# High School Science End-of-Course Assessment Recommendations

## Report to the Legislature

***Randy I. Dorn***
State Superintendent of
Public Instruction

December 2010

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# High School Science End-of-Course Assessment Recommendations

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**December 2010**

# Table of Contents

## EXECUTIVE SUMMARY

### Legislative Requirement

During the 2009 legislative session, the Office of Superintendent of Public Instruction (OSPI) was directed to develop a statewide high school end-of-course assessment measuring student achievement of Washington State science standards in biology to be implemented in the 2011–12 school year. OSPI was also directed to recommend by December 1, 2010, whether additional end-of-course assessments in science should be developed and in which content areas. The recommendation for additional assessments must include an implementation timeline and the projected cost to develop and administer the assessments.

### Background

New Washington Science Standards

The current Washington State science standards were adopted in spring 2009. These standards address the content disciplines of life, physical, and earth and space sciences, and the cross-cutting concepts of systems, inquiry, and application.

The high school comprehensive science assessment will assess the former version of the science standards, called the 2005 Grade Level Expectations, for the last time in spring 2011. An end-of-course exam in biology is being developed as part of the legislative requirement and is scheduled to be implemented in spring 2012. There are no other science end-of-course exams being developed as of this report.

Elementary and Secondary Education Act

As required by the Elementary and Secondary Education Act of 2001 (Public Law 107-110), every state must assess students in science at least once in three grade bands (Grades 3–5, 6–9 and 10–12). A high school test must be given to assess all students' proficiency in science standards. For the 2010–11 school year, the comprehensive science assessment will be used to meet this requirement. In the 2011–12 school year, the biology end-of-course assessment will be used for this purpose.

Next Generation Science Standards and Assessments

In 2010, the National Research Council (NRC) of the National Academies published a draft version of *A Conceptual Framework for Science Education* that provides a conceptual framework for the "Next Generation Science Standards". This framework is to be finalized by March 2011. The "Next Generation Science Standards" will be developed by Achieve, Inc. in collaboration with the NRC and are expected to be completed by December 2011.

Assessments measuring these standards could be accomplished through collaboration with other states following a multi-state assessment design similar to the one already in place for the Common Core State Standards Initiative to develop an assessment for common K–12 English language arts and mathematics standards. There is substantial fiscal advantage to the economies of scale realized in a multi-state assessment-development collaborative, even more so if there is federal support for this assessment development, as there is currently for common core English language arts and mathematics assessments.

Course Taking

Analysis of 2010 enrollment data from districts across the state predicts the specific science courses taken by a typical Washington high school student cohort during Grades 9 through 12. This information can be used to assist in making decisions regarding future end-of-course exams (See Appendix B).

| **Course** | **% of Students taken course during High School (Grades 9–12)** |
|---|---|
| Biology | 93.5% |
| Chemistry | 66.1% |
| Physical Science | 39.7% |
| Physics | 32.2% |
| Integrated Science | 28.8% |
| Life and Physical Sciences | 14.5% |
| Earth Science | 10.4% |
| Environmental Science | 6.8% |

## Graduation Requirements

Meeting Standard

Under current law, the Class of 2013 will be the first class required to meet standard on the science assessment to graduate.These students will be required to pass either the current comprehensive science assessment in spring 2011 or the new biology end-of-course exam in 2012 or 2013. Students may also meet standard on one of the legislatively-approved alternatives, such as the Collection of Evidence, the GPA Comparison, or the SAT/ACT/AP Option.

Students eligible for special education may also meet the science standard through a number of alternative pathways. Depending on the provisions outlined in the Individualized Education Plan, these students can meet the modified (Basic) standard on state science assessments or meet standard on the WAAS-Portfolio, the Developmentally Appropriate Proficiency Exam, or an approved Locally Determined Assessment. The WAAS-Portfolio is federally required and is designed for students with the most significant cognitive disabilities and will be redesigned to assess the new science standards in 2013.

Credits

The State Board of Education has recommended to the Legislature that the number of science credit requirements be increased from two to three credits, beginning with the Class of 2016. Two of the credits must be lab sciences.

Assessment Development Timeline

Development and implementation of a statewide assessment requires a minimum of three years. Item specifications are written to guide the development of test items. Items are reviewed then piloted. If approved after additional review, items are included in the item bank and available for future operational tests. If next generation science standards are adopted, the earliest operational assessment could be three years from the date of standards adoption.

## Costs of the Science Assessment Graduation Requirement

The cost to develop a new assessment of Washington learning standards is approximately $2.25 million. The annual cost of administering and scoring an assessment is approximately $3 million (approximately $40/student). If an assessment is used as a graduation requirement, alternative objective assessments (e.g., Collections of Evidence) must be provided and students must be afforded at least four opportunities for retakes. The cost of the Collection of Evidence is currently $600 per student. Additionally, school districts are required to provide learning opportunities (e.g., additional classes) for students who do not meet the standards.

## Considerations

Rationale for Additional End-of-Course Exams

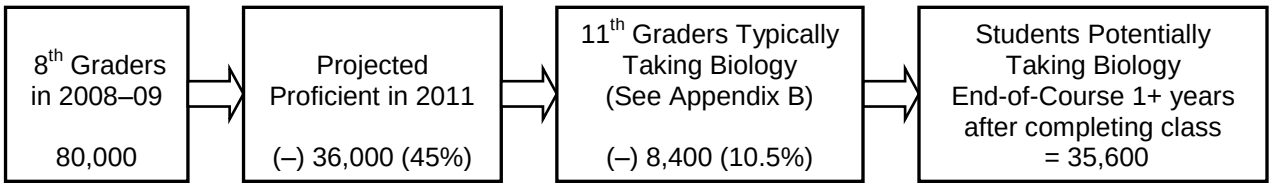
Current state and federal laws require that students be assessed at least once during high school to determine their level of science knowledge. The intent of the assessment is to measure students' overall attainment of skills and abilities commensurate with state standards. The state science standards address two content domains beyond biology. Additional end-of-course exams are necessary for an accountability system that is representative of the breadth of Washington's science learning standards, which include earth and space science and physical science.

Combined Impact of End-of-Course and Graduation Requirement

Under current law, students in the Class of 2013 who do not meet standard on the 2011 comprehensive science assessment will be required to meet standard on the biology end-of-course exam in order to graduate. This graduation requirement is not only being implemented during the transition from a comprehensive assessment to a course-specific exam, but also coincides with the transition from the 2005 Grade Level Expectations (GLEs) to the 2009 K–12 Science Learning Standards on the test. Very

high stakes will be attached to both the end-of-course exam and its measurement of the new standards before students and teachers have had an opportunity to become familiar with these two changes in the format and focus of the test.

In addition, a significant proportion of the Class of 2013 will experience a gap between receiving biology instruction and the administration of the end-of-course exam. If this cohort, which consisted of almost 80,000 students in 2008–09, meets standard on the current comprehensive science assessment at the same rate as the class of 2012, only about 45 percent of the class will be proficient or higher in science. Therefore, approximately 55 percent of the class, or 44,000 students, will be required to meet standard on the biology end-of-course exam in their junior year or later. However, most students complete biology as freshmen or sophomores, and only 10.5 percent (8,400 students) of 11th grade students typically take high school biology. Thus, in 2012 approximately 35,600 students will be required to sit for an end-of-course exam a year or more after the completion of the course being assessed.




**Recommendations**

1. Continue with the implementation of the biology end-of-course exam in 2012 as per ESSB 6444.
2. Delay the graduation requirement until the Class of 2017 so that districts, schools, educators, students and parents can become familiar with the measurement of the new K–12 Science Learning Standards on the biology end-of-course exam before high stakes are attached. Require students in the Class of 2017 to pass the biology end-of-course exam or an alternative for graduation.
3. Phase in two additional end-of-course exams, the first in physical science in 2015 and the second in integrated science in 2016.
4. Require students in the class of 2018 and beyond to meet standard in science by passing the biology end-of-course exam, or an additional science end-of-course exam, or an appropriate alternative for graduation.

## I. Legislative Requirement

During the 2009 legislative session, the Office of Superintendent of Public Instruction was directed to develop a statewide high school end-of-course assessment measuring student achievement of Washington State Science Standards in biology to be implemented in the 2011–12 school year. OSPI was also directed to recommend by December 1, 2010, whether additional end-of-course assessments in science should be developed and in which content areas. The recommendation for additional assessments must include an implementation timeline and the projected cost to develop and administer the assessments.

## II. Background

### Washington State K–12 Science Standards, 2009

In 2007, the Legislature passed Second Substitute House Bill (SSHB) 1906 directing the State Board of Education (SBE) and OSPI to review and revise the 2005 science standards. In 2008, the SBE contracted with David Heil & Associates, Inc. to conduct a comprehensive review of Washington's 2005 Science K–10 Grade Level Expectations. The purpose of the review was to provide recommendations to improve the science education standards enabling Washington students to be better prepared with science knowledge and skills needed to successfully participate in post-secondary education, meet the workforce needs of tomorrow, and contribute to Washington's future economic growth. A final report was issued on May 7, 2008[1], and served to inform the development of the Washington State K–12 Science Learning Standards (adopted 2009).

OSPI led the development of the K–12 Science Learning Standards (adopted 2009).[2] The standards are comprised of four Essential Academic Learning Requirements (EALRs) and twelve "Big Ideas." EALRs 1, 2, and 3 describe crosscutting concepts that characterize the nature and practice of science and technology, while EALR 4 describes what all students should know and be able to do in the domains of Life Science, Physical Science, and Earth and Space Science. See Appendix A for descriptions of the EALRS and domains.

- **EALR 1**: Systems
- **EALR 2**: Inquiry
- **EALR 3**: Application
- **EALR 4**: The Domains of Science (Life Science, Physical Science, and Earth and Space Science)

[1] David Heil & Associates, Inc, WA State Science Standards: An Independent Review, Final Report, May 7, 2008
[2] WA State K-12 Science Learning Standards, June 2009, http://www.k12.wa.us/Science/Standards.aspx

Following the adoption of the standards, OSPI and statewide science educators created teacher professional development modules on the new science standards. A series of "train-the-trainer" workshops were held with the Educational Service District (ESD) science coordinators, LASER Alliance staff, and other district leaders. Subsequently, professional development for the 2009 K–12 Science Learning Standards was provided through focused workshops or embedded in other regional offerings.

**Next Generation Science Standards**

On July 12, 2010, the National Research Council (NRC) of the National Academies of Science published a public review draft of "Conceptual Framework for Science Education". The document was developed by the NRC Committee on Conceptual Framework for New Science Education Standards. The development of this conceptual framework was partly in response to the common core standards movement in English language arts (ELA) and mathematics. The intent of the conceptual framework is that it will be used to inform the development of the "Next Generation Science Education Standards".

The draft conceptual framework is organized into three dimensions:

- **Dimension 1** addresses specific disciplinary ideas in four major domains: physical sciences, life sciences, earth and space sciences, and engineering and technology.
- **Dimension 2** includes cross-cutting elements.
- **Dimension 3** describes science and engineering practices.

The comment period for the draft conceptual framework closed on August 2, 2010, and the committee expects to issue a final document in early 2011. The education nonprofit organization, Achieve, Inc. will work with a consortium of states to develop a set of standards for K–12 science education based on and guided by the final NRC committee framework report.

The current adoption timeline for the Next Generation Science Standards is:

- Final Conceptual Frameworks: Early 2011
- Development of Next Generation Science Standards: December 2011
- Possible State Adoption of Next Generation Science Standards: June 2012

Washington will need to give serious consideration to the adoption of these standards. Upon adoption, significant changes in science education will need to be realized throughout the science education system. Professional development and curriculum revisions will need to be addressed throughout the entire K–12 science system.

Assessments measuring Next Generation Science Standards could be accomplished through collaboration with other states following a multi-state assessment design similar to the one already in place for the development of the common core standards in English language arts and mathematics. There is substantial fiscal advantage in the economies of scale realized in an across-state test-development collaborative.

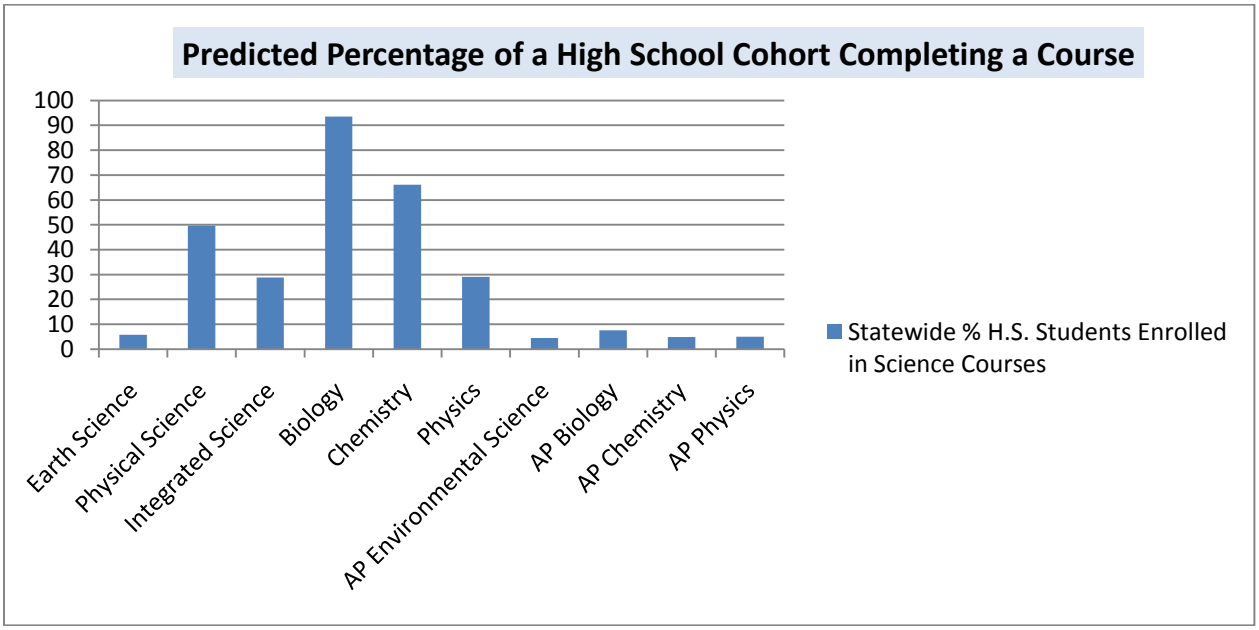
This fiscal advantage is even more so if there is federal support for this test development, as there currently is for the development of common core ELA and mathematics tests. An across-state test-development collaborative might make available end-of-course assessments for such courses as biology, integrated science, physical science, chemistry, and environmental science. The earliest possible availability of these assessments would be spring 2015.

### High School Science Courses

The following list of discipline-specific sciences predicts the courses taken by the typical Washington high school student cohort during Grades 9 through 12. These percents are based on analysis of current enrollment as of October 2010. (See Appendix B for details).

**Table 1: Science Course Enrollment**

| Course | % of Students taken course during High School (Grades 9–12) |
|---|---|
| Biology | 93.5% |
| Chemistry | 66.1% |
| Physical Science | 39.7% |
| Physics | 32.2% |
| Integrated Science | 28.8% |
| Life and Physical Sciences | 14.5% |
| Earth Science | 10.4% |
| Environmental Science | 6.8% |




The data will assist in determining the development of new end-of-course assessments.

Observing the course offerings throughout the state reveals that science curriculum has not varied much since the early 20th century and may also need to be addressed as a result of the Next Generation Science Standards.

## III. Graduation Requirement and Assessment

### Meeting Standard

Under current law, the Class of 2013 will be the first class required to meet standard on the science assessment to graduate. These students will be required to pass either the current comprehensive science assessment in spring 2011 or the new biology end of-course exam in 2012 or 2013. Students may also meet standard on one of the legislatively-approved alternatives, such as the Collection of Evidence, the GPA Comparison, and the SAT/ACT/AP Option.

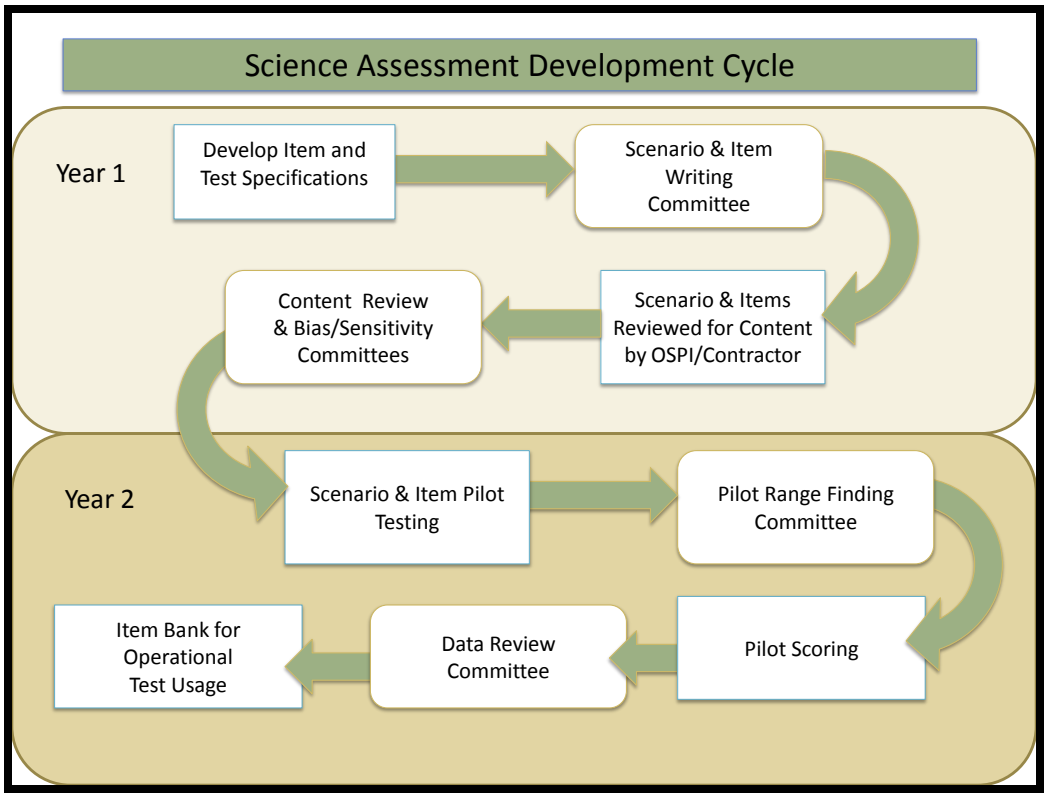
Students eligible for Special Education may also meet the science standard through a number of alternative pathways. Depending on the provisions outlined in the Individualized Education Plan, these students can meet the modified (Basic) standard on state science assessments or meet standard on the WAAS-Portfolio, a Developmentally Appropriate assessment, or an approved Locally Determined Assessment. The WAAS-Portfolio is federally required and is designed for students with the most significant cognitive disabilities and will be redesigned to assess the new science standards in 2013.

### Credits

The State Board of Education has recommended to the State Legislature increasing the number of science credit requirements from two to three credits. Two of the credits must be lab sciences. This resolution was adopted during the November 2010 State Board of Education meeting and sets forth new career and college-ready graduation requirements. Under the State Board's proposal, high school students will be enrolled in a common pathway that will keep all postsecondary options open and will align with the Higher Education Coordinating Board's minimum four-year public college admission requirements, unless otherwise specified in the student's High School and Beyond Plan.

### Biology End-of-Course Development

The current high school comprehensive science assessment, the Science High School Proficiency Exam (HSPE), will be administered for the last time in spring 2011. In 2012, the Science HSPE will be replaced by a biology end-of-course exam. This assessment is currently in a development process involving two years of review and piloting as shown in the Science Assessment Development Cycle flow-chart below.




In this process, each scenario and item is planned by the OSPI science assessment team in conjunction with an educational assessment contractor and is then written, reviewed, and revised during a scenario writing workshop. From there, the development process involves formal reviews with science educators of all scenarios, items, and the scoring criteria. Additional reviews are conducted following pilot testing. This development process assures the assessment contains items that meet the following criteria:

- Authentic scenarios describing what students might do in school
- Tight alignment to a specified science item specification
- Valid measure of a specified science learning standard
- Constructed response item scoring rubrics that can be applied in a valid manner
- Constructed response items that can be scored in a reliable manner

Because the biology end-of-course exam will be the first high school assessment of the content standards and performance expectations of the Washington State K–12 Science Learning Standards (adopted 2009), test and item specifications are also being developed. Item specifications guide the writing of items that match the standards, with sufficient restrictions to construct a valid and reliable on-demand assessment. Although the test map has not been articulated yet, it is anticipated that the biology end-of-course exam will assess the cross-cutting concepts and abilities in EALRs 1, 2 and 3 of the K-12 Science Learning Standards (see Appendix A), as well as the “Big Ideas” in the Life Science domain of EALR 4. Furthermore, the items being developed for the biology end

of course will include multiple choice, completion and short answer formats. These items will likely be embedded within the context of a scenario.

Scenarios have been used on the state science assessments to provide context for a group of items since 2001, when advisory groups composed of national education experts, science assessment experts, and science educators decided to utilize the scenario structure for several reasons. First, scenarios are less likely to lead to discrete teaching of science facts, concepts and skills. Second, it is easier for students to demonstrate their scientific knowledge when they move from item to item within a scenario than when they have to orient to a new context for each item. Third, scenarios are consistent with the structure of the standards.

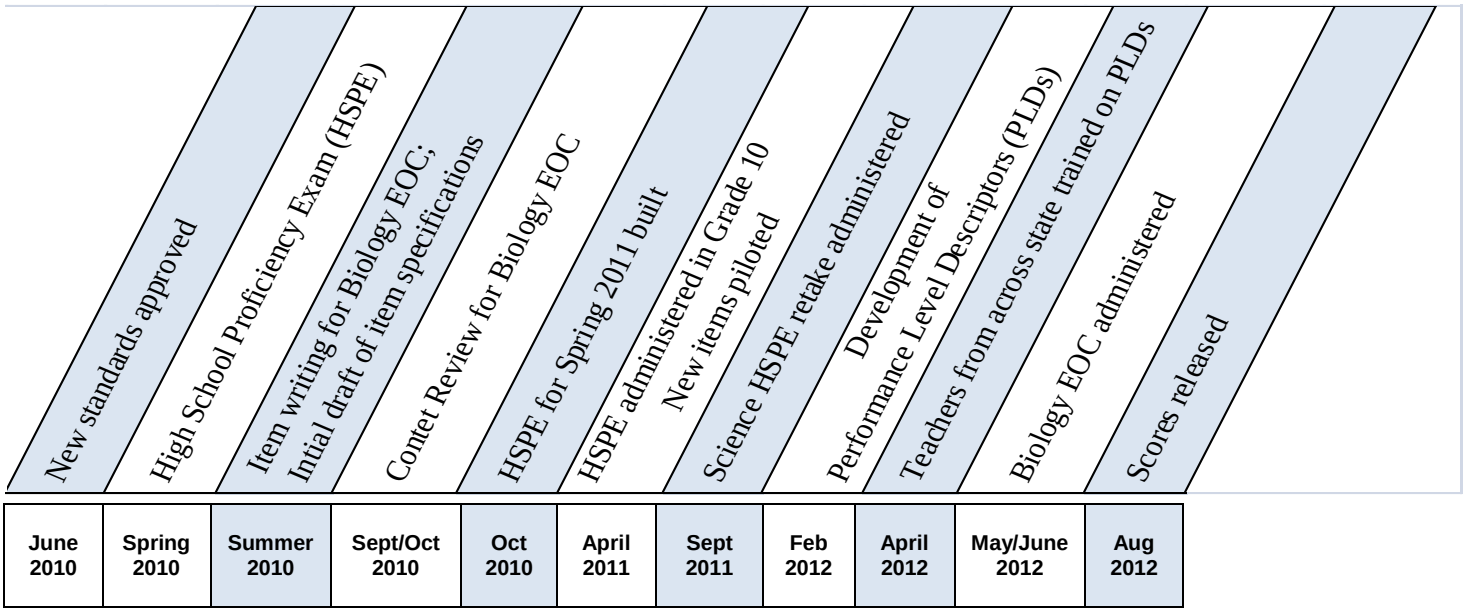
Based on the cross-cutting EALRs, a scenario on current state science assessments can depict an inquiry, application, or a system. Inquiry scenarios are descriptions of controlled experiments or field studies. Application scenarios describe how students designed a solution to a human problem. Systems scenarios provide descriptions of the properties, structure, and changes in living systems. All scenarios ask students questions measuring more than one strand of the content standards.

In preparation for the first biology end-of-course exam in 2012, draft item specifications have been written to guide the development of scenarios and their associated items. Ten scenarios have been formally reviewed and will be piloted in the spring of 2011. Following additional reviews of the pilot data, many of these items and scenarios will be accepted into the operational item bank.

Committees of educators and other stakeholders will also participate in meetings to determine the test blueprint for the operational end-of-course exam, and this plan will be formally presented to the National Technical Advisory Committee in the fall of 2011. Following the first operational use of the exam, a standard setting committee will be convened in the summer of 2012 to recommend the cut-scores for Advanced, Proficient and Basic proficiency levels. The State Board of Education will establish the cut-scores after reviewing the recommendation of the committee. Currently, the intention is to administer the biology end-of-course exam online, on a voluntary basis, in 2012 with a goal of 25 percent of the tests given online.

The transition timeline from the science HSPE to the biology end of course is summarized in the timeline below.

**Timeline of Test Development, Biology End-of-Course Exam**




Any end-of-course exams would have to be developed through a similar process over the same timeline. However, no other science end-of-course exams are being developed as of this report.

In a report prepared for the Washington State Office of Superintendent of Public Instruction (OSPI), Hanover Research Council summarizes the use of end-of-course exams for ESEA science accountability. The fourteen states shown in Table 2 all used end-of-course exams to satisfy the science component of ESEA; 13 of these used biology and one other state expressed intentions to transition to biology by 2010.

**Table 2: *ESEA* Accountability in States That Assess Science**

| Only End-of-Course Exams Used | Both Comprehensive and End-of-Course Exams Used |
|---|---|
| Indiana | Arkansas |
| Maryland | Massachusetts |
| Mississippi | New Jersey |
| Missouri | South Carolina |
| New York | |
| North Carolina | |
| Oklahoma | |
| Tennessee | |
| Utah | |
| Virginia | |

Note: Washington is listed in this report as using a comprehensive test only.

End-of-course exams either currently in use or in development by various states, were summarized by the Hanover Research Council's report as shown in Table 3. Of the 23 states reported with end-of-course exams for federal or state accountability purposes, all reported a biology exam. In addition, ten states gave chemistry, seven gave physics, four gave physical science and two gave earth science. Of the states reported as giving only one end-of-course, that test was always biology. Two states reported giving two science end-of-courses, six states gave three science end-of-courses, and three states gave four science end-of-courses.

## **Table 3:** States with EOC Exams in One or More Science Domain

| State | Science EOC #1 | Science EOC #2 | Science EOC #3 | Science EOC #4 |
|---|---|---|---|---|
| Alabama | Developing Biology | | | |
| Arkansas | Biology | | | |
| Delaware | Developing Biology | | | |
| Florida | Developing Biology | | | |
| Georgia | Biology | Physical Science | | |
| Indiana | Biology I | | | |
| Iowa | Biology | Chemistry | Physical Science | |
| Louisiana | Developing Biology | | | |
| Maryland | Biology | | | |
| Massachusetts | Biology | Chemistry | Introductory Physics | |
| Mississippi | Biology I | | | |
| Missouri | Biology | | | |
| New Jersey | Biology | | | |
| New York | Biology | Chemistry | Earth Science | Physics |
| North Carolina | Biology | Chemistry | Physical Science | Physics |
| Oklahoma | Biology I | | | |
| Pennsylvania | Biology | Chemistry | | |
| South Carolina | Biology I | | | |
| South Dakota | Biology | Chemistry | Physical Science | Physics |
| Tennessee | Biology | Chemistry | Physics | |
| Texas | Biology | Chemistry | Developing Physics | |
| Utah | Biology | Chemistry | Physics | |
| Virginia | Biology | Chemistry | Earth Science | |

The Center on Education Policy's (2010) report also summarized the use of science end-of-courses as exit exams (see Tables 4–6). Because these are exit exams, diplomas will be withheld if students do not score above a minimum level. These tables represent a snapshot of the current status of state exit exams.

**Table 4: States with EOC Exit Exams in Place.**

| State | Science Course Requirements | Required Test(s) for Graduation | Comments |
|---|---|---|---|
| Maryland | 3 years | EOC in biology | • Implemented in 2009. Replaced Maryland Functional Test. Working with PARCC to develop tests for 2014–15.<br>• State provides online assistance; specialist in state agency; train-the-trainer workshops; grants to districts; released test items; formative assessments; state developed courses. Specific funds for remediation are not provided. |
| New York | 3 years | EOC in biology, chemistry, or physics | • Implemented in 2008.<br>• Regular diploma, Regents diploma, Advanced Regents diploma.<br>• Online assistance; state specialist; released test items; no funding for remediation; some targeted remediation programs for students. |
| Virginia | 3 years | EOC in earth science, biology, and chemistry | • Implemented 2004. EOC is graduation requirement.<br>• Seals of Achievement attached to diploma.<br>• State provides online assistance; state specialist; some grants to local districts; funds are provided for remediation including summer programs, interventions and remediation. |
| Source: Center on Educational Policy( http://www.cep-dc.org/) | | | |

**Table 5: States with Planned or Revised Science EOCs**

| State | Science Course Requirements | Required Test(s) for Graduation | Comments |
|---|---|---|---|
| Massachusetts | 3 years | EOC in biology; chemistry; introductory physics, technology and engineering | • Implemented with class of 2010. Students must score at the Needs Improvement Level for graduation.<br>• State provides academic support funds (originally $54 million for all content areas) for students who scored at the Warning Level in Grades 8–10. Test items are released after the test. Test prep materials for teachers. Targeted remediation for students in Grade 11 who have not passed exam.<br>• Competitive Grants and Allocation Grants are available for remediation programs. |

| | | | |
|---|---|---|---|
| Mississippi | 3 years | EOC in biology | • Implemented in 2000. Replaced with implementation effective 2010–11.<br>• State provides online assistance; specialist at state level; Three Tier Instructional Model; no funding for remediation. |
| New Jersey | 3 years | EOC in biology | • Implementation in 2010–11. Class of 2014 will have to satisfy graduation requirement.<br>• State provides technical assistance through online resources. Some targeted remediation programs for students. No addition funding for remediation. |
| Tennessee | 3 years | EOC in both biology and chemistry | • Implemented in 2009–10. Students in 2013 will be required to pass new tests as graduation requirement.<br>• End-of-course assessment counts 25 percent of student grade.<br>• With Race-to-the-Top funds, programs are being reformed. |
| Source: Center on Educational Policy,( http://www.cep-dc.org/) | | | |

**Table 6: States that have Eliminated or Suspended Science EOC**

| State | Science Course Requirements | Required Test(s) for Graduation | Comments |
|---|---|---|---|
| North Carolina | 3 years | EOC in biology | • Implemented in 2006.<br>• The assessment was eliminated October 2010 and is used for accountability purposes only.<br>• State has an Academic Scholars Diploma. |
| South Carolina | 3 years | EOCs in biology and physical science | • Implemented in 2004.<br>• Assessment was suspended in 2010.<br>• Did count as 20 percent of student's grade. |
| Source: Center on Educational Policy (http://www.cep-dc.org/) | | | |

## IV. Costs of the Science Assessment Graduation Requirement

### State Costs

The cost to develop a new assessment of Washington learning standards is approximately $2.25 million. The annual cost of administering and scoring an assessment is approximately $3 million (approximately $40/student). If an assessment is used as a graduation requirement, alternative objective assessments (e.g., Collections of Evidence) must be provided and students must be afforded at least four opportunities for retakes. The cost of the Collection of Evidence is currently $600 per student and every re-take costs $40 per student.

## School District Costs

At the school and district levels, decisions will need to be made about how to best prepare students for the biology end-of-course assessment. To be successful on any assessment, students must have access to standards-based curriculum and instruction. Instruction must provide experiences that enable students to learn how to successfully apply their knowledge in new and unique inquiry situations. Biology in the 21st century is a science that utilizes the concepts of chemistry, physics, and earth and space sciences. Scientists working in biological fields are no longer the "Naturalists" of the 19th and 20th centuries. Schools and districts must plan and finance strong middle school programs to provide the foundational knowledge that high school science teachers can build upon ensuring student success on the biology end-of-course exam and any future end-of-course exams.

High school 9th and 10th grade science teachers will carry the responsibility of preparing students to be successful on the biology end-of-course. Students will need to engage in laboratory activities and teachers will need adequate funding to provide those experiences. Costs to provide professional development for teachers will need to be provided by school districts since funding for science professional development is no longer provided by the state (see Table 7).

As the test is implemented, it is predicted that more than 50 percent of the students will need remediation. Districts will need to determine appropriate methods of assistance such as remedial courses, tutoring and at-home study interventions. The costs of such remediation will impact science programs. Costs to gather "Collection of Evidence" potentially can be staggering. Attention to supporting courses at middle school and 9th grade could lower these anticipated costs. Strong leadership, articulation of science standards through teacher professional development and subsequent instruction, and close monitoring of student progress can all help improve student success. In states such as Massachusetts, the cost of supporting education reform was $54 million annually.

## Teacher Input

In a survey of Washington national board certified secondary science teachers, 40 percent of respondents indicated that science instruction would **not** be improved by requiring an end-of-course test in biology while 38 percent thought it would. Twenty-two percent remained neutral on the question. Further, 79 percent of respondents agreed that the biology end-of-course will potentially narrow biology instruction to the assessed topics. A total of 87 percent of respondents reported concern that significant amounts of their departments' resources would be diverted to support the assessment including instruction, collection of evidence and remediation. Sixty-five percent of survey responders indicated that a biology end-of-course would reduce the future growth of integrating and applying the core principles of science, technology, engineering and mathematics (STEM topics). Seventy percent suggested that consideration be given to offering a diploma with "Distinction in Science" for students taking four years of science

and passing SAT/ACT or AP science tests. Seventy-one percent felt that mandating 180 minutes of science instruction at the elementary level was necessary.

## V. State Funding

Table 7 below categorizes the budget allocated to science at the state level. Changes from fiscal year 2008 to fiscal year 2011 are dramatic and impact the ability of the state and districts to provide the professional development needed by high school teachers as the new biology end-of-course is scheduled to be implemented. In fiscal year 2009, more than $15 million was appropriated for statewide science professional development and two Learning Improvement Days were available. In this fiscal year, less than $3 million is available and funding for Learning Improvement Days has been eliminated. Professional development provided by LASER has been significantly reduced and funding for site-based science coaching has been halved. The combination of LASER, science ESD coordinators and science coaches have traditionally worked together to support and share resources with each other. Diminishing any one piece of the established infrastructure diminishes the entire science education infrastructure.

**Table 7:**

| **Science Education Funding** | **Appropriated** (After Dec. 2011 Supplemental Budget Reductions) | | | |
|---|---|---|---|---|
| | FY 08 | FY 09 | FY 10 | FY 11 |
| LASER | $ 4,079,000 | $ 1,579,000 | $ 1,473,000 | $ 197,000 |
| Science ESD Coordinators | $ - | $ 1,677,500 | $ 1,677,500 | $ 1,677,500 |
| Science Instructional Coaches | $ - | $ 1,792,000 | $ 943,250 | $ 943,250 |
| Science Professional Development | | | | |
| - 4th/5th grade teachers | $ 1,939,000 | $ 2,513,500 | $ 507,000 | $ - |
| - Middle/High School teachers | $ 7,173,000 | $ 8,101,500 | $ 1,620,402 | $ - |
| **TOTALS** | **$ 13,191,000** | **$ 15,663,500** | **$ 6,221,152** | **$ 2,817,750** |
| | | | | |
| **Other State Funding that can be used for Science** | **Appropriated** | | | |
| Learning Improvement Days | 2 Days | 2 Days | 1 Day | 0 Days |

## VI. Considerations

### Rationale for Additional End-of-Course Exams

Current state and federal laws require that students be assessed at least once during high school to determine their level of science knowledge. The intent of the assessment is to measure students' overall attainment of skills and abilities commensurate with state standards. The state science standards address two content domains beyond biology. Additional end-of-course exams are necessary for an accountability system that is representative of the breadth of Washington's science learning standards, which include earth and space science, and physical science. Adoption of Next Generation Science

Standards would further change curriculum and instruction at the local level and consideration needs to be given to the time required for successful implementation.

**Combined Impact of End-of-Course and Graduation Requirement**

If biology is the only content area being assessed and used for the purpose of graduation, it is very likely that instruction in all other areas of science will be given substantially less priorty (survey results). Ensuring that students will graduate will mean moving resources at the local level to support remediation.

Under current law, students in the Class of 2013 who do not meet standard on the 2011 comprehensive science assessment will be required to meet standard on the Biology end-of-course exam in order to graduate. This graduation requirement is not only being implemented during the transition from a comprehensive assessment to a course-specific exam, but also coincides with the transition from the 2005 Grade Level Expectations (GLEs) to the 2009 K–12 Science Learning Standards on the test. Very high stakes will be attached to both the end-of-course exam and its measurement of the new standards before students and teachers have had an opportunity to become familiar with these two changes in the format and focus of the test.

In addition, a significant proportion of the Class of 2013 will experience a gap between receiving biology instruction and the administration of the end-of-course exam. If this cohort, which consisted of almost 80,000 students in 2008–09, meets standard on the current comprehensive science assessment at the same rate as the Class of 2012, only about 45 percent of the class will be proficient or higher in science. Therefore, approximately 55 percent of the class, or 44,000 students, will be required to meet standard on the biology end-of-course exam in their junior year or later. However, most students complete biology as freshmen or sophomores, and only 10.5 percent (8,400) of 11th grade students typically take high school biology. Thus, in 2012 approximately 35,600 students will be required to sit for an end-of-course exam a year or more after the completion of the course being assessed.

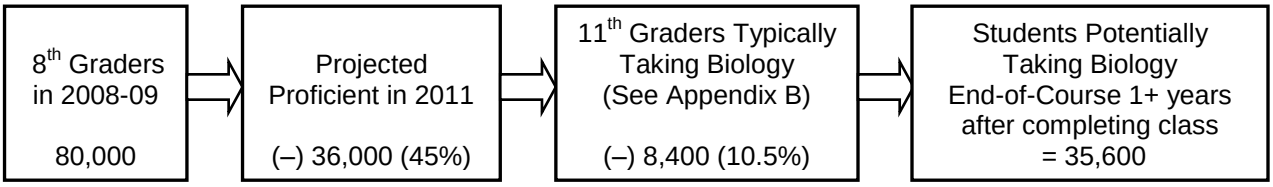


Table 8 details the current graduation requirement concurrent with the implementation of the new standards and the new exam.

### Table 8: Current Graduation Requirement in Science

| | 2010–2011 School Year | 2011–2012 School Year | 2012–2013 School Year |
|---|---|---|---|
| **Exam** | **High School Proficiency Exam (HSPE)** | **Biology End-of-Course (Bio EOC)** | **Biology End-of-Course (Bio EOC)** |
| **Standards Assessed** | 2005 Grade Level Expectations | 2009 Science Learning Standards | 2009 Science Learning Standards |
| **Population Tested** | All 10th graders | All 10th graders<br>AND<br>Juniors who did not pass the HSPE<br>AND<br>other students in HS Bio | Students in HS Bio |
| **Graduation Requirement** | Class of 2013 must pass HSPE assessing 2005 GLEs or Biology EOC<br>Class of 2014 and beyond must pass Bio EOC | | |
| **Re-Take Opportunities** | **HSPE** August 2011<br>**Bio EOC** May–June 2012<br>**Bio EOC** Jan–Feb 2013<br>**Bio EOC** May–June 2013 | **Bio EOC** Jan–Feb 2013<br>**Bio EOC** May–June 2013<br>**Bio EOC** Jan–Feb 2014<br>**Bio EOC** May–June 2014 | **Bio EOC** Jan–Feb 2014<br>**Bio EOC** May–June 2014<br>**Bio EOC** Jan–Feb 2015<br>**Bio EOC** May–June 2015 |
| **Alternatives** | | Collection of Evidence (**COE**) in Biology<br>SAT/ACT/ AP Option Grades Comparison<br>**DAPE*** based on 2005 GLEs<br>**WAAS-Portfolio** based on 2005 GLEs<br>Approved Locally Determined Assessment | Collection of Evidence (COE) in Biology<br>SAT/ACT/ AP Option Grades Comparison<br>**DAPE*** based on 2009 Standards<br>**WAAS-Portfolio** based on 2009 Standards<br>An approved Locally Determined Assessment |
| **Test Administrion Costs** | $40/ HSPE student plus cost of re-takes | $40/ Bio EOC student plus cost of re-takes<br>$600/ COE per collection<br>$150,000 / DAPE total cost (2005 standards)<br>$300/ WAAS-Portfolio per portfolio | $40/ Bio EOC student plus cost of re-takes<br>$600/ COE<br>$150,000 / DAPE<br>$300/ WAAS-Porfolio |
| **Needed New Development** | COE in Biology<br>DAPE based on 2005 GLEs<br>WAAS-Portfolio based on 2005 GLEs | | |
| **Initial Development Costs** | $3 million for Bio EOC<br>$250,000 COE in Biology<br>DAPE – no costs, pull from previous test pool<br>WAAS-Portfolio – $30,000 (build against 2009 standards) | | |

*Developmentally Appropriate Proficiency Exam

## VII. Recommendations

1. Continue with the implementation of the biology end-of-course exam in 2012 as per ESSB 6444.
2. Delay the graduation requirement until the Class of 2017 so that districts, schools, educators, students and parents can become familiar with the measurement of the new K–12 Science Learning Standards on the biology end-of-course exam before high stakes are attached. Require students in the Class of 2017 to pass the biology end-of-course exam or an alternative for graduation.
3. Phase in two additional end-of-course exams, the first in physical science in 2015 and the second in integrated science in 2016.
4. Require students in the Class of 2018 and beyond to meet standard in science by passing the biology end-of-course exam or an additional science end-of-course exam or appropriate alternative.

The implementation timeline and cost for these recommendations is summarized in Table 9.

**Table 9:** Recommendations with Implementation/Timeline

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|
| **End-of-Course Exam(s)** | **Biology** | **Biology** | **Biology** | **Biology**<br>**Physical Science** | **Biology**<br>**Physical Science**<br>**3rd Course** | **Biology**<br>**Physical Science**<br>**3rd Course** |
| **Population Tested** | All 10th graders<br>AND<br>Other students in HS Bio | Students in HS Bio | Students in HS Bio | Students in HS Bio<br>AND<br>Students in HS Phys Sci | Students in HS Bio<br>AND<br>Students in either<br>HS Phys Sci or 3rd course | Students in HS Bio<br>AND<br>Students in either<br>HS Phys Sci or 3rd course |
| **NCLB** | Bio EOC | Bio EOC | Bio EOC | Bio EOC | Bio EOC | Bio EOC |
| | | | | | | |
| **Graduation Requirement** | | | | Class of 2017 must pass Bio EOC | Class of 2018 and beyond must pass Bio EOC and one additional EOC | |
| **Costs – Grad Requirement** | | | | Development of **Bio** COE, DAPE, and WAAS-Portfolio<br>AND<br>Re-take opportunities | Scoring of **Bio** COE, DAPE, and WAAS-Portfolio<br>AND<br>Development and Scoring of COE, DAPE, and WAAS-Portfolio for 2 additional EOCs<br>AND<br>Additional re-takes | |
| | | | | | | |
| **Costs – Test Administrion** | $40/ Student | $40/ Student | $40/ Student | $40/ Student / Test plus cost of re-takes | $40/ Student / Test plus cost of re-takes | $40/ Student / Test plus cost of re-takes |
| **New EOC Development** | | Begin development for Phys Sci EOC | Begin development for 3rd EOC | | | |
| **Costs – New Development*** | | Yr 1 costs -- Phys Sci EOC | Yr 2 costs -- Phys Sci EOC<br>Yr 1 costs -- 3rd EOC | Yr 2 costs -- 3rd EOC<br>Yr 3 costs -- Phys Sci EOC | Yr 3 costs -- 3rd EOC | |

*Yearly costs for development of a new test are as follows: Writing and Review in Year 1; Piloting in Year 2; Standard-setting in Year 3

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## IX. Acknowledgements


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## X. Appendices

Appendix A: Big Ideas in K–12 Science Learning Standards

Appendix B: Statewide Science Course Enrollment

**Appendix A**

The content of the Washington State K–12 Science Learning Standards is organized according to 12 Big Ideas of Science: nine in the domains of Life, Physical, and Earth and Space Science, and three that cut across and unite all of the science domains: Systems, Inquiry, and Application. The 12 Big Ideas of Science are shown in the table below.

## Big Ideas in K–12 Science Learning Standards

| EALRs 1–3<br>Crosscutting Concepts and Abilities | EALR 4<br>Domains of Science |
|---|---|
| **EALR 1 Systems** | **Physical Science** |
| …is a way of thinking that makes it possible to analyze and understand complex phenomena. | Force and Motion<br>Matter: Properties and Change<br>Energy: Transfer, Transformation and Conservation |
| **EALR 2 Inquiry** | **Earth and Space Science** |
| …is a process of asking and answering questions about the natural world that forms the bedrock of science. | Earth and Space<br>Earth Systems, Structures and Processes<br>Earth History |
| **EALR 3 Application** | **Life Science** |
| …is about the interaction between science and technology, and how both can help solve real-world problems. | Structures & Functions of Living Systems<br>Ecosystems<br>Biological Evolution |

**Appendix B**

**Statewide Science Course Enrollment**

Grade-level enrollment in state Comprehensive Education Data and Reseach System (CEDARS) records, October 2010

| | | Course Name and State Code | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Biology 03051 | Integrated Science 03201 | Chemistry 03101 | Physical Science 03159 | Physics 03151 | Earth Science 03001 | Environmental Science 03003 | Life and Physical Sciences 03999 |
| Percent of students within a grade level enrolled in each course | 9th Grade | 15.2% | 19.9% | 1.1% | 32.6% | 1.9% | 5.7% | 0.7% | 7.2% |
| | 10th Grade | 62.4% | 6.1% | 9.5% | 3.0% | 1.3% | 1.1% | 0.6% | 1.4% |
| | 11th Grade | 10.5% | 1.6% | 40.5% | 2.1% | 7.6% | 1.9% | 2.5% | 2.6% |
| | 12th Grade | 5.4% | 1.2% | 15.0% | 2.0% | 21.4% | 1.7% | 3.0% | 3.3% |
| | TOTAL | 93.5% | 28.8% | 66.1% | 39.7% | 32.2% | 10.4% | 6.8% | 14.5% |

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