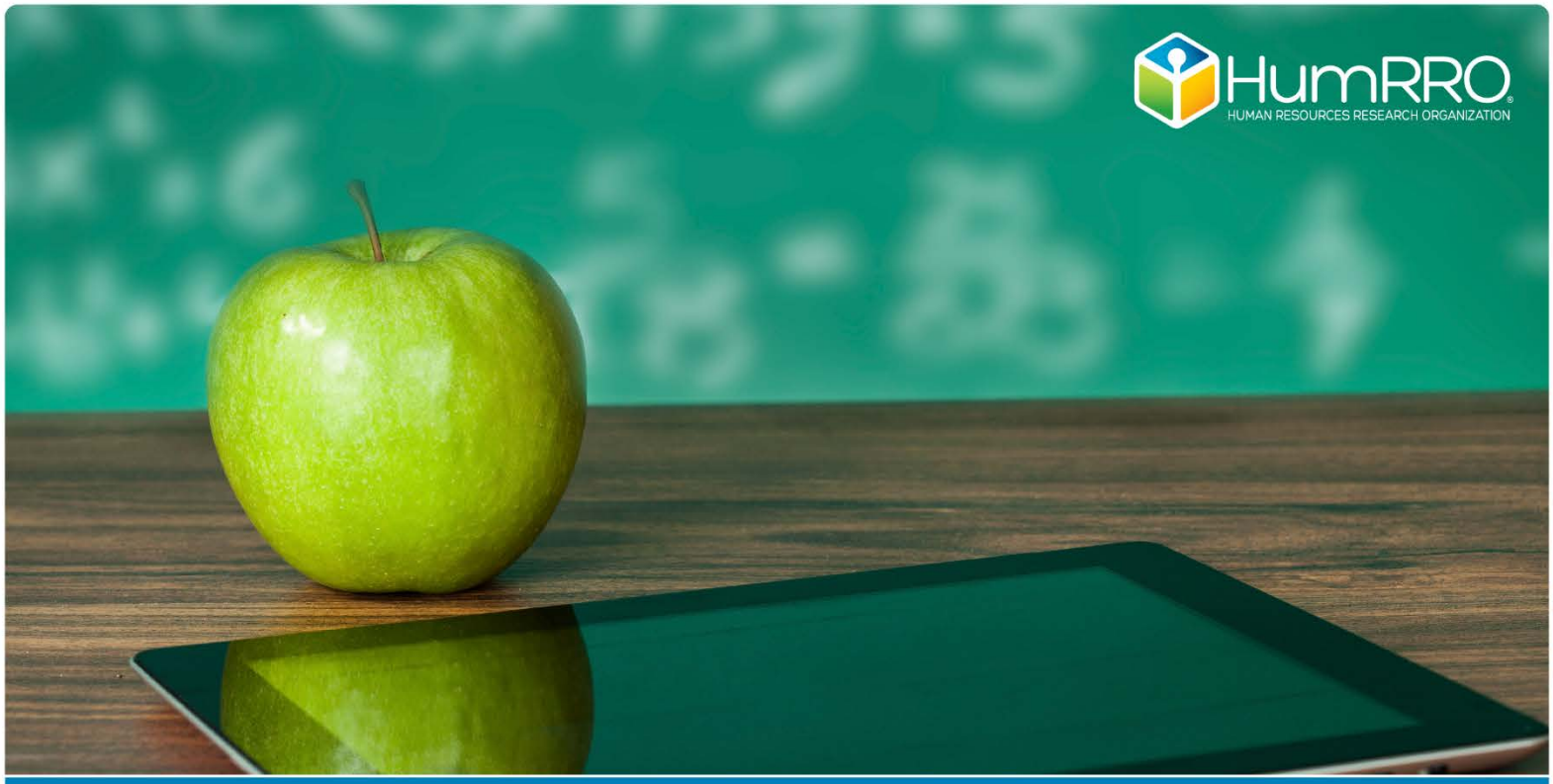

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Delaware System of Student Assessment and Maine Comprehensive Assessment System: SAT Alignment to the Common Core State Standards

Final Report – Revised

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Authors:	Yvette Nemeth Hillary Michaels Carrie Wiley Jing Chen	**Original Submission Date:**	December 16, 2016
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Headquarters: 66 Canal Center Plaza, Suite 700, Alexandria, VA 22314 | Phone: 703.549.3611 | humrro.org

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Delaware System of Student Assessment and Maine Comprehensive Assessment System: SAT Alignment to the Common Core State Standards

Executive Summary

Overview

The Delaware Department of Education (DDOE) and Maine Department of Education (MDOE) requested an external, independent alignment study of the SAT to the Common Core State Standards (CCSS) to provide documentation of the adherence of their assessment systems to Every Student Success Act (ESSA) requirements. The SAT is a college admissions test administered to high school students across the United States. As allowed by ESSA, both the DDOE and MDOE adopted the SAT as their high school achievement tests.

The Human Resources Research Organization (HumRRO) was contracted to complete the alignment of the College Board's SAT for the States of Delaware and Maine[1]. Our alignment approach was designed to indicate the extent to which the assessments represent the range of Delaware and Maine's content standards (CCSS) and measure student knowledge in the same manner at the same level of complexity as specified in those standards. We also investigated how well the items and blueprint support the reported scores and subscores.

Additionally, the design of this alignment study included gathering key assessment quality evidence, as defined by the Council of Chief State School Officers (CCSSO) in a method developed by the National Center for the Improvement of Educational Assessment (NCIEA). The evaluation methodology determines if assessments reflect the complexities of next generation testing goals, strategies, and formats.

Methodology

The HumRRO alignment method was developed to incorporate the widely accepted aspects of alignment, while addressing a number of concerns with traditional methods. The first three criteria were based on alignment ratings collected during an in-person alignment workshop and the fourth criterion was evaluated based on student assessment data. In addition, we collected supporting information that the panelists reviewed using selected criteria from the CCSSO high quality assessment method.

Criterion 1: Items Represent Intended Content. This is a basic measure of alignment between content standards and test items. Simply stated, this criterion is a check of the content standard(s) assigned to each item by College Board content experts.

Criterion 2: Items Represent Intended Categories. This is a measure of how well items represent a given subscore. For this criterion, we compared the expected distribution of items by subscore (e.g., Words in Context, Command of Evidence, and Heart of Algebra), as presented in the SAT test specifications to the actual proportion found on the examination.

Criterion 3: Item DOK Represents Test Specifications. This is a measure of the cognitive rigor and complexity of items. Instead of ensuring that 50% or more of items are at the same Depth of Knowledge (DOK) level as the standards, we typically prefer to focus on the DOK

[1] When referring to both the Delaware and Maine DOEs together, we will use the acronym DOEs.

targets identified in the test specifications. This is appropriate given that CCSS content domains are not typically addressed by a single item and there are often multiple, layered skills noted in a strand or domain that might be assessed by items representing a range of DOK levels.

Criterion 4: Item Sufficiency for Category Reporting. This is a measure of the extent to which reporting categories are sufficiently measured.

Special Study Evaluating the SAT Using the CCSSO Criteria. We measured the quality of the SAT using an innovative evaluation methodology to determine if the assessments reflected the complexities of next generation testing goals, strategies, and formats.[2] The methodology goes well beyond traditional studies that examine the alignment between discrete test items and learning objectives. It takes as its guiding framework elements of the *Criteria for Procuring and Evaluating High Quality Assessments*, which was developed by CCSSO and translated by the NCIEA (also referred to as the Center for Assessment) into specific rubrics and scoring procedures to facilitate both a credible and a practical evaluation of an assessment (NCIEA, 2016). The test content evaluation procedures that focused on the test form and items, were the focus of this special study.

Alignment Study Workshop

Two panels, one for reading and writing and one for math, were recruited for the alignment study. The panels consisted of (a) educators from Delaware and Maine who are familiar with the CCSS and (b) national content experts. The panelists provided the alignment data during a 2-day workshop in Wilmington, Delaware August 3 – 4, 2016. Panelists' training began with a whole group training that focused on the roles of all workshop participants and provided an overview of the alignment study and tasks. Panelists then went to their content group where they received a content-specific presentation by the College Board on their respective tests (math; reading and writing).

Panelists reviewed operational test items and resource materials (i.e., panelist training instructions, high-school standards, DOK reference sheets) in hard copy. They were also provided with a laptop to access the electronic workbook (MS Excel file) to enter their ratings. Training was offered by HumRRO staff on specific alignment tasks prior to the alignment activities. As part of the training process, each participant independently rated two to three SAT items, compared their results, and then discussed the ratings for a better understanding of the alignment and evaluation criteria. This was done throughout the workshop to identify any potential errors or bias. It also served to calibrate the panelists. Panelists also discussed their ratings after breaks to maintain their shared understanding and for calibration purposes.

HumRRO staff reviewed panelists' data throughout the workshop and conducted a calibration session to discuss ratings and address any rater errors or misunderstandings as necessary.

Alignment Results

Criterion 1: Items Represent Intended Content

In evaluating the first criterion, it is important to note that the SAT items were written to SAT content specifications rather than directly to the CCSS. A post hoc assignment of CCSS to items by College Board resulted in the identification of the CCSS measured by each item. The result of the post hoc assignment of CCSS standards was up to 15 CCSS grade-level standards

[2] https://www.humrro.org/CCSSOCriteria

identified for a single item and upwards of 10 CCSS anchor standards. Each of the identified grade-level standards were evaluated by panelists for linkage to the item. First, panelists rated the primary CCSS identified for an item as measuring the content of the item, partially or fully, for the majority of items. However, the majority, if not all, of the items were assigned more than one grade-level standard. Examining the linkage ratings across all College Board identified standards showed that panelists felt that approximately[3] six math items were not linked to any of the identified grade-level standards while only two such items existed for reading and none for writing/language arts. Panelists reviewing the math items tended to identify additional standards that were below the 11-12 grade range in the CCSS. Given the large number of standards identified by College Board for each item[4], panelists' linkage ratings of all of the standards across all items showed that a large portion of the College Board identified standards were rated as having no link to the item[5]. Finally, the collective set of standards associated with an item were rated by panelists as fully capturing the content of an item for the majority of items in reading and writing/language arts. Panelists felt they needed to identify additional standards before feeling confident that the collective set of standards fully covered an item. These standards were often not at the high school level in math or at grade 11 in reading or language arts.

The Essay test enhanced the coverage of number of CCSS English Language Arts standards that are aligned to the SAT. For the essay alignment, panelists identified standards for writing, language arts, reading for information, reading and writing in science and technical subjects, and language. Across these CCSS, panelists coded 22 unique standards in reading, language, and writing to the Essay test. Nine of the 22 standards also appear in the SAT Evidence-Based Reading and Writing/Language Arts tests. Thirteen are unique to the Essay test and focus on writing, such as standard W.11-12.2, *Write informative/explanatory texts to examine and convey complex ideas, concepts, and information,* and standard W.11-12.9, *Drawing evidence from texts to support analysis, reflection, and research*. Because students are required to produce an essay, language standards measuring their command of writing conventions (grammar and punctuation) and writing style are also assessed.

Criterion 2: Items Represent Intended Categories

The second criterion focused on whether the distribution of items by reporting category, as defined in the test specifications document (College Board, 2015b), holds true and whether panelists agreed with the reporting category assignment for the items. In general, the distribution of items by reporting category based on the test specifications is accurately depicted in the group of items administered to students. Additionally, panelists selected the reporting category they felt each item best fit. For the reading and writing/language arts items, panelists placed over 90% of items in the same reporting category as College Board. This was not the case for the math items, where over 30% of items were assigned to a different reporting category, particularly for those items the College Board assigned to Passport to Advanced Math.

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[3] We use the word "approximately" because this is the average across all panelists. In math, panelists identified between 3-11 items as not being linked to any of the grade-level standards. In reading, panelists identified between 0-6 items as not being linked to any grade-level standards. These data are located in Table 5.

[4] College Board identified between 1-4 standards for math items; 1-8 standards for reading items, and 1-10 standards for language arts items.

[5] The proportion of CCSS grade-level standards rated as not having a link were about 20% in math; 36% in reading, and 23% in language arts.

Criterion 3: Item DOK Represents Test Specifications

The third criterion, cognitive complexity of the items through DOK assignment, is important to evaluate to ensure that items are measuring an adequate range of DOKs and the item DOK is comparable to the identified standard DOK. In reading and writing/language arts, the DOK assigned to each item was provided by College Board and panelists rated their agreement with the assigned DOK. For the reading items, the majority of items panelists felt were at the proper DOK level; however, panelists rated roughly the same percent of items higher or lower than the assigned DOK in writing/language arts. In math, instead of DOK level, rigor level associated with each item was provided. There were a number of items that panelists rated as belonging to different rigor level than assigned. The distribution of DOK level by College Board and panelists shows that items with a range of DOK levels are being administered to students. When comparing item DOK levels with the College Board identified standards' DOK levels, panelists' ratings demonstrate that the majority of items are either equal to or lower than the grade-level standard.

Criterion 4: Item Sufficiency for Category Reporting

The fourth and final criterion evaluates whether the factor structure of the subscore reporting categories is supported by data from Delaware and Maine. There are several pieces of evidence used to evaluate this criterion. First, the subscore intercorrelations demonstrated that the reading, writing and language, and math constructs are being measured by their corresponding subscores, yet the subscores are not completely redundant. The coefficient alphas for all of the subscores are sufficiently high to support the subscores; although, Commands of Evidence (COE), a reading subscore, demonstrated borderline acceptability. Next, the confirmatory factor analysis (CFA) fit indices suggest that a 2-factor model of the reading and writing and language constructs is supported and the 3-factor math construct is also supported in Delaware but not in Maine. However, even though the fit indices suggest the 2-factor reading and writing and language constructs as well as the 3-factor math construct is supported, the below optimal factor loadings of the items and the high factor score intercorrelations, suggest that the subscores in each of the factor models (reading, writing and language, and math) are essentially the same. From a statistical viewpoint, additional useful information about performance on the reading, writing and language, or math tests is not being provided by the subscores.

Special Study Evaluating the SAT

To provide a greater understanding of the alignment, we also compared items and item stimuli to the CCSSO High Quality Assessment Criteria (*Criteria*). The SAT Evidence-Based Reading and Writing test and the SAT Math test received high ratings for quality and alignment to these criteria. The texts and graphics were of publishable quality and the items were judged as being generally rigorous. The Evidence-Based Reading and Writing test has students read different text types across genres. The Reading test requires students to closely read the passages and focus on important features and central ideas. The items are written to a range of DOK and the DOK index of 0 .75 indicates a range of cognitive demand is required.

The Essay test clearly identifies the writing purpose. Students need to organize and synthesize information. The essay clearly cued students for reading and analysis requirements in the rubric. However, panelists determined that it did not cue students for the writing requirements, such as conventions and style.

The Math test also meets or partially meets the high quality assessment criteria defined in the Center of Assessment's methodology. Panelists rated the items as being well crafted and there was more than one item type in the test. The CCSS has a focus on rigor: conceptual understanding, procedural skills and fluency and application. The *Criteria* state that high quality assessments should have a balance among these. Based on the form reviewed, the SAT Math test partially meets this criterion; it was a bit low in the score points associated with conceptual understanding. Panelists found that the math practices and content are meaningful connected. The DOK index was high, 0.83, and a range of cognitive demand is assessed. However, the test was just shy of the 10% threshold for the DOK3+ which technically classified this DOK range as partially meets.

Overall, compared to these CCSSO *Criteria* and its guidance, the SAT tests meet the requirements of quality and alignment.

Suggestions

Overall, the SAT is reasonably aligned to high school[6] reading and writing portions of the CCSS, but somewhat less so for the math portions. Based on findings of the present study, we offer the following suggestions:

- ***To the extent that SAT scores do not cover grade-level content of interest, develop strategies to supplement the SAT.*** In part, the DOEs adopted the SAT as their high school test to fulfill the Federal requirement for states to administer tests of college readiness. In particular, for the math test, the SAT emphasizes algebraic knowledge. This is consistent with the research the College Board highlights in their test specification documents showing the relationship between algebraic competence and college readiness. Other content (e.g., geometry) is emphasized in the high school CCSS but not well-represented on the SAT. So if the SAT results are going to be used to support evaluation of instruction across the CCSS, strategies for collecting and blending additional measures for math content and practices would be helpful so that districts have the information they need to evaluate instruction. At a minimum, they should be made aware of the content of interest that is not represented in the SAT scores so that additional instruction and assessment, conducted at either the state or local levels, can focus on these areas.
- ***To the extent that SAT math scores are based on below grade content, consider supplementing.*** The post hoc assignment of grade-level standards to items resulted in predominantly high school standards being assigned to math items. However, panelists identified additional lower grade-level standards to the math items. The College Board also aligned their math items to lower grade-level standards, but our focus was on the alignment of the SAT Math test to the high school CCSS. Because this is the state high school test, the Delaware and Maine DOE must decide what content needs to be included in their high school math test. If the SAT does not provide sufficient information in all areas the states want to report, they may want to consider supporting districts in their supplementation of their math results to ensure that adequate grade-level standards are being assessed.

[6] The grade 11-12 CCSS were the focus of the reading and writing alignment, and the high school CCSS were the focus of the math alignment.

- ***Given that the SAT Math Test, by design, does not specify or report math practices, if math practice information is desired, consider supplementing SAT.*** The SAT Math Test focuses on math content and skills that are prerequisites for college success. While the test includes content and math practices, the College Board does not identify math practices for items or report information about math practices. If math practice information is either required or desired by states, they may want to consider supporting districts in supplementing the SAT.
- ***Obtain more clearly defined math reporting categories.*** The assignment of math items to reporting categories were least agreed upon by panelists. This may have been a result of a lack of clear definitions of the content contained in each reporting category, or because these items typically reflected different aspects of algebra and algebraic problem solving. The use of the subscore reporting categories for any type of diagnostic evaluation of students' abilities necessitates a clear understanding of the content being evaluated by the reporting category.
- ***Be cautious of subscore use.*** The results of the CFA suggest that the subscores do not represent clearly distinguishable patterns of responses based on subscore item content. This does not mean that the subscores should not be reported. Items assigned to each subscore have been placed there based on expert content judgements and not psychometric factor loadings of items. However, reporting the subscores does not provide additional information, statistically, above and beyond the information offered through the total score used alone. Thus, caution should be used in placing too much emphasis on or over-interpreting what the subscores mean regarding strengths and weaknesses of a student. This cautionary message needs to be disseminated down to principals, teachers, and anyone who may use the subscores; the subscores may be misleading if used alone.

Delaware System of Student Assessment and Maine Comprehensive Assessment System: SAT Alignment to the Common Core State Standards

Chapter 1: Introduction

As with previous No Child Left Behind (NCLB) legislation, the Every Student Succeeds Act (ESSA) requires states to test students in reading and mathematics (math) in grades 3 through 8 and once in high school. In contrast to NCLB, ESSA allows districts to administer nationally recognized assessments such as the ACT and SAT, with state permission, at the high school level. However, these assessments must meet technical peer review requirements including alignment to the state's academic standards. For various reasons, including an effort to reduce the testing burden placed on high school students and a desire to report college readiness, Delaware and Maine have adopted the SAT for their high school state assessment. As a result, the Delaware and the Maine Departments of Education (DOEs) requested an external, independent alignment study of the SAT to the Common Core State Standards (CCSS) to provide documentation of the adherence of their assessment system to ESSA requirements.

Overview

Some widely used alignment methodologies have been developed by Webb (1997, 2005), Porter and Smithson (2001), Achieve (2006), and others. All of these alignment methodologies—while using different definitions, procedures, and criteria—have focused on the connection between content standards and assessment items and test forms. They provide evidence to support the validity of score interpretations used as an indicator of student mastery of targeted content. However, the current study needed to provide documentation to support the validity of Delaware and Maine's overall assessment system.

Our alignment approach was designed to indicate the extent to which the assessments represent the full range of Delaware and Maine's content standards (CCSS) and measure student knowledge in the same manner and at the same level of complexity as specified in those standards. We also investigated how well the items and blueprint support the reported scores and subscores.

Additionally, the design of this alignment study included gathering key assessment quality evidence, as defined by the Council of Chief State School Officers (CCSSO) in a method developed by the National Center for the Improvement of Educational Assessment (NCIEA). The evaluation methodology determines if assessments reflect the complexities of next generation testing goals, strategies, and formats.

Organization and Contents of the Report

The remaining chapters of this report present detailed information about the alignment workshop and analyses. Chapter 2 explains alignment methodologies, including the criteria used to evaluate alignment of the SAT. Chapter 3 presents results of the Math, Reading, Writing/Language Arts, and Essay test items reviewed relative to the CCSS. Chapter 4 presents results of the special study evaluating the SAT using the CCSSO criteria. Chapter 5 presents panelists' feedback on the workshop experience. Finally, Chapter 6 summarizes the results and provides recommendations for the States of Delaware and Maine to consider regarding the alignment of the SAT to the CCSS as well as the SAT and the high quality evaluation.

Chapter 2: Alignment Study Design and Methodology

In this section, we discuss key concepts related to alignment research, followed by a description of the alignment methods used in the present study.

Alignment of Assessments and Standards on Content and Performance

Alignment studies, at their heart, answer one vital question related to the validity of an assessment, "Does the assessment content adequately reflect the content that students are expected to learn as provided in the state standards?" School curriculum must include appropriate content as specified by the state and consequently assessments must measure the same content. Delaware and Maine have both adopted the CCSS as their state standards and replaced their previous high school state accountability assessments with the SAT. As such, alignment of the SAT's content to the high school CCSS is needed to ensure the validity of students' results.

In general, alignment evaluations for any assessment reveal the breadth, or scope, of knowledge as well as the depth of knowledge (DOK), or cognitive processing, expected of students by the state's content standards. In addition to the question related to assessment validity, alignment analyses help to answer questions such as the following:

- How much and what type of content is covered by the assessment?
- Are students asked to demonstrate this knowledge at the same level of rigor as expected in the content standards?
- Is the assessment deemed *high quality* according to select CCSSO high quality assessment criteria?

SAT Overview

The SAT, in general, is a college admissions test administered to high school students across the United States. The Redesigned SAT contains three tests: (a) Reading, (b) Writing and Language, and (c) Math. There is an optional Essay test that can be administered. Students are provided with multiple levels of scores. According to the test specifications for the Redesigned SAT (College Board, 2015b), the hierarchy of scores is Total Score, Sections, Test, and Subscores. The total score is a composite score of both the Evidence-Based Reading and Writing and the Math sections.

The Evidence-Based Reading and Writing section is composed of two tests (a) Reading and (b) Writing and Language. The Math section includes only the Math test. The Reading test has two subscores: (a) Words in Context and (b) Command of Evidence. The Writing and Language test has two subscores (a) Expression of Ideas and (b) Standard English Conventions.
The Math test has three subscores: (a) Heart of Algebra, (b) Passport to Advanced Math, and (c) Problem Solving and Data Analysis.

There is an optional Essay score reported, along with three scored dimensions: (a) Reading, (b) Analysis, and (c) Writing.

Prior Studies Evaluating the Alignment of the SAT to the CCSS

The College Board provided DDOE with their one-way standards alignment study (College Board, 2015a) which examined the relationship between the SAT and the CCSS. This alignment document indicated that there are several linkages between the two sets of standards[7]. The College Board has characterized their alignment as very strong. Their alignment findings indicate total or partial alignment of the following:

English/Language Arts (ELA)

- Seven of the ten Reading and Language Anchor standards. (Technology use and Speaking and Listening were not aligned.)
- Seven of the nine Reading standards for Literature at grades 11–12. (Standards that included synthesis of multiple literary texts and those that require understanding of eighteenth-, nineteenth-, and twentieth-century US literature, were not aligned. College Board did not include drawing from multiple texts in these standards but in the History/Social Studies and Science Reading standards.)
- All of the Informational Reading standards for grades 11–12 were at least partially aligned.
- Seven of the ten Writing standards at grades 11–12. (Those addressing technology, demonstrating understanding in extended and short topics, and gathering information from multiple sources were not aligned.)
- All Language standards for grades 11-12.
- Nine of the ten Reading standards for Literacy in History/Social Studies. (External validation of an author's argument was not aligned).
- Nine out of ten of the Reading standards for Literacy in Science and Technical Subjects. (Following multistep procedures was not aligned.)
- Four of the nine Writing standards for Literacy in History/Social Studies, Science, and Technical Subjects. (Technology and Research standards were not aligned.)

Math

- 20 of the 22 domains within conceptual categories (Number and Quantity, Algebra, Functions, Modeling, Geometry, and Statistics and Probability) were at least partially aligned.
- Vector and Matrix Quantities (from Number and Quantity) and Using Probability to Make Decisions (from Statistics and Probability) are not aligned and were intentionally not included in the design of the SAT.
- Modeling is interspersed and aligned to a variety of other conceptual categories.
- Math Practices (MP) are apparent in the SAT. Of note, MP 1 (*make sense of problems*), MP 2 (*represent quantities in context with math relationships and interpret results*), MP 3 (evaluate claims), MP 4 (*math modeling*), MP 5 (*strategic use of calculators*), and MP 7 (*make use of structure*) are prevalent in the test.

[7] Strictly speaking, the SAT "standards" are test/content specifications rather than standards per se.

The Connecticut Department of Education conducted an independent one-way standards-to-standards alignment that replicated the College Board methodology (Behuniak, Goldstein, & DiBlasio, 2016). Their method identified alignment matches as either strong, moderate, or low matches. If a reviewer identified at least one match as strong, the alignment of the SAT standards to the CCSS was considered strong. Behuniak et al. found "a high proportion of strong matches for Reading/Informational Text and Reading/Literature." (p. 14) The Language standards had a mix of strong and moderate matches, and the Writing standards had a range of matches from strong to no match.

The area noted for the most misalignment was Writing. In particular, the standards that pertain to *using technology* (W6), *conducting research projects* (W7), *gathering information from multiple sources* (W8), and *demonstrating knowledge of eighteenth-, nineteenth – and early-twentieth century foundational works and evaluating reasoning* (W9). In addition, they found standard W10, which includes writing across a range of tasks and purposes, was not measured by the SAT. Unlike Delaware and Maine, Connecticut did not include the SAT Essay. The Connecticut alignment results (Behuniak et al., 2016) were generally found to be similar to the College Board study (College Board, 2015a). For example, the standards identified as misaligned in Writing were mostly identified by the College Board as misaligned as well.

In math, the Connecticut alignment results reported strong matches for "Number and Quantity, Algebra, and Statistics and Probability." (p. 30) Functions and Geometry had more moderate matches. In particular, Geometry was found to have the largest percentage of Weak/No Match at 38% (Behuniak et al., 2016). These areas were identified similarly in College Board's math detail included in their alignment study (College Board, 2015a).

Challenges of Evaluating the Alignment of the SAT to the CCSS

The alignment of the SAT items to the CCSS poses unique challenges. SAT items and blueprints are developed to the content and test specifications adopted by the College Board and not the CCSS. While the College Board has provided crosswalks to the CCSS, the CCSS alignment was not the primary concern in the development of the assessment items, blueprint, and scoring.

One challenge, for the current study, was the number of standards that the College Board identified for each item. The identification of multiple standards for an item is not unique to the SAT. However, panelists can find it challenging to find connections between the identified standards and an item. In reading and writing, items had between 1 to 6 anchor standards and 1 to 10 grade-level standards identified for panelists to review. The math items had between 1 to 4 grade-level standards identified for panelists to review.

Interestingly, no standards were provided for the essay and no MPs were identified in math. Because no panelist ratings could not be compared to that of the College Board, they could only be compared to each other.

The identification of subscores was another area of concern. HumRRO had expected that each item would have been assigned to a single primary subscore. However, once we received the data from College Board after the workshop had been completed, we learned that (a) not all items were assigned to a subscore and (b) each of the writing/language arts items is often assigned to more than one subscore. We had to develop a way to analyze the data that would use what panelists provided and would not penalize the SAT alignment results because of the

double-coded items. This only impacted how we analyzed panelists' data for Criterion 2: Items Represent Intended Categories.

The College Board provided a detailed blueprint in the test specifications for the Redesigned SAT (2015b) which followed their own specification scheme rather than the CCSS. Because the blueprint is not identified in terms of CCSS standards or numbers of items, no statement about how well the test meets the blueprint using the CCSS can be made. However, to better understand how much of the CCSS are covered by the SAT, we created a frequency distribution of all unique standards that were either verified or identified by the reviewers. We also used the CCSSO High Quality Assessment Criteria methodology to be able to evaluate how well the SAT met some of their specification requirements as outlined in their test design documentation, such as the targeted distribution of text types in reading.

HumRRO Alignment Methodology

The HumRRO alignment method was developed to incorporate the widely accepted aspects of alignment, while addressing a number of concerns with traditional methods. The HumRRO method uses expert ratings to evaluate alignment based on three criteria (item content coverage, item coverage of standards, and item DOK distribution) and uses student assessment data to evaluate a fourth criterion (item sufficiency for category reporting). The method borrows much from Webb's (1997, 1999, 2005) alignment methodology, but diverges in key ways that allow it to address certain limitations, including the following:

- To decrease the cognitive load for the panelists required in traditional methodologies, instead of requiring them to identify a content standard or a DOK level, panelists are asked to evaluate the information assigned by the item writer and stored in the test bank. If panelists disagree with an assigned content standard or a DOK level, they are asked to provide a more appropriate one.
- To expand upon traditional alignment, which only includes the number of items aligned to each standard, HumRRO's methodology includes a degree of alignment rating: (1) not aligned, (2) partially aligned, and (3) fully aligned. On this scale, a rating of 3 (fully aligned) indicates that the item covers the main content in the standard and a rating of 2 (partially aligned) indicates the item covers some of the content. The degree of alignment is then analyzed to assess whether the assessments are capturing the intended content.
- To address criticism that Webb's suggested minimum number of six items to be sufficient for reporting out at a subscore level is too low, and in fact 20 items or more may be required (Sinharay, Haberman, & Puhan, 2007), the HumRRO method has incorporated several analyses to investigate item sufficiency for category reporting (see Criterion 4). These analyses use student assessment data to examine the factor structure of the categories, their internal consistency, and their relations with one another. Taken together, these results provide an indication of whether items are sufficiently similar in content to be considered the same construct, and whether the categories contain sufficient numbers of items to support reporting of reliable subscores.

Accordingly, the following four criteria were used for this study. The first three criteria were based on alignment ratings collected during an in-person alignment workshop and the fourth criterion was evaluated based on student assessment data.

Criterion 1: Items Represent Intended Content. This is a basic measure of alignment between the content standards and the test items. Simply stated, this criterion is a check of the content standard(s) assigned to each item by College Board content experts. Using a previously developed rating scale, panelists rated item alignment to the identified standard(s) as no link, partially linked, or fully linked. We report the proportion of items with each rating as well as the proportion of College Board identified standards with each rating.

Because the test items were identified as measuring multiple standards, we included a holistic item-level alignment rating to indicate the extent to which all of the identified standards fully measure the item's content. This indicates whether gaps exist between what the item measures and what the collective set of standards measure. Panelists rated either "yes" or "no" to indicated if the CB coding collectively capture the knowledge and skills required in the item. The panelists were also asked to provide additional standards as necessary to fill the knowledge and skills gap. They were then asked to rate the holistic item-level alignment to indicate whether the College Board identified CCSS and any additional standards identified by the panelist collectively capture the knowledge and skills required in the item.

Criterion 2: Items Represent Intended Categories. This is a measure of how well items represent a given subscore. For this criterion, we compared the expected distribution of items by subscore (e.g., Words in Context, Command of Evidence, and Heart of Algebra), as presented in the test specifications to the actual proportion found on the SAT. The results reflect the assignment of items to subscore categories by College Board and the judgments by panelists of the item assignment to subscore categories. According to the test specifications for the Redesigned SAT (College Board, 2016b) about the distribution of items by subscore, we could determine to what extent these requirements are met.

In addition, to better understand how much of the CCSS are covered by the SAT, we include a frequency distribution of all unique standards that were either verified or identified by the reviewers.

Criterion 3: Item DOK Represents Test Specifications. This is a measure of the cognitive rigor and complexity of items. Instead of ensuring that 50% or more of items are at the same DOK level as the standards, we typically focus on the DOK targets identified in the test specifications. This is appropriate given that CCSS content domains are not typically addressed by a single item and there are often multiple, layered skills noted in a strand or domain that might be assessed by items representing a range of DOK levels. Since the test specifications for the Redesigned SAT (College Board, 2016b) do not identify cognitive rigor or complexity targets for the items, we had panelists evaluate the cognitive complexity (DOK) assigned to the reading and writing/language arts items by College Board as well as the cognitive rigor assigned to the math items. The panelists also assigned a DOK level to each math item. We examined the DOK of the reading and writing/language arts items as well as the DOK and rigor of the math items.

Based on the DOK assigned to the reading and writing/language arts items during the item development process by the College Board, panelists indicated "no" or "yes" whether they agreed with the assigned DOK. If they did not agree with the College Board's assignment, each panelist provided the DOK for the item based on their best judgments. These judgments were individual ratings, not group consensus ones. We report the proportion of items with each rating and the proportion of items that were assigned a DOK too high or too low.

For math items, the cognitive rigor of an item was provided for panelists to evaluate whether they agreed with the rigor level assigned by College Board. The rigor levels were fluency, conceptual understanding, and application. If panelists did not agree with the assigned level, they identified the appropriate rigor level that they believed best represented the item. We report the proportion of items panelists agreed with the rigor level.

Since DOK ratings were not available for the math panelists to review, they were asked to individually assign DOK levels to the items. We also report the proportion of items assigned to each DOK level by panelists as well as the proportion of items assigned a DOK level at or below the item CCSS. We expected items to contain a range of DOK values with a greater percentage of higher DOK than lower DOK.

To analyze this criterion, a consensus DOK for each CCSS is needed. We used published CCSS DOKs developed by WestEd (Sato, Laguoff, & Worth, 2001) as the consensus DOKs to give panelists more time to focus on their ratings. We have used these DOKs in other alignment studies, and describe this in more detail in Chapter 3.

Criterion 4: Item Sufficiency for Category Reporting. This is a measure of the extent to which reporting categories are sufficiently measured. In contrast to the other criteria, we used student assessment data to inform this criterion. Specifically, we conducted psychometric analyses to determine if the SAT category reporting practices can be supported by evidence of factor structure and reliability estimates rather than simply requiring a minimum number of items per subscore.

Special Study Evaluating the SAT Using the CCSSO Criteria.

We measured the quality of the SAT using an innovative evaluation methodology to determine if the assessments reflected the complexities of next generation testing goals, strategies, and formats.[8] The methodology goes well beyond traditional studies that examine the alignment between discrete test items and learning objectives. It takes as its guiding framework elements of the *Criteria for Procuring and Evaluating High Quality Assessments*, which was developed by the CCSSO and released in 2014. CCSSO developed its criteria to be applicable to any assessment that was intended to measure college- and career-ready content standards in mathematics and English language arts (ELA)/literacy, especially the CCSS. The criteria to evaluate high quality test content were developed by the National Center for the Improvement of Educational Assessment (also known as the Center for Assessment; NCIEA, 2016). The Center for Assessment translated the CCSSO criteria into specific rubrics and scoring procedures to facilitate both a credible and a practical evaluation of an assessment. To facilitate development of its methodology, the Center for Assessment divided the CCSSO criteria into two parts: test content and test characteristics. The test content evaluation procedures that focused on the test form and items, were the focus of the special study. The results highlighted the extent to which an assessment aligned to content standards and the SAT's stated test specifications and design. In this special study, we could only evaluation one operational test form on its alignment to content standards.

Using the nomenclature convention[9] from the CCSSO *Criteria*, the following test-based criteria were included in our study:

[8] https://www.humrro.org/CCSSOCriteria

[9] Skipped criteria, such as B2, B6, B7, B8, and C1, measured information included in documentation not provided during this study.

For ELA, we included the following test content high quality assessment criteria:

- B1: Assessing student reading and writing achievement in both ELA and literacy
  - Texts are balanced (have similar emphasis) across literary and informational text types
  - Informational texts are primarily expository[10] rather than narrative
  - Informational texts in grades 6-12 are evenly distributed across literary non-fiction, history/social science, and science technical
  - Texts are publishable quality (content-rich, exhibit exceptional craft and thought, and/or provide useful information)
- B3: Requiring students to read closely and use evidence from texts
  - Items requiring close reading
  - Items focus on the central ideas and important particulars
  - Items require direct use of textual evidence
- B4: Requiring a range of cognitive demand
- B5: Assessing writing
  - Tasks are balanced more towards exposition and argument
  - Tasks requires writing to a text
- B9: Ensuring high-quality items and a variety of types are strategically used to appropriately assess the standard(s)
  - Item has more than one answer/incorrect key
  - Item has content or editorial inaccuracies
  - Item does not yield evidence of the targeted skill

For Math, we included the following test content high quality assessment criteria:

- C2: Assessing a balance of concepts, procedures, and applications
  - Item score points are balanced across math concepts, procedures/fluency, and application
- C3: Connecting practice to content
  - Assessments for each grade and course (in cases of end of course tests) meaningfully connect math practices and processes with math content
- C4: Requiring a range of cognitive demand
- C5: Ensuring high-quality items and a variety of item types
  - Item has more than one answer/incorrect key
  - Item has content or editorial inaccuracies
  - Item does not yield evidence of the targeted skill

Alignment studies focus on specific questions about an item's DOK and how well it aligns with content standards. To provide a greater understanding of the alignment, we also compared items and item stimuli to the CCSSO High Quality Assessment Criteria (*Criteria*). Because panelists were only able to compare one form of the SAT against the *Criteria*, only independently provided item-level or test stimuli level ratings could be obtained. This is a

[10] Including literacy nonfiction genres, such as biographies.

deviation of the full methodology developed by the Center for Assessment. The Center's methodology recommends that panelists:

(1) independently provide test documentation ratings (generalizability scores)

(2) independently provide item-level ratings and item-level sub-criterion scores

(3) panelists discuss their sub-criterion scores and come to consensus on a final score also considering the generalizability scores

(4) assign an overall group criterion score

(5) assign final content and depth group scores

In this study, panelists provided select ratings only for #2, omitting group consensus and consideration of test documentation. When examining the quality of the SAT tests, we used the suggested percentage cut-offs developed by the Center.

Alignment Study Procedure

The alignment evaluation we performed for the Delaware and Maine DOEs involved a comparison between the SAT and the CCSS. Two expert panels (one math and one reading and writing) of (a) current Delaware and Maine educators highly familiar with the CCSS and (b) national content experts provided the content alignment data.

Panelists

Panelists were recruited by the DOEs from a database of educators to fill six state educator slots per panel group. HumRRO recruited the math and ELA national content experts and directed the actual alignment reviews independently of the DOEs and the College Board. Table 1 presents the characteristics of the panelists, most of whom were high school teachers from Delaware (n = 6) and Maine (n = 5). There was a seventh panelist recruited from Delaware who was a University professor and represented higher education. In addition, each panel had a national content expert from outside the two states. These experts had a strong understanding of the CCSS, high school and college readiness expectations, and brought a wide understanding of education across the nation. The list of panelists can be found in Appendix A.

Table 1. Professional and Demographic Characteristics of Panelists

Panel	Experience		Gender		Highest Degree Obtained			Area of Specific Representation			
	Avg Years	Min – Max	Female	Male	BA/ BS	MA/ MS	PhD/ EdD	Nat'l	Univ	DE	ME
ELA	15	7 – 29	5	2		5	2	1	1	3	2
Math	17	7 – 25	5	2	2	5		1		3	3

Training

An essential aspect of alignment is training for both panelists and HumRRO facilitators. Alignment workshops do not occur weekly, nor are all studies exactly the same, so it is important to train even experienced alignment facilitators and panelists for the nuances of each study. Accordingly, facilitators attended a 2-hour training session that included a presentation of the redesigned

SAT assessment system, the alignment process steps, and examples of the rating documents panelists would use.

Panelists' training began with a whole-group training that focused on the roles of all workshop participants (Delaware DOE, Maine DOE, HumRRO, College Board, and the panelists) and provided an overview of the alignment study and tasks. Panelists then went to their content group where they received a content-specific presentation by the College Board on their respective tests (math and reading and writing). The College Board presentations provided additional context on the redesigned SAT and focused on item development processes and features specifically related to the alignment tasks. HumRRO facilitators then provided a detailed walkthrough of each specific alignment rating and the rating workbook. By design, not all items were developed to assess solely grade 11-12 or high school standards. For the purposes of this study, however, panelists were informed these were the standards of focus because the tests are being used as the grade 11 state accountability tests. Panelists were able to include the alignment of off-grade standards in their ratings if they felt it was appropriate. Panelists calibrated with each other on the first two to three items and additional calibrations were conducted over the course of the 2-day workshop as needed.

Test Security

Because we were handling operational test items, HumRRO staff followed strict procedures for ensuring their security. Immediately upon receipt of the SAT test forms, they were password protected and maintained on a secure server with access limited to project staff. Everyone using the forms were bound by confidentiality agreements, including panelists and observers. Both HumRRO staff and alignment panelists were reminded of the confidentiality agreement during the workshop.

To track paper copies of the forms needed in the workshop, we printed them on brightly colored paper and numbered them. Panelists had to check the forms in and out. Materials were never left unattended in a room unless the room was locked. The HumRRO lead facilitator had keys to the rooms and was in charge of the security of the forms during the workshop. Panelists, observers, and HumRRO staff were not allowed to have their cell phones by their workstations. Computers assigned to the panelists to enter their ratings had Internet access removed. Test information remained secure through the workshop. All paper test versions were shredded upon return to the HumRRO office.

Materials

Panelists reviewed hard copy operational test items. Panelists were also provided hard copies of resource materials such as the panelist training instructions, CCSS grade-level standards, anchor standards, math practices, DOK reference sheets, and the College Board test specifications. All panelists were provided one laptop to access the electronic rating workbook (MS Excel file). Panelist instructions and rating form examples are presented in Appendix B.

Test Forms. Panelists evaluated SAT operational items from a form administered Spring 2016. Table 2 presents the number of items contributing to a student's score in each content area.

Table 2. Item Counts Reviewed by Panelists

Grade	Number of Items
Math	58
Calculator	38
Non-calculator	20
Reading	52
Reading passages	5
Writing	44
Writing passages	4
Essay	1

Panelist Instructions and Rating Form. Panelists were given a Panelist Instruction document listing their alignment tasks, as well as rating codes and code definitions (see Appendix B). Panelists completed the Item Rating Form independently.

Procedures

HumRRO conducted this alignment workshop in three meeting rooms at a hotel in Wilmington, DE on August 3-4, 2016. The workshop began with introductions of HumRRO staff, DOE staff, logistical information, and a general training session introducing the alignment process. At the end of the general training session, panelists reported to their assigned meeting room based on their panel group. Panelists were provided laptops to enter their alignment ratings. DOE staff from both Maine and Delaware remained in each room, but were instructed to be unobtrusive observers. A College Board representative remained in the math room for 1.5 days to answer any questions about the College Board test design or processes. A College Board representative was on call in the ELA room.

Before beginning any of the specific alignment tasks, panelists read and signed affidavits of nondisclosure for the secure materials they would be reviewing during the workshop. There was one HumRRO staff assigned as a facilitator per panel group and one staff member who assisted with any issues or questions that arose in any of the groups. After the College Board gave their content-specific presentations on the SAT redesign and development process, HumRRO staff then began the specific alignment task training within each panel group.

Facilitators answered any questions regarding the rating codes and definitions and then finished with a brief calibration activity. For calibration, panelists first completed independent ratings on two to three SAT assessment items and then compared and discussed their responses. This activity was invaluable for ensuring panelists had a shared understanding of the ratings and were applying them in a similar fashion. After lunch and at the end of the day during the workshop, panelists' data were pulled from their laptops and analyzed. If significant discrepancies between raters were found, facilitators conducted a calibration session to discuss the ratings and address any rater errors or misunderstandings.

Ratings

The Item Rating Forms for each content area included the item number, assigned DOK or rigor level and CCSS linked to the item that were established by College Board, and the CCSSO High Quality Assessment Criteria ratings. Appendix B includes a sample of alignment review materials and rating forms. Appendix C shows the ratings panelists made in math, reading,

writing/language arts, and the essay. Some ratings were independent ratings and some were verifications of the College Board's metadata coded to each item.

For DOK and rigor, panelists provided their agreement with the assigned metadata from College Board. If they did not agree with the assigned metadata, then panelists provided a DOK or rigor level they felt was a better representation. There were numerous CCSS grade-level standards and CCSS anchor standards identified for each item. Panelists were asked to evaluate whether the first identified CCSS anchor standard was linked to the item. They were not asked to provide an alternative CCSS anchor standard if the link between the identified anchor standard and item was partially or not linked. For the CCSS grade-level standards, panelists evaluated the link between the item and all of the CCSS grade-level standards identified which was upwards of 10 CCSS grade-level standards. Panelists were then asked if the collective set of identified CCSS grade-level standards capture the knowledge and skills required in the item. If the collective set of identified CCSS grade-level standards did not capture the knowledge and skills required in the item, then panelists stated what content was missing from the collective set of standards and selected additional standard(s).

Facilitators reviewed each panelist's workbook upon completion for missing or inconsistent ratings. Once facilitators verified and finalized the workbooks, panelists completed an alignment debriefing form (reflection of the overall alignment) and were released. Facilitators then removed the files from the laptops and caches cleared. All paper materials were placed in designated areas for shredding.

Mid-Course Adjustments

For the most part, the alignment workshop concluded with no major problems. A few matters arose, however, that resulted in mid-course adjustment to procedures, as noted below. None of the procedural adjustments are believed to have compromised the integrity of this alignment study.

Math

- The College Board had very limited information on how math rigor is assigned. Panelists were instructed to do the best they could, but there was much discussion on the differences between each rating.
- One panelist did not assign any math practices to the items. He stated, "I do not think most of these questions captured the essence of the math practices." This reviewer was removed from the math practices analysis as his viewpoint was a clear outlier to the remaining panelists.
- Panelists were very diligent about identifying additional standards measured by the item, particularly off-grade level standards. The facilitator monitored panelist progress and after lunch on the second day of the workshop, asked them to focus on completing the other ratings and going to back to identifying off-grade level standards if time permitted.
- The College Board identified some primary CCSS grade-level standards as "Modeling." These items should have also had secondary or tertiary grade-level standards, but three items did not. The College Board representative stated that these items were thought to primarily measure the Modeling domain of the CCSS and were not content-specific.

ELA

- Multiple CCSS anchor standards were assigned to an item by College Board; however, due to time constraints, panelists were asked to only evaluate the alignment of the primary CCSS anchor standard identified.
- The College Board did not provide grade 11-12 standards for two of the reading items. These were designed to be off grade-level items.
- One of the pieces of metadata provided was the text complexity grade bands for the reading passages on the reading and writing/language arts sections. Initially, panelists were going to be asked to review the text complexity grade bands assigned to each reading passage. However, College Board stated that their definitions of text complexity grade bands were not available for release to the panelists and that their definitions were similar to the common definitions. Because we did not have access to the definitions used by College Board, we removed the evaluation of the assigned text complexity grade bands.
- For the most part, panelists seemed to understand the task and were confident in their ratings once they had rated a few items. Likely due to the overlapping nature of the standards, panelists did not always agree on the standard to which the item fell.

The issues listed above were quickly resolved and did not impact panelists' ratings.

Chapter 3: Alignment Results

In this chapter, we report the results on the three criteria specified in the HumRRO alignment methodology that required data from panelists, and the fourth criterion that required data from the DOEs.

Criterion 1: Items Represent Intended Content

Here we report on the content alignment between items and standards, beginning first with alignment of each item to a primary CCSS standard, followed by alignment of each item to multiple (if applicable) relevant CCSS standards.

SAT items are written to SAT content specifications and not the CCSS. As a post hoc activity, an independent group within College Board assigned CCSS standards to items. During this process, up to 15 CCSS grade-level standards and upwards of 10 CCSS anchor standards were identified for a given item. As seen in Tables 3 and 4, the CCSS are organized by levels becoming more specific at the lowest level, the standard. The results presented in this report are at the standard level. There are a few instances in math, reading, and writing/language arts where a higher level and not the standard is identified for an item. Typically, we evaluate the lowest level of the CCSS when looking for the link between items and standards. Since panelists did not select standards they felt an item measured but instead verified the CCSS assigned to items by College Board, we treated all identified CCSS grade-level standards as if they were from the lowest level.

Table 3. Math CCSS Organization

Levels	Code	Example
Grade	HS	High School
Domain	N	Number and Quantity
Strand	RN	The Real Number System
Cluster	A	Extend the properties of exponents to rational exponents.
Standard	1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.

Table 4. English Language Arts CCSS Organization

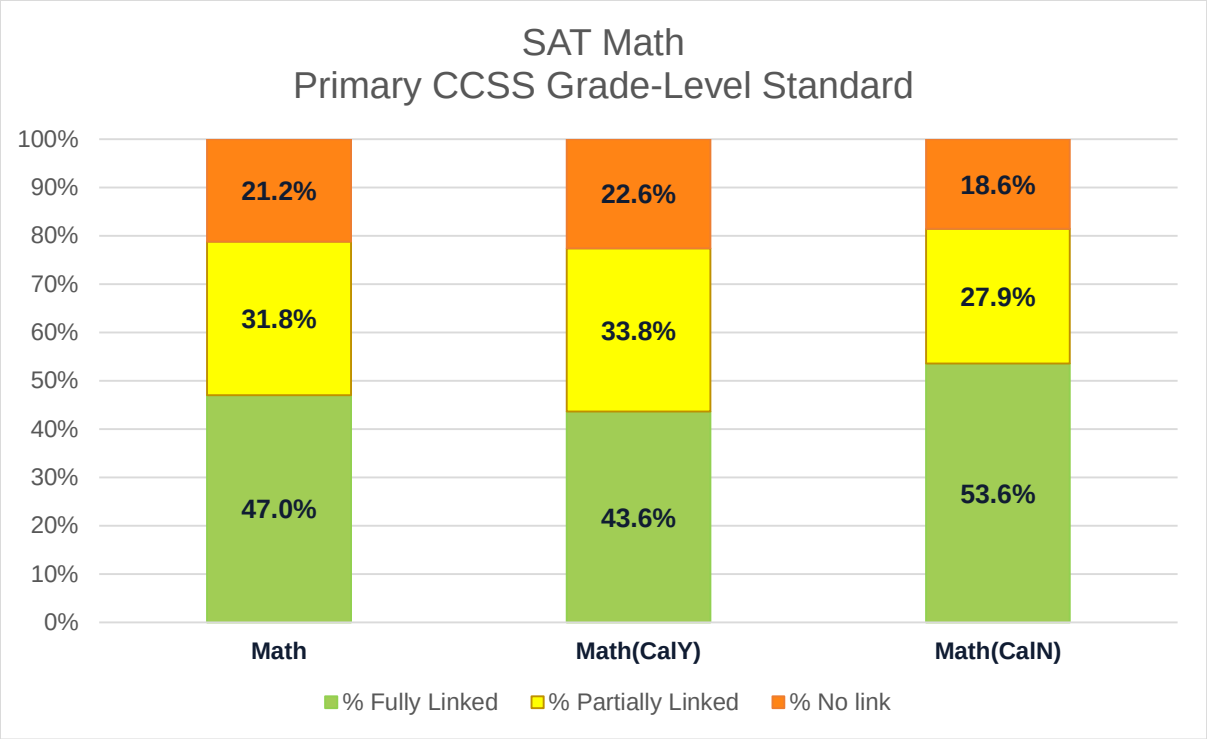
Levels	Code	Example
Strand	RL	Reading: Literature
Grade	11-12	Grades 11 and 12
Standard	1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

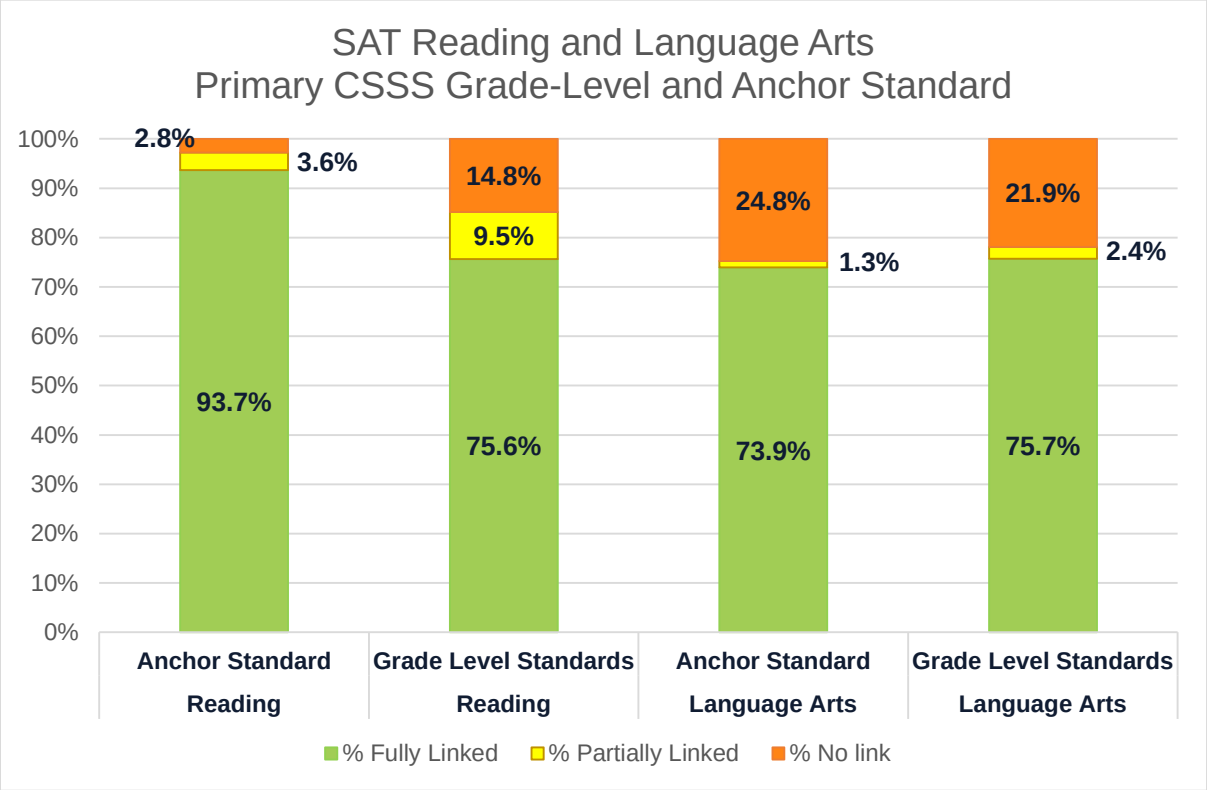
Panelists evaluated the alignment between the item and all identified CCSS grade-level standard(s) by indicating whether the content was: *Fully Linked*, *Partially Linked*, or *No Link*. Due to time constraints, we only asked panelists to evaluate the alignment between the item and the primary CCSS anchor standard in reading and writing/language arts.

Figure 1 presents average panelist agreement of the match between the item and the primary CCSS grade-level standard as well as the CCSS anchor standard in reading and

writing/language arts. The primary CCSS grade-level standard was only used in this analysis as we were interested in knowing how many items were aligned to a single standard rating. An overrepresentation and/or underrepresentation of the relationship between the item and all College Board identified standards was the reason we did not determine a mean linkage rating across the standards and utilized the primary identified standard instead. The number of items given each rating for the primary CCSS grade-level standard only were averaged across panelists and presented in the figure as percentages.

As Figure 1 illustrates, panelists indicated 76% of the reading items, 76% of the writing/language arts items, and 47% of the math items fully aligned with the assigned primary CCSS grade-level standard. Panelists rated 53% of the items in math as *Partially Linked* or *No Link* while 24% of the items in both reading and writing/language arts were rated as such. For the CCSS anchor standard, panelists indicated 94% of the reading items but only 74% of the writing/language arts items were fully aligned.





Note. The percentages displayed above are estimates of the agreement given complete data. If any raters failed to provide a rating for an item, the percentages will be slightly inflated and may add up to more than 100%.

Figure 1. Panelist agreement with item to primary standard content alignment.

To further inform the ratings on the CCSS grade-level standards linked to items, we looked to see if any items across panelists had all of the College Board identified standards assigned a rating of *No Link*. Table 5 shows the proportion of items across panelists that a rating of *No Link* was assigned to all of the College Board identified standards for a single item.

Table 5. Mean Percentage of Items with No Link to Standards

Grade	% No Match	Mean	Minimum	Maximum
Math	9.6%	5.57	3	11
Calculator	10.9%	4.14	2	8
Non-calculator	7.2%	1.43	0	3
Reading	4.1%	2.14	0	6
Writing/Language Arts	0.0%	0.00	0	0

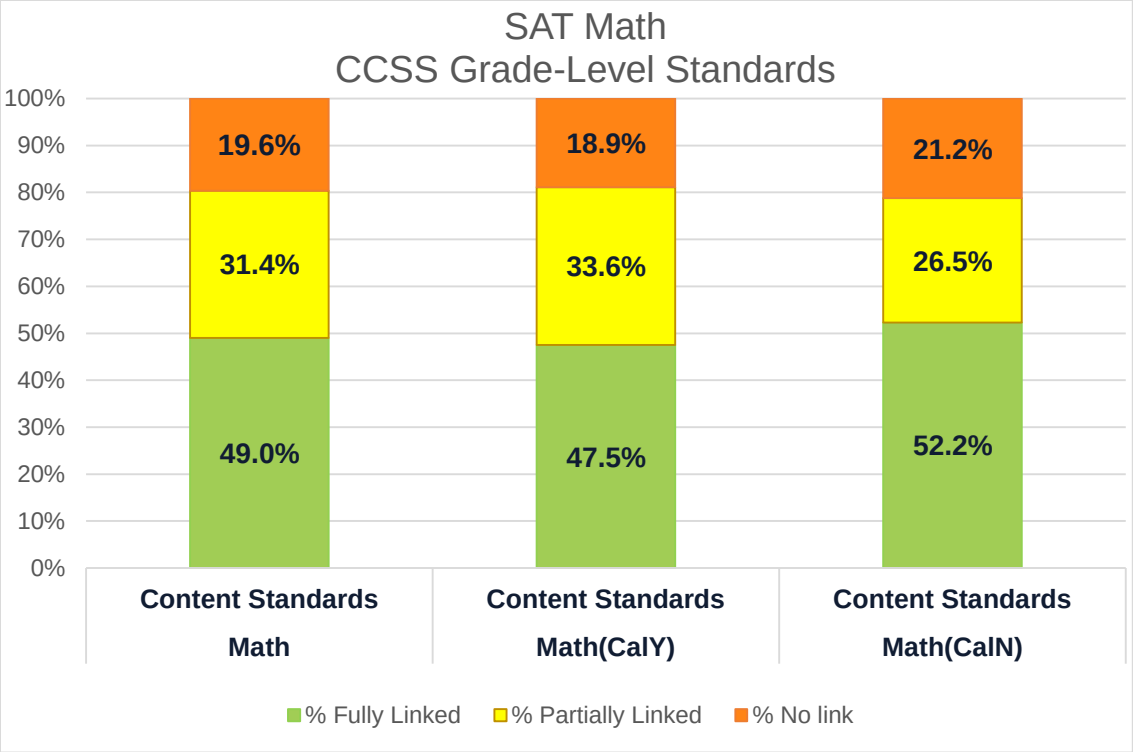
As expected from the proportion of linkage ratings of the primary standard to the items, a larger number of math items (5.57, 9.6%) were assigned a rating of *No Link* to all of the College Board identified standards. There were fewer instances in reading and none in language arts where a *No Link* rating was assigned to all of the College Board identified standards. It is also the case, however, that the math items had a maximum of four College Board identified standards in the first place, while reading had up to eight and language arts had up to 10 College Board identified standards.

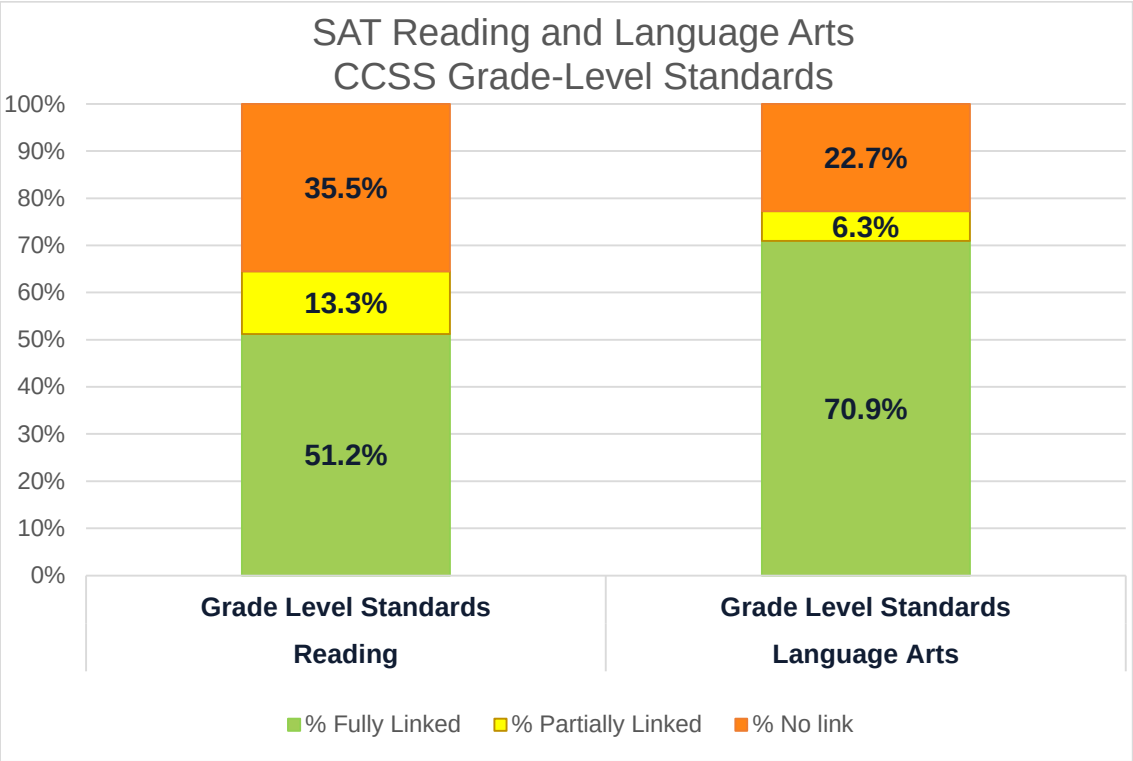
Given such a large number of CCSS grade-level standards identified per item, we can also determine the proportion of College Board identified standards across items at each rating. Table 6 shows the number of CCSS grade-level standards identified per section as well as the number of items.

Table 6. Number of College Board Identified Standards

Grade	Number of Standards	Number of Items	Range of Standards per Item	Avg Number of Standards per Item
Math	113	58	1-4	1.9
Calculator	78	38		
Non-calculator	35	20		
Reading	164	52	1-8	3.2
Writing/Language Arts	160	44	1-10	3.6

As seen in the Table 6, reading and writing/language arts had more College Board identified standards per item on average than the math items. This also shows that the number of standards identified per item was on the lower end of the range rather than the higher end. Figure 2 displays the proportion of CCSS grade-level standards at each linkage rating across items.



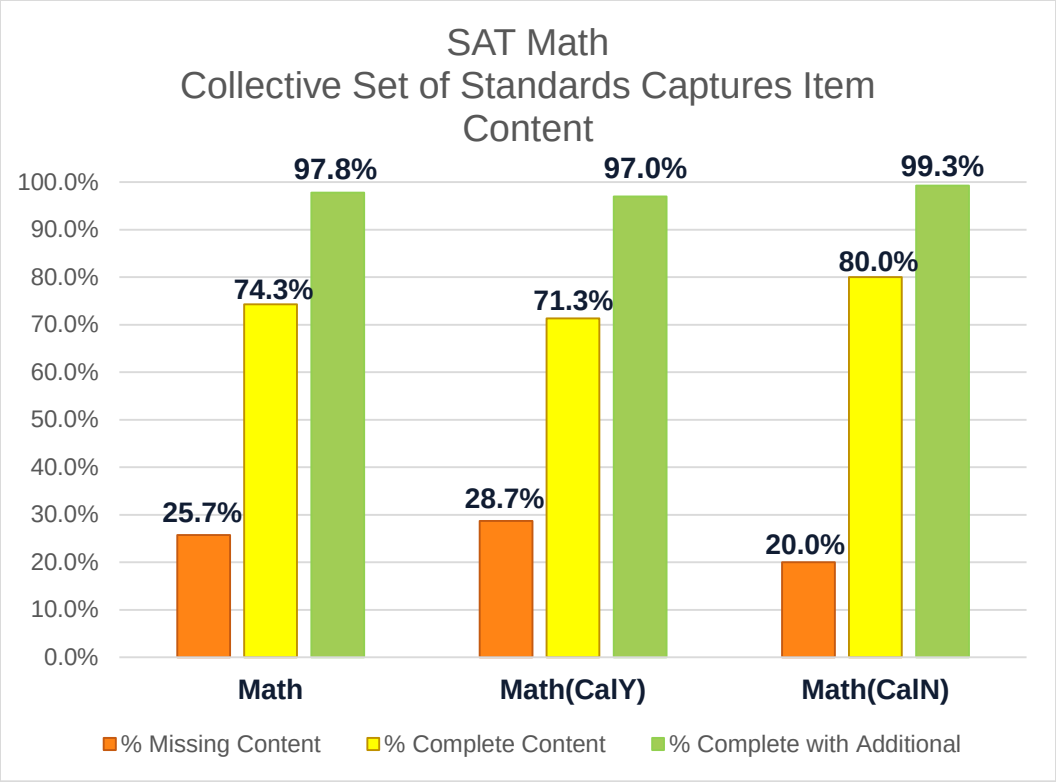


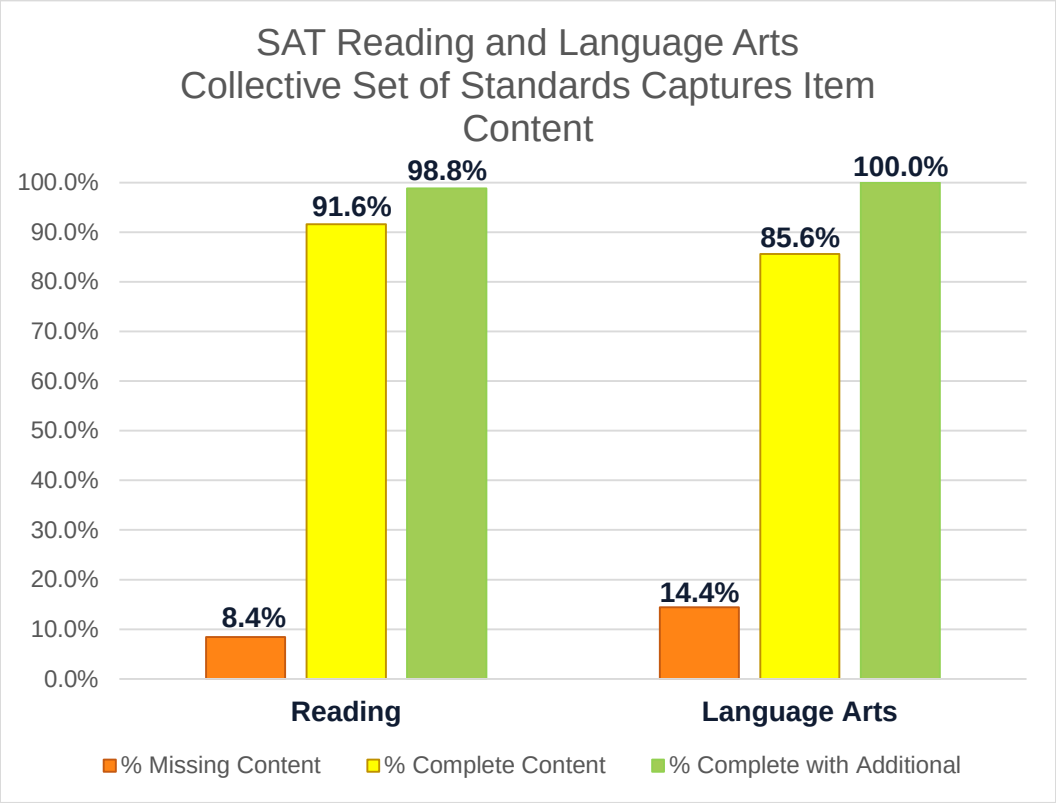
Note. The percentages displayed above are estimates of the agreement given complete data. If any raters failed to provide a rating for an item, the percentages will be slightly inflated and may add up to more than 100%.

Figure 2. Panelist agreement with item to standard content alignment.

In math, roughly 80% of the College Board identified standards were rated as *Fully Linked* or *Partially Linked* while 65% were rated as such in reading and 77% in writing/language arts.

As a final check of the alignment of all College Board identified CCSS grade-level standards, panelists were asked to evaluate whether the collective set of College Board identified standards as a whole captured the knowledge and skills required in the item. If the collective set of College Board identified standards did not capture all of the knowledge and skills required in the item, then panelists identified the missing content and any additional standards that would cover the missing content. Lastly, panelists evaluated whether the collective set of standards, College Board and panelist identified, now captured all of the knowledge and skills required in the item. Figure 3 presents the percent of items averaged across panelists that had missing content in the collective set of standards, contained all of the content in the collective set of standards, and contained all of the content in the collective set of standards with additional standards.





Note. The percentages displayed above are estimates of the agreement given complete data. If any raters failed to provide a rating for an item, the percentages will be slightly inflated and may add up to more than 100%.

Figure 3. Panelist agreement with collective set of standards.

Overall, panelists rated 25.7% of the math items as not having all of the item content covered by the College Board identified standards. However, they were able to identify additional standards that would satisfy the content missing from the identified set of standards. With the added standards, panelists thought that 97.8% of the items had a collective set of standards that captured the knowledge and skills required in the item. For reading and writing/language arts, 8.4% and 14.4%, respectively, of the items were thought by panelists to contain missing standards in the collective set. When additional standards were identified, the collective set of standards covered 98.8% in reading and 100% in writing/language arts of the knowledge and skills required in an item.

Comparison of College Board Ratings and Average Panelist Ratings

To better understand how well the SAT maps onto the CCSS, we graphed the number of times the College Board identified a standard and the average number of times panelists verified/identified the standard to a list of CCSS standards and sub-standards. These graphs are presented in Appendix D. The list of the CCSS Reading, Writing, and Language Arts standards can be found in Appendix E, and the list of high school and identified off-grade level CCSS Math standards are located in Appendices F and G.

As can be noted from the first graph shown for Reading Informational Texts (see Figure D-1), the most represented CCSS standard according to the College Board was RI. 11-12.1, *Citing textual evidence*, and RI.11-12.3, *Analyze sets of ideas/sequence of ideas*. On average, panelists identified RI.11-12.1 more than the College Board. They also identified a few standards that the College Board did not use, such as RI.11-12.5 and RI.11-12.6. One standard was not represented by either group, RI.11-12.2*, Identifying central idea and analyzing their development over the course of the text.* Overall, panelists typically verified or identified similar CCSS as the College Board.

Across the reading types (Readings for Information, Reading Literature, Reading History/Social Studies, Reading Science and Technical Subjects), the College Board and panelists identified the first Reading standard, *Citing textual evidence*, most often. In general, panelists and the College Board were similar in their identification for reading, writing, and language arts.

Both groups identified or verified the same standards in writing. However, nine of the 28 CCSS Writing standards and sub-standards were not measured, including those requiring students to use technology, conduct research projects, and gather information from multiple sources. The Writing in History/Social Studies and Technical Subjects followed the same pattern.

The College Board and panelists coded reading items and language arts items to the CCSS Language Arts standards. Most commonly coded were L.11-12.5a, *Interpret figures of speech,* and L.11-12.6, *Acquire and use accurately general academic and domain-specific words and phrases*. Some standards and sub-standards were not identified, such as L.11-12-4b to 4d, *Identify and use patterns of words, consulting reference materials, and verifying preliminary determination of a word.*

The CCSS Math standards are divided into five strands: Number and Quantity, Algebra, Functions, Geometry, and Statistics and Probability. The College Board and the panelists coded items to Algebra standards most often. The most commonly cited Math standards were HSA.REI.B.3, *Solving linear equations*, and HSA.REI.D.10, *Understanding that the graph of an equation in two variables is a set of all its solutions plotted in a coordinate plane.* Geometry and Statistics and Probability were the strands with the least amount of SAT item mapping. This is consistent with the SAT design and its college entrance purpose.

The math panelists identified a number of off-grade level standards. These are included in Appendix D Figure D-13 and are listed in Appendix G. Across the subject areas, the identification of standards by the College Board and the verification and identification of CCSS standards that map to the SAT items by panelists displayed consistency.

The College Board did not identify math practices for the 58 math items each panelist evaluated. However, panelists identified primary math practices, where appropriate, in their alignment review. Of the 406 data entries (58 items multiplied by 7 panelists) more than half of the items (*n*=205) were not assigned a math practice code. Panelists identified MP4, *Model with mathematics*, for 20% of the entries; MP1, *Make sense of problems and persevere in solving them*, for 11%; MP7, *Look for and make use of structure*, for 8%; and MP2, *Reason abstractly and* quantitatively, for 6%. The remaining MPs were identified for less than 2% of the items across all panelists. The distribution is displayed in Figure 4.

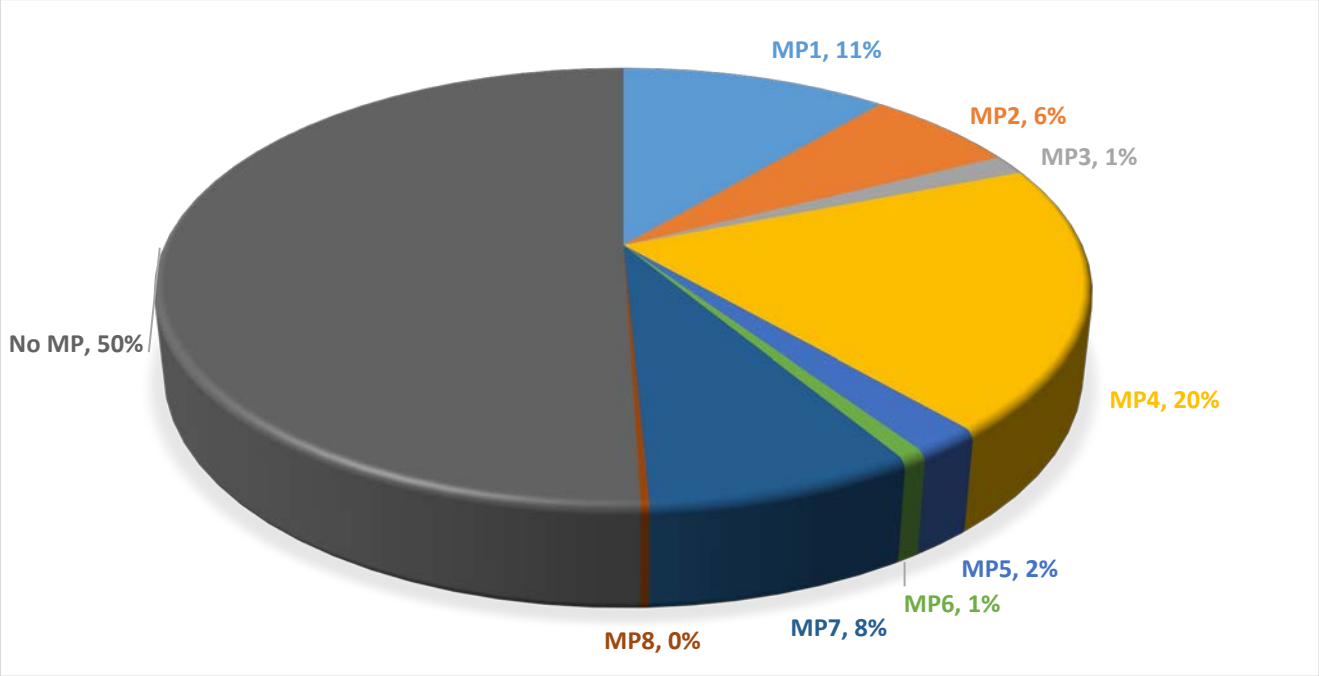


Figure 4. Frequency distribution of identified math practices.

Essay Results

The College Board did not provide standards aligned to the essay for panelists to verify. Therefore, panelists identified CCSS standards for each of the three essay dimensions: Reading, Analysis, and Writing. Across the seven panelists, 31 Reading standards, 38 Analysis standards, and 36 Writing standards were identified. Panelists used the same classification philosophy as the College Board did when assigning CCSS standards to items, which was to include all possible standards. Therefore, similar standards for Reading for Information (RI) and Reading in Science and Technology (RST) were both identified even though there was redundancy of content. Appendix E includes a list of all of the Grade 11-12 English Language Arts and Writing standards for reference. Off-grade standards identified by panelists in the essay alignment are included in Appendix E and shown in blue text instead of black.

For the reading dimension, all panelists identified standards RI.11-12.2, *Determine two or more central ideas of a text,* and RST.11-12.2, *Determine the central ideas of conclusions of a text* as being aligned to the essay prompt. Figure 5 displays the frequencies of the panelist identified standards. All standards identified by panelists in the reading dimension were rated as *Fully Linked*.

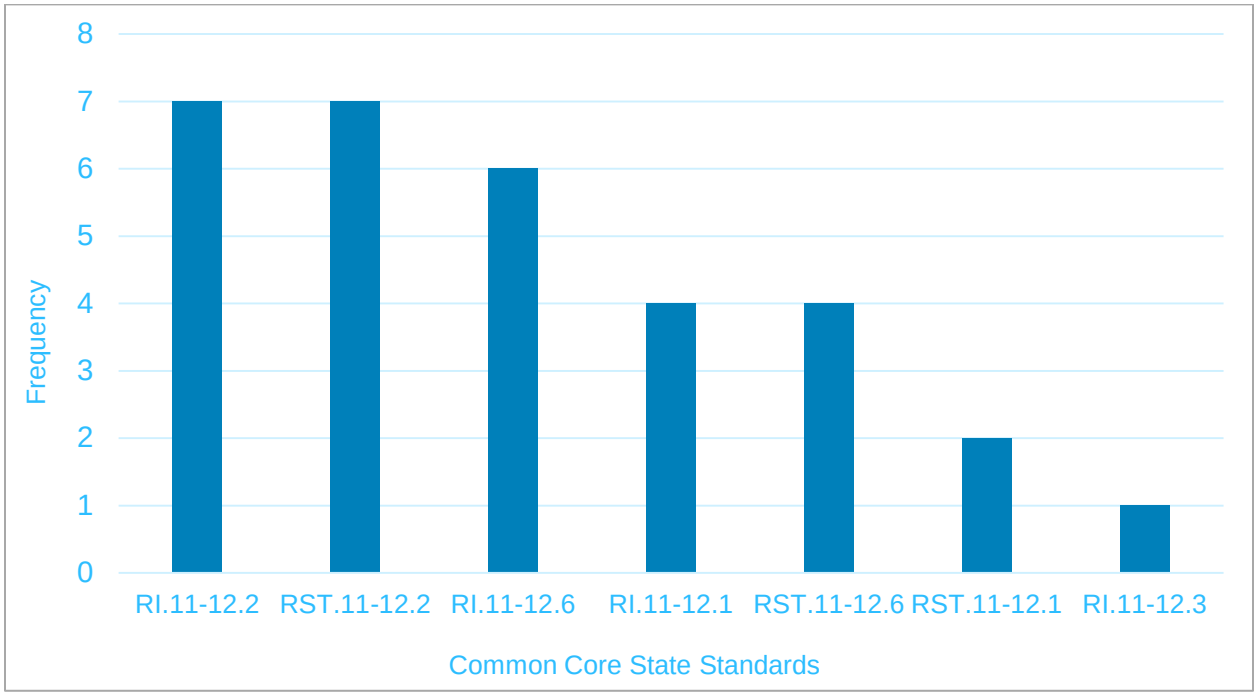


Figure 5. Frequency distribution of identified reading standards for the essay.

For the analysis dimension, five of the seven panelists identified standard RI.11-12.6, *Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective*. The frequencies of the panelist identified standards are displayed in Figure 6. All standards except one was identified by the panelists in the analysis dimension as *Fully Linked*. There was one standard identified as *Partially Linked*.

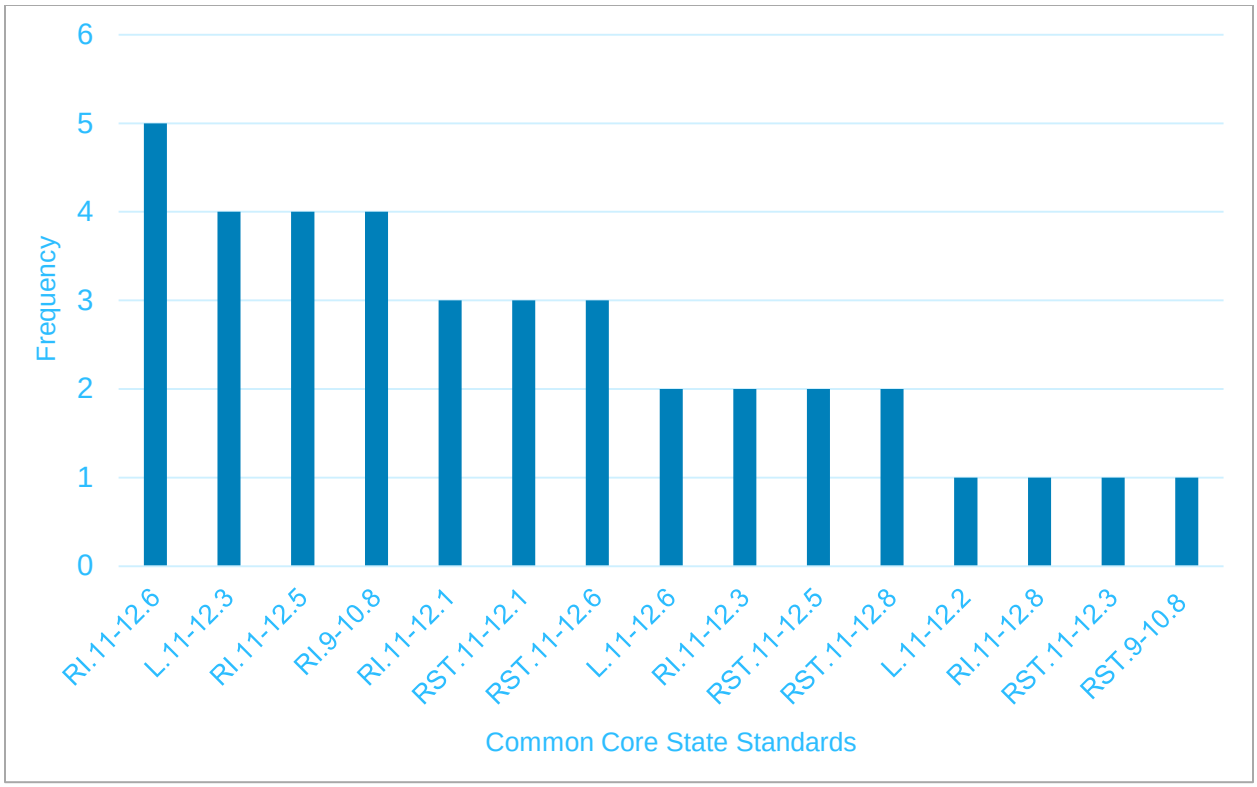


Figure 6. Frequency distribution of identified analysis standards for the essay.

For the language dimension, six of the seven panelists identified W.11-12.2, *Write informative/explanatory texts to examine and convey complex ideas, concepts, and information,* and W.11-12.4, *Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience,* most frequently in their alignment. In Figure 7, the frequencies of the panelist identified standards are displayed. All standards except one were identified by panelists in the language dimension as *Fully Linked*. There was one standard identified as *Partially Linked*.

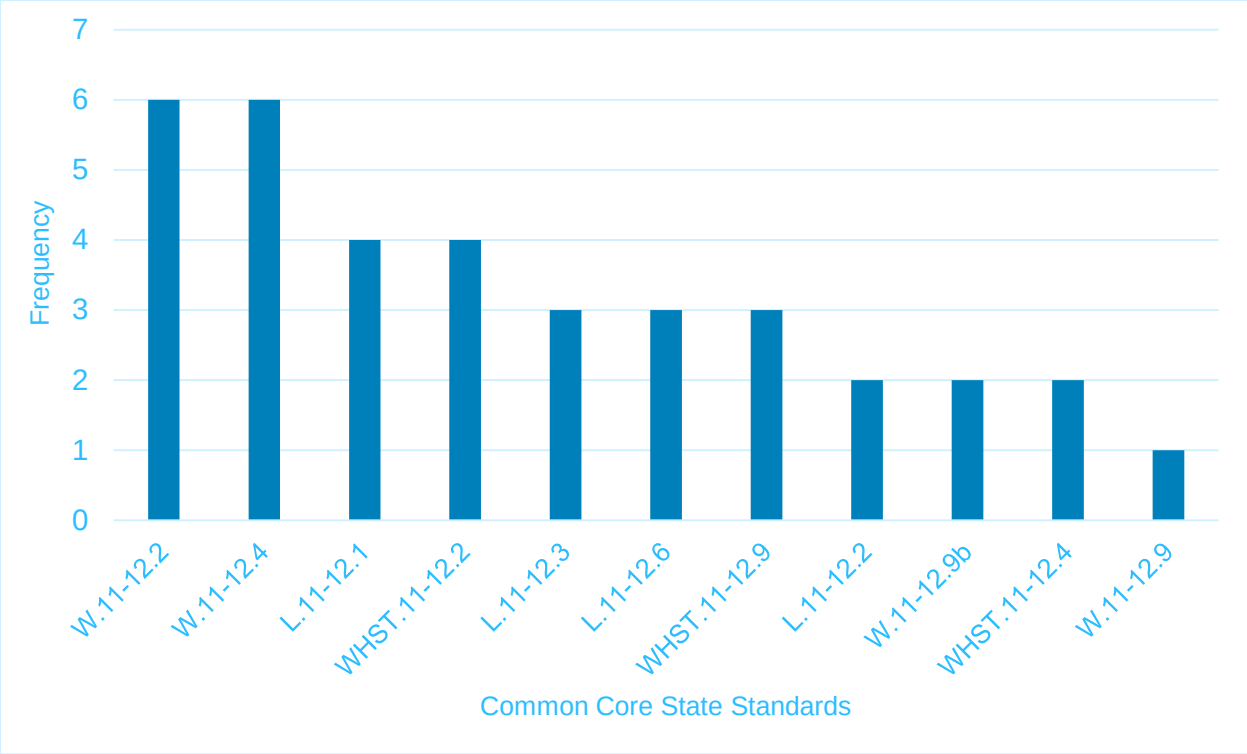


Figure 7. Frequency distribution of identified language standards for the essay.

Criterion 2: Items Represent Intended Categories

In this section, we examine the distribution of items by subscore and compare this to the target stated in the test specifications for the Redesigned SAT as well as panelists' agreement with the subscore categorization. Data for this analysis was provided through panelists' assignment of items to each subscore and College Board's subscore mapping of items. For math, there are three subscores that are reported to students: Heart of Algebra, Problem Solving and Data Analysis, and Passport to Advanced Math. Not all of the math items are assigned to one of these three subscores but all items do contribute to the overall math test score. In reading, items contribute to the Words in Context and Command of Evidence subscore; however, not all items are assigned to one of the two subscore categories. All of the items do contribute to the Reading test score. Finally, all of the writing/language arts items are allocated to either the Expression of Ideas or Standard English Conventions subscore grouping. In addition, a subset of the writing/language arts items is also assigned to the Words in Context and Command of Evidence subscores in conjunction with the reading items. This means that a group of items on the writing/language arts section are accounted for in two subscores, either Expression of Ideas and Words in Context or Expression of Ideas and Command of Evidence.

Panelists selected the subscore they thought an item best fit as we did not receive the subscore designation of items from College Board until after the workshop had concluded. Panelists assigned items to one of the three subscore categories in math and to one of the two subscore categories in reading. In writing/language arts, panelists assigned items to one of the four subscore categories. At the time of the workshop, we assumed a single item would be assigned to only one subscore. Thus, panelists assigned Expression of Ideas, Standard English Conventions, Words in Context, or Command of Evidence to an item. To account for the fact that some items were included in two subscores, we present agreement between panelists and

College Board on subscore assignment by combining these items into a single agreement rating.

Table 7 accumulates the distribution of items by subscore category. The number of items assigned to each subscore was summed, by rater. These numbers were then averaged across raters to determine the average subscore distribution of the items.

Table 7. Test and Subscore Distribution of Items

Subscore Category	Number of Items (Test Specs)	Number of Items (Actual)	Panelist % Match	Panelist % No Match
Math	58	58	79.6%	20.4%
Heart of Algebra	19	19	87.2%	
Passport to Advanced Math	16	16	70.5%	
Problem Solving and Data Analysis	17	17	79.0%	
Reading	52	52	95.7%	4.3%
Command of Evidence	10	10	97.1%	
Words in Context	10	10	94.3%	
Writing/Language Arts	44	44	90.9%	9.1%
Standard English Conventions	20	20	89.3%	
Expression of Ideas	24	24	92.3%	
Expression of Ideas/Words in Context	8	8	87.5%	
Expression of Ideas/Command of Evidence	8	8	98.2%	

As shown in Table 7, the number of items on the actual form exactly matches the number of items listed in the Redesigned SAT test specifications (College Board, 2015b). Even though panelists received the subscore definitions in math, however, they were only able to match 79.6% of the items to the subscore category assigned by College Board. Panelists matched 95.7% and 90.9% of the subscore categorization in reading and writing/language arts, respectively.

As mentioned previously, the blueprint and test specifications are associated with the content standards for the SAT, not the CCSS. To understand how many CCSS grade-level standards were either verified or identified by panelists, Appendix H presents frequency distributions for CCSS Reading, Writing/Language Arts, and Math.

The College Board identified 164 CCSS links to the 52 reading items using 28 unique CCSS. The most common alignment was made to L.11-12.5a, *Interpret figures of speech,* and L11-12.6, *Acquire and use accurately general academic and domain specific words and phrases*. Twenty-three of the 52 items were coded to these standards. The panelists indicated between 88-147 links during their verification. About 30 additional on-grade level links were added by panelists. On average, across the panelists, standards L.11-12.4a, *Use context as a clue to the meaning of a word or phrase,* and L.11-12.6, *Acquire and use accurately general academic and domain specific words and phrases,* were the most frequent.

In writing/language arts, the College Board identified 165 links to the 44 item items using 29 unique CCSS. College Board identified standard W.11-12.5, *Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach,* for all items and WHST.11-12.5, *Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach,* for 22 of the items. On average, the panelists agreed with the frequency of these standards.

During the alignment verification process, panelists had between 118-142 CCSS links using the 28 unique standards. Panelists indicated that neither W.11-12.3b, *Use narrative techniques,* or W.11-12.3e, *Provide a conclusion that follows from and reflects on what is experienced, observed or resolved over the course of the narrative,* were linked. In addition to the standards identified by the College Board, panelists identified about 100 additional standards. They noted that often when L.11-12.1, *Demonstrate command of conventions of standard English grammar and usage when writing or speaking,* was used to classify an item by College Board, they thought that L.11-12.2, *Demonstrate command of conventions of standard English capitalization, punctuation, and spelling when writing,* would be a more appropriate fit.

The College Board identified 101 CCSS links to the 58 math items using 42 unique CCSS. Panelists indicated between 69-91 links during their verification. They also identified many off-grade links they thought were well aligned.

Criterion 3: Item DOK Represents Test Specifications

In this section, we review the DOK of the items and make two comparisons. First, we compare the DOK assigned to an item by College Board with panelists' agreement with the DOK, and then we compare the DOK of the items with the DOK associated with the College Board identified CCSS standard(s). Typically, we make a comparison between panelists' agreement of DOK assigned to items and the DOK targets listed in the test specifications for inclusion on a form. Since the Redesigned SAT test specifications (College Board, 2015b) do not contain targets for item DOK, we made a comparison with a published DOK rating of the CCSS to assess DOK breadth. Specifically, we used a published set of DOK ratings for the CCSS developed for the Smarter Balanced Assessment Consortium by Sato, Laguoff, and Worth (2001) at WestEd. For the math test, College Board does not assign DOK levels to items; they do, however, assign a cognitive rigor rating. Thus, panelists verified cognitive rigor and assigned DOK levels for each item. For the Reading and Writing/Language Arts test, panelists reviewed and verified the DOK level assigned to each item.

No DOK was provided for the essay either, nor were panelists asked to identify one. Instead of focusing on DOK, the essay rubric and dimensions of reading, analysis, and language were evaluated. Having only one associated DOK seemed unlikely to reflect all of the required essay components.

Panelist Agreement

Table 8 presents average panelist agreement with assigned item DOK level for reading and writing/language arts. The number of items at each agreement level were averaged across panelists and presented as percentages.

As displayed in Figure 8, panelists found 93% of reading items and 72% of writing/language arts items match the DOK level specified by College Board. For writing/language arts, an average of

14% of the items were assigned a DOK level that was too low and an average of 13% of the items were assigned a DOK that was too high.

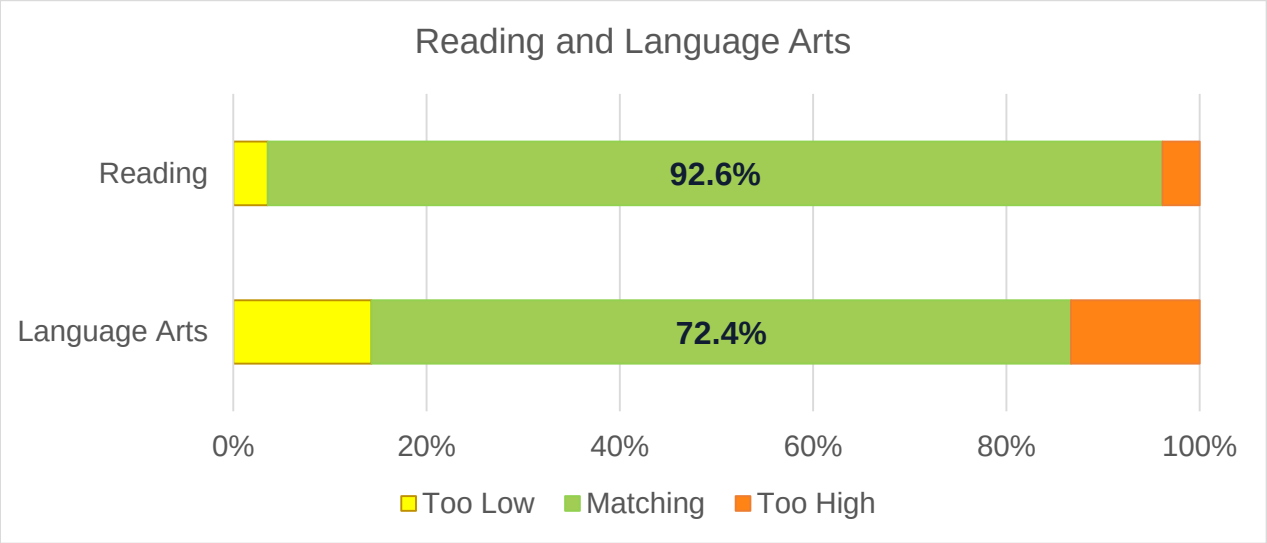


Figure 8. Panelist agreement with assigned item DOK.

For math, we compared panelist agreement of each item's rigor to the rigor level (Fluency, Conceptual Understanding, Application) assigned by College Board. In general, panelists agreed with College Board's rigor level on 83% of the items. Table 8 lists the number of items at each rigor level according to College Board's assignment and panelists' agreement.

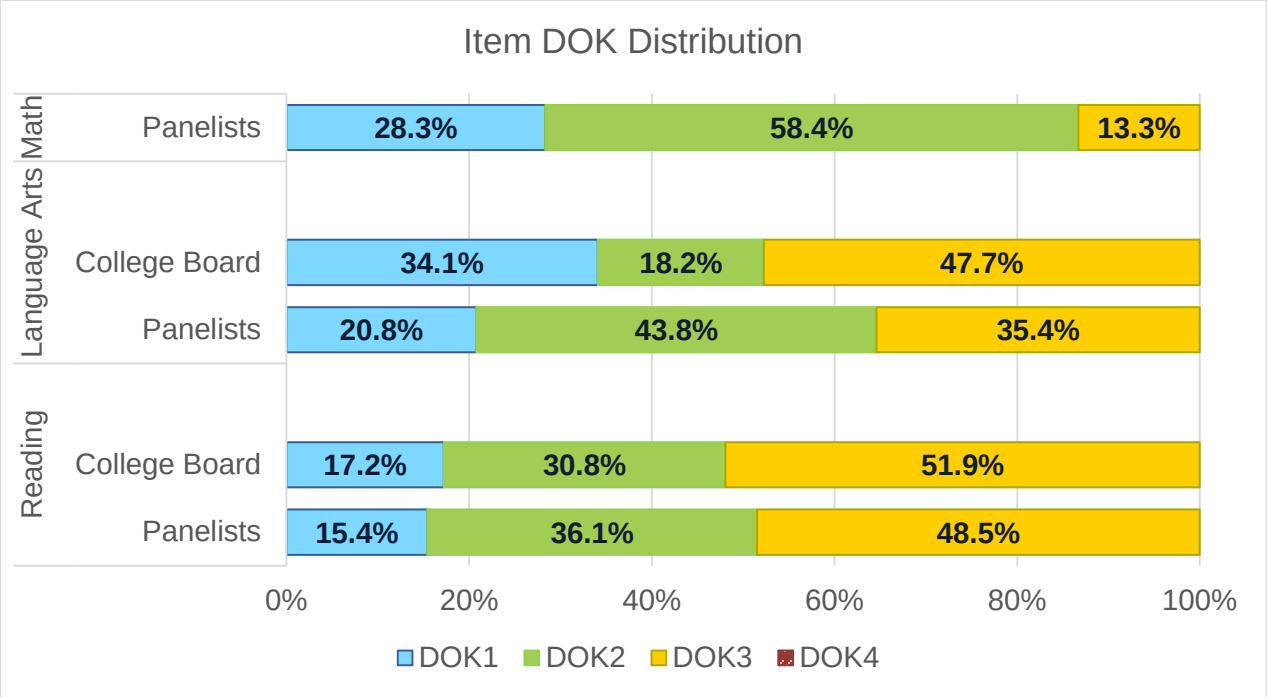
Table 8. Rigor Levels of Math Items

Rigor	Number of Items (College Board)	Mean Number of Items (Panelists)
Fluency	15	19
Conceptual Understanding	14	13
Application	29	25

As seen in Table 8, panelists rated more items as measuring Fluency and fewer items measuring Conceptual Understanding and Application than College Board.

College Board DOK and Rigor Distributions

We can further look at the agreement relationship between College Board and panelists by looking at the percent of items assigned by each group to the DOK levels. Figure 9 compares the panelists' DOK levels (agreed upon or assigned) to the proportion of items at each DOK level assigned by College Board. The average number of items (across raters) with each rating was computed to get the mean number of items at each DOK level.



Note. College Board does not assign DOK to math items; thus, there is no College Board item DOK distribution.

Figure 9. Item DOK distribution from College Board and panelists.

For math, panelists rated roughly 58% of the items at a DOK level 2 and 28% at a DOK level 1 while only 13% of the items reached a DOK level 3. The proportion of items does not seem to be overly skewed, though more DOK level 3 items may be preferable by the DOEs depending on their state specifications for assessment at this grade level. In writing/language arts, panelists mainly disagreed with College Board on the DOK level 1 and 3 items where they assigned a DOK level 2 to 13% of the DOK level 1 items and 12% of the DOK level 3 items. The percentages between panelists and College Board at each of the DOK levels were in much closer agreement for the reading items.

Figure 10 shows the distribution of math rigor levels by both the panelists and College Board. The average number of items (across raters) with each rating was computed to get the mean number of items at each rigor level. The largest discrepancies are with fluency and application, with College Board assigning more application and fewer fluency items than did the panelists.

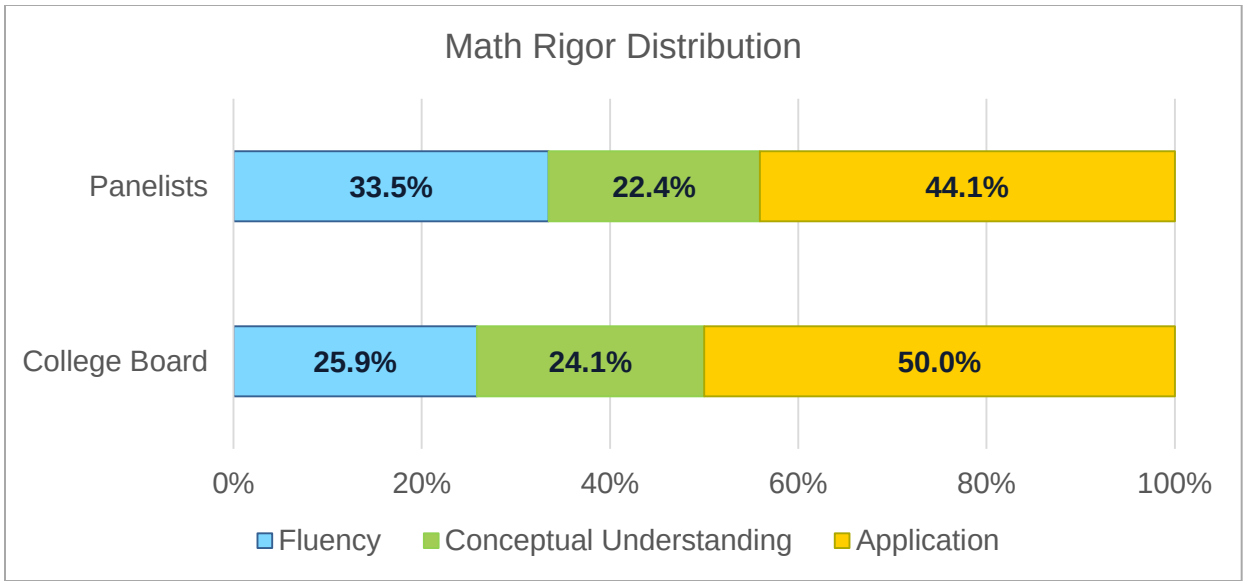


Figure 10. Math rigor distribution from College Board and panelists.

Item DOK Compared to CCSS DOK

In traditional alignment studies, items are compared to the standards to which they are measured, with the assumption that the item requires cognitive processing lower than or equal to that required in the standard. There is also an assumption that alignment of items and standards is one-to-one. Assessments developed using the CCSS deviate from that assumption; it is not only permitted, but encouraged to measure more than one standard with a given item. Because of this multiplicative nature, we examined the extent to which the cognitive processing required by the items match that required by the standards in four ways:

(1) item DOK matches the DOK level of at least one of the College Board assigned standards,

(2) the maximum DOK required by the item matches the maximum DOK required by the standards,

(3) the maximum DOK required by the item is less than the maximum DOK required by the standards, and

(4) the percent of standards that match the item's DOK.

Because of the multiplicative nature of item to CCSS assignment, classifying an item DOK as "matching" the standards' DOK results in an all or nothing metric. Rows one through three in Table 9 wholly code a single item as matching the criteria or not. Row four examines the extent to which all of the standards assigned to the item match the DOK of the item. Because the CCSS can include multiple DOK levels (e.g., DOK 1 and DOK 2), we considered a match when the item's DOK matched at least one of the standards' DOK levels. For example, an item at a DOK 3 is considered a match to a standard at a DOK 2 and DOK 3. We computed agreement of each standard for a given item, resulting in the average percentage of standards assigned to an item. We then averaged across items and panelists. A high percentage indicates a large percentage of standards with DOK levels that match the DOK of the item.

Table 9 shows that more math items (83.9%) than reading and writing/language arts items (75.6% and 64.9% respectively) have at least one standard that requires the same cognitive demand as does the item. When looking at the highest cognitive demand required across the assigned standards, all of the writing/language arts items require a lower DOK. These percentages likely reflect over-identification of ELA CCSS on the Writing/Language Arts test. That is, math only has seven items with more than two aligned standards (maximum number of aligned standards is four). However, writing/language arts has 30 items with more than two aligned standards (maximum of aligned standards is 10; number of items with 10 aligned standards is two). Additionally, many writing/language arts items are aligned to the writing (W) or writing history/social studies, science, and technical subjects (WHST) strands, which tend to require higher cognitive demand.

Table 9. Cognitive Demand Alignment of Items and Standards

DOK Alignment Criteria	Average Percent		
	Math	Reading	Language Arts
(1) Item DOK matches DOK of at least one of the assigned standards	83.9%	75.6%	64.9%
(2) Maximum DOK required by the item matches the maximum DOK of all the assigned standards	53.8%	28.3%	0.0%
(3) Maximum DOK required by the item is less than the maximum DOK of all the assigned standards	35.3%	71.7%	100%
(4) Percent of assigned standards per item that match the DOK of the item	73.2%	61.8%	42.1%

Figure 11 further explores the discrepancies by the highest cognitive demand required by the standards compared to the cognitive demand required by the item. As stated, all of the writing/language arts items were at a lower cognitive demand than the highest DOK of the assigned standard. However, approximately 10% of math items required a *higher* cognitive demand than the highest cognitive demand of the assigned standards. It should be noted that panelists independently assigned DOK levels to the math items whereas they verified (and assigned a new DOK level if they disagreed) the DOK levels assigned by College Board for reading and writing/language arts.

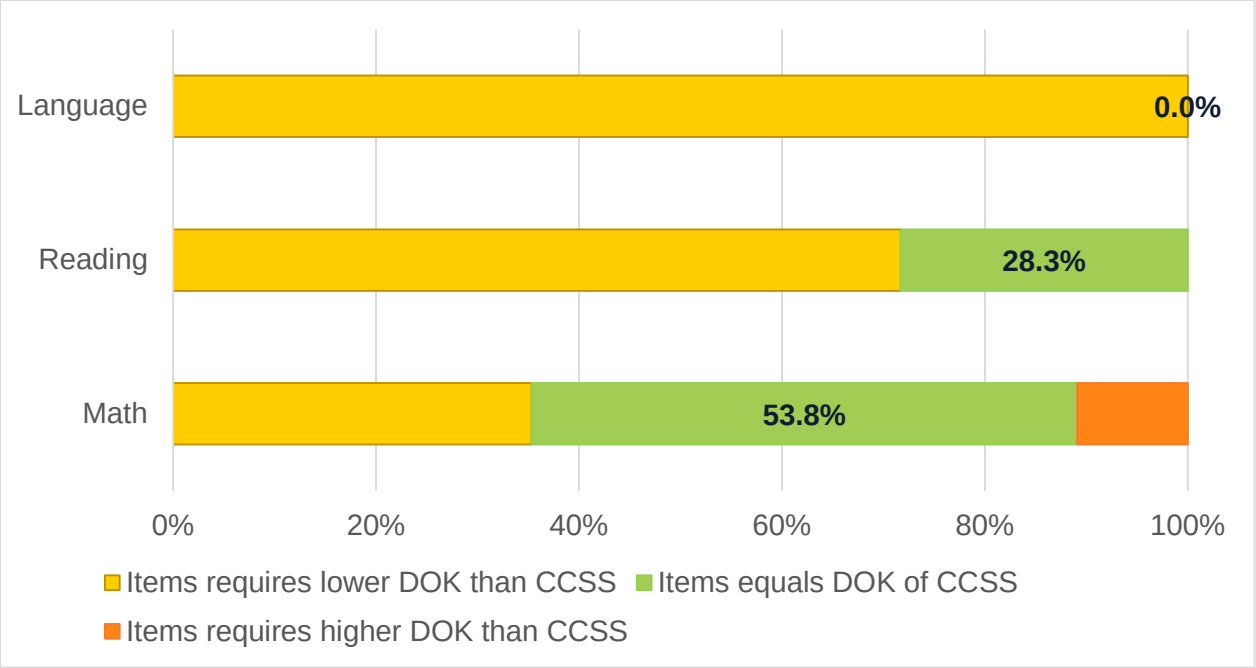


Figure 11. Match between item DOK and highest cognitive demand of CCSS.

Criterion 4: Item Sufficiency for Category Reporting

In this section, we examine whether the test items on the forms reviewed support reporting of subscores for Words in Context (WIC) and Command of Evidence (COE) in Reading, Expression of Ideas (EOI) and Standard English Conventions (SEC) in Writing and Language, and Heart of Algebra (HOA), Passport to Advanced Math (PAM), and Problem Solving and Data Analysis (PSD) in Math.

This criterion was not evaluated based on panelists' results as items were already reported within the specified subscores. The main premise behind examining item sufficiency for category reporting is that simply declaring a minimum number of items is not sufficient support to do so. Therefore, several analyses (i.e., correlation, coefficient alpha, and confirmatory factor analysis) of items assigned to the seven subscores were conducted for Delaware, Maine, and the combined states. Student data were provided by the DOEs stripped of any personally identifying information. The data files were cleaned such that students with invalidated scores, students with missing data for subscores, students who were not administered form code 253589 (indicating an alternative assessment), and students not in grade 11 were removed from the analyses. This resulted in the Delaware data file containing 7,603 students and the Maine data file containing 11,013 students.

The first analysis conducted was a correlation between students' subscores on WIC, COE, EOI, SEC, HOA, PAM, and PSD. In this analysis, the WIC and COE subscores should be correlated with each other as they are measuring an overall reading construct. The EOI and SEC subscores should be correlated as they are measuring an overall writing and language construct. Finally, the HOA, PAM, and PSD subscores should be correlated as they are measuring an overall math construct. However, the correlations should not be so strong as to be indicative of redundancy between the subscores. It should be noted that even though the WIC and COE subscores are categorized as measuring a reading construct, these two subscores are composed of items from both the Reading test as well as the Writing/Language Arts test. Table 10 displays the subscore intercorrelations.

Table 10. Subscore Intercorrelations

Subscore Category	Words in Context	Expression of Ideas	Heart of Algebra	Passport to Advanced Math
Delaware and Maine				
Command of Evidence	0.72	--	--	--
Standard English Conventions	--	0.73	--	--
Passport to Advanced Math	--	--	0.73	--
Problem Solving and Data Analysis	--	--	0.73	0.69
Delaware				
Command of Evidence	0.73	--	--	--
Standard English Conventions	--	0.73	--	--
Passport to Advanced Math	--	--	0.72	--
Problem Solving and Data Analysis	--	--	0.72	0.69
Maine				
Command of Evidence	0.71	--	--	--
Standard English Conventions	--	0.73	--	--
Passport to Advanced Math	--	--	0.74	
Problem Solving and Data Analysis	--	--	0.73	0.70

The correlations between WIC and COE for Delaware and Maine as well as the combined states are not strong enough to suggest the reporting of only the overall reading score. The correlations demonstrate the overall construct of reading being measured by the two subscores; however, the two subscores are not completely redundant since none of the correlations are close to 1.00. The same conclusion can be supported by the correlations between EOI and SEC measuring writing and language as well as the correlations between HOA, PAM, and PSD for the math construct.

The next analysis calculated the coefficient alphas for each of the seven subscores (see Table 11). Coefficient alpha is a measure of internal consistency or the extent to which items within a construct, such as WIC, are related to each other.

Table 11. Coefficient Alphas by Subscores

Subscore Category	Items Per Subscore	Delaware and Maine	Delaware	Maine
Words in Context	18[a]	0.77	0.77	0.77
Command of Evidence	18[a]	0.70	0.69	0.71
Expression of Ideas	24	0.78	0.77	0.79
Standard English Conventions	20	0.79	0.78	0.79
Heart of Algebra	19	0.72	0.75	0.71
Passport to Advanced Math	16	0.68	0.73	0.65
Problem Solving and Data Analysis	17	0.80	0.80	0.79

[a.] For WIC and COE, 10 questions come from the Reading test and 8 questions come from the Writing and Language test.

The coefficient alphas for all of the subscores except for COE are sufficiently high to provide additional support for the reporting of these subscores. The coefficient alphas for COE are borderline with what would be ideal. The internal consistency of the COE subscore could be improved by adding additional items that evaluate this construct. As not all of the items on the Reading test are assigned to the WIC or COE subscore, the potential exists for other items to be classified on one of the two subscores.

The next analysis consisted of a confirmatory factor analysis (CFA) of two 2-factor models and one 3-factor model. Unweighted least squares (ULS) extraction was used as this method does not require assumptions about normality and is known to be a more robust estimator in instances of dichotomous data (Nunnally & Bernstein, 1994; Osborne & Banjanovic, 2016). In the first model, WIC items were loaded on factor 1 and COE items were loaded on factor 2. In the second model, EOI items were loaded on factor 1 and SEC items were loaded on factor 2. In the last model, HOA items were loaded on factor 1, PAM items were loaded on factor 2, and PSD items were loaded on factor 3. For a CFA model to be supported, a set of fit indices are evaluated to determine whether they are within a predefined range of acceptability. The fit indices that can be produced vary by extraction method. Since ULS extraction is used, the current report reviews the Standardized Root Mean Square Residual (SRMR), the Adjusted Goodness of Fit Index (AGFI), and the normed fit index (NFI) as they represent indicators of absolute, parsimonious, and incremental fit, respectively. Good fit is indicated when the SRMR values are less than 0.08 and the AGFI and NFI values are greater than 0.90 (Browne & Cudeck, 1993; Byrne, 1994). Table 12 summarizes the CFA fit results and the orange bold-type indicates indices that did not meet criterion levels.

Table 12. CFA Fit Indices

Model	Delaware & Maine			Delaware			Maine		
	SRMR (<0.08)	AGFI (>0.90)	NFI (>0.90)	SRMR (<0.08)	AGFI (>0.90)	NFI (>0.90)	SRMR (<0.08)	AGFI (>0.90)	NFI (>0.90)
WIC & COE	0.020	0.991	0.982	0.022	0.989	0.977	0.020	0.991	0.981
EOI & SEC	0.027	0.982	0.968	0.028	0.980	0.963	0.028	0.982	0.967
HOA, PAM, & PSD	0.065	0.907	**0.867**	0.037	0.981	0.974	**0.083**	**0.856**	**0.792**

For each of the 2-factor models, the SRMR is less than 0.08 and the AGFI and NFI values are all greater than 0.90 indicating good model fit for Delaware, Maine, and the two states combined. The 3-factor model associated with the math subscores gives a mixed picture of model fit. The fit indices show a good model fit with the Delaware data. However, none of the fit indices are met with the Maine data; thus, the fit indices for Delaware and Maine, together, are impacted. An examination of the Maine data shows that none of the fit index criteria are met.

Table 13 displays the mean standardized factor loadings for each of the subscores. A standardized factor loading can be viewed as the correlation between an item and a factor. They are reported on a scale from 0 to 1, with higher values indicative of a stronger relationship between the item and the factor. In general, the standardized factor loadings tended to be around 0.4 for WIC and SEC and .3 for COE and EOI, indicating the items demonstrate limited coverage of the factors. The factor loadings from Delaware are around 0.4 for all of the math subscores. However, the factor loadings in Maine for HOA and PAM are around 0.3 while PSD is 0.4. As with the Reading and Writing and Language Arts subscores, the items associated with the math subscores, HOA, PAM, and PSD, demonstrate limited coverage of the factors.

Table 13. Average Standardized Factor Loadings

Subscore Category	Items Per Subscore	Delaware and Maine		Delaware		Maine	
		Mean	*SD*	Mean	*SD*	Mean	*SD*
Words in Context	18	0.409	0.090	0.409	0.089	0.407	0.092
Command of Evidence	18	0.350	0.064	0.343	0.065	0.355	0.065
Expression of Ideas	24	0.360	0.120	0.351	0.134	0.364	0.112
Standard English Conventions	20	0.406	0.077	0.398	0.077	0.410	0.078
Heart of Algebra	19	0.379	0.144	0.413	0.144	0.362	0.151
Passport to Advanced Math	16	0.372	0.131	0.419	0.119	0.352	0.147
Problem Solving and Data Analysis	17	0.462	0.087	0.475	0.084	0.456	0.092

Lastly, the correlations between the factors constructed through each CFA factor model are reported in Table 14. The factors yielded nearly perfect correlations on the reading subscores, WIC and COE, while the writing and language subscores, EOI and SEC, yielded high correlations between the factors. The HOA and PAM factor correlations are all around 1.00 while the HOA and PSD factor correlations as well as the PAM and PSD factor correlations are nearly perfect. These results suggest the factors extracted from the CFA model are very similar. This is not unexpected since WIC and COE both measure reading, EOI and SEC measure writing and language, and HOA, PAM, and PSD measure math.

Table 14. CFA Factor Score Intercorrelations

Subscore Category	Words in Context	Expression of Ideas	Heart of Algebra	Passport to Advanced Math
Delaware and Maine				
Command of Evidence	0.97	--	--	--
Standard English Conventions	--	0.93	--	--
Passport to Advanced Math	--	--	1.04	--
Problem Solving and Data Analysis	--	--	0.97	0.97
Delaware				
Command of Evidence	0.99	--	--	--
Standard English Conventions	--	0.93	--	--
Passport to Advanced Math	--	--	1.01	--
Problem Solving and Data Analysis	--	--	0.97	0.97
Maine				
Command of Evidence	0.97	--	--	--
Standard English Conventions	--	0.94	--	--
Passport to Advanced Math	--	--	1.04	
Problem Solving and Data Analysis	--	--	0.97	0.97

Chapter 4: Special Study Comparing the SAT to Selected CCSSO High Quality Assessment Results

Tables 15 and 16 display each of the selected CCSSO High Quality Assessment Criteria that we included in this study for reading, writing/language arts, and essay. It is important to note that these findings reflect only a piece of the recommended methodology; however, the results provide a broad examination of the quality of the SAT items and their fidelity to some of what is expected in a college and career readiness test. Based on the criteria we included, the reading and writing/language arts items generally reflect high quality standards.

Table 15. ELA CCSSO High Quality Assessment Results

Criterion Description		CCSSO Tentative Scoring Cutoffs	Average %	Criterion Met
B.1. Assessing student reading and writing achievement in both ELA and literacy				
B.1.1	Texts are balanced (equally distributed) across literary and informational text types	For high school grades: 2 –Meets: 60-72% are informational 1 – Partially Meets: 40-59% or 73-90% are informational 0 – Does Not Meet: 0-39% or 91-100% are informational	71.4%	Meets
B.1.2	Texts are publishable quality (content-rich, exhibit exceptional craft and thought, and/or provide useful information)	2 – Meets: 90-100% 1 – Partially Meets: 75-89% 0 – Does Not Meet: 0-74%	100.0%	Meets
B.1.3	Informational texts are primarily expository rather than narrative. Informational texts in grades 6-12 are evenly distributed across literary non-fiction, history/social science, and science technical	2 – Meets: 90-100% are expository AND for grades 6-12, the informational texts are split nearly evenly for literary nonfiction, history/social science, and science/technical 1 – Partially Meets: 75-89% are expository AND/OR for grades 6-12, the informational texts address only two of the three disciplines mentioned above. 0 – Does Not Meet: 0-74% are expository AND/OR for grades 6-12, the informational texts address only one of the three disciplines mentioned above.	85.4% are expository; 0% are literary non-fiction; 53.1% are history/social science; 46.9% are science/technical	Partially Meets

(continued)

Table 15. ELA CCSSO High Quality Assessment Results (continued)

Criterion Description		CCSSO Tentative Scoring Cutoffs	Average %	Criterion Met
B.3: Requiring students to read closely and use evidence from texts				
B.3.1	Items requiring close reading	2 – Meets: 90-100% require close reading 1 – Partially Meets: 75-89% require close reading 0 – Does Not Meet: 0-74% require close reading	94.4%	Meets
B.3.2	Items focus on the central ideas and important particulars	2 – Meets: 90-100% focus on central ideas 1 – Partially Meets: 75-89% focus on central ideas 0 – Does Not Meet: 0-74% focus on central ideas	80.4%	Partially Meets
B3.4	Items require direct use of textual evidence	2 – Meets: 51-100% require direct use of textual evidence 1 – Partially Meets: 33-50% require direct use of textual evidence 0 – Does Not Meet: 0-32% require direct use of textual evidence	34.4%	Partially Meets
B.4: Requiring a range of cognitive demand				
B.4.1	2 – Meets: The DOK Index is at least 80% AND the percentage of score points associated with DOK3+ items is no more than 10% less than the percentage of standards that are DoK3+. 1 – Partially Meets: The DOK Index is at least 60% AND the percent of DOK1 score points is no more than 20% higher than the percentage of standards that are DoK1. 0 – Does Not Meet: The DOK Index is less than 60% OR the percent of DOK1 score points is more than 20% greater than the percentage of standards that are DOK1.		DOK Index = .75; DOK 3+ items = 42.4%; DOK 3+ CCSS = 67.7%; DOK 1 items = 17.9%; DOK 1 CCSS = 6.6%	Partially Meets
B.5: Assessing writing				
B.5.1	Tasks are balanced more towards exposition and argument	For high school programs that do NOT include narrative writing: 2 – Meets: 40-60% each for expository and argument types. 1 – Partially Meets: Both expository and argument types are represented but one writing type accounts for more than 60% of the balance of these two types. 0 – Does Not Meet: Either expository or argument is not represented, or neither is represented.	1 item prompt	Does Not Meet
B.5.2	Tasks requires writing to a text	2 – Meets: 90-100% require writing to sources 1 – Partially Meets: 75-89% require writing to sources 0 – Does Not Meet: 0-74% require writing to sources	100.0%	Meets

(continued)

Table 15. ELA CCSSO High Quality Assessment Results (continued)

Criterion Description		CCSSO Tentative Scoring Cutoffs	Average %	Criterion Met
B9: Ensuring high-quality items and a variety of types are strategically used to appropriately assess the standard(s)				
B.9.1	Item format	2 – Meets: At least two item formats are used, including one that requires students to generate, rather than select, a response (i.e., CR, extended writing). 1 – Partially Meets: At least two formats (but not including CR) are used, including technology-based formats and/or two-part selected response formats. 0 – Does Not Meet: Only a traditional multiple choice format is used.	Two item formats required	RD & LA tests are MC only. The Essay test is an extended constructed response. Does Not Meet at Section or Test or Subscore levels[a]
B.9.2	Items are high quality, ensure technical quality, and editorial accuracy[b]	2 – Meets: 95-100% for editorial and technical. 1 – Partially Meets: 90-94% for editorial and technical. 0 – Does Not Meet: 0-89% for editorial and technical.	99.7%	Meets

[a] The section is Evidence-Based Reading and Writing. Tests are Reading, Writing/Language Arts, and the Essay and the Subscores are Words in Context and Command of Evidence in Reading and Expression of Ideas and Standard English Conventions in Writing and Language Arts. The Essay has three dimensions: Reading, Analysis, and Writing.
[b] We excluded the alignment to standards criterion in B.9.2 in the description and tentative scoring cutoffs since the HumRRO alignment method used in this study more fully examined alignment.

For the essay section, we asked panelists to rate the quality of essay components that are not reflected in the high quality criteria. Table 14 shows that the one essay prompt generally cued for its rubric elements and had a clearly defined purpose. However, almost all of the panelists thought that the writing requirements section of the rubric was not cued for in the prompt. Panelists consistently noted that students were not prompted to produce a formal essay and what elements of the essay would be scored. A typical panelist comment was “Several of the criteria for writing are not cued for, including command of conventions and variety of sentence structure, strong introduction and conclusion.”

Table 16. Additional Essay Criteria

Additional Essay Criteria	% of Panelists Responding *Yes*
Task has a clearly identified purpose for writing	100%
Task specify or clearly imply an audience	14%
Does the item require a minimum of two informational passages?	0%
Does item require analysis, synthesis, and/or organization of information (mirroring real-world activities)?	100%
Does the writing essay clearly cue for all of the reading requirements in the rubric?	100%
Does the writing essay clearly cue for all of the analysis requirements in the rubric?	100%
Does the writing essay clearly cue for all of the writing requirements in the rubric?	14%

Table 17 displays each of the selected CCSSO High Quality Assessment Criteria that we included in this study for math. It is important to note that these findings reflect only a piece of the recommended methodology; however, the results provide a broad examination of the quality of the SAT items. Based on the criteria we included, the math items generally reflect high quality standards for assessment outcomes.

Table 17. Math CCSSO High Quality Assessment Results

Criterion Description		CCSSO tentative scoring cutoffs	Average %	Criterion Met
C.2: Assessing a balance of concepts, procedures, and applications				
C.2.1	Item score points are balanced across math concepts, procedures/fluency, and application	2 –Meets: 25-50% are allocated for each of the three categories 1 – Partially Meets: 19-24% of score points are allocated for one of the three categories 0 – Does Not Meet: Less than 18% of the score points are allocated for one or more of the three categories	33.5% are fluency; 22.4% are conceptual understanding; 44.1% are application	Partially Meets
C.3: Connecting practice to content				
C.3.1	Assessments for each grade and course meaningfully connect math practices and processes with math content	2 –Meets: 90-100% of the items that measure a math practice also align to a content standard. 1 – Partially Meets: 75-89% of the items that measure a math practice also align to a content standard. 0 – Does Not Meet: 0- 74% of the items that measure a math practice also align to a content standard.	100%	Meets
C.4: Requiring a range of cognitive demand				
C.4.1	2 – Meets: The DOK Index is at least 80% AND the percentage of score points associated with DOK3+ items is no more than 10% less than the percentage of standards that are DOK3+. 1 – Partially Meets: The DOK Index is at least 60% AND the percent of DOK1 score points is no more than 20% higher than the percentage of standards that are DOK1. 0 – Does Not Meet: The DOK Index is less than 60% OR the percent of DOK1 score points is more than 20% greater than the percentage of standards that are DOK1.		DOK Index = .83; DOK 3+ items = 13.3%; DOK 3+ CCSS = 9.7%; DOK 1 items = 28.3%; DOK 1 CCSS = 15.3%	Partially Meets

(continued)

Table 17. Math CCSSO High Quality Assessment Results (continued)

Criterion Description		CCSSO tentative scoring cutoffs	Average %	Criterion Met
C5: Ensuring high-quality items and a variety of item types				
C.5.1	Distribution of item types	2 –Meets: At least two item formats are used, including one that requires students to generate, rather than select a response (i.e., CR, gridded response). 1 – Partially Meets: At least two item formats are used but the item formats only require students to select, rather than generate a response. 0 – Does Not Meet: Only a traditional multiple choice format is used.	Two item formats (Selected response and gridded)	Meets at Section or Test or Subscore levels[a]
C.5.2	Degree of high-quality items[b]	2 – Meets: 95-100% for editorial and technical. 1 – Partially Meets: 90-94% for editorial and technical. 0 – Does Not Meet: 0-89% for editorial and technical.	93.8%	Partially Meets

[a] The section is Math. The test is also Math, and the Subscores are Heart of Algebra, Passport to Advanced Math, and Problem Solving/Data Analysis. [b] We excluded the alignment to standards criterion in C.5.2 in the description and tentative scoring cutoffs since the HumRRO alignment method used during this study more fully examined alignment.

Chapter 5: Panelist Debriefing and Evaluation Survey

After the workshop, the seven panelists in each group completed a debriefing and evaluation survey which can be found in Appendix I. The survey had 13 questions that covered panelists' opinions of the ratings they completed and their views on the alignment study process and procedures. All but one of the items had six response options: *Strongly Agree, Agree, Somewhat Agree, Somewhat Disagree, Disagree,* and *Strongly Disagree*. One question, "What is your general opinion of the alignment between the content area items you reviewed and the CCSS?" had five response options: *Strong alignment, Acceptable alignment, Needs slight improvement. Needs major improvement,* and *Not aligned in any way*.

The ELA panelists reported that they felt the items and CCSS content were acceptability aligned and that the SAT Evidence-based Reading and Language test was a good measure of what students should know and do in the 11th grade and to be prepared for college. They strongly agreed that they were confident in their ratings (mean = 5.4 on a 6-point scale). These results are presented in Table 18.

Table 18. Means and Standard Deviations of the ELA Panelists' General Alignment Opinions

Question	Mean	Standard Deviation
What is your general opinion of the alignment between the content area items you reviewed and the CCSS	4.1*	0.7
Overall, do you think the SAT is a good measure of what 11th grade students know and should do in your state	4.7**	0.8
Overall, do you think the SAT is a good measure of what students prepared for college know and should do	4.9**	0.7
I am confident in my individual ratings	5.4**	0.5

* Scale ranged from 1 = *Not aligned in any way* to 5 = *Strong alignment*
** Scaled ranged from 1 = *Strongly disagree* to 6 = *Strongly agree*

The Math panelists reported that they felt the items and CCSS content needed slight improvement to be aligned. The SAT Math test was a reasonably good measure of what students should know and do in the 11th grade and a good measure of what students need to know to be prepared for college. Panelists agreed that they were confident in their ratings (mean = 5.0 on a 6-point scale). These results are presented in Table 19.

Table 19. Means and Standard Deviations of the Math Panelists' General Alignment Opinions

Question	Mean	Standard Deviation
What is your general opinion of the alignment between the content area items you reviewed and the CCSS	3.6*	1.0
Overall, do you think the SAT is a good measure of what 11th grade students know and should do in your state	4.3**	1.1
Overall, do you think the SAT is a good measure of what students prepared for college know and should do	4.6**	1.4
I am confident in my individual ratings	5.0**	0.6

* Scale ranged from 1 = *Not aligned in any way* to 5 = *Strong alignment*
** Scaled ranged from 1 = *Strongly disagree* to 6 = *Strongly agree*

The remaining questions asked panelists about their opinions of the workshop goals, understanding of the process, and materials. The results are presented in Table 20. Overall, panelists agreed that workshop goals were achieved and they received sufficient training and guidance. They reported the documentation and rating forms were clear and understandable. These results were consistent with facilitators' reports of panelists' understanding and use of materials.

Table 20. Means and Standard Deviations for the Process and Procedure Survey Questions by Panelist Group

Question	ELA		Math	
	Mean	*SD*	Mean	*SD*
Overall, do you feel the goals of the workshop were achieved?	5.3	0.8	5.4	0.8
The training provided was comprehensive and effective in covering the major steps in reviewing and rating the items.	5.4	0.8	5.3	0.8
I understood the guidance provided by facilitators.	5.4	0.5	5.7	0.5
Documentation provided for the alignment tasks were clear and understandable.	5.6	0.5	5.3	0.6
Rating forms provided for the alignment tasks were clear and understandable.	5.4	0.8	5.4	0.8
Documentation provided for the alignment tasks were useful in performing the actual ratings.	5.6	0.5	5.4	0.8
Rating forms provided for the alignment tasks were useful in performing the actual ratings.	5.4	0.8	5.3	0.8
The use of laptops for data entry was relatively easy.	5.6	0.5	5.7	0.5
HumRRO staff was courteous and helpful.	5.9	0.4	5.9	0.4

Chapter 6: Summary and Recommendations

In this chapter, we summarize the results of the alignment study and provide recommendations to strengthen the Delaware and Maine assessment systems.

SAT Alignment Summary

In this alignment study, the SAT was evaluated on four criteria. The first criterion reviewed the content alignment between CCSS and test items. The second criterion examined the distribution of items by reporting category. The third criterion compared the DOK of the items to (a) panelists' DOK ratings and (b) the DOK levels of the standards. The fourth criterion evaluated the factor structure of the subscore reporting categories.

Criterion 1: Items Represent Intended Content

In evaluating the first criterion, it is important to note that the SAT items were written to SAT content specifications and not CCSS. A post hoc assignment of CCSS standards to items by College Board resulted in the identification of the CCSS measured by each item. The result of the post hoc assignment of CCSS standards was up to 15 CCSS grade-level standards identified for a single item and upwards of 10 CCSS anchor standards. Each of the identified grade-level standards were evaluated by panelists for linkage to the item. Multiple analyses were conducted using panelists' ratings. First, panelists rated the primary CCSS identified for an item as measuring the content of the item, partially or fully, for the majority of items. However, the majority, if not all, of the items were assigned more than one grade-level standard. Examining the linkage ratings across all College Board identified standards showed that panelists felt that approximately six math items were not linked to any of the identified grade-level standards while only two such items existed for reading and none for writing/language arts. Panelists reviewing the math items tended to identify additional standards that were below the 11-12 grade range in the CCSS. Given the large number of College Board identified standards and the potential that standards have been over-identified, panelists' linkage ratings of all of the standards showed that a large portion of the College Board identified standards were rated as having no link to the item. Finally, the collective set of standards associated with an item were rated by panelists as fully capturing the content of an item for the majority of items in reading and writing/language arts. Panelists felt they needed to identify additional standards, typically at lower grade levels, before feeling confident that the collective set of standards fully covered an item.

The Essay test enhanced the coverage of number of CCSS English Language Arts standards that are aligned to the SAT. For the essay alignment, panelists identified standards for writing, language arts, reading for information, reading and writing in science and technical subjects, and language. Across these CCSS, panelists coded 22 unique standards in reading, language, and writing to the Essay test. Nine of the 22 standards also appear in the SAT Evidence-Based Reading and Writing/Language Arts tests. Thirteen are unique to the Essay test and focus on writing, such as standard W.11-12.2, *Write informative/explanatory texts to examine and convey complex ideas, concepts, and information,* and standard W.11-12.9, *Drawing evidence from texts to support analysis, reflection, and research*. Because students are required to produce an essay, language standards measuring their command of writing conventions (grammar and punctuation) and writing style are also assessed.

Criterion 2: Items Represent Intended Categories

The second criterion focused on whether the distribution of items by reporting category, as defined in the test specifications, holds true and whether panelists agreed with the reporting category assignment for the items. In general, the distribution of items by reporting category based on the test specifications is accurately depicted in the group of items administered to students. Additionally, panelists selected the reporting category they felt each item best fit. For the reading and writing/language arts items, panelists placed over 90% of items in the same reporting category as College Board. This was not the case for the math items where upwards of 30% of items were assigned to a different reporting category.

Criterion 3: Item DOK Represents Test Specifications

The third criterion, cognitive complexity of the items through DOK assignment, is important to evaluate to ensure that items are measuring an adequate range of DOKs and the item DOK is comparable to the identified standard DOK. In reading and writing/language arts, the DOK assigned to each item was provided by College Board and panelists rated their agreement with the assigned DOK. For the reading items, the majority of items panelists felt were at the proper DOK level; however, panelists rated roughly the same percent of items higher or lower than the assigned DOK in writing/language arts. In math, instead of DOK level, rigor level associated with each item was provided. There were a number of items that panelists rated as belonging to different rigor level than assigned. The distribution of DOK level by College Board and panelists shows that items with a range of DOK levels are being administered to students. When comparing item DOK levels with the College Board identified standards' DOK levels, panelists' ratings demonstrate that the majority of items are either equal to or lower than the grade-level standard.

Criterion 4: Item Sufficiency for Category Reporting

The fourth and final criterion evaluates whether the factor structure of the subscore reporting categories is supported by data from Delaware and Maine. There are several pieces of evidence used to evaluate this criterion. First, the subscore intercorrelations demonstrated that the reading, writing and language, and math constructs are being measured by their corresponding subscores, yet the subscores are not completely redundant. The coefficient alphas for all of the subscores are sufficiently high to support the subscores; although, COE, a reading subscore, demonstrated borderline acceptability. Next, the CFA fit indices suggest that a 2-factor model of the reading and writing and language constructs is supported and the 3-factor math construct is also supported but not in Maine. However, even though the fit indices suggest the 2-factor reading and writing and language constructs as well as the 3-factor math construct is supported, the below optimal factor loadings of the items and the high factor score intercorrelations, suggest that the subscores in each of the factor models, reading, writing and language, and math, are essentially the same. From a statistical viewpoint, additional information about the reading, writing and language, or math construct is not being provided by the subscores.

Special Study Evaluating the SAT Using the CCSSO Criteria Summary

Alignment studies focus on specific questions about an item's DOK and how well it aligns with content standards. To provide greater a greater understanding of the alignment, we also compared items and item stimuli to the CCSSO High Quality Assessment Criteria (*Criteria*) Using the *Criteria* thresholds to evaluate SAT assessments for this study were developed by the

Center. The SAT Evidence-Based Reading and Writing test and Math tests received high ratings for quality and alignment to these criteria. The texts and graphics were of publishable quality and the items were judged as being generally rigorous. The Evidence-Based Reading and Writing test has students read different text types across genres. The Reading test requires students to closely read the passages and focus on important features and central ideas. The items are written to a range of DOK and the DOK index of 0 .75 indicates a range of cognitive demand is required.

The Essay test clearly identifies the writing purpose. Students need to organize and synthesize information. The essay clearly cued students for reading and analysis requirements in the rubric. However, panelists determined that it did not cue students for the writing requirements, such as conventions and style.

The Math test also meets or partially meets the high quality assessment criteria defined in the Center's methodology. Panelists rated the items as being well crafted and there was more than one item type within the test. The CCSS has a focus on rigor: conceptual understanding, procedural skills and fluency and application. The Criteria state that high quality assessments should have a balance among these. Based on the form reviewed, the SAT Math test partially meets this criterion; it was a bit low in the score points associated with conceptual understanding. Panelists found that the math practices and content are meaningful connected. The DOK index was high, 0.83, and a range of cognitive demand is assessed. However, the test was just shy of the 10% threshold for the DOK3+ which technically classified this DOK range as partially meets.

Overall, compared to these CCSSO *Criteria* and its guidance, the SAT tests meet the requirements of quality and alignment.

Suggestions

Overall, the SAT is reasonably aligned to the high school[11] reading and writing portions of the CCSS, but somewhat less so for the math portions. Based on findings of the present study, we offer the following suggestions:

- ***To the extent that SAT scores do not cover grade-level content of interest, develop strategies to supplement the SAT.*** In part, the DOEs adopted the SAT as their high school test to fulfill the Federal requirement for states to administer tests of college readiness. In particular, for the math test, the SAT emphasizes algebraic knowledge. This is consistent with the research the College Board highlights in their test specification documents showing the relationship between algebraic competence and college readiness. Other content (e.g., geometry) is emphasized in the high school CCSS but not well-represented on the SAT. So if the SAT results are going to be used to support evaluation of instruction across the CCSS, strategies for collecting and blending additional measures for math content and practices would be helpful so that districts have the information they need to evaluate instruction. At a minimum, they should be made aware of the content of interest that is not represented in the SAT scores so that additional instruction and assessment, conducted at either the state or local levels, can focus on these areas.

[11] The grade 11-12 CCSS were the focus of the reading and writing alignment, and the high school CCSS were the focus of the math alignment.

- ***To the extent that SAT math scores are based on below grade content, consider supplementing.*** The post hoc assignment of grade-level standards to items resulted in predominantly high school standards being assigned to math items. However, panelists identified additional lower grade-level standards to the math items. The College Board also aligned their math items to lower grade-level standards, but our focus was on the alignment of the SAT Math test to the high school CCSS. Because this is the state high school test, the Delaware and Maine DOE must decide what content needs to be included in their high school math test. If the SAT does not provide sufficient information in all areas the states want to report, they may want to consider supporting districts in their supplementation of their math results to ensure that adequate grade-level standards are being assessed.
- ***Given that the SAT Math Test, by design, does not specify or report math practices, if math practice information is desired, consider supplementing SAT.*** The SAT Math Test focuses on math content and skills that are prerequisites for college success. While the test includes content and math practices, the College Board does not identify math practices for items or report information about math practices. If math practice information is either required or desired by states, they may want to consider supporting districts in supplementing the SAT.
- ***Obtain more clearly defined math reporting categories.*** The assignment of math items to reporting categories were least agreed upon by panelists. This may have been a result of a lack of clear definitions of the content contained in each reporting category, or because these items typically reflected different aspects of algebra and algebraic problem solving. The use of the subscore reporting categories for any type of diagnostic evaluation of students' abilities necessitates a clear understanding of the content being evaluated by the reporting category.
- ***Be cautious of subscore use.*** The results of the CFA suggest that the subscores do not represent clearly distinguishable patterns of responses based on subscore item content. This does not mean that the subscores should not be reported. Items assigned to each subscore have been placed there based on expert content judgements and not psychometric factor loadings of items. However, reporting the subscores does not provide additional information, statistically, above and beyond the information offered through the total score used alone. Thus, caution should be used in placing too much emphasis on or over-interpreting what the subscores mean regarding strengths and weaknesses of a student. This cautionary message needs to be disseminated down to principals, teachers, and anyone who may use the subscores; the subscores may be misleading if used alone.

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Appendix A.
SAT Alignment Workshop Attendees

Last Name	First Name	Role
Maine Panelists		
Godfrey	Nancy	Observer
Mailhot	Michele	Observer
Murphy	Daniel	ELA
Ross	Elizabeth	MA
St. Onge	Crystal	MA
Tribou	Stephanie	ELA
Twitchell	Brian	MA
External Experts		
Goldberg	Gail	ELA
Hickman	Judy	MA
College Board Participant		
Lazzaro	Chris	MA Lead
HumRRO Staff		
Dvorak	Rebecca	Facilitator
Nemeth	Yvette	Lead Facilitator
Wiley	Carrie	Facilitator
Woods	Anne	Runner

Last Name	First Name	Role
Delaware Panelists		
Barber	Carrie	MA
Bennett	Theresa	Observer
Crowley	Lara	ELA
Foret	Katia	Observer
Frazier	Geoffrey	ELA
Hockman	Marissa	ELA
Lazar	Carolyn	Observer
Reitemeyer	Michael	MA
Sutton	Hester	MA
Zhang	Liru	Observer

Appendix B.
Sample Panelist Alignment Review Materials

Panelists used the following materials during the alignment workshop: Panelist Instructions (printed), Item Rating Form (Excel), CCSS (printed), and excerpts of the SAT test specifications (printed).

SAT Task Mathematics Alignment Study
Panelist Instructions

Task	Documents Needed	File Format
Alignment Workbook	Item Rating Workbook	Excel spreadsheet
	DOK Reference Material	Print Copy
	Rigor Reference Material	Print Copy
	CCSS	Print Copy
	Test Specifications Excerpts	Print Copy
	SAT Mathematics Test	Print Copy

Prior to alignment task:

(1) Access HumRRO item rating workbook:
   a. Locate folder on desktop, double click to open.
   b. 'Save As' file name with an underscore and your 3 initial extension (e.g., *Alignment Workbook – Math SAT_eas.xlsx*).
   c. Autosave will be set to every "1" minute. Save often as autosave doesn't always work.

(2) Be mindful of the NDA requirements and test security:
- Do not have cell phones out while test materials are being reviewed. If you need to take a call or check email, please do so out of the room.
- Do not access and view items in public places or post about them on social media outlets.
- Do not take notes (hard copy or electronic) about the items.
- Do not discuss the items or the content you have viewed with others. You are, however, able to share your experience of the alignment process.

Alignment Worksheet

The SAT Mathematics Test covers a range of math practices, with an emphasis on problem solving, modeling, using tools strategically, and using algebraic structure.

We will fully rate 2-3 items together to calibrate the group. These ratings should be recorded in your Excel rating form.

You will work independently once the group is calibrated. You should feel free to discuss any process-related issues with the group. Content-related discussion/interpretation is permitted as **occasional** calibration, but it is not necessary to change your ratings to match the group discussion.

General Worksheet Directions:

- Verify the information in the shaded columns
- Provide ratings in the unshaded columns

Mathematics

1. Item Number (Col A)
   a. Each item number is in test book order.

2. Calculator (Col B)
   a. Whether or not calculator use is allowed.

3. DOK (Col C)
   Materials Needed: Refer to printed DOK reference material for extended definitions
   a. In Col C, assign a DOK for the item.

4. Rigor (Col D)
   Materials Needed: Refer to printed Rigor reference material for extended definitions
   a. Review Rigor determination.
   b. If you do not agree with the assigned Rigor, provide an alternate Rigor in Col E.

5. Grade-Level Common Core State Standards (CCSS) (Cols F – M)
   Materials Needed: Mathematics CCSS Binder
   a. Review the Grade-Level Standards (CCSS 1-4) in Cols F, H, J and L.
   b. For each identified standard, indicate how well the content and knowledge in the item reflect the content and knowledge in the Grade-Level Standards in Cols G, I, K, and M.
      - A rating of 2, fully linked, doesn't mean the standard is fully covered – no standard will with one item. Fully linked means the content measured by the item is fully part of that standard.
      - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
      - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.

6. Holistic Rating (N – R)
   a. Determine whether the identified Grade-Level Standards collectively capture the knowledge and skills required in the item in Col N. 0 = No; 1 = Yes.
   b. If you put a "No" in Col N,
      - Briefly describe what content in the item is not captured by the identified Grade-Level Standards in Col O.
      - Please provide one or more additional Grade-Level Standards the item is linked to, if applicable, in Col P. Separate each identified standard with a comma.
        1. Identify the additional Grade-Level Standard to the most specific level applicable.
        2. If a standard includes sub-standards, provide to the most detailed level to which the item aligns.
        3. Enter the ID of the HS Grade-Level Standard to include the CONCEPTUAL CATEGORY-DOMAIN.CLUSTER.STANDARD (e.g., F-IF.A.1)
        4. For the non-HS Grade-Level Standards, include the grade level in the ID (e.g., 8.F.A.1). K-8 standards do not have conceptual categories.

c. If additional standards are provided in Col P, rate if these additional standards in conjunction with the identified standards collectively capture the knowledge and skills required in the item in Col Q. 0 = No; 1 = Yes.
d. If you put a "No" in Col Q, describe what content in the item is still not captured by all of the Grade-Level Standards listed in Cols F-M.

7. Mathematical Practice (MP) (Cols S – U)
   Materials Needed: Mathematics CCSS Binder (pp. 6-8)
   a. In Col S, identify the primary Mathematical Practice (MP) reflected by the item. If there is no MP, indicate 'None.'
   b. In Col T, decide how well the item reflects the MP (0=Not at all; 1=Partially; 2=Fully)
      - If you indicate 'None' in Col S, leave Col T blank
   c. In Col U, decide if there is a meaningful connection between content and practice.
      - If you indicate 'None' in Col S, leave Col U blank

8. Subscale Mapping (Cols V – Y)
   Materials Needed: Test Summary (Test Specs Excerpt)
   a. Choose the subscale that the item best fits. Choose only one subscale.

9. Item Quality (Cols W – AC)
   a. In Cols W – AB, indicate whether the item has issues related to:
      - More than one correct answer
      - Incorrectly keyed
      - Readability
      - Content inaccuracies
      - Editorial inaccuracies
      - Item not yielding evidence of the targeted skill
   b. In Col AQ, note any additional comments about item quality

10. General Comments (Col AD)

SAT Task ELA Alignment Study
Panelist Instructions

Task	Documents Needed	File Format
Alignment Workbook	Item Rating Workbook	Excel spreadsheet
	DOK Reference Material	Print Copy
	CCSS	Print Copy
	Test Specifications Excerpts	Print Copy
	SAT Reading Test	Print Copy
	SAT Language Arts and Writing Test	Print Copy
	SAT Essay	Print Copy

Prior to alignment task:

(1) Access HumRRO item rating workbook:
   a. Locate folder on desktop, double click to open.
   b. 'Save As' file name with an underscore and your 3 initial extension (e.g., *Alignment Workbook – Reading and Writing SAT_eas.xlsx*).
   c. Autosave will be set to every "1" minute. Save often as autosave doesn't always work.

(2) Be mindful of the NDA requirements and test security:
- Do not have cell phones out while test materials are being reviewed. If you need to take a call or check email, please do so out of the room.
- Do not access and view items in public places or post about them on social media outlets.
- Do not take notes (hard copy or electronic) about the items.
- Do not discuss the items or the content you have viewed with others. You are, however, able to share your experience of the alignment process.

Alignment Workbook

We will fully rate 2-3 items together to calibrate the group. These ratings should be recorded in your Excel rating form.

You will work independently once the group is calibrated. You should feel free to discuss any process-related issues with the group. Content-related discussion/interpretation is permitted as **occasional** calibration, but it is not necessary to change your ratings to match the group discussion.

General Worksheet Directions:
- Verify the information in the shaded columns
- Provide ratings in the unshaded columns

Reading

1. Click on the "Reading" tab of the workbook.

2. Item Number (Column A)
   a. Each item is presented in test book order.

3. DOK (Columns B – D)
    a. Review intended DOK (Column B).
    b. Indicate your agreement with the identified DOK level in Column C. 0 = No; 1 = Yes.
    c. If you do not agree with the assigned DOK, provide an alternate DOK in Column D.

4. Anchor Standards (Columns E – P)
    a. Review the first identified Anchor Standard (CCR) in Column E.
    b. In Column F, indicate how well the content and knowledge in the item reflect the content and knowledge in the CCR. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn't mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
        - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.
    c. Repeat for all anchor standards identified for the item (Columns G-P).

5. Holistic Rating for Anchor Standards (Columns Q – U)
    a. Determine whether the identified Anchor Standards collectively capture the knowledge and skills required in the item in Column Q. 0 = No; 1 = Yes.
    b. If you put a "No" in column Q,
        - Briefly describe what content in the item is not captured by the identified Anchor Standards in Column R.
        - Please provide one or more additional Anchor Standards the item is linked to, if applicable, in Column S. Separate each identified standard with a comma.
    c. If additional standards are provided in Column S, rate if these additional standards in conjunction with the identified standards collectively capture the knowledge and skills required in the item in Column T. 0 = No; 1 = Yes.
    d. In Column U, if you put a "No" in Column T, describe what content in the item is still not captured by all of the Anchor Standards listed in Columns E-S.

6. Grade-Level Standards (Columns V – AK)
    a. Review the first identified Grade-Level Standard in Column V.
    b. In column W indicate how well the content and knowledge in the item reflect the content and knowledge in the Grade-Level Standard. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn't mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
        - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.
    c. Repeat for all Grade-Level Standards identified for the item (Columns X-AK).

7. Holistic Rating for Grade-Level Standards (Columns AL – AP)
    a. Determine whether the identified Grade-Level Standards collectively capture the knowledge and skills required in the item in Column AL. 0 = No; 1 = Yes.

b. If you put a “No” in column AL,
   - Briefly describe what content in the item is not captured by the identified Grade-Level Standards in Column AM.
   - Please provide one or more additional Grade-Level Standards the item is linked to, if applicable, in Column AN. Separate each identified standard with a comma.
     1. Could be at any grade-level, not only Grade 11-12.
     2. Identify the additional Grade-Level Standard to the most specific level applicable.

c. If additional standards are provided in Column AN, rate if these additional standards in conjunction with the identified standards collectively capture the knowledge and skills required in the item in Column AO. 0 = No; 1 = Yes.

d. If you put a “No” in Column AO, describe what content in the item is still not captured by all the Grade-Level Standards listed in Columns V-AN.

8. Item Specifics (Columns AQ – AS). See rating descriptions at the end of this document to make these ratings.

   a. In Column AQ, decide if the item requires close reading and analysis. 0 = No; 1 = Yes.
   b. In Column AR, decide if the item focuses on central ideas and important particulars. 0 = No; 1 = Yes.
   c. In Column AS, decide if the item requires direct use of textual evidence. 0 = No; 1 = Yes.

9. Subscale Mappings (Columns AT)
   a. In Column AT, indicate which primary subscale the item best fits.
      - Words in Context, or Command of Evidence.

10. Item Quality (Columns AU – BA)
   a. In Column AU, decide if there are more than one possible correct answer. 0 = No; 1 = Yes.
   b. In Column AV, decide if the response is incorrectly keyed. 0 = No; 1 = Yes.
   c. In Column AW, decide if there is a quality issue regarding readability. 0 = No; 1 = Yes.
   d. In Column AX, decide if there are content inaccuracies. 0 = No; 1 = Yes.
   e. In Column AY, decide if there are editorial inaccuracies. 0 = No; 1 = Yes.
   f. In Column AZ, decide if the item does not yield evidence of the targeted skill. 0 = No; 1 = Yes.
   g. If you have comments related to item quality, indicate in Column BA.

11. Comments (Column BB)
   a. If you have any additional notes on the items, type them in Column BB.

Passages

1. Click on the Reading Passages tab of the workbook.

2. Passage information (Columns A-C)
   a. Columns A – C provide information about which passage is to be rated.
      - There are reading passages in the reading test (RD) and language arts and writing test (W&L)
      - Review the items associated with the passage.

3. Balance of text types (Columns D-E)
    a. In Column D, rate whether the passage is literary, nonfiction narrative, informative/explanatory, or persuasive.
    b. In Column E, rate whether the passage is primarily narrative or expository.

4. Informational Passage Content (Columns F – I)
    a. Review the passage content identified in Column F.
    b. In Column G, rate whether you agree with the passage content. 0 = No; 1 = Yes.
    c. If you rated a “No” in Column G, identify the passage type in Column H.

5. Passage Quality (Column I)
    a. In Column I, rate whether the passage content is rich - does it exhibit exceptional craft and thought, and/or provide useful information? 0 = No; 1 = Yes.

6. Passage Complexity (Columns J-L)
    a. Review the text complexity grade band presented in Column J.
        - The College Board ELA specialist will provide information on how text complexity was determined and how to interpret the ranges
    b. In Column K, rate whether the passage is placed in the appropriate grade band. 0 = No; 1 = Yes.
    c. If you answered "No" in Column K, rate what a more appropriate grade band would be in Column L.

7. Comments
    a. If you have any additional notes on the passages, type them in Column M

Language Arts and Writing

1. Click on the “Language Arts and Writing” tab of the workbook.

2. Item Number (Column A)
    a. Each item is presented in test book order.

3. DOK (Columns B – D)
    a. Review intended DOK (Column B).
    b. Indicate your agreement with the identified DOK level in Column C. 0 = No; 1 = Yes.
    c. If you do not agree with the assigned DOK, provide an alternate DOK in Column D.

4. Anchor Standards (Columns E – P)
    a. Review the first identified Anchor Standard (CCR) in Column E.
    b. In Column F, indicate how well the content and knowledge in the item reflect the content and knowledge in the CCR. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn’t mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
        - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.
    c. Repeat for all Anchor Standards identified for the item (Columns G-P).

5. Holistic Rating for Anchor Standards (Columns Q – U)
    a. Determine whether the identified Anchor Standards collectively capture the knowledge and skills required in the item in Column Q. 0 = No; 1 = Yes.
    b. If you put a "No" in column Q,
        - Briefly describe what content in the item is not captured by the identified Anchor Standards in Column R.
        - Please provide one or more additional Anchor Standards the item is linked to, if applicable, in Column S. Separate each identified standard with a comma.
    c. If additional standards are provided in Column S, rate if these additional standards in conjunction with the identified standards collectively capture the knowledge and skills required in the item in Column T. 0 = No; 1 = Yes.
    d. In Column U, if you put a "No" in Column T, describe what content in the item is still not captured by all the Anchor Standards listed in Columns E-S.

6. Grade-Level Standards (Columns V – AO)
    a. Review the first identified Grade-Level Standard in Column V.
    b. In column W indicate how well the content and knowledge in the item reflect the content and knowledge in the Grade-Level Standard. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn't mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
        - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.
    c. Repeat for all Grade-Level Standards identified for the item (Columns X-AO).

7. Holistic Rating for Grade-Level Standards (Columns AP – AT)
    a. Determine whether the identified Grade-Level Standards collectively capture the knowledge and skills required in the item in Column AP. 0 = No; 1 = Yes.
    b. If you put a "No" in column AP,
        - Briefly describe what content in the item is not captured by the identified Grade-Level Standards in Column AQ.
        - Please provide one or more additional Grade-Level Standards the item is linked to, if applicable, in Column AR. Separate each identified standard with a comma.
            1. Could be at any grade-level, not only Grade 11-12.
            2. Identify the additional Grade-Level Standard to the most specific level applicable.
    c. If additional standards are provided in Column AR, rate if these additional standards in conjunction with the identified standards collectively capture the knowledge and skills required in the item in Column AS. 0 = No; 1 = Yes.
    d. If you put a "No" in Column AT, describe what content in the item is still not captured by all the Grade-Level Standards listed in Columns V-AR.

8. Subscale Mappings (Columns AU)
    a. In Column AU, indicate which primary subscale best fits the item.
        - Standard English Conventions, or Expression of Ideas.

9. Item Quality (Columns AV – BB)
    a. In Column AV, decide if there are more than one possible correct answer. 0 = No; 1 = Yes.
    b. In Column AW, decide if the response is incorrectly keyed. 0 = No; 1 = Yes.
    c. In Column AX, decide if there is a quality issue regarding readability. 0 = No; 1 = Yes.
    d. In Column AY, decide if there are content inaccuracies. 0 = No; 1 = Yes.
    e. In Column AZ, decide if there are editorial inaccuracies. 0 = No; 1 = Yes.
    f. In Column BA, decide if the item does not yield evidence of the targeted skill. 0 = No; 1 = Yes.
    g. If you have comments related to item quality, indicate in Column BB.

10. Comments (Column BC)
    a. If you have any additional notes on the items, type them in Column BC.

Essay

1. Review the Essay Prompt (Column A)

2. Anchor Standards (Columns B – M)
    a. Review the list of Anchor Standards. Identify the Anchor Standard with the strongest link to the essay prompt and input in Column B.
    b. In column C indicate how well the content and knowledge in the item reflect the content and knowledge in the Anchor Standard. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn't mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.
        - A rating of 0, no link, means the standard does not contain any part of the content measured by the item.
    c. Repeat this process in Columns D – M for up to 6 Anchor Standards that are linked.

3. Holistic Rating for Anchor Standards (Columns N-O)
    a. Determine whether the identified Anchor Standards collectively capture the knowledge and skills required in the item in Column N. 0 = No; 1 = Yes.
    b. If you put a "No" in column N,
        - Briefly describe what content in the item is not captured by the identified Anchor Standards in Column O.

4. Grade-Level Standards (Columns P-AA)
    a. Review the list of Grade-Level Standards. Identify the Grade-Level Standard with the strongest link to the essay prompt and input in Column P.
        - Could be at any grade-level, not only Grade 11-12.
        - Identify the Grade-Level Standard to the most specific level applicable.
    b. In column Q indicate how well the content and knowledge in the item reflect the content and knowledge in the Grade-Level Standard. 0=No Link; 1= Partial Link; 2 = Fully Linked.
        - A rating of 2, fully linked, doesn't mean the standard is fully covered, no standard will with one item. Fully linked means the content measured by the item is fully covered by that standard.
        - A rating of 1, partially linked, is used when the item measures more than what is covered in the standard.

- A rating of 0, no link, means the standard does not contain any part of the content measured by the item.

c. Repeat this process in Columns R – AA for up to 6 Grade-Level Standards that are linked.

5. Holistic Rating for Grade-Level Standards (Columns AB-AC)
   a. Determine whether the identified Grade-Level Standards collectively capture the knowledge and skills required in the item in Column AB. 0 = No; 1 = Yes.
   b. If you put a "No" in column N,
      - Briefly describe what content in the item is not captured by the identified Grade-Level Standards in Column AC.

6. Writing Specifications (Columns AD-AL)
   a. Provide responses for all writing specification questions in AD through AL.

7. Comments (Column AM)
   a. If you have any additional notes on the essay prompt, type them in Column AM.

<u>Rating Information</u>

Narrative vs Expository Text Structure

- If the structure of the informational passage is primarily **narrative** (told in chronological order), choose *Narrative.*

- If the structure of the informational passage is primarily **expository** (for example, a blend of cause and effect, proposition and support, comparison and contrast), choose *Expository*.

Close Reading: Items aligned to the CCSS for reading should require students to read deeply and analyze passages carefully. Make your own judgment about the depth of reading the item requires, determining if students must read closely or if they can obtain the answer by skimming the passage or engaging in a similar surface strategy. Note that items assessing vocabulary require **close reading** only if they ask students to use context to determine meaning.

Central Ideas: Items aligned to the CCSS for reading should focus on important, rather than trivial, aspects of the text, so that students have an opportunity to demonstrate their full understanding of the passage. Make your own judgment about the focus of the item, determining whether or not it calls for students to grasp **central ideas** and understand important particulars.

Textual Evidence: A majority of items aligned to the CCSS for reading should require students to select or cite evidence from texts in support of a claim or inference. Make your own judgment about whether or not the item requires direct selection or citation of **textual evidence** (i.e., does the item ask students to point to one or more places in the passage that support a particular statement about the passage?).

Panelists rated SAT assessment items using the following rating form in electronic format. The first example is from the math workbook while the second is from the reading.

Alignment Worksheet: SAT Mathematics								
		Depth of Knowledge and Rigor			Mathematical Content Standard 1		Mathematical Content Standard 2	
Item Number	Calc Yes/No	Assign a DOK 1=Recall 2=Skill/Concept 3=Strategic Thinking 4=Extended Thinking	Rigor	If you do not agree with the assigned Rigor, provide an alternate Rigor 1=Procedural Fluency 2=Conceptual Understanding 3=Application	Identified CCSS 1	How well does the content and knowledge in the item reflect the content and knowledge in the CCSS? 0=No Link 1=Partially Linked 2=Fully Linked	Identified CCSS 2	How well does the content and knowledge in the item reflect the content and knowledge in the CCSS? 0=No Link 1=Partially Linked 2=Fully Linked
1	No		Conceptual Understanding		A-SSE.A.1a		F-LE.B.5	
2	No		Application		A-CED.A.2			
3	No		Fluency		N-CN.A.1		N-CN.A.2	

Alignment Worksheet: SAT Evidence Based Reading							
		DOK		Anchor Standard 1		Grade Level Standard 1	
Item Number	(DOK) Depth Of Knowledge	Do you agree with the stated DOK level? 0=No 1=Yes	If no, which DOK level(s) is appropriate? Provide alternate DOK: 1 - Recall 2 - Concept 3 - Strategic thinking 4 - Extending thinking	Identified CCR Standard 1	How well does the content and knowledge in the item reflect the content and knowledge in the CCR? 0=No Link 1=Partially Linked 2=Fully Linked	Identified Grade Level Standard 1	How well does the content and knowledge in the item reflect the content and knowledge in the CCSS? 0=No Link 1=Partially Linked 2=Fully Linked
1	3			R6		RL.3	
2	2			R4		RL.4	
3	3			R5		RL.3	

Appendix C.
Summary of Item Workbook Ratings

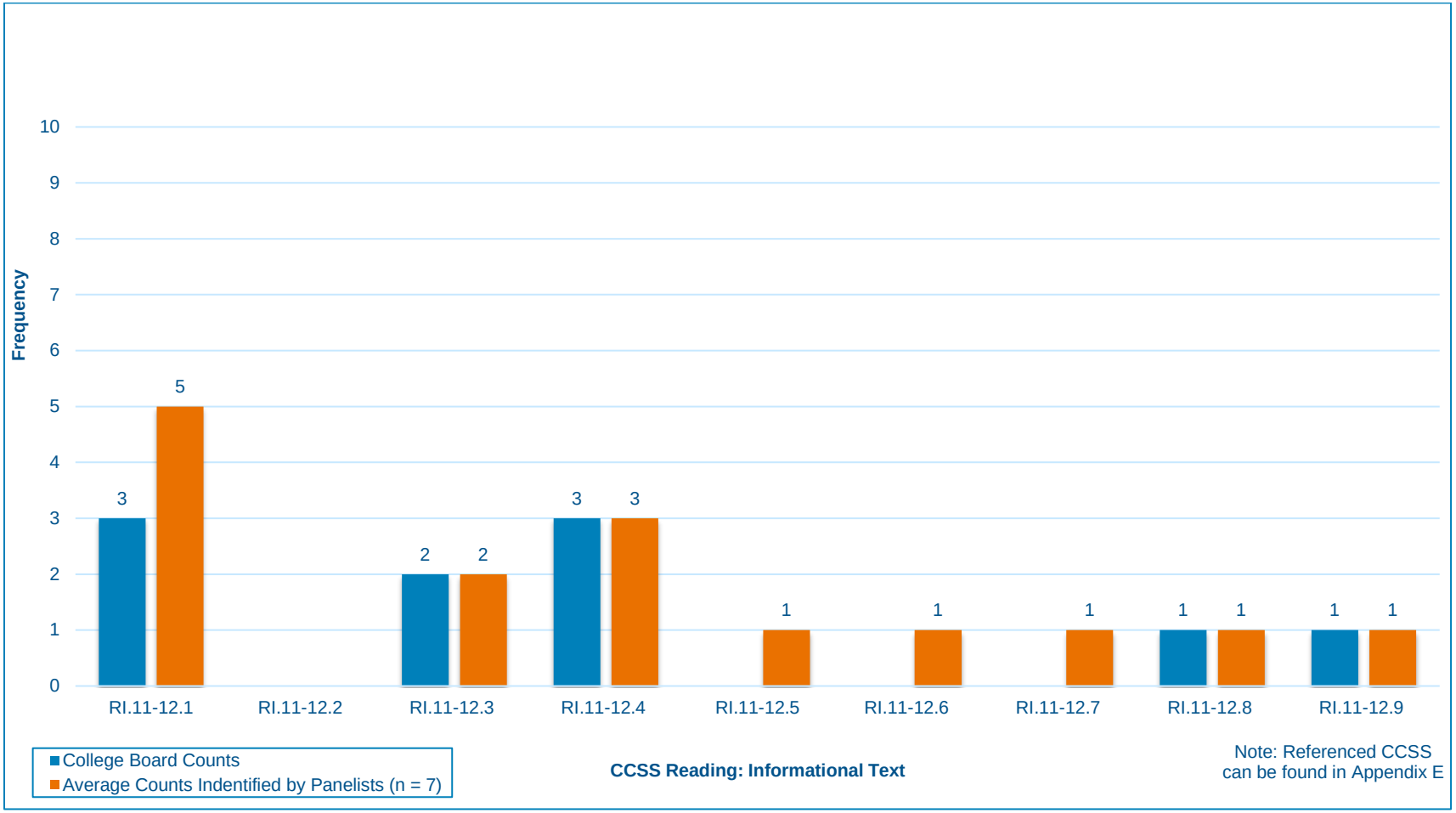
Content Area Keys

M = math
R = reading
W = language arts and writing
E = essay
RP = reading passages

Feature	Verification?	Rating scale	Content area
DOK rating	Yes	1=Recall 2=Skill/Concept 3=Strategic Thinking 4=Extended Thinking	MRW
Rigor	Yes	1=Procedural Fluency 2=Conceptual Understanding 3=Application	M
CCSS grade-level standard	Yes	0=No Link 1=Partially Linked 2=Fully Linked	MRWE
CCSS anchor standard	Yes	0=No Link 1=Partially Linked 2=Fully Linked	RWE
Holistic rating of assigned CCSS	No	0=No 1=Yes	MRWE
Additional standards that align to item	No	CCSS grade-level standards	MRWE
Holistic rating including any additional standards	No	0=No 1=Yes	MRWE
Primary mathematical practice (MP)	No	CCSS MPs	M
Primary MP rating	No	0=No Link 1=Partially Linked 2=Fully Linked	M
Meaningful connection between content and practice	No	0=No 1=Yes	M
Subscale mapping	No	SAT reporting categories	MRW
Item requires close reading and analysis	No	0=No 1=Yes	RW
Item focuses on central ideas and important particulars	No	0=No 1=Yes	RW
Item requires direct use of textual evidence	No	0=No 1=Yes	RW
Item has more than one answer	No	0=No 1=Yes	MRW
Item has incorrect key	No	0=No 1=Yes	MRW

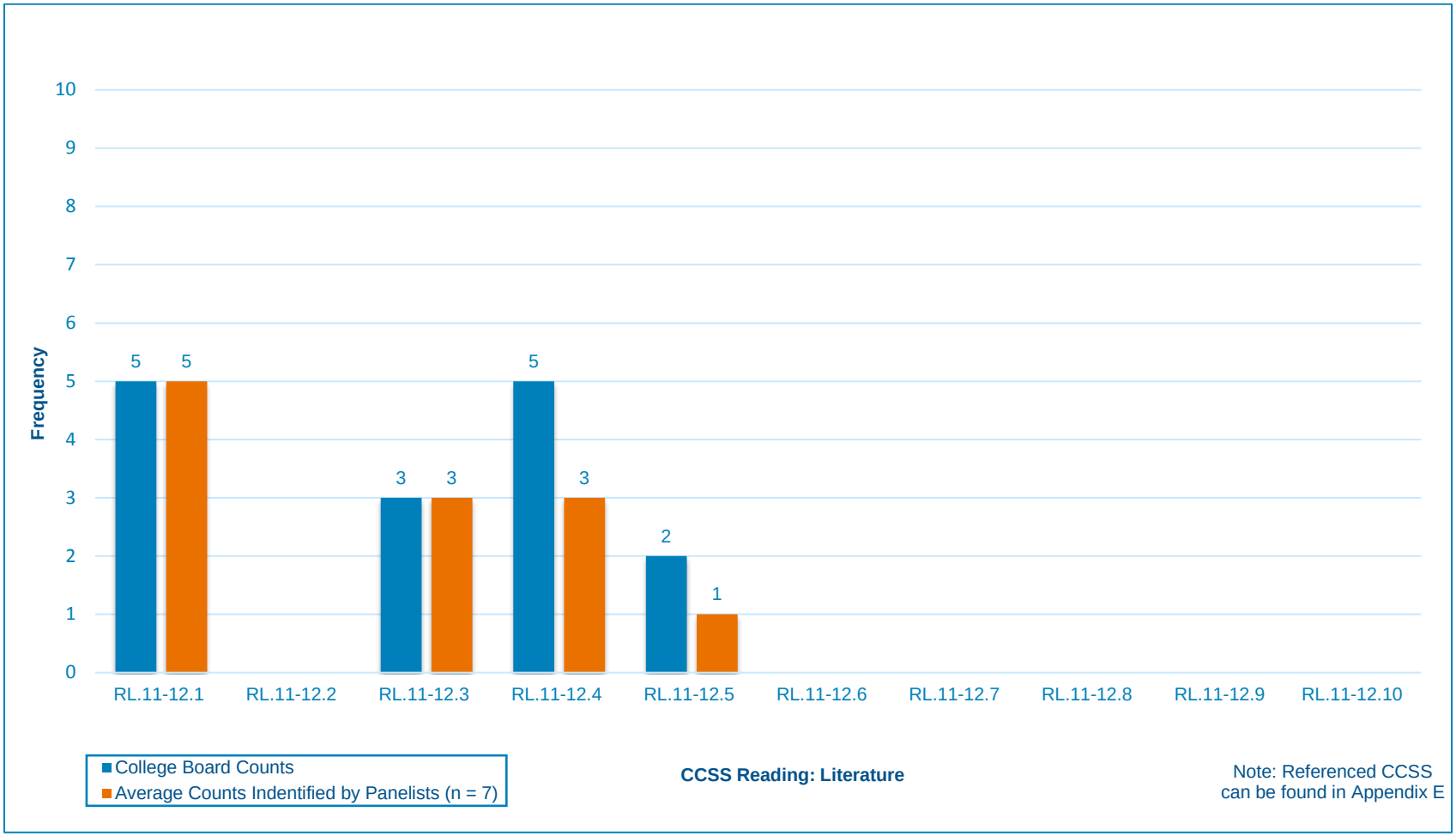
Feature	Verification?	Rating scale	Content area
Item has a quality issue regarding readability	No	0=No 1=Yes	MRW
Item has content inaccuracies	No	0=No 1=Yes	MRW
Item has editorial inaccuracies	No	0=No 1=Yes	MRW
Item does not yield evidence of the targeted skill	No	0=No 1=Yes	MRW
	Verification?	Rating scale	Content area
Text type	No	Literary, Persuasive, Informative	RP
Text structure	No	Expository, Narrative	RP
Passage content	Yes	US and World Literature, Social Science, Founding Documents/Great Global Conversation, Science, History/Social Studies, Careers, Humanities	RP
Passage content is rich	No	0=No 1=Yes	RP
Essay has a clearly identified purpose for writing	No	0=No 1=Yes	E
Essay specifies or clearly implies an audience	No	0=No 1=Yes	E
Type of writing required	No	Expository, Persuasive, Narrative	E
Item requires writing to a text	No	0=No 1=Yes	E
Item requires a minimum of two information passages	No	0=No 1=Yes	E
Item requires analysis, synthesis, and/or organization of information	No	0=No 1=Yes	E
Essay clearly cues for all of the reading requirements in the rubric	No	0=No 1=Yes	E
Essay clearly cues for all of the analysis requirements in the rubric	No	0=No 1=Yes	E
Essay clearly cues for all of the writing requirements in the rubric	No	0=No 1=Yes	E

Appendix D.
Graphical Representations of the Identified and Verified CCSS by College Board and Panelists



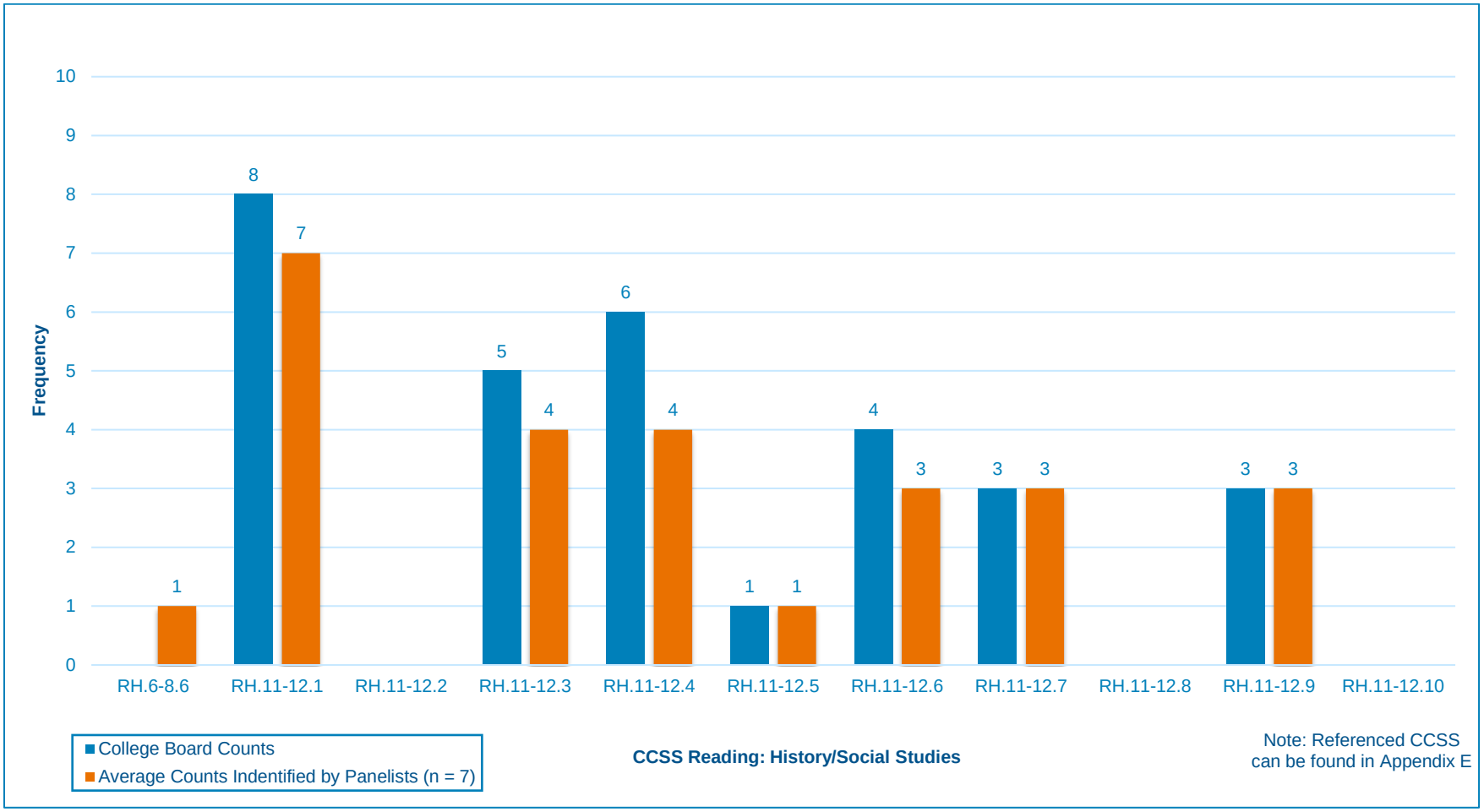
Note. Average counts rounded up to nearest whole number.

Figure D-1. Counts of CCSS Reading: Informational text identified by College Board and the average counts verified/identified by panelists.



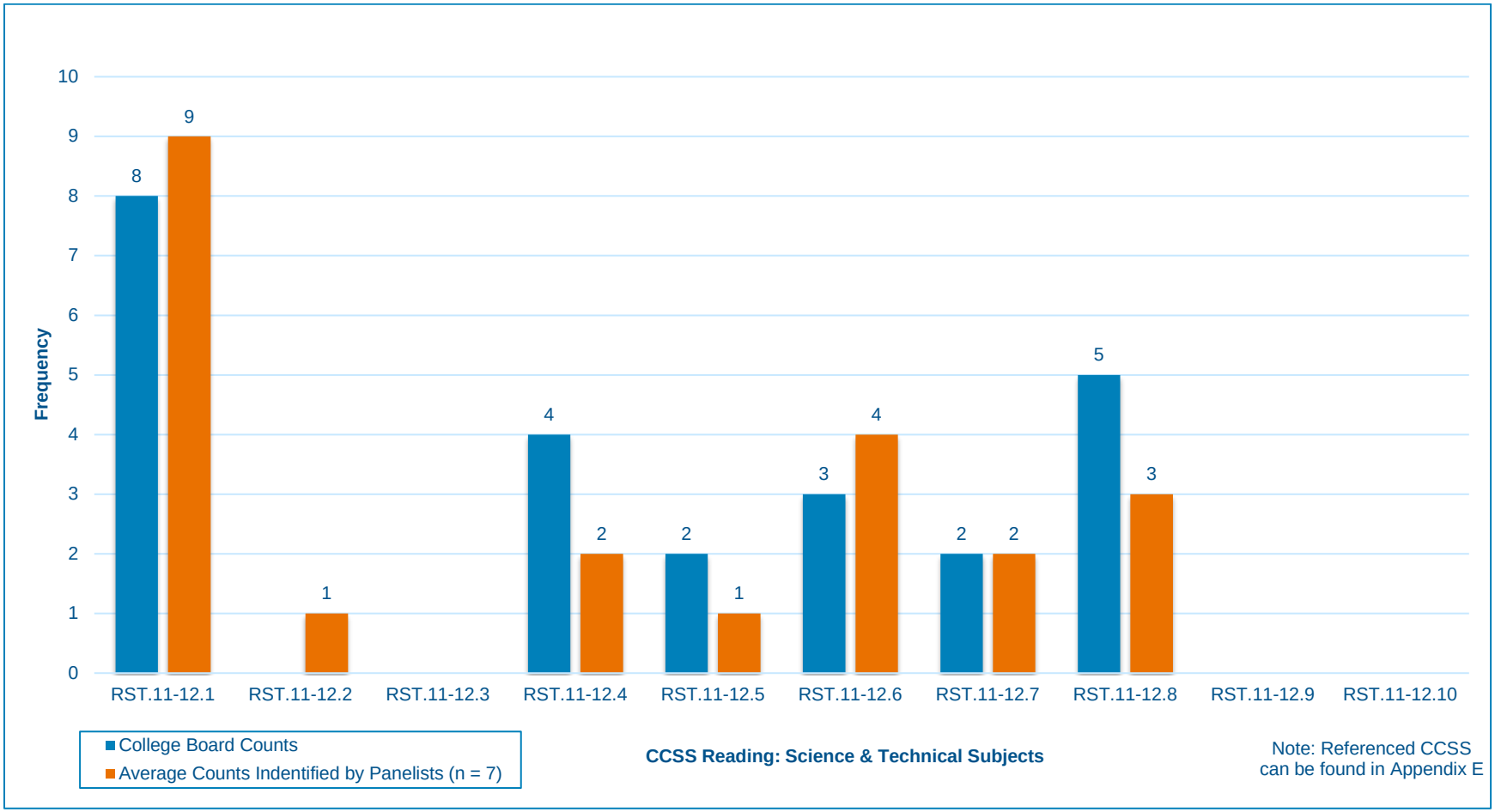
Note. Average counts rounded up to nearest whole number.

Figure D-2. Counts of CCSS Reading: Literature identified by College Board and the average counts verified/identified by panelists.



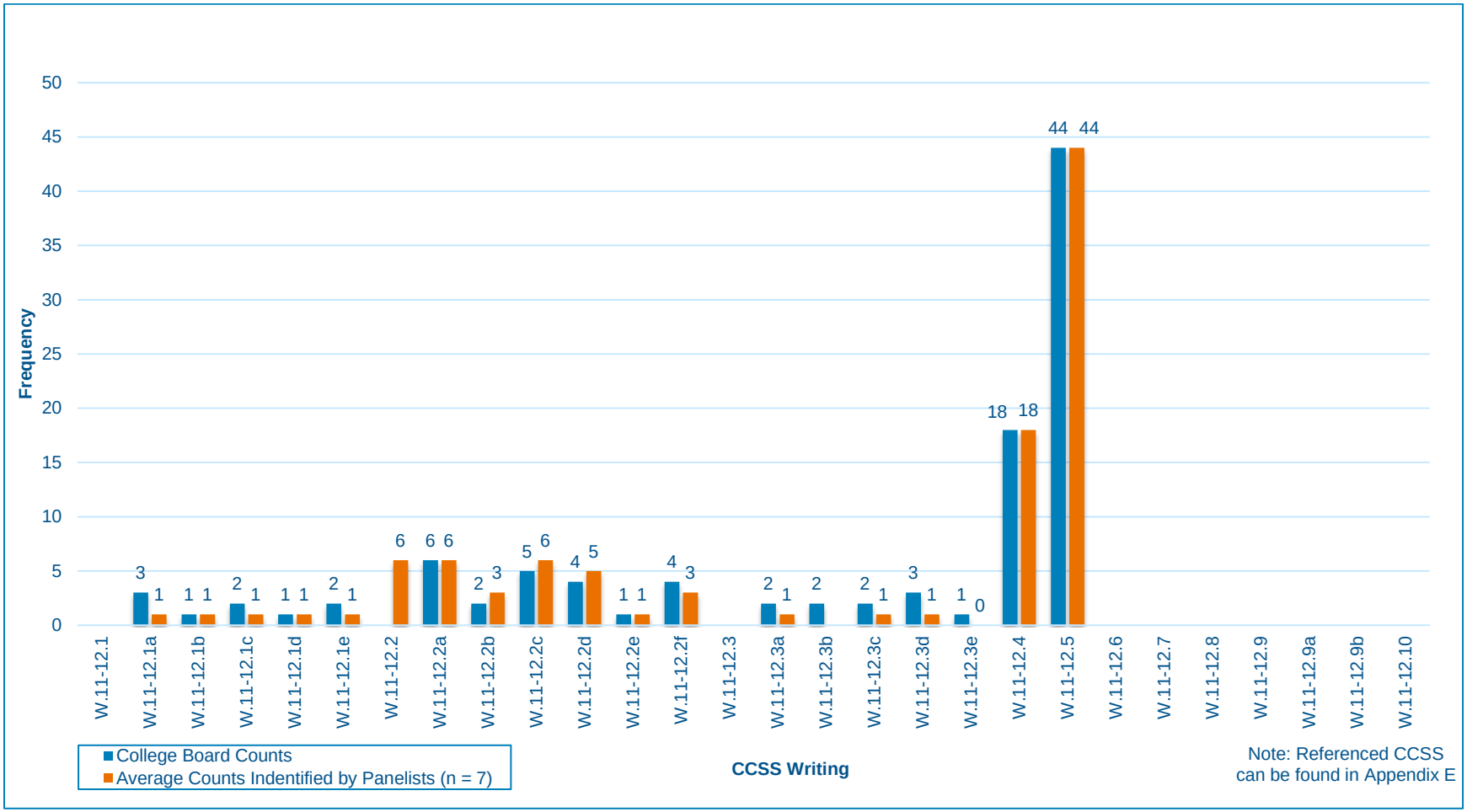
Note. Average counts rounded up to nearest whole number.

Figure D-3. Counts of CCSS Reading: History and Social Studies identified by College Board and the average counts verified/identified by panelists.



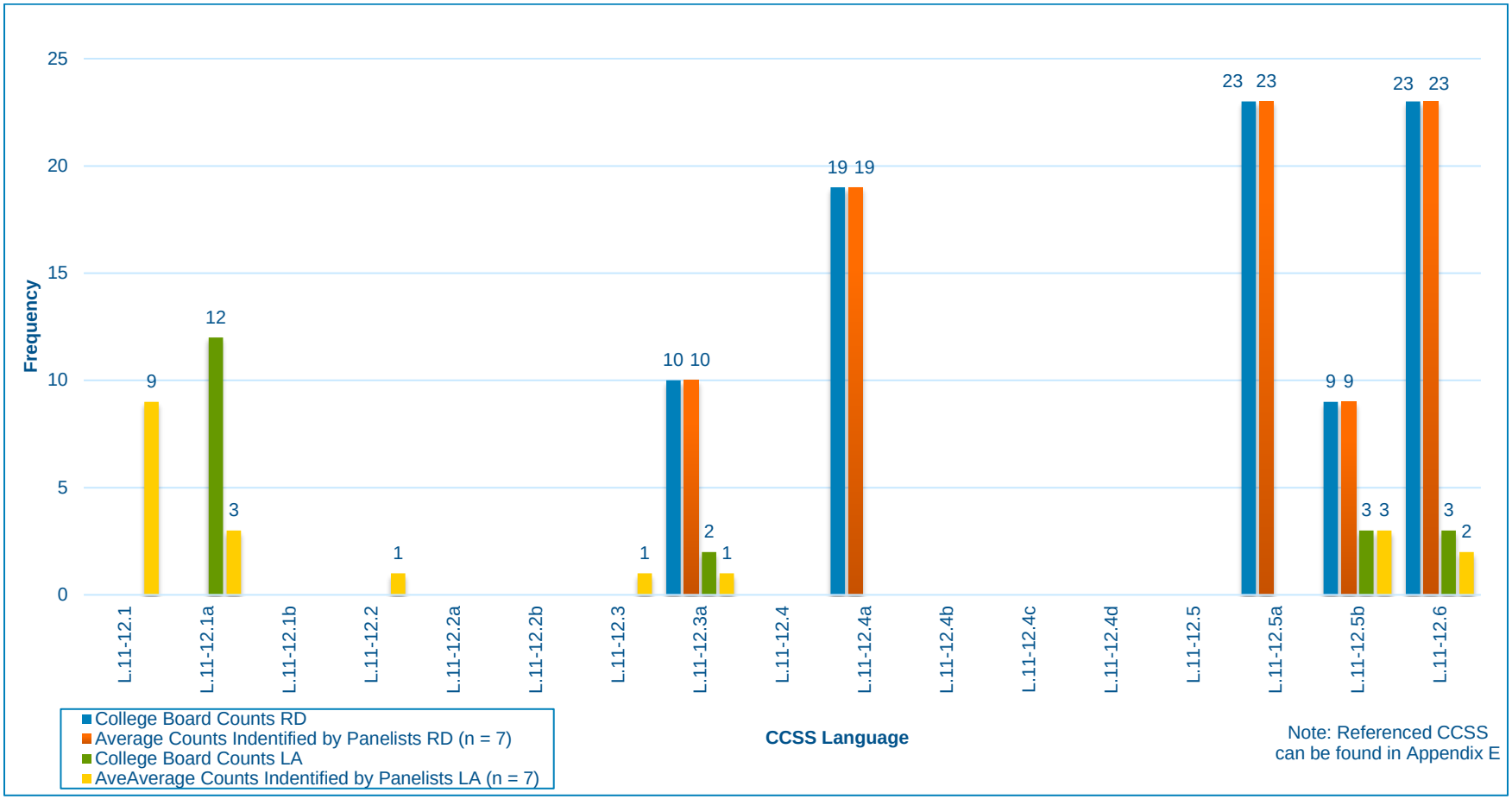
Note. Average counts rounded up to nearest whole number.

Figure D-4. Counts of CCSS Reading: Science and Technical Subjects identified by College Board and the average counts verified/identified by panelists.



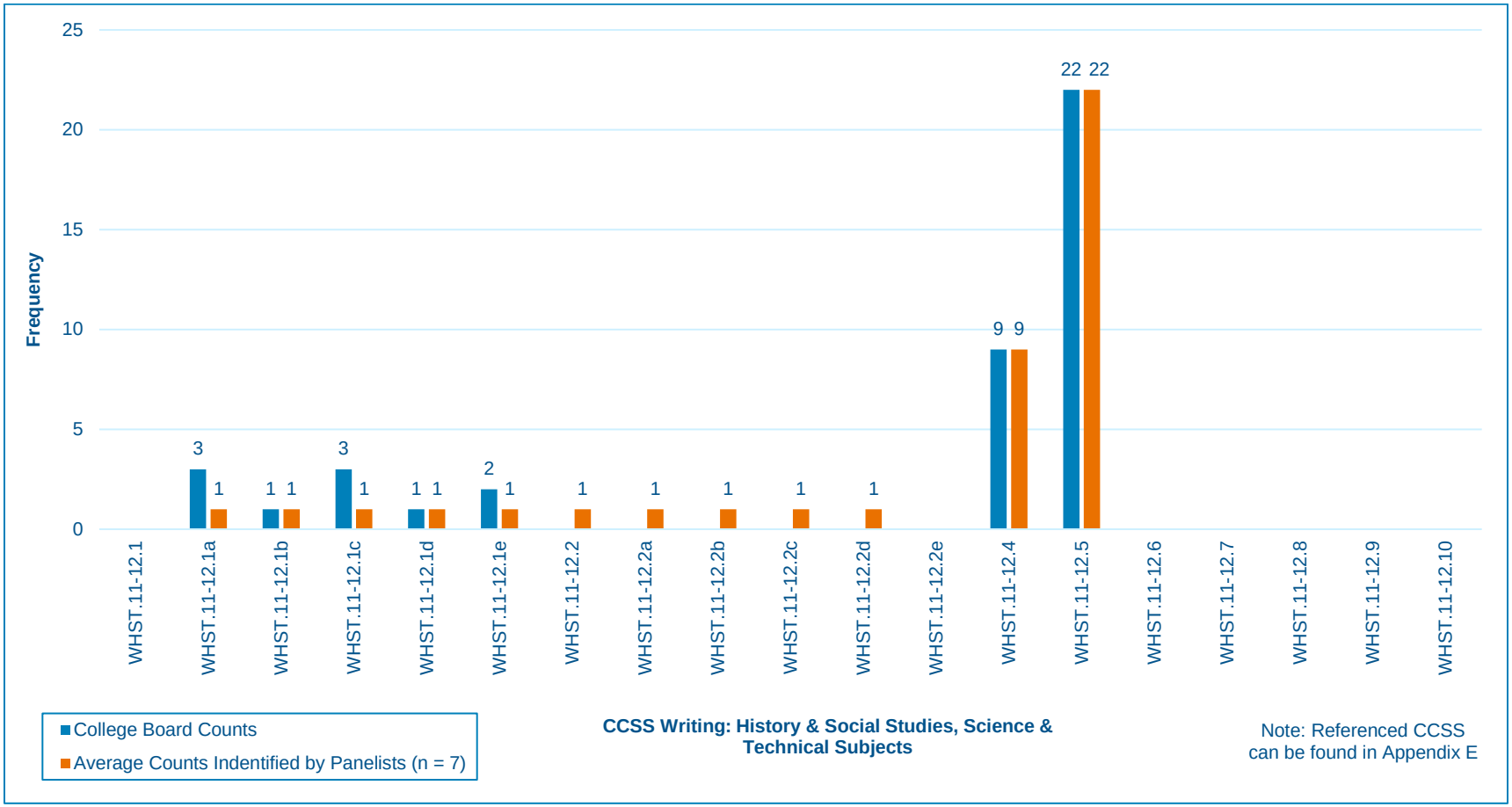
Note. Average counts rounded up to nearest whole number.

Figure D-5. Counts of CCSS Writing identified by College Board and the average counts verified/identified by panelists.



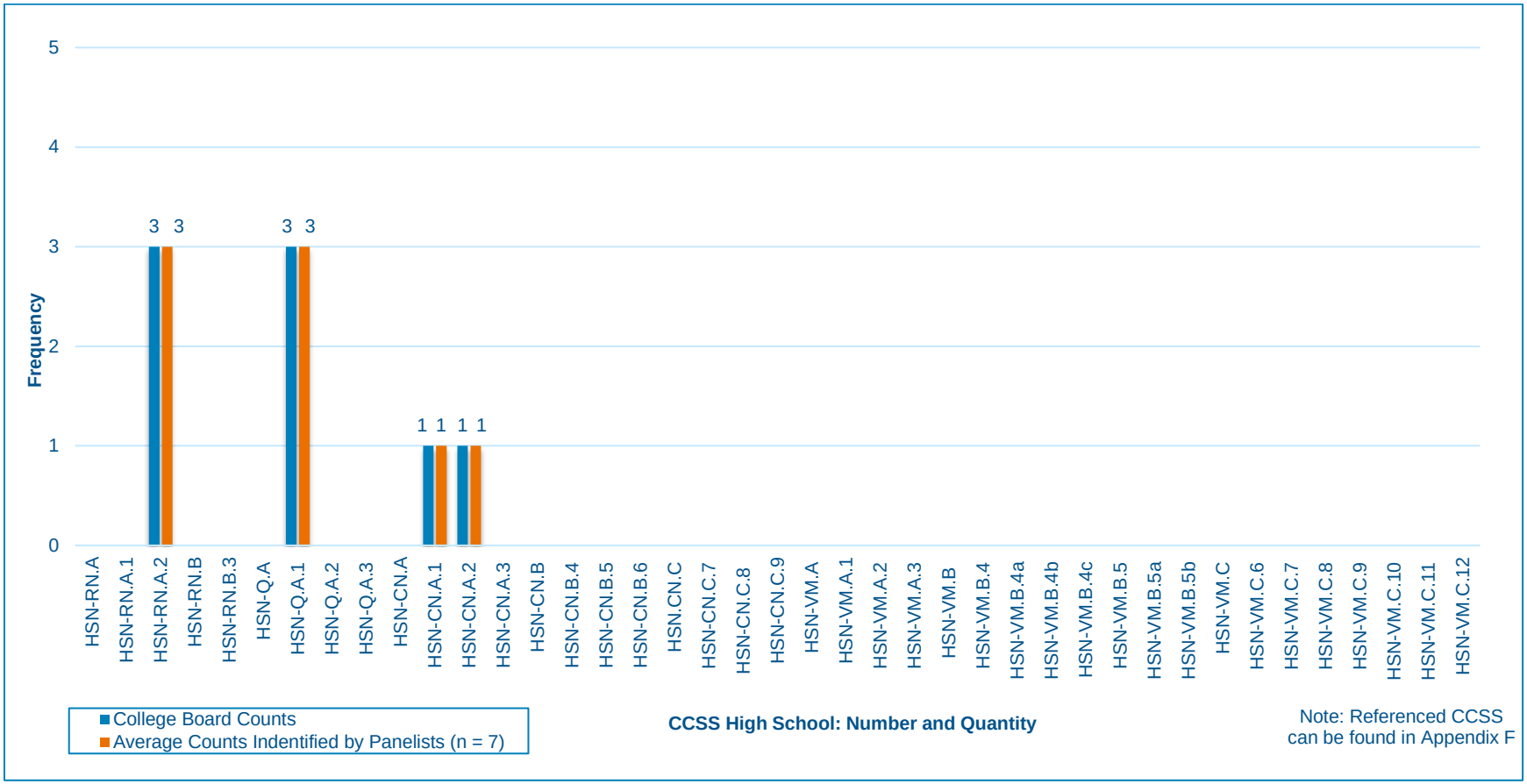
Note. Average counts rounded up to nearest whole number.

Figure D-6. Counts of CCSS Language identified by College Board and the average counts verified/identified by panelists.



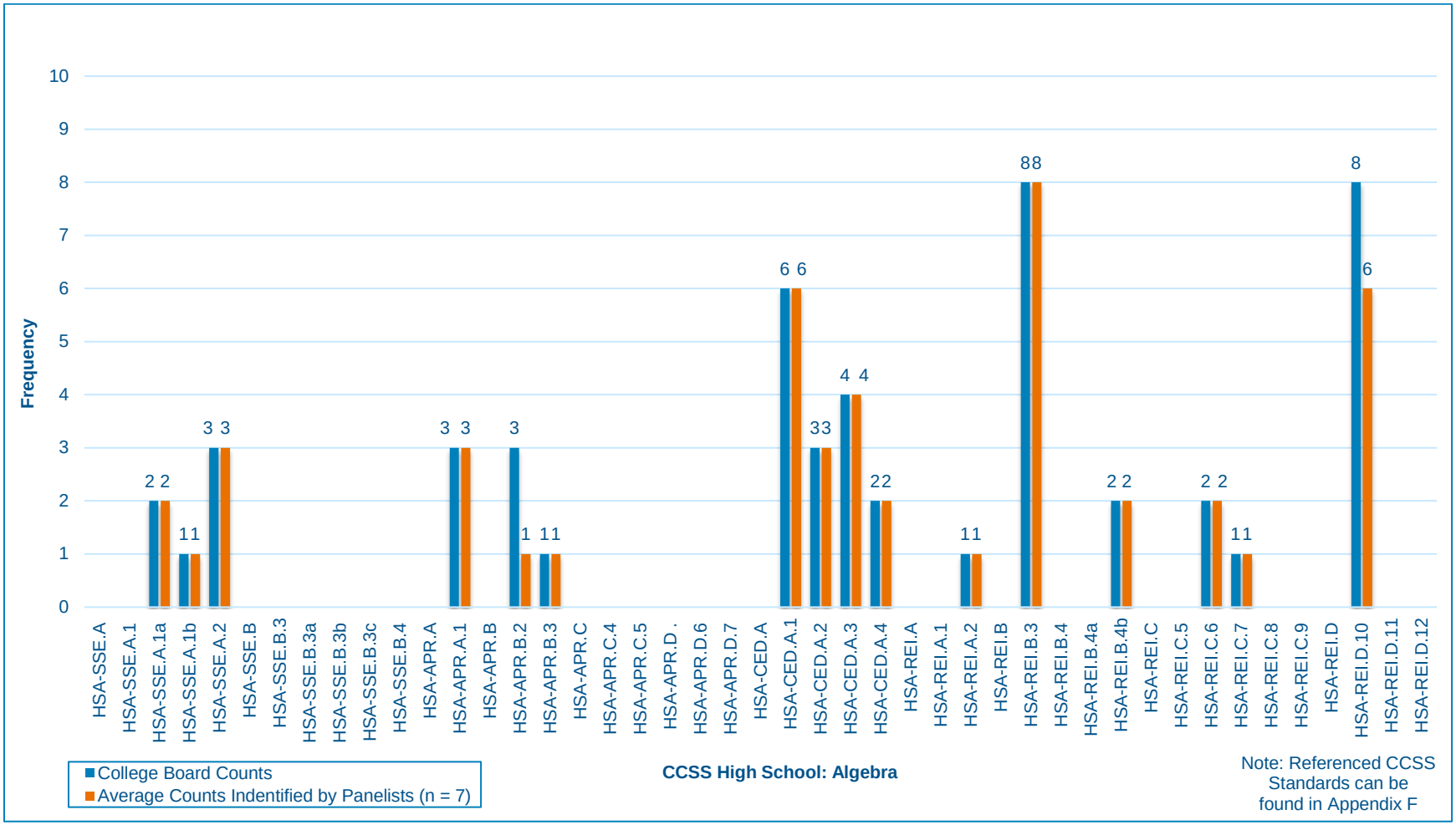
Note. Average counts rounded up to nearest whole number.

Figure D-7. Counts of CCSS Writing: History and Social Studies, Science and Technical Subjects identified by College Board and the average counts verified/identified by panelists.



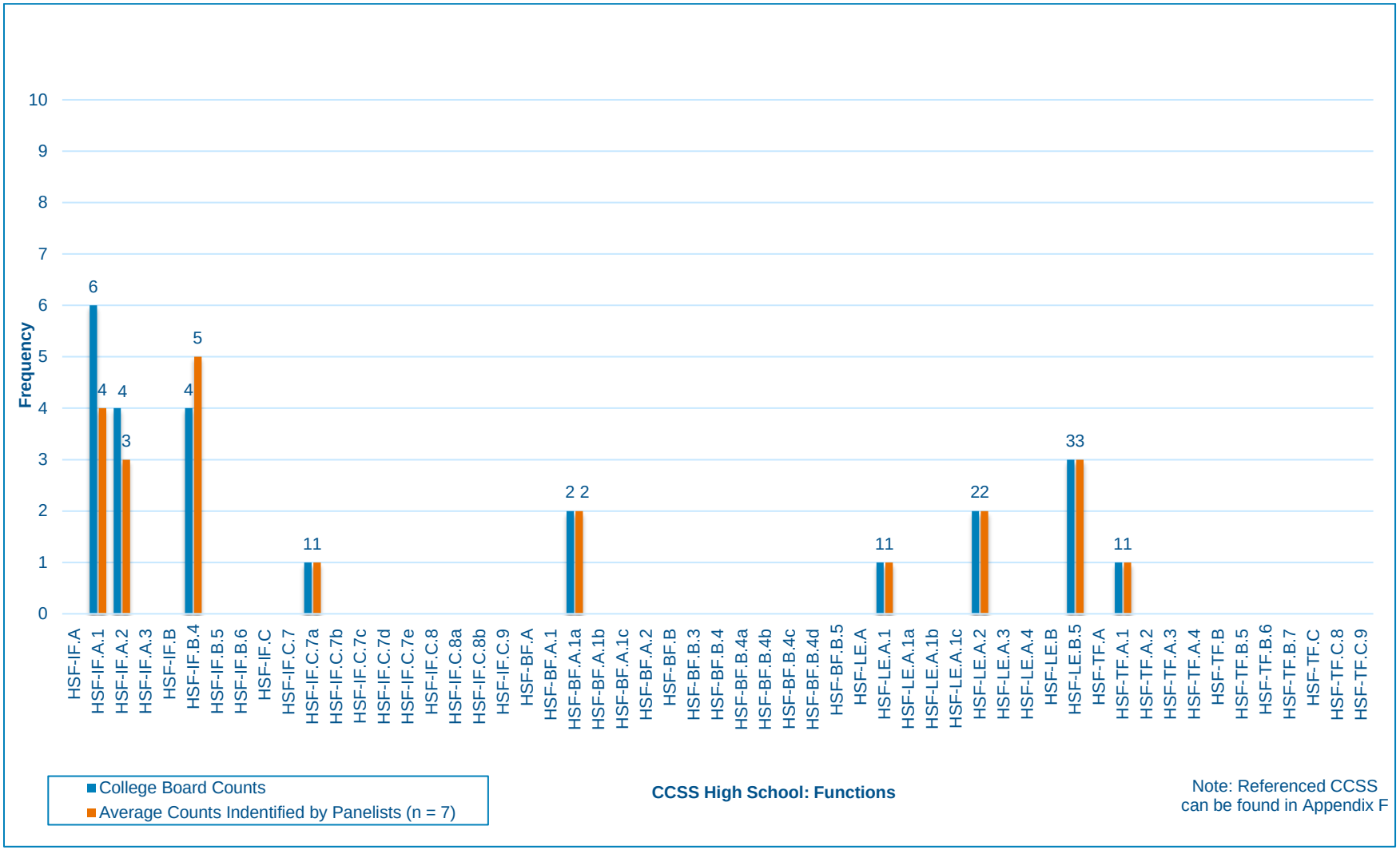
Note. Average counts rounded up to nearest whole number.

Figure D-8. Counts of CCSS High School: Number and quantity identified by College Board and the average counts verified/identified by panelists.



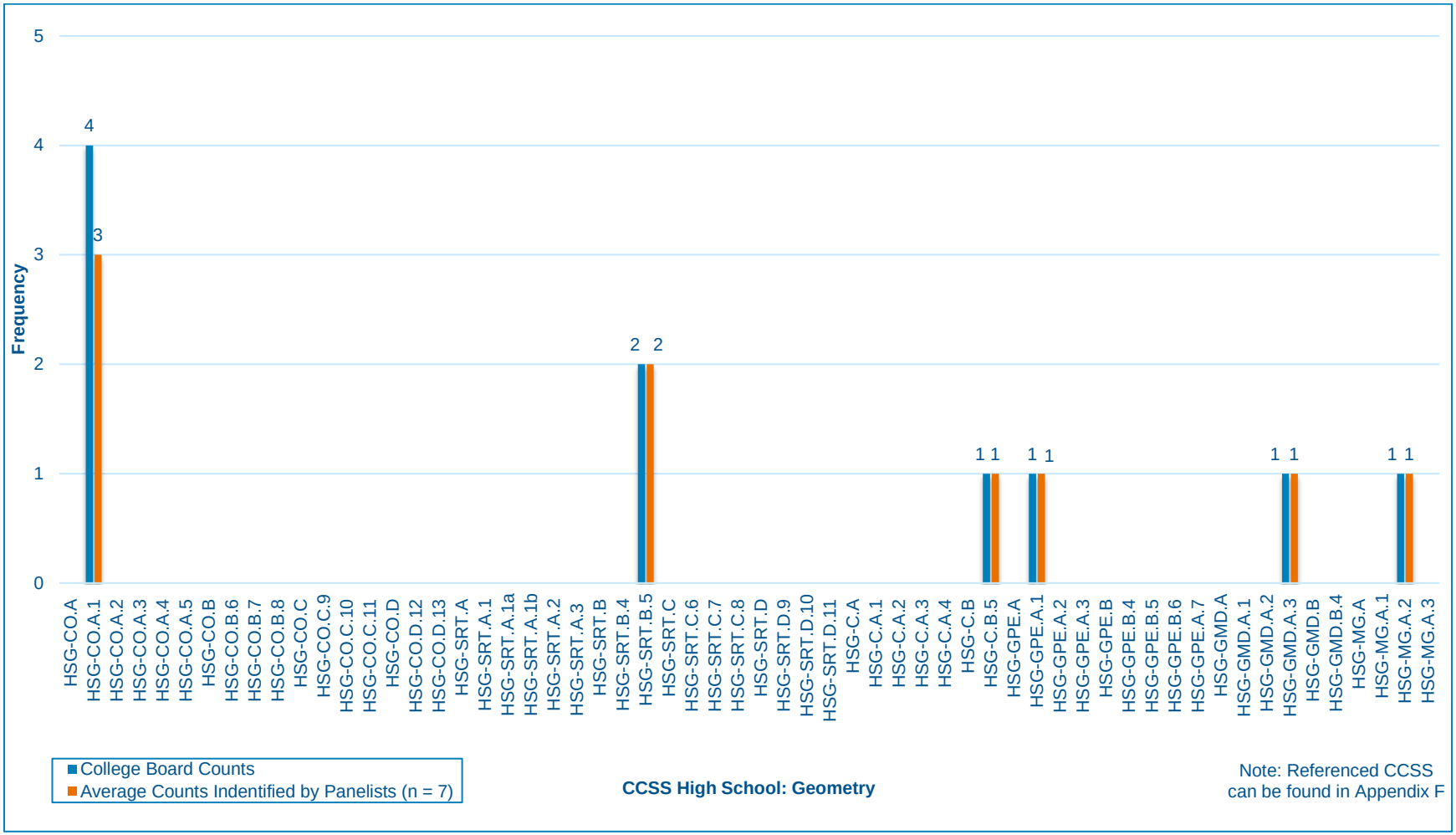
Note. Average counts rounded up to nearest whole number.

Figure D-9. Counts of CCSS High School: Algebra identified by College Board and the average counts verified/identified by panelists.



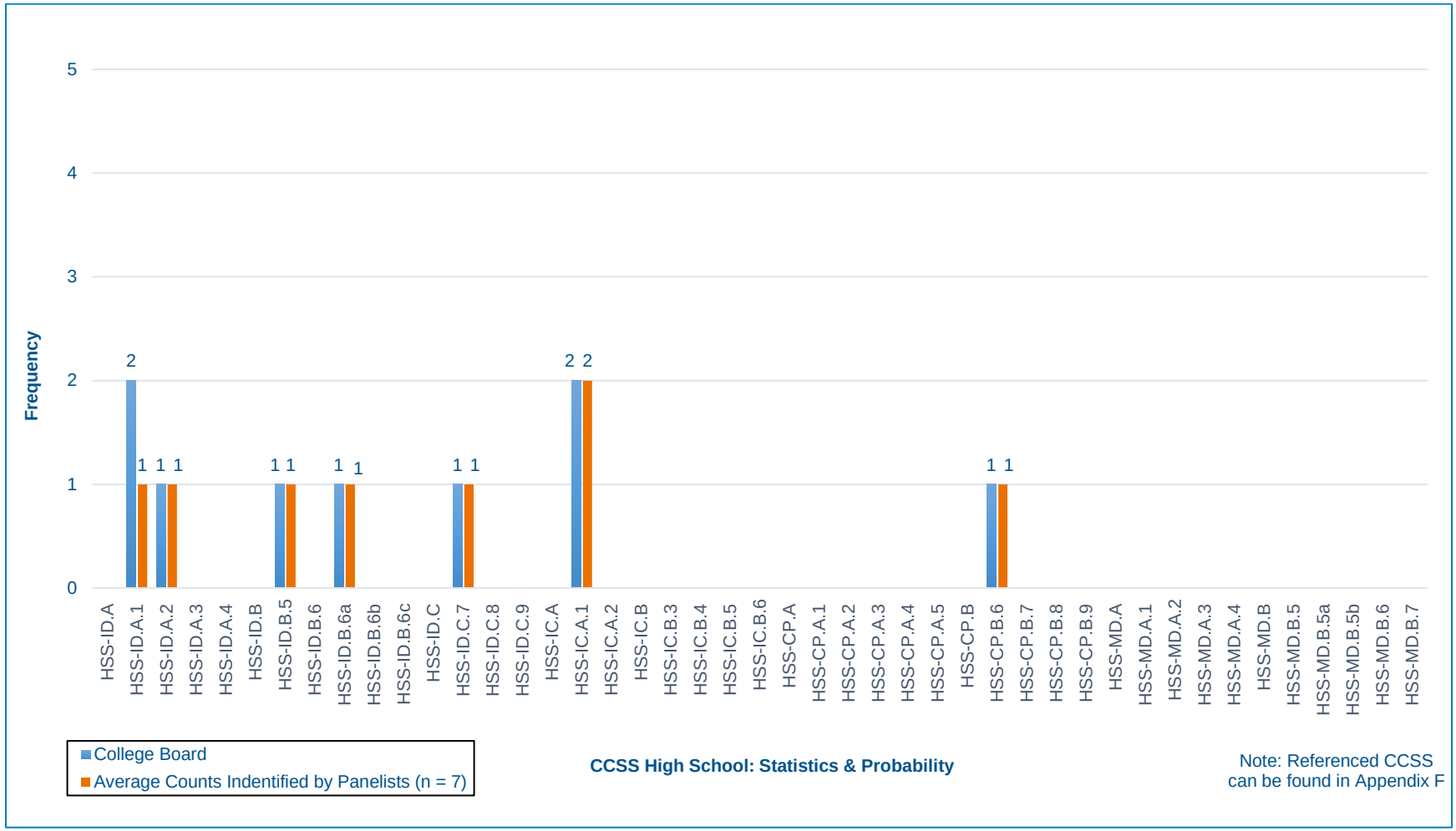
Note. Average counts rounded up to nearest whole number.

Figure D-10. Counts of CCSS High School: Functions identified by College Board and the average counts verified/identified by panelists.



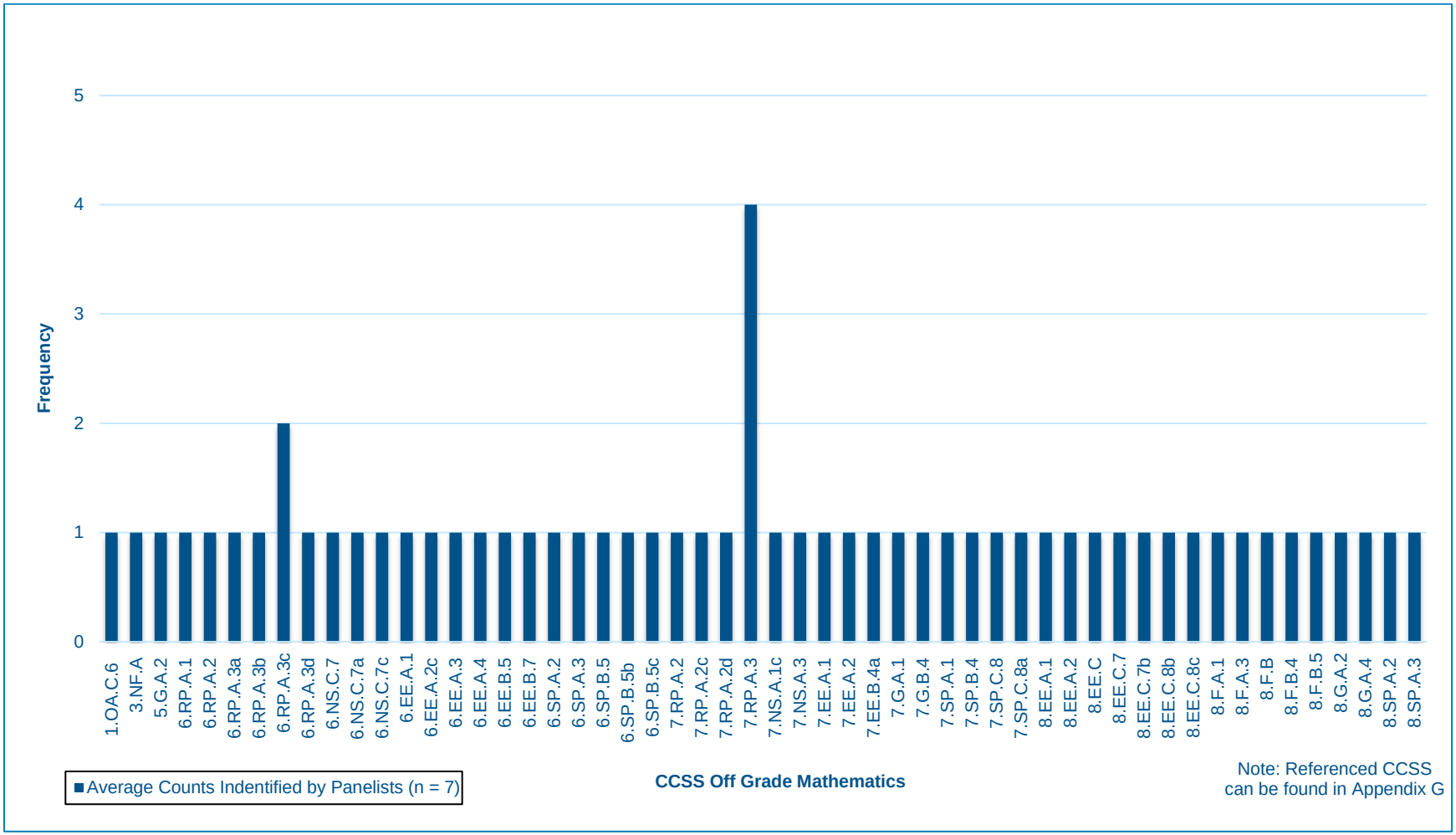
Note. Average counts rounded up to nearest whole number.

Figure D-11. Counts of CCSS High School: Geometry identified by College Board and the average counts verified/identified by panelists.



Note. Average counts rounded up to nearest whole number.

Figure D-12. Counts of CCSS High School: Statistics and Probability identified by College Board and the average counts verified/identified by panelists.



Note. Average counts rounded up to nearest whole number.

Figure D-13. Counts of CCSS off-grade Mathematics identified by College Board and the average counts verified/identified by panelists.

Appendix E.
List of CCSS in Reading, Writing, and Language Arts

Grade	Strand	CCSS
11-12	**History/Social Studies**	
11-12	RH	Key Ideas and Details
11-12	RH	RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
11-12	RH	RH.11-12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.
11-12	RH	RH.11-12.3 Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
11-12	RH	Craft and Structure
11-12	RH	RH.11-12.4 Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines *faction* in *Federalist* No. 10).
11-12	RH	RH.11-12.5 Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.
11-12	RH	RH.11-12.6 Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.
11-12	RH	Integration of Knowledge and Ideas
11-12	RH	RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.
11-12	RH	RH.11-12.8 Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.
11-12	RH	RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
11-12	RH	Range of Reading and Level of Complexity
11-12	RH	RH.11-12.10 By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently.

Grade	Strand	CCSS
11-12	**Science & Technical Subjects**	
11-12	RST	Key Ideas and Details
11-12	RST	RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
11-12	RST	RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
11-12	RST	RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
11-12	RST	Craft and Structure
11-12	RST	RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.
11-12	RST	RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
11-12	RST	RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
11-12	RST	Integration of Knowledge and Ideas
11-12	RST	RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
11-12	RST	RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9-10	RST	RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
11-12	RST	RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
11-12	RST	Range of Reading and Level of Complexity
11-12	RST	RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.

Note. Standards identified in blue type face are off-grade level standards or sub-standards identified by panelists.

Grade	Strand	CCSS
11-12	**Writing**	
11-12	WHST	Text Types and Purposes
11-12	WHST	WHST.11-12.1 Write arguments focused on discipline-specific content.
11-12	WHST	WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
11-12	WHST	WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
11-12	WHST	WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
11-12	WHST	WHST.11-12.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
11-12	WHST	WHST.11-12.1e Provide a concluding statement or section that follows from or supports the argument presented.
11-12	WHST	WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
11-12	WHST	WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
11-12	WHST	WHST.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
11-12	WHST	WHST.11-12.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
11-12	WHST	WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
11-12	WHST	WHST.11-12.2e Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Grade	Strand	CCSS
11-12	**Writing (continued)**	
11-12	WHST	Production and Distribution of Writing
11-12	WHST	WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
11-12	WHST	WHST.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
11-12	WHST	WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
11-12	WHST	Research to Build and Present Knowledge
11-12	WHST	WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
11-12	WHST	WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
11-12	WHST	WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
11-12	WHST	Range of Writing
11-12	WHST	WHST.11-12.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Note. Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In history/social studies, students must be able to incorporate narrative accounts into their analyses of individuals or events of historical import. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. (http://www.corestandards.org/ELA-Literacy/WHST/11-12)

Grade	Strand	CCSS
11-12	**Reading: Literature**	
11-12	RL	Key Ideas and Details
11-12	RL	RL.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
11-12	RL	RL.11-12.2 Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
11-12	RL	RL.11-12.3 Analyze the impact of the author's choices regarding how to develop and relate elements of a story or drama (e.g., where a story is set, how the action is ordered, how the characters are introduced and developed).
11-12	RL	Craft and Structure
11-12	RL	RL.11-12.4 Determine the meaning of words and phrases as they are used in the text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including words with multiple meanings or language that is particularly fresh, engaging, or beautiful. (Include Shakespeare as well as other authors.)
11-12	RL	RL.11-12.5 Analyze how an author's choices concerning how to structure specific parts of a text (e.g., the choice of where to begin or end a story, the choice to provide a comedic or tragic resolution) contribute to its overall structure and meaning as well as its aesthetic impact.
11-12	RL	RL.11-12.6 Analyze a case in which grasping a point of view requires distinguishing what is directly stated in a text from what is really meant (e.g., satire, sarcasm, irony, or understatement).
11-12	RL	Integration of Knowledge and Ideas
11-12	RL	RL.11-12.7 Analyze multiple interpretations of a story, drama, or poem (e.g., recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text. (Include at least one play by Shakespeare and one play by an American dramatist.)
11-12	RL	RL.11-12.8 not applicable to literature.
11-12	RL	RL.11-12.9 Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics.
11-12	RL	Range of Reading and Level of Text Complexity
11-12	RL	RL.11-12.10 By the end of grade 11, read and comprehend literature, including stories, dramas, and poems, in the grades 11-CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.
11-12	RL	By the end of grade 12, read and comprehend literature, including stories, dramas, and poems, at the high end of the grades 11–CCR text complexity band independently and proficiently.

Grade	Strand	CCSS
11-12	**Reading: Informational Text**	
11-12	RI	Key Ideas and Details
11-12	RI	RI.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
11-12	RI	RI.11-12.2 Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.
11-12	RI	RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.
11-12	RI	Craft and Structure
11-12	RI	RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in *Federalist* No. 10).
11-12	RI	RI.11-12.5 Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.
11-12	RI	RI.11-12.6 Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.
11-12	RI	Integration of Knowledge and Ideas
11-12	RI	RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
11-12	RI	RI.11-12.8 Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning (e.g., in U.S. Supreme Court majority opinions and dissents) and the premises, purposes, and arguments in works of public advocacy (e.g., *The Federalist*, presidential addresses).
9-10	RI	RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.
11-12	RI	RI.11-12.9 Analyze seventeenth-, eighteenth-, and nineteenth-century foundational U.S. documents of historical and literary significance (including The Declaration of Independence, the Preamble to the Constitution, the Bill of Rights, and Lincoln's Second Inaugural Address) for their themes, purposes, and rhetorical features.
11-12	RI	Range of Reading and Level of Text Complexity
11-12	RI	RI.11-12.10 By the end of grade 11, read and comprehend literary nonfiction in the grades 11-CCR text complexity band proficiently, with scaffolding as needed at the high end of the range.
11-12	RI	By the end of grade 12, read and comprehend literary nonfiction at the high end of the grades 11-CCR text complexity band independently and proficiently.

Note. Standards identified in blue type face are off-grade level standards or sub-standards identified by panelists.

Grade	Strand	CCSS
11-12	**Writing**	
11-12	W	Text Types and Purposes
11-12	W	W.11-12.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
11-12	W	W.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
11-12	W	W.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
11-12	W	W.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
11-12	W	W.11-12.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
11-12	W	W.11-12.1e Provide a concluding statement or section that follows from and supports the argument presented.
11-12	W	W.11-12.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
11-12	W	W.11-12.2a Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
11-12	W	W.11-12.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
11-12	W	W.11-12.2c Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
11-12	W	W.11-12.2d Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.
11-12	W	W.11-12.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
11-12	W	W.11-12.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

Grade	Strand	CCSS
11-12	**Writing (continued)**	
11-12	W	Text Types and Purposes (continued)
11-12	W	W.11-12.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
11-12	W	W.11-12.3a Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.
11-12	W	W.11-12.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
11-12	W	W.11-12.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).
11-12	W	W.11-12.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
11-12	W	W.11-12.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.
11-12	W	Production and Distribution of Writing
11-12	W	W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
11-12	W	W.11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12 here.)
11-12	W	W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
11-12	W	Research to Build and Present Knowledge
11-12	W	W.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
11-12	W	W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

Grade	Strand	CCSS
11-12	**Writing (continued)**	
11-12	W	Research to Build and Present Knowledge (continued)
11-12	W	W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
11-12	W	W.11-12.9a Apply *grades 11–12 Reading standards* to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").
11-12	W	W.11-12.9b Apply *grades 11–12 Reading standards* to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., *The Federalist*, presidential addresses]").
11-12		Range of Writing
11-12	W	W.11-12.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.
11-12	**Speaking and Listening**	
11-12	SL	Comprehension and Collaboration
11-12	SL	SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 11–12 topics, texts, and issues*, building on others' ideas and expressing their own clearly and persuasively.
11-12	SL	SL.11-12.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
11-12	SL	SL.11-12.1b Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed.
11-12	SL	SL.11-12.1c Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
11-12	SL	SL.11-12.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
11-12	SL	SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
11-12	SL	SL.11-12.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Grade	Strand	CCSS
11-12	**Speaking and Listening (continued)**	
11-12	SL	Presentation of Knowledge and Ideas
11-12	SL	SL.11-12.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
11-12	SL	SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
11-12	SL	SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 here for specific expectations.)
11-12	**Language**	
11-12	L	Conventions of Standard English
11-12	L	L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
11-12	L	L.11-12.1a Apply the understanding that usage is a matter of convention, can change over time, and is sometimes contested.
11-12	L	L.11-12.1b Resolve issues of complex or contested usage, consulting references (e.g., *Merriam-Webster's Dictionary of English Usage, Garner's Modern American Usage*) as needed.
11-12	L	L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
11-12	L	L.11-12.2a Observe hyphenation conventions.
11-12	L	L.11-12.2b Spell correctly.
11-12	L	Knowledge of Language
11-12	L	L.11-12.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
11-12	L	L.11-12.3a Vary syntax for effect, consulting references (e.g., Tufte's *Artful Sentences*) for guidance as needed; apply an understanding of syntax to the study of complex texts when reading.
11-12	L	Vocabulary Acquisition and Use
11-12	L	L.11-12.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 11–12 reading and content*, choosing flexibly from a range of strategies.
11-12	L	L.11-12.4a Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
11-12	L	L.11-12.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *conceive, conception, conceivable*).

Grade	Strand	CCSS
11-12	**Language (continued)**	
11-12	L	Vocabulary Acquisition and Use (continued)
11-12	L	L.11-12.4c Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.
11-12	L	L.11-12.4d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
11-12	L	L.11-12.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
11-12	L	L.11-12.5a Interpret figures of speech (e.g., hyperbole, paradox) in context and analyze their role in the text.
11-12	L	L.11-12.5b Analyze nuances in the meaning of words with similar denotations.
11-12	L	L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
	College and Career Readiness Anchor Standards for Reading	
CCRA	R	Key Ideas and Details
CCRA	R	CCRA.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
CCRA	R	CCRA.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
CCRA	R	CCRA.R.3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
CCRA	R	Craft and Structure
CCRA	R	CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
CCRA	R	CCRA.R.5 Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
CCRA	R	CCRA.R.6 Assess how point of view or purpose shapes the content and style of a text.

Grade	Strand	CCSS
		College and Career Readiness Anchor Standards for Reading (continued)
CCRA	R	Integration of Knowledge and Ideas
CCRA	R	CCRA.R.7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.* (FN: Please see "Research to Build Knowledge" in Writing and "Comprehension and Collaboration" in Speaking and Listening for additional standards relevant to gathering, assessing, and applying information from print and digital sources.)
CCRA	R	CCRA.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
CCRA	R	CCRA.R.9 Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
CCRA	R	Range of Reading and Level of Text Complexity
CCRA	R	CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently.
		College and Career Readiness Anchor Standards for Writing
CCRA	W	Text Types and Purposes
CCRA	W	CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
CCRA	W	CCRA.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
CCRA	W	CCRA.W.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.
CCRA	W	Production and Distribution of Writing
CCRA	W	CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCRA	W	CCRA.W.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
CCRA	W	CCRA.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
CCRA	W	Research to Build and Present Knowledge
CCRA	W	CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
CCRA	W	CCRA.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
CCRA	W	CCRA.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCRA	W	Range of Writing
CCRA	W	CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Grade	Strand	CCSS
	College and Career Readiness Anchor Standards for Speaking and Listening	
CCRA	SL	Comprehension and Collaboration
CCRA	SL	CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
CCRA	SL	CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
CCRA	SL	CCRA.SL.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
CCRA	SL	Presentation of Knowledge and Ideas
CCRA	SL	CCRA.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
CCRA	SL	CCRA.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
CCRA	SL	CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
	College and Career Readiness Anchor Standards for Language	
CCRA	L	Conventions of Standard English
CCRA	L	CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
CCRA	L	CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
CCRA	L	Knowledge of Language
CCRA	L	CCRA.L.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
CCRA	L	Vocabulary Acquisition and Use
CCRA	L	CCRA.L.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
CCRA	L	CCRA.L.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
CCRA	L	CCRA.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

Appendix F.
List of Mathematics Grade 11-12 CCSS

Grade	Category	Domain	Cluster	Standard
HS	**Number and Quantity**			
HS	N	RN	A	HSN-RN.A Extend the properties of exponents to rational exponents.
HS	N	RN	A	HSN-RN.A.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
HS	N	RN	A	HSN-RN.A.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
HS	N	RN	B	HSN-RN.B Use properties of rational and irrational numbers.
HS	N	RN	B	HSN-RN.B.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
HS	N	Q	A	HSN-Q.A Reason quantitatively and use units to solve problems.
HS	N	Q	A	HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HS	N	Q	A	HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
HS	N	Q	A	HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
HS	N	CN	A	HSN-CN.A Perform arithmetic operations with complex numbers.
HS	N	CN	A	HSN-CN.A.1 Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form $a + bi$ with *a* and *b* real.
HS	N	CN	A	HSN-CN.A.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
HS	N	CN	A	HSN-CN.A.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
HS	N	CN	B	HSN-CN.B Represent complex numbers and their operations on the complex plane.
HS	N	CN	B	HSN-CN.B.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
HS	N	CN	B	HSN-CN.B.5 (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example, $(-1 + \sqrt{3}\, i)^3 = 8$ because $(-1 + \sqrt{3}\, i)$ has modulus 2 and argument 120°.*
HS	N	CN	B	HSN-CN.B.6 (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

Grade	Category	Domain	Cluster	Standard
HS	**Number and Quantity (continued)**			
HS	N	CN	C	HSN.CN.C Use complex numbers in polynomial identities and equations.
HS	N	CN	C	HSN-CN.C.7 Solve quadratic equations with real coefficients that have complex solutions.
HS	N	CN	C	HSN-CN.C.8 (+) Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as $(x + 2i)(x – 2i)$.*
HS	N	CN	C	HSN-CN.C.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
HS	N	VM	A	HSN-VM.A Represent and model with vector quantities.
HS	N	VM	A	HSN-VM.A.1 (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\|\boldsymbol{v}\|$, $\|\|\boldsymbol{v}\|\|$, v).
HS	N	VM	A	HSN-VM.A.2 (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
HS	N	VM	A	HSN-VM.A.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.
HS	N	VM	B	HSN-VM.B Perform operations on vectors.
HS	N	VM	B	HSN-VM.B.4 (+) Add and subtract vectors.
HS	N	VM	B	HSN-VM.B.4a Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
HS	N	VM	B	HSN-VM.B.4b Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
HS	N	VM	B	HSN-VM.B.4c Understand vector subtraction $\boldsymbol{v} – \boldsymbol{w}$ as $\boldsymbol{v} + (–\boldsymbol{w})$, where $–\boldsymbol{w}$ is the additive inverse of $\boldsymbol{w}$, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.
HS	N	VM	B	HSN-VM.B.5 (+) Multiply a vector by a scalar.
HS	N	VM	B	HSN-VM.B.5a Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$.
HS	N	VM	B	HSN-VM.B.5b Compute the magnitude of a scalar multiple $c\boldsymbol{v}$ using $\|\|c\boldsymbol{v}\|\| = \|c\|\boldsymbol{v}$. Compute the direction of $c\boldsymbol{v}$ knowing that when $\|\|\boldsymbol{v} \neq 0$, the direction of cv is either along $\boldsymbol{v}$ (for $c > 0$) or against $\boldsymbol{v}$ (for $c < 0$).

Grade	Category	Domain	Cluster	Standard
HS	**Number and Quantity (continued)**			
HS	N	VM	C	HSN-VM.C Perform operations on matrices and use matrices in applications.
HS	N	VM	C	HSN-VM.C.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
HS	N	VM	C	HSN-VM.C.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
HS	N	VM	C	HSN-VM.C.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.
HS	N	VM	C	HSN-VM.C.9 (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
HS	N	VM	C	HSN-VM.C.10 (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
HS	N	VM	C	HSN-VM.C.11 (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
HS	N	VM	C	HSN-VM.C.12 (+) Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area.
HS	**Algebra**			
HS	A	SSE	A	HSA-SSE.A Interpret the structure of expressions.
HS	A	SSE	A	HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context.★
HS	A	SSE	A	HSA-SSE.A.1a Interpret parts of an expression, such as terms, factors, and coefficients.
HS	A	SSE	A	HSA-SSE.A.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.*
HS	A	SSE	A	HSA-SSE.A.2 Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$*.*
HS	A	SSE	B	HSA-SSE.B Write expressions in equivalent forms to solve problems.
HS	A	SSE	B	HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★
HS	A	SSE	B	HSA-SSE.B.3a Factor a quadratic expression to reveal the zeros of the function it defines.
HS	A	SSE	B	HSA-SSE.B.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Grade	Category	Domain	Cluster	Standard
HS	**Algebra (continued)**			
HS	A	SSE	B	HSA-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
HS	A	SSE	B	HSA-SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*★
HS	A	APR	A	HSA-APR.A Perform arithmetic operations on polynomials.
HS	A	APR	A	HSA-APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
HS	A	APR	B	HSA-APR.B Understand the relationship between zeros and factors of polynomials.
HS	A	APR	B	HSA-APR.B.2 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so p(a) = 0 if and only if $(x - a)$ is a factor of $p(x)$.
HS	A	APR	B	HSA-APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
HS	A	APR	C	HSA-APR.C Use polynomial identities to solve problems.
HS	A	APR	C	HSA-APR.C.4 Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.*
HS	A	APR	C	HSA-APR.C.5 (+) Know and apply the Binomial Theorem for the expansion of (x + y)n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle. (FN: The Binomial Theorem can be proved by mathematical induction or by a combinatorial argument.)
HS	A	APR	D	HSA-APR.D Rewrite rational expressions.
HS	A	APR	D	HSA-APR.D.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
HS	A	APR	D	HSA-APR.D.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Grade	Category	Domain	Cluster	Standard
HS	**Algebra (continued)**			
HS	A	CED	A	HSA-CED.A Create equations that describe numbers or relationships.
HS	A	CED	A	HSA-CED.A.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
HS	A	CED	A	HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
HS	A	CED	A	HSA-CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
HS	A	CED	A	HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*
HS	A	REI	A	HSA-REI.A Understand solving equations as a process of reasoning and explain the reasoning.
HS	A	REI	A	HSA-REI.A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
HS	A	REI	A	HSA-REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
HS	A	REI	B	HSA-REI.B Solve equations and inequalities in one variable.
HS	A	REI	B	HSA-REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
HS	A	REI	B	HSA-REI.B.4 Solve quadratic equations in one variable.
HS	A	REI	B	HSA-REI.B.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
HS	A	REI	B	HSA-REI.B.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Grade	Category	Domain	Cluster	Standard
HS	**Algebra (continued)**			
HS	A	REI	C	HSA-REI.C Solve systems of equations.
HS	A	REI	C	HSA-REI.C.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
HS	A	REI	C	HSA-REI.C.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
HS	A	REI	C	HSA-REI.C.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line* $y = -3x$ *and the circle* $x^2 + y^2 = 3$.
HS	A	REI	C	HSA-REI.C.8 (+) Represent a system of linear equations as a single matrix equation in a vector variable.
HS	A	REI	C	HSA-REI.C.9 (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).
HS	A	REI	D	HSA-REI.D Represent and solve equations and inequalities graphically.
HS	A	REI	D	HSA-REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
HS	A	REI	D	HSA-REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★
HS	A	REI	D	HSA-REI.D.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
HS	**Functions**			
HS	F	IF	A	HSF-IF.A Understand the concept of a function and use function notation.
HS	F	IF	A	HSF-IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$.
HS	F	IF	A	HSF-IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
HS	F	IF	A	HSF-IF.A.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ *for* $n \geq 1$.

Grade	Category	Domain	Cluster	Standard
HS	**Functions (continued)**			
HS	F	IF	B	HSF-IF.B Interpret functions that arise in applications in terms of the context.
HS	F	IF	B	HSF-IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★
HS	F	IF	B	HSF-IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★
HS	F	IF	B	HSF-IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★
HS	F	IF	C	HSF-IF.C Analyze functions using different representations.
HS	F	IF	C	HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★
HS	F	IF	C	HSF-IF.C.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.
HS	F	IF	C	HSF-IF.C.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
HS	F	IF	C	HSF-IF.C.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
HS	F	IF	C	HSF-IF.C.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
HS	F	IF	C	HSF-IF.C.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
HS	F	IF	C	HSF-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
HS	F	IF	C	HSF-IF.C.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
HS	F	IF	C	HSF-IF.C.8b Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*
HS	F	IF	C	HSF-IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Grade	Category	Domain	Cluster	Standard
HS	**Functions (continued)**			
HS	F	BF	A	HSF-BF.A Build a function that models a relationship between two quantities.
HS	F	BF	A	HSF-BF.A.1 Write a function that describes a relationship between two quantities.★
HS	F	BF	A	HSF-BF.A.1a Determine an explicit expression, a recursive process, or steps for calculation from a context.
HS	F	BF	A	HSF-BF.A.1b Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*
HS	F	BF	A	HSF-BF.A.1c (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*
HS	F	BF	A	HSF-BF.A.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.★
HS	F	BF	B	HSF-BF.B Build new functions from existing functions.
HS	F	BF	B	HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
HS	F	BF	B	HSF-BF.B.4 Find inverse functions.
HS	F	BF	B	HSF-BF.B.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2 x3 or f(x) = (x+1)/(x–1) for x ≠ 1.*
HS	F	BF	B	HSF-BF.B.4b (+) Verify by composition that one function is the inverse of another.
HS	F	BF	B	HSF-BF.B.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
HS	F	BF	B	HSF-BF.B.4d (+) Produce an invertible function from a non-invertible function by restricting the domain.
HS	F	BF	B	HSF-BF.B.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Grade	Category	Domain	Cluster	Standard
HS	Functions (continued)			
HS	F	LE	A	HSF-LE.A Construct and compare linear, quadratic, and exponential models and solve problems.
HS	F	LE	A	HSF-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
HS	F	LE	A	HSF-LE.A.1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
HS	F	LE	A	HSF-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
HS	F	LE	A	HSF-LE.A.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
HS	F	LE	A	HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
HS	F	LE	A	HSF-LE.A Construct and compare linear, quadratic, and exponential models and solve problems. (continued)
HS	F	LE	A	HSF-LE.A.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
HS	F	LE	A	HSF-LE.A.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
HS	F	LE	B	HSF-LE.B Interpret expressions for functions in terms of the situation they model.
HS	F	LE	B	HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.
HS	F	TF	A	HSF-TF.A Extend the domain of trigonometric functions using the unit circle.
HS	F	TF	A	HSF-TF.A.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
HS	F	TF	A	HSF-TF.A.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
HS	F	TF	A	HSF-TF.A.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.
HS	F	TF	A	HSF-TF.A.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

Grade	Category	Domain	Cluster	Standard
HS	**Functions (continued)**			
HS	F	TF	B	HSF-TF.B Model periodic phenomena with trigonometric functions.
HS	F	TF	B	HSF-TF.B.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★
HS	F	TF	B	HSF-TF.B.6 (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
HS	F	TF	B	HSF-TF.B.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.★
HS	F	TF	C	HSF-TF.C Prove and apply trigonometric identities.
HS	F	TF	C	HSF-TF.C.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
HS	F	TF	C	HSF-TF.C.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
HS	**Geometry**			
HS	G	CO	A	HSG-CO.A Experiment with transformations in the plane.
HS	G	CO	A	HSG-CO.A.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
HS	G	CO	A	HSG-CO.A.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
HS	G	CO	A	HSG-CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
HS	G	CO	A	HSG-CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
HS	G	CO	A	HSG-CO.A.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Grade	Category	Domain	Cluster	Standard
HS	**Geometry (continued)**			
HS	G	CO	B	HSG-CO.B Understand congruence in terms of rigid motions.
HS	G	CO	B	HSG-CO.B.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
HS	G	CO	B	HSG-CO.B.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
HS	G	CO	B	HSG-CO.B.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
HS	G	CO	C	HSG-CO.C Prove geometric theorems.
HS	G	CO	C	HSG-CO.C.9 Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*
HS	G	CO	C	HSG-CO.C.10 Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*
HS	G	CO	C	HSG-CO.C.11 Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*
HS	G	CO	D	HSG-CO.D Make geometric constructions.
HS	G	CO	D	HSG-CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*
HS	G	CO	D	HSG-CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Grade	Category	Domain	Cluster	Standard
HS	**Geometry (continued)**			
HS	G	SRT	A	HSG-SRT.A Understand similarity in terms of similarity transformations.
HS	G	SRT	A	HSG-SRT.A.1 Verify experimentally the properties of dilations given by a center and a scale factor:
HS	G	SRT	A	HSG-SRT.A.1a A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
HS	G	SRT	A	HSG-SRT.A.1b The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
HS	G	SRT	A	HSG-SRT.A.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
HS	G	SRT	A	HSG-SRT.A.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.
HS	G	SRT	B	HSG-SRT.B Prove theorems involving similarity.
HS	G	SRT	B	HSG-SRT.B.4 Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.*
HS	G	SRT	B	HSG-SRT.B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
HS	G	SRT	C	HSG-SRT.C Define trigonometric ratios and solve problems involving right triangles.
HS	G	SRT	C	HSG-SRT.C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
HS	G	SRT	C	HSG-SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.
HS	G	SRT	C	HSG-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★
HS	G	SRT	D	HSG-SRT.D Apply trigonometry to general triangles.
HS	G	SRT	D	HSG-SRT.D.9 (+) Derive the formula A = 1/2 *ab* sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
HS	G	SRT	D	HSG-SRT.D.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.
HS	G	SRT	D	HSG-SRT.D.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Grade	Category	Domain	Cluster	Standard
HS	**Geometry (continued)**			
HS	G	C	A	HSG-C.A Understand and apply theorems about circles.
HS	G	C	A	HSG-C.A.1 Prove that all circles are similar.
HS	G	C	A	HSG-C.A.2 Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*
HS	G	C	A	HSG-C.A.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
HS	G	C	A	HSG-C.A.4 (+) Construct a tangent line from a point outside a given circle to the circle.
HS	G	C	B	HSG-C.B Find arc lengths and areas of sectors of circles.
HS	G	C	B	HSG-C.B.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.
HS	G	GPE	A	HSG-GPE.A Translate between the geometric description and the equation for a conic section.
HS	G	GPE	A	HSG-GPE.A.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
HS	G	GPE	A	HSG-GPE.A.2 Derive the equation of a parabola given a focus and directrix.
HS	G	GPE	A	HSG-GPE.A.3 (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
HS	G	GPE	B	HSG-GPE.B Use coordinates to prove simple geometric theorems algebraically.
HS	G	GPE	B	HSG-GPE.B.4 Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*
HS	G	GPE	B	HSG-GPE.B.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
HS	G	GPE	B	HSG-GPE.B.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
HS	G	GPE	B	HSG-GPE.A.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.★

Grade	Category	Domain	Cluster	Standard
HS	**Geometry (continued)**			
HS	G	GMD	A	HSG-GMD.A Explain volume formulas and use them to solve problems.
HS	G	GMD	A	HSG-GMD.A.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. *Use dissection arguments, Cavalieri's principle, and informal limit arguments.*
HS	G	GMD	A	HSG-GMD.A.2 (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
HS	G	GMD	A	HSG-GMD.A.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.★
HS	G	GMD	B	HSG-GMD.B Visualize relationships between two-dimensional and three-dimensional objects.
HS	G	GMD	B	HSG-GMD.B.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
HS	G	MG	A	HSG-MG.A Apply geometric concepts in modeling situations.
HS	G	MG	A	HSG-MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).★
HS	G	MG	A	HSG-MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).★
HS	G	MG	A	HSG-MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).★
HS	**Statistics and Probability**			
HS	S	ID	A	HSS-ID.A Summarize, represent, and interpret data on a single count or measurement variable.
HS	S	ID	A	HSS-ID.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
HS	S	ID	A	HSS-ID.A.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
HS	S	ID	A	HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
HS	S	ID	A	HSS-ID.A.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Grade	Category	Domain	Cluster	Standard
HS	**Statistics and Probability (continued)**			
HS	S	ID	B	HSS-ID.B Summarize, represent, and interpret data on two categorical and quantitative variables.
HS	S	ID	B	HSS-ID.B.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
HS	S	ID	B	HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
HS	S	ID	B	HSS-ID.B.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
HS	S	ID	B	HSS-ID.B.6b Informally assess the fit of a function by plotting and analyzing residuals.
HS	S	ID	B	HSS-ID.B.6c Fit a linear function for a scatter plot that suggests a linear association.
HS	S	ID	C	HSS-ID.C Interpret linear models.
HS	S	ID	C	HSS-ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
HS	S	ID	C	HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
HS	S	ID	C	HSS-ID.C.9 Distinguish between correlation and causation.
HS	S	IC	A	HSS-IC.A Understand and evaluate random processes underlying statistical experiments.
HS	S	IC	A	HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
HS	S	IC	A	HSS-IC.A.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*
HS	S	IC	B	HSS-IC.B Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
HS	S	IC	B	HSS-IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
HS	S	IC	B	HSS-IC.B.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
HS	S	IC	B	HSS-IC.B.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
HS	S	IC	B	HSS-IC.B.6 Evaluate reports based on data.

Grade	Category	Domain	Cluster	Standard
HS	**Statistics and Probability (continued)**			
HS	S	CP	A	HSS-CP.A Understand independence and conditional probability and use them to interpret data.
HS	S	CP	A	HSS-CP.A.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
HS	S	CP	A	HSS-CP.A.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
HS	S	CP	A	HSS-CP.A.3 Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.
HS	S	CP	A	HSS-CP.A.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*
HS	S	CP	A	HSS-CP.A.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*
HS	S	CP	B	HSS-CP.B Use the rules of probability to compute probabilities of compound events in a uniform probability model.
HS	S	CP	B	HSS-CP.B.6 Find the conditional probability of A given B as the fraction of B’s outcomes that also belong to A, and interpret the answer in terms of the model.
HS	S	CP	B	HSS-CP.B.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.
HS	S	CP	B	HSS-CP.B.8 (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.
HS	S	CP	B	HSS-CP.B.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Grade	Category	Domain	Cluster	Standard
HS	**Statistics and Probability (continued)**			
HS	S	MD	A	HSS-MD.A Calculate expected values and use them to solve problems.
HS	S	MD	A	HSS-MD.A.1 (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
HS	S	MD	A	HSS-MD.A.2 (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
HS	S	MD	A	HSS-MD.A.3 (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*
HS	S	MD	A	HSS-MD.A.4 (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?*
HS	S	MD	B	HSS-MD.B Use probability to evaluate outcomes of decisions.
HS	S	MD	B	HSS-MD.B.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
HS	S	MD	B	HSS-MD.B.5a Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*
HS	S	MD	B	HSS-MD.B.5b Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.
HS	S	MD	B	HSS-MD.B.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
HS	S	MD	B	HSS-MD.B.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Grade	Category	Domain	Cluster	Standard
Math Practice				
K-12	MP	MP1		K-12.MP.1 Make sense of problems and persevere in solving them.
K-12				Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
	MP	MP2		K-12.MP.2 Reason abstractly and quantitatively.
K-12				Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

Grade	Category	Domain	Cluster	Standard
Math Practice				
	MP	MP3		K-12.MP.3 Construct viable arguments and critique the reasoning of others.
K-12				Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

Grade	Category	Domain	Cluster	Standard
Math Practice				
	MP	MP4		K-12.MP.4 Model with mathematics.
K-12				Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
	MP	MP5		K-12.MP.5 Use appropriate tools strategically.
K-12				Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

Grade	Category	Domain	Cluster	Standard
Math Practice				
	MP	MP6		K-12.MP.6 Attend to precision.
K-12				Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.
	MP	MP7		K-12.MP.7 Look for and make use of structure.
K-12				Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression x^2 + 9x + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see 5 – 3(x – y)^2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.
	MP	MP8		K-12.MP.8 Look for and express regularity in repeated reasoning.
K-12				Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (y – 2)/(x –1) = 3. Noticing the regularity in the way terms cancel when expanding (x – 1)(x + 1), (x – 1)(x^2 + x + 1), and (x – 1)(x^3 + x^2 + x + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Appendix G.
List of Panelist Identified Off-Grade Level Mathematics CCSS

Grade	Domain	Cluster	Standard
1	OA	A	1.OA.C.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 - 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).
3	NF	A	3.NF.A Develop understanding of fractions as numbers.
5	G	A	5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.
6	RP	A	6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."*
6	RP	A	6.RP.A.2 Understand the concept of a unit rate *a*/*b* associated with a ratio *a*:*b* with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* (FN: Expectations for unit rates in this grade are limited to non-complex fractions.)
6	RP	A	6.RP.A.3a Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
6	RP	A	6.RP.A.3b Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*
6	RP	A	6.RP.A.3c Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
6	RP	A	6.RP.A.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.
6	NS	C	6.NS.C.7 Understand ordering and absolute value of rational numbers.
6	NS	C	6.NS.C.7a Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.*
6	NS	C	6.NS.C.7c Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write* $\lvert -30 \rvert = 30$ *to describe the size of the debt in dollars.*
6	EE	A	6.EE.A.1 Write and evaluate numerical expressions involving whole-number exponents.

Grade	Domain	Cluster	Standard
6	EE	A	6.EE.A.2c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas $V = s^3$ and $A = 6 s^2$ to find the volume and surface area of a cube with sides of length $s = 1/2$.*
6	EE	A	6.EE.A.3 Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression $3 (2 + x)$ to produce the equivalent expression $6 + 3x$; apply the distributive property to the expression $24x + 18y$ to produce the equivalent expression $6 (4x + 3y)$; apply properties of operations to $y + y + y$ to produce the equivalent expression $3y$.*
6	EE	A	6.EE.A.4 Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions $y + y + y$ and $3y$ are equivalent because they name the same number regardless of which number y stands for.*
6	EE	B	6.EE.B.5 Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
6	EE	B	6.EE.B.7 Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.
6	SP	A	6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
6	SP	A	6.SP.A.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
6	SP	B	6.SP.B.5 Summarize numerical data sets in relation to their context, such as by:
6	SP	B	6.SP.B.5b Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
6	SP	B	6.SP.B.5c Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
7	RP	A	7.RP.A.2 Recognize and represent proportional relationships between quantities.
7	RP	A	7.RP.A.2c Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.*
7	RP	A	7.RP.A.2d Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.
7	RP	A	7.RP.A.3 Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

Grade	Domain	Cluster	Standard
7	NS	A	7.NS.A.1c Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.
7	NS	A	7.NS.A.3 Solve real-world and mathematical problems involving the four operations with rational numbers. (FN: Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)
7	EE	A	7.EE.A.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
7	EE	A	7.EE.A.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, $a + 0.05a = 1.05a$ means that "increase by 5%" is the same as "multiply by 1.05."*
7	EE	B	7.EE.B.4a Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*
7	G	A	7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.
7	G	B	7.G.B.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
7	SP	A	7.SP.A.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
7	SP	B	7.SP.B.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*
7	SP	C	7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
7	SP	C	7.SP.C.8a Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
8	EE	A	8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.*
8	EE	A	8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
8	EE	C	8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.
8	EE	C	8.EE.C.7 Solve linear equations in one variable.

Grade	Domain	Cluster	Standard
8	EE	C	8.EE.C.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
8	EE	C	8.EE.C.8b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.*
8	EE	C	8.EE.C.8c Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*
8	F	A	8.F.A.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (FN: Function notation is not required in Grade 8.)
8	F	A	8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*
8	F	B	8.F.B Use functions to model relationships between quantities.
8	F	B	8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
8	F	B	8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
8	G	A	8.G.A.2 Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.
8	G	A	8.G.A.4 Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.
8	SP	A	8.SP.A.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
8	SP	A	8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

Appendix H.
CCSS Identified by College Board and Panelists

Table H-1. Frequencies of Identified CCSS the College Board and Average Panelist Agreement for the SAT Reading Test

CCSS Identified by CB	Frequency of CB Identified CCSS	CB % of Items on Test Identified by CCSS	N of CCSS Identified by Panelists Across All Items (k=52)	Average of Panelist (n=7) Identified CCSS Across Items	Panelists Average % of Identified CCSS
L.11-12.3a	10	19.23%	13	2	3.57%
L.11-12.4a	19	36.54%	83	12	22.80%
L.11-12.5a	23	44.23%	65	9	17.86%
L.11-12.5b	9	17.31%	41	6	11.26%
L.11-12.6	23	44.23%	75	11	20.60%
RH.11-12.1	8	15.38%	50	7	13.74%
RH.11-12.3	5	9.62%	30	4	8.24%
RH.11-12.4	6	11.54%	29	4	7.97%
RH.11-12.5	1	1.92%	6	1	1.65%
RH.11-12.6	4	7.69%	23	3	6.32%
RH.11-12.7	3	5.77%	21	3	5.77%
RH.11-12.9	3	5.77%	21	3	5.77%
RH.8.6	1	1.92%	7	1	1.92%
RI.11-12.1	3	5.77%	21	3	5.77%
RI.11-12.3	2	3.85%	13	2	3.57%
RI.11-12.4	3	5.77%	16	2	4.40%
RI.11-12.8	1	1.92%	7	1	1.92%
RI.11-12.9	1	1.92%	5	1	1.37%
RL.11-12.1	5	9.62%	33	5	9.07%
RL.11-12.3	3	5.77%	20	3	5.49%
RL.11-12.4	5	9.62%	20	3	5.49%
RL.11-12.5	2	3.85%	9	1	2.47%
RST.11-12.1	8	15.38%	52	7	14.29%
RST.11-12.4	4	7.69%	10	1	2.75%
RST.11-12.5	2	3.85%	7	1	1.92%
RST.11-12.6	3	5.77%	21	3	5.77%
RST.11-12.7	2	3.85%	13	2	3.57%
RST.11-12.8	5	9.62%	23	3	6.32%
Grand Total	**164**		**734**		

Note. The Reading test is composed of 52 items.

Table H-2. Frequencies of Identified CCSS the College Board and Average Panelist Agreement for the SAT Writing/Language Arts Test

CCSS Identified by CB	Frequency of CB Identified CCSS	CB % of Items on Test Identified by CCSS	N of CCSS Identified by Panelists Across All Items (k=44)	Average of Panelist (n=7) Identified CCSS Across Items	Panelists Average % of Identified CCSS
L.11-12.1a	12	27.27%	21	3	6.82%
L.11-12.3a	2	4.55%	10	1	3.25%
L.11-12.5b	3	6.82%	20	3	6.49%
L.11-12.6	3	6.82%	11	2	3.57%
W.11-12.1a	3	6.82%	6	1	1.95%
W.11-12.1b	1	2.27%	1	0	0.32%
W.11-12.1c	3	6.82%	6	1	1.95%
W.11-12.1d	1	2.27%	1	0	0.32%
W.11-12.1e	2	4.55%	2	0	0.65%
W.11-12.2a	6	13.64%	39	6	12.66%
W.11-12.2b	2	4.55%	14	2	4.55%
W.11-12.2c	5	11.36%	35	5	11.36%
W.11-12.2d	4	9.09%	25	4	8.12%
W.11-12.2e	1	2.27%	7	1	2.27%
W.11-12.2f	4	9.09%	18	3	5.84%
W.11-12.3a	2	4.55%	2	0	0.65%
W.11-12.3b	2	4.55%	0	0	0.00%
W.11-12.3c	2	4.55%	2	0	0.65%
W.11-12.3d	3	6.82%	2	0	0.65%
W.11-12.3e	1	2.27%	0	0	0.00%
W.11-12.4	18	40.91%	125	18	40.58%
W.11-12.5	44	100.00%	305	44	99.03%
WHST.11-12.1a	3	6.82%	8	1	2.60%
WHST.11-12.1b	1	2.27%	1	0	0.32%
WHST.11-12.1c	3	6.82%	8	1	2.60%
WHST.11-12.1d	1	2.27%	2	0	0.65%
WHST.11-12.1e	2	4.55%	3	0	0.97%
WHST.11-12.4	9	20.45%	59	8	19.16%
WHST.11-12.5	22	50.00%	152	22	49.35%
Grand Total	**165**		**885**		

Note. The Writing/Language Arts test is composed of 44 items.

Table H-3. Frequencies of Identified CCSS the College Board and Average Panelist Agreement for the SAT Math Test

CCSS Identified by CB	Frequency of CB Identified CCSS	CB % of Items on Test Identified by CCSS	N of CCSS Identified by Panelists Across All Items (k=58)	Average of Panelist (n=7) Identified CCSS Across Items	Panelists Average % of Identified CCSS
HSA-APR.A.1	3	5.17%	16	2	4.02%
HSA-APR.B.2	3	5.17%	1	0	0.29%
HSA-APR.B.3	1	1.72%	7	1	1.72%
HSA-CED.A.1	6	10.34%	38	5	9.48%
HSA-CED.A.2	3	5.17%	20	3	5.17%
HSA-CED.A.3	4	6.90%	25	4	6.03%
HSA-CED.A.4	2	3.45%	14	2	3.45%
HSA-REI.A.2	1	1.72%	7	1	1.72%
HSA-REI.B.3	8	13.79%	49	7	12.36%
HSA-REI.B.4B	2	3.45%	14	2	3.45%
HSA-REI.C.6	2	3.45%	14	2	3.45%
HSA-REI.C.7	1	1.72%	7	1	1.72%
HSA-REI.D.10	8	13.79%	43	6	10.92%
HSA-SSE.A.1A	2	3.45%	14	2	3.45%
HSA-SSE.A.1B	1	1.72%	6	1	1.44%
HSA-SSE.A.2	3	5.17%	16	2	4.02%
HSF-BF.A.1A	2	3.45%	13	2	3.45%
HSF-IF.A.1	6	10.34%	30	4	7.18%
HSF-IF.A.2	4	6.90%	19	3	4.60%
HSF-IF.B.4	4	6.90%	25	4	6.03%
HSF-IF.C.7A	1	1.72%	7	1	1.72%
HSF-LE.A.1	1	1.72%	7	1	1.72%
HSF-LE.A.2	2	3.45%	13	2	3.16%
HSF-LE.B.5	3	5.17%	18	3	4.60%
HSF-TF.A.1	1	1.72%	6	1	1.44%
HSG-C.B.5	1	1.72%	6	1	1.44%
HSG-CO.A.1	4	6.90%	18	3	4.02%
HSG-GMD.A.3	1	1.72%	7	1	1.72%
HSG-GPE.A.1	1	1.72%	7	1	1.72%
HSG-MG.A.2	1	1.72%	7	1	1.72%
HSG-SRT.B.5	2	3.45%	13	2	3.16%
HSN-CN.A.1	1	1.72%	3	0	0.86%
HSN-CN.A.2	1	1.72%	6	1	1.44%
HSN-Q.A.1	3	5.17%	20	3	5.17%
HSN-RN.A.2	3	5.17%	17	2	4.02%
HSS-CP.B.6	1	1.72%	6	1	1.44%
HSS-IC.A.1	2	3.45%	14	2	3.45%

CCSS Identified by CB	Frequency of CB Identified CCSS	CB % of Items on Test Identified by CCSS	N of CCSS Identified by Panelists Across All Items (k=58)	Average of Panelist (n=7) Identified CCSS Across Items	Panelists Average % of Identified CCSS
HSS-ID.A.1	2	3.45%	4	1	1.15%
HSS-ID.A.2	1	1.72%	6	1	1.72%
HSS-ID.B.5	1	1.72%	6	1	1.44%
HSS-ID.B.6A	1	1.72%	7	1	1.72%
HSS-ID.C.7	1	1.72%	7	1	1.72%
Grand Total	**101**		**583**		

Note. The Math test is composed of 58 items.

Appendix I.
SAT Alignment Workshop Evaluation Form

Circle the response that best represents your experience with the alignment workshop activities.

1. What content area did you review?
   a. ELA and Writing
   b. Mathematics

2. What is your general opinion of the alignment between the content area items you reviewed and the CCSS?
   a. Strong alignment
   b. Acceptable alignment
   c. Needs slight improvement
   d. Needs major improvement
   e. Not aligned in any way

3. Overall, do you think the SAT is a good measure of what 11th grade students know and should do in your state?
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

4. Overall, do you think the SAT is a good measure of what students prepared for college know and should do?
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

5. Overall, do you feel the goals of the workshop were achieved?
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

6. The training provided was comprehensive and effective in covering the major steps in reviewing and rating the items.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

7. I understood the guidance provided by facilitators.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

8. I am confident in my individual ratings.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

9. Documentation provided for the alignment tasks were clear and understandable.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

10. Rating forms provided for the alignment tasks were clear and understandable.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

11. Documentation provided for the alignment tasks were useful in performing the actual ratings.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

12. Rating forms provided for the alignment tasks were useful in performing the actual ratings.
   a. Strongly Agree
   b. Agree
   c. Somewhat Agree
   d. Somewhat Disagree
   e. Disagree
   f. Strongly Disagree

13. The use of laptops for data entry was relatively easy.
    a. Strongly Agree
    b. Agree
    c. Somewhat Agree
    d. Somewhat Disagree
    e. Disagree
    f. Strongly Disagree

14. HumRRO staff was courteous and helpful.
    a. Strongly Agree
    b. Agree
    c. Somewhat Agree
    d. Somewhat Disagree
    e. Disagree
    f. Strongly Disagree

15. Comments

Your feedback is appreciated.