Science, Technology Engineering, and Mathematics (STEM) Education

2011 Interim Project

Senate Early Learning and K-12 Education Committee

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As a 2011 interim project, Senate Education Committee staff reviewed many of Washington's efforts to promote and improve STEM education in K-12 education. Additionally, staff conducted limited research on efforts at the federal level and in other states and compiled that information. Please refer to the 2011 Senate Education Committee interim project on High School Mathematics and Science Assessments for related information.

I. Washington STEM Teachers[1]

The exact number of STEM teachers currently teaching STEM subjects in Washington State public schools is not readily available. It is anticipated that CEDARS *(the new student/teacher data system at the Office of the Superintendent of Public Instruction)* will be able to provide this information in the future.

The following is the available information from the Washington Professional Educator Standards Board (PESB) website regard the number of STEM subject endorsements that were issued in Washington in 2009 and the number of beginning and experienced teachers with a STEM endorsement hired in 2010. There were more mathematics endorsements issued than mathematics teachers hired and generally less science and technology endorsements issued than teachers hired.

	2009 Endorsements Issued	Beginning & Experience Teachers Hired in 2010
• Mathematics	259	232
• Middle level Math	133	76
• Biology	125	242
• Science	100	114
• Middle level Science	54	28
• Middle level Math/Science	49	32
• Chemistry	40	82
• Earth & Space Science	37	31
• Physics	24	67
• Technology Education	9	24

The PESB website has trend data, beginning in 2003, that shows that Washington school districts are hiring fewer new mathematics and science teachers each year. The PESB attributes this lack of beginning teacher hiring to an overall reduction in workforce but has also determined that much more of this trend is due to currently employed teachers staying longer then was typical in past years (*i.e.,* lack of teacher attrition). The PESB has determined this is due to changing retirement patterns, which is likely due to the current economic climate.

Section VIII of this paper provides information on different Washington and other efforts regarding training, professional development, scholarships, and coaching programs to increase the number of STEM teachers and/or to improve the capacity of teachers in STEM related education.

II. Washington STEM Essential Academic Learning Requirements (EALRs)

Washington's student learning standards are known as the Essential Academic Learning Requirements (EALRs) and describe what students should know and be able to do.

A. Mathematics[2]

In 2008 the Washington State K-12 mathematics EALRs were revised and adopted by the Office of the Superintendent of Public Instruction (OSPI). On July 20, 2011, Washington became one of 45 states that have formally adopted the Common Core State Standards (CCSS) for mathematics. Students will continue to be tested on the 2008 mathematics EALRs through the 2013-14 school year. Assessments for the newly adopted mathematics CCSS will be piloted in 2013 and are to be administered statewide in the 2014-15 school year. States that have adopted CCSS have the option to add additional standards. The OSPI website provides that Washington will implement the CCSS before making a decision on whether to add more standards.

B. Science[3]

In 2009 the Washington State K-12 science EALRs were revised and adopted by OSPI. Currently, the National Research Council, the National Science Teachers Association, the American Association for the Advancement of Science, and Achieve, Incorporated are working to develop the CCSS in science. The effort is similar to that done for English/language arts and mathematics. The framework for the science standards was released in July 2011. The science standards are expected to be available for states to review by spring of 2012. The Washington State Legislature has authorized the OSPI to participate in the development of the CCSS science standards and assessments and to adapt state high school science assessments accordingly, as long as the legislative education committees have an opportunity to review any proposed modifications before they are adopted.

C. Technology[4]

The 2007 Washington State Legislature directed the OSPI to develop EALRs and grade level expectations for educational technology literacy and technology fluency. The assessments for educational technology have been integrated into the core content areas — science, mathematics, health, English/language arts, social studies and the arts. In 2011, the Legislature required school districts to provide students with the opportunity to integrate technology literacy and fluency along with other experiences and knowledge to form reasoned judgments and solve problems.

III. STEM Curricula in Washington[5]

Washington has no state-adopted curriculum in any academic subject at any K-12 level. However, in 2007 the Legislature directed the OSPI, in consultation with the State Board of Education (SBE), to recommend no more than three mathematics and science curricula at the elementary, middle and high school levels. The OSPI reported curricula recommendations for mathematics in 2008 and for science in 2009. While the recommendations serve as a guide to school districts regarding which curricula are most aligned with the revised K-12 EALRs, it is not a state requirement for any district to use a recommended curriculum.

A. Mathematics[6]

In 2007, OSPI commissioned a curriculum study by the University of Washington and the Center for Strengthening the Teaching Profession that included a survey of teachers in high performing or

improving schools.[7] Most teachers that responded to the survey indicated that they spent at least 75 percent of their teaching time using district-adopted textbooks and instructional materials, while a third of the teachers spent at least a quarter of their instructional time using teacher-developed instructional materials and tools. However, the responding teachers were not overly satisfied with the mathematics textbooks they were using, as only about a quarter *(27 percent)* strongly agreed that they were generally satisfied with their textbooks, and another 35 percent somewhat agreed. The teachers also reported a lack of appropriate curricula and textbooks to work with struggling students, which was identified as a moderate or great challenge by 38 percent.

The OSPI 2008 recommendations for mathematics curricula are shown in the table below as well as results from a 2008 survey conducted by the OSPI regarding mathematics curricula used in Washington school districts *(the survey was done prior the curriculum recommendations being finalized.)* Although survey responses were not received from all districts, ninety-nine percent, or 293 of 295 districts reported, representing 99.9 percent of the statewide student population. However, not all districts reported all elementary, middle, and high school curricula usage. The results show that no districts that responded to the survey were using a recommended science curriculum at the elementary level or middle school level. At the high school level, the majority of school districts that responded to the survey used a traditional Algebra/Geometry curriculum rather than an Integrated Mathematics curriculum.

OSPI Recommended Mathematics Curricula **(Publisher)**	**Curriculum Used by Reporting School Districts** **Number of districts and percentage of student population using the curriculum**
Elementary School Grades (Grades K-5)	
• *Math Connects* (McMIllan McGaw-Hill) • *Math Expressions* (Houghton Mifflin)	• *Everyday Mathematics* (75 districts of the 290 reporting; serving 33.61 % of the state's student population) • *Investigations* (68 districts of the 290 reporting; serving 31.88 % of the state's student population)
Middle School Level (Grades 6-8)	
• *Holt Mathematics* (Holt McDougal) • *Math Connects* (Glencoe McGraw-Hill) • *Prentice Hall Mathematics* (Pearson Prentice-Hall)	*Connected Math Project* (160 of the 267 districts reporting; serving 64.31% the state's student population)
High School Level (Grades 9-12)	
• 9-12: *Holt Algebra I, II, Geometry* (Holt McDougal).	• 189 (approximately 77%) of the 246 districts with high schools reported curricula usage at the high school level. • Approximately 50% of districts that reported use traditional curricula materials (Algebra I & Geometry). • 64 districts reported using integrated mathematics curricula for high school instruction, representing approximately 36% of the state's student population.

B. Science[8]

The OSPI 2009 recommendations for science are shown in the table below as well as results from a 2009 survey conducted by the OSPI and the nine Educational Service Districts (ESDs) regarding science curriculum used in Washington school districts *(the survey was done after the curriculum recommendations were finalized.)* Although survey responses were not received from all districts, a majority of districts did respond representing a majority of the student population. The results show that the majority of districts that responded are using a recommended science curriculum at the elementary school level and no school district is using a recommended science curriculum at the middle school level. At the high school level, less than a quarter of the responding school districts use a recommended biology curriculum; no district uses a recommended chemistry or physics curricula; and all the districts that responded use a recommended integrated science curricula.

Course	OSPI Recommended Science Curricula (Publisher)	Number and Percentage of School Districts Reporting	Curriculum Used by percentage of School Districts
Elementary School Grades (Grades K-5)			
N/A	• *Science Companion* (Chicago Ed Pub Co). • *Science and Technology for Children* (Carolina Curriculum) • *Full Option Science System* (Delta Education)	230 Districts (78%) Represents 92% of all students statewide	• *Science & Technology for Children* – 21% • *Full Option Science Study* – 49% • A blended set of materials from multiple publishers – 25%
Middle School Level (Grades 6-8)			
N/A	• *Science Explorer* (Pearson Prentice-Hall) • *McDougal Littell Science Modules* (Holt McDougal) • *Full Option Science System* (Delta Education)	187 Districts (64%) Represents 89% of all students statewide	• *Science & Technology for Children Middle School* – 16% • *Prentice Hall Science* – 11% • A blended set of materials from multiple publishers – 53%
High School Level (Grades 9-12)			
Biology (Life Science Domain)	• *Biology: A Human Approach* (Kendall/Hunt) • *Insights in Biology* (Kendall/Hunt)	128 Districts (43%)	• *Biology: A Human Approach* – 20% • *Biology* • (Prentice Hall) – 29%

Course	OSPI Recommended Science Curricula (Publisher)	Number and Percentage of School Districts Reporting	Curriculum Used by percentage of School Districts
High School Level (Grades 9-12) *continued*			
Chemistry (Physical Science Domain)	• *Active Chemistry* (It's About Time Publishing) • *Chemistry* (Kendall/Hunt)	115 Districts (39%)	• *Modern Chemistry* (Holt) – 22% • *Chemistry* (Prentice Hall) – 22%
Earth/Space Science (Earth and Space Science Domain)	• *EarthComm* (It's About Time Publishing)	N/A	N/A
Integrated Science (Physical Science Domain)	• *Science: An Inquiry Approach* (Kendall/Hunt) • *Coordinated Science* (It's About Time Publishing)	25 Districts (8%)	• *Science: An Inquiry Approach* – 40% • *Coordinated Science* – 24%
Physical Science (Physical Science Domain)	• *Active Physical Science* (It's About Time Publishing) • *Foundations of Physical Science* (CPO Science)	N/A	N/A
Physics (Physical Science Domain)	• *Active Physics* (It's About Time Publishing)	106 Districts (36%)	• *Physics: Principles & Problems* (Glencoe) – 32% • *Conceptual Physics* (Prentice Hall) – 24%

IV. Washington STEM High School Courses[9]

In 2008, the Washington SBE commissioned a transcript study by the Baker Education Research Consulting (BERC) Group to determine which course credits were being taken by the students in the graduating class of 2008. The BERC Group examined course-taking patterns of 14,875 high school seniors from 100 schools in 100 districts. Every Washington County was represented in the sample. The results of the study are below.

A. Mathematics

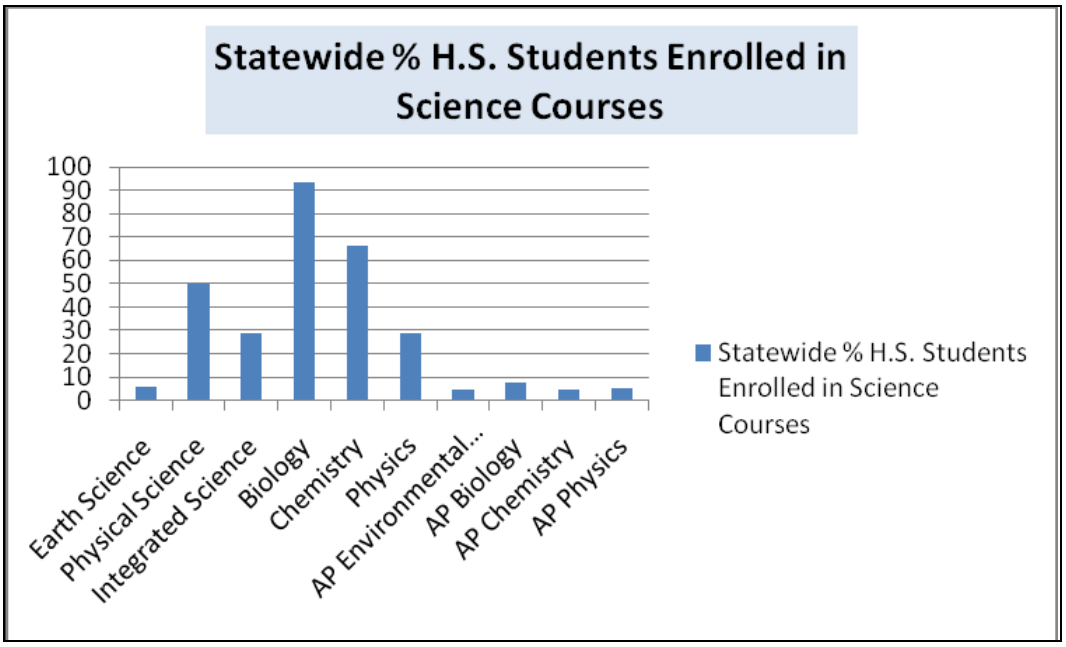
Over 65 percent of Washington students completed the advanced mathematics requirements *(Algebra I, geometry, & Algebra II),* that meet the freshman minimum admission requirements established by the Higher Education Coordination Board (HECB) for admission to Washington's public four-year baccalaureate institutions. in Washington. Over 43 percent of the students completed Geometry by the end of the second year of high school; of these, 79.2 percent of students met standard on the

mathematics WASL (the statewide assessment at the time), 30.4 percent completed Algebra II or above by the end of their sophomore year; of these, 95.6 percent met standard on the WASL. There was a statistically significant relationship between the level of mathematics completed and meeting standard on the mathematics WASL.

B. Science

Over 72 percent of students completed two credits of science, including at least one lab credit, by the end of their second year of high school; of these, 59.5 percent met standard on the statewide science assessment. There was a statistically significant relationship between the level of science completed and meeting standard on the statewide science assessment. Over 87 percent took 2 credits, 1 lab. Over 78 percent took 2 lab courses, but fewer than 3 credits, *(which meets the HECB minimum admissions requirements)*, and 54.6 percent met the proposed SBE CORE 24 requirement of 3 credits, 2 labs.

According to a July 2011 OSPI report, the most frequently taught high school science courses are biology, chemistry, and physical science. The chart below depicts the percentage of the most commonly taught science courses in Washington State high schools.



V. STEM Graduation Requirements[10]

A. Required STEM Course Credits

1. Other States

The Washington SBE recently reviewed high school graduation credit requirements across the nation. The SBE found that the majority of states require more science credits than Washington and a little more than a third of the states require more mathematics credits than Washington. Specifically, among the 47 states with state graduation requirements:

- 36 states require more than the 2 credits of science that Washington currently requires.
- 16 states require more than 3 credits of mathematics *(Although, beginning in 2013, Washington will require 3 mathematics credits to graduate.)*

2. Washington State

a) *Mathematics*[11]

Currently, high school students must earn two credits of mathematics to graduate. Beginning with the graduating class of 2013 and beyond, students must earn three credits of mathematics to graduate. The mathematics credits must include Algebra I or Integrated Mathematics I, Geometry or Integrated Mathematics II, and Algebra II or Integrated Mathematics III. Students may take a different third credit of mathematics under specific circumstances defined in the SBE rules.

b) *Science*[12]

Currently, high school students must earn two credits of science to graduate, one of which must be a lab science. The SBE's 24 credit proposal recommends 3 credits of science, two of which must be a lab science.

B. High School Exit Exams in STEM subject areas[13]

Some states use an assessment at the high school level as a high school graduation requirement. These assessments are often referred to as exit exams.

1. Other States

In 2010, 25 states had high school exit exams: *(10 in mathematics but not science/15 in both mathematics & science):*

- Mathematics*:* Alaska, Arizona, Arkansas, California, Florida, Idaho, Indiana, Minnesota, South Carolina, and Washington.
- Mathematics & Science: Louisiana, Maryland, Massachusetts, Mississippi, Nevada, New York, Ohio, Texas, and Virginia; and the following states that are making changes:
  - Georgia *(Phasing out the exit exams. Beginning with the graduating class of 2013-14 will have EOCs in Mathematics I and II, Biology, and Physical Science that will count as 15% of the course grade & for NCLB purposes.*[14]*)*
  - New Jersey *(Temporarily suspended the mathematics exam as a graduation requirement until the Common Core Assessments are ready; postponed science requirement.*[15]*)*
  - New Mexico *(Temporarily suspended the graduation exam requirement*[16]*)*
  - North Carolina *(Ended use of exit exams beginning with the graduating class of 2011 but EOCs must still be taken by students and will count for 25% of the student's course grade.*[17]*)*
  - Tennessee *(Ending exit exams beginning with the graduating class of 2013 but EOCs will count for 25% of a student's final grade in the course.*[18]*)*

In 2010, 25 states did not have state exit exams: Colorado, Delaware, Hawaii, Illinois, Iowa, Kansas, Kentucky, Maine, Michigan, Missouri, Montana, Nebraska, New Hampshire, North Dakota, South Dakota, Utah, Vermont, West Virginia, Wisconsin, Wyoming and the following that are making changes:

- Connecticut *(Planning to require students take EOCs in Algebra I, Geometry, Biology, American History, & English beginning with the graduating class of 2018. The exam results will count for at least 25% of the course grade and the student must score at least 70% to successfully complete the course.*[19]*)*
- Oklahoma *(Phasing in exit exams in 2012: an Algebra I EOC plus 2 of the following EOCs: Algebra II, Geometry, English III, Biology or U.S. History*.[20]*)*

- Oregon *(Phasing in mathematics exit exam beginning with class of 2014, reading phased in for class of 2012 & writing for class of 2013.*[21]
- Pennsylvania *(Planning to phase-in requiring high school students to demonstrate proficiency through local, state EOCs, or national assessments, beginning with the class of 2015. School districts will determine whether scores will be a portion of the student's course grade or need to meet minimum level of proficiency. These are not considered exit exams because determinations made at the local level.*[22]*)*
- Rhode Island *(planning to begin using exit exams in 2012)*, Washington State

2. Washington State

a) *Mathematics*[23]

Since 2008, students have been required to meet the state standard on the statewide mathematics assessment, the High School Proficiency Exams (HSPE), to graduate with a Certificate of Academic Achievement (CAA). Students through the class of 2012 may still graduate without a CAA, if they do not pass the mathematics HSPE, by earning two credits of mathematics after 10th grade. Students will continue to be tested on the 2008 mathematics EALRs through the 2013-14 school year. Assessments for the newly adopted mathematics CCSS will be piloted in 2013 and are to be administered statewide in the 2014-15 school year.

b) *Science*[24]

Beginning with the class of 2015 and beyond, students must pass the science HSPE. The science HSPE will be an end-of-course (EOC) test in biology beginning in 2012. However, the Legislature has declared that it does not intend to narrow the statewide science assessment to only a Biology EOC and at the appropriate time intends to direct the OSPI to develop one or more EOCs in additional science subjects. The OSPI is also authorized to participate with consortia of multiple states as common science standards (*i.e., the Common Core State Standards*) and assessments are developed, and may adapt state high school science standards and assessments accordingly, as long as the legislative education committees have an opportunity to review any proposed modifications to the standards and assessments before they are adopted.

C. High School Exams as a Factor in Course Grade in STEM subject areas

South Carolina uses the state science assessment results as a factor in determining the course grade. *(North Carolina is planning to implement in both mathematics and science in 2011; Georgia planning to implement in both mathematics and science in 2014; Pennsylvania will permit districts to use as a factor in course grade in both mathematics and science in 2015; and Connecticut planning to implement in both mathematics and science in 2018.)*

VI. College/University Entrance Requirements[25]

A. Minimum Required Courses

The Washington State Community and Technical Colleges have an open admissions policy with no minimum courses required to enter into one of the colleges. The HECB establishes minimum admission standards for freshman admission to Washington's public four-year baccalaureate institutions. For entry in the fall of 2012, students must have earned three credits of mathematics, and two credits of laboratory science.

B. Placement and Entrance Exams

There currently is no state level placement assessment policy for Washington community and technical colleges. The specific placement tests used by the community colleges are determined by individual colleges; roughly 2/3 of the colleges use COMPASS, *(an assessment produced by ACT),* while the other 1/3 use ACCUPLACER *(from College Board)*.[26] The local colleges determine the cut scores for student placement based on their curriculum in mathematics and English so, as a result, the cut scores vary across the system. In the area of mathematics, two community colleges have developed their own local placement tests and a few colleges offer multiple test options.[27]

There is a requirement at each Washington four-year baccalaureate public college and university for students to take a placement or admissions test. All of Washington's public, four-year institutions of higher education accept both the ACT and SAT scores for admission.[28]

VII. Washington's State and National Assessment Results

A. Washington Statewide Assessment Results[29]

Below are the student results for the 2010 Washington state assessments, the Measures of Student Progress (MSP) for grades 3 through 8 and the High School Proficiency Exam (HSPE):

2010-11 MSP/HSPE Results

Grade Level	Reading	Math	Writing	Science
3rd Grade	73.1%	61.6%		
4th Grade	67.3%	59.3%	61.4%	
5th Grade	67.7%	61.3%		55.7%
6th Grade	70.6%	58.8%		
7th Grade	56.5%	57.0%	71.0%	
8th Grade	68.7%	50.4%		61.6%
10th Grade	82.6%	*See EOC info below*	86.3%	49.9%
Mathematics EOCs @ all grades		1st year: 64.3% 2nd year: 73.5%		

B. No Child Left Behind (NCLB) Act

In January 2002, Congress passed and the President signed the NCLB Act that, among other things, requires statewide assessments in mathematics and science in grades three through eight and at least once at the high school level.[30]

A recently released study compared state expectations for student performance on the statewide eighth grade science assessments. In 15 of the 37 states examined, the bar for proficiency in eighth grade science fell below the National Assessment of Educational Progress (NAEP) threshold for "Basic." Washington was one of 18 states that had eighth grade proficiency levels that fell between the NAEP "Basic" and "Proficient" levels. Only four states set the bar near or above NAEP's cutoff for Proficient *(New Hampshire, Rhode Island, Massachusetts, and Louisiana).*[31]

C. National Assessment of Educational Progress (NAEP) Results[32]

1. Mathematics

The NAEP samples student achievement periodically in each state. In 2009, the average score of the fourth-grade students in Washington who took the NAEP mathematics assessment was 242, which was higher than the average score of 239 for fourth-grade students in the nation. However, 242 was not significantly different from Washington's fourth-grade average score in 2007 (243) but was higher than Washington's fourth-grade average score in 1996 (225). In 2009, the average score of eighth-grade students in Washington was 289, which was higher than the average score of 282 for eighth-grade students in the nation; and was higher than Washington's eighth-grade average score in 2007 (285) and higher than Washington's eighth-grade average score in 1996 (276).

2. Science

In 2009, the average score of fourth-grade students in Washington who took the NAEP science assessment was 151. This was not significantly different from the average score of 149 for fourth-grade students in the nation. In 2009, the average score of eighth-grade students in Washington was 155. This was higher than the average score of 149 for eighth-grade students in the nation.

D. ACT and SAT Results[33]

In 2011, 13,677 Washington 12th graders took the ACT *(62% were white students, 11% Hispanic students, 10% Asian students, 4% African American, and 1% American Indian students; 43% were male, and 57% were female.)* For the eighth straight year, Washington students scored above the national average on the ACT exam: Washington students had an average composite score *(for all four subject matter assessments of English, mathematics, reading, and science)* of 22.8, while the national average composite score was 21.1. Washington's composite scores was the ninth highest of all the states, finishing behind students in Connecticut, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York and Rhode Island.

In 2011, 13,972 Washington 12th graders took the SAT *(66 % were white students, 8% Hispanic students, 14% Asian students, 5% African-American, and 1% American Indian students; 46.1 were male, 53.9% were female).* For the seventh straight year, Washington students scored above the national average on the SAT: Washington students had an average mathematics score of 529, while the national average mathematics score WAS 514. Washington students had an average composite score *(in all three subject matter assessments of reading, mathematics, and writing)* of 520, followed by New Hampshire with an average score of 519.6, Massachusetts with 516, Oregon with 513, Vermont 512.6 and Connecticut 511.6.

VIII. STRATEGIES

A number of strategies have been employed at the federal, state, and local levels to improve student access and achievement in STEM and STEM-related education, including entrepreneurial and other funding efforts; targeting professional development; expanding the school day by using STEM-related videos on school buses; authorizing special STEM teacher scholarships and certification; implementing STEM-focused curriculum, instruction, assessments and best practices; and creating a state STEM education office. Some examples of strategies used by Washington at the state-level are also included in the Senate Committee Services 2011 interim project entitled: High School Mathematics and Science

Assessments. Below are summaries of some other efforts in Washington State, at the federal level, and in other states. This information is not intended to be a comprehensive list -- there are many other activities that are not summarized due to time limitations.

A. Washington State Efforts in STEM Education

The Washington State Legislature has taken many legislative actions to promote, improve, and increase access to STEM education in Washington State and since 2007 has taken such actions annually.[34] The following summarizes many of those actions and efforts but it is not a comprehensive list.

There has been growth in STEM programs since 2007.[35] There are now engineering programs at 44 middle schools and 63 high schools and biomedical science programs at 18 high schools using Project Lead the Way (PLTW). In 2009, middle school Career and Technical Education (CTE) in STEM was legislatively authorized.[36] Now over 260 STEM CTE courses have been approved in 108 school districts. These programs are required to demonstrate substantial integration of state standards in technology, science, and mathematics.

In the last 14 years Washington State has increased online access across Washington State. In 1994, four percent of K-12 classrooms were able to connect to the Internet via the K-20 network. In 2008, more than 99.6 percent of the K-12 classrooms were able to connect the Internet via the K-20 network, although the connection may be only one computer in the district or may be several computer labs in a district.[37]

1. The Washington State Mathematics, Engineering, Science Achievement (MESA) Program[38]

The Washington State Mathematics, Engineering, Science Achievement (MESA) Program began providing educational services to students in 1982. The MESA program assists academically disadvantaged students and schools and especially targets students of color, girls and students in poverty, by helping them to prepare for and successfully complete a four-year college program. MESA helps students develop interests and proficiency in math-based fields, such as engineering, science, computer science and mathematics. In the 2007-08 school year, Washington MESA served 19 school districts, 75 schools, 123 teachers, and 4,186 K-12 students. Each MESA Center is sponsored by a university partner. The Legislature began providing funding for the MESA Program in 1995. The funding has been both increased and decreased over time. Line item funding for the MESA Program was discontinued in 2003.

2. K-20 Network[39]

Started in 1996, the K-20 Educational Network is a high-speed, high-capacity network that connects the OSPI, colleges, universities, K-12 school districts, the Washington State Schools for the Deaf and Blind, and the public libraries across Washington State. K-12 schools and districts rely on the K-20 network to run hundreds of data-based applications that support school administration, distance learning and school district operations.

In 2011, the State Auditor's Office (SAO) conducted a performance audit of the K-20 Network and found the following:[40]

- The Network serves the purpose for which it was created. It enables about schools, community colleges, universities, and libraries to connect to each other and to the Internet.

- The General-Fund appropriations before 2009-11 were about $20 million per biennium. For 2009-11, the Legislature decreased the appropriation to about $16 million per biennium. Co-payment charges for the users have remained steady at about $7 million per biennium.
- The SAO found that the state does not have a more cost-effective way to achieve the objectives of the Network and identified a number of costly effects that could occur if the Network were eliminated, including a cost to participating agencies of $10 to $15 million to transition to other systems and networks, an estimated cost of $15 to $25 million for most of the school districts to redevelop administrative and back-office functions, and the University of Washington's telemedicine program being forced to spend more money to gain access to a different high-capacity system.

3. Leadership and Assistance for Science Education Reform (LASER)[41]

Washington State LASER is a public/private partnership that began in January 1999. It provides financial, professional development, and technical assistance to individual classrooms, schools, individual school districts, and a consortium of school districts. Through June 30, 2010, educators in more than 200 Washington school districts have received science education products, services and technical assistance from the LASER network. The Pacific Science Center serves as the fiscal agent for the partnership and manages LASER's statewide technical assistance efforts. Funding for LASER is provided by the Washington State Legislature, Battelle, the Boeing Company, and the Paul G. Allen Family Foundation. The Washington State Legislature began funding LASER in 2001 with an allocation of approximately $1.5 million per year but since then funding has been reduced over the years. The 2011-13 Biennial Operating Budget reduced funding for LASER by 50 percent, which resulted in $356,000 for each year of the biennium.

4. Future Teachers Conditional Scholarship and Loan Repayment Program[42]

In 2005, the Legislature created the Future Teachers Conditional Scholarship and Loan Repayment Program to encourage outstanding students to become teachers, and to encourage current teachers to obtain additional endorsements in priority designated subjects, including mathematics and science. Participants were receiving conditional scholarships or loan repayments for up to five years. Award amounts could not exceed tuition and fees at the participant's college or university, or full-time resident undergraduate tuition and fees at the University of Washington – whichever was lower. Funding for the program was suspended by the Legislature for 2011-12. There were no new awards in 2011-12 but the suspension will not affect the awards for the teacher candidates already in the program.

5. Statewide Director for STEM at the OSPI[43]

In 2007, the Legislature required the OSPI to employ a statewide Director for STEM and gave that person a large number of tasks, some of which were subject to specific appropriations. The 2011-13 Biennial Operating Budget intended the OSPI to combine the state positions of STEM Director and Skills Centers Director.

6. Washington Community Learning Center[44]

In 2007 the Legislature established the Washington Community Learning Center Program to provide students with tutoring and educational enrichment when school is not in session. The 2007-09 Biennial Operating Budget provided $3 million for the program grants. The OSPI was required to give priority to grant requests that focus on improving reading and mathematics proficiency for students who attend schools that have been identified as in need of improvement based on the federal NCLB Act and include a proposal related to providing free transportation for those students in need that are involved in the program. The after-school grant funds could be used to carry out a broad array of out-of-school activities that support and enhance academic achievement. Funding was reduced in 2009 and discontinued in 2010.

7. GET Ready for Math and Science Conditional Scholarship Program[45]

In 2007, the Legislature created the GET Ready for Math and Science Conditional Scholarship program that provided conditional scholarships to low-and-middle income high school students with top mathematics and science scores *(level 4)* on the high school state assessments. Recipients had to agree to obtain a bachelor's degree in a mathematics or science field, and work in a mathematics or science profession for three years after obtaining their degree. Funding for this scholarship was suspended in the 2011 legislative session.

8. Project Lead the Way (PLTW) Teacher Training[46]

PLTW has several components including interactive, project-based high school and middle school curriculum in the areas of technology, engineering, and biomedical science and a professional development program. Since 2007, the Legislature has provided funding for $2,500 grants for twenty middle and high school teachers to annually receive professional development training to implement and integrate STEM education into their classrooms through PLTW. The training takes place at Seattle University and Washington State University-Spokane. Funding for this training is maintained in the 2011-13 Biennial Operating Budget. There are currently engineering programs at 44 middle schools and 63 high schools and biomedical science programs at 18 high schools using PLTW that serve 7,150 students.

9. Regional Mathematics, Science, and Technology Support and Professional Development[47]

Mathematics, science, and technology specialists are located at each of the nine ESDs to provide support to school districts through coordination of regional and state initiatives, professional development, regional collaboration facilitation, and technical support. The mathematics and science coordinators and the educational technology support centers continue to be funded in the 2011-13 Biennial Operating Budget.

a) *Mathematics Coordinators*[48]

In the 2007 Operating Budget, the Legislature began funding regional professional development and support related to mathematics curriculum and instructional strategies beginning in 2008. The funding provides a certificated instructional staff with expertise in mathematics and professional development delivery at each of the nine ESDs.

b) *Science Coordinators*[49]

In the 2007 Operating Budget, the Legislature began funding regional professional development and support related to science curriculum and instructional strategies beginning in 2009 The funding provides a certificated instructional staff with expertise in science and professional development delivery at each of the nine ESDs.

During the spring of 2010, the ESDs surveyed teachers and administrators who had been supported by the work of the regional coordinators. Seventy-three percent of program participants indicated that they applied the content of professional development support received from the ESDs and were able to see evidence of a change in student learning as a result.

c) *Educational Technology Support Centers (ETSC)*[50]

Since 1993, as part of education reform, the Legislature has allocated funding for regional educational technology support centers at each of the nine ESDs to provide professional development and technical support.

The ETSC staff collaborated to create Prepare to Integrate Learning Opportunities with Technology (PILOT) [51], which is a free, online self-assessment that helps students and educators determine how proficient they are with technology. Designed in a simple question-answer format PILOT takes about 20-30 minutes to complete. The self-assessment data PILOT returns provides a way to evaluate:

- Technology proficiencies of certified administrators
- Technology proficiencies of certified teacher-librarians and library-media specialists
- Technology proficiencies and integration skills of certified teachers
- Technology literacy levels of 8th-grade students

10. Mathematics, Science, and Technology Coaches

Despite the prevalence of coaching in schools and school districts across the country, there is not a standard model or uniform definition of an instructional coach. Washington has implemented mathematics, science, and technology coaching programs.

a) *Mathematics and Science* [52]

In 2007, the Washington Legislature authorized the Mathematics and Science Instructional Coach Program to increase instructional capacity for teachers. Funding was provided for 25 mathematics middle school and high school coaches in the 2007-08 school year, and 25 mathematics and 25 science middle school and high school coaches in the 2008-09 school year. The Program included a coach development institute, coaching seminars, coaching activities in schools, and program evaluation. In 2009, the funding was reduced. The 2011-13 Operating Budget further reduced the funding.

The Washington State University Social and Economic Sciences Research Center (WSU-SESRC) issued an external interim program evaluation in September of 2008 with the following findings:[53]

- The Mathematics Instructional Coach Program received positive evaluations from administrators and teachers. The science program was not yet reviewed.
- The OSPI did not but should have helped guide districts' selection of coaches.
- The OSPI should have had greater communication with the districts about the conditions necessary for a strong coaching program.

In 2009, the OSPI issued a final report on the program that found the program to be beneficial. The report found differences in the strategies used by coaches that were considered to be highly effective and resulting in changes in teacher instructional practices. According to the report, the more effective coaches accomplished this by keeping a clear focus on improving student learning and using student data as a vehicle for talking about changes to teachers' instructional practices.[54]

b) *Technology*[55]

The federal Department of Education (DOE) funds the Washington's Enhanced Peer Coaching Initiative through "Enhancing Education through Technology" program (EEtT), funds. Each school-based grant is $9,000. Recipient teachers receive the funds in year one of the two-year program. In year two, peer coaches receive an additional $4,500 that makes it possible to bring in more participating teachers and support the peer coach with additional training.

11. Ensuring an Adequate Supply of Well-Qualified Mathematics and Science Teachers[56]

The 2008 Operating Budget directed the Professional Educator Standards Board (PESB) to make recommendations for ensuring an adequate supply of well-qualified mathematics and science teachers. The PESB made several low-cost, maintenance, small/medium, and larger investment recommendations. Generally, the recommendations for action to be taken by the PESB have been completed but recommendations for action by others have not been completed.

12. First Robotics[57]

The FIRST Robotics competition is an international high school robotics competition organized by For Inspiration and Recognition of Science and Technology (FIRST), which is a 501(c)(3) not-for-profit organization. Each year, teams of high school students compete to build robots weighing up to 120 pounds, *(not including battery and bumpers)*, that can complete a task, which changes every year. Teams are given a standard set of parts and the game details at the beginning of January and are given six weeks to construct a competitive robot, that can operate autonomously as well as when guided by wireless controls, to accomplish the game's tasks. The Legislature began providing funding to support participation in the program in 2008. The first year of funding required that priority be given to high poverty schools starting up a First Robotics Program. Since 2010 the Legislature has provided funding to support the program if matched by private donations and includes no award priority criteria. The funding is maintained in the 2011-13 Biennial Operating Budget.

13. Community and Technical Colleges Authorized to Issue High School Diplomas in Specific Instances[58]

In 2009, the Legislature authorized community or technical colleges to issue a high school diploma when an enrolled student satisfactorily completes specified associate degrees, including an associate of science degree, associate of technology degree, or associate in applied science degree, upon written request from the student.

14. STEM Lighthouse Schools[59]

In 2010 the Legislature passed legislation to recognize STEM lighthouse schools and promote best practices in STEM education. A total of $150,000 was provided to designate up to three high schools and three middle schools in Washington as STEM lighthouse schools to identify, share, and promote best practices in STEM education. In 2011, state funding was reduced by 50 percent resulting in a total appropriation of $75,000, which was awarded to three schools/districts but eliminated the remaining funding for fiscal year 2011. The districts that received funding were:

- Aviation High School - A magnet high school with grades nine through twelve, which enrolls students from several Puget Sound area school districts. Staff and students are engaged in integrated project based learning.
- Komachin Middle School - To individualize learning, the school is divided into three "dens" that are identical in terms of core subjects. The school uses professional learning communities and the departments function as teams. The school provides student experiences that expand beyond the classroom.
- Mead and Mount Spokane High Schools - Mead School District provides engineering and biomedical sciences courses through Project Lead the Way. In the first year of offering biomedical sciences, over 300 ninth graders enrolled in the course.

Recognized for honorable mention were:

- Delta High School, Kennewick, Pasco, and Richland School Districts.
- Brier Terrace Middle School, Edmonds School District.

More information on STEM-focused schools can be found on pages 17.

15. Washington State STEM Work Group Recommendations[60]

The 2010 Washington Legislature passed legislation and provided funding for a STEM working group to complete recommendations to improve STEM education in Washington. The working group issued its report December 1, 2010. Recommendations included:

- Improved teaching throughout K-12
- Deep and sustained commitment to STEM innovation throughout K-12
- Ensuring strong community and business engagement for STEM education

16. Microsoft IT Academy[61]

The 2011 Legislature provided $4 million to fund a contract that the OSPI entered into with Microsoft to provide all high schools training and certification in a number of Microsoft products, including Word, Excel, Access, Project, as well as advanced topics, including programming, Web development, and database development. The OSPI has also partnered with CCI Learning Solutions to provide free certification testing for students, teachers and staff at each high school. The IT Academy is being rolled out over a period of six months, beginning in the summer of 2011 with a pilot group of 50-60 schools, along with training delivered through live meetings, support materials, and dedicated deployment resources for the teachers and staff of Washington.

17. A-STEM Innovation Schools and Zones[62]

In 2011, the creation of innovation schools and innovation zones with a priority on models focused on the arts, science, technology, engineering, and mathematics (A-STEM) was authorized by the Legislature. The OSPI must devise a process to designate a school as an Innovation School or a group of schools to be designated as an Innovation Zone. These schools will be able to get waivers from specified state statutes *(within the OSPI and SBE authority)*, and administrative rules to implement their innovations. A majority of the schools recommended by ESDs to receive the designation must have a focus on the arts, science, technology, engineering, and mathematics (A-STEM).

18. Basic Education Funding Formula[63]

On September 1, 2011, a new basic education funding formula based on the staff and non-staff costs of prototypical schools necessary to provide a program of basic education was implemented. In the new formula, technology is a specified portion of materials, supplies, and operating costs, which is a component of the new apportionment formula.

B. Additional Efforts in Washington State

There are additional efforts to promote and improve STEM education in Washington State that are not being generated at the state level or through federal funding.

1. Washington STEM[64]

Washington STEM is a recently organized 501(c)(3) nonprofit designed to advance innovation, equity, and excellence in STEM education that was originally conceived by Washington business and philanthropic leaders. Washington STEM plans to make investments to create and support a dynamic network able to implement effective STEM teaching and learning programs and practices in the field. Washington STEM is housed at the Innovation Center at McKinstry. Washington STEM's founding Board of Directors is composed of business and education leaders.

2. STEM-Focused Programs and Schools

A number of school districts have created STEM-Focused Programs or Schools, including the following:

a) *SCI-MA-TECH, Brier-Terrace Middle School, Edmonds School District*[65]

SCI-MA-TECH is a program at Brier Terrace Middle School in the seventh and eighth grades that integrates core academic concepts using technology as a process. Each unit of curriculum taught in this program incorporates engineering concepts with a component in mathematics, science, technical writing, reading, vocabulary, design, hands-on, and safety.

a) *Ballard Maritime Academy*[66]*, Seattle School District*

Since the 2001-02 school year, Ballard Maritime Academy, a career academy within Ballard High School in the Seattle public school district, has provided high school students with a curriculum that organizes instruction in academic subjects around maritime industry and marine science. Students also have the opportunity to participate in an internship project between their junior and senior years. The internship allows the students to see firsthand what a career in their chosen field is really like.

b) *Delta High School, Richland School District*[67]

Delta is a public high school for students living in the Kennewick, Richland, and Pasco School Districts. Battelle, Washington State University Tri-Cities, Columbia Basin College and the Washington State STEM have collaborated to offer this STEM education program that includes inquiry, problem-solving, and project-based learning.

c) *Technology Access Foundation (TAF) Academy, Federal Way School District*[68]

TAF Academy is a sixth through twelfth grade public school with a STEM-focused curriculum that opened in September 2008 as a result of a public-private partnership. The school receives additional support from the Technology Access Foundation. The school caps classes at 25 students, with each grade level having less than 100 students. The teachers use Project Based Learning and direct instruction. Technology plays a significant role at the school. The school provides students with a Period 7. This after-school academic support and enrichment program starts immediately after the traditional school day ends. In Period 7 students attend programs taught by community members, become active participants in their communities through service learning, and participate in career path courses that involve paid summer internships at the high school level.

d) *Aviation High School, Highline School District*[69]

Aviation High School is the only college preparatory aviation-themed high school in the Northwest. It uses a STEM-focused curriculum. The school opened in 2004 and is now at capacity of 400 students in grades nine through twelfth; 50 percent are local students and the rest commute, on their own, from surrounding districts, including Olympia, Everett, and Bremerton. The school's partners include the Boeing Museum of Flight, Microsoft, Seattle Biomedical Research Institute, and higher education and others. Each student is connected with an industry mentor.

C. Federal Efforts

1. Federal Inventory[70]

On September 19, 2011, the Office of Science and Technology Policy in the Executive Office of the President released the initial results of an inventory of federal programs designed to strengthen STEM education. The inventory tallied 252 specific programs in STEM education across 13 federal agencies, representing a total federal investment of $3.5 billion. About $1 billion of that is being spent to train individuals for activities specific to the mission of the funding agencies. The other $2.5 billion is being applied to STEM education more generally.

2. **Race to the Top Grants** (RTTT)[71]

The federal DOE announced in November 2009, the opportunity for states to apply for four-year competitive RTTT grants. The DOE awarded specific points for STEM education activities included in the state applications. Tennessee, Delaware, the District of Columbia, Florida, Georgia, Hawaii, Maryland, Massachusetts, New York, North Carolina, Ohio, and Rhode Island each were awarded RTTT grants. Washington applied but did not receive a grant. A summary of the STEM activities that were funded has been published by a nonprofit organization.[72]

3. **Federal Mathematics and Science Partnership (MSP) Grants**[73]

The MSP Program supports partnerships between the mathematics, science, and/or engineering faculty of institutions of higher education and high need school districts. Each project has received a three-year federal grant. Some of the Washington State projects are summarized below.

a) *Science Alliance Project* [74]

The Project is providing professional development for 60 teachers of science in two high need school districts. The partners include STEM and education faculty from Washington State University – Physics and Teaching and Learning Departments, Columbia Basin College Math/Science Division, Laser Interferometer Gravitational-Wave Observatory (LIGO), the ESD 123 Mathematics and Science Coordinators and two representatives from LASER. Partner school districts include Pasco and Othello with 18 elementary and middle schools. The Project targets teachers in grades three through eight in 18 school buildings in the two school districts. The Project intends to increase content knowledge and instructional capacity of teachers of science using scientific research-based teaching strategies. The professional development will focus on Washington State Science Standards.

b) *The Everett Science Partnership*[75]

The Partnership includes the Everett School District, the Center for Inquiry Science at the Institute for Systems Biology, the University of Washington, and Seattle Pacific University. It provides professional development for all secondary science teachers and principals of the Everett school district to implement the model "Observing for Evidence of Learning" in each middle and high school three times per year, as well as a summer institute each year.

c) *The Math: Getting It Project.* [76]

The University Place, Fife, and Peninsula school districts in partnership with the University of Washington, Tacoma and the Pierce County Staff Development Consortium are working together to establish an integrated, multifaceted network of professional development, building-based teacher learning, and administrative support. The overarching goal of this project is to improve student achievement in mathematics by improving teacher content knowledge; implementing instructional strategies designed to deeply embed core mathematical structures in student thinking; improving teacher and principal understanding of how students learn mathematics, including awareness of vertical alignment of standards and mathematical structure; improving teachers' understanding of how students think about mathematics, specifically students from diverse economic and cultural backgrounds; and, increasing productive principal-teacher and teacher-teacher dialogue about mathematical content and effective instructional strategies. The Getting It Project action plan consists of five components:

- Intensive Summer Institutes, serving up to 260 K-12 mathematics teachers and pre-service teachers over three years.
- Pierce County Staff Development Consortium courses, serving up to 320 K-12 teachers and pre-service teachers over three years.

- Building-based professional learning communities led by trained teacher cadre leaders, serving up to 150 K-12 mathematics teachers and involving up to 20 K-12 cadre leaders over three years.
- Administrator observation training to increase principals' knowledge and use of evidence of mathematics content and effective strategies in observations, involving up to 60 building K-12 administrators.
- Pre-service teachers' participation in Institutes, Consortium courses, and student teaching in partner districts.

d) *The Mathematics and Science Teaching (MAST) Project*[77]

The MAST Project provides professional learning opportunities designed to improve 8th and 9th grade mathematics and science teachers' content knowledge and their abilities to analyze student thinking in order to increase student learning and achievement of Washington standards for forty teachers within the region. Thirty-four middle school and high school teachers from Battle Ground, Evergreen, Hockinson, Ridgefield, Vancouver, and Washougal school districts, are working with six Clark Community College faculties to improve content knowledge, align pedagogy, and instructional practice. Over the course of three years, they will participate in 240 hours of professional development, focused on either physical science or algebra at the 8th and 9th grade level.

e) *Mid-Columbia Mathematics and Science Program* [78]

The Mid-Columbia Mathematics and Science Program consists of the Kiona-Benton, Patterson, Prosser, and Finley school districts, WSU Tri-Cities, and Columbia Basin College. The program intends to increase the content knowledge and effective pedagogical strategies for K-5 teachers in all three districts by sponsoring a summer institute centered on specific Washington mathematic standards. Additionally, job-embedded professional development using a collaborative/coaching model will creating opportunities for enhanced and ongoing professional learning that improves K-5 teachers' ability to analyze student thinking and make corresponding instructional decisions.

f) *Olympic Mathematics Science Partnership (OMSP)* [79]

The OMSP consists of the Olympic ESD 114, Western Washington University, Peninsula College, North Mason School District, Quillayute Valley School District, Sequim School District, Chimacum School District, Port Townsend School District, and the Bremerton School District. The partnership is working toward achieving three goals:

- Increasing teacher knowledge and skills related to implementing high quality instruction and engaging in effective professional collaborations
- Building capacity and support for greater data literacy with an emphasis on the use of classroom-based formative assessments and
- Building greater capacity for leadership and collaboration among all participants in the K-16 system.

The primary focus of the partnership is promoting and sustaining Professional Learning Communities (PLCs). In partnership with the ESDs throughout the state, the OMSP is connecting district administrators to the Robert Marzano Washington initiative, "Getting Serious About School Reform, Three Critical Commitments." Leadership Support Meetings are also being used to develop teacher leadership skills for facilitating the PLCs working in the Professional Teaching and Learning Cycle. In addition, regional events will target the needs of PLC members to deepen their knowledge of assessment for learning and key findings from research on formative assessment as it relates to the work of the PTLC. Local visits also provide support and expertise to teacher teams working through the PTLC and to increase principals'

knowledge and skills for supporting the work of the PLCs. OMSP staff and higher education faculty visit partnership school districts to provide technical assistance to the PLCs. Finally, PLC members will engage in a five-day Content Immersion to deepen their knowledge of key findings from research on effective teaching and learning, science and mathematics content knowledge relevant to teaching, and instructional strategies that support student learning.

g) *Professional Teachers of Science (PToS)* [80]

This project is a partnership between the Seattle Public Schools, Vashon Island Public Schools, Seattle Urban Academy, Everett Community College, Seattle Pacific University, University of Washington Department of Biology and the College of Education, Western Washington University, the Northwest Association for Biomedical Research, the Seattle Biomedical Research Institute, and FACET Innovations. It supports 9th through 12th grade science through three courses that focus on physics, biology, and chemistry. Each course provides teachers with higher-level, multi-faceted learning experiences in the National Science Education Standards *(National Research Council 1996),* of learning science, learning to teach science, and learning to learn.

h) *Progress to Mathematics and Science Proficiency: Reaching Out to Rural Schools*[81]

THE objective of this project is to provide teachers and administrators with the tools and commitment needed for students, especially in high minority, low income, and isolated rural schools, to reach Washington State's mathematics and science proficiency levels by building teachers' science and mathematics content and pedagogical content knowledge, including research-based instructional practices recommended for English Language Learners (ELL) and creating cross-curricula collaboration within building site teams, between districts and among the higher education partners. The partners in this project include Eastmont, Waterville, Oroville, Pateros, Bridgeport, Tonasket, Brewster, Warden, Soap Lake, Quincy, Mansfield, Grand Coulee, Manson, and Nespelem school districts, Central Washington University (CWU), and Wenatchee Valley College. All 14 school districts are "high-need" districts and the project will impact over 70 percent of the eligible teachers in these districts, serving 96 teachers and 24 administrators through this project. In addition, enrollment is provided for eight pre-service teachers from CWU's College of Education. The project will have three intensive Summer Institutes *(5-day duration)* in each of three years, which will include nine *(2-day duration)* follow-up sessions.

i) *Sustaining Partnerships-Enhancing Collaboration K-8*[82]

This partnership consists of the Concrete, La Conner, Nooksack Valley, and Sedro-Woolley school districts and Western Washington University. The project will provide three six-day summer academies that contain science content immersion experiences led by STEM faculty from Western Washington University, Everett Community College, Skagit Valley College, or Whatcom Community College regarding research-based instructional and assessment tools, professional learning communities, differentiation of instruction for all students, and leadership for student success. Eight two-hour professional learning community (PLC) meetings in each building will be facilitated by Teacher Leaders trained in PLC facilitation and supported by the building administrator. These sessions are intended to help teachers use tools to improve instruction based on their students' performance. Additionally, two full-day professional development sessions, will be provided: One, just prior to the school year to set the plan for the year, and one joint session mid-year to allow all of the partners to interact. There is project oversight and guidance by an inclusive leadership team representing the stakeholders.

4. Technology professional development[83]

Washington State receives $3.52 million in Title II, Part D funds for teacher training and another $8.69 million, with half of it earmarked as competitive dollars for professional development programming.
The money is used to provide technology professional development, including the Teaching & Learning in the 21st Century, which is a two-year course of professional development designed for educators who want to learn the basics of technology integration.

5. Presidential Awards for Excellence in Mathematics and Science Teaching (PAEMST)[84]

The PAEMST is the highest federal recognition that a K-12 mathematics or science teacher may receive for outstanding teaching in the United States. Nominations are accepted beginning in October. Nominated teachers have until May of that school year to complete an application. Applications are reviewed by a statewide committee, and recommendations are submitted to the national program over the summer. Recipients are typically announced by the President of the United States in the spring. Recipients of the PAEMST receive:

- A citation signed by the President of the United States.
- A paid trip for two to Washington, D.C., to attend a weeklong series of recognition events and professional development opportunities.
- Gifts from program sponsors from around the country.
- A $10,000 award from the National Science Foundation.

2011 PAEMST Washington State Finalists are:

- George Christoph, Math, River Ridge High School, North Thurston Public Schools
- Andrew Means, Math, Enumclaw Middle School, Enumclaw School District
- Nathan Shields, Math, Fort Vancouver High School, Vancouver Public Schools
- Robert Ettinger, Science, Asa Mercer Middle School, Seattle Public Schools
- John Gallagher, Science, Port Angeles High School, Port Angeles School District
- Kimberly Taylor, Science, Enumclaw Middle School, Enumclaw School District

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D. Other National Efforts

There are national efforts to promote STEM education other than the federal governmental actions.

1. National Governors Association's Center for Best Practices[85]

In September began a public-private partnership with states and a business alliance called "Innovate and Educate" to improve STEM education through the sharing of best practices and leveraging industry investments.

2. President's Council of Advisors on Science and Technology[86]

In September 2010, the President's Council of Advisors on Science and Technology issued a report with recommendations to prepare and inspire students and improve STEM education in America:

- Standards: Support the current state-led movement for shared standards in mathematics and science.
- Teachers:
    - Recruit and train 100,000 great STEM teachers over the next decade who are able to prepare and inspire students.
    - Recognize and reward the top five percent of the nation's STEM teachers by creating a STEM master teachers corp.

- Educational Technology: Use technology to drive innovation by creating an advance research projects agency for education.
- Students: Create opportunities for inspiration through individual and group experiences outside the classroom.
- Schools: Create 1,000 new STEM-focused schools over the next decade, concentrated at the high school level.
- Leadership: Ensure strong and strategic national leadership in K-12 STEM education.

3. The National Academies[87]

In 2011, the National Academies, advisors to the nation on science, engineering, and medicine, issued a report that included the following:

- Goals for U.S. STEM education
- Criteria to identify successful STEM schools
- Recommendations for what schools and school districts can do to support effective STEM education
- Recommendations for what state and national policy makers can do to support effective STEM education

4. Education Commission of the States (ECS)[88]

The ECS has created a database of state high school-level STEM Initiatives, that includes information on:

- State recruitment efforts for STEM teachers
- Targeted professional development for STEM teachers
- State support for pre-AP alignment programs
- State support for STEM mentoring and real work internship programs for students
- State-level dual enrollment/early college/middle college programs focused on STEM
- State support for afterschool programs in STEM such as robotics, science Olympiad, INTEL, that focus on supporting student interest in STEM
- Rigorous graduation requirements and assessments in mathematics and science
- State programs targeted at STEM achievement among female, low-income, and minority students.

E. Other States' Efforts

1. Science & Mathematics videos on school buses[89]

ARKANSAS: The Hector School District -- in partnership with Vanderbilt University Aspirenaut Program and a philanthropist -- has outfitted a school bus with five monitors that broadcast mathematics and science content to students, who are provided with headphones for their two-hour ride to and from school on the bus. The videos, which vary based on the children's ages, feature programming from the Discovery Channel, NASA, PBS, and the Smithsonian Institute. The project aims to engage students -- and take advantage of the fact that the students are a captive audience with few distractions. The school district reports another beneficial result of the program is there are less disciplinary issues on the bus.

2. Elementary STEM Teaching Certificate

MARYLAND: Developed a new elementary STEM teaching certificate, with an emphasis on integrating STEM across the curriculum.[90]

3. Diagnostic Assessments

NORTH DAKOTA: During the 2009 legislative session, language was incorporated into the Century Code requiring schools to annually administer the NWEA Measures of Academic Progress, or any other interim assessment approved by the Superintendent of Public Instruction, to grades two through ten.[91]

4. Curriculum

ARKANSAS: Requires parents to opt a student out of increased curriculum/high school requirements of four years mathematics, three years English & three years social studies.[92]

ARKANSAS: On August 17, 2011, Arkansas officials announced a $2.68 million program aimed at increasing the number of students studying in high-tech fields by overhauling the curriculum in some high schools to create "New Tech High Schools" and recruiting more college graduates to teach in STEM areas.[93]

ALASKA. The state initiated a K-12 science curriculum that provides lesson plans for each of the student grade level expectations that are online and in a searchable format.[94]

INDIANA AND NORTH DAKOTA: Students must complete 40 credits to graduate from high school, unless a parent opts the student out of the CORE 40 program. Differential diplomas are award: For the Core 40 with Technical Honors, a student must, among other things, achieve a specified score on the ACT WorkKeys; for the Core 40 with Academic Honors, a student must, among other things, achieve a specified score on the ACT or SAT.[95]

WEST VIRGINIA. In 1963 as part of West Virginia's Centennial Celebration, the National Youth Science Camp (NYSC) was created. Two students are chosen to represent each state as delegates to the Camp, at no cost, including transportation. Delegates must have demonstrated exceptional academic achievement, leadership in school and community activities, and a genuine interest in the sciences. Delegates attend the summer after their high school graduation. The NYSC was totally supported by the State of West Virginia from its first session in 1963 through its twentieth session in 1982, and is now funded through contributions to the National Youth Science Foundation, a 501(c)(3) nonprofit. While a generous portion of the funding still comes from the State of West Virginia, support increases each year from the private and corporate sectors. The hands-on experiences and lectures expose delegates to current work across the spectrum of scientific disciplines. To reinforce and encourage well-rounded development, the NYSC's scientific program is supplemented by an outdoor adventure program. Three times during camp, delegates go on overnight outdoor trips which may include backpacking, rock climbing, caving, kayaking, mountain biking, or science field experiences. Many of these activities are also offered on "day trips", making it possible for most delegates to try several different offerings. Participation is voluntary.[96]

5. Rewards

ARKANSAS: Schools that receive an annual performance category level of Level 5 or Level 4 based on student results on the statewide assessments *(mathematics and reading)* are eligible for school recognition awards and performance-based funding. Each school that receives performance-based funding for the Annual Improvement Category *(Gains)* shall submit a proposal for spending to the Arkansas Department of Education. The Office of Academic Accountability, along with staff from the School Improvement Division and the Finance Division, will review and approve each proposal, and approve spending of performance-based funding for those academic expenses listed in the "Award

Allocation and Use" section below. School recognition awards must be used for the following:

- Nonrecurring bonuses to the faculty and staff;
- Nonrecurring expenditures for educational equipment or materials to assist in maintaining and improving student performance; or
- Temporary personnel for the school to assist in maintaining and improving student performance.[97]

6. State STEM Office[98]

LOUISIANA: A STEM Goal Office was created to work with school districts, educators and STEM-focused partners to create a world-class STEM Education System for all students. The Office provides teachers of grades three through twelve, professional development, training, tools and strategies to improve STEM education including integrating STEM content across grades and disciplines. Additionally, the Office provides STEM programs for K-12 students, often during the summer months, to expose them to STEM education, majors, and careers.

Endnotes

[1] PESB website: http://data.pesb.wa.gov/

[2] OSPI website: http://www.k12.wa.us/Mathematics/Standards.aspx ; Common Core Standards website: http://www.corestandards.org/in-the-states , Adopted CCSS: Alabama, Arkansas, Arizona, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, New York, Nevada, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Vermont, Washington, West Virginia, Wisconsin, Wyoming. Not Adopted CCSS: Alaska, Minnesota, Montana, Nebraska, Texas, and Virginia.

[3] http://www.achieve.org/next-generation-science-standards and ESHB 1410 (2011): http://wsldocs/2011-12/Pdf/Bills/Session%20Law%202011/1410-S.SL.pdf

[4] 2SHB 1906: http://aor/tld/results.aspx?ID=21&params=2007-08,1906&desc=Text%20of%20a%20Legislative%20Document:%202007-08%20(2007-08) ; OSPI website: http://www.k12.wa.us/EdTech/StandardsAssessments.aspx ; SSB 5392: http://aor/billsummary/default.aspx?Bill=5392&year=2011

[5] Mathematics curriculum: http://www.k12.wa.us/CurriculumInstruct/InstructionalMaterialsReviewMathematics.aspx ; Science Curriculum: http://www.k12.wa.us/CurriculumInstruct/pubdocs/PublishersNotices/OnlineAvailabilityofRecommendedScienceInstructionalMaterials.pdf

[6] OSPI website: http://www.k12.wa.us/LegisGov/2008documents/SchoolDistrictMathCurriculaAdoptionandUsage-FINAL.pdf

[7] OSPI website: http://www.k12.wa.us/research/pubdocs/UW_Math_Report_Final.pdf

[8] OSPI website: http://www.k12.wa.us/CurriculumInstruct/InstructionalMaterialsReviewScience.aspx

[9] SBE: http://www.sbe.wa.gov/documents/Transcript%20Study%20What%20Are%20Students%20Taking.pdf and http://www.sbe.wa.gov/documents/TranscriptStudy2008_FINAL_000.pdf & OSPI: http://www.k12.wa.us/Science/pubdocs/SciencewhitepaperFINAL.pdf

[10] SBE website: http://www.sbe.wa.gov/ ; and OSPI website: http://www.k12.wa.us/GraduationRequirements/default.aspx

[11] SBE website: http://www.sbe.wa.gov/documents/FAQ%20Graduation%20Requirements.pdf & http://www.k12.wa.us/Mathematics/Standards.aspx; &WAC website: http://apps.leg.wa.gov/WAC/default.aspx?cite=180-51-066

[12] SBE website: http://www.sbe.wa.gov/documents/FAQ%20Graduation%20Requirements.pdf

[13] Sources for this section are referenced in detail in the Washington State Senate Services 2011 Interim Project on Mathematics and Science Assessments.

[14] Georgia Department of Education website: http://www.gadoe.org/ci_testing.aspx?PageReq=CI_TESTING_EOCT

[15] New Jersey Department of Education website: https://www.measinc.com/nj/Downloads/NJBCT/Your_Guide_to_the_NJBCT_2012.pdf

[16] New Mexico Public Education Department website: http://www.ped.state.nm.us/AssessmentAccountability/AssessmentEvaluation/dl11/Assessment%20Changes%20Memo%20FAQ.20110616.pdf

[17] Public Schools of North Carolina website: http://www.ncpublicschools.org/docs/accountability/policyoperations/exitstandards/gatewayfaq.pdf and http://www.ncpublicschools.org/accountability/policies/highschoolexit

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