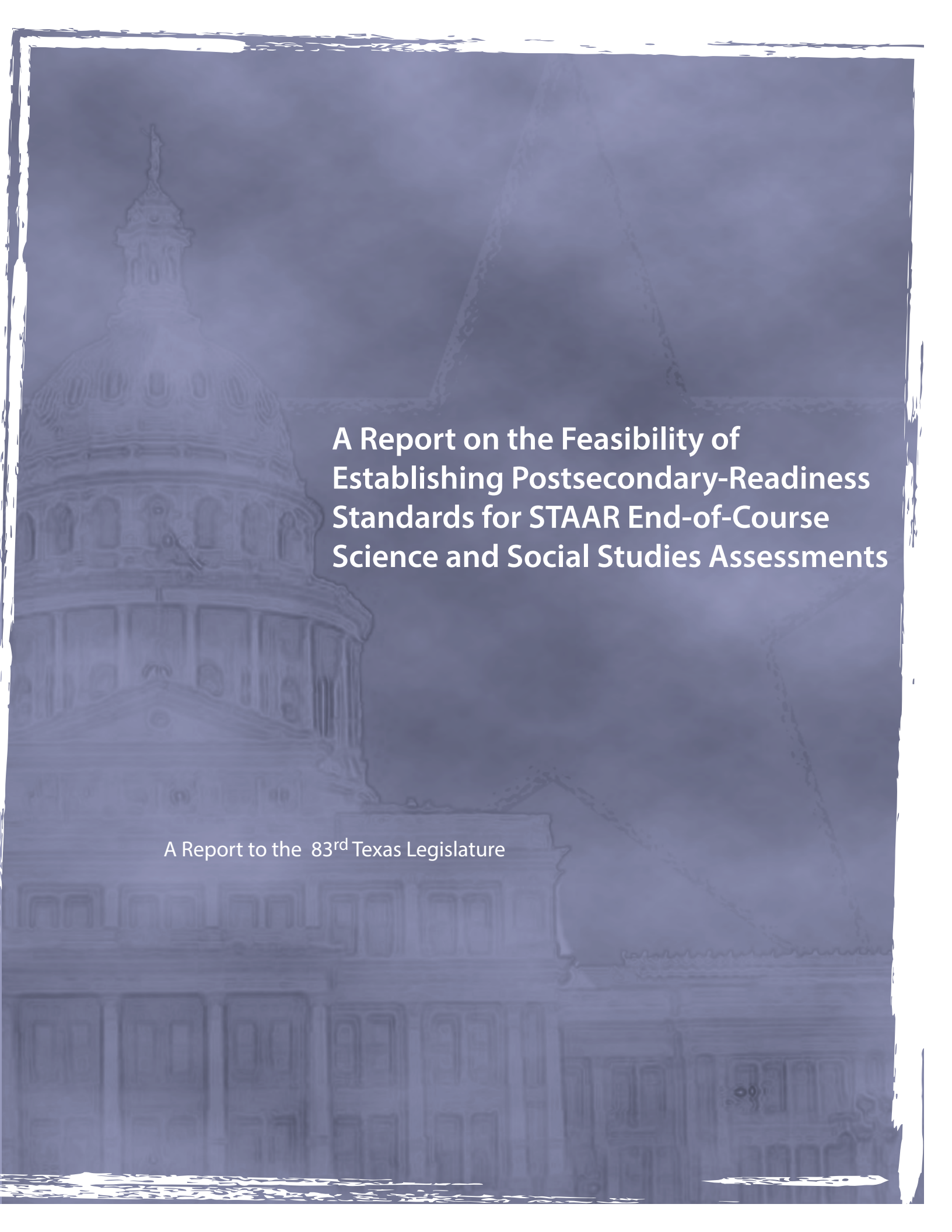

A Report on the Feasibility of Establishing Postsecondary-Readiness Standards for STAAR End-of-Course Science and Social Studies Assessments

A Report to the 83rd Texas Legislature

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A Report to the
83rd Texas Legislature
from the Texas Education Agency
in collaboration with the
Texas Higher Education Coordinating Board

Executive Summary

Introduction

This report addresses the feasibility of establishing postsecondary-readiness standards for science and social studies assessments included in the State of Texas Assessments of Academic Readiness (STAAR) End-of-Course (EOC) program, as required by Texas Education Code (TEC) §39.024(f). The purposes of this report are to summarize research and current practices related to postsecondary-readiness indicators for science and social studies assessments and outline plans for possible additional research, if appropriate. Four STAAR EOC assessments are the focus of the report: biology, chemistry, physics, and U.S. history. These are specified by the college-readiness plan published by TEA and THECB in 2009 (found in Appendix B of the House Bill 3 Transition Plan: http://www.tea.state.tx.us/student.assessment/hb3plan/) as courses for which postsecondary-readiness indicators on associated STAAR EOC assessments may be appropriate.

In 2008, the College and Career Readiness Standards (CCRS, www.txccrs.org) were adopted and compared to the Texas Essential Knowledge and Skills (TEKS), as required by TEC §28.008 in mathematics, English, science, and social studies. The TEKS in those four areas were revised as needed to incorporate the CCRS. STAAR, in turn, is designed to measure knowledge and skills relative to the TEKS. The alignment of the CCRS, the TEKS, and STAAR was an important part of the process in establishing the postsecondary-readiness indicators for STAAR Algebra II and English III assessments, both of which were explicitly required in TEC §39.0241. Likewise, the alignment of the CCRS, the TEKS, and STAAR is an important consideration in determining the feasibility of postsecondary-readiness indicators for STAAR EOC science and social studies assessments.

Postsecondary-Readiness Indicators on STAAR Assessments

As part of the standard-setting process for STAAR, policy definitions were developed describing different levels of performance. Emphasis was placed on readiness for future grades or courses. The policy definitions apply to all STAAR assessments. *Level II: Satisfactory Academic Performance* indicates a reasonable likelihood of success in the next grade or course, and *Level III: Advanced Academic Performance* indicates a high likelihood of success in the next grade or course. Readiness components of the policy definitions are important to bear in mind because in some cases, the next science or social studies course for a high school student may be a college-level course in the same content area.

Existing Practice and Relevant Research

The use of high school science and social studies assessment results by Texas colleges is rare. In general, Texas colleges tend to rely on mathematics, writing, and reading scores to make determinations about college preparedness. Furthermore, a review of practices in other states suggests there is little precedent for setting postsecondary-readiness standards for science and social studies tests. Scholarly research on the topic is limited, although studies have correlated performance on college admissions tests with college course performance in science and social studies. Specifically, the ACT science assessment has been linked to college-level science grades, and the ACT reading assessment has been linked to college-level social science grades. Although STAAR EOC assessments were linked to ACT scores as part of the standard-setting process in 2012, no formal postsecondary-readiness indicators were established for biology, chemistry, physics, or U.S. history. Additional validity research using available Texas data could help the Texas Education Agency (TEA) and the Texas Higher Education Coordinating Board (THECB) determine the viability of postsecondary-readiness standards for these assessments.

Available Data and Future Studies

Some validity research relevant to postsecondary readiness in science and social studies has already been completed. To inform STAAR standard setting, eight studies were performed linking STAAR biology, chemistry, physics, and U.S. history scores to two external tests, SAT and ACT. These studies benefited from large numbers of students assessed and strong statistical correlations between the STAAR assessments and external measures, although some important caveats should be noted. First, overlap in assessed content is limited across STAAR and SAT or ACT tests. Second, research to date is based on STAAR scores from 2011 and prior, when these assessments were administered under low-stakes conditions and students' motivation to perform well was probably limited. Looking ahead, as cohorts of students taking STAAR under high-stakes conditions progress through high school, low-stakes data will no longer impact validity research.

In addition, TEA has collected SAT II Subject Test scores from smaller groups of Texas students who have also taken STAAR science and social studies assessments. Preliminary analyses indicate similarities between SAT II Subject Tests and corresponding STAAR EOC assessments. All the caveats noted above specific to SAT and ACT links also apply here, and the SAT II links were based on a very small number of students. As the STAAR program is fully implemented, however, high-stakes scores will be available for analysis, so SAT II linkages (along with similarly purposed tests such as AP and IB) may provide evidence for establishing postsecondary-readiness indicators on STAAR EOC science and social studies assessments. However, TEA's ability to conduct the necessary studies will depend on sufficient numbers of students taking these assessments. The new Texas Success Initiative (TSI) assessment, to be implemented in fall 2013, may also provide useful information in this regard.

Recommendation

Longitudinal data from STAAR students ultimately provide the best information for determining the feasibility of science and social studies postsecondary-readiness indicators. Longitudinal data for these analyses will be available following the 2015–2016 academic year, when the first cohort of students taking STAAR under high-stakes conditions enters college. In short, analysis of longitudinal data will focus on the extent to which performance on STAAR science and social studies assessments provides information about the likelihood of postsecondary success *above and beyond the information already provided by Algebra II and English III scores*. In order to support the establishment of postsecondary-readiness indicators for STAAR EOC science and social studies assessments, TEA and THECB recommend that these assessments provide substantively greater predictive power not already available via postsecondary-readiness indicators for STAAR Algebra II and English III.

Overview

This report addresses TEC §39.024(f), requiring TEA, in collaboration with THECB, to examine the feasibility of establishing performance standards indicating postsecondary readiness on STAAR EOC science and social studies assessments.

The purposes of this report are to (1) summarize research and current practices related to postsecondary-readiness indicators for science and social studies assessments and (2) describe potential plans to conduct additional research on the linkages between performance on STAAR EOC science and social studies assessments and postsecondary readiness. The first section provides an overview of the legislative requirements for research on science and social studies postsecondary-readiness indicators and discusses the process by which the CCRS have been integrated into the assessed curriculum in Texas. The second section describes the STAAR standard-setting process – with specific focus on the establishment of postsecondary-readiness standards in English and mathematics – conducted in spring 2012. The third and fourth sections describe current practices (both in Texas higher education institutions and in other states) and relevant research literature, respectively.

The fifth section summarizes analyses performed to date linking performance on STAAR EOC science and social studies assessments to external measures of postsecondary readiness. While the analyses suggest relationships may exist between STAAR EOC science and social studies assessments and postsecondary measures, the data are limited and results are not conclusive. As such, the sixth section outlines plans for future research that could be conducted, if warranted, as the first cohorts of STAAR students graduate from high school and begin postsecondary endeavors.

1. LEGISLATIVE CONTEXT

Texas legislation called for STAAR EOC assessments to replace the Texas Assessment of Knowledge and Skills (TAKS) high school tests. Beginning with incoming ninth-grade students in the 2011–2012 school year, testing requirements specific to the STAAR program are used to determine eligibility for high school graduation instead of the TAKS program. The STAAR program has been designed to have a stronger emphasis on rigor, be a more comprehensive assessment system with performance standards aligned from elementary through high school, and include indicators of each student's readiness for postsecondary endeavors.

TEC §39.024 (see Appendix A) requires TEA and THECB to set postsecondary-readiness performance standards on STAAR Algebra II and English III and to investigate the feasibility of establishing postsecondary-readiness performance standards on the STAAR EOC science and social studies assessments. These requirements include the following activities:

- ❒ conducting research studies similar to those conducted to establish postsecondary-readiness standards for STAAR Algebra II and English III,
- ❒ determining if the research studies substantiate a correlation between a certain level of performance by students on STAAR EOC science and social studies assessments and college readiness, and
- ❒ completing a report to the Texas Legislature that includes an analysis of the feasibility of establishing postsecondary-readiness performance standards for STAAR EOC science and social studies assessments as well as a summary of any implementation procedures adopted for each standard.

Establishing postsecondary-readiness indicators for STAAR EOC mathematics and English assessments has a well developed research base. These content areas have been studied most frequently; thus, their relationship to student success after high school is understood better than that of other academic disciplines. Research also shows that assessments taken in closer proximity to matriculation to college have better predictive value than assessments taken in earlier years. Thus, STAAR English III and Algebra II are positioned as the most reliable predictors of postsecondary outcomes among the STAAR EOC English and mathematics assessments. While English language arts and mathematics are considered to be reliable predictors of college readiness, performance in these subjects is not the only indicator of college success. The college-readiness plan published by TEA and THECB in 2009 (which can be found in Appendix B of the House Bill 3 Transition Plan: http://www.tea.state.tx.us/student.assessment/hb3plan/) specifies four STAAR EOC science and social studies assessments, beyond Algebra II and English III, for which postsecondary-readiness indicators may be established: biology, chemistry, physics, and U.S. history. Those four assessments are the focus of this report.

It should be noted that although postsecondary-readiness indicators may be established for all three STAAR EOC science assessments, only one STAAR EOC social studies assessment is named in the Transition Plan. Because no state-mandated course sequence exists, any science assessment may be closest in proximity to college matriculation. However, Texas student enrollment data suggest the same cannot be said of STAAR EOC social studies assessments. Specifically, few students take world geography or world history in their junior year.

College- and Career-Readiness Standards in Texas

In January 2008, Texas became the first state to adopt college- and career-readiness standards. The CCRS (www.txccrs.org) were developed by teams of secondary and postsecondary educators, and they outline the knowledge and skills that students need to demonstrate in order to be successful in entry-level college courses. The CCRS focus not only on content knowledge but also on cognitive strategies and behaviors that are important for college success across academic disciplines.

Following the adoption of the CCRS, per requirements of TEC §28.008, vertical teams were convened in four content areas (mathematics, English, science, and social studies) to compare the secondary-level TEKS curriculum standards with the CCRS and identify any gaps. The teams found strong alignment between the TEKS and CCRS in mathematics[1] and English language arts[2]. In science there was adequate but not strong alignment[3]. For social studies, the teams generally found strong or adequate alignment between most of the standards[4]. Any gaps identified by the vertical teams have been addressed as the TEKS for each content area were revised and adopted by the State Board of Education.

STAAR is designed to measure knowledge and skills relative to the TEKS. Because the CCRS have been incorporated into the TEKS for mathematics, English language arts, science, and social studies, the STAAR assessments in all four content areas include measurements of the knowledge and skills associated with postsecondary readiness.

1 http://www.txccrs.org/downloads/CCRS_MathGapAnalysis.pdf
2 http://www.txccrs.org/downloads/CCRS_ELAGapAnalysis.pdf
3 http://www.txccrs.org/downloads/CCRS_ScienceGapAnalysis.pdf
4 http://www.txccrs.org/downloads/CCRS_SocialStudiesGapAnalysis.pdf

2. POSTSECONDARY-READINESS INDICATORS ON STAAR ASSESSMENTS

Policy Definitions for STAAR EOC Performance Standards

In fall 2010, TEA, in collaboration with THECB, convened a committee of stakeholders in public education and higher education in Texas. This group was charged with recommending (1) the labels used to describe the performance categories on STAAR and (2) the key words and phrases that would be used to develop the policy definitions for each category. For more information about committee membership and the discussions and recommendations of this committee, a report is available in Appendix A of the House Bill 3 Transition Plan at http://www.tea.state.tx.us/student.assessment/hb3plan/. The work of this committee resulted in three performance categories:

- ❒ Level III: Advanced Academic Performance
- ❒ Level II: Satisfactory Academic Performance
- ❒ Level I: Unsatisfactory Academic Performance

The policy definitions for each of the performance categories are as follows:

Level III: Advanced Academic Performance

Performance in this category indicates that students are well prepared for the next grade or course. They demonstrate the ability to think critically and apply the assessed knowledge and skills in varied contexts, both familiar and unfamiliar. Students in this category have a high likelihood of success in the next grade or course with little or no academic intervention.

For Algebra II and English III, this level of performance also indicates students are well prepared for postsecondary success.

Level II: Satisfactory Academic Performance

Performance in this category indicates that students are sufficiently prepared for the next grade or course. They generally demonstrate the ability to think critically and apply the assessed knowledge and skills in familiar contexts. Students in this category have a reasonable likelihood of success in the next grade or course but may need short-term, targeted academic intervention.

For Algebra II and English III, this level of performance also indicates students are sufficiently prepared for postsecondary success.

Level I: Unsatisfactory Academic Performance

Performance in this category indicates that students are inadequately prepared for the next grade or course. They do not demonstrate a sufficient understanding of the assessed knowledge and skills. Students in this category are unlikely to succeed in the next grade or course without significant, ongoing academic intervention.

The *italicized* notes for Levels II and III highlight postsecondary-readiness interpretations for Algebra II and English III. According to TEC §39.024, postsecondary readiness is the level of preparation a student must attain in English language arts and mathematics courses to enroll and succeed, without remediation, in an entry-level general education course for credit in that same content area for a baccalaureate degree or associate degree program or for certificates or credentials other than baccalaureate or advanced degrees.

Postsecondary readiness as measured through the Algebra II and English III assessments constitutes only *one piece* of information students, parents, and schools have in making readiness determinations. Algebra II and English III are courses students typically take in grade 11. Subsequent to taking the associated STAAR assessments, students will take higher-level courses (e.g., pre-calculus and English IV) in grade 12. Students will need to continue to acquire content knowledge to prepare fully for postsecondary success.

To determine the feasibility of establishing postsecondary-readiness indicators specifically for STAAR EOC science and social studies assessments, empirical data may be examined to identify potential postsecondary-readiness interpretations. These data could include linkages between STAAR EOC science and social studies assessments and other measures of postsecondary readiness. Although some evidence has been collected to date and will be described in the sections that follow, more data are forthcoming and may be analyzed as students progress through the STAAR program and into college.

Standard Setting for STAAR EOC Assessments

Summarizing the 2012 STAAR EOC standard-setting process, where postsecondary-readiness indicators were established for Algebra II and English III assessments, can further clarify the meaning and intended interpretation of a "postsecondary-readiness indicator" or a "postsecondary-readiness performance standard."

A comprehensive process called Evidence Based Standard Setting (O'Malley, Keng, & Miles, 2012; Beimers, Way, McClarty, & Miles, 2012) was used to set performance standards on the STAAR EOC assessments. The process was supported by empirical studies that involve comparisons between STAAR scores and standards on related national and international assessments, such as the SAT, ACT, and NAEP. The process also involved educators from secondary and higher education, education administrators, special population representatives, business and workplace leaders, policy experts, legislative staff, and community representatives from across Texas. A nine-step process was developed to set performance standards for the STAAR EOC assessments. Figure 1 provides a summary of that process.

Figure 1 – STAAR EOC Standard-Setting Process

Standard-Setting Step		Description	Timeline
1	Conduct validity and linking studies	External validity evidence was collected to inform standard setting and support interpretations of the performance standards. Scores on each assessment were linked to performance on other assessments in the same content area.	Studies started in spring 2009 and will continue throughout the program.
2	Develop performance labels and policy definitions	Committee convened jointly by TEA and THECB to recommend performance categories, performance category labels, and general policy definitions for each performance category.	September 2010
3	Develop grade/course specific performance level descriptors (PLDs)	Committees consisting primarily of educators developed performance level descriptors (PLDs) as an aligned system, describing a reasonable progression of skills within each content area (English, mathematics, science, and social studies).	November 2011
4	Convene policy committee	Committee considered policy implications of performance standards and empirical study results and made recommendations to identify reasonable ranges ("neighborhoods") for the cut scores.	February 1–2, 2012
5	Convene standard-setting committees	Committees consisting of K–12 educators and higher education faculty used the performance labels, policy definitions, performance-level descriptors, and neighborhoods set by the policy committee to recommend cut scores for each STAAR EOC assessment.	Mathematics and English: February 22–24, 2012 Science and Social Studies: February 29–March 2, 2012
6	Review performance standards for reasonableness	TEA and THECB reviewed the cut-score recommendations across content areas.	March 2012
7	Approve performance standards	The Commissioner of Education approved performance standards for satisfactory academic performance and advanced academic performance.*	April 2012
8	Implement performance standards	Performance standards will be reported to students after the spring 2012 administration with phase-in standards applied.	May 2012
9	Review performance standards	Performance standards will be reviewed at least once every three years.	Fall 2014

* Texas Success Initiative (TSI) exemption standards are under discussion by TEA and THECB.

Two key steps in the process (Step 4, the policy committee and Step 5, the standard-setting committees) involved convening committees of stakeholders to provide recommendations for the STAAR EOC performance standards.

The policy committee met February 1–2, 2012. This committee included policy experts, legislative staff, business and workplace leaders, and secondary and higher education representatives. The group reviewed the results from empirical research studies, considered the policy implications of the performance standards, and made recommendations to identify reasonable ranges ("neighborhoods") for the cut scores on all STAAR EOC assessments. The policy committee considered results from five types of studies:

- ❒ Studies comparing STAAR assessments to established national and international assessments, such as the SAT, ACT, NAEP, and PISA
- ❒ Studies comparing STAAR assessments to other assessments (THEA, ACCUPLACER) used by Texas colleges and universities to place students in credit-bearing courses
- ❒ Studies linking STAAR scores to corresponding grades in entry-level, credit-bearing college courses
- ❒ Studies comparing STAAR assessments and corresponding TAKS tests
- ❒ Studies comparing students' scores on STAAR assessments to corresponding high school course grades

All five types of studies were conducted for the STAAR Algebra II and English III assessments in order to inform postsecondary-readiness performance standards. When data were available, the same types of studies were used to inform recommendations about the performance standards for the STAAR science and social studies assessments. Specific information about studies conducted for the STAAR science and social studies assessments will be provided in Section 5 of this report.

Standard-setting committees met February 22–24, 2012, and February 29–March 2, 2012. The committees consisted of secondary and higher education representatives. Each committee was provided the neighborhoods recommended by the policy committee to help inform cut-score recommendations. The standard-setting committees recommended a total of thirty cut scores – two cut scores for each of the fifteen STAAR EOC assessments.

TEA then conducted a reasonableness review (Step 6) of the cut-score recommendations across content areas and made adjustments as appropriate. For more detailed descriptions of the standard-setting process and results, see the STAAR EOC Standard Setting Technical Report (available at http://www.tea.state.tx.us/student.assessment/staar/).

The performance standards have been approved and implemented (Steps 7 and 8); the postsecondary-readiness performance standards are under consideration by the Commissioner of Education and the Commissioner of Higher Education, to be approved in fall 2012. The Commissioner of Education and the Commissioner of Higher Education will continue to review the reasonableness of the standards. Per legislative requirements, the performance standards will be reviewed at least once every three years (Step 9). During standards review, TEA and THECB will examine additional impact and validity study data, including data from longitudinal studies and studies evaluating the relationship between performance on STAAR and success in military service or workforce training, certification, or other credential programs. This ongoing review process will provide TEA and THECB additional information to verify whether the established performance standards are appropriate or should be adjusted.

This additional data collection would also provide the opportunity for TEA in collaboration with THECB to evaluate whether postsecondary-readiness performance standards for science and social studies are warranted. Although linkages were established from STAAR EOC assessments in science and social studies to some external college-readiness measures for the purpose of setting performance standards (e.g., STAAR physics was linked to ACT science), those linkages come with caveats. STAAR data used for the 2012 standard-setting meetings derived from low-stakes testing scenarios, and content overlap for some links was relatively weak. Future research may focus on more closely aligned college-readiness assessments using high-stakes Texas assessment data (e.g., links between high-stakes STAAR physics scores and high-stakes AP physics scores). Additional validity evidence used to inform the standard setting for Algebra II and English III included the college course performance of students who had taken those STAAR assessments. Parallel data for science and social studies – college grades for students who have taken STAAR physics, chemistry, biology, and U.S. history – were not available for the 2012 standard setting but could be available once current STAAR students move on to college if additional studies are warranted. All three of these key sources of data for examining the viability of postsecondary-readiness interpretations for science and social studies – high-stakes STAAR scores, high-stakes external measures (e.g., AP tests), and college grades – would potentially be available from two longitudinal cohorts of STAAR students prior to the 2017 standards review.

Intended Use of Postsecondary-Readiness Indicators for Science and Social Studies

Science and social studies postsecondary indicators on STAAR assessments have a variety of potential uses. Considering potential uses of readiness indicators is important because different score interpretations have different stakes attached – for schools, teachers, and students. In short, knowing the interpretation and use of a test score is critical to researching the validity of that test score. Test scores with consequences require strong evidence supporting their use for high-stakes purposes. The higher the stakes associated with a particular test, the greater the demand for a strong validity argument. Thus, the intended uses of postsecondary-readiness indicators for science and social studies may influence feasibility decisions.

3. EXISTING PRACTICE

Science- and Social-Studies-Readiness Indicators in Texas Institutions of Higher Education

The use of high school science and social studies assessment results by Texas colleges is rare. THECB data suggest that Texas colleges do not use statewide tests specific to science and social studies to determine college readiness. In general, to make determinations regarding college preparedness, Texas colleges tend to rely only on mathematics, writing, and reading scores. Specifically, some Texas colleges use mathematics assessment scores as a proxy for determining college readiness in science. In addition, some Texas colleges use reading assessment scores as a proxy for determining college readiness for social studies. The use of mathematics and reading scores to gauge students' readiness for science and social studies courses in colleges is neither systematic nor high-stakes. Furthermore, Texas does not require institutions of higher education to provide developmental education courses in science or social studies.

Science- and Social-Studies-Readiness Indicators in Other States

There is little precedent for establishing postsecondary-readiness indicators for science and social studies on high school tests in other states. Below, development and implementation efforts are described for two state-level systems: Minnesota and Washington. For each assessment system, college- and career-ready standards are reviewed, and any postsecondary-readiness interpretations are summarized. For some assessment systems where fewer details are available – Florida, New York, Tennessee, and the General Educational Development (GED) test – the status of postsecondary-readiness indicator use is briefly discussed. These sections are followed by a summary of documented existing practice.

Minnesota. Minnesota has adopted college- and career-ready standards in reading/language arts and mathematics. These postsecondary-readiness standards include a memorandum of understanding from Minnesota's colleges and universities stating that students who meet the postsecondary-readiness standards will not need remedial coursework in college. In addition, Minnesota participates in the American Diploma Project's Alignment Institutes to design performance standards reflecting the knowledge and skills needed for success in college and careers.

High school social studies standards were released in 2011 for implementation by the 2013–2014 school year. Students in Minnesota are required to complete units in social studies, encompassing U.S. history, geography, government and citizenship, world history, and economics.

Science standards most recently established in 2009 have been updated, and implementation of revised standards was planned for the 2011–2012 school year. Included in the requirements for the new standards is college- and work-readiness alignment. Revisions to the science standards relied on four national frameworks for science and technology literacy: National Science Education Standards (National Academy of Science); Benchmarks for Science Literacy (American Association for the Advancement of Science); 2009 Draft National Assessment of Educational Progress (NAEP) Framework; and Standards for Technological Literacy (International Technology Education Association). In addition, Minnesota relied on state-level input, including the Report of the Postsecondary and Workforce Science Readiness Working Group, sponsored by the Minnesota P–16 Education Partnership.

Washington. Through collaboration with the Washington Higher Education Coordinating Board and Learning Connections, the state content standards in English, science, and mathematics were revised between 2006 and 2010. Initially, efforts to tie standards and curricula to college readiness in the state of Washington extended across content areas. To date, the work of linking Washington's assessments to postsecondary readiness has occurred only in the English language arts and science content areas. The state does plan to establish postsecondary-readiness standards in mathematics, although work on that initiative is being handled by separate stakeholders and has not yet begun. Establishment of postsecondary-readiness indicators for English and science is an ongoing collaborative effort involving primary, secondary, and higher education stakeholders.

This project is generally intended to

- ❒ define what students must know and be able to do to succeed in entry-level, credit-bearing college coursework;
- ❒ align learning outcomes emphasized in K–12 with requirements for college success; and
- ❒ be relevant to today's technology-driven workplace, which increasingly requires students to have education beyond high school and higher-level skills.

Limited information is available for four additional state-level or national assessment systems — ***Florida, New York, Tennessee***, and the ***GED***. In brief, these three states are implementing postsecondary-readiness standards in English and mathematics but have no plans to set corresponding standards in science or social studies. Although science and social studies postsecondary-readiness indicators have not been established for the GED, discussions surrounding the feasibility of those standards are ongoing.

In summary, science and social studies assessments are generally not used to provide postsecondary-readiness indicators to parents, teachers, schools, or institutions of higher education. Information from three states and a national assessment program that have implemented postsecondary-readiness indicators suggests little movement in the direction of college and career readiness for science and social studies. Minnesota and Washington are the only two states where work toward this end seems to have begun in earnest. In both states, content standards have been articulated that specify postsecondary-readiness interpretations for science and social studies, but the assessments that would provide those indicators have not been developed. Moreover, in both states the research and development emphasis seems to be in science rather than in social studies. Minnesota's work on science-readiness indicators seems further developed than parallel work on its social studies assessments, and Washington's efforts have not focused on social studies at all. The subsequent section will summarize research literature on this topic, specifically, that little work has been done with regard to postsecondary readiness in science and social studies, and the work that has been done has focused disproportionately on science rather than on social studies.

4. RESEARCH LITERATURE

This section describes research on postsecondary-readiness measures, with specific focus on science and social studies. General research on readiness across content areas is summarized first. The two subsections that follow address readiness in science – where the bulk of research has been conducted – and social studies, where available research is limited.

In general, courses that suitably prepare students for college have high-level content (often denoted by honors, AP, or IB distinctions), qualified teachers, flexible and responsive teaching as well as provide extra student support when necessary (ACT, 2004). Completion of such high-level coursework does not necessarily signal preparedness for college work; grading standards and curricular focus can vary widely across schools and districts. Accordingly, the most commonly cited avenue for determining college readiness in high school is linking first-year college success to associated state tests. This is most easily completed in subjects with relatively homogenous content (e.g., mathematics). It becomes more complicated in social studies, which encompasses several subdisciplines (e.g., history, geography, economics) and science, where course offerings and expectations vary widely (Conley, 2010; Otterman, 2011).

Some research has recommended specific criteria that can be used to facilitate definitions of college success. While it is important that a statewide test's scores are related to postsecondary outcomes or readiness measures, it is equally important that defensible readiness benchmarks on those statewide tests can be set. For example, an ACT (2008) report outlines recommendations for states in supporting their science and social studies students' transitions to college and careers. First, fewer but more specific state standards for each content area are recommended. These should supplement "essential college-readiness standards" and should be mapped downward through K–12 grades. Second, students should be prepared by enrolling in, and passing, three years of social studies and science courses in high school (including biology, chemistry, and physics) with complementary progress standards. Third – and most importantly for the purposes of this report – progress standards need to be tied to eventual success rates in college.

These recommendations align well with the STAAR standard-setting process for mathematics and English assessments, described in Section 2. STAAR measures deep understanding of academic content, and both mathematics and English performance standards have been linked down through high school assessments. Links across tests support an aligned system that provides, at each phase in a student's high school career, indicators of readiness for a subsequent course. Finally, high-level STAAR mathematics and English assessments were linked to measures of postsecondary readiness (e.g., SAT scores) and success (e.g., college grades). So, the philosophy of STAAR standard setting was grounded in the examination of readiness evidence, as recommended by ACT and others. The question that remains is whether a similar process can be executed for STAAR science and social studies assessments.

Research on Science Readiness

There is a wide range of science courses in college, each with its own content base. These courses typically emphasize scientific thinking in all its facets (see Sadler & Tai, 2007a). In addition to using all the steps in the scientific method, students learn what it means to think like a scientist. This includes the communication conventions that scientists follow, the way that empirical evidence is used to draw conclusions, and how such conclusions are then subject to challenge and interpretation (Conley, 2008; Conley, Aspengren, Stout & Veach, 2006). To the extent that high school science courses emphasize these concepts, students who succeed in high-level science courses are more likely to graduate prepared for college-level work. Empirical research supports this line of thinking: Success in high school biology, chemistry, and physics courses – as measured by course grades – is associated with college success in the same fields (Tai, Sadler, & Mintzes, 2006; Sadler & Tai, 2001, 1997). These research findings are echoed in studies linking performance on AP

tests to college outcomes. The College Board found that students who perform well on the AP Biology exam (specifically, attain a score of 3 or higher) tend to have higher first-year college grades and higher second-year retention rates, relative to those students who either score poorly on or do not take the AP Biology exam (Mattern, Shaw, & Xiong, 2009).

Obviously there is more to success in college science than high school science coursework. Other academic content areas also provide useful, predictive information. Not surprisingly, fluency in advanced mathematics is a strong predictor of success in college-level science (Sadler & Tai, 2007b; Tai, Sadler, & Loehr, 2005). Research on the relationship between mathematics attainment and college science performance has typically measured "fluency in advanced mathematics" via college admissions or placement exams such as the SAT, SAT II Subject Tests, and AP tests. This focus on external measures is important to keep in mind, because much of the available evidence for establishing postsecondary-readiness indicators on STAAR science assessments capitalizes on Texas students taking both STAAR assessments and college admissions or placement tests.

In fact, one study by ACT (2005) established a direct link between the ACT science assessment and performance on college science courses. An ACT science score of 24 is associated with a 75% probability of earning a C or better and a 50% probability of earning a B or better in an entry-level college biology course. This ACT link was used as one piece of evidence to inform the STAAR standard-setting process for science assessments. Specifically, ACT demonstrated a strong empirical relationship between its science assessment and examinees' performance in college-level science courses, and STAAR EOC science assessments were shown to be relatively good predictors of performance on the ACT science assessments (see Section 5 for further details on this link). For STAAR standard setting, the science assessments' linkages to ACT scores provided external validity evidence to support the establishment of rigorous standards. However, because linkages to college course performance are available (via ACT research), the same analyses could be used to determine whether STAAR science standards are in fact indicators of postsecondary readiness. ACT conducted similar research examining social studies outcomes in college. Those results are summarized in the following section.

Research on Social Studies Readiness

The research literature covering postsecondary readiness for social studies is limited. Social studies courses in college entail a range of subdisciplines, each with its own content base, analytical techniques, and conventions. The analytical methods that are common across the social studies emphasize the skills of interpreting sources, evaluating evidence and competing claims, and understanding themes and events within larger frameworks. For these reasons, it has been difficult to isolate social studies assessments in high school that reasonably predict college performance. Still, research from the College Board suggests social studies performance in high school may be measurably related to postsecondary success. Mattern et al. (2009) show that students who perform well on the AP U.S. History exam (attain a score of 3 or higher) tend to have higher first-year grades and higher second-year retention rates than those students who do not perform well on this exam (attain a score less than 3).

Beyond the links between AP exam performance and postsecondary outcomes, the task of predicting success in college social studies courses often falls on assessments in other academic content areas. One of the few empirical research studies predicting social studies outcomes in higher education uses a reading test to do so. Specifically, ACT's college-readiness research (2005) established a statistical link between an ACT reading score of 21 and a 75% probability of earning a C or better and a 50% probability of earning a B or better in entry-level college social science courses. As with the ACT science link described above, this ACT reading link was used in the STAAR standard-setting process. Specifically, each STAAR EOC social studies assessment was linked to ACT reading via students who took both tests, and strong empirical relationships were observed (see Section 5 for further details). These links provided empirical external validation for STAAR social studies

standards, but an explicit connection to postsecondary readiness in social studies was not made. The same may be said for STAAR EOC science assessments – external validity evidence exists using national college-readiness assessments, but no explicit claim about postsecondary readiness in each science course (biology, chemistry, physics) has been made. The next section details the data available that may be used to support such claims in the future.

5. CURRENT DATA: LINKS BETWEEN STAAR AND EXTERNAL TESTS

This section presents results from multiple analyses conducted to date linking STAAR EOC science and social studies assessments to external assessments. Each of the external tests functions as a measure of college readiness or college placement, so results are relevant to the feasibility of establishing postsecondary-readiness indicators on STAAR EOC science and social studies assessments. The section begins with a discussion of the linkages established for the STAAR standard setting. Next, additional preliminary linkages to SAT II Subject Tests are discussed, where very few students are available for analyses. The section concludes with a summary of results and suggestions for additional research if necessary.

STAAR EOC Standard-Setting Validity Evidence

To inform STAAR EOC standard setting, eight external validity studies were performed linking STAAR biology, chemistry, physics, and U.S. history scores to external measures. The present discussion will focus solely on these assessments, because the college-readiness plan published by TEA and THECB in 2009 listed biology, chemistry, physics, and U.S. history as the STAAR assessments where postsecondary-readiness indicators may be established (see Section 1 for further details). To inform the standard-setting process, STAAR biology, chemistry, and physics assessments were linked to both SAT mathematics and ACT science assessments. The STAAR U.S. history assessment was linked to both SAT critical reading and ACT reading assessments.

For each external test (SAT or ACT), links to corresponding college course grades were available via research from the College Board and ACT. The College Board provided separate links for SAT mathematics scores to specific college science courses (i.e., biology, chemistry, and physics). In addition, SAT critical reading scores were linked to college social studies courses. ACT reading college-readiness benchmarks were established via links to college social science courses, and ACT science benchmarks were established via links to college biology courses. Research-based links between admissions test scores and college grades are critical if the objective is to ultimately connect STAAR performance to postsecondary outcomes. Table 1 presents the results of these links. Included in the results are the pair of assessments linked, the available sample size, correlation, external benchmark, associated STAAR score (in scale score units), and Level II and Level III cut scores for the relevant STAAR assessment.

Table 1 – Links between STAAR and College-Readiness Assessments

STAAR Assessment	External Assessment	Sample Size	Correlation	External Benchmark	Linked STAAR Score*	Level II Cut	Level III Cut
Biology	SAT Math ACT Science	17,213 9,739	0.69 0.66	470 24	3826 4419	4000	4576
Chemistry	SAT Math ACT Science	60,206 35,416	0.70 0.65	470 24	3643 4257	4000	4607
Physics	SAT Math ACT Science	66,281 36,634	0.68 0.64	480 24	3538 4159	4000	4499
U.S. History	SAT Reading ACT Reading	42,346 23,238	0.71 0.65	390 21	3345 3968	4000	4440

* SAT benchmarks were calculated as the point on the SAT scale at which a student would have a 75% chance of earning a C or better. ACT college-readiness benchmarks were calculated as the point on the ACT scale where a student would have a 75% chance of earning a C or better in a corresponding college course *or a 50% chance of earning a B or better*. The discrepancy between these definitions explains the different mappings to the STAAR scales. The SAT definition aligns most closely with STAAR policy definitions for performance standards.

In Table 1, "correlations" measure the strength of the empirical relationship between linked tests. While a thorough understanding of correlation coefficients is not necessary to interpret the table above, it is useful to point out that the strength of the relationships described above is roughly equivalent to relationships for other linkages (e.g., Algebra II – SAT mathematics) used in the standard-setting process. The studies described in Table 1 benefited from large sample sizes and large empirical correlations, although some important caveats should be noted. First, content analyses determined limited overlaps exist between STAAR science and social studies tests and external tests. For the links to all SAT tests, as well as the U.S. history – ACT reading link, content overlap analyses indicate no relationship[5]. For all STAAR science – ACT science links, content overlap analyses indicate minimal overlap[6]. Second, the links above are based on EOC assessment scores from 2011 and prior. During these years EOC assessments had no consequences attached. As such, students' motivation to perform well was probably low.

That said, in the years leading up to the 2017 standards review, data from multiple cohorts of students taking both STAAR assessments and college admissions tests for high-stakes purposes will become available. Therefore, motivation issues will not be a factor in future linkages. A critical piece of the STAAR standard-setting process involved summarizing the strengths and weaknesses of each validity study. Summarizing study quality required in-depth discussion of both qualitative (e.g., overlap in assessed content) and quantitative (e.g., statistical correlations) components of linking STAAR and external assessments. This was accomplished via individualized "study profiles" and a "study quality summary." The former detailed the characteristics of each study (e.g., content overlap, correlations), and the latter summarized these characteristics across studies to help policy committee members decide which pieces of validity evidence should receive consideration. Study profiles and the study quality summary specific to the links detailed in Table 1 are available online (http://www.tea.state.tx.us/staar/vldstd.aspx). These documents are useful in comparing the science and social studies links to other links used during the standard-setting process.

5 For these purposes, "no relationship" signifies no overlap in assessed content areas across linked assessments. Detailed content overlap analyses for links between STAAR and external assessments are available online (http://www.tea.state.tx.us/staar/vldstd.aspx)

6 For these purposes, "minimal overlap" signifies similarity in content areas across linked assessments, but limited (between 1% and 25%) overlap in assessed knowledge and skills (http://www.tea.state.tx.us/staar/vldstd.aspx).

EOC assessment scores collected in 2011 and prior were low stakes, and classroom instruction will likely continue to evolve as the STAAR program matures. As such, the statistics presented in Table 1 are best viewed as a postsecondary-readiness research "proof of concept" – expected to improve in both validity and reliability as multiple waves of high-stakes data become available. When larger samples of high-stakes STAAR scores are analyzed and presented for the 2017 standards review, results will be accompanied by updated study profiles and study quality summaries to support reasonable interpretations of validity evidence. SAT and ACT data will be collected to support evidence-based adjustments to STAAR performance standards, as will additional college placement tests detailed in the next section.

Additional Validity Evidence

SAT II Subject Tests are assessments with more focused content, taken by fewer Texas students, relative to SAT and ACT admissions tests. Still, TEA has collected SAT II scores from a small group of Texas students who have also taken STAAR science and social studies assessments. From this single group, links could be constructed, similar to those described above, although the small sample sizes would limit interpretability of the findings. Table 2 summarizes those links.

STAAR biology has been linked to two assessments – SAT II Ecological Biology and SAT II Molecular Biology, while other relevant science and social studies tests have been linked to corresponding SAT II Subject Tests.

Table 2 – Links between STAAR EOC Assessments and SAT II Subject Tests

STAAR Assessment	External Assessment	Sample Size	Correlation
Biology	SAT II Ecological Biology SAT II Molecular Biology	36 33	0.69 0.57
Chemistry	SAT II Chemistry	279	0.74
Physics	SAT II Physics	302	0.61
U.S. History	SAT II U.S. History	340	0.73

The preliminary analyses summarized above indicate strong correlations between SAT II Subject Tests and corresponding STAAR EOC assessments. However, all the caveats addressed in the previous section on SAT and ACT links must be emphasized here. First, the available sample sizes for these analyses are quite small (i.e., 33–340 students per assessment), and SAT II examinees are likely not representative of the full STAAR test-taking population. Second, it is reasonable to expect that STAAR – SAT II content overlap will not be extensive. Third, formal college-readiness benchmarks do not exist on the SAT II, as they do for both ACT and SAT assessments. Finally, the correlations in Table 2 above are affected by low-stakes testing scenarios, as these data were collected in 2011 and prior.

Again, student motivation will not be a problem during standards review in 2017. In addition, multiple cohorts of students will have progressed through high school in Texas taking STAAR EOC science and social studies assessments. SAT II benchmarks may be estimated using existing links to SAT tests. These factors – high-stakes testing conditions and the already strong correlations shown in Table 2 – suggest SAT II linkages may provide some validity evidence for establishing postsecondary-readiness indicators on STAAR EOC science and social studies assessments if needed. However, there is no evidence to suggest that most Texas students will take SAT II Subject Tests, so even after additional waves of data have been collected, SAT II examinees will still not be representative of the full STAAR test-taking population. At present, the links presented in this section suffice only as proof-of-concept results. Postsecondary-readiness interpretations require high standards of evidence, including not only college admissions and college placement scores but also college grades from high-stakes STAAR examinees. Plans to collect, analyze, and present such evidence are outlined in the next section.

6. FUTURE STUDIES AND NEXT STEPS

Links between STAAR and External Assessments

The STAAR science and social studies assessments could be linked to the new assessment being developed by THECB for the Texas Success Initiative (TSI), to be implemented beginning in fall 2013. Under TEC §51.3063, THECB has the authority to develop an assessment for TSI that assesses incoming undergraduate students' academic skills and readiness to enroll in entry-level coursework in reading, writing, and mathematics. In contrast to the current TSI requirements in which four assessments are eligible for use (i.e., ACCUPLACER, ASSET, COMPASS, and THEA), beginning in fall 2013 only one assessment will be available for students needing to meet the TSI requirement. This new TSI assessment will have a single performance standard set by THECB, and Texas institutions of higher education will not be permitted to set different cut scores. Students who do not meet the postsecondary-readiness performance standards on STAAR English III and Algebra II (and who do not qualify for other exemptions) will need to meet or exceed the new TSI assessment's cut scores in order to enroll in entry-level credit-bearing courses.

When sufficient overlap in assessed content can be shown, the new TSI assessment could be included in validity research to support future STAAR performance-standards reviews. In addition, multiple additional external assessments could be linked to STAAR science and social studies scores. Possible areas for validity research are listed in Table 3 below.

Table 3 – Potential Linkages between STAAR and External Assessments

STAAR Assessment	External Assessment
Biology	SAT Mathematics ACT Science SAT II: Ecological Biology SAT II: Molecular Biology AP Biology IB Biology New TSI Mathematics
Chemistry	SAT Mathematics ACT Science SAT II: Chemistry AP Chemistry IB Chemistry New TSI Mathematics
Physics	SAT Mathematics ACT Science SAT II: Physics AP Physics B AP Physics C IB Physics New TSI Mathematics
U.S. History	SAT Critical Reading ACT Reading SAT II: U.S. History AP U.S. History New TSI Reading New TSI Writing

Links between STAAR Assessments and Course Performance in College

Although TEA and THECB will continue to collect external measures and construct the appropriate linkages to STAAR science and social studies assessments, the primary source of validity evidence for science and social studies postsecondary-readiness indicators will be longitudinal data from STAAR students. First, via STAAR students' performance in college English and mathematics courses, TEA and THECB could evaluate the predictive validity of the postsecondary-readiness indicators already established for STAAR English III and Algebra II. This would include analyses of postsecondary success for students meeting the Level II and Level III standards on STAAR English III and Algebra II. Per the policy definitions for STAAR, students achieving Level II on STAAR English III and Algebra II should have a reasonable likelihood of success in postsecondary endeavors. This has been defined for standard setting as at least a 60% probability of obtaining a C or higher. Students achieving Level III on STAAR English III and Algebra II should have a high likelihood of success in postsecondary endeavors. For standard setting this has been defined as at least 75%. The results of longitudinal studies for STAAR English and mathematics assessments should support the policy definitions and current interpretations of those assessments' performance levels.

In addition to evaluating the predictive validity of STAAR Algebra II and English III, TEA and THECB can evaluate the relationship between performance on STAAR science and social studies assessments (i.e., biology, chemistry, physics, and U.S. history) and success in corresponding college science and social studies courses. The focus of this analysis would be the extent to which performance on STAAR science and social studies assessments provides information about the likelihood of postsecondary success *above and beyond the information already provided by Algebra II and English III scores.* In order words, it is expected that Algebra II performance will be associated with performance in college science courses, and English III will be associated with performance in college social studies courses. The analysis will focus on whether STAAR science and social studies assessments add substantive value in predicting postsecondary outcomes. For example, results may show STAAR Algebra II sufficiently predicts success in college-level physics courses due to the level of mathematics knowledge required for that course. Accordingly, including STAAR physics scores in a prediction model may add little explanatory power above and beyond Algebra II.

In order to support postsecondary-readiness indicators for STAAR science and social studies assessments, it would be necessary for the science and social studies assessments to provide sufficient predictive advantage over the existing Algebra II and English III postsecondary cut scores. That is, STAAR science and social studies scores should provide substantively greater information about a student's chances of success in college science and social studies courses than what can be known via Algebra II and English III scores. Otherwise, it would be reasonable to simply use the postsecondary cut scores on STAAR Algebra II and English III to predict student success in a variety of college courses, not limited to mathematics or English.

Longitudinal data for evaluating STAAR by way of college course performance will first be available after the 2015–2016 academic year. The first cohort of students for whom STAAR is a graduation requirement includes 9th graders in 2011–2012; they are expected to graduate from high school in 2014–2015. Many will enroll in institutions of higher education (e.g., community college, university) in fall 2015. Once they have completed one semester of postsecondary study and their performance is reported to THECB, it will be possible to link students' high school STAAR results with their first-year college grades. Longitudinal outcomes could be incorporated in the 2017 standards review if the results suggest postsecondary-readiness performance standards on STAAR biology, chemistry, physics, and/or U.S. history are feasible. Figure 2 provides the timeline of activities to evaluate and possibly recommend postsecondary performance standards for the STAAR science and social studies assessments.

Figure 2 – Timeline for STAAR Science and Social Studies Analysis and Possible Implementation

2011–2012	• First cohort of 9th grade students takes STAAR for graduation requirements • Initial STAAR performance standards set
2012–2013	• Linking studies comparing STAAR performance with external measures
2013–2014	• Linking studies comparing STAAR performance with external measures
2014–2015	• Review of STAAR performance standards • First cohort of STAAR students graduates high school
2015–2016	• First cohort of STAAR students enroll in postsecondary education
2016–2017	• Linking studies comparing STAAR performance with college course performance
2017–2018	• Review of STAAR performance standards • Establish science and social studies postsecondary-readiness performance standards, if appropriate
2018–2019	• Implement revised performance standards, including science and social studies postsecondary-readiness standards, if appropriate

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Appendix A

Legislative Requirements for College Readiness for Science and Social Studies

Texas Education Code

Sec. 39.024. MEASURE OF COLLEGE READINESS.

(c) Before the beginning of the 2011-2012 school year, the agency, in collaboration with the Texas Higher Education Coordinating Board, shall gather data and conduct research studies to substantiate the correlation between a certain level of performance by students on the Algebra II and English III end-of-course assessment instruments and college readiness.

(d) Studies under Subsection (c) must include an evaluation of any need for remediation courses to facilitate college readiness.

(e) Based on the results of the studies conducted under Subsection (c), the commissioner of education and the commissioner of higher education shall establish student performance standards for the Algebra II and English III end-of-course assessment instruments indicating that students have attained college readiness.

(f) The agency, in collaboration with the Texas Higher Education Coordinating Board, shall conduct research studies similar to the studies conducted under Subsection (c) for the appropriate science and social studies end-of-course assessment instruments. If the commissioner of education, in collaboration with the commissioner of higher education, determines that the research studies conducted under this subsection substantiate a correlation between a certain level of performance by students on science and social studies end-of-course assessment instruments and college readiness, the commissioner of education, in collaboration with the commissioner of higher education, as soon as practicable, may establish student performance standards for the science and social studies end-of-course assessment instruments indicating that students have attained college readiness.

(f-l) Not later than December 1, 2012, the agency and the Texas Higher Education Coordinating Board shall deliver to the lieutenant governor, the speaker of the house of representatives, and the clerks of the standing committees of the senate and the house of representatives with primary jurisdiction over public education and higher education a report that includes:

(1) an analysis of the feasibility of establishing college readiness performance standards for science and social studies end-of-course assessment instruments; and

(2) a summary of any implementation procedures adopted for each standard.

(f-2) Subsection (f-1) and this subsection expire January 1, 2013.

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