



WASHINGTON STATE BOARD OF EDUCATION

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SCIENCE: STANDARDS REVISION UPDATE AND END-OF-COURSE ASSESSMENT STUDY

SUMMARY OF POLICY ISSUE /STATE BOARD OF EDUCATION (SBE) STRATEGIC PLAN GOALS

The SBE has developed a math action plan and is in the process of developing a science action plan to help meet its goal of preparing all Washington State students for the opportunity to succeed in postsecondary education, in the 21st century world of work, and citizenship. These initiatives are in addition to the legislatively-required (RCW 28A.305.215) tasks given to the SBE to review and make recommendations on the science standards, receive the revised standards from the Office of Superintendent of Public Instruction (OSPI), and provide official comment and recommendations to OSPI regarding science curricula OSPI recommends to align with the revised standards.

BACKGROUND

Science standards revision. The SBE recommended changes to the science standards in May 2008, based on a review by its consultant, David Heil & Associates, Inc., and the science advisory panel. The OSPI is in the process of revising the science standards, which are due December 1, 2008. The SBE amended the Heil contract to add more opportunities for the Heil team to review the revisions and provide formative feedback to OSPI before they were completed.

The Heil team met with OSPI's science standards revision team in July 2008 to orient the team to the recommendations and their intent. Since then, the Heil team has provided formal and informal feedback on the revisions, meeting with the science advisory panel on September 19, 2008 and again on November 12, 2008 to review the most recent drafts.

The SBE will convene a special meeting on December 10 to receive the revised science standards from OSPI and to accept the Heil report on the revised standards.

End-of-course science assessment. The 2008 legislature changed the math assessment graduation requirement by instituting end-of-course math assessments for the graduating class of 2014. Students in the graduating class of 2013 will have the option of taking end-of-course math assessments in lieu of the math Washington

Assessment of Student Learning (WASL). In anticipation that the legislature might explore similar options in science, the SBE sought to become better informed about the issues associated with science end-of-course assessments. The SBE issued a contract to David Heil & Associates, Inc. to prepare a briefing paper on the topic. That paper is included in your packet.

POLICY CONSIDERATION

The SBE is not required, at this time, to take a position on science end-of-course assessments. This briefing is strictly informative.

EXPECTED ACTION

None; information only



Washington State
Board of Education



Working to Raise Student Achievement Dramatically

Implications of Using Science End-of-Course Assessments for High School Exit Exams

A Briefing Paper

*Submitted
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Innovations in Science Learning

Introduction

This report was commissioned by the Washington State Board of Education (SBE) to inform the discussion about end-of-course (EOC) assessments that began with a report by Education First Consulting (2008) examining the role of EOC assessments in high school assessment systems. The discussion in this review complements the Education First Consulting report but focuses specifically on science. Where the Education First Consulting report addressed the central question – “How Well Do Comprehensive and EOC Assessments Meet the Four Major Purposes of High School Assessments?” – this report answers the question, “How Well Do Comprehensive and EOC Assessments Serve the Major Goals of Science Education?” In addressing this question, David Heil and Associates, Inc. (DHA) uses the unique features of the Washington science standards and the implied translation of those standards in school science programs as a basis for the discussion.

This brief: 1) reviews the use of science EOC assessments in the national context; 2) describes the Washington context for the use of science EOC assessments; 3) discusses implications for the use of EOC assessments with regard to the main goals of science education; and 4) outlines other considerations for science EOC assessments in Washington. This review does not present formal recommendations. Rather, it attempts to provide a deeper understanding and an insightful perspective on issues associated with the implementation of EOC assessments in Washington, especially in the science content areas.

The Use of Science EOC Assessments in the National Context

In the past 5 years, statewide EOC assessments have gained increasing interest in the education community. Although comprehensive assessments such as the Washington Assessment for Student Learning (WASL) remain the prominent statewide assessment vehicle across the country, the use of EOC assessments is increasing. Tables 1 and 2 are adapted from the Education First Consulting report (2008) and summarize states' uses of comprehensive and EOC assessments. Sixteen (16) states include EOC assessments in their high school assessment system and another 11 plan to implement EOC assessments in the near future. By 2012, twenty-six (26) states will have exit exams and 13 of these states will use EOC assessments as their exit exam.

Table 1		
Status of EOC Assessments in State Systems (in Place or Planned)		
Have EOC assessments in place (or field-testing in 2007-2008 school year).	16	AR, CA, GA, IN, LA, MD, MA, MS, NJ, NY, NC, OK, SC, TN, UT, VA
Report plans to have EOC assessments in at least one subject area.	11	AZ, FL, HI, KY, MI, NM, OH, PA, RI, TX, WV
Planning to keep both EOC assessments and comprehensive assessments.	7	AR, CA, GA, LA, MA, MI, SC

Adapted from the Education First Consulting report, January 2008.

Table 2		
States with EOC Assessments for Exit Exams and School Accountability (In Place or Planned)		
All states currently or planning to have exit exams for students.	26	AL, AK, AR, AZ, CA, FL, GA, ID, IN, LA, MD, MA, MN, MS, NV, NJ, NM, NY, NC, OH, OK, SC, TN, TX, VA, WA
States currently or planning to use EOC assessments to hold students accountable.	10	AR (2010), IN (2000), MD (2009), MS (2006), NY (2000), NC (2010), OK (2012), TN (2005), TX (2012), VA (2004)
States that will use comprehensives in English/math and EOC assessments in other subjects.	3	MA (English, math 2003, science EOC assessments 2010, U.S. History EOC assessment 2012) NJ (English/math 2003, Biology EOC 2010) SC (English/math 2006, Biology and U.S. History EOC assessments 2010)
Use or plan to use some or all of their EOC assessments for school accountability under NCLB.	12	AR, MA, MD, MS, NJ, NY, NC, OK, SC, TN, UT, VA

Adapted from the Education First Consulting report, January 2008.

The national landscape for science assessment shows a considerable amount of variation in terms of how the results of comprehensive and EOC assessments are used for the purposes of documenting student performance or determining school, district, and state-level accountability. Table 3 summarizes state exit exam requirements for science. By 2012 of the fourteen (14) states using a comprehensive exam as a graduation requirement, only 8 plan to

include a science component. Thirteen (13) states will require students to pass a science EOC assessment as a requirement for graduation, and another state (New Jersey) is considering this requirement. These states have different specifications for which science tests a student must pass. Six states will require students to pass only a biology EOC assessment for graduation. Other variations of science EOC assessment requirements include requiring students to 1) pass one science EOC assessment (MA, SC, VA); 2) pass two EOC assessments out of a set of five that include biology (OK); 3) obtain an average score across EOC assessments for biology, chemistry, and physics that meets the cutoff for graduating (TX); and 4) pass an EOC assessment for an integrated science course (WV).

Table 3		State Exit Exam Requirements for Science Current or Planned by 2012	
Exit Exam Requirement		Number of States¹	
No exit exam requirement		24	
Comprehensive exit exam without a science component and without a science EOC		6	
Comprehensive exit exam with a science component		8	
Science EOC exit exam requirement		13	
<i>Biology EOC Assessment Only</i>		7	
<i>1 Science EOC Assessment</i>		3	
<i>Biology as 1 EOC Assessment Option</i>		1	
<i>Average of 3 Science EOC Assessments</i>		1	
<i>Integrated Science EOC Assessment</i>		1	

Sources: Education First Consulting (2008); U.S. Department of Education (2007).

1) Includes Washington DC. Washington State is included in the "Comprehensive exit exam with a science component" category.

Although this paper is focused on the use of science EOC assessments as a graduation requirement, it is important to note additional and alternative uses of science EOC assessments (see Table 4 below). Currently, all of the 13 states that use or plan to use science EOC assessments as a component of their graduation requirement also will use the science EOC assessment to meet the accountability requirement for federal No Child Left Behind (NCLB) legislation. An additional 5 states (GA, LA, CA, MI, UT) that do not use a science EOC assessment as a graduation requirement include science EOC assessments as a component of their science assessment system. These states use the science EOC assessments to 1) provide a diagnostic tool for teachers and students to gauge student progress towards performance on a comprehensive exam; 2) serve as a state-level measure of school or district accountability and ensure consistency in core science curricular areas; and/or 3) measure student performance for the purpose of determining a portion of their course grade.

Table 4		State Uses of Science EOC Assessments		
EOC Assessment	Total States Offering Exam¹	States Requiring Exam for Graduation	States Using Exam as a Graduation Option²	States Using Exam for NCLB
Biology	18	8	4	14
Physics	9	1	2	4
Chemistry	8	1	2	4
Earth Science	5	0	1	2
Integrated Science	2	1	0	1
Living Environment	1	0	0	0
Technology/Engineering	1	0	0	1

Sources: Education First Consulting (2008); U.S. Department of Education (2007).

1) Includes states for which the exam is currently under development.

2) Students may choose this EOC assessment as one of their required EOC assessments.

The Use of Science EOC Assessments in the Washington Context

Excerpts from the Education First Consulting report (2008) provide background for a specific discussion of science EOC assessment in the Washington context. The report thoroughly analyzed the relative strengths and limitations of comprehensive exams and EOC assessments in meeting four major purposes of assessment. Overall, the report found both similarities and differences between comprehensive tests and EOC assessments. Figure 1 provides an excerpt from the report summarizing key features of each type of assessment.

Figure 1	Comparison of Comprehensive & EOC Assessments
<p>State high school assessment systems that are based on comprehensive tests:</p> <ul style="list-style-type: none"> ▪ Usually focus on 10th grade or lower standards; ▪ Assess a slice of the high school standards, rather than deep knowledge of subjects; ▪ Can potentially narrow the delivered curriculum to what is tested; ▪ Provide a “snapshot” of system performance at a point in time for all students; ▪ Take less testing time overall and cost less; ▪ Take a straightforward approach to exit exams and school accountability; ▪ Rarely provide information on students’ readiness for postsecondary education coursework and training. 	

**Figure 1
Cont'd****State Uses of Science EOC Assessments****State high school assessments systems based on EOC assessment testing:**

- Vary widely relative to the number and kinds of courses assessed;
- Measure a broader and deeper range of standards, including advanced subject matter, but only if there are a sufficient number of EOC assessments in each subject;
- Do not assess all students against common standards unless states require all students to take a certain series of courses and/or require all students to take certain EOC assessments;
- Are typically implemented to promote more consistency of teaching and provide more timely information on learning and course quality;
- Motivate students to learn through exit exams as well as other forms of lesser student stakes, such as counting test results as a portion of course grades;
- Make it more complicated to hold students and schools accountable, yet offer the potential to produce more validity and reliability;
- Can be better suited for placing students in postsecondary education courses than comprehensive tests given by states in the 10th grade.

Excerpted from Education First Consulting (2008), pages 2-3.

The Education First Consulting report concluded that although the two formats for assessments can serve many similar purposes, they also have different strengths in different areas. Given that comprehensive and EOC assessments have much in common, and that neither format is in itself a panacea to problems of low student or school performance, the report concluded that Washington policy-makers must first determine the extent to which the four purposes are most important in Washington, in order to choose the most appropriate testing format:

If, for example, Washington leaders want the high school assessment system to ensure greater consistency and bring teaching and learning more closely in line with statewide standards, then EOC assessments are probably better suited to serve this goal. If state leaders instead place a higher priority on preserving simplicity and minimizing complexity in the testing system, then continuing to use the WASL as the state's high school assessment is more appropriate.

Education First Consulting (2008), page 3.

To further the discussion that began with the Education First Consulting report and to extend this discussion specifically to implications within the discipline of science, it is necessary to first clarify several assumptions about the context of science education in Washington.

I. New Standards for Science Education. In 2009 Washington will introduce new standards for K-12 science education. The document will include content standards and performance expectations for science content, scientific inquiry, and applications of science in personal and social perspectives. The standards can serve as the basis for EOC assessments, a comprehensive assessment (the WASL), or both.

- 2. Science Credit Requirement for Graduation.** The SBE has approved a graduation requirements policy framework (CORE 24) that includes three credits of science with two of those being laboratory credits. Although contingent upon funding, the new CORE 24 requirements are scheduled to be phased in, beginning in 2013, and are planned to be fully implemented by 2016.
- 3. Science Assessment Requirement for Graduation.** Beginning with the class of 2013, students will be required to pass a science assessment (currently the WASL) to graduate.
- 4. National Requirement for State Accountability for Science.** Beginning in 2007-2008, states are required to administer annual assessments in science at least once in grades 3 through 5, grades 6 through 9, and grades 10 through 12. States may use EOC assessments at the high school level if they are used for high school courses that all students are required to take to graduate from high school. If used, EOC assessments must measure the depth and breadth of the content that the State expects all high school students to know and be able to do by the time they graduate (Department of Education, 2003).
- 5. Stakeholders Value Local Control.** Focus groups conducted with Washington educators during April 2008 revealed that stakeholders value having local control over decisions concerning science education programs and practices at the district, school, and classroom levels. This is a significant note about the Washington context for science education, because decisions about a transition to EOC assessments and/or changes in the WASL will affect local decisions about selection of instructional materials, instructional practices, the curriculum, and the courses and exit exams that meet graduation requirements.

Implications of EOC Assessments for Meeting the Main Goals of Science Education

The new Washington science standards are framed around four widely accepted goals of science education: science content, inquiry, application of science, and career awareness. Each of these goals is briefly described below, so that they may be used as the framework for understanding implications of implementing a science EOC assessment system.

Science Content. Students should understand core concepts and principles that are described in the Washington standards using the categories physical science, earth and space science, and life sciences.

Inquiry. A second major goal of science education involves students' understanding and use of methods associated with scientific investigation. The Washington standards describe this goal using the contemporary term—inquiry.

Applications of Science. This goal involves the application of scientific knowledge and methods to issues of health, resources, environments, as well as understanding the interrelationships among science, technology, and society. The Washington standards use the category—applications—to describe this goal.

Career Awareness. One goal that is always present but rarely dominant centers on careers in science, engineering, health professions, and other science/technology related jobs. Although the current Washington standards do not have an explicit category for this goal, the intent is implicit through each of the categories above. Washington Learns (2006) highlighted the importance of this goal to ensure the development of a 21st Century Workforce that makes the State competitive in the global economy.

Policy makers for education have the challenging task of achieving the highest possible levels of these goals for all students while accommodating constraints of budget, individual student variations, accountability, and other priorities thoroughly described in the Education First Consulting report. Although many factors must be considered when making policy decisions related to implementing EOC assessments for science, one priority should predominate—what will maximize student learning with respect to the major goals of science education. The implications of science EOC assessments are summarized below for each of the major goals of science education previously provided.

Science Content

Identification of a common set of science concepts to be assessed through a comprehensive exam presents some difficulty due to the persistence of the separate academic courses by discipline such as biology, chemistry, physics, geology, and meteorology. EOC assessments better accommodate this condition, but require implementation of several separate assessments. Alignment of EOC assessments would be necessary to accommodate courses such as Physical Science, Earth Science, and Biology, as well as courses with titles such as General Science, Coordinated Science, Science I, and Integrated Science.

In contrast to a comprehensive assessment, EOC assessments would provide more direct feedback on students' depth and breadth of knowledge in specific science content. In some districts and schools, the use of EOC assessments also would have the likely consequence of narrowing the variety of science courses offered, resulting in greater alignment among standards, courses, and assessments.

Scientific Inquiry

The science education community generally agrees on the importance of laboratory experiences as part of school science programs and by extension, the importance of appropriate assessment of these experiences. These assessments should focus on measuring students' knowledge of scientific inquiry and abilities such as the design of investigations; control of variables; collection of data; and use of evidence in support of a conclusion, recommendation, or decision. In comparison to comprehensive examinations, EOC assessments present greater opportunities for in-depth and subject specific evaluation of students' knowledge and abilities of scientific inquiry and the nature of science. These abilities are closely related to 21st century workforce skills and abilities such as problem-solving and critical thinking.

Applications

The science standards call for the application of science and technology to "real-world" problems. Although comprehensive examinations can include items with contexts such as health, resources, and environments, EOC assessments are better suited to assess specific disciplines and types of investigations.

Career Awareness

Inquiry and applications standards in the new Washington science standards address many of the outcomes necessary for 21st Century Workforce skills. A comprehensive assessment will assess these student skills at a single point in time, whereas a collection of EOC assessments could be developed to provide multiple assessments of these skills as they are introduced and learned in different courses or content areas. However, to ensure uniformity and comprehensive coverage, using EOC assessments to measure career awareness would require statewide coordination with regard to which science courses are used to address specific career awareness skills and abilities, and which courses would be required as opposed to elective.

Other Considerations for Science EOC Assessments in Washington

In addition to the implications for the main goals of science education, the selection of either EOC assessments or comprehensive assessments intersects with other issues within the educational system. As discussed previously, the Education First Consulting report provided a number of comparisons between comprehensive and EOC assessments. This report extends this discussion to issues that are specific to science education by highlighting some of the important issues that will require consideration by policy-makers, including graduation requirements; development and implementation of EOC assessments; statewide accountability; measurement of student knowledge and skills; and alignment of standards, curriculum, and assessment.

Graduation Requirements

Recognizing that assessment systems should be designed to measure the depth and breadth of the content that a state expects all high school students to know and be able to do by the time they graduate, increasing the graduation requirement to 3 courses (2 with a laboratory) and maintaining the WASL at 10th grade presents a significant alignment challenge for the State. Using EOC assessments for the three required courses could meet both graduation requirements and serve as a high school exit examination. It also would be possible to use EOC assessments as both criteria for meeting individual course requirements and calculating grades while also maintaining the comprehensive WASL but administering the WASL at grade 11 instead of grade 10. Maintaining the WASL and introducing EOC assessments could provide the state and local districts with accountability options while maintaining a focus on the new standards and purposes of science education.

Development and Implementation of EOC Assessments

Although states use various approaches to designing, administering, and scoring EOC assessments (including providing teachers with rubrics to score tests locally) most states centrally develop the assessments for statewide implementation. This approach helps to ensure that the standards and assessments are fully aligned at the state level but leaves open the potential for local options relative to: instructional materials, teachers' professional development, and course selection for graduation. Implementation of a standard set of EOC assessments would demand greater statewide consistency in high school course offerings as

well as the curricula and instruction for those courses and therefore, could raise tensions around issues of local control.

Implementation of EOC assessments in science will result in an upfront financial investment for the state to develop the new assessments, and additional local costs as the EOC assessments would likely result in some districts and schools selecting new instructional materials and revising their science course offerings and classroom practices. On an on-going basis, EOC assessments require more time for administration, but the tests can be easily administered within the class for which they are designed and within the normal class schedule, thus creating little, if any, disruption to the normal school schedule. Administration of a single comprehensive exam such as the WASL usually requires dedication of time outside of the normal instructional schedule.

Despite their upfront costs at the state and local levels, EOC assessments could ultimately serve as better tools for assessing state and local needs and developing district and school improvement plans. Through increased depth of student assessment in a particular subject, EOC assessments provide a more valid and reliable measure of student performance, making the EOC assessments more effective as tools for diagnosis and improvement of instruction, curriculum, and professional support.

State, District, and School Accountability

The legislature has required the SBE to develop a statewide accountability system. Based on this legislative mandate, the SBE has considered principles for an accountability system such as (SBE, August 12, 2008):

- Encourage the improvement of student learning.
- Be fair, reasonable, and accurate.
- Be a valid assessment.
- Focus educational priorities at classroom, school, and district levels.
- Apply to all schools in the state.
- Use standards-based concepts.
- Rely on criterion-referenced measures (criterion are the content standards).

Either comprehensive or EOC assessments could be effectively implemented to support these principles for accountability, and both approaches could be used to meet federal NCLB legislative requirements. However, the assessment approaches would differ with regard to the types of information that they provide about student, school, and district performance. Although comprehensive examinations would measure school and district performance as a snapshot of student achievement in science standards at a particular point in time, EOC assessments would more closely measure how specific courses support student achievement of science standards.

Student Accountability and Engagement in Learning

As evidenced in the discussion of the national context for EOC assessments, unlike comprehensive assessments, EOC assessments offer a number of medium stakes options for student accountability in addition to the high stakes approach of using the assessment as a graduation requirement. Medium stakes uses include recording the results of an EOC assessment on a student's transcript and basing a final course grade on the assessment.

Research conducted by John Bishop and his colleagues suggests a variety of positive benefits of using EOC assessments to promote student accountability (Bishop, Mane, Bishop, Moriarity, 2000; Bishop, Mane, Bishop, 2001; Bishop, 2007). Student outcomes include increased attention in class, higher levels of engagement in learning, and increased conscientiousness about completing assignments. Holding students accountable in this manner also appears to support changes in teachers and teaching including setting higher standards for students, spending more time teaching cognitively demanding skills, not giving “inflated grades,” and improving relationships with students.

Alignment of Standards, Curriculum, Assessments

Implementation of a comprehensive science exit exam will have implications for course sequencing at the high school level. Implementation of science EOC assessment exit exams will likely narrow the range of course options statewide but clarify the specific content and performance expectations covered by those courses. For example, the SBE database of district-level graduation requirements for the 2007-2008 academic year lists 12 different science courses that imply “Integrated Science” content, including “Science I,” “Introductory High School Lab Science,” “General Science,” “Integrated Science,” “Coordinated Science,” “Freshman Science,” and “Essential Science.” This is a wide array of courses that could be narrowed by the new content standards, a focus on the implied goals of science education, and the development and implementation of a single EOC assessment to measure student knowledge and skills in integrated science.

Conclusion

The previous discussion was presented to assist the SBE in comparing the effectiveness of science EOC assessments and comprehensive assessments with regard to measuring the major goals of science education as outlined in the Washington State science standards and to present other important considerations with regard to the statewide educational system. With the development and implementation of new science standards for the state of Washington, a revision to the number of science credits required for graduation, and current federal requirements for science assessment, Washington is in a position to act decisively on science assessment. Comprehensive and EOC assessments for science have different implications for motivating and measuring student achievement as well as meeting the major goals of science education across the educational system overall. The SBE must weigh these differences and choose an assessment system that acknowledges the values of statewide stakeholders and Washington’s goals for improving science teaching and learning.

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