AN OVERVIEW OF STEM: SCIENCE, TECHNOLOGY ENGINEERING, MATHEMATICS

Alaska Workforce Investment Board – May 9, 2012

What does STEM stand for?

- Science, Technology, Engineering, and Math
- 1990s National Science Foundation
- □ Four discrete subjects
 - Science the study of the natural world, including laws of nature associated with physics, chemistry, and biology, along with the facts, principles, concepts, or conventions associated with these disciplines. (National Research Council, 2001)
 - Technology the innovation, change, or modification of the natural environment in order to satisfy perceived human wants and needs. (Standards for Technological Literacy, ITEA, 2000)
 - Engineering the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practices are applied with judgments to develop ways to utilize economically the materials and forces of nature for the benefit of mankind.

(Accreditation Board for Engineering and Technology (ABET, 2002)

- Mathematics the science of numbers and their operations, interrelations, combinations, generalizations, and abstractions and of space configurations and their structure, measurement, transformations, and generalizations (Webster's Ninth New Collegiate Dictionary, 2004)
- □ Common Definitions?

Defining STEM

STEM Jobs - STEM Workforce - STEM Education

- □ A few definitions . . .
 - Career Clusters and Pathways
 - National Research Council
 - National Science Foundation
 - National Governors' Association
 - California Department of Education

STEM Knowledge & Skills STEM Literacy

STEM Knowledge and Skills

- Mathematical and scientific reasoning
- Technology design
- Systems analysis and evaluation
- Deductive and inductive reasoning
- Practical application of engineering science
- STEM Literacy
 - ability to apply understanding of how the world works within and across the areas of science, technology, engineering, and math
 - ability to problem-solve, analyze, communicate, and understand technology

STEMmania!

National STEM Activities

- States' activities
- Other national STEM efforts
- Workforce Investment Boards and STEM activities
- STEM-related reports
- Alaska STEM Activities
 - School districts
 - University of Alaska
 - Other STEM programs

AWIB STEM Panel

- Dan Robinson, Department of Labor and Workforce Development, Director of Research & Analysis
- Kim Rice, Department of Transportation & Public Facilities, Central Region Design & Construction Director
- Michael Fenster, Anchorage School District, STEM Coordinator
- Becca Parks, Juneau Economic Development Council, Education Specialist for STEM AK Program

STEM Definitions

1. National Career Clusters (<u>http://www.careertech.org/career-clusters/glance/</u>)



Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services.

Includes occupations such as engineer (all types), technician (all types), drafter, chemist, mathematician, archeologist, biologist, economist, metallurgist, math or science teacher, nutritionist, oceanographer, materials analyst, computer programmer, technical sales manager, CAD operator, and technical writer.

2. National Research Council (<u>http://www.nationalacademies.org/about/whoweare.html</u>)

The four STEM subjects as defined by the National Research Council:

- *Science* is the study of the natural world, including the laws of nature associated with physics, chemistry, and biology and the treatment or application of facts, principles, concepts, or conventions associated with these disciplines.
- *Technology* comprises the entire system of people and organizations, knowledge, processes, and devices that go into creating and operating technological artifacts, as well as the artifacts themselves.
- *Engineering* is a body of knowledge about the design and creation of products and a process for solving problems. Engineering utilizes concepts in science and mathematics and technological tools.
- *Mathematics* is the study of patterns and relationships among quantities, numbers, and shapes. Mathematics includes theoretical mathematics and applied mathematics.

3. National Science Foundation (NSF) (<u>http://www.nsf.gov/</u>)

The NSF definition of STEM fields includes mathematics, natural sciences, engineering, computer and information sciences, and the social and behavioral sciences – psychology, economics, sociology, and political science.

STEM education and training provides the United States with three kinds of intellectual capital:

- Scientists and engineers who continue the research and development that is central to the economic growth of our country;
- Technologically proficient workers who are able to keep pace with rapidly developing scientific and engineering innovations; and
- Scientifically literate voters and citizens who make intelligent decisions about public policy and who understand the world around them.

To achieve this expanded human capital, STEM initiatives are aimed at improving the educational experience from elementary school to graduate education, and thus prepare students to eventually solve not only current problems but also unimagined ones of the future.

4. National Governors' Association (NGA) (<u>http://www.nga.org/cms/stem</u>)

Different studies often use slightly different groupings for STEM-related occupations. Science, technology, engineering, and math positions appear consistently, but some studies include management and sales in STEM fields, while other research does not. Additional workers not consistently represented are STEM education employees, social scientists, certain health care professionals, and economists. In general, most studies tend to *under-represent* the total number of positions that involve STEM knowledge, such as understanding quantitative analysis.

In its report, "Innovation America: Building a Science, Technology, Engineering, and Math Agenda," the NGA notes a main goal of STEM education is "STEM literacy", or the ability to apply understanding of how the world works within and across the areas of science, technology, engineering, and math. STEM is an interdisciplinary area of study that bridges the four areas; it does not simply mean achieving literacy in each of these strands or silos. A STEM-literate student also is experienced in problem-solving, analytical, communication, and technology skills.

5. California Department of Education (<u>http://www.cde.ca.gov/pd/ca/sc/stemintrod.asp</u>)

STEM education is a sequence of courses or program of study that prepares students ...:

- for successful employment, post-secondary education, or both that require different and more technically sophisticated skills including the application of mathematics and science skills and concepts, and
- to be competent, capable citizens in our technology-dependent, democratic society.

STEM education can be an interdisciplinary or trans-disciplinary approach to learning where rigorous academic concepts are coupled with real-world problem-based and performance-based lessons. At this level, STEM education exemplifies the axiom "the whole is more than the sum of the parts."

STEM in Other States

From Education Commission of the States - www.ecs.org

Report on Economic/Workforce Development – High Tech/(STEM)

States' initiatives have diverse origins and goals, and include executive orders, legislation, STEM councils or commissions, and agreements between national organizations and states. Policies are as diverse in their scope as they are in their origin. Some examples:

- Eight states Arizona, Arkansas, Connecticut, Kentucky, Minnesota, Missouri, Rhode Island and West Virginia – have convened councils, commissions or roundtables to provide recommendations and guidance on how STEM education can be improved.
- Five states Florida, Illinois, Massachusetts, Virginia and West Virginia have created specialized grant programs to improve STEM education. These funds employ a variety of strategies for improving STEM achievement. Virginia's program seeks to attract students to STEM degrees and employment by providing grants to those who earn a degree in a STEM field and become employed in a STEM field in the state. Florida has established a policy to attract world-class scholars to selected institutions of higher education in the state.
- Five states Indiana, Massachusetts, Minnesota, Ohio and Texas intend to improve the skills of teachers in STEM subjects through their initiatives.
- Two states Minnesota and Ohio include opportunities for students to earn college credit while in high school.
- Eleven states Arizona, Connecticut, Florida, Indiana, Massachusetts, Minnesota, Rhode Island, Texas, Utah, Virginia, Washington, and Wyoming – include some sort of workforce development activities in the STEM policies or initiatives.

Other National STEM-related Efforts

- National Lieutenant Governors' Association (NLGA) adopted Lt. Governor Treadwell's resolution supporting STEM Education (July 2011) -<u>http://ltgov.alaska.gov/treadwell/press-room/full-press-release.html?pr=67</u>
- National Science Foundation
 - o STEP (Science, Technology, Engineering, and Mathematics Talent Expansion Program) Grant Solicitation due Sept. 25, 2012
- STEM Education Coalition <u>www.stemedcoalition.org</u>
- STEM Education Caucus US Congress (<u>http://stemedcaucus2.org/</u>)
- National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics (STEM) Education created February 2011 (from Office of Science Technology and Policy)
- US Department of Education -

Workforce Investment Boards with STEM Initiatives/Activities – A Sample

- South Bay, CA conference for STEM academy students to learn about STEM-related • companies and STEM jobs.
- North Shore, MA Summer STEM Externships •
- Eastern Connecticut WIB assistance to dislocated workers and disadvantaged youth by • providing resources for STEM-related activities, such as a virtual STEM Center and STEM mentors.
- Southwest Corner, PA STEM Employment Expo, STEM Industry Partnerships, state STEM Conference.
- Upper Rio Grande, TX STEM competition for high school students at UT El Paso. •
- Will County, IL Workforce Indicator Report on local STEM workforce. ٠
- FL 9 WIBs are partners in the "STEMflorida" Initiative and forming regional STEM • Collaboratives to collect and communicate STEM-enabled opportunities such as externships, internships, and apprenticeships across the state
- Eastern Connecticut WIB CT STEM Jobs Interactive website for students, jobseekers, • employers, mentors, educators, and the public - provides information and resources about education, training, career coaching, jobs, etc. about STEM-related occupations.

STEM-related Reports

- "Report to the President Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America's Future" - President's Council of Advisors on Science and Technology, September 2010 http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf
- National Governors' Association (NGA)
 - "Promoting STEM Education: A Communications Toolkit" http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemedreport.pdf - July 2011
 - "Building a Science, Technology, Engineering, and Math Agenda" December 2011
- "STEM: Science, Technology, Engineering, and Mathematics" Georgetown University -Center on Education & the Workforce - http://cew.georgetown.edu/stem/ - October 2011
- "The Federal Science, Technology, Engineering, and Mathematics (STEM) Education Portfolio" - Committee on STEM Education, National Science and Technology Council http://cew.georgetown.edu/stem/ - December 2011
- "The STEM Workforce Challenge: the Role of the Public Workforce System in a National Solution for a Competitive Science, Technology, Engineering, and Mathematics (STEM) Workforce" - April 2007 -

http://www.doleta.gov/vouth_services/pdf/STEM_Report_4%2007.pdf

School District STEM Programs*

Anchorage: Engineering is Elementary teacher training; AK Science & Engineering Fair; AK Zoo day - first graders, Science Olympiad; ROV Riot; Math Derby; Outdoor Week (Grade 6); school Science Fairs.

Annette Island: Robotics and a Simulator in conjunction with other schools across the nation from Florida to Seattle.

Chatham: The oceanography class built underwater robots.

Delta Greely: Intervention Math program open to all students in grades 4 – 12 who need help with math - there have been measurable gains in achievement

Juneau: High schools - Architecture, Construction, Engineering-(ACE) program; Project Lead the Way (PLTW) engineering program; robotics club; courses in Oceanography, Anatomy and Physiology, Intro to Health Sciences, Medical Terminology, ETT and EMT, Video Production, Digital Arts, GIS, Forensic Science, Principles of Nutrition; working with JEDC springboard to infuse engineering into Physical Science classes and with SeaPerch Curriculum; planning Fisheries Tech program next year. Middle schools - Lego FIRST.

Kodiak: CTE programs in Drafting, Welding, Auto, Culinary Arts, Multimedia, Maritime Science, A+ Certification, Woods/Construction, Business/Accounting, and Health Occupations. Four Career Tech Student Organizations (CTSO's): FCCLA, FFA, HOSA, and SkillsUSA. Elementary and middle school programs -- iMovie, Art/Graphic Design, Keyboarding, and Smartboard presentations. Extended Learning Program (ELP) has class on basic engineering design; LEGO robotics, ROVs furnished by Prince William Sound Science Center.

Mat-Su: K12 STEM program at Machetanz Elementary, Teeland Middle, and the Career & Technical High School, using Edmodo, Moodle, Lego robotics, and a STEM curriculum to promote STEM education.

Wrangell: LeConte Glacier Trip and associated activities as part of 3rd Grade curriculum. Some high school students work on a project using tech equipment to monitor the glacier.

Yukon-Koyukuk: MapTEACH program (hybrid GPS/GIS)

* Thank you to Roxy Mourant, Educational Technology Coordinator at the Alaska Department of Education & Early Development, for providing school-district STEM information (<u>Roxanne.Mourant@alaska.gov</u>)

University of Alaska - Sample of STEM-related Programs

- Alaska Space Grant Program (<u>http://spacegrant.alaska.edu/</u>)
- Alaska Native Science and Engineering Program (http://www.ansep.net/)
- STEM Transition Event for students with disabilities (http://www.washington.edu/doit/Stem/articles?411)
- UAS working with Greens Creek Mine on grade 3- 12 STEM curriculum
- Mining and Petroleum Training Service (<u>http://www.alaska.net/~mapts/</u>)
- UAF Geophysical Institute (<u>http://www.gi.alaska.edu/category/general/stem</u>)
- UA Pathways Science, Technology, Engineering, and Research Pathway Programs and Degrees (<u>http://www.alaska.edu/files/research/Science-Technology-Engineering-Research.pdf</u>)

Overview of Alaska STEM Activities/Programs

Other STEM Programs in Alaska

Real World Design Challenge

http://www.realworlddesignchallenge.org/AK.php Sponsored by Aerospace States Association, Lt. Governor Mead Treadwell, Chair

Geospatial Technologies for the Environmental Studies Classroom

Alaska's Learning Network - <u>www.aklearn.net</u> Summer Course for Alaska Teachers and High School Students

Alaska Process Industry Careers Consortium (APICC)

http://www.apicc.org/servlet/content/home.html

- Alaska Engineering Academies Initiative
- Teacher Industry Externships
- Process Technology Curriculum

Alaska Health Workforce Coalition

https://sites.google.com/site/alaskahealthworkforcecoalition/

Project Lead the Way

National engineering and biomedical sciences curriculum is used in the following schools:

- Dimond and Service High Schools and Mears Middle School, Anchorage
- Juneau Douglas High School
- Lathrop High School, Fairbanks
- Career and Technical High School and Palmer High School in Mat-Su
- Soldotna High School in Kenai

Juneau Economic Development Council (JEDC)

STEM AK <u>http://stemak.org/</u>

- FIRST LEGO League (FIRST = For the Inspiration and Recognition of Science and Technology)
- FIRST Tech Challenge
- SeaPerch underwater robotics program
- CryoConn Connections
- Engineering is Elementary
- Materials World Modules

AKELP – Alaska Environmental Literacy Plan

http://www.eed.state.ak.us/tls/AKELP/home.html

Anchorage Museum

School Outreach Programs (<u>http://www.anchoragemuseum.org/learn/SCHOOL_outreach.aspx</u>) STEM opportunities for teachers & students, e.g., Science on a Sphere, Science Festivals, Starlab

STEM-related software for Alaska schools

Google SketchUp Pro 3-D and ArcGIS software available to all Alaska schools at no charge http://www.aklearn.net/resources/

Math-in-CTE Teacher Professional Development

http://www.eed.alaska.gov/tls/cte/mathincte.html