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Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Maine Department of Education

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Submitted by the **Maine Department of Education**

December 2010

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December 27, 2010

The Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM) is a thoughtful, deliberate plan to support the STEM knowledge and skills essential to the success of Maine's students and to the economic future of our State. This plan articulates Maine's vision and goals for STEM learning and defines the action steps and partnerships the Maine Department of Education will pursue to achieve those goals. According to the Maine Department of Labor, in the next decade, one in seven new Maine jobs will be STEM-related and the wages associated with the jobs in these areas are 58% higher than wages for other Maine jobs. It is also critical that Maine's students be prepared to act as responsible citizens in a global community to solve energy, medical, and environmental challenges, all of which depend upon an understanding of science, technology, engineering, and mathematics. To prepare for this future success, we must act now.

The Statewide Strategic Plan is part of a larger, historic dialogue about science, technology, engineering, and mathematics education taking place in our country. National reports, including the report from the President's Council of Advisors on Science and Technology, the National Academy of Science report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, and the Carnegie Corporation and Institute for Advanced Study's report the *Opportunity Equation: Transforming Mathematics and Science Education for Citizenship and the Global Economy*, all call for action at the national, state, and local level to enhance the quality of and access to STEM learning for all students. Within the State, the STEM Collaborative, a partnership that includes the Maine Department of Education as well as other business, non-profit, higher education and governmental agency partners, has worked since 2007 to advance STEM learning and raise awareness in this pivotal area. STEM dialogue is especially important because it naturally unites with conversations about high school reform, graduation rates, student engagement, teacher pre-service and in-service training, career and technical education, career pathways, advanced courses of study, environmental literacy, and economic development.

The Maine Department of Education has taken the first step among many toward preparing our students and State for the future by developing this Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM). A STEM team at the Department will meet regularly to advance the work outlined in this plan to improve student achievement and elevate student aspirations to pursue career pathways in science, technology, engineering and mathematics. We are committed to this important work.

Angela R. Faherty, Ph.D.
Commissioner of Education

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Vision for STEM Education in Maine

The Maine Department of Education (DOE) believes that greater access to quality STEM (science, technology, engineering, and mathematics) teaching and learning can positively impact student career options and personal and civic decision-making, and give students a vital role in strengthening Maine's economy. The Department believes that student understanding in the STEM areas is essential to being an informed citizen and a successful participant in the work place. Therefore the Department seeks to elevate the aspirations of Maine students to pursue STEM and STEM-related careers and develop among educators the leadership skills to support STEM programming in PreK-12 schools and Career and Technical Education (CTE) centers.

The Department supports professional development and the underlying technology that enhances teacher content knowledge in science, technology, engineering, and mathematics and effective instructional strategies in those learning areas. Effective professional development has been shown to increase student learning in the STEM areas. The Department recognizes that collaboration with governmental, non-governmental and higher education partners is essential to strengthening STEM education for Maine students.

The Department of Education envisions an educational system in which all students:

- Have equitable access to effective STEM instruction;
- Receive instruction in which STEM concepts are applied and integrated; and
- Understand the relevance of STEM to their communities and to their own career aspirations.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

To achieve this vision, the Maine Department Of Education has developed a plan with the following three goals:

Goal #1: Overall student achievement in science, mathematics, engineering and technology demonstrates a gain of 15 percentage points within four years as measured by the combined percentage of students who “meet” and “exceed” expectations on State assessments of science and mathematics.

Goal #2: The number of students interested in pursuing STEM-related careers increases by 15 percentage points (from 33% to 48%) within four years, as reported on the PSAT and SAT student surveys; and the number of Maine students who graduate from two-year and four-year engineering and STEM-related programs statewide increases by 10%.

Goal #3: The STEM initiatives of the Department of Education and the STEM Collaborative, which includes governmental, non-profit and business partners, are coordinated and three million dollars in federal grants is secured by the Department of Education to support STEM learning and growth in the State.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Goal I-Improved Student Achievement in STEM Areas

Goal #1: Overall student achievement in science, mathematics, engineering and technology demonstrates a gain of 15 percentage points within four years as measured by the combined percentage of students who “meet” and “exceed” expectations on State assessments of science and mathematics.

Objectives:

1. Increase in-service teacher content knowledge, pedagogical knowledge, and pedagogical content knowledge in science, technology, engineering and mathematics
2. Increase teacher leadership in science, technology, engineering and mathematics
3. Increase pre-service teacher programming and recruitment
4. Continue to adopt rigorous core standards
5. Encourage innovative instructional practices to increase student achievement

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
1.1.1 Target in-service teachers in low-achieving schools to participate in STEM professional development programs modeled on research-based practices. Improve core grade level (or span) content knowledge, pedagogical knowledge, and understanding of career pathways. Include a minimum of 80 hours of professional development time over more than one year with embedded follow up	2011	2014	Mailhot/ Bernhardt/ Garton	Mailhot/ Bernhardt/ Garton	To be met within existing position responsibilities and external funding streams to be identified	Identification of numbers/locations of teachers participating especially in low-achieving schools; improved content, pedagogical and pedagogical knowledge of teachers; and changes in instructional practices as measured

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
to support changes in instruction. Leverage the Internet and the existing Maine Learning Technology Initiative (MLTI) infrastructure to deliver high quality online professional development.						through pre- and post-assessment of teachers knowledge and practices.
1.1.2 Collaborate with the University of Maine System and the State Board of Education to create a Masters of Education in STEM Literacy linked to current National Science Foundation (NSF) grants (based on a hybrid model with face-to-face and online course offerings). Leverage the MLTI for teachers at grades 7-12 as a support for making courses accessible to more teachers in the State and for ensuring the delivery of high quality online professional development.	2011	2013	Osgood/ Bernhardt/ Mailhot/ Garton		To be met within existing position responsibilities	Paper describing the proposed degree program by the end of January 2011.
1.1.3 Target 5 CTE centers and their affiliated high schools for Project Lead the Way programs in either engineering or biomedical studies and implement these programs.	2010	2013	Lagasse/ Littlefield/ Robertson		To be met within existing position responsibilities and external funding streams to be identified	Grants to fund the implementation of the programs in 5 CTE centers and their affiliated high schools.
1.1.4 Implement and support Mathematics-in-CTE programs in all CTE centers and partner sending schools.	2010	2015	Robertson/M ailhot/ Littlefield	Downing	External funding streams to be identified	Greater than 50% participation of the teachers in CTE centers and their partner sending school mathematics teachers.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
1.1.5 Work with the University of Maine System to integrate the MLTI resources into the pre-service teacher training.	2010	2015	Garton/Osgood		To be met within existing position responsibilities	Information/training sessions on MLTI resources for University faculty.
1.1.6 Create 8 regional STEM coordinators and Resource Centers to support all schools in increasing student achievement in STEM.	2011	2018	Monthey		Legislative funding or external funding streams to be identified	Identification of regions and their coordinators. Funding.
1.2.1 Develop 100 additional STEM teacher leaders in the State through the creation and implementation of 3 two-year cohorts for a STEM Leadership Academy (modeled after the National Leadership Academy by West Ed) by funding the 3 rd , 4 th and 5 th cohort groups of the Maine Governor's Academy for Science and Mathematics Leadership for 4 years from 2010 through 2014.	2010	2014	Bernhardt	MMSA/ University of Maine System	Federal Title IIA funds	Graduation of 120 Governor's Academy fellows and documentation of their leadership roles/work over five years.
1.3.1 Meet with the University of Maine System to discuss and develop an elementary STEM specialist teacher training/mentoring program. Recruit talented mathematics and science high school students to participate. Provide tuition payment in exchange for a commitment to teach in a low-achieving school for 2 years following graduation from the program.	2011	2018	Hupp	Shelley Reed/Harry Osgood/ Bernhardt/ Department of Labor (John Dorrer)	To be met within existing position responsibilities and external funding streams to be identified	Minutes from meetings with University of Maine leadership. Paper describing the proposed training/mentoring program by the end of January 2011. Funding. Letters to students with high scores on the State mathematics and/or science assessment at grade 8 in 2011, introducing them to

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
						STEM careers and encouraging them to pursue STEM careers. Professional development delivered to guidance counselors at middle schools and high schools to provide tools to promote STEM career paths.
1.4.1 Adopt the Common Core State Standards for mathematics and support the development of revised standards in science and the adoption of core standards in science.	2010	2012	Mailhot/ Bernhardt		To be met within existing position responsibilities	Adoption of the Common Core State Standards for mathematics. Documentation of meetings/webinars related to Common Core State Standards development. Documentation of meetings/webinars related to science standards revision. Adoption of revised science standards.
1.5.1 Support effective STEM technology integration into classroom practices to promote higher level thinking skills. Move technology integration above the substitution and augmentation level into the meaningful realm of redefinition and transformation. Focus on professional development using the Technological Pedagogical Content	2010	2013	Garton	Small	To be met within existing position responsibilities	Documentation of TPCK and SAMR models workshops offered through consultative district professional development.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
Knowledge (TPCK) and the Substitution, Augmentation, Modification, and Redefinition (SAMR) models to increase technology integration.						

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Goal 2- Increased Aspiration to and Graduation in STEM-Related Careers

Goal #2: The number of students interested in pursuing STEM-related careers increases by 15 percentage points (from 33% to 48%) within four years, as reported on the PSAT and SAT student surveys; and the number of Maine students who graduate from two-year and four-year engineering and STEM-related programs statewide increases by 10%.

Objectives:

1. Improve student awareness of and participation in STEM-related pathways
2. Increase after-school programming that supports STEM learning
3. Increase internship opportunities that provide awareness of STEM opportunities

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
2.1.1 Target 5 CTE centers and their affiliated high schools for Project Lead the Way programs in either engineering or biomedical studies and implement these programs to increase student awareness of and engagement in STEM-related pathways.	2011	2013	Lagasse/ Littlefield/ Robertson		To be met within existing position responsibilities and external funding streams	Grants to fund the implementation of the programs in 5 CTE centers and their affiliated high schools.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
2.1.2 Create STEM social networks for students using the existing MLTI collaboration space (Studywiz) that is part of the existing base on the laptops.	2010	2013	Garton	Small	To be met within existing position responsibilities	A social network each school year for the next three years. Measurement of awareness of STEM pathways for students who participate in the networks as compared with students who do not participate in the networks.
2.1.3 Bring outside STEM resources (including scientists, virtual field trips, experiments and engineering challenges, self-directed exploration, simulations, industry experts, etc.) into the classroom. Leverage the Internet and the existing MLTI infrastructure to deliver high quality online resources.	2010	2013	Garton	Bernhardt/ Mailhot	To be met within existing position responsibilities	Catalog of resources on the MLTI website and showcase of them at 2012 STEM Summit. Measurement of awareness of STEM pathways for students who participate in the networks as compared with students who do not participate in the networks.
2.1.4. Partner with the University of Southern Maine to identify and provide scholarships for high achieving females and students from underrepresented groups to pursue undergraduate STEM degrees.	2010	2014	Bernhardt/ Osgood		To be met within existing position responsibilities	Identification of funding and University scholarship opportunities.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
2.2.1 Identify areas of the State demonstrating low achievement on State assessments and/or low aspirations to pursue STEM careers. Focus professional development efforts on effective instructional methods and leverage the existing MLTI infrastructure to disseminate and use the TPCK and SAMR models to increase technology integration.	2011	2013	Robertson/Mailhot/ Bernhardt/ Lagasse	Educational Development Center/ Hutton/ Smith/	To be met within existing position responsibilities and external funding streams	Identification of key areas of the State for focus. Grant to support the programming. Documentation of TPCK and SAMR models workshops offered through consultative district professional development.
2.2.2 Coordinate with organizations and programs such as First Lego League, First Robotics and Maine Environmental Education Association and others to identify and secure grant funding that will support after-school programs for students from underrepresented groups in STEM activities (including students in poverty and females).	2010	2014	Robertson/Mailhot/ Bernhardt/ Lagasse	EDC/ Hutton/ Smith/	To be met within existing position responsibilities and external funding streams	Identification of key areas of the State for focus. Grant to support the programming.
2.2.3 Develop and promote individualized after-school programs/networks in mathematics and science through the MLTI network.	2010	2014	Garton	Small	To be met within existing position responsibilities	Showcase, at the 2012 STEM Summit, of the programs/networks developed.
2.3.2 Partner with University of Maine at Augusta and the University of Maine at Farmington to identify and promote summer internships for undergraduates within MLTI/DOE.	2010	2013	Garton/ Bernhardt/ Mailhot		To be met within existing position responsibilities and external funding streams	Identification of funding and establishment of two ongoing internships at MLTI/DOE by 2013.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Goal 3 – Coordinated Initiative and Increased Federal Grant Funding of STEM Programs

Goal #3: The STEM initiatives of the Department of Education and the STEM Collaborative, which includes governmental, non-profit and business partners, are coordinated and three million dollars in federal grants is secured by the Department of Education to support STEM learning and growth in the State.

Objectives:

1. Increase Maine Department of Education STEM integration and grant awards
2. Develop common STEM goals
3. Identify and scale up promising and proven STEM programs
4. Collaborate with key stakeholders to assess STEM teaching and learning and the State’s capacity to improve them

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		Start
3.1.1 Create a Maine Department of Education STEM team that meets regularly to discuss initiatives and coordinate efforts to apply for federal grants.	2010	2018	Mailhot	Lagasse	To be met within existing position responsibilities	Documentation of quarterly meetings and progress on the STEM Strategic Plan.
3.1.2 Create a plan for grant development that will include collaboration with industry.	2010	2010	Lagasse	Mailhot/ Bernhardt	To be met within existing position responsibilities	Written plans by January 30, 2011.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		
3.1.3 Train all DOE STEM team members in grant writing.	2010	2011	Mailhot	Moody	To be met within existing position responsibilities	Documentation of trainings and DOE STEM team members who attended by June 2011.
3.1.4 Invest in grant research to understand the grant funding streams that are available.	2010	2012	Bernhardt/ Mailhot	Moody/ Tome	To be met within existing position responsibilities	List of places to monitor for potential grant sources: <ul style="list-style-type: none"> • Department of Labor • NASA • National Science Foundation • U.S. Department of Energy • U.S. Department of Education (including Title I and Title II) • Gates Foundation • Math Science Partnership
3.1.5 Support innovation and the investigation of new technology practices, including practices such as mathematics and science Open Educational Resources (OER) that leverage the MLTI infrastructure.	2012	2013	Garton		To be met within existing position responsibilities	Grant for innovation.
3.1.6 Collaborate with DOE Title I staff to ensure that STEM professional development opportunities are coordinated with Title I and school improvement work and influence the instruction in these schools (PreK-8). Use the research/model supplied by the National Academy of Sciences report <i>Ready, Set,</i>	2011	2011	Tome	Bernhardt	To be met within existing position responsibilities	Plan for coordinating mathematics and science with literacy efforts at PreK-8 Level in low-achieving schools that are Title I served and in CIPS status.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Key Activities	Timeframe		Tasking		Funding	Deliverable/Evidence Start
	Start	Finish	Primary Lead	Support		
<i>Science!</i> as a foundation for the work.						
3.2.1 Partner with the STEM Collaborative on the development and implementation of a cross organization STEM strategic plan.	2010	2013	Bernhardt		To be met within existing position responsibilities	Strategic plan by December 2010. Participate in the STEM Collaborative by serving on the Executive Committee and the Steering Committee for this organization.
3.2.2 Collaborate with the Maine Environmental Education Association, Maine Audubon, and the Department of Conservation to develop and implement an Environmental Literacy Plan for the State.	2010	2010	Bernhardt	Lagasse	To be met within existing position responsibilities	Environmental Literacy Plan by December 31, 2010
3.2.3 Collaborate with other organizations throughout the State to develop and implement scalable programs that support learning related to sustainability and energy.	2010	2012	Bernhardt/Mao		To be met within existing position responsibilities	Sustainability/energy education programs that provide statewide outreach to teachers and students.
3.3.1. Partner with other stakeholders (business, the Department of Labor, the University of Maine System, etc.) to develop criteria for high quality internships linked to workforce needs for students in high schools and CTE centers. Target areas will include <ul style="list-style-type: none"> • engineering design, • environmental sustainability, and • biomedical studies. 	2010	2012	Lagasse/ Littlefield		To be met within existing position responsibilities	Showcase partners and criteria for high quality internships at the 2012 STEM Summit.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

	Timeframe		Tasking		Funding	Deliverable/Evidence
	Start	Finish	Primary Lead	Support		Start
3.4.1 Partner with the STEM Collaborative to conduct a comprehensive statewide STEM study that: describes student achievement, student aspirations, and teacher certification and endorsement data: and analyzes statewide capacity to support STEM learning.	2010	2010	Bernhardt		To be met within existing position responsibilities	Initial STEM study report results at Maine EPCOR (Experimental Program to Stimulate Competitive Research) Meeting.

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Statewide Strategic Plan for STEM – The Importance of Partnerships

The successful implementation of the Statewide Strategic Plan for STEM will require collaboration across agencies and organizations in the State. The following is a list of some but not all of the existing and anticipated partners essential to the success of improving science, technology, engineering, and mathematics education in Maine.

Maine Audubon

Maine Department of Conservation

Maine Environmental Education Association

Maine Robotics

Maine STEM Collaborative Steering Committee Members (Listing of member organizations follows)

STEM Collaborative Executive Committee Members

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Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

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**Maine Department of Education
Statewide Strategic Plan for
Science, Technology, Engineering, and Mathematics (STEM)**

**Technology Education Association of Maine
The Maine Community College System
University of Maine System**

Maine Department of Education Statewide Strategic Plan for Science, Technology, Engineering, and Mathematics (STEM)

Glossary

CIPS – Continuous Improvement Priority Schools

CTE – Career and Technical Education

DOE – Maine Department of Education

EPSCoR – Experimental Program to Stimulate Competitive Research

MLTI – Maine Learning Technology Initiative

NASA – National Aeronautics and Space Administration

NSF – National Science Foundation

OER – Open Education Resources

SAMR – Substitution, Augmentation, Modification, and Redefinition

STEM – Science, Technology, Engineering and Mathematics

TPCK – Technological Pedagogical Content Knowledge