STEM (Science, Technology, Engineering, and Mathematics) Materials

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*The programs, curricula, research, and resources identified on this list are provided in an effort to inform the development of new **Math/Science Partnership Projects** that will have a particular focus on engineering. Inclusion on this list does not signify endorsement by the Vermont Department of Education. The hope is that partners will investigate and utilize materials to move work forward and improve the quality of applications.*

Programs/Curricula

Building Structures with Young Children Trainers' Guide (Young Scientist Series, Education Development Center, PreK-K) by Ingrid Chalufour and Karen Worth provides a framework for supporting teachers' understanding of inquiry-based teaching. This unit enables teachers to guide children's explorations to help deepen their understanding of the physical science present in building block structures, including concepts such as gravity, stability, and balance. This curriculum supports children's early development of important science inquiry skills through learning opportunities that range from exploring blocks to designing and building complex block structures: http://www.redleafpress.org/Building-Structures-with-Young-Children-Teachers-Guide-P70.aspx.

Building Math (Boston Museum of Science, Grades 6-8) was created with support from the GE Foundations Math Excellence Program. This program inspires students to learn algebra by solving engineering challenges on imagined adventures to Mount Everest, the Amazon, and a deserted South Pacific island: http://www.mos.org/educators/classroom_resources/curricula_and_research&d=2020.

***Engineering is Elementary*® (EiE) project** (Boston Museum of Science, Grades 1-5) fosters engineering and technological literacy among children. EiE is creating a research-based, standards-driven, and classroom-tested curriculum that integrates engineering and technology concepts and skills with elementary science topics. EiE lessons promote science, technology, engineering, and mathematics (STEM) learning and make meaningful connections to literacy and social studies: http://www.mos.org/eie/index.php.

***Engineering the Future: Science, Technology, and the Design Process*™** (Boston Museum of Science, High School) is a full-year course designed to introduce students to the world of technology and engineering, as a first step in becoming technologically literate citizens. Additionally, the course will help beginning high school students answer the question: "Why should I study math, science and engineering if I don't plan on a technical career?" Through this course's practical real-world connections, students have an opportunity to see how science, mathematics, and engineering are part of their everyday world, and why it is important for every citizen to be technologically and scientifically literate: http://www.mos.org/etf/.

Exploring Water with Young Children Trainers' Guide *(Young Scientist Series, Education Development Center, PreK-K)* by Ingrid Chalufour and Karen Worth focuses children's explorations to help deepen their understanding of water and its properties—including concepts related to water's flow, appearance, and effect on objects. This curriculum supports children's early development of important science inquiry skills such as questioning, investigating, discussing, and formulating ideas and theories: http://www.redleafpress.org/Exploring-Water-with-Young-Children-Teachers-Guide-P75C1288.aspx.

Project Lead the Way (Middle and High School) provides innovative STEM education for middle schools and high schools. PLTW's curriculum is collaboratively developed by PLTW teachers, university educators, engineering and biomedical professionals, and school administrators to emphasize critical thinking, creativity, innovation, and real-world problem solving – all important skills for students to develop in today's 21st century global economy. The hands-on, project-based program engages students by showing them how what they are learning in math and science class applies to real-world challenges: http://www.pltw.org/.

Research/Resources

A New Definition (2009) by Stephanie Hirsh (Learning Forward previously the National Staff Development Council) identifies essential components of quality professional learning opportunities. "Recognizing the need to ensure high-quality professional learning for every educator, NSDC is advocating for a powerful new definition of professional development based on this model of continuous improvement." This document is available at: http://www.aea9.k12.ia.us/documents/filelibrary/pdf/csin/A_New_Definition_698714AA7ADAE.pdf.

Engineering Go for It (EGFI) has a variety of tools to boost students' math and science skills, enliven the classroom with engineering projects, expand your own professional horizons and stay informed: http://teachers.egfi-k12.org/.

Engineering in K-12 Education: Understanding the Status and Improving the Prospects by Linda Katehi, Greg Pearson, and Michael Feder, *Editors*; Committee on K-12 Engineering Education; National Academy of Engineering and National Research Council, 2009—Engineering education in K-12 classrooms is a small but growing phenomenon that may have implications for engineering and also for the other "STEM" subjects--science, technology, and mathematics. Specifically, engineering education may improve student learning and achievement in science and mathematics, increase awareness of engineering and the work of engineers, boost youth interest in pursuing engineering as a career, and increase the technological literacy of all students. The teaching of STEM subjects in U.S. schools must be improved in order to retain U.S. competitiveness in the global economy and to develop a workforce with the knowledge and skills to address technical and technological issues: http://books.nap.edu/catalog.php?record_id=12635#description.

Note: *As of June 2, 2011, all pdf versions of books published by the National Academies Press will be downloadable to anyone free of charge.*

Innovation America: Building a Science, Technology, Engineering, and Math Agenda, National Governors' Association, 2010—In the new global economy, states need a workforce with the knowledge and skills to compete. A new workforce of problem solvers, innovators, and inventors who are self-reliant and able to think logically is one of the critical foundations that drive innovative capacity in a state. A key to developing these skills is strengthening STEM competencies in every K–12 student: http://www.eric.ed.gov/PDFS/ED496324.pdf.

Ioannis Miaoulis NCTL STEM video provides some important reasons for educators to focus on the T and the E within STEM: http://www.youtube.com/watch?v=4B-g1_6QCWU.

Maine Pathways to STEM is committed to supporting students throughout their education as they move towards potential careers in the STEM fields. The goal is to make careers in the sciences more accessible for Maine students. An on-going exchange of ideas and resources for Maine students, parents, educators, businesses and policy makers is fostered through this website: http://www.mainestem.org/.

Math and Science Teacher Partnership (MSTP), funded by the Minnesota Department of Education, is a collaboration between the University of Minnesota, Intermediate District 287, Metro ECSU, North East Metro District 916, Brooklyn Center Schools, Hamline University, Normandale College, and Sci-MathMN. The MSTP is committed to high quality professional development in math and science: http://www.cehd.umn.edu/stem/Projects/MTSA/default.html.

Slow Off the Mark: Elementary School Teachers and the Crisis in Science, Technology, Engineering, and Math Education, Center for American Progress, 2011—In general, the workforce pipeline of elementary school teachers fails to ensure that the teachers who inform children's early academic trajectories have the appropriate knowledge of and disposition toward math-intensive subjects and mathematics itself. Prospective teachers can typically obtain a license to teach elementary school without taking a rigorous college-level STEM class such as calculus, statistics, or chemistry, and without demonstrating a solid grasp of mathematics knowledge, scientific knowledge, or the nature of inquiry. This is not a recipe for ensuring that students have successful early experiences with math and science, or for generating curiosity and confidence in these topics that students need to pursue careers in STEM: http://www.americanprogress.org/issues/2011/05/stem_paper.html.

MN-STEM has been made possible through the support of state organizations that include the Minnesota Department of Education, Minnesota High Tech Association, Minnesota Business Partnership, and the Minnesota Chamber of Commerce. It is an educational website launched to promote STEM in order to help students discover how their participation in certain coursework can lead directly to STEM careers. Through an assortment of compelling multimedia tools, students can learn that STEM applies directly to virtually every career field. From auto mechanics to aircraft engineers to firefighters, everyone in the workforce is touched daily by STEM.: http://www.mn-stem.com/.

Science and Literacy—A Natural Fit: A Guide for Professional Development Leaders by Karen Worth, Jeff Winokur, Sally Crissman, Martha Heller-Winokur, and Martha Davis provides professional development leaders with the materials needed to help teachers understand and use the many connections between balanced literacy instruction and inquiry science. Organized around eight modules, the comprehensive guide shows how to make talk and writing essential tools in science: http://www.heinemann.com/products/E02127.aspx.

STEM Teachers in Professional Learning Communities: From Good Teachers to Great Teaching, National Commission on Teaching and America's Future (NCTAF), 2011—With the support of the National Science Foundation and in collaboration with WestEd, NCTAF released this report. NCTAF and WestEd conducted a two-year analysis of research studies that documents what happens when science, technology, engineering, and math teachers work together in professional learning communities to improve teaching and increase student achievement. This report summarizes that work and provides examples of projects building on that model: http://www.nctaf.org/NCTAFReportNSFKnowledgeSynthesis.htm.

Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics, The National Academies Press, 2011—Science, mathematics, engineering, and technology (STEM) are fundamental aspects of everyone's lives as citizens, consumers, parents, and workers. This book provides an overview of the landscape of K-12 STEM education by considering different school models, highlighting research on effective STEM education practices, and identifying conditions that promote and limit school- and student-level success in STEM. It can serve as a guide for those involved in K-12 education at all levels; policy makers; decision makers at the school and district levels; local, state, and federal government agencies; curriculum developers; educators; and parent and education advocacy groups: http://www.nap.edu/catalog.php?record_id=13158.

Transformation and Technology: A New Way of Learning: The scenarios in this document were created in the fall of 2009 by Vermont educators in order to provide examples of what one might see in classrooms as standards are addressed. Divided into sections based first on the National Education Technology Standards for Students and then on grade clusters, the scenarios include the use of Web 2.0 tools, best practice teaching methods, and innovative uses of technology. School leaders should use this resources to gain knowledge on what is possible. Teachers should use this resource to help design meaningful learning opportunities that integrate technology: http://transformation-technology.wikispaces.com/.

Standards

Common Core State Standards provide a consistent, clear message about what students are expected to know, understand, and be able to do. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that young people need for success in college and careers: http://www.corestandards.org/.

The Next Generation Science Standards (NGSS) are expected to be released in the Fall of 2012. The report, ***A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, for the NGSS***, that will serve as a foundation for NGSS is now available. For additional information, please go to: http://www7.nationalacademies.org/bose/Standards_Framework_Homepage.html.