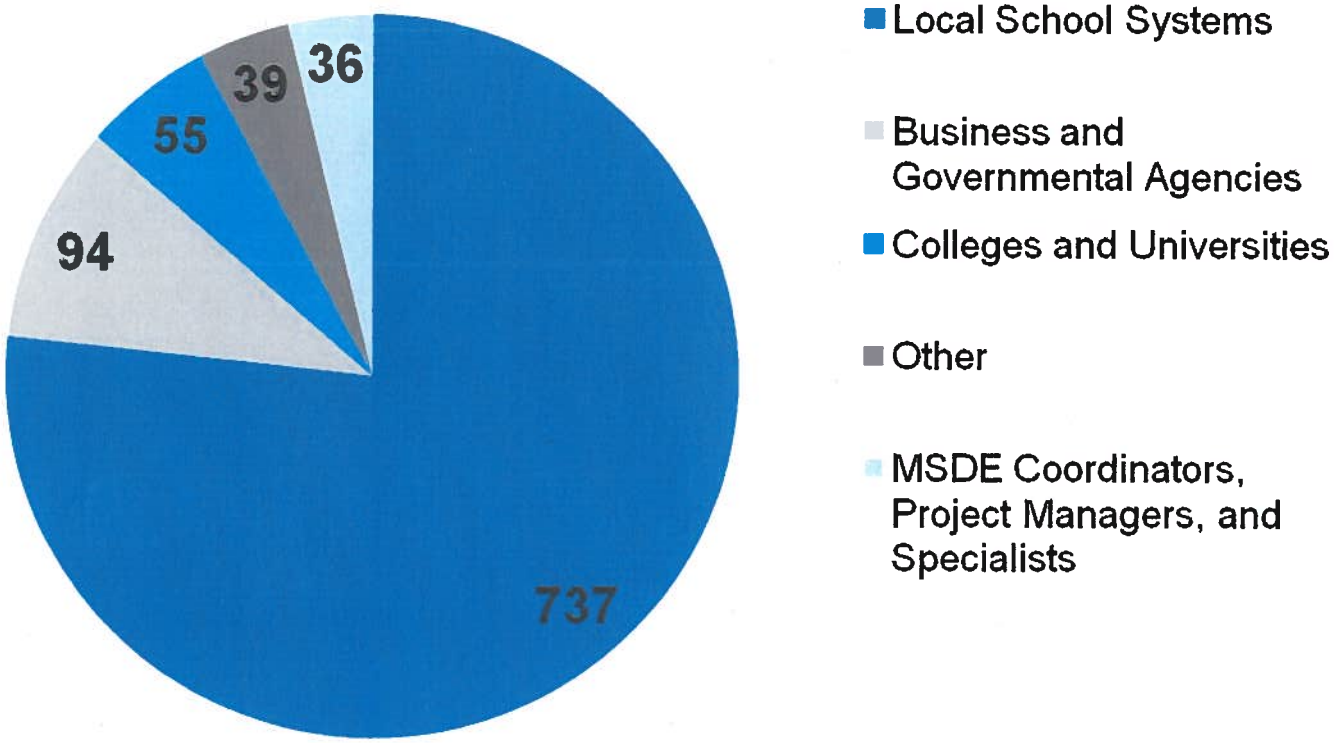
Maryland State Department of Education
STEM Standards of Practice
Stakeholder Groups

A total of 961 stakeholders reviewed and provided input on the STEM Standards of Practice from September 2011 – January 2012 via an on-line survey and face-to-face meetings. Stakeholders included representatives from all 24 Maryland local school systems, businesses and governmental agencies, colleges and universities, and other members of the community. The pie chart below depicts the total number of respondents in each stakeholder group.



STEM Standards of Practice Stakeholder Review

250 stakeholders representing state educational coordinators, master teachers, LEA supervisors, MSDE Division of Instruction, and business and governmental organizations reviewed the draft STEM Standards of Practice in face-to-face meetings to provide feedback for refinement of the Practices. Face – to - face review sessions were conducted at the 30%, 40%, and 60% review drafts. A data-driven decision process was used to refine the STEM Standards of Practice. The refined draft STEM Standards of Practice were posted as a survey.

711 stakeholders representing local school systems, businesses, higher education, governmental agencies, and other participants (parents, non-public school teachers, and STEM professionals) responded the STEM Standards of Practice survey. Survey participants were asked to identify whether they strongly agree, agree, are undecided, disagree, or strongly disagree to the following three statements for each STEM Standard of Practice:

1. The Practice is applicable to most content areas.
2. The Practice meets workforce training expectations.
3. The Practice meets college training expectations.

85% of survey respondents strongly agreed/agreed that the STEM Standards of Practice were applicable to most content areas and met college and workforce training expectations. 6% of stakeholders strongly disagreed/disagreed that the STEM Standards of Practice were applicable to most content areas and met college and workforce training expectations and 9% of stakeholders were undecided. Survey participants were also given the opportunity to provide written feedback for each STEM Standard of Practice. A data-driven decision process was used to refine the STEM Standards of Practice. We continue to collect feedback from additional stakeholders. All submitted comments are reviewed and taken into consideration. Further refinement of the STEM Standards of Practice is ongoing.