

# TECHNICAL REPORT

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**pennsylvania**  
DEPARTMENT OF EDUCATION

**2023–2024 CDT Technical Report**

Provided by Data Recognition Corporation

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## GLOSSARY OF COMMON TERMS

The following table contains some terms used in this technical report and their meanings. Some of these terms are used universally in the assessment community, and some of these terms are used commonly by psychometric professionals.

Term	Common Definition
Ability	In Rasch scaling, <i>ability</i> is a generic term indicating the level of an individual on the construct measured by an exam. As an example, for the CDT, a student's reading ability is measured by how the student performed on the CDT Reading/Literature test.
Alternative Forms	<i>Alternative forms</i> are two or more versions of a test that are considered exchangeable; for example, they measure the same constructs in the same ways, are intended for the same purposes, and are administered using the same directions. More specific terminology applies depending on the degree of statistical similarity between the test forms (e.g., parallel forms, equivalent forms, comparable forms), where parallel forms refers to the situation in which the test forms have the highest degree of similarity to each other.
Average	<i>Average</i> is a measure of central tendency in a score distribution that usually refers to the arithmetic mean of a set of scores. In this case, it is determined by adding all the scores in a distribution and then dividing the obtained value by the total number of scores. Sometimes people use the word average to refer to other measures of central tendency such as the median (the score in the middle of a distribution) or mode (the score value with the greatest frequency).
Benchmark Activity	Also referred to as benchmarking, <i>benchmark activity</i> is a procedure used in the determination of the cut score(s) for a given assessment. It is used to measure students' progress towards certain performance standards. Methods vary (e.g., modified Angoff, Bookmark Method), but most use a panel of educators and expert judgments to operationalize the level of achievement students must demonstrate in order to be categorized within each performance level.
Benchmark Cut	A <i>benchmark cut</i> marks a specified point on a score scale where scores at or above that point are interpreted differently from scores below that point (e.g., a score designated as the minimum level of performance needed to pass a competency test). A test can be divided into multiple proficiency levels by setting one or more cut scores. Methods for establishing cut scores vary. For the CDT, one benchmark cut was set that separates students into two categories: solidly ready for the next grade or course and not solidly ready for the next grade or course.
Bias	In a statistical context, <i>bias</i> refers to any source of systematic error in the measurement of a test score. In discussing test fairness, bias may refer to construct-irrelevant components of test scores that differentially affect the performance of different groups of test takers (e.g., gender, ethnicity). Attempts are made to reduce bias by conducting item fairness reviews and various differential item functioning (DIF) analyses, detecting potential areas of concern, and either removing or revising the flagged test items prior to including them in the final operational pools (see also <i>Differential Item Functioning</i> ).
Computer Adaptive Test (CAT)	A <i>computer adaptive test (CAT)</i> is a computer-based test with an item selection routine that adjusts (adapts) to a student's performance during the test. For this reason, it has also been called a tailored test. Rather than all students taking the same set of items (fixed form), each student's test is individually tailored with items selected from a large item pool based on the student's performance.
Constructed-Response Item	A <i>constructed-response item</i> —referred to by some as an open-ended response item—is an item format that requires examinees to create their own responses, which can be expressed in various forms. This format is in contrast to multiple-choice items, which require students to make a choice from a supplied set of answer options. There are no constructed-response items on the CDT.
Content Validity Evidence	<i>Content validity evidence</i> shows the extent to which an exam provides an appropriate sampling of a content domain of interest (e.g., assessable portions of a state's grade 6 mathematics curriculum in terms of the knowledge, skills, objectives, and processes sampled).
Criterion-Referenced Interpretation	The <i>criterion-referenced interpretation</i> is a measure of a student's performance against an expected level of mastery, educational objective, or standard. The types of resulting score interpretations provide information about what a student knows or can do in a given content area.

Term	Common Definition
Decision Consistency	<i>Decision consistency</i> is the extent to which classifications based on test scores would match the decisions on students' proficiency levels based on scores from a second parallel form of the same test. It is often expressed as the proportion of examinees who are classified the same way from the two test administrations.
Diagnostic Category	A <i>diagnostic category</i> is a grouping used for reporting results on the CDT. Each CDT test has four or five diagnostic categories which are based on the Pennsylvania Academic Standards (Mathematics, Reading, and Writing) or the Pennsylvania Academic Standards (Science).
Differential Item Functioning (DIF)	<i>Differential item functioning (DIF)</i> is a statistical property of a test item in which different groups of test takers (who have the same total test score) have different average item scores. In other words, students with the same ability level but different group memberships do not have the same probability of answering the item correctly (see also <i>Bias</i> ).
Distractor	A <i>distractor</i> is an incorrect option in a multiple-choice item (also called a foil).
Equating	<i>The process that results in scores that can be used interchangeably across different test forms and/or test administrations. Equated test scores are considered exchangeable. Consequently, the requirements for equating are strong and somewhat complex (equal construct and precision, equity, and invariance). In practical terms, it is often stated that students should perceive no differences regardless of the test form administered (see also Scale Linking, Pre-equating, and Post-equating).</i>
Evidence-Based Selected-Response Item	A type of item that has two parts and requires the test taker to select a response from a group of possible answer choices in Part One, one of which is the correct answer (or key) to the question posed, and to then select one or two responses from a group of possible answer choices in Part Two, which provide evidence to support the correct answer in Part One.
Field-Test item	A <i>field-test item</i> is a newly developed item that is ready to be tried out to determine its statistical properties (e.g., see <i>p</i> -value and Point-Biserial Correlation). Items are field tested prior to operational administration. Items with acceptable statistical properties in field-test form the pool of CDT operational items.
Frequency	<i>Frequency</i> is the number of times that a certain value or range of values (score interval) occurs in a distribution of scores.
Frequency Distribution	<i>Frequency distribution</i> is a tabulation of scores from low to high or high to low with the number and/or percent of individuals who obtain each score or who fall within each score interval.
Infit/Outfit	<i>Infit</i> and <i>outfit</i> are statistical indicators of the agreement of the data and the measurement model. Infit and outfit are highly correlated, and they both are highly correlated with the point-biserial correlation. Underfit can be caused when low-ability students correctly answer difficult items (perhaps by guessing or atypical experience) or high-ability students incorrectly answer easy items (perhaps because of carelessness or gaps in instruction). Any model expects some level of variability, so overfit can occur when nearly all low-ability students miss an item while nearly all high-ability students get the item correct.
Item Difficulty	For the Rasch model, the dichotomous <i>item difficulty</i> represents the point along the latent trait continuum where an examinee has a 0.50 probability of making a correct response.
Key	The <i>key</i> is the correct response option or answer to a test item.
Learning Progression	A <i>learning progression</i> shows the developmental sequences or building blocks of content/skills students need to master as they progress toward career and college readiness and is tied directly to the Assessment Anchors and Eligible Content as well as the Voluntary Model Curriculum Units and Lesson Plans.
Linking	A generic term referring to a number of processes by which scores from one or more tests are made comparable to some degree. Linking includes several classes of transformations (equating, scale alignment, prediction, etc.). Equating is associated with the strongest degree of comparability (exchangeable scores). Other linkages may be very strong but fail to meet one or more of the strict criteria required of equating (see also <i>Equating</i> ). CDT scores are equated.
Logit	In Rasch scaling, <i>logits</i> are units used to express both examinee ability and item difficulty. When expressing examinee ability, if two students take the same set of items, a student who answers more items correctly has a higher logit than a student who answers fewer items correctly. Logits are transformed into scale scores through a linear transformation. When expressing item difficulty, logits are transformed <i>p</i> -value (see also <i>P-value</i> ). The logit difficulty scale is inversely related to <i>p</i> -values. A higher logit value would represent a relatively harder item, while a lower logit value would represent a relatively easier item.

Term	Common Definition
Mean	<i>Mean</i> is also referred to as the arithmetic mean of a set of scores. It is found by adding all the score values in a distribution and dividing by the total number of scores. For example, the mean of the set {66, 76, 85, and 97} is 81. The value of a mean can be influenced by extreme values in a score distribution.
Measure	In Rasch scaling, <i>measure</i> generally refers to a specific estimate of an examinee's ability (often expressed as logits) or an item's difficulty (again, often expressed as logits). As an example, for the CDT, a student's literature measure might be equal to 0.525 logit. Or, a CDT literature test item might have a logit equal to -0.905.
Median	The <i>median</i> is the middle point or score in a set of rank-ordered observations that divides the distribution into two equal parts; each part contains 50 percent of the total data set. More simply put, half of the scores are below the median value and half of the scores are above the median value. As an example, the median for the following ranked set of scores {2, 3, 6, 8, 9} is 6.
Multiple-Choice Item	A <i>multiple-choice item</i> is a type of item format that requires the test taker to select a response from a group of possible choices, one of which is the correct answer (or key) to the question posed. All items on the CDT are multiple-choice items.
<i>N</i> -count	Sometimes designated as <i>N</i> or <i>n</i> , it is the number of observations (usually individuals or students) in a particular group. Some examples include the number of students tested, the number of students tested from a specific subpopulation (e.g., females), and the number of students who attained a specific score. In the following set {23, 32, 56, 65, 78, 87}, <i>n</i> = 6.
Operational Item	After initial item tryout (field test), all items with acceptable statistical properties form the pool of CDT <i>operational items</i> . Students' tests are selected from this pool.
Percent Correct	When referring to an individual item, the <i>percent correct</i> is the item's <i>p</i> -value from the field test administration expressed as a percent (instead of a proportion). Under a computer adaptive administration, percent correct scores are not appropriate for individual items or students.
Percentile	<i>Percentile</i> is the score or point in a score distribution at or below which a given percentage of scores fall. It should be emphasized that it is a value on the score scale, not the associated percentage (although sometimes in casual usage this misinterpretation is made). For example, if 72 percent of the students score at or below a scale score of 1500 on a given test, then the scale score of 1500 would be considered the 72nd percentile. As another example, the median is the 50th percentile.
Percentile Rank	The <i>percentile rank</i> is the percentage of scores in a specified distribution that fall at/below a certain point on a score distribution. Percentile ranks range in value from 1 to 99. They indicate the status or relative standing of an individual within a specified group by indicating the percent of individuals in that group who obtained equal or lower scores. An individual's percentile rank can vary depending on which group is used to determine the ranking. As suggested above, percentiles and percentile ranks are sometimes used interchangeably; however, strictly speaking, a percentile is a value on the score scale.
Point-Biserial Correlation	In classical test theory, <i>point-biserial correlation</i> is an item discrimination index. It is the correlation between a dichotomously scored item and a continuous criterion, usually represented by the total test score (or the corrected total test score with the reference item removed). It reflects the extent to which an item differentiates between high-scoring and low-scoring examinees. This discrimination index ranges from -1.00 to +1.00. The higher the discrimination index (the closer to +1.00), the better the item is considered to be performing. For multiple-choice items scored as 0 or 1, it is rare for the value of this index to exceed 0.5.
Post-Equating	Post-equating refers to the method of utilizing data from the current administration for scale linking and equating. Post-equating relies heavily on collecting data from a representative sample, estimating new item parameters, linking the item parameters to the base scale, and estimating student ability based on the linked item parameters. In order to provide immediate results, CDT utilizes pre-equating. Post-equating is conducted for field-test analyses and updating item parameters.
Pre-Equating	Pre-equating refers to the method of utilizing previously estimated and linked item parameters for equating. Because item parameters have already been linked to the base scale, pre-equated solutions are available immediately after a CDT is completed.



Term	Common Definition
P-value	A <i>p-value</i> is an index indicating an item's difficulty for some specified group (perhaps grade). It is calculated as the proportion (sometimes percent) of students in the group who answer an item correctly. <i>P-values</i> range from 0.0 to 1.0 on the proportion scale. Lower values correspond to more difficult items and higher values correspond to easier items. <i>P-values</i> are usually provided for multiple-choice items or other items worth one point. For open-ended items or items worth more than one point, difficulty on a <i>p-value</i> -like scale can be estimated by dividing the item mean score by the maximum number of points possible for the item (see also <i>Logit</i> ).
Raw Score	<i>Raw score</i> is an unadjusted score usually determined by tallying the number of questions answered correctly or by the sum of item scores (i.e., points). Raw scores typically have little or no meaning by themselves and require additional information like the number of items on the test and the difficulty of the test items. Under a computer adaptive administration, where each student takes a unique set of items, raw scores are not comparable across students.
Reliability	<i>Reliability</i> is the expected degree to which test scores for a group of examinees are consistent over exchangeable replications of an assessment procedure and, therefore, considered dependable and repeatable for an individual examinee. A test that produces highly consistent, stable results (i.e., relatively free from random error) is said to be highly reliable. The reliability of a test is typically expressed as a reliability coefficient or by the standard error of measurement derived by that coefficient.
Reliability Coefficient	<i>Reliability coefficient</i> is a statistical index that reflects the degree to which scores are free from random measurement error. Theoretically, it expresses the consistency of test scores as the ratio of true score variance to total score variance (true score variance plus error variance). This statistic is often expressed as a correlation coefficient (e.g., correlation between two forms of a test) or with an index that resembles a correlation coefficient (e.g., calculation of a test's internal consistency using coefficient alpha). Expressed this way, the reliability coefficient is a "unitless" index. The higher the value of the index (closer to 1.0), the greater the reliability of the test (see also <i>Standard Error of Measurement</i> ).
Scale Linking	<i>The first step in any equating process in which independent item estimates are placed on the same scale of measurement (the logit scale). Scale linking results in item parameters that are on the same scale of measurement. Equating procedures can only be implemented once scale linking is achieved (see also Equating).</i>
Scale Score	<i>Scale score</i> is a mathematical transformation of a Rasch ability estimate developed through a process called scaling. Scale scores are most useful when comparing test results over time. Several different methods of scaling exist, but each is intended to provide a continuous and meaningful score scale across different forms of a test.
Standard Deviation	<i>Standard deviation</i> is a statistic that measures the degree of spread or dispersion of a set of scores. The value of this statistic is always greater than or equal to zero. If all of the scores in a distribution are identical, the standard deviation is equal to zero. The further the scores are away from one another in value, the greater the standard deviation. This statistic is calculated using the information about the deviations (distances) between each score and the distribution's mean. It is equivalent to the square root of the variance statistic. The standard deviation is a commonly used method of examining a distribution's variability since the standard deviation is expressed in the same units as the data.
Standard Error of Measurement (SEM)	<i>Standard error of measurement (SEM)</i> is the amount an observed score is expected to fluctuate around the true score. As an example, across replications of a measurement procedure, the true score will not differ by more than plus or minus one standard error from the observed score about 68 percent of the time (assuming normally distributed errors). The SEM is frequently used to obtain an idea of the consistency of a person's score in actual score units, or to set a confidence band around a score in terms of the error of measurement. Often a single SEM value is calculated for all test scores. On other occasions, however, the value of the SEM can vary along a score scale. Conditional standard error of measurement (CSEM) also indicates the degree of measurement error in scale score units but varies as a function of a student's unique set of items and actual scale score.
Step Difficulty	<i>Step difficulty</i> is a parameter estimate in Master's Partial Credit Model (PCM) that represents the relative difficulty of each score step (e.g., going from a score of 1 to a score of 2). The higher the value of a particular step difficulty, the more difficult a particular step is relative to other score steps (e.g., is it harder to go from a 1 to a 2, or to go from a 2 to a 3).

Term	Common Definition
Technical Advisory Committee (TAC)	The <i>technical advisory committee (TAC)</i> is a group of individuals (most often professionals in the field of testing) that are either appointed or selected to make recommendations for and to guide the technical development of a given testing program.
Technology-Enhanced (TE) Items	<i>Technology-Enhanced (TE)</i> items are items that capitalize on computer-based interactions for collecting response data. Examples of TE items include drop-down menus, drag and drop functionality, text highlighting, and other interactions.
Validity	<i>Validity</i> is the degree to which accumulated evidence and theory support specific interpretations of test scores entailed by the purpose of a test. There are various ways of gathering validity evidence.

# PREFACE: AN OVERVIEW OF THE CDT

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## CLASSROOM DIAGNOSTIC TOOLS (CDT) OVERVIEW

The Pennsylvania Classroom Diagnostic Tools (CDT) is a set of online assessments, divided by content area, designed to provide diagnostic information in order to guide instruction and intervention. The CDT reporting system is fully integrated in Pennsylvania’s Standards Aligned System (SAS). It assists educators in identifying student academic strengths and areas in need of improvement by providing links to classroom resources. The diagnostic reports feature easy-to-follow links to targeted curricular resources and materials, including units and lesson plans found within the SAS system. Students in grades 3 through high school at all Pennsylvania schools may take the CDT up to five times throughout the school year at no cost.

The purpose of the CDT is to provide information that will help guide instruction by providing support to students and teachers. The CDT reports are designed to provide a picture or snapshot of how students are performing in relation to the Pennsylvania Assessment Anchors and Eligible Content and Keystone Assessment Anchors and Eligible Content. The CDT goes beyond focusing only on **What** students should know and be able to do at a particular grade and/or course. It also provides a snapshot of **How** and **Why** students may still be struggling or extending beyond the grade and/or course Eligible Content. This valuable information is typically not identified through other types of assessments. Teachers, through the use of the CDT reports, may access additional information through the Learning Progression Map. The Learning Progression Map allows teachers to pinpoint where students are struggling or where they are extending beyond the learning continuum. The CDT helps identify and provides suggestions for next steps in student academic development.

The CDT consists of multiple-choice, evidence-based selected-response, and technology-enhanced questions. The questions were developed to specifically align to the Pennsylvania Assessment Anchors and Eligible Content at kindergarten through high school and the Keystone Assessment Anchors and Eligible Content for end-of-course. The CDT is based on content assessed by the Pennsylvania System of School Assessments (PSSA) and the Keystone Exams. It includes interactive and dynamic reporting for various diagnostic reporting categories.

### CDT Activities for the 2023–2024 School Year

Description	Date
Test Setup System Available	August 9, 2023
First Day of Testing	August 14, 2023
Last Day of Testing	June 17, 2024

# CHAPTER ONE: BACKGROUND OF THE CLASSROOM DIAGNOSTIC TOOLS

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This brief overview of the Pennsylvania Classroom Diagnostic Tools summarizes the program’s intent and purpose, as well as key dates in the development process.

## THE CLASSROOM DIAGNOSTIC TOOLS

The Classroom Diagnostic Tools (CDT) is a set of online assessments, divided by content area, designed to provide diagnostic information in order to guide instruction and enrichment. The CDT reporting system is fully integrated in the Standards Aligned System (SAS). It assists educators in identifying student academic strengths and areas in need of improvement by providing links to classroom resources. The diagnostic reports feature easy-to-follow links to targeted curricular resources and materials, including units and lesson plans found within the SAS system. The CDT is available to districts at no cost.

The CDT is:

- Offered to students in grades 3 through high school
- Available for use in the classroom throughout the school year on a voluntary basis
- Based on content assessed by the Keystone Exams and the Pennsylvania System of School Assessment (PSSA)
- Comprised of multiple-choice items (all content areas), technology-enhanced items (in Science only), and evidence-based selected-response items (in Reading and Literature only)
- Delivered as an online Computer Adaptive Test (CAT), ensuring valid and reliable measures of a student’s skills while minimizing testing time
- Designed to provide real-time results for students and teachers with links to Materials and Resources in SAS
- Available for Mathematics Lower Grades<sup>1</sup>, Mathematics, Algebra I, Geometry, Algebra II, Reading Lower Grades, Reading/Literature, Science Lower Grades, Science, Biology, Chemistry, Writing Lower Grades, and Writing/English Composition
- Available as Full CDT, which covers multiple diagnostic categories, or as Diagnostic Category CDT, which covers a single category.

## KEY DATES

The items for each course of the CDT were field tested online using fixed-form computer-based tests prior to their use in operational computer adaptive tests. Additional items were field tested as items embedded within the operational CDT to increase the pool of items aligned to the Pennsylvania Core Standards and to allow the extension of the CDT to students in grades 3 through 5. The timeline for implementation of the field tests and operational availability is shown in the following table.

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<sup>1</sup> CDTs with the “Lower Grades” designation are for students in grades 3 through 5.

**Table 1–1. Key Dates**

<b>Course</b>	<b>Field Test Dates</b>	<b>Operational Rollout Dates</b>
Mathematics, Algebra I, Geometry, Algebra II	Spring 2010	Fall 2010
Reading/Literature	Fall 2010	Spring 2011
Science, Biology, Chemistry	Fall 2010	Spring 2011
Writing/English Composition	Spring 2011	Fall 2011
Mathematics, Reading/Literature, and Writing/English Composition aligned to the Pennsylvania Core Standards <sup>2</sup>	Spring 2013	Fall 2013
Mathematics Lower Grades, Reading Lower Grades, Science Lower Grades, and Writing Lower Grades	Fall 2013	Spring 2014
Mathematics, Algebra I, Algebra II, Reading, Literature, Writing, English Composition, Science, Biology, and Chemistry	Fall 2018	Fall 2019
Science and Biology	Spring 2019	Spring 2020
Mathematics, Algebra I, Algebra II, Reading, Literature, Writing, English Composition, Science, Biology, and Chemistry	Summer 2022	Summer 2023
Science, Biology, and Chemistry	Fall 2023	Summer 2024
Science and Biology	Fall 2024	Summer 2025

For more details on field-test events, see Chapter Six.<sup>2</sup>

<sup>2</sup> The alignment of Mathematics, Reading/Literature, and Writing/English Composition to the Pennsylvania Core Standards did not include field-test items for Writing/English Composition, as the Writing/English Composition pool did not require additional items to be fully aligned to the Pennsylvania Core Standards.

## **CHAPTER TWO: TEST DEVELOPMENT OVERVIEW OF THE PENNSYLVANIA CDT FRAMEWORK**

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The Pennsylvania Classroom Diagnostic Tools (CDT) is available for Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Reading Lower Grades, Reading/Literature, Science Lower Grades, Science, Biology, Chemistry, Writing Lower Grades, and Writing/English Composition for students in grades 3 through high school. The assessments are administered online in a computer adaptive test (CAT) format.

The Pennsylvania CDT consists of multiple-choice, evidence-based selected-response, and technology-enhanced, questions that align to the Pennsylvania Assessment Anchors and Eligible Content at grades 3 through high school for mathematics, reading, writing, and science and the Keystone Assessment Anchors and Eligible Content for end-of-course for Algebra I, Algebra II, Geometry, Literature, English Composition, Biology, and Chemistry and evidence-based selected-response questions that align to the Pennsylvania Assessment Anchors and Eligible Content at grade 3 through 8 for reading. With the exception of grades 3, 5, 6, and 7 for Science, these Pennsylvania Assessment Anchors and Eligible Content were developed previously for the PSSA and Keystone Exams as described in the following sections. In addition, Learning Progressions were developed to show the pathways along which students travel as they progress towards mastery of the skills in each content area.

### **BACKGROUND FOR THE PSSA ASSESSMENT ANCHORS AND ELIGIBLE CONTENT**

The PSSA Assessment Anchor Content Standards and Eligible Content in Mathematics, Reading, and Writing are based on the Pennsylvania Core Standards. The PSSA Assessment Anchor Content Standards and Eligible Content in Science are based on the Pennsylvania Academic Standards. Although the Pennsylvania Core Standards and the Pennsylvania Academic Standards indicate what students should know and be able to do, educator concerns regarding the number and breadth of Academic Standards led to an initiative by the Pennsylvania Department of Education (PDE) to develop Assessment Anchor Content Standards (Assessment Anchors) to indicate which parts of the Academic Standards (Instructional Standards) would be assessed on the PSSA. Based on recommendations from Pennsylvania educators, the Assessment Anchors were designed as a tool to improve the articulation of curricular, instructional, and assessment practices. The Assessment Anchors clarify what is expected across each grade span and focus the content of the standards into what is assessable on a large-scale test. The Assessment Anchor documents also serve to communicate Eligible Content, also called assessment limits, or the range of knowledge and skills from which the PSSA would be designed.

The Assessment Anchor's coding is read like an outline. The coding includes the content, grade level, Reporting Category, Assessment Anchor, descriptor (Sub-Assessment Anchor), and Eligible Content. Thus, S.4.A.1.3.1 would be Science, Grade 4, Reporting Category A, Assessment Anchor 1, descriptor (Sub-Assessment Anchor) 3, and Eligible Content 1.

Each of the Assessment Anchors has one or more descriptors (Sub-Assessment Anchors) and Eligible Content varying to reflect grade-level appropriateness. The Assessment Anchors form the basis of the test design for the grades undergoing new test development. In turn, this hierarchy is the basis for organizing the total content scores (based on the core [common] sections).

With Pennsylvania's decision to adopt the Pennsylvania Core Standards based on the Common Core State Standards, committees of Pennsylvania educators met in October 2011 to write, review, and approve the Assessment Anchors and Eligible Content statements. To provide initial focus, each content and grade span committee was presented with materials specific to the content and grade span in question, including a basic blueprint structure, the Pennsylvania Academic Standards, the Pennsylvania Assessment Anchors and Eligible Content aligned to the Pennsylvania Academic Standards, the Common Core State Standards, and draft Eligible Content statements. Committees then completed an iterative process of reviewing and revising the draft Eligible Content statements followed by discussions across grade-span committees to ensure vertical articulation across the grades. The results from the committee work were evaluated by national, state, and local subject matter experts, and, following revisions, they were ultimately validated by another committee of Pennsylvania educators. Following committee approval, the Pennsylvania Core Standards-aligned Assessment Anchors and Eligible Content for English Language Arts and Mathematics were approved by the State Board of Education in September 2013.

The complete set of Assessment Anchors and Eligible Content can be referenced at PDE’s website: [www.education.pa.gov](http://www.education.pa.gov).

- Roll over ‘Data and Reporting’ in the bar across the top of the page.
- Select ‘Assessment and Accountability.’ Click on the link that reads ‘PSSA - PA System of School Assessment’. Then click on Assessment Anchors/Eligible Content

For Science, Assessment Anchors and Eligible Content had only been previously developed at grades 4, 8, and 11 for the PSSA and for the Biology and Chemistry Keystone Exams. Therefore, to provide a vertical articulation of science content from grade to grade, a group of Pennsylvania educators were brought together to develop Assessment Anchors and Eligible Content for the off grades (those that do not assess Science on the PSSA). These educators, in collaboration with DRC Science Test Development staff, used the Assessment Anchors and Eligible Content for grades 4, 8, and 11 as the foundation to develop Assessment Anchors and Eligible Content for grades 3, 5, 6, and 7.

With the extension of the CDT to allow students in grades 3 through 5 to participate in the assessments, it was necessary to include items appropriate to assess skills and understandings that students should learn in kindergarten through grade 2. For Mathematics, Reading, and Writing, test questions were developed based to align to the Pennsylvania Core Standards for grades K through 2. For Science, a group of Pennsylvania educators was brought together in March 2013 to develop the Science Grades K-2 Assessment Anchors and Eligible Content, which are organized as a single grade band and contain foundational science concepts in order to promote flexibility in classroom instruction for these early grade levels.

## BACKGROUND FOR THE KEYSTONE ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

The Keystone Test Blueprints—known as the Keystone Assessment Anchors and Eligible Content—are based on Pennsylvania Keystone Course Standards and the Common Core State Standards. Prior to the development of the Assessment Anchors, multiple groups of Pennsylvania educators convened to create a set of standards for each of the Keystone Exams. Derived from a review of existing standards, these Enhanced Standards (Course Standards) focus on what students need to know and be able to do in order to be college and career ready.

Although the Keystone Course Standards indicate what students should know and be able to do, Assessment Anchors are designed to indicate which parts of the Keystone Course Standards (Instructional Standards) will be assessed on the Keystone Exams. Based on recommendations from Pennsylvania educators, the Assessment Anchors were designed as a tool to improve the articulation of curricular, instructional, and assessment practices. The Assessment Anchors clarify what is expected and focus the content of the standards into what is assessable on a large-scale exam. The Assessment Anchor documents also serve to communicate Eligible Content, or the range of knowledge and skills from which the Keystone Exams are designed.

The Keystone Assessment Anchors and Eligible Content have been designed to hold together or *anchor* the state assessment system and curriculum/instructional practices in schools following these design parameters:

- **Clear:** The Assessment Anchors are easy to read and are user-friendly; they clearly detail which standards are assessed on the Keystone Exams.
- **Focused:** The Assessment Anchors identify a core set of standards that could be reasonably assessed on a large-scale assessment, which will keep educators from having to guess which standards are critical.
- **Rigorous:** The Assessment Anchors support the rigor of the state standards by assessing higher order and reasoning skills.
- **Manageable:** The Assessment Anchors define the standards in a way that can be easily incorporated into a course to prepare students for success.

The Assessment Anchors and Eligible Content are organized into cohesive blueprints, each structured with a common labeling system. This framework is organized first by Module (Reporting Category), then by Assessment Anchor, followed by Anchor Descriptor, and then finally, at the greatest level of detail, by an Eligible Content statement. The common format of this outline is followed across the Keystone Exams.

Here is a description of each level in the labeling system for the Keystone Exams.

- **Module:** The Assessment Anchors are organized into two thematic modules for each of the Keystone Exams, and these modules serve as the Reporting Categories for the Keystone Exams. The Module title appears at the top of each page in the Assessment Anchor document. The Module level is also important because the Keystone Exams are built using a Module format, with each of the Keystone Exams divided into two equally sized test modules. Each Module is made up of two or more Assessment Anchors.
- **Assessment Anchor:** The Assessment Anchor appears in the shaded bar across the top of each Assessment Anchor table in the Assessment Anchor document. The Assessment Anchors represent categories of subject matter that anchor the content of the Keystone Exams. Each Assessment Anchor is part of a Module and has one or more Anchor Descriptors unified under it.
- **Anchor Descriptor:** Below each Assessment Anchor in the Assessment Anchor document is a specific Anchor Descriptor. The Anchor Descriptor level provides further details that delineate the scope of content covered by the Assessment Anchor. Each Anchor Descriptor is part of an Assessment Anchor and has one or more Eligible Content statements unified under it.
- **Eligible Content:** The column to the right of the Anchor Descriptor in the Assessment Anchor document contains the Eligible Content statements. The Eligible Content is the most specific description of the content that is assessed on the Keystone Exams. This level is considered the assessment limit and helps educators identify the range of content covered on the Keystone Exams.
- **Enhanced Standard:** In the column to the right of each Eligible Content statement is a code representing one or more Enhanced Standards that correlate to the Eligible Content statement. Some Eligible Content statements include annotations that indicate certain clarifications about the scope of an Eligible Content.
- **Notes:** There are three types of notes included in the Assessment Anchor document:
  - “e.g.” (“for example”)—sample approach, but not a limit to the Eligible Content
  - “i.e.” (“that is”)—specific limit to the Eligible Content
  - “Note”—content exclusions or definable range of the Eligible Content

The Assessment Anchor’s coding is read like an outline. The coding includes the Subject (Exam), Reporting Category/Module, Assessment Anchor, Anchor Descriptor, and Eligible Content. Each exam has two modules. Each Module has two or more Assessment Anchors. Each of the Assessment Anchors has one or more Anchor Descriptors, and each Anchor Descriptor has at least one Eligible Content statements (generally more than one). The Assessment Anchors form the basis of the test design for the exams undergoing test development. In turn, this hierarchy is the basis for organizing the total Module and exam scores.



**Table 2–1. Sample Keystone Assessment Anchor Coding**

Sample Code	Subject (Exam)	Reporting Category (Module)	Assessment Anchor (AA)	Anchor Descriptor (AD)	Eligible Content (EC)
A1.1.1.2.1	A1–Algebra I	1 – Operations and Linear Equations & Inequalities	1 – Linear Equations	2 – Write, solve, and/or graph linear equations using various methods.	1 – Write, solve, and/or apply a linear equation (including problem situations).
BIO.A.2.1.1	BIO –Biology	A – Cells and Cell Processes	2 – The Chemical Basis for Life	1 – Describe how the unique properties of water support life on Earth.	1 – Describe the unique properties of water and how these properties support life on Earth (e.g., freezing point, high specific heat, cohesion).
L.F.2.4.1	L –Literature	F – Fiction	2 – Analyzing and Interpreting Literature— Fiction	4 – Use appropriate strategies to interpret and analyze the universal significance of literary fiction.	1 – Interpret and analyze works from a variety of genres for literary, historical, and/or cultural significance.

The complete set of Assessment Anchors and Eligible Content can be referenced at *PDE’s Standards Aligned System (SAS) website* at <http://www.pdesas.org/Standard>. Assessment Anchors and Eligible Content for Grades 3–8 can be found by selecting “Download PSSA and PASA Anchors and Eligible Content” while Assessment Anchors and Eligible Content for high school courses can be found by selecting “Download Keystone Anchors.”

## DIAGNOSTIC CATEGORIES FOR THE CLASSROOM DIAGNOSTIC TOOLS

The Classroom Diagnostic Tools provide information for teachers, students, and other stakeholders regarding student performance at the Overall Score level and also for each diagnostic category within the selected assessment. These diagnostic categories provide more detailed information about student strengths and areas of need for a related group of Eligible Content. A description of the diagnostic categories for each assessment follows.

### MATHEMATICS LOWER GRADES AND MATHEMATICS

There are four diagnostic categories for the mathematics assessments. These are *Numbers & Operations*, *Algebraic Concepts*, *Geometry*, and *Measurement, Data, and Probability*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the table below.

**Table 2–2. Number of Eligible Content per Diagnostic Category by Grade for Mathematics Lower Grades and Mathematics**

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Numbers & Operations	1	3	3	9	20	13	15	9	5	6
Algebraic Concepts	1	2	3	14	8	4	11	5	17	46
Geometry	2	2	2	3	3	3	6	8	8	29
Measurement, Data, and Probability	2	3	5	15	9	5	4	7	4	12

\* Eligible Content for Kindergarten, Grade 1, and Grade 2 are not included in the Mathematics CDT.

## ALGEBRA I

The Keystone Algebra I Assessment Anchors and Eligible Content has two reporting categories: Module 1, Operations and Linear Equations & Inequalities, and Module 2, Linear Functions and Data Organizations. These modules are each divided into two diagnostic categories. Module 1 is divided into *Operations with Real Numbers and Expressions* and *Linear Equations & Inequalities*. Module 2 is divided into *Functions & Coordinate Geometry* and *Data Analysis*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–3. Number of Eligible Content per Diagnostic Category by Grade for Algebra I**

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Operations with Real Numbers and Expressions	13	11	5	17	10	7	18
Module 1 – Linear Equations & Inequalities	0	0	0	3	3	8	16
Module 2 – Functions & Coordinate Geometry	0	3	1	4	1	10	21
Module 2 – Data Analysis	3	0	1	4	7	4	11

## GEOMETRY

The Keystone Geometry Assessment Anchors and Eligible Content has two reporting categories: Module 1, Geometric Properties & Reasoning, and Module 2, Coordinate Geometry & Measurement. These modules are each divided into two diagnostic categories. Module 1 is divided into *Geometric Properties* and *Congruence, Similarity, & Proofs*. Module 2 is divided into *Coordinate Geometry & Right Triangles* and *Measurement*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–4. Number of Eligible Content per Diagnostic Category by Grade for Geometry**

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Geometric Properties	2	2	1	1	5	1	18
Module 1 – Congruence, Similarity, & Proofs	0	1	0	0	0	2	3
Module 2 – Coordinate Geometry & Right Triangles	0	0	1	3	1	7	5
Module 2 – Measurement	6	4	2	4	3	0	13

## ALGEBRA II

The Keystone Algebra II Assessment Anchors and Eligible Content has two reporting categories: Module 1, Number Systems and Non-Linear Expressions & Equations, and Module 2, Functions and Data Analysis. These modules are each divided into two diagnostic categories. Module 1 is divided into *Operations with Complex Numbers* and *Non-Linear Expressions & Equations*. Module 2 is divided into *Functions* and *Data Analysis*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–5. Number of Eligible Content per Diagnostic Category by Grade for Algebra II**

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Operations with Complex Numbers	0	0	0	0	0	0	4
Module 1 – Non-Linear Expressions & Equations	0	1	1	16	9	8	30
Module 2 – Functions	0	3	0	1	0	5	20
Module 2 – Data Analysis	3	0	1	4	7	3	11

## SCIENCE LOWER GRADES AND SCIENCE

There are four diagnostic categories for the science assessments. These are *The Nature of Science*, *Biological Sciences*, *Physical Sciences*, and *Earth/Space Sciences*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the table below.

**Table 2–6. Number of Eligible Content per Diagnostic Category by Grade for Science Lower Grades and Science**

Diagnostic Category	K–2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
The Nature of Science	7	9	20	8	10	19	31	27
Biological Sciences	7	14	18	11	7	21	21	38
Physical Sciences	1	10	9	12	12	12	12	46
Earth/Space Sciences	8	13	16	8	7	11	13	14

## BIOLOGY

The Keystone Biology Exam has two reporting categories: Module 1[A], Cells and Cell Processes, and Module 2[B], Continuity and Unity of Life. These modules are each divided into two diagnostic categories. Module 1 is divided into *Basic Biological Principles/Chemical Basis for Life* and *Bioenergetics/Homeostasis & Transport*. Module 2 is divided into *Cell Growth & Reproduction/Genetics* and *Theory of Evolution/Ecology*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–7. Number of Eligible Content per Diagnostic Category by Grade for Biology**

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Basic Biological Principles/Chemical Basis for Life	5	5	3	3	5	5	9
Module 1 – Bioenergetics/Homeostasis & Transport	0	0	0	0	0	0	7
Module 2 – Cell Growth & Reproduction/Genetics	2	1	1	0	5	4	10
Module 2 – Theory of Evolution/Ecology	8	13	5	3	18	18	12

## CHEMISTRY

The Keystone Chemistry Assessment Anchors and Eligible Content has two reporting categories: Module 1[A], Structure and Properties of Matter, and Module 2[B], The Mole Concept and Chemical Interactions. These modules are each divided into two diagnostic categories. Module 1 is divided into *Properties & Classification of Matter* and *Atomic Structure & the Periodic Table*. Module 2 is divided into *The Mole & Chemical Bonding* and *Chemical Relationships & Reactions*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–8. Number of Eligible Content per Diagnostic Category by Grade for Chemistry**

Diagnostic Category	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Module 1 – Properties & Classification of Matter	7	4	7	7	3	3	10
Module 1 – Atomic Structure & The Periodic Table	0	0	0	0	1	0	8
Module 1 – The Mole & Chemical Bonding	0	0	0	0	1	1	9
Module 2 – Chemical Relationships & Reactions	0	0	1	0	1	1	7

## READING LOWER GRADES AND READING/LITERATURE

The Reading Lower Grades and Reading/Literature Assessments use the same diagnostic categories across grades 3 through 8 and the high school Literature course. These diagnostic categories are not divided across the two Keystone Literature Modules (reporting categories) of Fiction and Non-fiction. The diagnostic categories for Reading Lower Grades and Reading/Literature are *Key Ideas and Details – Literature Text*; *Key Ideas and Details – Informational Text*; *Craft and Structure/Integration of Knowledge and Ideas – Literature Text*; *Craft and Structure/Integration of Knowledge and Ideas – Informational Text*; and *Vocabulary Acquisition and Use*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–9. Number of Eligible Content per Diagnostic Category by Grade for Reading Lower Grades and Reading/Literature**

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Key Ideas and Details— Literature Text	3	3	3	3	3	3	3	3	3	8
Key Ideas and Details— Informational Text	3	3	3	3	3	3	3	3	3	12
Craft and Structure/ Integration of Knowledge and Ideas—Literature Text	2	2	2	2	2	2	4	4	4	14
Craft and Structure/ Integration of Knowledge and Ideas— Informational Text	4	4	4	5	5	5	5	5	5	18
Vocabulary Acquisition and Use	2	2	2	4	4	4	4	4	4	6

\* Eligible Content for Kindergarten, Grade 1, and Grade 2 are not included in the Reading/Literature CDT.

## WRITING LOWER GRADES AND WRITING/ENGLISH COMPOSITION

The Writing Lower Grades and Writing/English Composition Assessments use the same diagnostic categories across grades 3 through 8 and the high school English Composition course. The diagnostic categories for Writing Lower Grades and Writing/English Composition are *Quality of Writing: Focus and Organization*, *Quality of Writing: Content and Style*, *Quality of Writing: Editing*, *Conventions: Punctuation, Capitalization, and Spelling*, and *Conventions: Grammar and Sentence Formation*. The number of Eligible Content from each grade that map to these diagnostic categories is shown in the following table.

**Table 2–10. Number of Eligible Content per Diagnostic Category by Grade for Writing Lower Grades and Writing/English Composition**

Diagnostic Category	Kindergarten*	Grade 1*	Grade 2*	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	HS
Quality of Writing: Focus and Organization	3	6	6	6	6	6	6	6	6	4
Quality of Writing: Content and Style	2	3	3	3	3	5	5	5	5	4
Quality of Writing: Editing	0	3	3	4	10	12	11	10	6	13
Conventions: Punctuation, Capitalization, and Spelling	1	3	2	6	4	5	3	3	3	5
Conventions: Grammar and Sentence Formation	2	3	2	10	9	9	9	7	5	2

\* Eligible Content for Kindergarten, Grade 1, and Grade 2 are **not** included in the Writing/English Composition CDT.

## CHAPTER THREE: GENERAL CLASSROOM DIAGNOSTIC TOOLS TEST DEVELOPMENT PROCESSES

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The operational item pool for each Classroom Diagnostic Tool (CDT) subject is made up of multiple-choice items that were field tested in a stand-alone field test administration in addition to a smaller number of multiple-choice, evidence-based selected-response (Reading only), and technology-enhanced (Science only) items embedded later in operational assessments. Due to the large number of items needed for each CDT Computer Adaptive Test (CAT) to provide reliable information about student strengths and areas of need, it was decided to stagger the content areas for both development and field testing. Appendix A shows a graphic representation of the basic process flow and overlap of the development cycles.

Mathematics (comprising Mathematics, Algebra I, Algebra II, and Geometry) was developed first. After initial development and internal reviews by DRC, the items were taken to be reviewed by Pennsylvania educators. Upon completion of the educator reviews, edits were incorporated, and items were placed into online field-test fixed-forms for a stand-alone, voluntary field test. For more information regarding the field test, see Chapter Six. After the field test, item statistics were reviewed, and those items that had questionable data were taken to an item data review with Pennsylvania educators. See Chapter Six for more information about this meeting. Following the item data review, all items administered during the field test were reviewed by a committee of Pennsylvania educators for alignment to the Learning Progression Maps. More information about this meeting is found later in this chapter. After the alignment review, committees of Pennsylvania educators participated in a benchmarking activity to determine the points on the scale at which students in each of grades 5 through high school could be considered solidly ready for the next course. For more information about the benchmarking process, see Chapter Ten. Following this set of meetings, the statuses of items were updated, and accepted items were included in the item pool for the operational administrations.

This same process was then repeated for Literature (comprising Reading and Literature) and for Science (comprising Science, Biology, and Chemistry), and then finally for Writing (comprising Writing and English Composition). See Appendix A for more information about the basic development cycles for these three subjects.

Additional items in Mathematics and Reading/Literature were developed for an embedded field test in spring 2013. The purpose of this development was to supplement the pool with additional items aligned to the Pennsylvania Core Standards in preparation for the transition to align all Mathematics and Literacy (Reading/Literature and Writing/English Composition) assessments with the Pennsylvania Core Standards. Following the field test, the items that had questionable data were taken to an item data review with Pennsylvania educators (more information about this meeting can be found in Chapter Six). Following the item data review, all items administered during the field test were reviewed by a committee of Pennsylvania educators for alignment to the Learning Progression Maps using the same procedure that was used for the initial development of each pool of items.

In fall 2013, a voluntary stand-alone field test was conducted for items aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content for grades 3 and 4. These were administered to students in grades 3 through 5, as described in Chapter Six. At the same time, items developed to align to the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content for grade 5 were administered as part of an embedded field test to students in grade 6 that completed an operational CDT administration. The purpose of these two field test administrations was to provide enough items to allow students in grades 3 through 5 to be included in the CDT assessments. The Mathematics Lower Grades, Reading Lower Grades, Science Lower Grades, and Writing Lower Grades assessments became available in spring 2014.

Additional items were developed in 2015 for an embedded field test in 2016. The purpose of this development was to supplement the pool with additional items including Evidence-Based Selected-Response (EBSR) items aligned to the Pennsylvania Core Standards for the reading/literature CDT. These EBSR items were developed to align to the English Language Arts Assessment Anchors and Eligible Content for grades 3 through 8 and were administered as part of an embedded field test to students that completed an operational CDT administration. Additional multiple-choice items were also field tested in mathematics and science.

An additional set of items were developed in 2018 for an embedded field test in 2018. The purpose of this development was to supplement the pool with additional items in mathematics, English language arts and science. These items were aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content. The additional items made for a more robust pool of items from which the Diagnostic Category assessments and the full CDT could draw.

An additional set of items were developed in 2018 and 2019 for science. These items were aligned to the Science Assessment Anchors and Eligible Content. All additional items were technology-enhanced items meant to increase the rigor of the science pool as well as provide alternative ways to assess various science concepts. The additional items made for a more robust pool of science items from which the Diagnostic Category assessments and the full CDT could draw.

An additional set of items were developed in 2021 and 2022 for an embedded field test in 2022 and 2023. The purpose of this development was to supplement the pool with additional items in mathematics, English language arts and science. These items were aligned to the Mathematics and English Language Arts (Reading and Writing) Pennsylvania Core Standards in kindergarten through grade 2, the K–2 Science Assessment Anchors and Eligible Content, and the Mathematics, English Language Arts, and Science Assessment Anchors and Eligible Content. The additional items made for a more robust pool of items from which the Diagnostic Category assessments and the full CDT could draw.

An additional set of items were developed in 2023 and 2024 for science. These items were aligned to the PA STEELS standards. This development effort was meant to begin the transition of the science pool to the PA STEELS standards. The additional items made for a more robust pool of science items from which the Diagnostic Category assessments and the full CDT could draw.

## ITEM DEVELOPMENT CONSIDERATIONS

Alignment to the PSSA and Keystone Assessment Anchors and Eligible Content, grade- or course-level appropriateness (as specified by PDE), depth of knowledge (DOK), item/task level of complexity, estimated difficulty level, relevancy of context, rationale for distractors, style, accuracy, and correct terminology were major considerations in the item development process. The *Standards for Educational and Psychological Testing* (AERA, APA, NCME, 1999) and the *Principles of Universal Design* (Thompson, Johnstone, & Thurlow, 2002) guided the development process. In addition, DRC's *Bias, Fairness, and Sensitivity Guidelines* were used for developing items. All items were reviewed for fairness by bias and sensitivity committees and for content by Pennsylvania educators and field specialists.

## BIAS, FAIRNESS, AND SENSITIVITY OVERVIEW

At every stage of the item and test development process, DRC employs procedures that are designed to ensure that items and tests meet Standard 7.4 of the Standards for Educational and Psychological Testing (AERA, APA, NCME, 1999).

*Standard 7.4: Test developers should strive to identify and eliminate language, symbols, words, phrases, and content that are generally regarded as offensive by members of racial, ethnic, gender, or other groups, except when judged to be necessary for adequate representation of the domain.*

To meet Standard 7.4, DRC employs a series of internal quality steps. DRC provides specific training for test developers, item writers, and reviewers on how to write, review, revise, and edit items for issues of bias, fairness, and sensitivity (as well as for technical quality). Training also includes an awareness of and sensitivity to issues of cultural diversity. In addition to providing *internal* training in reviewing items in order to eliminate potential bias, DRC also provides *external* training to the review panels of minority experts, teachers, and other stakeholders.

DRC’s guidelines for bias, fairness, and sensitivity includes instruction concerning how to eliminate language, symbols, words, phrases, and content that might be considered offensive by members of racial, ethnic, gender, or other groups. Areas of bias that are specifically targeted include, but are not limited to, stereotyping, gender, regional/geographic, ethnic/cultural, socioeconomic/class, religious, experiential, and biases against a particular age group (ageism) or persons with disabilities. DRC catalogues topics that should be avoided and maintains balance in gender and ethnic emphasis within the pool of available items and passages.

## **UNIVERSAL DESIGN OVERVIEW**

The Principles of Universal Design were incorporated throughout the item development process to allow participation of the widest possible range of students in the Classroom Diagnostic Tools. The following checklist was used as a guideline:

- Items measure what they are intended to measure.
- Items respect the diversity of the assessment population.
- Items have a clear format for text.
- Stimuli and items have clear pictures and graphics.
- Items have concise and readable text.
- The arrangement of the items on the test has an overall appearance that is clean and well organized.

A more extensive description of the application of the Principles of Universal Design is found in Chapter Four.

## **DEPTH OF KNOWLEDGE (DOK) OVERVIEW**

An important element in statewide assessments is the alignment between the overall assessment system and the state’s standards. A methodology developed by Norman Webb (1999, 2006) offers a comprehensive model that can be applied to a wide variety of contexts. With regard to the alignment between standards statements and the assessment instruments, Webb’s criteria include five categories, one of which deals with content. Within the content category is a useful set of levels for evaluating depth of knowledge (DOK). According to Webb (1999), “depth-of-knowledge consistency between standards and assessments indicates alignment if what is elicited from students on the assessment is as demanding cognitively as what students are expected to know and do as stated in the standards” (p. 7–8). The four levels of cognitive complexity (i.e., depths of knowledge) are as follows:

- Level 1: Recall
- Level 2: Application of Skill/Concept
- Level 3: Strategic Thinking
- Level 4: Extended Thinking

Depth-of-knowledge levels were incorporated in the item writing and review process, and items were coded with respect to the level each represented.

## **PASSAGE READABILITY OVERVIEW**

Evaluating the readability of a passage is essentially a judgmental process by individuals familiar with the classroom context and what is linguistically appropriate. Although various readability indices were computed and reviewed, it is recognized that such methods measure different aspects of readability and are often fraught with particular interpretive liabilities. Thus, the commonly available readability formulas were not used in a rigid way, but more informally to provide for several snapshots of a passage that senior test development staff considered along with experience-based judgments in guiding the passage selection process. In addition, passages were reviewed by committees of Pennsylvania educators who evaluated each passage for readability and grade-level appropriateness.



## TEST ITEM READABILITY OVERVIEW

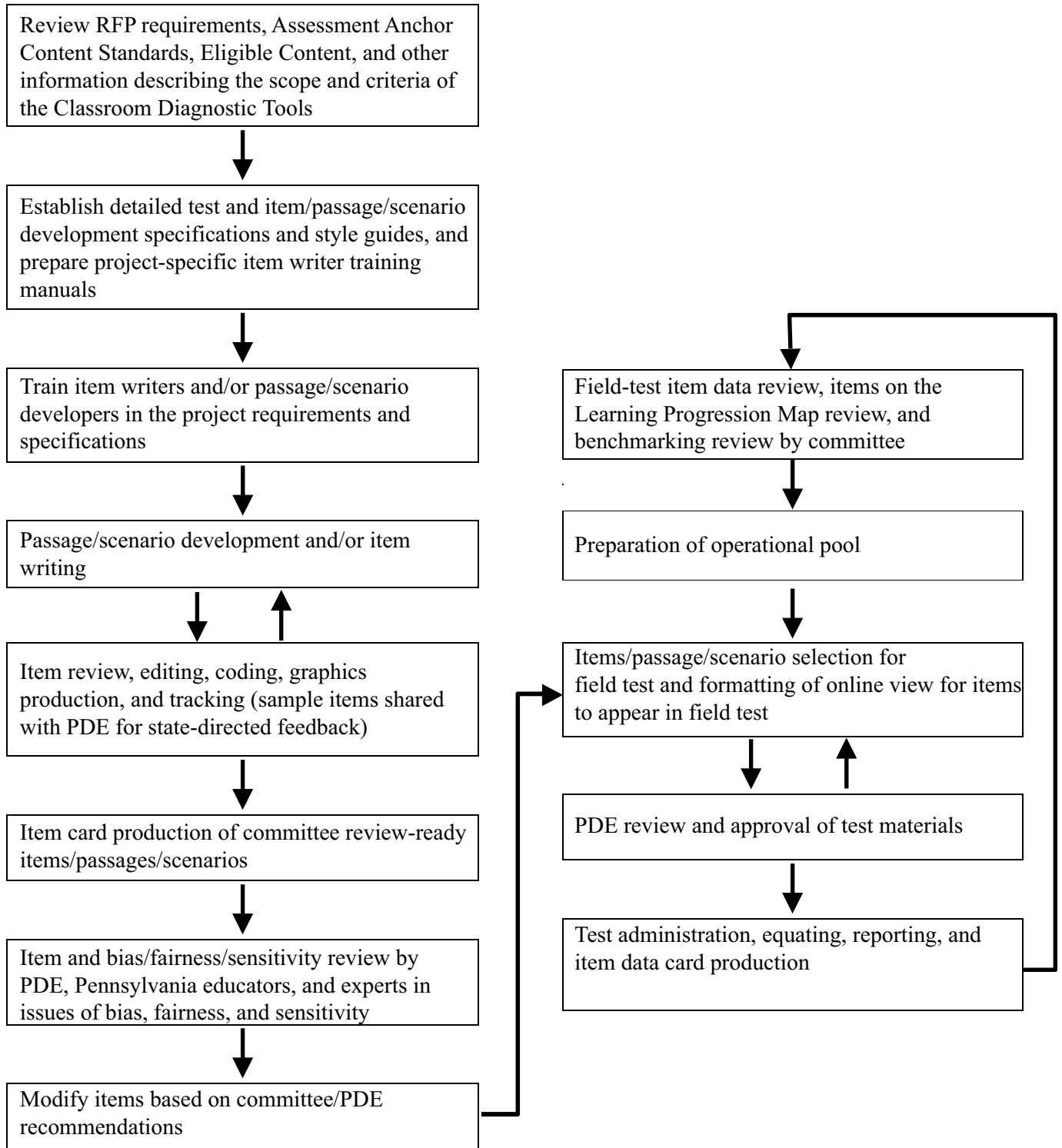
Careful attention was given to the readability of the items to make certain that the assessment focus of the item did not shift based on the difficulty of reading the item. Subject/course areas such as Mathematics, Algebra I, Science, or Biology contain many content-specific vocabulary terms. As a result, readability formulas were not used. However, wherever it was practicable and reasonable, every effort was made to keep the vocabulary at or one level below the grade or course level for non-Reading/Literature items. There was a conscious consideration made to ensure that each question was evaluating a student's ability to build toward mastery of the course standards versus the student's reading ability. Resources used to verify the vocabulary level were the *EDL Core Vocabularies* and the *Children's Writer's Word Book*.

In addition, every test question is brought before committees comprised of Pennsylvania educators who are course-level/grade-level experts in the content field in question. They review each question from the perspective of the students they teach, and they determine the validity of the vocabulary used and work to minimize the level of reading required.

## ITEM AND TEST DEVELOPMENT CYCLE

The item development process for items followed a logical cycle and timeline, which is outlined in the figure on the following page. On the front end of the schedule, tasks were generally completed with the goal of presenting field test candidate items to committees of Pennsylvania educators. On the back end of the schedule, all tasks lead to the field test data review and operational test construction. This presentation represents a typical life cycle for a field test event.

### DRC Item and Test Development Primary Cycle



## **GENERAL ITEM AND TEST DEVELOPMENT PROCESS**

The following describes the processes which lead up to an operational assessment. These processes were used to develop the entire pool of items that appeared within the field test administrations for potential inclusion in the operational item pool.

### **ITEM DEVELOPMENT PLANNING MEETING**

Prior to the start of any item development work, DRC's test development staff meets with PDE's assessment office to discuss the test development plans, including the test blueprint, the field test plan (including development counts), procedures, timelines, etc.

### **ITEM WRITER TRAINING**

Item writers were selected and trained for the subject areas of Mathematics, Algebra I, Algebra II, Geometry, Science, Biology, Chemistry, Reading, Literature, Writing, and English Composition. Qualified writers were college graduates with teaching experience and a demonstrated base of knowledge in the content area. Many of these writers were content assessment specialists and curriculum specialists. The writers were trained individually and had previous experience in writing multiple-choice items. Prior to developing items for the Classroom Diagnostic Tools, the cadre of item writers was trained with regard to the following:

- PSSA and Keystone Assessment Anchors and Eligible Content
- Webb's Levels of Cognitive Complexity, Depth of Knowledge
- Bias, Fairness, and Sensitivity Guidelines
- Principles of Universal Design
- Item Quality Technical Style Guidelines
- Reference Information
- Sample Items

### **LITERATURE PASSAGE DEVELOPMENT**

The task of developing passages was conducted by DRC professionals with classroom experience in reading/English language arts. These professionals also underwent specialized training (provided by DRC) in the characteristics of acceptable passages. Guidelines for passage development included appropriate length, text structure, density, and vocabulary. A judgment was also made about whether the reading level required by a particular passage was at the independent level—that is, where the average student should be able to read 90 percent of words in the text independently. Passage writers were given the task of writing a specified number of passages for each genre. Passages were commissioned by experienced authors.

Passages underwent an internal review by several test development content editors to judge their merit with regard to the following criteria:

- Passages have interest value for students.
- Passages are appropriate in terms of vocabulary and language characteristics.
- Passages are free of bias, fairness, and sensitivity issues.
- Passages represent different cultures.
- Passages are able to stand the test of time.
- Passages are sufficiently rich to generate a variety of multiple-choice items.
- Passages avoid dated subject matter unless a relevant historical context is provided.
- Passages should not require students to have extensive background knowledge in a certain discipline or area to understand a text.

Once through the internal review process, those passages deemed potentially acceptable were reviewed by the Reading Content Committee and Bias, Fairness, and Sensitivity Committee for final approval.

## **ITEM AUTHORIZING AND TRACKING**

Initially, items are generated with software-prepared Classroom Diagnostic Tools Item Cards, which allows for preliminary sorting and reviewing. A column against the right margin includes codes to identify the subject area, grade, content categories, passage information (in the case of reading), item type, depth of knowledge (cognitive complexity), estimated difficulty, answer key, and calculator use (for mathematics items).

All items undergoing field testing were entered into the DRC Item Development and Educational Assessment System (IDEAS), which is a comprehensive, secure, online item banking system. It accommodates item writing, item viewing and reviewing, and item tracking and versioning. IDEAS manages the transition of an item from its developmental stage to its approval for use within a test form. The system supports item history records that include item usage within a form, item-level notes, content categories and subcategories, item statistics from both classical and Rasch item analyses, and classifications derived from analyses of differential item functioning (DIF).

## **INTERNAL REVIEWS**

To ensure that the items produced were sufficient in number and adequately distributed across subcategories and levels of difficulty, item writers were informed of the required quantities of items. As items were written, an item authoring card was completed. It contained information about the item, such as subject, content category, and subcategories. Based on the item writer's classroom teaching experience, knowledge of the content area curriculum, and cognitive demands required by the item, estimates were recorded for level of cognitive complexity and difficulty level. Items were written to provide for a range of difficulties and cognitive complexities.

As part of the item construction process, each item was reviewed by content specialists and editors at DRC. Content specialists and editors evaluated each item to make sure that it measured the intended Eligible Content and Assessment Anchor. They also assessed each item to make certain that it was appropriate for the intended grade and that it provided only one correct answer. In addition, the difficulty level, depth of knowledge, graphics, language demand, and distractors were also evaluated. Other elements considered in this process include, but are not limited to, Universal Design, bias, source of challenge, grammar/punctuation, and Pennsylvania style. Following these reviews, the items were prepared for the content review meetings conducted with Pennsylvania educators.

## **ITEM CONTENT REVIEWS**

Prior to the 2010, 2011, 2013, 2015, 2018, 2019, 2022, 2023 and 2024 field testing, all newly developed test items were submitted to content committees for review. The content committees consisted of Pennsylvania educators from school districts throughout the Commonwealth of Pennsylvania, some with postsecondary university affiliations. The primary responsibility of the content committee was to evaluate items for quality and content classification, including grade-level or course appropriateness, estimated difficulty, depth of knowledge, and source of challenge. With source of challenge, items are identified where the cognitive demand is focused on an unintended content, concept, or skill (Webb, 2002). In addition, source of challenge may be attributed if the reason that an answer could be given results from a cultural bias, an inappropriate reading level, or a flawed graphic in an item, or if an item requires specialized, non-content-related knowledge to answer. Source of challenge could result in a student who has mastered the intended content or skill answering the item incorrectly or a student who has not mastered the intended content or skill answering the item correctly. Committee members were asked to note any items with a source of challenge and to suggest revisions to remove the source of challenge. They also suggested revisions and made recommendations for reclassification of items. The committee members also reviewed the items for adherence to the Principles of Universal Design, including language demand and issues of bias, fairness, and sensitivity.

The content review meetings were held in January 2010 for Mathematics, Algebra I, Algebra II, and Geometry, in May/June 2010 for Reading/Literature, Science, Biology, and Chemistry, and in January 2011 for Writing/English Composition. Additional content review meetings were held in November 2012 (for the additional items aligned to the Pennsylvania Core Standards) and in July 2013 (for the items to allow students in grades 3 through 5 to participate in the CDT). Content review meetings were again held in May of 2015 for Writing items and June of 2015 for Science, Reading, and Math (for additional items aligned to the Pennsylvania Core Standards and the Assessment Anchors and Eligible Content to supplement the pool). Another set of content review meetings took place in January of 2018 to supplement the item pool. Another set of content review meetings took place in January of 2019 for Science technology-enhanced items. In the spring of 2022, another set of content review meetings were held for all content areas. In the spring of 2023 and again in 2024, content review meetings were held for science items. Committee members were approved by PDE, and PDE-approved invitations were sent to them by DRC. PDE also selected internal staff members for attendance. The meeting commenced with a welcome by PDE and DRC. This was followed by an overview of the test development process by DRC. PDE, along with DRC, also provided training on the procedures and forms to be used for item content review.

DRC content assessment specialists facilitated the reviews and were assisted by representatives of PDE. Committee members, grouped by content area, received training by working through and reviewing a group of items for quality and content, as well as for the following categories:

- Assessment Anchor Alignment
- Content Limits
- Grade-Level (Course-Level) Appropriateness
- Difficulty Level
- Depth of Knowledge
- Appropriate Source of Challenge
- Correct Answer
- Quality of Distractors
- Graphics in Regards to Appropriateness
- Appropriate Language Demand
- Freedom from Bias

The members then received a binder containing items to independently review and provided their recommendation for the status of each item: Approved, Accepted with Revision, or Rejected. All comments were reviewed and addressed by DRC content staff, and, when necessary, PDE staff were consulted.

Security was addressed by adhering to a strict set of procedures. All attendees, with the exception of PDE staff, were required to sign a confidentiality agreement. All materials not in use at any time were stored in a locked room. Secure materials that did not need to be retained after the meetings were deposited in secure barrels, the contents of which were shredded.

## **BIAS, FAIRNESS, AND SENSITIVITY REVIEWS**

Prior to field testing, all newly developed test items were also submitted to a Bias, Fairness, and Sensitivity Committee for review. These reviews took place prior to the Item Content Review for each content area. The committee's primary responsibility was to evaluate items with regard to bias, fairness, and sensitivity issues. They also made recommendations for changes or deletion of items in order to remove the potential for issues of bias, fairness, and/or sensitivity. Included in the review were proposed reading passages. An expert, multi-ethnic committee composed of men and women was trained by a DRC test development lead to review items for bias, fairness, and sensitivity issues. Training materials included a manual developed by DRC (DRC, 2003–2013). Members of the committee also had expertise with special-needs students and English Language Learners. All items were read by a cross-section of committee members. Each member noted bias, fairness, and/or sensitivity comments on tracking sheets and on the item, if needed, for clarification. Committee members individually categorized any concerns as related to ageism, disability, ethnicity/culture, gender, region, religion, socioeconomics, or stereotypes. These categories were the framework through which recommendations for modification or rejection of items occurred during the subsequent committee consensus process. The committee discussed each of the issues as a group and came to a consensus as to which issues should represent the view of the committee. All consensus comments were then compiled, and the suggested actions on these items were recorded and submitted to DRC content staff. This review followed the same security procedures as outlined above.

## **ITEMS ALIGNED TO LEARNING PROGRESSION MAPS**

Following the initial field test of items, all items were brought before a committee of Pennsylvania educators for review of each item's alignment to the Learning Progression Map. DRC and PDE provided a general overview of the item and test development process for the Classroom Diagnostic Tools and provided information about the Learning Progression Maps and the purpose of the Classroom Diagnostic Tools. Then the committee reviewed the Learning Progression Map, which shows the vertical articulation of the Assessment Anchors and Eligible Content across grades within a given subject area. Once it was determined that the Learning Progression Map containing the Assessment Anchors and Eligible Content was an accurate representation of how the content progressed across grades, teachers worked in grade-span committees to review items for their alignment with the Assessment Anchor and Eligible Content. When reviewing the alignment to the Assessment Anchor and Eligible Content, educators considered whether the test item measured the content that it purported to measure, as well as the appropriateness of the difficulty and cognitive complexity of the item in relation to the Assessment Anchor and Eligible Content to which the item was aligned. Committees came to a consensus regarding the status of each item: Accepted, Accepted with Revised Alignment, or Rejected.

Security was addressed by adhering to a strict set of procedures. All attendees, with the exception of PDE staff, were required to sign a confidentiality agreement. All materials not in use at any time were stored in a locked room. Secure materials that did not need to be retained after the meetings were deposited in secure barrels, the contents of which were shredded.

# CHAPTER FOUR: UNIVERSAL DESIGN PROCEDURES APPLIED TO THE CLASSROOM DIAGNOSTIC TOOLS TEST DEVELOPMENT PROCESS

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## UNIVERSAL DESIGN

Universally designed assessments allow participation of the widest possible range of students and contribute to valid inferences about participating students. Principles of Universal Design are based on the premise that each child in school is a part of the population to be tested and that testing results should not be affected by disability, gender, race, or English language ability (Thompson, Johnstone, & Thurlow, 2002). At every stage of the item and test development process, procedures were employed to ensure that items and subsequent tests were designed and developed using the elements of universally designed assessments developed by the National Center for Educational Outcomes (NCEO).

Federal legislation addresses the need for universally designed assessments. The No Child Left Behind Act (Elementary and Secondary Education Act) requires that each state must “provide for the participation in [statewide] assessments of all students” [Section 1111(b)(3)(C)(ix)(I)]. Both Title I and IDEA regulations call for universally designed assessments that are accessible and valid for all students, including students with disabilities and English Language Learners. The benefits of universally designed assessments not only apply to these groups of students, but to all individuals with wide-ranging characteristics. Therefore, it is important that the development of all assessments, including voluntary assessments such as the Classroom Diagnostic Tools, be guided by the Principles of Universal Design.

DRC’s test development team was trained in the elements of Universal Design as it relates to developing large-scale statewide assessments. Team leaders were trained directly by NCEO, and other team members were subsequently trained by team leaders. Committees involved in content review included some members who were familiar with the unique needs of students with disabilities and English Language Learners. Likewise some members of the Bias, Fairness, and Sensitivity Committee were conversant with these issues. What follows are the Universal Design guidelines followed during all stages of the item development process for the Classroom Diagnostic Tools.

## ELEMENTS OF UNIVERSALLY DESIGNED ASSESSMENTS

After a review of research relevant to the assessment development process and the Principles of Universal Design (Center for Universal Design, 1997), NCEO has produced seven elements of Universal Design as they apply to assessments (Thompson, Johnstone & Thurlow, 2002). These elements served to guide item development for the Classroom Diagnostic Tools.

- **Inclusive Assessment Population**

The target population includes students attending Commonwealth schools in grades 3 through 12 who will be participating in either the Pennsylvania System of School Assessment or the Keystone Exams.

- **Precisely Defined Constructs**

An important function of well-designed assessments is that they actually measure what they are intended to measure. The Assessment Anchor Content Standards and Eligible Content for both PSSA and the Keystone Exams, as well as the Pennsylvania Academic Standards for Writing, provided clear descriptions of the constructs to be measured by the Classroom Diagnostic Tools assessments. Universally designed assessments must remove all non-construct-oriented cognitive, sensory, emotional, and physical barriers.

- **Accessible, Non-biased Items**

DRC conducted both internal and external reviews of items and test specifications to ensure that they did not create barriers because of lack of sensitivity to disability, culture, or other subgroups. Items and test specifications were developed by a team of individuals who understand the varied characteristics of items that might create difficulties for any group of students. Accessibility is incorporated as a primary dimension of test specifications, so accessibility was woven into the fabric of the test rather than being added after the fact.

- **Amenable to Accommodations**

Even though items on universally designed assessments are accessible for most students, there are some students who continue to need accommodations. This essential element of a universally designed assessment requires that the exam is compatible with accommodations and a variety of widely used adaptive equipment and assistive technology.

- **Simple, Clear, and Intuitive Instructions and Procedures**

Assessment instructions should be easy to understand, regardless of a student's experience, knowledge, language skills, or current concentration level. Questions that are posed using complex language can invalidate the test if students cannot understand how they are expected to respond to a question. To meet this guideline, directions and questions were prepared in simple, clear, and understandable language that underwent multiple reviews.

- **Maximum Readability and Comprehensibility**

A variety of guidelines exist to ensure the maximum readability and comprehensibility of a test. These features go beyond what is measured by readability formulas. Readability and comprehensibility are affected by many factors, including student background, sentence difficulty, text organization, and others. All of these features were considered as item text was developed.

Plain language is a concept now being highlighted in research on assessments. Plain language has been defined as language that is straightforward and concise. The following strategies for editing text to produce plain language were used during the editing process of the Classroom Diagnostic Tools items:

- Reduction of excessive length
- Use of common words
- Avoidance of ambiguous words
- Avoidance of irregularly spelled words
- Avoidance of proper names
- Avoidance of inconsistent naming and graphic conventions
- Avoidance of unclear signals about how to direct attention

- **Maximum Legibility**

Legibility is the physical appearance of text, the way that the shapes of letters and numbers enable people to read text easily. Bias can result when tests contain physical features that interfere with a student's focus on or understanding of the constructs that test items are intended to assess. A style guide was developed and was utilized which included dimensions of style consistent with Universal Design.

## **GUIDELINES FOR UNIVERSALLY DESIGNED ITEMS**

All test items written and reviewed adhered closely to the following guidelines for Universal Design. Item writers and reviewers used a checklist during the item development process to ensure that each aspect was attended to.

1. **Items measure what they are intended to measure.** Item writing training included ensuring that writers and reviewers had a clear understanding of Pennsylvania's Core Standards, Pennsylvania's Academic Standards, and the PSSA and Keystone Assessment Anchors and Eligible Content. During all phases of test development, items were presented with content-standard information to ensure that each item reflected the intended Academic Standard (Mathematics, Reading, and Writing items aligned to Kindergarten, grade 1, or grade 2) or Eligible Content (all other grades and content areas). Careful consideration of the content standards was important in determining which skills involved in responding to an item were extraneous and which were relevant to what was being tested. In certain types of items an additional skill is necessary, such as the Algebra I test, which requires the student to read.



2. **Items respect the diversity of the assessment population.** To develop items that avoid content that might unfairly advantage or disadvantage any student subgroup, item writers, test developers, and reviewers were trained to write and review items to avoid issues of bias, fairness, and sensitivity. Training also included an awareness of, and sensitivity to, issues of cultural and regional diversity.
3. **Items have a clear format for text.** Decisions about how items are presented to students must allow for maximum readability for all students. Appropriate fonts and point sizes were employed with minimal use of italics, which is far less legible and is read considerably more slowly than standard typeface. Captions, keys, and legends were at least a 12-point size, while footnotes and sentence numbers use a 10-point font.<sup>1</sup> Legibility was enhanced by sufficient spacing between letters, words, and lines. Blank space around paragraphs and between columns and staggered right margins were used.
4. **Stimuli and items have clear pictures and graphics.** When pictures and graphics were used, they were designed to provide essential information in a clear and uncluttered manner. Illustrations were placed directly next to the information to which they referred, and labels were used where possible. Sufficient contrast between background and text, with minimal use of shading, increased readability for students with visual impairments. Color was not used to convey important information.
5. **Items have concise and readable text.** Linguistic demands of stimuli and items can interfere with a student's ability to demonstrate knowledge of the construct being assessed. During item writing and review, the following guidelines were used.
  - Simple, clear, commonly used words were used whenever possible.
  - Extraneous text was omitted.
  - Vocabulary and sentence complexity were appropriate for the grade level being assessed.
  - Technical terms and abbreviations were used only if they were related to the content being measured.
  - Definitions and examples were clear and understandable.
  - Idioms were avoided unless idiomatic speech was being assessed.
  - The questions to be answered were clearly identifiable.
6. **Items allow changes to format without changing meaning or difficulty.** An audio accommodation is available in Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Science Lower Grades, Science, Biology, and Chemistry for any student with Individualized Education Program (IEP) requirements related to receiving audio assistance during testing. Additionally, a Magnifier tool that can be used to enlarge an area of the screen is available to all students. This tool can be used at the same time as other tools, such as the Highlighter or Line Guide.
7. **The test has an overall appearance that is clean and organized.** Images, pictures, and text that may not be necessary (e.g., sidebars, overlays, callout boxes, shading, visual crowding caused by excess information) and that could be potentially distracting to students were avoided. Also avoided were purely decorative features that did not serve a purpose. Information was organized in a left-right, top-bottom format.

## ITEM DEVELOPMENT

DRC works closely with the Pennsylvania Department of Education to help ensure that the Classroom Diagnostic Tools comply with nationally recognized Principles of Universal Design. In addition to the Principles of Universal Design as described in the Classroom Diagnostic Tools Technical Report, DRC applies to each exam the standards for test accessibility as described in *Tests Access: Making Tests Accessible for Students with Visual Impairments—A Guide for Test Publishers, Test Developers, and State Assessment Personnel* (Allman, 2004).

To this end, DRC ensures that committee members at item and bias reviews are made aware of the Principles of Universal Design and of issues that may adversely affect students with disabilities with the goal of ensuring that Classroom Diagnostic Tools assessments are bias-free for all students.

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<sup>1</sup> While font size follows specific requirements during online setup of an exam, the screen resolution used at the local level can impact the effective font size visible to the student.

## ITEM FORMAT

For all Classroom Diagnostic Tools assessments, DRC formats the items to maximize accessibility for all students by using text that is in a size and font style that is easily readable. DRC limits shading, graphics, and charts. DRC ensures that graphics, pictures, diagrams, charts, and tables are positioned on the page with the associated test items. DRC uses high contrast for text and background where possible to convey pertinent information.

DRC ensures consistency across Classroom Diagnostic Tools assessments by following these Principles of Universal Design:

- High contrast and clarity is used to convey detailed information.
- Typically, shading is avoided; when necessary for content purposes, 10-percent screens are used as the standard.
- Overlaid print on diagrams, charts, and graphs is avoided.
- Charts, graphs, diagrams, and tables are clearly labeled with titles and with short descriptions where applicable.
- Only relevant information is included in diagrams, pictures, and graphics.
- Symbols used in keys and legends are meaningful and provide reasonable representations of the topics they depict.

## ASSESSMENT ACCOMMODATIONS

While universally designed assessments provide for participation of the widest range of students, many students require accommodations in order to participate in the regular assessment. Clearly, the intent of providing accommodations for students is to ensure that students are not unfairly disadvantaged during testing and that the accommodations used during instruction, if appropriate, are made available as students take the test. The literature related to assessment accommodations is still evolving and often focuses on state policies regulating accommodations rather than on providing empirical data that supports the reliability and validity of the use of accommodations. On a yearly basis, the Pennsylvania Department of Education examines accommodations policies and current research to ensure that valid, acceptable accommodations are available for students. At this time, an audio accommodation is available in Mathematics Lower Grades, Mathematics, Algebra I, Geometry, Algebra II, Science Lower Grades, Science, Biology, and Chemistry for any student with Individualized Education Program (IEP) requirements related to receiving audio assistance during testing. A separate audio accommodation is available for all CDT assessments for students with visual impairments. Additionally, a color choices accommodation allows students who would benefit from a background other than white to select a background color from several choices (in addition to the white background). A contrasting color allows students who would benefit from different text and background color combinations to select from several options (in addition to black text on a white background).

## CHAPTER FIVE: TEST ADMINISTRATION PROCEDURES

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### TEST SETUP

The process to set up students to take the Classroom Diagnostic Tools (CDT) is accomplished through an online interface located on the DRC INSIGHT Portal (<https://www.drcedirect.com/all/eca-portal-ui/welcome/PA>). The DRC INSIGHT Portal is a permission-based site that enables districts to assign users different roles and permissions depending on their role in the setup process. Each district can set up users with as much or as little permission as deemed necessary. A user's role and permission may be modified at any time.

The student and teacher information can be imported into the Portal at any time. Once the data is imported, users organize students into student groups and test sessions. Student groups and test sessions can be created by class, grade, school, or any other variation.

Each student group is assigned to a specific teacher. Students may belong to multiple student groups and multiple teachers can be assigned to the same student group. This allows districts/schools the ability to allow multiple users to view the data by class, grade, or even school. Student groups may be created and modified at any time during the administration window.

Test sessions are generated to create test tickets that are distributed to students prior to testing. A test ticket contains the student's full name, username, password, and the assessment he/she will be taking. The test session, like the student group, may also be created by class, grade, or school. Each time an assessment is administered, a new test session must be created. Test sessions can be copied to simplify administering the CDT to the same students multiple times each year.

### SAMPLE TEST SESSION TICKET

<p><b>CDT</b></p> <p><b>ASHLEE ABBOTT</b></p> <p>Reading/Literature</p> <p>Username: 3924540101</p> <p>Password: SWAM8481</p>
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The CDT is untimed. Each full CDT should take the typical student 50 to 90 minutes to complete and is between 48 and 60 items in length. Each Diagnostic Category (DC) CDT should take the typical student 20–30 minutes to complete. The writing, science and math Diagnostic Category CDTs are between 15–18 items. The reading Diagnostic Category CDTs are between 35–45 items. The CDT may be administered in one sitting, but it is possible to administer the CDT over multiple days and recommended for the Grades 3–5 assessments.

Teachers have flexibility in using the different full and diagnostic category tests within a school year. For instance, some elementary teachers may choose to use the full mathematics CDT at the beginning of the year to understand where their students are starting, and follow-up with DC tests as they go through different units. High school teachers may choose a DC test first, based on the course or unit of study. Regardless of how the CDT is used in the classroom, there should be enough time between CDT administrations to allow for instructional impact to be reflected in the student's results. Though there are no restrictions on the time between CDT administrations, there is a restriction in the Test Setup system that only allows a student to be associated with a single CDT/DC CDT a maximum of five (5) times within a given school year.

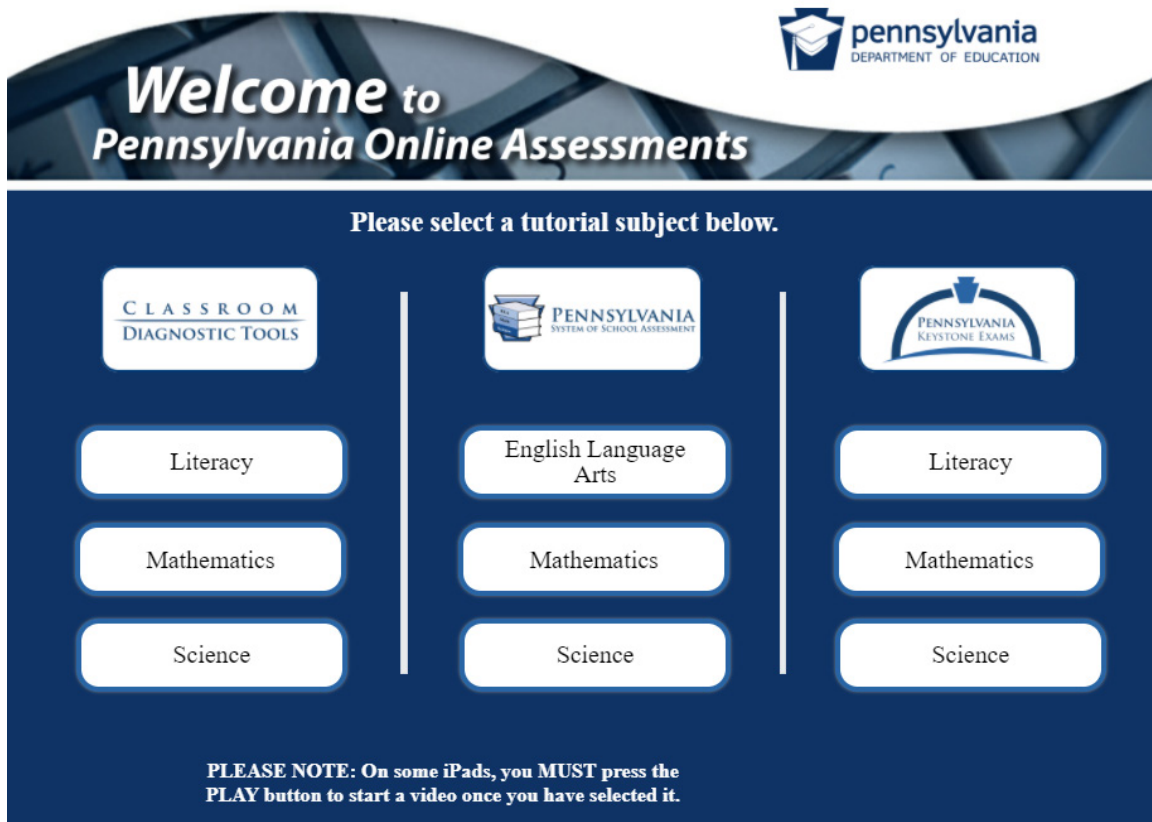
## PA ONLINE ASSESSMENTS SOFTWARE


Prior to testing, each student computer needs to have the PA Online Assessments software installed. The testing software downloads are located on the DRC INSIGHT Portal. The installer is an MSI file that can be pushed out across a server to expedite the installation process. Once the software is installed, users also have access to the PA Assessment Online Student Tutorials and the PA Assessment Online Tools Training (OTT).

The PA Assessment Online Tools Training (OTT) is designed to provide an introductory experience using the online assessment software in preparation for taking the CDT. The purpose of the OTT is for students to observe and experiment with the features of the online assessment software prior to the actual assessment. The OTT is NOT designed to demonstrate complete coverage of the tested content, and it is NOT scored. Rather, sample items have been chosen to demonstrate online assessment features and uses.

Technology coordinators are encouraged to run the Online Tools Training prior to testing because it interacts with DRC servers exactly like an actual CDT assessment. Completion of the OTT will provide a good indication that the software installed correctly, and everything is configured properly on the network.




The web-based PA Online Assessment Student Tutorials are available for each operational assessment and are designed to be used by students at all grade levels. They use pictures, motion, and sound to present visual and verbal descriptions of the features and functionality of the PA Online Assessment system. It is recommended to allow a minimum of 20 minutes to view the tutorials. Tutorials may be reviewed as often as needed.



 **pennsylvania**  
DEPARTMENT OF EDUCATION

# Welcome to Pennsylvania Online Assessments

Please select a tutorial subject below.

 CLASSROOM DIAGNOSTIC TOOLS	 PENNSYLVANIA SYSTEM OF SCHOOL ASSESSMENT	 PENNSYLVANIA KEYSTONE EXAMS
Literacy	English Language Arts	Literacy
Mathematics	Mathematics	Mathematics
Science	Science	Science

**PLEASE NOTE: On some iPads, you MUST press the  
PLAY button to start a video once you have selected it.**

## **TRAINING AND CUSTOMER SERVICE SUPPORT**

Prior to testing, training was provided to District Technology Coordinators and District Assessment Coordinators. All training was administered via web conference and lasted approximately 1½ hours. Test Coordinator Training goes over tasks that need to be completed prior to testing. A large portion of the training is dedicated to the setup of users and the creation of student groups and test sessions.

Technology Coordinator Training focuses on all technical aspects required for the setup of the CDT. Detailed installation instructions for the PA Online Assessments Software and Central Office Services – Service Device (COS-SD) are provided. The COS-SD runs on a server within the local network and helps mitigate internet traffic by allowing student machines to retrieve items from the COS-SD rather than from DRC servers. The CDT requires an internet connection at all times.

Users are encouraged to call or email DRC with any questions or error messages that cannot be resolved. If the problem cannot be resolved via a customer service representative, the issue is escalated to DRC developers. Ninety percent of the time, a solution is provided within twenty-four hours. If the issue requires more research, DRC will contact the caller daily to provide an update.

## CHAPTER SIX: FIELD TEST

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### FIELD TEST OVERVIEW

All items appearing in the 2023–2024 Classroom Diagnostic Tools (CDT) operational item pools were field tested prior to their use on the operational CDT. The purpose of administering field-test items is to obtain statistics for them so they can be reviewed and approved before becoming operational. Based on this statistical review, many of the field-test items were selected for use in the 2023–2024 CDT operational item pools.

There were ten separate CDT field-test events that contributed items to the 2023–2024 operational item pools—four stand-alone field-test events and six embedded field-test events. Separate field-test events were needed because the operational CDT was rolled out in phases by content area and available grades.

There were three stand-alone field-test events to build the item pools for students in grade 6 and above. Items in mathematics were field tested in spring 2010. Items in reading and science were field tested in fall 2010. Items in writing were field tested in spring 2011. During these three field-test events, CDT items were field tested on stand-alone fixed forms. The forms were administered in computer-based format only. No paper/pencil versions were available. Field test administration mode was limited to computer-based to mirror the operational CDT, which is an adaptive test requiring computer administration. CDT stand-alone field tests were designed to build vertical scales across all grades and courses within a content area. In order to accomplish this, some field-test forms had items from one grade above or below in addition to on-grade level items. For example, some grade 7 mathematics forms contained items from grade 6 in addition to items from grade 7. Other grade 7 mathematics forms contained items from both grade 7 and grade 8. See Chapter Nine for more details.

There was one stand-alone field-test event to build the item pools for students in grades 3 through 5. Items in mathematics, reading, science, and writing were field tested in fall 2013. Again, CDT items were field tested on stand-alone fixed forms. The forms were administered in computer-based format only. No paper/pencil versions were available. In order to link to the existing operational scales, some operational grade-level items were included in the field-test forms. See Chapter Twelve for more details.

In addition to the four stand-alone field-test events that contributed items to the 2023–2024 operational item pools, there were six field-test events in which a small number of field-test items were included (embedded) within the operational CDT. In spring 2013, field-test items were included in mathematics and reading. The purpose of this embedded field test was to add items to the operational item pools that align to the Pennsylvania Core Standards. In fall 2013, field-test items were included in mathematics, reading, science, and writing. The purpose of this embedded field test was to field test additional items in grade 5 that could be used in the item pools for students in grades 3 through 5. In 2015–2016, seven of the thirteen CDTs included a small number of embedded field-test items. The purpose of this embedded field test was to supplement the existing item pools and to introduce the evidence-based selected-response (EBSR) item type in the reading content area. In 2018–2019, all CDTs included a small number of embedded field-test items. The purpose of this embedded field test was to supplement the existing item pools in all content areas and grades/courses. In 2019–2020, all CDTs in the science content area except Chemistry included a small number of embedded field-test items. The purpose of the embedded field test was to supplement the existing item pools and to introduce the technology-enhanced (TE) item type. In 2022–2023, all CDTs except Chemistry included a small number of embedded field-test items. The purpose of the embedded field test was to supplement the existing item pools in all content areas.

In 2023–2024, all science CDTs except Chemistry included a small number of embedded field-test items in addition to the operational items used to generate a student’s score. The purpose of the embedded field test was to introduce items aligned to Science, Technology & Engineering, and Environmental Literacy & Sustainability Standards (STEELS). As in previous embedded field tests, field-test items were included within the operational administration and students did not know which items were field-test items (items that do not count toward a student’s score). Therefore, the embedded field-test items can be linked to the existing operational scales. See Chapter Twelve for details.

## FIELD TEST EVENTS PRIOR TO 2023–2024

Details on all field test events prior to 2022–23 can be found in Chapter Six of the 2021–2022 technical report. Starting with the 2022–2023 technical report, Chapter Six covers only the current year field test.

## CDT EMBEDDED FIELD TEST FALL 2023

### SCIENCE

The embedded field test administered in fall 2023 was designed to field test new items aligned to STEELS.

**Table 6–1. Fall 2023 Embedded Field Test Item Pools**

Content Area	Item Grade/Course	Number of MC Items	Number of EBSR or TE Items	Total Number of Items
Science	2	3	3	6
Science	3	3	2	5
Science	4	3	2	5
Science	5	2	3	5
Science	6	3	2	5
Science	7	2	2	4
Science	8	2	4	6
Science	Biology	13	12	25
Science	Chemistry	20	16	36

Starting on August 14, 2023, all CDTs except Chemistry included embedded field-test items:

- Students using grade level tests in science took five field-test items. Since testing occurred throughout the year, items were given to students whose grade matched the item’s grade and to students one grade above the item’s grade (e.g., grade 7 items were given to students in grades 7 and 8).
- Students using CDT Biology and CDT Chemistry took five field-test items from the relevant course.

In all cases, students did not know which items were operational and which were field test. Field test items did not count in calculation of total or diagnostic category scores.

**Table 6–2. Fall 2023 Embedded Field Test Design**

Content Area	CDT	Item Grade/Course	Number of Items Embedded	Student Test Grade(s)
Science	Science Grades 3–5	2	5	3
Science	Science Grades 3–5	3	5	3,4
Science	Science Grades 3–5	4	5	4,5
Science	Science Grades 3–5	5	5	5,6
Science	Science Grades 6–HS	6	5	6,7
Science	Science Grades 6–HS	7	5	7,8
Science	Science Grades 6–HS	8	5	8,9+
Science	Biology	Biology	5	Biology
Science	Chemistry	Chemistry	5	Chemistry

## STATISTICAL ANALYSIS OF ITEM DATA

All field-tested items were analyzed statistically following conventional item analysis methods. For MC items, traditional or classical item statistics included the point-biserial correlation (Pt. Bis.) for the correct and incorrect responses (distractors), percent correct ( $p$ -value), and the percent selecting each incorrect response. For EBSR and TE items, the statistical indices included the item-test correlation, the point-biserial correlation for each score category, and the percent in each score category.

In general, more capable students are expected to respond correctly to easy items and less capable students are expected to respond incorrectly to difficult items. If either of these situations does not occur, the item will be reviewed by DRC test development staff and committees of Pennsylvania educators to determine the nature of the potential problem and the characteristics of the students affected. The primary way of detecting such conditions is through the point-biserial correlation coefficient for MC items and the item-test correlation for EBSR and TE items. In each case the statistic will be positive if the total-test mean score is higher for the students who respond correctly to MC items or attain a higher EBSR or TE score and negative when the reverse is true.

Item statistics are used as a means of detecting items that deserve closer scrutiny rather than as a mechanism for automatic retention or rejection. Toward this end, a set of criteria was used as a screening tool to identify items needing a closer review by committees of Pennsylvania educators.

For an MC item to be flagged, the criteria included any of the following:

- Point-biserial correlation for the correct response of less than 0.10
- Point-biserial correlation for any incorrect response greater than the point-biserial correlation for the correct response
- Differential item functioning (DIF) code of either C- or C+<sup>1</sup>

For an EBSR item to be flagged, the criteria included any of the following:

- Part One point-biserial correlation for the correct response of less than 0.10
- Part One point-biserial correlation for any incorrect response greater than the point-biserial correlation for the correct response
- Score proportion less than 0.05
- Differential item functioning (DIF) code of either C- or C+

For a TE item to be flagged, the criteria included any of the following:

- Item-test correlation less than 0.20
- Score proportion less than 0.05
- Differential item function (DIF) code of either C- or C+

These criteria differ slightly from the criteria used for end-of-year/course summative tests such as the Pennsylvania System of School Assessment (PSSA) or the Keystone Exams. For example, CDT items are not flagged for low and high  $p$ -values. While very easy and very difficult items may not be appropriate for summative tests, they are needed in diagnostic item pools so the computer adaptive item selection routine can find appropriate items for students at various levels.

Item analysis results for all items field tested prior to 2018–19 can be found in Appendix B of the 2017–2018 technical report. For field tests in 2018 or later, item analysis results are in Appendix B of the corresponding year's technical report.

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<sup>1</sup> Items classified as C+ or C- have strong evidence of DIF. The plus sign indicates that the item favors the focal group (female or black or Hispanic) and a minus sign indicates that the item favors the reference group (male or white). For more details, see the section in this chapter on Differential Item Functioning.



## REVIEW OF ITEMS WITH DATA

In the preceding section on Statistical Analysis of Item Data, it was stated that content-area test development specialists used certain statistics from item and DIF analyses of the field tests to identify items for further review. Specific flagging criteria for this purpose were specified in the previous section. Items not identified for this review were those that had good statistical characteristics and, consequently, were regarded as statistically acceptable, or had extremely poor statistical quality and, consequently were regarded as unacceptable, were removed from the CDT item pools, and needed no further review. However, there were some items that DRC content-area test development specialists and DRC psychometric specialists regarded as needing further review by committees of Pennsylvania educators. Items from the 2023-2024 embedded field tests were reviewed by seven Pennsylvania educators in Spring 2024.

At each of the item data review meetings committee members were first trained with regard to the statistical indices used in item evaluation. This was followed by a discussion with examples concerning reasons that an item might be retained regardless of the statistics. The committee review process involved a brief exploration of possible reasons for the statistical profile of an item (e.g., possible sensitivity/bias, grade appropriateness, instructional issues) and a decision regarding acceptance. DRC content-area test development specialists facilitated the review of the items. Each committee reviewed the pool of field-test items and made recommendations (i.e., accept or reject) for each item.

**Table 6–3. CDT Data Review Results for Science in April 2024**

Grade/Course	Number of Items Field Tested	Number Flagged and Examined at Data Review Committee	Percent Flagged and Examined at Data Review Committee	Number Rejected by Data Review Committee	Percent Rejected by Data Review Committee	Number Removed from CDT Item Pools (all sources)*	Percent Removed from CDT Item Pools (all sources)*
K–2	6	1	16.7%	0	0.0%	0	0.0%
3	5	0	0.0%	0	0.0%	0	0.0%
4	5	1	20.0%	1	20.0%	1	20.0%
5	5	1	20.0%	0	0.0%	1	20.0%
6	5	0	0.0%	0	0.0%	0	0.0%
7	4	1	25.0%	0	0.0%	1	25.0%
8	6	2	33.3%	1	17.7%	1	17.7%
Biology	25	0	0.0%	0	0.0%	0	0.0%
Chemistry	36	15	41.7%	13	36.1%	13	36.1%

\*Data Review Committee, PDE, and DRC

## DIFFERENTIAL ITEM FUNCTIONING

Differential item functioning (DIF) occurs when examinees with the same ability level but different group memberships do not have the same probability of answering an item correctly. This pattern of results may suggest the presence of item bias. As a statistical concept, however, DIF can be differentiated from item sensitivity/bias, which is a content issue that can arise when an item presents negative group stereotypes, uses language that is more familiar to one subpopulation than to another, or is presented in a format that disadvantages certain learning styles. While the source of item sensitivity/bias is often easily recognized by trained judges, DIF may have no clear cause. However, studying how DIF arises and how it presents itself can help to detect and correct for it.

## LIMITATIONS OF STATISTICAL DETECTION

No statistical procedure should be used as a substitute for rigorous, hands-on reviews by content and bias specialists. The statistical results can help organize the review so the effort is concentrated on the most problematic cases. Further, no items should be automatically rejected simply because a statistical method flagged them or accepted because they were not flagged.

Statistical detection of DIF is an inexact science. There have been a variety of methods proposed for detecting DIF, but no one statistic can be considered either necessary or sufficient. Different methods are more or less successful depending on the situation. No analysis can guarantee that a test is free of bias, but almost any thoughtful analysis will uncover the most flagrant problems.

A fundamental shortcoming of all statistical methods used in DIF evaluation is that all are intrinsic to the test being evaluated. If a test is unbiased overall but contains one or two DIF items, any method will locate the problems. If, however, all items on the test show consistent DIF to the disadvantage of a given subpopulation, a statistical analysis of the items will not be able to separate DIF effects from true differences in achievement.

## **MANTEL-HAENSZEL PROCEDURE OF DIFFERENTIAL ITEM FUNCTIONING**

For MC items, the Mantel-Haenszel (MH) procedure (Mantel & Haenszel, 1959) for detecting differential item functioning is a commonly used technique in educational testing. It does not depend on the application or the fit of any specific measurement model. However, it does have significant philosophical overlap with the Rasch model since it uses a test's total score to organize the analysis.

The procedure as implemented by DRC contrasts a focal group with a reference group. While it makes no practical difference in the analysis which group is defined as the focal group, the group most apt to be disadvantaged by a biased measurement is typically defined as the focal group. In these analyses, the focal group was female for gender-based DIF and black or Hispanic<sup>2</sup> for ethnicity-based DIF; reference groups were male and white respectively. The MH statistic for each item is computed from a contingency table. It has two groups (focal and reference) and two outcomes (right or wrong). The ability groups are defined by the test's score distribution for the total examinee population.

The basic MH statistic is a single degree of freedom chi-square that compares the observed number in each cell to the expected number. The expected counts are computed to ensure that the analysis is not confounded with differences in the achievement level of the two groups.

For EBSR and TE items, a comparable statistic is computed based on the standardized mean difference (SMD) (Dorans, Schmitt, & Bleistein, 1992), which is computed as the differences in mean scores for the focal and reference groups if both groups had the same score distribution.

To assist the review committees in interpreting the analyses, the items are assigned a severity code based on the magnitude of the DIF statistic. Items classified as A+ or A- have little or no statistical indication of DIF. Items classified as B+ or B- have some indication of DIF but may be judged to be acceptable for future use. Items classified as C+ or C- have strong evidence of DIF and should be reviewed and possibly rejected from the eligible item pool. The plus sign indicates that the item favors the focal group and a minus sign indicates that the item favors the reference group.

## **RESULTS AND OBSERVATIONS**

Counts of the number of items field tested from each content area and grade/course that were assigned to each severity code are shown in Table 6-4. Some field-test items are classified as N/A (not applicable) because the number of students in either the reference or focal groups who took the item was insufficient for analysis. Where there are sufficient data to run DIF analyses, relatively few items had B or C DIF for the Male/Female, White/Black, or White/Hispanic reference and focal groups.

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<sup>2</sup> Based on the population of CDT testers, ethnicity DIF on the white/Hispanic pairing was not run prior to 2018.

**Table 6–4a. Gender DIF Summary for Science in April 2024**

Grade/ Course	Number of Field-test items	Male/ Female A+	Male/ Female A-	Male/ Female B+	Male/ Female B-	Male/ Female C+	Male/ Female C-	Male/ Female N/A*
2	6	2	4	0	0	0	0	0
3	5	3	2	0	0	0	0	0
4	5	2	3	0	0	0	0	0
5	5	3	2	0	0	0	0	0
6	5	3	2	0	0	0	0	0
7	4	2	2	0	0	0	0	0
8	6	2	4	0	0	0	0	0
Biology	25	12	11	0	2	0	0	0
Chemistry	36	17	17	0	2	0	0	0

**N/A\*** Items with insufficient counts for DIF analysis.

The plus sign indicates that the item favors the focal group (female) and a minus sign indicates that the item favors the reference group (male).

**Table 6–4b. Ethnicity DIF Summary for Science in May 2023**

Grade/ Course	Number of Field-test items	White/ Black A+	White/ Black A-	White/ Black B+	White/ Black B-	White/ Black C+	White/ Black C-	White/ Black N/A*	White/ Hispanic A+	White/ Hispanic A-	White/ Hispanic B+	White/ Hispanic B-	White/ Hispanic C+	White/ Hispanic C-	White/ Hispanic N/A*
2	6	4	1	0	0	0	1	0	2	4	0	0	0	0	0
3	5	2	3	0	0	0	0	0	4	1	0	0	0	0	0
4	5	1	3	0	0	0	1	0	0	4	0	0	0	1	0
5	5	3	2	0	0	0	0	0	3	2	0	0	0	0	0
6	5	1	4	0	0	0	0	0	1	4	0	0	0	0	0
7	4	0	4	0	0	0	0	0	1	3	0	0	0	0	0
8	6	2	4	0	0	0	0	0	2	4	0	0	0	0	0
Biology	25	5	20	0	0	0	0	0	7	18	0	0	0	0	0
Chemistry	36	11	20	1	4	0	0	0	9	18	3	3	0	3	0

**N/A\*** Items with insufficient counts for DIF analysis.

The plus sign indicates that the item favors the focal group (black or Hispanic) and a minus sign indicates that the item favors the reference group (white).

## CHAPTER SEVEN: CLASSICAL ITEM STATISTICS

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This chapter provides an overview of the two most familiar item-level statistics obtained from classical (traditional) item analysis: item difficulty and item discrimination. The summary tables in this chapter pertain to all items field tested in the stand-alone and embedded field-test events. Other statistics such as Rasch item statistics are discussed in Chapter Eight.

### ITEM-LEVEL STATISTICS

Classical item statistics for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Classical item statistics for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year’s technical report. In all versions of Appendix B, results are organized by content area, field-test event, and item type (multiple-choice, evidence-based selected-response, and technology-enhanced). These statistics represent the item characteristics most often used to determine whether an item functioned properly and/or how a group of students performed on a particular item. The item statistics in Appendix B include:

- Number of students taking the item (denoted as  $N$ )
- Indicators of item difficulty (denoted as  $P_{Val}$ )
  - $p$ -values for multiple-choice (MC) items
  - item mean divided by maximum possible item score for evidence-based selected-response (EBSR) and technology-enhanced (TE) items
- Proportions by response option or score point
  - proportions of students who chose each response option for MC items (denoted as  $P(A)$ ,  $P(B)$ ,  $P(C)$ ,  $P(D)$ )
  - proportions of students who gained each score point for EBSR and TE items (denoted as  $P(0)$ ,  $P(1)$ ,  $P(2)$ , and/or  $P(3)$ )
  - Proportions of students who did not respond to an item (denoted as  $P(-)$ )
- Indicators of item discrimination
  - item-total correlations (denoted as  $P_{tBis}$ )
  - point-biserial correlation for each response option for MC items (denoted as  $PT(A)$ ,  $PT(B)$ ,  $PT(C)$ , and  $PT(D)$ )
  - point-biserial correlation for each score point for EBSR and TE items (denoted as  $PT(0)$ ,  $PT(1)$ ,  $PT(2)$ , and  $PT(3)$ )

### ITEM DIFFICULTY

At the most general level, an item’s difficulty is indicated by its mean score in some specified group (e.g., grade level).

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^n x_i$$

In the mean score formula above, the individual item scores ( $x_i$ ) are summed and then divided by the total number of students ( $n$ ). For MC items, student scores are represented by 0s and 1s (0 = wrong, 1 = right). With 0/1 scoring, the equation above also represents the number of students correctly answering the item divided by the total number of students. So, this is also the *proportion correct* for the item, or as it is better known, the  $p$ -value. In theory,  $p$ -values can range from 0.00<sup>1</sup> to 1.00 on the proportion-correct scale. For example, if an item has a  $p$ -value of 0.89, it means 89 percent of the students answered the item correctly. Additionally, this value might also suggest that the item is relatively easy and/or the students who attempted the item are relatively high achievers. In other words, item difficulty and student ability are somewhat confounded.

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<sup>1</sup> For multiple-choice (MC) items with four response options, pure random guessing would lead to an expected  $p$ -value of 0.25.

For EBSR items, mean scores can range from the minimum possible score of zero to the maximum possible score of either two or three depending upon the item. Similarly, for TE items, mean scores can range from the minimum possible score of zero to the maximum possible score of either one or two depending upon the item. A *pseudo p*-value is provided for EBSR and TE items by dividing the mean item score by the maximum possible item score.

The minimum and maximum extremes of the difficulty scale are virtually never seen in applied practice. However, understanding what those values are helps illustrate that relatively lower values correspond to more difficult items and that relatively higher values correspond to easier items. (Because of this, some assert that this index would be better referred to as the item's *easiness*.)

Item difficulty is an important consideration for the Classroom Diagnostic Tools (CDT) because it is a computer adaptive test. The item selection routine selects items based on student performance during the test. While very easy or very difficult items may not be appropriate for many students, they are needed in the CDT item pools to ensure that the item selection routine can find appropriate items for students at various levels.

Utilizing the proportion of students who chose each MC option can be helpful for verifying keys. For example, if a large proportion of students chose a distractor instead of the key answer, it may, but not always, indicate the key is not correct.

## ITEM DISCRIMINATION

At the most general level, item discrimination<sup>2</sup> indicates an item's ability to differentiate between high and low achievers. It is expected that students with high ability (i.e., those who perform well on the CDT overall) would be more likely to answer any given CDT item correctly, while students with low ability (i.e., those who perform poorly on the CDT overall) would be more likely to answer the same item incorrectly. For the CDT, Pearson's product-moment correlation coefficient between item scores and test scores is used to indicate discrimination. The correlation coefficient can range from -1.0 to +1.0. If the aforementioned expectation is met (high-scoring students tend to get the item right while low-scoring students do not), the correlation between the item score and the total test score will be both positive and noticeably large in its magnitude (i.e., well above zero), meaning the item is a good discriminator between high- and low-ability students.

Item total correlation for each option is another indicator of an item's ability to differentiate between high and low achievers. It is expected that students with high ability (i.e., those who perform well on the CDT overall) would be less likely to choose any distractors, while students with low ability (i.e., those who perform poorly on the CDT overall) would be more likely to choose a distractor. In other words, the item total correlations for the distractors are expected to be negative.

In summary, the correlation will be positive in value when the mean test score of the students answering the item correctly is higher than the mean test score of the students answering the item incorrectly.<sup>3</sup> In other words, this indicates that students who did well on the total test tended to do well on the item, as well. However, an interaction can exist between item discrimination and item difficulty. Items answered correctly (or incorrectly) by a large proportion of examinees (i.e., they have extreme *p*-values) can have reduced power to discriminate, and, thus, can have lower correlations.

Discrimination is an important consideration for the operational CDT because the use of more discriminating items on a test is associated with more precise score estimates (i.e., there will be smaller confidence intervals around the scores).

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<sup>2</sup> As noted earlier, the discrimination index for dichotomous MC items is typically referred to as the *point-biserial correlation coefficient*. For EBSR and TE items, the *item-test correlation* is sometimes used.

<sup>3</sup> It is legitimate to view the point-biserial correlation as a standardized mean. A positive value indicates students who chose that response had a higher mean score than the average student; a negative value indicates students who chose that response had a lower-than-average mean score.

## OBSERVATIONS AND INTERPRETATIONS

Table 7–1 provides the mean  $p$ -values and point-biserial correlations for the CDT item pools in each content area. The mean  $p$ -value ranged from 0.199 to 0.824. The mean point-biserial correlations ranged from 0.145 to 0.530.

It is difficult to make global conclusions about overall quality from these item statistics alone. With that caveat in mind, the results presented in this chapter indicate that the CDT item pools contain items within expected and acceptable ranges of item difficulty and discrimination.

**Table 7–1. Mean  $P$ -value and Point-Biserial**

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean $P$ -value	Mean Point-Biserial
Aug 2010	Mathematics	3	86	0.824	0.415
Aug 2010	Mathematics	4	86	0.737	0.414
Aug 2010	Mathematics	5	85	0.717	0.439
Aug 2010	Mathematics	6	259	0.684	0.413
Aug 2010	Mathematics	7	258	0.575	0.432
Aug 2010	Mathematics	8	257	0.497	0.361
Aug 2010	Mathematics	11	149	0.521	0.339
Aug 2010	Mathematics	Algebra I	256	0.411	0.317
Aug 2010	Mathematics	Geometry	257	0.439	0.349
Aug 2010	Mathematics	Algebra II	256	0.419	0.369
Jan 2011	Reading	3	86	0.595	0.437
Jan 2011	Reading	4	87	0.665	0.440
Jan 2011	Reading	5	86	0.666	0.433
Jan 2011	Reading	6	210	0.607	0.423
Jan 2011	Reading	7	192	0.679	0.395
Jan 2011	Reading	8	192	0.623	0.404
Jan 2011	Reading	Literature	348	0.568	0.408
Jan 2011	Science	3	91	0.637	0.371
Jan 2011	Science	4	123	0.602	0.348
Jan 2011	Science	5	102	0.482	0.335
Jan 2011	Science	6	178	0.503	0.322
Jan 2011	Science	7	327	0.486	0.322
Jan 2011	Science	8	377	0.504	0.335
Jan 2011	Science	11	115	0.381	0.238
Jan 2011	Science	Biology	390	0.420	0.294
Jan 2011	Science	Chemistry	335	0.355	0.255
Aug 2011	Writing	3	140	0.584	0.392
Aug 2011	Writing	4	149	0.566	0.372
Aug 2011	Writing	5	165	0.566	0.380
Aug 2011	Writing	6	193	0.556	0.369
Aug 2011	Writing	7	176	0.550	0.346

**Table 7–1 (continued). Mean *P*-value and Point-Biserial**

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean <i>P</i> -value	Mean Point-Biserial
Aug 2011	Writing	8	195	0.538	0.332
Aug 2011	Writing	English Composition	365	0.514	0.357
July 2013	Mathematics	6	156	0.448	0.290
July 2013	Mathematics	7	73	0.431	0.257
July 2013	Mathematics	8	157	0.354	0.204
July 2013	Reading	6	56	0.585	0.351
July 2013	Reading	7	58	0.545	0.339
July 2013	Reading	8	57	0.577	0.358
Jan 2014	Mathematics	K	60	0.798	0.408
Jan 2014	Mathematics	1	90	0.801	0.426
Jan 2014	Mathematics	2	130	0.695	0.437
Jan 2014	Mathematics	3	235	0.596	0.413
Jan 2014	Mathematics	4	248	0.595	0.413
Jan 2014	Mathematics	5	221	0.508	0.326
Jan 2014	Reading	K	84	0.734	0.426
Jan 2014	Reading	1	98	0.575	0.415
Jan 2014	Reading	2	98	0.506	0.441
Jan 2014	Reading	3	178	0.546	0.398
Jan 2014	Reading	4	189	0.577	0.413
Jan 2014	Reading	5	134	0.566	0.364
Jan 2014	Science	K–2 span	280	0.619	0.404
Jan 2014	Science	3	155	0.641	0.391
Jan 2014	Science	4	213	0.570	0.362
Jan 2014	Science	5	152	0.424	0.240
Jan 2014	Writing	K	44	0.823	0.462
Jan 2014	Writing	1	118	0.729	0.444
Jan 2014	Writing	2	117	0.642	0.444
Jan 2014	Writing	3	60	0.626	0.415
Jan 2014	Writing	4	60	0.642	0.398
Jan 2014	Writing	5	71	0.550	0.326
June 2016	Mathematics	6	122	0.473	0.298
June 2016	Mathematics	7	177	0.456	0.286
June 2016	Mathematics	8	151	0.396	0.232
June 2016	Mathematics	Algebra I	150	0.414	0.228
June 2016	Reading	3	22	0.467	0.430
June 2016	Reading	4	22	0.568	0.421
June 2016	Reading	5	22	0.603	0.394

**Table 7–1 (continued). Mean *P*-value and Point-Biserial**

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean <i>P</i> -value	Mean Point-Biserial
June 2016	Reading	6	126	0.535	0.360
June 2016	Reading	7	126	0.557	0.397
June 2016	Reading	8	126	0.577	0.398
June 2016	Reading	Literature	126	0.532	0.339
June 2016	Science	6	72	0.431	0.233
June 2016	Science	7	159	0.446	0.231
June 2016	Science	8	238	0.447	0.236
June 2016	Science	Biology	136	0.439	0.246
June 2016	Writing	6	93	0.531	0.327
June 2016	Writing	7	93	0.522	0.322
June 2016	Writing	8	110	0.504	0.308
June 2016	Writing	English Composition	104	0.485	0.298
March 2019	Mathematics	K	20	0.778	0.362
March 2019	Mathematics	1	20	0.758	0.389
March 2019	Mathematics	2	20	0.672	0.422
March 2019	Mathematics	3	178	0.602	0.379
March 2019	Mathematics	4	179	0.578	0.362
March 2019	Mathematics	5	180	0.569	0.350
March 2019	Mathematics	6	96	0.495	0.321
March 2019	Mathematics	7	103	0.476	0.328
March 2019	Mathematics	8	99	0.401	0.256
March 2019	Mathematics	Algebra I	299	0.401	0.246
March 2019	Mathematics	Geometry	100	0.378	0.228
March 2019	Mathematics	Algebra II	100	0.375	0.230
March 2019	Reading	K	32	0.527	0.368
March 2019	Reading	1	20	0.500	0.389
March 2019	Reading	2	32	0.459	0.343
March 2019	Reading	3	162	0.448	0.353
March 2019	Reading	4	162	0.484	0.357
March 2019	Reading	5	162	0.483	0.352
March 2019	Reading	6	123	0.508	0.371
March 2019	Reading	7	123	0.476	0.343
March 2019	Reading	8	120	0.503	0.356
March 2019	Reading	Literature	249	0.491	0.340
March 2019	Science	K-2 span	31	0.515	0.321
March 2019	Science	3	89	0.501	0.303
March 2019	Science	4	95	0.474	0.287



**Table 7–1 (continued). Mean *P*-value and Point-Biserial**

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean <i>P</i> -value	Mean Point-Biserial
March 2019	Science	5	90	0.439	0.273
March 2019	Science	6	97	0.446	0.265
March 2019	Science	7	99	0.479	0.294
March 2019	Science	8	102	0.459	0.269
March 2019	Science	Biology	290	0.421	0.267
March 2019	Science	Chemistry	110	0.356	0.155
March 2019	Writing	K	10	0.713	0.491
March 2019	Writing	1	10	0.520	0.351
March 2019	Writing	2	12	0.445	0.281
March 2019	Writing	3	99	0.525	0.349
March 2019	Writing	4	90	0.589	0.364
March 2019	Writing	5	90	0.549	0.351
March 2019	Writing	6	93	0.517	0.329
March 2019	Writing	7	111	0.518	0.342
March 2019	Writing	8	93	0.514	0.333
March 2019	Writing	English Composition	294	0.475	0.285
May 2020	Science	3	19	0.458	0.336
May 2020	Science	4	22	0.300	0.282
May 2020	Science	5	20	0.293	0.307
May 2020	Science	6	18	0.284	0.275
May 2020	Science	7	19	0.312	0.283
May 2020	Science	8	20	0.283	0.294
March 2023	Mathematics	K	5	0.798	0.367
March 2023	Mathematics	1	10	0.606	0.431
March 2023	Mathematics	2	21	0.613	0.406
March 2023	Mathematics	3	103	0.569	0.388
March 2023	Mathematics	4	120	0.533	0.369
March 2023	Mathematics	5	135	0.529	0.360
March 2023	Mathematics	6	100	0.485	0.314
March 2023	Mathematics	7	124	0.407	0.263
March 2023	Mathematics	8	85	0.387	0.252
March 2023	Mathematics	Algebra I	149	0.344	0.186
March 2023	Mathematics	Geometry	45	0.363	0.190
March 2023	Mathematics	Algebra II	45	0.293	0.150
March 2023	Reading	K	18	0.488	0.406
March 2023	Reading	1	30	0.467	0.376
March 2023	Reading	2	30	0.458	0.383

**Table 7–1 (continued). Mean *P*-value and Point-Biserial**

Meeting Date	Content Area	Grade/Course	Number of Items Field Tested	Mean <i>P</i> -value	Mean Point-Biserial
March 2023	Reading	3	126	0.496	0.425
March 2023	Reading	4	101	0.494	0.404
March 2023	Reading	5	107	0.496	0.375
March 2023	Reading	6	132	0.496	0.390
March 2023	Reading	7	132	0.483	0.370
March 2023	Reading	8	185	0.532	0.421
March 2023	Reading	Literature	187	0.507	0.398
May 2023	Science	K-2 span	9	0.484	0.401
May 2023	Science	3	9	0.496	0.360
May 2023	Science	4	4	0.446	0.310
May 2023	Science	5	13	0.411	0.305
May 2023	Science	6	4	0.459	0.363
May 2023	Science	7	11	0.334	0.206
May 2023	Science	8	28	0.379	0.252
May 2023	Science	Biology	20	0.339	0.247
May 2023	Science	Chemistry	0	N/A	N/A
March 2023	Writing	K	2	0.733	0.525
March 2023	Writing	1	3	0.647	0.530
March 2023	Writing	2	5	0.483	0.345
March 2023	Writing	3	20	0.483	0.352
March 2023	Writing	4	25	0.596	0.397
March 2023	Writing	5	35	0.613	0.445
March 2023	Writing	6	35	0.614	0.426
March 2023	Writing	7	40	0.513	0.383
March 2023	Writing	8	33	0.559	0.413
March 2023	Writing	English Composition	20	0.476	0.344
April 2024	Science	K-2 span	6	0.443	0.310
April 2024	Science	3	5	0.613	0.319
April 2024	Science	4	5	0.544	0.357
April 2024	Science	5	5	0.271	0.200
April 2024	Science	6	5	0.405	0.366
April 2024	Science	7	4	0.214	0.167
April 2024	Science	8	6	0.199	0.211
April 2024	Science	Biology	25	0.326	0.297
April 2024	Science	Chemistry	36	0.279	0.145

## CHAPTER EIGHT: RASCH ITEM CALIBRATION

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The particular item response theory (IRT) model used for the Classroom Diagnostic Tools (CDT) is based on the work of Georg Rasch. Rasch models have had a long-standing presence in applied testing programs and have been the methodology used to calibrate the Pennsylvania System of School Assessment (PSSA) items and Keystone Exam items. Consequently, this model was chosen to be used for the CDT. IRT has several advantages over classical test theory, so it has become the standard procedure for analyzing item response data in large-scale assessments. However, IRT models make a number of strong assumptions related to dimensionality, local independence, and model-data fit. Resulting inferences derived from any application of IRT rest strongly on the degree to which the underlying assumptions are met.

This chapter outlines the procedures used for calibrating the CDT items. Generally, item calibration is the process of assigning a difficulty-parameter estimate to each item so that they are placed onto a common scale. This chapter briefly introduces the Rasch model and reports the results from evaluations of the adequacy of the Rasch assumptions. See Chapter Nine for a description of the common scale across grades and courses within a content area and for summaries of the Rasch item statistics for the CDT item pools.

### DESCRIPTION OF THE RASCH MODEL

The Rasch partial credit model (RPCM) (Wright & Masters, 1982) was used to calibrate CDT items because the item pools contain multiple item types. The RPCM extends the Rasch model (Rasch, 1960) for dichotomous multiple-choice (0, 1) items so that it accommodates the polytomous evidence-based selected-response and technology-enhanced items. Under the RPCM, for a given item  $i$  with  $m_i$  score categories, the probability of person  $n$  scoring  $x$  ( $x = 0, 1, 2, \dots, m_i$ ) is given by:

$$P_{ni}(X = x) = \frac{\exp \sum_{j=0}^x (\theta_n - D_{ij})}{\sum_{k=0}^{m_i} \exp \sum_{j=0}^k (\theta_n - D_{ij})}, \quad x = 0, 1, \dots, m_i$$

where  $\theta_n$  represents a student's proficiency (ability) level, and  $D_{ij}$  is the step difficulty of the  $j^{\text{th}}$  step on item  $i$ . For dichotomous MC items, the RPCM reduces to the standard Rasch model and the single step difficulty is referred to as the item's difficulty. The Rasch model predicts the probability of person  $n$  getting item  $i$  correct as follows:

$$P_{ni}(X = 1) = \frac{\exp(\theta_n - D_{ij})}{1 + \exp(\theta_n - D_{ij})}$$

The Rasch model places both student ability and item difficulty (estimated in terms of log-odds or logits) on the same continuum. When the model assumptions are met, it also provides person ability estimates that are independent of the items employed in the assessment, and, conversely, estimates item difficulty independently of the sample of examinees.

### SOFTWARE AND ESTIMATION ALGORITHM

Item calibration was implemented via the WINSTEPS 3.71 computer program (Linacre, 2009). The unconditional, joint maximum likelihood (UCON) estimation procedure estimates the person parameters (i.e., ability) simultaneously with the item parameters (i.e., difficulty).

## CHECKING RASCH ASSUMPTIONS

Because the Rasch model was the basis of all calibration, scoring, and scaling analyses associated with the CDT, the validity of the inferences from these results depends on the degree to which the assumptions of the model are met and how well the model fits the test data. Therefore, it is important to check these assumptions. This section evaluates the dimensionality of the data, local item independence, and model-data fit at the item level. Though a variety of methods are available for assessing these issues, the Rasch analyses and criteria available from WINSTEPS were used here.

### UNIDIMENSIONALITY

Rasch models assume that one dominant dimension determines the difference in students' performances. WINSTEPS provides results from a principal components analysis (PCA) that can be used to assess the unidimensionality assumption. Different from standard applications of PCA, WINSTEPS conducts its PCA on the response residuals, not the original observations. That is, the primary dimension from the Rasch model is removed first and then the residual variance is analyzed. The purpose of the analysis is to verify whether any other dominant components exist among the residuals (i.e., they account for a practically significant amount of residual variance). If any other dimensions are found, the unidimensionality assumption would be violated. For CDT, the standardized residuals were used to conduct the PCA because simulation studies indicate that it gives the most accurate reflection of secondary dimensions in the items (Linacre, 2009).

Table 8–1 presents the PCA results for the CDT Mathematics item pool. The results include the total variance, variance explained by the model, unexplained total variance, and unexplained variance explained by the first factor (both eigenvalue units and percentage values are shown in the table). In addition, the modeled column provides variance components that would be explained if the data complied with the Rasch definition of unidimensionality.

As can be seen from Table 8–1, the primary dimension in the Rasch model explained between 21 and 63 percent of the total variances across the grades and courses. The empirical and model-based percentages were close, suggesting that the estimation of a primary Rasch dimension was successful. The unexplained variances were between 38 and 79 percent. This includes the Rasch-predicted randomness and any departures in the data from the Rasch model (e.g., departure from unidimensionality).

The most important variance for evaluating dimensionality is in the row named “unexplained variance explained by 1st factor.” The eigenvalue of unexplained total variance equals the total number of items, since PCA was conducted with residuals. The eigenvalues of the first factor in the residual (again, this is the second dimension beyond the first Rasch model dimension in WINSTEPS PCA) were between 0.2 and 1.8 percent. Overall, WINSTEPS PCA suggests that there is one clearly dominant dimension for the CDT mathematics item pool.

**Table 8–1. Results from PCA of Residuals in WINSTEPS for Mathematics**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2010	3	Total variance in observations	208.5	100.0%	100.0%
Aug 2010	3	Variance explained by model	122.5	58.7%	58.5%
Aug 2010	3	Unexplained variance (total)	86	41.3%	41.5%
Aug 2010	3	Unexplained variance explained by 1st factor	1.6	0.8%	
Aug 2010	4	Total variance in observations	167.8	100.0%	100.0%
Aug 2010	4	Variance explained by model	81.8	48.7%	48.1%
Aug 2010	4	Unexplained variance (total)	86	51.3%	51.9%
Aug 2010	4	Unexplained variance explained by 1st factor	1.5	0.9%	
Aug 2010	5	Total variance in observations	177.3	100.0%	100.0%
Aug 2010	5	Variance explained by model	92.3	52.1%	52.9%
Aug 2010	5	Unexplained variance (total)	85	47.9%	47.1%
Aug 2010	5	Unexplained variance explained by 1st factor	1.5	0.9%	
Aug 2010	6	Total variance in observations	606.2	100.0%	100.0%
Aug 2010	6	Variance explained by model	347.2	57.3%	58.0%
Aug 2010	6	Unexplained variance (total)	259	42.7%	42.0%
Aug 2010	6	Unexplained variance explained by 1st factor	2.0	0.3%	
Aug 2010	7	Total variance in observations	529.8	100.0%	100.0%
Aug 2010	7	Variance explained by model	271.8	51.3%	52.3%
Aug 2010	7	Unexplained variance (total)	258	48.7%	47.7%
Aug 2010	7	Unexplained variance explained by 1st factor	2.2	0.4%	
Aug 2010	8	Total variance in observations	476.9	100.0%	100.0%
Aug 2010	8	Variance explained by model	219.9	46.1%	47.3%
Aug 2010	8	Unexplained variance (total)	257	53.9%	52.7%
Aug 2010	8	Unexplained variance explained by 1st factor	2.1	0.4%	
Aug 2010	Algebra I*	Total variance in observations	365.4	100.0%	100.0%
Aug 2010	Algebra I*	Variance explained by model	109.4	29.9%	30.6%
Aug 2010	Algebra I*	Unexplained variance (total)	256	70.1%	69.4%
Aug 2010	Algebra I*	Unexplained variance explained by 1st factor	1.9	0.5%	
Aug 2010	Geometry*	Total variance in observations	408.9	100.0%	100.0%
Aug 2010	Geometry*	Variance explained by model	151.9	37.2%	38.3%
Aug 2010	Geometry*	Unexplained variance (total)	257	62.8%	61.7%
Aug 2010	Geometry*	Unexplained variance explained by 1st factor	1.9	0.5%	

**Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2010	Algebra II*	Total variance in observations	464.8	100.0%	100.0%
Aug 2010	Algebra II*	Variance explained by model	208.8	44.9%	46.1%
Aug 2010	Algebra II*	Unexplained variance (total)	256	55.1%	53.9%
Aug 2010	Algebra II*	Unexplained variance explained by 1st factor	2.0	0.4%	
July 2013	6	Total variance in observations	323.3	100.0%	100.0%
July 2013	6	Variance explained by model	167.3	51.7%	48.4%
July 2013	6	Unexplained variance (total)	156	48.3%	51.6%
July 2013	6	Unexplained variance explained by 1st factor	1.3	0.4%	
July 2013	7	Total variance in observations	148.3	100.0%	100.0%
July 2013	7	Variance explained by model	75.3	50.8%	48.7%
July 2013	7	Unexplained variance (total)	73	49.2%	51.3%
July 2013	7	Unexplained variance explained by 1st factor	1.1	0.8%	
July 2013	8	Total variance in observations	243.3	100.0%	100.0%
July 2013	8	Variance explained by model	86.3	35.5%	33.0%
July 2013	8	Unexplained variance (total)	157	64.5%	67.0%
July 2013	8	Unexplained variance explained by 1st factor	1.3	0.6%	
Jan 2014	K–2**	Total variance in observations	728.0	100.0%	100.0%
Jan 2014	K–2**	Variance explained by model	448.0	61.5%	60.5%
Jan 2014	K–2**	Unexplained variance (total)	280	38.5%	39.5%
Jan 2014	K–2**	Unexplained variance explained by 1st factor	1.8	0.3%	
Jan 2014	3	Total variance in observations	564.0	100.0%	100.0%
Jan 2014	3	Variance explained by model	329.0	58.3%	59.4%
Jan 2014	3	Unexplained variance (total)	235	41.7%	40.6%
Jan 2014	3	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	4	Total variance in observations	646.9	100.0%	100.0%
Jan 2014	4	Variance explained by model	398.9	61.7%	62.5%
Jan 2014	4	Unexplained variance (total)	248	38.3%	37.5%
Jan 2014	4	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	5	Total variance in observations	417.9	100.0%	100.0%
Jan 2014	5	Variance explained by model	196.9	47.1%	43.1%
Jan 2014	5	Unexplained variance (total)	221	52.9%	56.9%
Jan 2014	5	Unexplained variance explained by 1st factor	1.2	0.3%	
June 2016	6	Total variance in observations	212.5	100.0%	100.0%
June 2016	6	Variance explained by model	94.5	44.5%	39.8%
June 2016	6	Unexplained variance (total)	118	55.5%	60.2%
June 2016	6	Unexplained variance explained by 1st factor	1.1	0.5%	

**Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2016	7	Total variance in observations	267.9	100.0%	100.0%
June 2016	7	Variance explained by model	101.9	38.0%	32.0%
June 2016	7	Unexplained variance (total)	166	62.0%	68.0%
June 2016	7	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2016	8	Total variance in observations	197.5	100.0%	100.0%
June 2016	8	Variance explained by model	50.5	25.6%	20.9%
June 2016	8	Unexplained variance (total)	147	74.4%	79.1%
June 2016	8	Unexplained variance explained by 1st factor	1.1	0.6%	
June 2016	Algebra I	Total variance in observations	243.8	100.0%	100.0%
June 2016	Algebra I	Variance explained by model	95.8	39.3%	36.8%
June 2016	Algebra I	Unexplained variance (total)	148	60.7%	63.2%
June 2016	Algebra I	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2019	K–2**	Total variance in observations	116.0	100.0%	100.0%
June 2019	K–2**	Variance explained by model	56.0	48.3%	35.6%
June 2019	K–2**	Unexplained variance (total)	60.0	51.7%	64.4%
June 2019	K–2**	Unexplained variance explained by 1st factor	1.2	1.1%	
June 2019	3	Total variance in observations	384.3	100.0%	100.0%
June 2019	3	Variance explained by model	206.3	53.7%	46.7%
June 2019	3	Unexplained variance (total)	178.0	46.3%	53.3%
June 2019	3	Unexplained variance explained by 1st factor	1.2	0.3%	
June 2019	4	Total variance in observations	338.4	100.0%	100.0%
June 2019	4	Variance explained by model	159.4	47.1%	38.0%
June 2019	4	Unexplained variance (total)	179.0	52.9%	62.0%
June 2019	4	Unexplained variance explained by 1st factor	1.1	0.3%	
June 2019	5	Total variance in observations	316.3	100.0%	100.0%
June 2019	5	Variance explained by model	136.3	43.1%	36.5%
June 2019	5	Unexplained variance (total)	180.0	56.9%	63.5%
June 2019	5	Unexplained variance explained by 1st factor	1.1	0.4%	
June 2019	6	Total variance in observations	156.0	100.0%	100.0%
June 2019	6	Variance explained by model	60.0	38.4%	31.1%
June 2019	6	Unexplained variance (total)	96.0	61.6%	68.9%
June 2019	6	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2019	7	Total variance in observations	154.8	100.0%	100.0%
June 2019	7	Variance explained by model	51.8	33.5%	28.4%
June 2019	7	Unexplained variance (total)	103.0	66.5%	71.6%
June 2019	7	Unexplained variance explained by 1st factor	1.1	0.7%	

**Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	8	Total variance in observations	147.9	100.0%	100.0%
June 2019	8	Variance explained by model	48.9	33.1%	27.6%
June 2019	8	Unexplained variance (total)	99.0	66.9%	72.4%
June 2019	8	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	Algebra I	Total variance in observations	456.3	100.0%	100.0%
June 2019	Algebra I	Variance explained by model	157.3	34.5%	33.1%
June 2019	Algebra I	Unexplained variance (total)	299.0	65.5%	66.9%
June 2019	Algebra I	Unexplained variance explained by 1st factor	1.1	0.2%	
June 2019	Geometry	Total variance in observations	158.5	100.0%	100.0%
June 2019	Geometry	Variance explained by model	58.5	36.9%	35.5%
June 2019	Geometry	Unexplained variance (total)	100.0	63.1%	64.5%
June 2019	Geometry	Unexplained variance explained by 1st factor	1.2	0.7%	
June 2019	Algebra II	Total variance in observations	161.0	100.0%	100.0%
June 2019	Algebra II	Variance explained by model	61.0	37.9%	35.9%
June 2019	Algebra II	Unexplained variance (total)	100.0	62.1%	64.1%
June 2019	Algebra II	Unexplained variance explained by 1st factor	1.2	0.7%	
June 2023	K–2**	Total variance in observations	66.1	100.0%	100.0%
June 2023	K–2**	Variance explained by model	30.1	45.6%	34.5%
June 2023	K–2**	Unexplained variance (total)	36.0	54.4%	65.5%
June 2023	K–2**	Unexplained variance explained by 1st factor	1.2	1.8%	
June 2023	3	Total variance in observations	191.7	100.0%	100.0%
June 2023	3	Variance explained by model	88.7	46.3%	41.1%
June 2023	3	Unexplained variance (total)	103.0	53.7%	58.9%
June 2023	3	Unexplained variance explained by 1st factor	1.1	0.6%	
June 2023	4	Total variance in observations	207.7	100.0%	100.0%
June 2023	4	Variance explained by model	87.7	42.2%	35.8%
June 2023	4	Unexplained variance (total)	120.0	57.8%	64.2%
June 2023	4	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2023	5	Total variance in observations	221.0	100.0%	100.0%
June 2023	5	Variance explained by model	86.0	38.9%	33.7%
June 2023	5	Unexplained variance (total)	135.0	61.1%	66.3%
June 2023	5	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2023	6	Total variance in observations	162.7	100.0%	100.0%
June 2023	6	Variance explained by model	62.7	38.5%	31.8%
June 2023	6	Unexplained variance (total)	100.0	61.5%	68.2%
June 2023	6	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2023	7	Total variance in observations	183.4	100.0%	100.0%
June 2023	7	Variance explained by model	59.4	32.4%	28.5%



**Table 8–1 (continued). Results from PCA of Residuals in WINSTEPS for Mathematics**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2023	7	Unexplained variance (total)	124.0	67.6%	71.5%
June 2023	7	Unexplained variance explained by 1st factor	1.1	0.6%	
June 2023	8	Total variance in observations	118.7	100.0%	100.0%
June 2023	8	Variance explained by model	33.7	28.4%	25.2%
June 2023	8	Unexplained variance (total)	85.0	71.6%	74.8%
June 2023	8	Unexplained variance explained by 1st factor	1.1	1.0%	
June 2023	Algebra I	Total variance in observations	213.5	100.0%	100.0%
June 2023	Algebra I	Variance explained by model	64.5	30.2%	29.3%
June 2023	Algebra I	Unexplained variance (total)	149.0	69.8%	70.7%
June 2023	Algebra I	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2023	Geometry	Total variance in observations	84.6	100.0%	100.0%
June 2023	Geometry	Variance explained by model	39.6	46.8%	45.6%
June 2023	Geometry	Unexplained variance (total)	45.0	53.2%	54.4%
June 2023	Geometry	Unexplained variance explained by 1st factor	1.2	1.4%	
June 2023	Algebra II	Total variance in observations	61.9	100.0%	100.0%
June 2023	Algebra II	Variance explained by model	16.9	27.3%	26.6%
June 2023	Algebra II	Unexplained variance (total)	45.0	72.7%	73.4%
June 2023	Algebra II	Unexplained variance explained by 1st factor	1.1	1.8%	

\*Grade 11 items were tested on grade 8, Algebra I, Geometry, and Algebra II forms.

\*\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

Table 8–2 presents the PCA results for the CDT reading item pool. The primary dimension in the Rasch model explained between 26 and 58 percent of the total variances across the grades and courses. The second dimension (the row named “unexplained variance explained by 1st factor”) accounted for between 0.3 and 3.2 percent of the total variance in observations. These results suggest that the CDT reading item pool essentially measures a single dominant dimension.

**Table 8–2. Results from PCA of Residuals in WINSTEPS for Reading**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2011	3	Total variance in observations	179.8	100.0%	100.0%
Jan 2011	3	Variance explained by model	93.8	52.2%	51.9%
Jan 2011	3	Unexplained variance (total)	86	47.8%	48.1%
Jan 2011	3	Unexplained variance explained by 1st factor	1.7	0.9%	
Jan 2011	4	Total variance in observations	157.4	100.0%	100.0%
Jan 2011	4	Variance explained by model	70.4	44.7%	43.9%
Jan 2011	4	Unexplained variance (total)	87	55.3%	56.1%
Jan 2011	4	Unexplained variance explained by 1st factor	1.6	1.0%	
Jan 2011	5	Total variance in observations	171.5	100.0%	100.0%
Jan 2011	5	Variance explained by model	85.5	49.8%	50.5%
Jan 2011	5	Unexplained variance (total)	86	50.2%	49.5%
Jan 2011	5	Unexplained variance explained by 1st factor	1.7	1.0%	
Jan 2011	6	Total variance in observations	442.8	100.0%	100.0%
Jan 2011	6	Variance explained by model	232.8	52.6%	53.5%
Jan 2011	6	Unexplained variance (total)	210	47.4%	46.5%
Jan 2011	6	Unexplained variance explained by 1st factor	2.3	0.5%	
Jan 2011	7	Total variance in observations	364.4	100.0%	100.0%
Jan 2011	7	Variance explained by model	172.4	47.3%	46.8%
Jan 2011	7	Unexplained variance (total)	192	52.7%	53.2%
Jan 2011	7	Unexplained variance explained by 1st factor	2.1	0.6%	
Jan 2011	8	Total variance in observations	345.5	100.0%	100.0%
Jan 2011	8	Variance explained by model	153.5	44.4%	44.5%
Jan 2011	8	Unexplained variance (total)	192	55.6%	55.5%
Jan 2011	8	Unexplained variance explained by 1st factor	2.0	0.6%	
Jan 2011	Literature	Total variance in observations	699.1	100.0%	100.0%
Jan 2011	Literature	Variance explained by model	351.1	50.2%	50.2%
Jan 2011	Literature	Unexplained variance (total)	348	49.8%	49.8%
Jan 2011	Literature	Unexplained variance explained by 1st factor	2.2	0.3%	
July 2013	6	Total variance in observations	111.7	100.0%	100.0%
July 2013	6	Variance explained by model	55.7	49.8%	47.3%
July 2013	6	Unexplained variance (total)	56	50.2%	52.7%
July 2013	6	Unexplained variance explained by 1st factor	1.5	1.3%	

**Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
July 2013	7	Total variance in observations	103.4	100.0%	100.0%
July 2013	7	Variance explained by model	45.4	43.9%	42.2%
July 2013	7	Unexplained variance (total)	58	56.1%	57.8%
July 2013	7	Unexplained variance explained by 1st factor	1.4	1.4%	
July 2013	8	Total variance in observations	105.4	100.0%	100.0%
July 2013	8	Variance explained by model	48.4	45.9%	44.8%
July 2013	8	Unexplained variance (total)	57	54.1%	55.2%
July 2013	8	Unexplained variance explained by 1st factor	1.4	1.3%	
Jan 2014	K–2*	Total variance in observations	656.5	100.0%	100.0%
Jan 2014	K–2*	Variance explained by model	376.5	57.4%	57.6%
Jan 2014	K–2*	Unexplained variance (total)	280	42.6%	42.4%
Jan 2014	K–2*	Unexplained variance explained by 1st factor	1.9	0.3%	
Jan 2014	3	Total variance in observations	391.5	100.0%	100.0%
Jan 2014	3	Variance explained by model	213.5	54.5%	55.6%
Jan 2014	3	Unexplained variance (total)	178	45.5%	44.4%
Jan 2014	3	Unexplained variance explained by 1st factor	1.9	0.5%	
Jan 2014	4	Total variance in observations	434.7	100.0%	100.0%
Jan 2014	4	Variance explained by model	245.7	56.5%	57.1%
Jan 2014	4	Unexplained variance (total)	189	43.5%	42.9%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	0.4%	
Jan 2014	4	Total variance in observations	434.7	100.0%	100.0%
Jan 2014	4	Variance explained by model	245.7	56.5%	57.1%
Jan 2014	4	Unexplained variance (total)	189	43.5%	42.9%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	0.4%	
June 2016	3	Total variance in observations	53.5	100.0%	100.0%
June 2016	3	Variance explained by model	31.5	58.8%	41.7%
June 2016	3	Unexplained variance (total)	22	41.2%	58.3%
June 2016	3	Unexplained variance explained by 1st factor	1.1	2.1%	
June 2016	4	Total variance in observations	54.3	100.0%	100.0%
June 2016	4	Variance explained by model	33.3	61.4%	37.4%
June 2016	4	Unexplained variance (total)	21	38.6%	62.6%
June 2016	4	Unexplained variance explained by 1st factor	1.7	3.2%	
June 2016	5	Total variance in observations	57.5	100.0%	100.0%
June 2016	5	Variance explained by model	36.5	63.5%	43.5%
June 2016	5	Unexplained variance (total)	21	36.5%	56.6%
June 2016	5	Unexplained variance explained by 1st factor	1.2	2.1%	

**Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2016	6	Total variance in observations	232.3	100.0%	100.0%
June 2016	6	Variance explained by model	110.3	47.5%	45.1%
June 2016	6	Unexplained variance (total)	122	52.5%	54.9%
June 2016	6	Unexplained variance explained by 1st factor	1.6	0.7%	
June 2016	7	Total variance in observations	245.8	100.0%	100.0%
June 2016	7	Variance explained by model	120.8	49.1%	47.2%
June 2016	7	Unexplained variance (total)	125	50.9%	52.8%
June 2016	7	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2016	8	Variance explained by model	132.5	51.9%	49.8%
June 2016	8	Unexplained variance (total)	123	48.1%	50.2%
June 2016	8	Unexplained variance explained by 1st factor	1.7	0.7%	
June 2016	Literature	Total variance in observations	206.4	100.0%	100.0%
June 2016	Literature	Variance explained by model	82.4	39.9%	39.0%
June 2016	Literature	Unexplained variance (total)	124	60.1%	61.0%
June 2016	Literature	Unexplained variance explained by 1st factor	1.5	0.7%	
June 2019	K–2*	Total variance in observations	117.8	100.0%	100.0%
June 2019	K–2*	Variance explained by model	33.8	28.7%	26.0%
June 2019	K–2*	Unexplained variance (total)	84.0	71.3%	74.0%
June 2019	K–2*	Unexplained variance explained by 1st factor	1.5	1.3%	
June 2019	3	Total variance in observations	272.3	100.0%	100.0%
June 2019	3	Variance explained by model	110.3	40.5%	39.3%
June 2019	3	Unexplained variance (total)	162.0	59.5%	60.7%
June 2019	3	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2019	4	Total variance in observations	288.0	100.0%	100.0%
June 2019	4	Variance explained by model	126.0	43.8%	42.7%
June 2019	4	Unexplained variance (total)	162.0	56.2%	57.3%
June 2019	4	Unexplained variance explained by 1st factor	1.7	0.6%	
June 2019	5	Total variance in observations	291.2	100.0%	100.0%
June 2019	5	Variance explained by model	129.2	44.4%	42.7%
June 2019	5	Unexplained variance (total)	162.0	55.6%	57.3%
June 2019	5	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2019	6	Total variance in observations	216.3	100.0%	100.0%
June 2019	6	Variance explained by model	93.3	43.1%	42.2%
June 2019	6	Unexplained variance (total)	123.0	56.9%	57.8%
June 2019	6	Unexplained variance explained by 1st factor	1.6	0.7%	
June 2019	7	Variance explained by model	89.2	42.0%	41.2%
June 2019	7	Unexplained variance (total)	123.0	58.0%	58.8%
June 2019	7	Unexplained variance explained by 1st factor	1.6	0.8%	

**Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading**

<b>Date</b>	<b>Grade/Course</b>	<b>Statistic</b>	<b>Eigenvalue</b>	<b>Empirical</b>	<b>Modeled</b>
June 2019	8	Total variance in observations	209.3	100.0%	100.0%
June 2019	8	Variance explained by model	89.3	42.7%	41.5%
June 2019	8	Unexplained variance (total)	120.0	57.3%	58.5%
June 2019	8	Unexplained variance explained by 1st factor	1.7	0.8%	
June 2019	Literature	Total variance in observations	396.2	100.0%	100.0%
June 2019	Literature	Variance explained by model	147.2	37.2%	36.4%
June 2019	Literature	Unexplained variance (total)	249.0	62.8%	63.6%
June 2019	Literature	Unexplained variance explained by 1st factor	1.5	0.4%	
June 2023	K–2*	Total variance in observations	126.2	100.0%	100.0%
June 2023	K–2*	Variance explained by model	48.2	38.2%	36.2%
June 2023	K–2*	Unexplained variance (total)	78.0	61.8%	63.8%
June 2023	K–2*	Unexplained variance explained by 1st factor	1.5	1.2%	
June 2023	3	Total variance in observations	220.7	100.0%	100.0%
June 2023	3	Variance explained by model	94.7	42.9%	40.7%
June 2023	3	Unexplained variance (total)	126.0	57.1%	59.3%
June 2023	3	Unexplained variance explained by 1st factor	1.6	0.7%	
June 2023	4	Total variance in observations	169.0	100.0%	100.0%
June 2023	4	Variance explained by model	68.0	40.2%	38.6%
June 2023	4	Unexplained variance (total)	101.0	59.8%	61.4%
June 2023	4	Unexplained variance explained by 1st factor	1.6	0.9%	
June 2023	5	Total variance in observations	200.5	100.0%	100.0%
June 2023	5	Variance explained by model	93.5	46.6%	44.2%
June 2023	5	Unexplained variance (total)	107.0	53.4%	55.8%
June 2023	5	Unexplained variance explained by 1st factor	1.6	0.8%	
June 2023	6	Total variance in observations	238.2	100.0%	100.0%
June 2023	6	Variance explained by model	106.2	44.6%	42.4%
June 2023	6	Unexplained variance (total)	132.0	55.4%	57.6%
June 2023	6	Unexplained variance explained by 1st factor	1.6	0.7%	
June 2023	7	Total variance in observations	246.8	100.0%	100.0%
June 2023	7	Variance explained by model	114.8	46.5%	45.3%
June 2023	7	Unexplained variance (total)	132.0	53.5%	54.7%
June 2023	7	Unexplained variance explained by 1st factor	1.6	0.6%	
June 2023	8	Total variance in observations	346.9	100.0%	100.0%
June 2023	8	Variance explained by model	161.9	46.7%	44.3%
June 2023	8	Unexplained variance (total)	185.0	53.3%	55.7%
June 2023	8	Unexplained variance explained by 1st factor	1.6	0.5%	

**Table 8–2 (continued). Results from PCA of Residuals in WINSTEPS for Reading**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2023	Literature	Total variance in observations	366.2	100.0%	100.0%
June 2023	Literature	Variance explained by model	179.2	48.9%	46.0%
June 2023	Literature	Unexplained variance (total)	187.0	51.1%	54.0%
June 2023	Literature	Unexplained variance explained by 1st factor	1.5	0.4%	

\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

Table 8–3 presents the PCA results for the CDT science item pool. The primary dimension in the Rasch model explained between 20 and 68 percent of the total variances across the grades and courses. The second dimension (the row named “unexplained variance explained by 1st factor”) accounted for between 0.3 and 4.6 percent of the total variance in observations. These results suggest that the CDT science item pool essentially measures a single dominant dimension.

**Table 8–3. Results from PCA of Residuals in WINSTEPS for Science**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2011	3	Total variance in observations	229.1	100.0%	100.0%
Jan 2011	3	Variance explained by model	138.1	60.3%	60.3%
Jan 2011	3	Unexplained variance (total)	91	39.7%	39.7%
Jan 2011	3	Unexplained variance explained by 1st factor	1.7	0.7%	
Jan 2011	4	Total variance in observations	285.9	100.0%	100.0%
Jan 2011	4	Variance explained by model	162.9	57.0%	56.9%
Jan 2011	4	Unexplained variance (total)	123	43.0%	43.1%
Jan 2011	4	Unexplained variance explained by 1st factor	1.5	0.5%	
Jan 2011	5	Total variance in observations	161.9	100.0%	100.0%
Jan 2011	5	Variance explained by model	59.9	37.0%	37.4%
Jan 2011	5	Unexplained variance (total)	102	63.0%	62.6%
Jan 2011	5	Unexplained variance explained by 1st factor	1.5	0.9%	
Jan 2011	6	Total variance in observations	290.8	100.0%	100.0%
Jan 2011	6	Variance explained by model	112.8	38.8%	39.3%
Jan 2011	6	Unexplained variance (total)	178	61.2%	60.7%
Jan 2011	6	Unexplained variance explained by 1st factor	2.1	0.7%	
Jan 2011	7	Total variance in observations	487.1	100.0%	100.0%
Jan 2011	7	Variance explained by model	160.1	32.9%	33.3%
Jan 2011	7	Unexplained variance (total)	327	67.1%	66.7%
Jan 2011	7	Unexplained variance explained by 1st factor	2.2	0.4%	
Jan 2011	8*	Total variance in observations	658.8	100.0%	100.0%
Jan 2011	8*	Variance explained by model	281.8	42.8%	43.9%
Jan 2011	8*	Unexplained variance (total)	377	57.2%	56.1%
Jan 2011	8*	Unexplained variance explained by 1st factor	1.9	0.3%	

**Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science**

<b>Date</b>	<b>Grade/Course</b>	<b>Statistic</b>	<b>Eigenvalue</b>	<b>Empirical</b>	<b>Modeled</b>
Jan 2011	Biology	Total variance in observations	545.2	100.0%	100.0%
Jan 2011	Biology	Variance explained by model	155.2	28.5%	29.7%
Jan 2011	Biology	Unexplained variance (total)	390	71.5%	70.3%
Jan 2011	Biology	Unexplained variance explained by 1st factor	2.0	0.4%	
Jan 2011	Chemistry	Total variance in observations	418.1	100.0%	100.0%
Jan 2011	Chemistry	Variance explained by model	83.1	19.9%	20.1%
Jan 2011	Chemistry	Unexplained variance (total)	335	80.1%	79.9%
Jan 2011	Chemistry	Unexplained variance explained by 1st factor	2.0	0.5%	
Jan 2014	K–2	Total variance in observations	652.2	100.0%	100.0%
Jan 2014	K–2	Variance explained by model	372.2	57.1%	57.4%
Jan 2014	K–2	Unexplained variance (total)	280	42.9%	42.6%
Jan 2014	K–2	Unexplained variance explained by 1st factor	2.6	0.4%	
Jan 2014	3	Total variance in observations	369.9	100.0%	100.0%
Jan 2014	3	Variance explained by model	214.9	58.1%	57.8%
Jan 2014	3	Unexplained variance (total)	155	41.9%	42.2%
Jan 2014	3	Unexplained variance explained by 1st factor	2.0	0.5%	
Jan 2014	4	Total variance in observations	668.3	100.0%	100.0%
Jan 2014	4	Variance explained by model	455.3	68.1%	68.0%
Jan 2014	4	Unexplained variance (total)	213	31.9%	32.0%
Jan 2014	4	Unexplained variance explained by 1st factor	2.0	0.3%	
Jan 2014	5	Total variance in observations	235.5	100.0%	100.0%
Jan 2014	5	Variance explained by model	83.5	35.5%	34.5%
Jan 2014	5	Unexplained variance (total)	152	64.5%	65.5%
Jan 2014	5	Unexplained variance explained by 1st factor	1.3	0.6%	
June 2016	6	Total variance in observations	99.6	100.0%	100.0%
June 2016	6	Variance explained by model	33.6	33.7%	29.2%
June 2016	6	Unexplained variance (total)	66	66.3%	70.8%
June 2016	6	Unexplained variance explained by 1st factor	1.1	1.1%	
June 2016	7	Total variance in observations	218.9	100.0%	100.0%
June 2016	7	Variance explained by model	65.9	30.1%	24.9%
June 2016	7	Unexplained variance (total)	153	69.9%	75.1%
June 2016	7	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2016	8	Total variance in observations	338.2	100.0%	100.0%
June 2016	8	Variance explained by model	112.2	33.2%	28.2%
June 2016	8	Unexplained variance (total)	226	66.8%	71.8%
June 2016	8	Unexplained variance explained by 1st factor	1.2	0.3%	

**Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science**

<b>Date</b>	<b>Grade/Course</b>	<b>Statistic</b>	<b>Eigenvalue</b>	<b>Empirical</b>	<b>Modeled</b>
June 2016	Biology	Total variance in observations	205.4	100.0%	100.0%
June 2016	Biology	Variance explained by model	70.4	34.3%	32.0%
June 2016	Biology	Unexplained variance (total)	135	65.7%	68.0%
June 2016	Biology	Unexplained variance explained by 1st factor	1.1	0.5%	
June 2019	K–2**	Total variance in observations	49.6	100.0%	100.0%
June 2019	K–2**	Variance explained by model	18.6	37.5%	26.9%
June 2019	K–2**	Unexplained variance (total)	31.0	62.5%	73.1%
June 2019	K–2**	Unexplained variance explained by 1st factor	1.4	2.8%	
June 2019	3	Total variance in observations	154.7	100.0%	100.0%
June 2019	3	Variance explained by model	65.7	42.5%	36.0%
June 2019	3	Unexplained variance (total)	89.0	57.5%	64.0%
June 2019	3	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2019	4	Total variance in observations	140.1	100.0%	100.0%
June 2019	4	Variance explained by model	45.1	32.2%	27.3%
June 2019	4	Unexplained variance (total)	95.0	67.8%	72.7%
June 2019	4	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	5	Total variance in observations	128.0	100.0%	100.0%
June 2019	5	Variance explained by model	38.0	29.7%	24.8%
June 2019	5	Unexplained variance (total)	90.0	70.3%	75.2%
June 2019	5	Unexplained variance explained by 1st factor	1.1	0.9%	
June 2019	6	Total variance in observations	136.2	100.0%	100.0%
June 2019	6	Variance explained by model	39.2	28.8%	24.2%
June 2019	6	Unexplained variance (total)	97.0	71.2%	75.8%
June 2019	6	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	7	Total variance in observations	135.5	100.0%	100.0%
June 2019	7	Variance explained by model	36.5	26.9%	22.3%
June 2019	7	Unexplained variance (total)	99.0	73.1%	77.7%
June 2019	7	Unexplained variance explained by 1st factor	1.1	0.8%	
June 2019	8	Total variance in observations	152.6	100.0%	100.0%
June 2019	8	Variance explained by model	50.6	33.1%	27.6%
June 2019	8	Unexplained variance (total)	102.0	66.9%	72.4%
June 2019	8	Unexplained variance explained by 1st factor	1.1	0.7%	
June 2019	Biology	Total variance in observations	414.2	100.0%	100.0%
June 2019	Biology	Variance explained by model	124.2	30.0%	28.7%
June 2019	Biology	Unexplained variance (total)	290.0	70.0%	71.3%
June 2019	Biology	Unexplained variance explained by 1st factor	1.1	0.3%	



**Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	Chemistry	Total variance in observations	142.9	100.0%	100.0%
June 2019	Chemistry	Variance explained by model	42.9	30.0%	27.5%
June 2019	Chemistry	Unexplained variance (total)	100.0	70.0%	72.5%
June 2019	Chemistry	Unexplained variance explained by 1st factor	1.3	0.9%	
May 2020	3	Total variance in observations	50.3	100.0%	100.0%
May 2020	3	Variance explained by model	31.3	62.2%	37.5%
May 2020	3	Unexplained variance (total)	19.0	37.8%	62.5%
May 2020	3	Unexplained variance explained by 1st factor	1.2	2.5%	
May 2020	4	Total variance in observations	50.1	100.0%	100.0%
May 2020	4	Variance explained by model	28.1	56.1%	34.2%
May 2020	4	Unexplained variance (total)	22.0	43.9%	65.8%
May 2020	4	Unexplained variance explained by 1st factor	1.3	2.5%	
May 2020	5	Total variance in observations	83.4	100.0%	100.0%
May 2020	5	Variance explained by model	63.4	76.0%	60.8%
May 2020	5	Unexplained variance (total)	20.0	24.0%	39.2%
May 2020	5	Unexplained variance explained by 1st factor	1.4	1.7%	
May 2020	6	Total variance in observations	27.8	100.0%	100.0%
May 2020	6	Variance explained by model	9.8	35.1%	19.8%
May 2020	6	Unexplained variance (total)	18.0	64.9%	80.2%
May 2020	6	Unexplained variance explained by 1st factor	1.3	4.6%	
May 2020	7	Total variance in observations	44.6	100.0%	100.0%
May 2020	7	Variance explained by model	25.6	57.4%	34.3%
May 2020	7	Unexplained variance (total)	19.0	42.6%	65.7%
May 2020	7	Unexplained variance explained by 1st factor	1.3	2.8%	
May 2020	8	Total variance in observations	39.3	100.0%	100.0%
May 2020	8	Variance explained by model	19.3	49.1%	29.4%
May 2020	8	Unexplained variance (total)	20.0	50.9%	70.6%
May 2020	8	Unexplained variance explained by 1st factor	1.3	3.2%	
May 2020	Biology	Total variance in observations	72.7	100.0%	100.0%
May 2020	Biology	Variance explained by model	32.7	45.0%	28.5%
May 2020	Biology	Unexplained variance (total)	40.0	55.0%	71.5%
May 2020	Biology	Unexplained variance explained by 1st factor	1.1	1.5%	
June 2023	2–5***	Total variance in observations	55.6	100.0%	100.0%
June 2023	2–5***	Variance explained by model	20.6	37.0%	35.2%
June 2023	2–5***	Unexplained variance (total)	35.0	63.0%	64.8%
June 2023	2–5***	Unexplained variance explained by 1st factor	1.2	2.1%	

**Table 8–3 (continued). Results from PCA of Residuals in WINSTEPS for Science**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2023	6–8***	Total variance in observations	61.4	100.0%	100.0%
June 2023	6–8***	Variance explained by model	18.4	29.9%	28.0%
June 2023	6–8***	Unexplained variance (total)	43.0	70.1%	72.0%
June 2023	6–8***	Unexplained variance explained by 1st factor	1.1	1.8%	
June 2023	Biology	Total variance in observations	26.1	100.0%	100.0%
June 2023	Biology	Variance explained by model	6.1	23.3%	22.4%
June 2023	Biology	Unexplained variance (total)	20.0	76.7%	77.6%
June 2023	Biology	Unexplained variance explained by 1st factor	1.1	4.4%	
April 2024	2-5***	Total variance in observations	39.2	100.0%	100.0%
April 2024	2-5***	Variance explained by model	18.2	46.4%	45.6%
April 2024	2-5***	Unexplained variance (total)	21.0	53.6%	54.4%
April 2024	2-5***	Unexplained variance explained by 1st factor	1.2	3.0%	
April 2024	6-8***	Total variance in observations	30.7	100.0%	100.0%
April 2024	6-8***	Variance explained by model	15.7	51.1%	46.6%
April 2024	6-8***	Unexplained variance (total)	15.0	48.9%	53.4%
April 2024	6-8***	Unexplained variance explained by 1st factor	1.2	4.0%	
April 2024	Biology	Total variance in observations	40.2	100.0%	100.0%
April 2024	Biology	Variance explained by model	15.2	37.9%	34.2%
April 2024	Biology	Unexplained variance (total)	25.0	62.1%	65.8%
April 2024	Biology	Unexplained variance explained by 1st factor	1.1	2.8%	
April 2024	Chemistry	Total variance in observations	50.6	100.0%	100.0%
April 2024	Chemistry	Variance explained by model	14.6	28.8%	26.0%
April 2024	Chemistry	Unexplained variance (total)	36.0	71.2%	74.0%
April 2024	Chemistry	Unexplained variance explained by 1st factor	1.2	2.3%	

\*Grade 11 items were tested on grade 8 forms.

\*\*Items in the kindergarten through grade 2 span were co-mingled on forms taken by students in grade 3.

\*\*\*Due to small number of items, analyses completed by grade spans.

Table 8–4 presents the PCA results for the CDT writing item pool. The primary dimension in the Rasch model explained between 21 and 55 percent of the total variances across the grades and courses. The second dimension (the row named “unexplained variance explained by 1st factor”) accounted for between 0.3 and 4.7 percent of the total variance in observations. These results suggest that the CDT writing item pool essentially measures a single dominant dimension.

**Table 8–4. Results from PCA of Residuals in WINSTEPS for Writing**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Aug 2011	3	Total variance in observations	297.7	100.0%	100.0%
Aug 2011	3	Variance explained by model	157.7	53.0%	55.0%
Aug 2011	3	Unexplained variance (total)	140	47.0%	45.0%
Aug 2011	3	Unexplained variance explained by 1st factor	1.7	0.6%	
Aug 2011	4	Total variance in observations	283.6	100.0%	100.0%
Aug 2011	4	Variance explained by model	134.6	47.5%	49.0%
Aug 2011	4	Unexplained variance (total)	149	52.5%	51.0%
Aug 2011	4	Unexplained variance explained by 1st factor	1.8	0.6%	
Aug 2011	5	Total variance in observations	280.7	100.0%	100.0%
Aug 2011	5	Variance explained by model	115.7	41.2%	42.2%
Aug 2011	5	Unexplained variance (total)	165	58.8%	57.8%
Aug 2011	5	Unexplained variance explained by 1st factor	1.8	0.6%	
Aug 2011	6	Total variance in observations	340.5	100.0%	100.0%
Aug 2011	6	Variance explained by model	147.5	43.3%	44.2%
Aug 2011	6	Unexplained variance (total)	193	56.7%	55.8%
Aug 2011	6	Unexplained variance explained by 1st factor	2.0	0.6%	
Aug 2011	7	Total variance in observations	317.9	100.0%	100.0%
Aug 2011	7	Variance explained by model	141.9	44.6%	45.5%
Aug 2011	7	Unexplained variance (total)	176	55.4%	54.5%
Aug 2011	7	Unexplained variance explained by 1st factor	2.1	0.6%	
Aug 2011	8	Total variance in observations	336.0	100.0%	100.0%
Aug 2011	8	Variance explained by model	141.0	42.0%	42.4%
Aug 2011	8	Unexplained variance (total)	195	58.0%	57.6%
Aug 2011	8	Unexplained variance explained by 1st factor	2.3	0.7%	
Aug 2011	English Composition	Total variance in observations	763.2	100.0%	100.0%
Aug 2011	English Composition	Variance explained by model	398.2	52.2%	53.4%
Aug 2011	English Composition	Unexplained variance (total)	365	47.8%	46.6%
Aug 2011	English Composition	Unexplained variance explained by 1st factor	2.3	0.3%	
Jan 2014	K–2*	Total variance in observations	93.2	100.0%	100.0%
Jan 2014	K–2*	Variance explained by model	49.2	52.8%	39.9%
Jan 2014	K–2*	Unexplained variance (total)	44	47.2%	60.1%
Jan 2014	K–2*	Unexplained variance explained by 1st factor	2.0	2.2%	
Jan 2014	3	Total variance in observations	132.5	100.0%	100.0%
Jan 2014	3	Variance explained by model	72.5	54.7%	54.6%
Jan 2014	3	Unexplained variance (total)	60	45.3%	45.4%
Jan 2014	3	Unexplained variance explained by 1st factor	1.8	1.4%	

**Table 8–4 (continued). Results from PCA of Residuals in WINSTEPS for Writing**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
Jan 2014	4	Total variance in observations	132.4	100.0%	100.0%
Jan 2014	4	Variance explained by model	72.4	54.7%	55.4%
Jan 2014	4	Unexplained variance (total)	60	45.3%	44.6%
Jan 2014	4	Unexplained variance explained by 1st factor	1.7	1.3%	
Jan 2014	5	Total variance in observations	146.5	100.0%	100.0%
Jan 2014	5	Variance explained by model	75.5	51.5%	47.7%
Jan 2014	5	Unexplained variance (total)	71	48.5%	52.3%
Jan 2014	5	Unexplained variance explained by 1st factor	1.3	0.9%	
June 2016	6	Total variance in observations	154.7	100.0%	100.0%
June 2016	6	Variance explained by model	64.7	41.8%	38.2%
June 2016	6	Unexplained variance (total)	90	58.2%	61.8%
June 2016	6	Unexplained variance explained by 1st factor	1.2	0.8%	
June 2016	7	Total variance in observations	126.6	100.0%	100.0%
June 2016	7	Variance explained by model	34.6	27.3%	22.4%
June 2016	7	Unexplained variance (total)	92	72.7%	77.6%
June 2016	7	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2016	8	Total variance in observations	150.7	100.0%	100.0%
June 2016	8	Variance explained by model	44.7	29.7%	25.2%
June 2016	8	Unexplained variance (total)	106	70.3%	74.8%
June 2016	8	Unexplained variance explained by 1st factor	1.2	0.8%	
June 2016	English Composition	Total variance in observations	149.5	100.0%	100.0%
June 2016	English Composition	Variance explained by model	47.5	31.8%	26.3%
June 2016	English Composition	Unexplained variance (total)	102	68.2%	73.7%
June 2016	English Composition	Unexplained variance explained by 1st factor	1.3	0.9%	
June 2019	K–2*	Total variance in observations	69.0	100.0%	100.0%
June 2019	K–2*	Variance explained by model	37.0	53.6%	40.9%
June 2019	K–2*	Unexplained variance (total)	32.0	46.4%	59.1%
June 2019	K–2*	Unexplained variance explained by 1st factor	1.5	2.2%	
June 2019	3	Total variance in observations	165.5	100.0%	100.0%
June 2019	3	Variance explained by model	66.5	40.2%	36.4%
June 2019	3	Unexplained variance (total)	99.0	59.8%	63.6%
June 2019	3	Unexplained variance explained by 1st factor	1.3	0.8%	
June 2019	4	Total variance in observations	163.6	100.0%	100.0%
June 2019	4	Variance explained by model	73.6	45.0%	37.8%
June 2019	4	Unexplained variance (total)	90.0	55.0%	62.2%
June 2019	4	Unexplained variance explained by 1st factor	1.3	0.8%	

**Table 8–4 (continued). Results from PCA of Residuals in WINSTEPS for Writing**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2019	5	Total variance in observations	139.1	100.0%	100.0%
June 2019	5	Variance explained by model	49.1	35.3%	29.9%
June 2019	5	Unexplained variance (total)	90.0	64.7%	70.1%
June 2019	5	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2019	6	Total variance in observations	136.5	100.0%	100.0%
June 2019	6	Variance explained by model	43.5	31.9%	26.3%
June 2019	6	Unexplained variance (total)	93.0	68.1%	73.7%
June 2019	6	Unexplained variance explained by 1st factor	1.2	0.9%	
June 2019	7	Total variance in observations	158.9	100.0%	100.0%
June 2019	7	Variance explained by model	47.9	30.1%	25.7%
June 2019	7	Unexplained variance (total)	111.0	69.9%	74.3%
June 2019	7	Unexplained variance explained by 1st factor	1.2	0.7%	
June 2019	8	Total variance in observations	131.9	100.0%	100.0%
June 2019	8	Variance explained by model	38.9	29.5%	24.5%
June 2019	8	Unexplained variance (total)	93.0	70.5%	75.5%
June 2019	8	Unexplained variance explained by 1st factor	1.3	1.0%	
June 2019	English Composition	Total variance in observations	523.2	100.0%	100.0%
June 2019	English Composition	Variance explained by model	229.2	43.8%	41.3%
June 2019	English Composition	Unexplained variance (total)	294.0	56.2%	58.7%
June 2019	English Composition	Unexplained variance explained by 1st factor	1.5	0.3%	
June 2023	K–3*	Total variance in observations	48.4	100.0%	100.0%
June 2023	K–3*	Variance explained by model	18.4	38.0%	38.6%
June 2023	K–3*	Unexplained variance (total)	30.0	62.0%	61.4%
June 2023	K–3*	Unexplained variance explained by 1st factor	1.2	2.5%	
June 2023	4	Total variance in observations	43.7	100.0%	100.0%
June 2023	4	Variance explained by model	18.7	42.8%	36.4%
June 2023	4	Unexplained variance (total)	25.0	57.2%	63.6%
June 2023	4	Unexplained variance explained by 1st factor	1.1	2.6%	
June 2023	5	Total variance in observations	49.8	100.0%	100.0%
June 2023	5	Variance explained by model	14.8	29.8%	23.8%
June 2023	5	Unexplained variance (total)	35.0	70.2%	76.2%
June 2023	5	Unexplained variance explained by 1st factor	1.1	2.3%	
June 2023	6	Total variance in observations	60.6	100.0%	100.0%
June 2023	6	Variance explained by model	25.6	42.2%	33.7%
June 2023	6	Unexplained variance (total)	35.0	57.8%	66.3%
June 2023	6	Unexplained variance explained by 1st factor	1.2	1.9%	

**Table 8–4 (continued). Results from PCA of Residuals in WINSTEPS for Writing**

Date	Grade/Course	Statistic	Eigenvalue	Empirical	Modeled
June 2023	7	Total variance in observations	62.5	100.0%	100.0%
June 2023	7	Variance explained by model	22.5	36.0%	30.9%
June 2023	7	Unexplained variance (total)	40.0	64.0%	69.1%
June 2023	7	Unexplained variance explained by 1st factor	1.1	1.8%	
June 2023	8	Total variance in observations	57.5	100.0%	100.0%
June 2023	8	Variance explained by model	24.5	42.6%	38.8%
June 2023	8	Unexplained variance (total)	33.0	57.4%	61.2%
June 2023	8	Unexplained variance explained by 1st factor	1.2	2.0%	
June 2023	English Composition	Total variance in observations	27.2	100.0%	100.0%
June 2023	English Composition	Variance explained by model	7.2	26.4%	21.0%
June 2023	English Composition	Unexplained variance (total)	20.0	73.6%	79.0%
June 2023	English Composition	Unexplained variance explained by 1st factor	1.3	4.7%	

\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

## LOCAL INDEPENDENCE

Local independence (LI) is a fundamental assumption of IRT. No relationship should exist between examinees’ responses to different items after accounting for the abilities measured by a test. In formal statistical terms, a test  $X$  that is comprised of items  $X_1, X_2, \dots, X_n$  is locally independent with respect to the latent variable  $\theta$  if, for all  $\mathbf{x} = (x_1, x_2, \dots, x_n)$  and  $\theta$ ,

$$P(\mathbf{X} = \mathbf{x} | \theta) = \prod_{i=1}^n P(X_i = x_i | \theta).$$

This formula essentially states that the probability of any pattern of responses across all items ( $\mathbf{x}$ ), after conditioning on the abilities measured by the test, should be equal to the product of the conditional probabilities across each item (cf. the multiplication rule for independent events where the joint probabilities are equal to the product of the associated marginal probabilities).

The equation above shows the condition after satisfying the “strong form” of local independence. A “weak form” of local independence (WLI) was proposed by McDonald (1979). The distinction is important, as many indicators of local dependency are actually framed by WLI. The requirement here would be for the conditional covariances of all pairs of item responses, conditioned on the abilities, to be equal to zero. When this assumption is met, the joint probability of responses to an item pair, conditioned on abilities, is the product of the probabilities of responses to these two items, as show below. (This is a “weaker” form because higher-order dependencies among items are allowed.) Based on the WLI, the following expression can be derived:

$$P(X_i = x_i, X_j = x_j | \theta) = P(X_i = x_i | \theta) P(X_j = x_j | \theta).$$

Marais and Andrich (2008) pointed out that local item dependence in the Rasch model can occur in two ways that some may not distinguish. The first way occurs when the assumption of unidimensionality is violated. Here, other nuisance dimensions besides a dominant dimension also determine students’ performance (this can be called “trait dependence”). The second violation occurs when responses to an item depend on responses to another. This is a violation of statistical independence and can be called “response dependence.” Many people treat the assumptions of “unidimensionality” and “local independence” as one phenomenon and believe that once unidimensionality holds, that local independence also holds. By distinguishing the two sources of local dependence, one can see that while local independence can be related

to unidimensionality, the two are different assumptions, and, therefore, require different tests.

Residual item correlations provided in WINSTEPS for each item pair were used to assess the local dependence among the CDT items. In general, these residuals are computed as follows. First, expected item performance based on the Rasch model is determined using ability and item parameter estimates. Next, deviation (residual) between the examinees' expected and observed performance is determined for each item. Finally, for each item pair, a correlation between the respective deviations is computed.

There are three types of residual correlations available in WINSTEPS: raw, standardized, and logit. Since the three residual correlations are very similar, the default "standardized residual correlation" in WINSTEPS was used for these analyses. Tables 8–5 through 8–8 show the summary statistics—mean, standard deviation (SD), minimum (Min), maximum (Max), and several percentiles (P10, P25, P50, P75, P90)—for all the residual correlations for each content area and grade/course. The total number of item pairs (N) and the number of pairs with the residual correlations greater than 0.20 are also reported in the tables.

**Table 8–5. Summary of Item Residual Correlations for Mathematics**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
Aug 2010	3	1,372	-0.03	0.03	-0.15	-0.06	-0.04	-0.03	-0.01	0.01	0.32	0	2
Aug 2010	4	1,122	-0.03	0.04	-0.18	-0.08	-0.06	-0.03	-0.01	0.01	0.28	0	2
Aug 2010	5	1,132	-0.03	0.04	-0.17	-0.07	-0.05	-0.03	-0.01	0.01	0.38	0	1
Aug 2010	6	5,410	-0.02	0.04	-0.15	-0.06	-0.04	-0.02	0.00	0.02	0.34	0	12
Aug 2010	7	5,409	-0.02	0.04	-0.24	-0.07	-0.05	-0.02	0.00	0.03	0.35	3	4
Aug 2010	8	4,935	-0.02	0.06	-0.36	-0.10	-0.06	-0.02	0.01	0.05	0.27	18	3
Aug 2010	Algebra I	5,024	-0.02	0.04	-0.19	-0.07	-0.05	-0.02	0.00	0.02	0.26	0	2
Aug 2010	Geometry	5,470	-0.02	0.04	-0.20	-0.07	-0.04	-0.02	0.00	0.02	0.27	0	1
Aug 2010	Algebra II	5,457	-0.02	0.04	-0.18	-0.07	-0.05	-0.02	0.00	0.02	0.22	0	2
July 2013	6	12,090	-0.01	0.01	-0.12	-0.02	-0.01	0.00	0.00	0.00	0.06	0	0
July 2013	7	2,628	-0.01	0.01	-0.05	-0.03	-0.02	-0.01	-0.01	0.00	0.01	0	0
July 2013	8	12,246	-0.01	0.01	-0.09	-0.02	-0.01	0.00	0.00	0.01	0.06	0	0
Jan 2014	K–2*	2,660	-0.04	0.06	-0.23	-0.11	-0.08	-0.05	-0.01	0.02	0.35	4	4
Jan 2014	3	2,278	-0.05	0.06	-0.24	-0.12	-0.09	-0.05	-0.01	0.02	0.27	12	2
Jan 2014	4	2,462	-0.05	0.05	-0.24	-0.11	-0.08	-0.05	-0.01	0.02	0.46	2	2
Jan 2014	5	24,310	0.00	0.01	-0.05	-0.01	-0.01	0.00	0.00	0.00	0.02	0	0
June 2016	6	6,903	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2016	7	13,695	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	8	10,731	-0.01	0.01	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	Algebra I	10,878	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	K–2*	1,770	-0.02	0.01	-0.09	-0.03	-0.02	-0.02	-0.01	0.00	0.02	0	0
June 2019	3	15,753	-0.01	0.00	-0.05	-0.01	-0.01	-0.01	0.00	0.00	0.02	0	0
June 2019	4	15,931	-0.01	0.00	-0.04	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	5	16,110	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2019	6	4,560	-0.01	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	7	5,253	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0	0

**Table 8–5 (continued). Summary of Item Residual Correlations for Mathematics**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
June 2019	8	4,851	-0.01	0.01	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	Algebra I	44,551	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.01	0	0
June 2019	Geometry	4,950	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	Algebra II	4,950	-0.01	0.01	-0.07	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2023	K–2*	630	-0.03	0.01	-0.07	-0.04	-0.04	-0.03	-0.02	-0.01	0.00	0	0
June 2023	3	5,253	-0.01	0.01	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2023	4	7,140	-0.01	0.01	-0.04	-0.01	-0.01	-0.01	0.00	0.00	0.02	0	0
June 2023	5	9,045	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2023	6	4,950	-0.01	0.00	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2023	7	7,626	-0.01	0.00	-0.03	-0.01	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2023	8	3,570	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	-0.01	0.00	0.01	0	0
June 2023	Algebra I	11,026	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0	0
June 2023	Geometry	990	-0.02	0.01	-0.06	-0.04	-0.03	-0.02	-0.01	-0.01	0.01	0	0
June 2023	Algebra II	990	-0.02	0.01	-0.06	-0.03	-0.03	-0.02	-0.02	-0.01	0.00	0	0

\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.



**Table 8–6. Summary of Item Residual Correlations for Reading**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
Jan 2011	3	1,334	-0.02	0.04	-0.17	-0.07	-0.04	-0.02	-0.01	0.01	0.14	0	0
Jan 2011	4	1,272	-0.02	0.03	-0.18	-0.07	-0.04	-0.02	-0.01	0.01	0.27	0	2
Jan 2011	5	1,262	-0.02	0.03	-0.17	-0.06	-0.04	-0.02	-0.01	0.01	0.18	0	0
Jan 2011	6	4,245	-0.02	0.05	-0.24	-0.07	-0.04	-0.02	0.00	0.02	0.35	2	13
Jan 2011	7	3,782	-0.02	0.04	-0.23	-0.07	-0.04	-0.02	0.00	0.02	0.22	2	1
Jan 2011	8	3,782	-0.02	0.04	-0.26	-0.07	-0.04	-0.02	0.00	0.03	0.34	2	5
Jan 2011	Literature	7,517	-0.02	0.05	-0.28	-0.09	-0.04	-0.01	0.01	0.04	0.40	25	10
July 2013	6	1,540	-0.02	0.05	-0.43	-0.03	-0.01	0.00	0.00	0.00	0.05	42	0
July 2013	7	1,653	-0.02	0.05	-0.33	-0.04	-0.01	0.00	0.00	0.00	0.01	38	0
July 2013	8	1,596	-0.02	0.05	-0.32	-0.04	-0.01	0.00	0.00	0.00	0.02	39	0
Jan 2014	K–2	2,660	-0.05	0.06	-0.26	-0.12	-0.09	-0.05	-0.01	0.02	0.29	7	5
Jan 2014	3	1,709	-0.05	0.05	-0.23	-0.11	-0.08	-0.05	-0.02	0.02	0.20	2	0
Jan 2014	4	1,888	-0.05	0.05	-0.23	-0.10	-0.08	-0.05	-0.02	0.01	0.20	1	0
Jan 2014	5	8,911	-0.01	0.02	-0.26	-0.01	-0.01	0.00	0.00	0.00	0.03	33	0
June 2016	3	231	-0.04	0.02	-0.10	-0.08	-0.06	-0.04	-0.02	-0.01	0.00	0	0
June 2016	4	210	-0.04	0.06	-0.74	-0.08	-0.06	-0.03	-0.02	0.00	0.01	1	0
June 2016	5	210	-0.04	0.03	-0.13	-0.09	-0.06	-0.04	-0.02	-0.01	0.00	0	0
June 2016	6	7,381	-0.01	0.04	-0.36	0.00	0.00	0.00	0.00	0.00	0.00	117	0
June 2016	7	7,750	-0.01	0.04	-0.40	0.00	0.00	0.00	0.00	0.00	0.09	123	0
June 2016	8	7,503	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.04	115	0
June 2016	Literature	7,626	-0.01	0.04	-0.33	0.00	0.00	0.00	0.00	0.00	0.00	161	0
June 2019	K–2*	3,486	-0.01	0.06	-0.45	0.00	0.00	0.00	0.00	0.00	0.00	121	0
June 2019	3	13,041	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.05	150	0
June 2019	4	13,041	-0.01	0.04	-0.40	0.00	0.00	0.00	0.00	0.00	0.06	152	0
June 2019	5	13,041	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.06	156	0
June 2019	6	7,503	-0.01	0.04	-0.46	0.00	0.00	0.00	0.00	0.00	0.06	121	0
June 2019	7	7,503	-0.01	0.04	-0.44	0.00	0.00	0.00	0.00	0.00	0.09	109	0
June 2019	8	7,140	-0.01	0.04	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	118	0
June 2019	Literature	30,876	0.00	0.03	-0.33	0.00	0.00	0.00	0.00	0.00	0.02	319	0
June 2023	K–2*	3,003	-0.01	0.05	-0.30	0.00	0.00	0.00	0.00	0.00	0.00	95	0
June 2023	3	7,875	-0.01	0.04	-0.38	0.00	0.00	0.00	0.00	0.00	0.08	130	0
June 2023	4	5,050	-0.01	0.05	-0.39	0.00	0.00	0.00	0.00	0.00	0.04	101	0
June 2023	5	5,671	-0.01	0.04	-0.42	0.00	0.00	0.00	0.00	0.00	0.06	104	0
June 2023	6	8,646	-0.01	0.04	-0.37	0.00	0.00	0.00	0.00	0.00	0.07	121	0
June 2023	7	8,646	-0.01	0.04	-0.37	0.00	0.00	0.00	0.00	0.00	0.03	124	0

**Table 8–6 (continued). Summary of Item Residual Correlations for Reading**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
June 2023	8	17,020	-0.01	0.03	-0.39	0.00	0.00	0.00	0.00	0.00	0.13	177	0
June 2023	Literature	17,391	0.00	0.02	-0.30	-0.01	0.00	0.00	0.00	0.00	0.16	46	0

\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

**Table 8–7. Summary of Item Residual Correlations for Science**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
Jan 2011	3	1,400	-0.03	0.03	-0.16	-0.07	-0.04	-0.02	-0.01	0.01	0.09	0	0
Jan 2011	4	1,950	-0.02	0.03	-0.19	-0.07	-0.04	-0.02	0.00	0.01	0.09	0	0
Jan 2011	5	1,530	-0.03	0.03	-0.17	-0.07	-0.04	-0.02	-0.01	0.01	0.08	0	0
Jan 2011	6	3,642	-0.02	0.04	-0.18	-0.07	-0.04	-0.02	0.00	0.02	0.19	0	0
Jan 2011	7	6,934	-0.02	0.04	-0.22	-0.08	-0.04	-0.01	0.00	0.03	0.24	7	2
Jan 2011	8	6,881	-0.02	0.05	-0.27	-0.09	-0.04	-0.01	0.00	0.02	0.24	30	2
Jan 2011	Biology	8,255	-0.02	0.05	-0.24	-0.09	-0.04	-0.01	0.00	0.03	0.26	17	1
Jan 2011	Chemistry	7,105	-0.02	0.05	-0.22	-0.08	-0.04	-0.01	0.01	0.03	0.24	8	2
Jan 2014	2*	2,660	-0.05	0.10	-0.43	-0.17	-0.11	-0.05	0.01	0.08	0.68	152	28
Jan 2014	3	1,510	-0.05	0.06	-0.33	-0.12	-0.09	-0.05	-0.01	0.03	0.25	5	3
Jan 2014	4	2,069	-0.05	0.09	-0.31	-0.16	-0.11	-0.05	0.01	0.07	0.32	83	13
Jan 2014	5	11,476	-0.01	0.01	-0.08	-0.02	-0.01	-0.01	0.00	0.01	0.06	0	0
June 2016	6	2,145	-0.02	0.01	-0.05	-0.03	-0.02	-0.02	-0.01	0.00	0.02	0	0
June 2016	7	11,628	-0.01	0.01	-0.04	-0.01	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	8	25,425	0.00	0.01	-0.03	-0.01	-0.01	0.00	0.00	0.00	0.02	0	0
June 2016	Biology	9,045	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	2*	465	-0.03	0.03	-0.15	-0.07	-0.05	-0.03	-0.01	0.00	0.04	0	0
June 2019	3	3,916	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	-0.01	0.00	0.01	0	0
June 2019	4	4,465	-0.01	0.01	-0.04	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	5	4,005	-0.01	0.01	-0.06	-0.02	-0.02	-0.01	-0.01	0.00	0.01	0	0
June 2019	6	4,656	-0.01	0.01	-0.04	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	7	4,851	-0.01	0.00	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0	0
June 2019	8	5,151	-0.01	0.01	-0.03	-0.02	-0.01	-0.01	-0.01	0.00	0.01	0	0
June 2019	Biology	41,905	0.00	0.00	-0.02	-0.01	-0.01	0.00	0.00	0.00	0.01	0	0
June 2019	Chemistry	4,950	-0.01	0.01	-0.06	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
May 2020	3	171	-0.05	0.02	-0.14	-0.08	-0.07	-0.05	-0.04	-0.02	0.00	0	0
May 2020	4	231	-0.05	0.03	-0.14	-0.08	-0.06	-0.04	-0.02	-0.01	0.00	0	0
May 2020	5	190	-0.05	0.04	-0.24	-0.10	-0.07	-0.04	-0.02	-0.01	0.01	1	0
May 2020	6	153	-0.06	0.05	-0.26	-0.12	-0.07	-0.04	-0.03	-0.02	-0.01	5	0
May 2020	7	171	-0.05	0.03	-0.22	-0.09	-0.06	-0.05	-0.04	-0.03	0.00	1	0
May 2020	8	190	-0.05	0.03	-0.19	-0.09	-0.06	-0.04	-0.03	-0.02	0.00	0	0
May 2020	Biology	780	-0.02	0.01	-0.08	-0.04	-0.03	-0.02	-0.01	-0.01	0.00	0	0
May 2023	2*	36	-0.06	0.01	-0.08	-0.07	-0.06	-0.06	-0.05	-0.04	-0.03	0	0
May 2023	3	36	-0.08	0.01	-0.09	-0.09	-0.08	-0.08	-0.07	-0.06	-0.05	0	0
May 2023	4	6	-0.08	0.01	-0.09	-0.09	-0.09	-0.08	-0.08	-0.08	-0.08	0	0
May 2023	5	78	-0.06	0.01	-0.09	-0.08	-0.07	-0.06	-0.05	-0.04	-0.02	0	0
May 2023	6	6	-0.10	0.02	-0.12	-0.12	-0.12	-0.10	-0.07	-0.07	-0.07	0	0

**Table 8–7 (continued). Summary of Item Residual Correlations for Science**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	> .20
May 2023	7	55	-0.05	0.01	-0.08	-0.06	-0.06	-0.05	-0.05	-0.04	-0.03	0	0
May 2023	8	378	-0.03	0.01	-0.07	-0.03	-0.03	-0.03	-0.02	-0.02	-0.01	0	0
May 2023	Biology	190	-0.05	0.01	-0.14	-0.06	-0.06	-0.05	-0.05	-0.04	-0.03	0	0
April 2024	2	15	-0.09	0.03	-0.13	-0.12	-0.11	-0.10	-0.06	-0.05	-0.05	0	0
April 2024	3	10	-0.10	0.01	-0.12	-0.12	-0.11	-0.10	-0.10	-0.09	-0.08	0	0
April 2024	4	10	-0.11	0.02	-0.14	-0.14	-0.12	-0.11	-0.10	-0.09	-0.09	0	0
April 2024	5	10	-0.09	0.02	-0.13	-0.13	-0.10	-0.08	-0.07	-0.07	-0.06	0	0
April 2024	6	10	-0.17	0.03	-0.21	-0.20	-0.18	-0.16	-0.14	-0.14	-0.14	2	0
April 2024	7	6	-0.10	0.03	-0.14	-0.13	-0.11	-0.10	-0.08	-0.07	-0.06	0	0
April 2024	8	15	-0.09	0.06	-0.19	-0.17	-0.12	-0.07	-0.05	-0.03	-0.02	0	0
April 2024	Biology	300	-0.04	0.01	-0.12	-0.05	-0.05	-0.04	-0.03	-0.03	-0.02	0	0
April 2024	Chemistry	630	-0.03	0.01	-0.07	-0.05	-0.04	-0.03	-0.02	-0.01	0.01	0	0

\*Items in grade 2 were co-mingled on forms taken by students in grade 3.

**Table 8–8. Summary of Item Residual Correlations for Writing**

Date	Grade/ Course	N	Mean	SD	Min	P <sub>10</sub>	P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>	P <sub>90</sub>	Max	< -.20	>.20
Aug 2011	3	2,205	-0.02	0.05	-0.26	-0.08	-0.04	-0.02	0.00	0.02	0.19	6	0
Aug 2011	4	2,315	-0.02	0.05	-0.24	-0.09	-0.04	-0.02	0.00	0.02	0.28	9	2
Aug 2011	5	2,580	-0.02	0.05	-0.25	-0.09	-0.04	-0.02	0.00	0.02	0.19	11	0
Aug 2011	6	3,795	-0.02	0.05	-0.25	-0.08	-0.04	-0.02	0.01	0.03	0.27	4	5
Aug 2011	7	3,544	-0.02	0.05	-0.24	-0.08	-0.04	-0.02	0.00	0.03	0.24	10	2
Aug 2011	8	3,815	-0.02	0.07	-0.29	-0.11	-0.05	-0.02	0.01	0.06	0.29	58	13
Aug 2011	Eng. Comp	7,705	-0.02	0.06	-0.30	-0.10	-0.04	-0.01	0.01	0.05	0.33	72	18
Jan 2014	K–2*	2,641	-0.05	0.09	-0.39	-0.15	-0.11	-0.05	0.01	0.06	0.35	84	19
Jan 2014	3	570	-0.05	0.06	-0.20	-0.12	-0.08	-0.05	-0.02	0.02	0.23	1	1
Jan 2014	4	570	-0.05	0.04	-0.18	-0.10	-0.08	-0.05	-0.02	0.01	0.21	0	1
Jan 2014	5	2,485	-0.01	0.02	-0.13	-0.04	-0.02	-0.01	0.00	0.01	0.05	0	0
June 2016	6	4,005	-0.01	0.01	-0.05	-0.02	-0.02	-0.01	-0.01	0.00	0.02	0	0
June 2016	7	4,186	-0.01	0.01	-0.06	-0.02	-0.02	-0.01	0.00	0.00	0.01	0	0
June 2016	8	5,565	-0.01	0.01	-0.05	-0.02	-0.01	-0.01	0.00	0.00	0.01	0	0
June 2016	Eng. Comp	5,151	-0.01	0.01	-0.13	-0.03	-0.02	-0.01	0.00	0.00	0.03	0	0
June 2019	K–2*	496	-0.03	0.04	-0.39	-0.07	-0.05	-0.02	-0.01	0.00	0.04	3	0
June 2019	3	4,851	-0.01	0.01	-0.21	-0.03	-0.02	-0.01	0.00	0.00	0.05	1	0
June 2019	4	4,005	-0.01	0.01	-0.12	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
June 2019	5	4,005	-0.01	0.01	-0.09	-0.03	-0.02	-0.01	0.00	0.00	0.06	0	0
June 2019	6	4,278	-0.01	0.01	-0.07	-0.02	-0.02	-0.01	0.00	0.00	0.02	0	0
June 2019	7	6,105	-0.01	0.01	-0.05	-0.02	-0.01	-0.01	0.00	0.00	0.02	0	0
June 2019	8	4,278	-0.01	0.01	-0.14	-0.03	-0.02	-0.01	0.00	0.00	0.04	0	0
June 2019	Eng. Comp	43,071	0.00	0.01	-0.24	-0.02	-0.01	0.00	0.00	0.01	0.18	2	0
June 2023	K–2*	45	-0.03	0.01	-0.06	-0.05	-0.04	-0.03	-0.02	-0.01	0.00	0	0
June 2023	3	190	-0.04	0.01	-0.07	-0.05	-0.04	-0.04	-0.03	-0.02	0.00	0	0
June 2023	4	300	-0.04	0.01	-0.10	-0.06	-0.05	-0.04	-0.03	-0.02	0.00	0	0
June 2023	5	595	-0.03	0.01	-0.06	-0.04	-0.04	-0.03	-0.02	-0.02	0.00	0	0
June 2023	6	595	-0.03	0.01	-0.12	-0.04	-0.04	-0.03	-0.02	-0.01	0.00	0	0
June 2023	7	780	-0.02	0.01	-0.06	-0.04	-0.03	-0.02	-0.02	-0.01	0.01	0	0
June 2023	8	528	-0.03	0.01	-0.06	-0.04	-0.04	-0.03	-0.02	-0.02	0.00	0	0
June 2023	Eng. Comp	190	-0.05	0.02	-0.26	-0.07	-0.06	-0.05	-0.04	-0.03	0.00	1	0

\*Items in kindergarten through grade 2 were co-mingled on forms taken by students in grade 3.

Across the content areas and grades/courses, the mean residual correlations were slightly negative and the values were close to zero. The vast majority of the correlations were very small, suggesting local item independence generally holds for the CDT mathematics, reading, science, and writing item pools.

## ITEM FIT

WINSTEPS provides two item-fit statistics (infit and outfit) for evaluating the degree to which the Rasch model predicts the observed item responses. Each fit statistic can be expressed as a mean square (MnSq) statistic or on a standardized metric (Zstd with mean = 0 and variance = 1). MnSq values are more oriented toward practical significance, while Zstd values are more oriented toward statistical significance. MnSq values are presented in this chapter.

Both infit and outfit MnSq are the average of standardized residual variance (the difference between the observed score and the Rasch estimated score divided by the square root of the Rasch model variance). The difference is that the outfit statistic gives all examinees equal weight in computing the fit and tends to be affected more by unexpected responses far from the person, item, or rating scale category measure (i.e., it is more sensitive to outlying, off-target, low information responses). The infit statistic is weighted by the examinee locations relative to item difficulty and tends to be affected more by unexpected responses close to the person, item, or rating scale category measure (i.e., informative, on-target responses). Some feel that extreme infit values are a greater threat to the measurement process than extreme outfit values since most tests intend to measure the on-target population rather than extreme outliers.

The expected MnSq value is 1.0, and it can range from 0 to infinity. Deviation in excess of the expected value can be interpreted as noise or lack of fit between the items and the model. Values lower than the expected value can be interpreted as item redundancy or overfitting items (too predictable, too much redundancy), and values greater than the expected value indicate underfitting items (too unpredictable, too much noise). Rules of thumb regarding practically significant MnSq values vary. More conservative users might prefer items with MnSq values that range from 0.8 to 1.2. Others believe reasonable test results can be achieved with values from 0.5 to 1.5. In the following results, values outside of 0.7 to 1.3 are given practical importance.

Table 8–9 presents the summary statistics of infit and outfit mean square statistics for the CDT item pools, including the mean, standard deviation, minimum, and maximum values. The number of items within the range of (0.7, 1.3) is also reported in Table 8–9. As can be seen, the mean values for both fit statistics were close to 1.00 for nearly all grades/courses. Nearly all items had infit values falling in the range of (0.7, 1.3). These results indicate that the Rasch model fits the CDT data well.

**Table 8–9. Summary of Infit and Outfit Mean Square Statistics**

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
Aug 2010	Mathematics	3	86	0.99	0.08	0.78	1.17	86/86	0.99	0.24	0.21	1.56	71/86
Aug 2010	Mathematics	4	86	0.99	0.08	0.81	1.20	86/86	0.98	0.18	0.50	1.65	78/86
Aug 2010	Mathematics	5	85	0.99	0.12	0.80	1.32	84/85	1.00	0.24	0.46	1.56	69/85
Aug 2010	Mathematics	6	259	0.99	0.11	0.80	1.38	256/259	1.00	0.31	0.40	3.92	217/259
Aug 2010	Mathematics	7	258	1.00	0.12	0.80	1.49	253/258	1.01	0.25	0.56	2.24	213/258
Aug 2010	Mathematics	8	257	1.00	0.11	0.75	1.37	254/257	1.03	0.22	0.48	2.40	226/257
Aug 2010	Mathematics	11	149	0.99	0.10	0.80	1.27	149/149	0.99	0.18	0.67	1.67	141/149
Aug 2010	Mathematics	Algebra I	256	1.00	0.09	0.79	1.28	256/256	1.02	0.14	0.65	1.61	249/256
Aug 2010	Mathematics	Geometry	257	1.00	0.10	0.81	1.31	256/257	1.02	0.17	0.66	1.78	239/257
Aug 2010	Mathematics	Algebra II	256	1.00	0.10	0.78	1.41	254/256	1.03	0.20	0.66	1.99	233/256
Jan 2011	Reading	3	86	0.99	0.12	0.74	1.30	86/86	0.97	0.24	0.40	1.53	66/86
Jan 2011	Reading	4	87	0.99	0.10	0.79	1.28	87/87	0.95	0.22	0.32	1.58	74/87
Jan 2011	Reading	5	86	0.96	0.09	0.78	1.22	86/86	0.91	0.20	0.44	1.64	72/86
Jan 2011	Reading	6	210	1.01	0.13	0.70	1.30	210/210	1.02	0.31	0.37	2.65	151/210
Jan 2011	Reading	7	192	1.00	0.10	0.76	1.30	192/192	0.96	0.23	0.21	2.00	162/192
Jan 2011	Reading	8	192	0.98	0.11	0.75	1.33	191/192	0.96	0.22	0.41	1.84	158/192
Jan 2011	Reading	Literature	348	1.01	0.13	0.75	1.31	347/348	1.01	0.25	0.38	2.00	282/348
Jan 2011	Science	3	91	1.01	0.09	0.83	1.20	91/91	1.00	0.21	0.45	1.48	80/91
Jan 2011	Science	4	123	1.01	0.08	0.85	1.23	123/123	1.00	0.18	0.52	1.81	112/123
Jan 2011	Science	5	102	1.00	0.08	0.84	1.21	102/102	1.02	0.16	0.74	1.85	98/102
Jan 2011	Science	6	178	1.00	0.09	0.80	1.22	178/178	1.02	0.17	0.61	1.82	165/178
Jan 2011	Science	7	327	0.99	0.09	0.78	1.22	327/327	1.01	0.17	0.54	1.83	300/327
Jan 2011	Science	8	377	1.02	0.12	0.77	1.37	372/377	1.06	0.24	0.57	2.12	307/377
Jan 2011	Science	11	115	1.08	0.10	0.81	1.30	115/115	1.19	0.26	0.73	2.19	82/115
Jan 2011	Science	Biology	390	1.00	0.08	0.84	1.28	390/390	1.03	0.14	0.73	1.63	372/390
Jan 2011	Science	Chemistry	335	1.00	0.06	0.85	1.26	335/335	1.02	0.09	0.79	1.48	333/335
Aug 2011	Writing	3	140	0.99	0.11	0.80	1.43	139/140	1.00	0.24	0.42	1.95	115/140
Aug 2011	Writing	4	149	0.99	0.10	0.79	1.26	149/149	1.00	0.24	0.52	1.74	123/149
Aug 2011	Writing	5	165	0.98	0.09	0.80	1.24	165/165	0.97	0.19	0.62	1.92	151/165
Aug 2011	Writing	6	193	0.99	0.10	0.78	1.23	193/193	0.98	0.20	0.53	1.76	170/193
Aug 2011	Writing	7	176	1.00	0.11	0.75	1.36	175/176	1.02	0.23	0.56	1.92	147/176
Aug 2011	Writing	8	195	0.99	0.11	0.77	1.31	194/195	0.99	0.21	0.45	1.68	166/195
Aug 2011	Writing	Eng. Comp.	365	1.00	0.12	0.77	1.38	362/365	1.03	0.25	0.38	2.16	304/365
July 2013	Mathematics	6	156	1.07	0.14	0.78	1.50	144/156	1.35	0.62	0.51	4.77	96/156
July 2013	Mathematics	7	73	1.11	0.13	0.82	1.40	69/73	1.52	0.68	0.76	4.74	33/73
July 2013	Mathematics	8	157	1.14	0.13	0.87	1.45	138/157	1.61	0.58	0.85	3.46	62/157
July 2013	Reading	6	56	1.03	0.13	0.78	1.31	55/56	1.13	0.37	0.58	2.48	35/56

**Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics**

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
July 2013	Reading	7	58	1.05	0.14	0.82	1.42	55/58	1.17	0.38	0.65	2.91	41/58
July 2013	Reading	8	57	1.03	0.13	0.78	1.32	56/57	1.11	0.29	0.48	2.03	42/57
Jan 2014	Mathematics	K	60	0.98	0.12	0.77	1.34	58/60	0.90	0.30	0.40	1.53	37/60
Jan 2014	Mathematics	1	91	0.97	0.12	0.76	1.33	89/91	0.92	0.30	0.23	2.00	61/91
Jan 2014	Mathematics	2	130	0.99	0.10	0.77	1.29	130/130	0.98	0.27	0.36	1.95	99/130
Jan 2014	Mathematics	3	235	0.99	0.12	0.77	1.44	231/235	1.02	0.31	0.47	3.11	191/235
Jan 2014	Mathematics	4	248	1.00	0.12	0.75	1.31	247/248	1.03	0.27	0.45	2.21	199/248
Jan 2014	Mathematics	5	221	1.02	0.11	0.79	1.37	218/221	1.07	0.25	0.58	2.22	182/221
Jan 2014	Reading	K	84	0.97	0.11	0.77	1.36	83/84	0.91	0.24	0.39	1.51	61/84
Jan 2014	Reading	1	98	0.99	0.12	0.77	1.35	96/98	1.02	0.35	0.36	2.75	73/98
Jan 2014	Reading	2	98	0.98	0.11	0.76	1.24	98/98	1.02	0.25	0.44	1.80	77/98
Jan 2014	Reading	3	178	1.00	0.12	0.77	1.29	178/178	1.04	0.31	0.43	2.44	127/178
Jan 2014	Reading	4	189	1.00	0.11	0.78	1.35	188/189	1.01	0.28	0.40	2.70	149/189
Jan 2014	Reading	5	134	1.01	0.11	0.77	1.28	134/134	1.04	0.24	0.44	1.91	112/134
Jan 2014	Science	K-2 grade span	280	0.99	0.13	0.73	1.43	273/280	1.01	0.34	0.23	2.79	199/280
Jan 2014	Science	3	155	0.99	0.11	0.72	1.29	155/155	0.98	0.28	0.23	1.99	114/155
Jan 2014	Science	4	213	1.00	0.11	0.70	1.27	213/213	1.01	0.24	0.37	1.88	179/213
Jan 2014	Science	5	152	1.07	0.15	0.70	1.59	141/152	1.16	0.29	0.50	2.39	111/152
Jan 2014	Writing	K	44	0.90	0.11	0.73	1.20	44/44	0.72	0.26	0.33	1.38	20/44
Jan 2014	Writing	1	118	0.96	0.15	0.70	1.42	117/118	0.89	0.32	0.27	1.76	74/118
Jan 2014	Writing	2	117	0.98	0.13	0.70	1.46	115/117	0.99	0.26	0.32	1.65	93/117
Jan 2014	Writing	3	60	0.98	0.12	0.78	1.22	60/60	0.98	0.27	0.35	1.97	48/60
Jan 2014	Writing	4	60	1.00	0.11	0.83	1.34	59/60	1.02	0.29	0.60	2.41	51/60
Jan 2014	Writing	5	71	1.03	0.13	0.71	1.37	70/71	1.13	0.40	0.61	2.59	48/71
June 2016	Mathematics	6	122	1.08	0.13	0.87	1.49	113/122	1.31	0.36	0.72	2.38	70/122
June 2016	Mathematics	7	176	1.09	0.13	0.84	1.54	161/176	1.42	0.48	0.74	3.42	89/176
June 2016	Mathematics	8	150	1.13	0.12	0.85	1.61	139/150	1.61	0.50	0.82	3.32	51/150
June 2016	Mathematics	Algebra I	149	1.10	0.09	0.85	1.36	148/149	1.49	0.47	0.73	3.45	57/149
June 2016	Reading	3	22	1.13	0.17	0.85	1.49	18/22	1.15	0.19	0.82	1.54	16/22
June 2016	Reading	4	22	1.10	0.15	0.87	1.44	19/22	1.15	0.30	0.76	2.24	19/22
June 2016	Reading	5	21	1.10	0.13	0.96	1.40	20/21	1.14	0.20	0.91	1.67	18/21
June 2016	Reading	6	123	1.06	0.13	0.81	1.54	121/123	1.13	0.29	0.58	2.48	98/123
June 2016	Reading	7	126	1.04	0.15	0.79	1.51	122/126	1.12	0.37	0.40	2.91	90/126
June 2016	Reading	8	124	1.06	0.16	0.79	2.00	115/124	1.16	0.40	0.50	3.14	82/124
June 2016	Reading	Literature	125	1.07	0.12	0.75	1.36	122/125	1.24	0.38	0.60	2.53	83/125
June 2016	Science	6	72	1.08	0.10	0.87	1.30	72/72	1.27	0.35	0.73	2.36	45/72
June 2016	Science	7	159	1.08	0.09	0.82	1.34	158/159	1.29	0.32	0.64	2.28	98/159



**Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics**

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
June 2016	Science	8	238	1.07	0.10	0.77	1.34	236/238	1.27	0.36	0.50	3.55	151/238
June 2016	Science	Biology	136	1.08	0.10	0.87	1.51	135/136	1.25	0.24	0.83	1.94	88/136
June 2016	Writing	6	93	1.06	0.12	0.83	1.34	91/93	1.24	0.47	0.70	4.66	62/93
June 2016	Writing	7	93	1.08	0.10	0.81	1.39	91/93	1.31	0.45	0.70	3.14	59/93
June 2016	Writing	8	110	1.09	0.11	0.88	1.37	106/110	1.37	0.48	0.76	3.93	63/110
June 2016	Writing	Eng. Comp.	104	1.08	0.11	0.75	1.34	103/104	1.46	0.84	0.58	8.30	51/104
June 2019	Mathematics	K	20	1.00	0.14	0.84	1.38	19/20	0.97	0.27	0.63	1.57	14/20
June 2019	Mathematics	1	20	1.00	0.11	0.84	1.25	20/20	0.98	0.27	0.53	1.47	15/20
June 2019	Mathematics	2	20	0.97	0.10	0.79	1.14	20/20	1.00	0.40	0.59	2.50	18/20
June 2019	Mathematics	3	178	1.02	0.11	0.81	1.38	174/178	1.13	0.41	0.40	3.97	142/178
June 2019	Mathematics	4	179	1.03	0.10	0.80	1.27	179/179	1.12	0.28	0.53	2.17	139/179
June 2019	Mathematics	5	180	1.05	0.10	0.85	1.32	179/180	1.14	0.27	0.66	2.12	136/180
June 2019	Mathematics	6	96	1.09	0.11	0.88	1.45	93/96	1.28	0.32	0.71	2.22	60/96
June 2019	Mathematics	7	103	1.09	0.12	0.86	1.45	101/103	1.35	0.45	0.73	3.07	60/103
June 2019	Mathematics	8	99	1.14	0.12	0.89	1.40	93/99	1.62	0.56	0.86	4.00	32/99
June 2019	Mathematics	Algebra I	299	1.14	0.11	0.86	1.45	270/299	1.58	0.56	0.73	5.27	110/299
June 2019	Mathematics	Geometry	100	1.18	0.15	0.88	1.51	82/100	1.84	0.75	0.80	5.11	25/100
June 2019	Mathematics	Algebra II	100	1.13	0.15	0.86	1.58	86/100	1.61	0.60	0.86	3.80	37/100
June 2019	Reading	K	32	1.01	0.15	0.82	1.37	30/32	1.03	0.22	0.71	1.60	28/32
June 2019	Reading	1	20	1.00	0.10	0.87	1.22	20/20	1.00	0.14	0.76	1.27	20/20
June 2019	Reading	2	32	1.05	0.15	0.82	1.43	30/32	1.08	0.24	0.72	1.55	25/32
June 2019	Reading	3	162	1.10	0.16	0.81	1.68	145/162	1.16	0.27	0.59	2.51	125/162
June 2019	Reading	4	162	1.09	0.17	0.75	1.67	139/162	1.19	0.35	0.52	2.78	109/162
June 2019	Reading	5	162	1.07	0.16	0.77	1.64	147/162	1.16	0.33	0.61	2.35	116/162
June 2019	Reading	6	123	1.06	0.16	0.76	1.60	114/123	1.14	0.35	0.61	2.93	87/123
June 2019	Reading	7	123	1.09	0.16	0.76	1.62	112/123	1.20	0.34	0.54	2.59	85/123
June 2019	Reading	8	120	1.09	0.15	0.79	1.67	111/120	1.19	0.32	0.63	2.34	81/120
June 2019	Reading	Literature	249	1.07	0.14	0.74	1.53	238/249	1.20	0.39	0.59	3.41	171/249
June 2019	Science	K-2 grade span	31	1.11	0.16	0.82	1.37	27/31	1.37	0.58	0.72	3.23	16/31
June 2019	Science	3	89	1.09	0.12	0.78	1.38	87/89	1.37	0.45	0.67	3.20	45/89
June 2019	Science	4	95	1.11	0.11	0.79	1.39	92/95	1.39	0.47	0.60	3.58	44/95
June 2019	Science	5	90	1.09	0.11	0.81	1.30	90/90	1.27	0.31	0.62	2.34	51/90
June 2019	Science	6	97	1.10	0.12	0.84	1.34	95/97	1.28	0.36	0.68	2.53	60/97
June 2019	Science	7	99	1.08	0.10	0.86	1.29	99/99	1.21	0.27	0.72	2.37	73/99
June 2019	Science	8	102	1.08	0.10	0.86	1.31	101/102	1.27	0.36	0.75	2.60	64/102
June 2019	Science	Biology	290	1.11	0.12	0.81	1.45	276/290	1.31	0.33	0.67	2.94	166/290
June 2019	Science	Chemistry	100	1.06	0.08	0.87	1.25	100/100	1.16	0.16	0.78	1.83	84/100

**Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics**

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
June 2019	Writing	K	10	0.96	0.12	0.73	1.10	10/10	0.81	0.20	0.37	1.14	8/10
June 2019	Writing	1	10	1.07	0.19	0.71	1.25	10/10	1.47	0.82	0.51	2.90	5/10
June 2019	Writing	2	12	1.13	0.17	0.90	1.36	9/12	2.15	2.02	0.85	6.91	7/12
June 2019	Writing	3	99	1.10	0.14	0.78	1.44	91/99	1.39	0.82	0.39	8.12	54/99
June 2019	Writing	4	90	1.09	0.13	0.81	1.45	85/90	1.31	0.60	0.55	4.05	54/90
June 2019	Writing	5	90	1.09	0.14	0.79	1.47	83/90	1.24	0.42	0.49	2.80	54/90
June 2019	Writing	6	93	1.12	0.13	0.78	1.41	87/93	1.30	0.39	0.47	2.80	48/93
June 2019	Writing	7	111	1.11	0.13	0.76	1.42	101/111	1.32	0.41	0.63	2.77	70/111
June 2019	Writing	8	93	1.14	0.14	0.79	1.48	82/93	1.41	0.58	0.57	3.84	47/93
June 2019	Writing	Eng. Comp.	294	1.16	0.21	0.66	1.72	219/294	1.61	1.00	0.22	9.69	124/294
May 2020	Science	3	19	1.04	0.09	0.87	1.16	19/19	1.27	0.42	0.81	2.26	13/19
May 2020	Science	4	22	1.05	0.15	0.88	1.54	21/22	1.28	0.48	0.78	2.98	14/22
May 2020	Science	5	20	1.00	0.08	0.86	1.19	20/20	1.01	0.30	0.40	1.84	15/20
May 2020	Science	6	18	1.06	0.10	0.92	1.27	18/18	1.17	0.21	0.88	1.66	13/18
May 2020	Science	7	19	1.05	0.12	0.81	1.25	19/19	1.15	0.25	0.74	1.76	15/19
May 2020	Science	8	20	1.02	0.10	0.85	1.20	20/20	1.16	0.32	0.79	2.02	13/20
May 2020	Science	Biology	40	1.04	0.12	0.87	1.48	39/40	1.16	0.27	0.76	1.79	30/40
June 2023	Mathematics	K	5	0.97	0.11	0.83	1.12	5/5	1.14	0.36	0.58	1.54	2/5
June 2023	Mathematics	1	10	1.02	0.11	0.89	1.17	10/10	1.07	0.26	0.74	1.63	8/10
June 2023	Mathematics	2	21	1.05	0.14	0.83	1.38	20/21	1.13	0.34	0.69	1.80	14/21
June 2023	Mathematics	3	103	1.07	0.12	0.87	1.60	100/103	1.28	0.69	0.72	6.68	70/103
June 2023	Mathematics	4	120	1.08	0.12	0.81	1.41	116/120	1.27	0.43	0.65	4.32	72/120
June 2023	Mathematics	5	135	1.09	0.14	0.81	1.48	123/135	1.26	0.37	0.57	2.39	87/135
June 2023	Mathematics	6	100	1.12	0.16	0.85	1.56	87/100	1.44	0.58	0.67	4.10	49/100
June 2023	Mathematics	7	124	1.18	0.15	0.88	1.64	98/124	1.71	0.64	0.78	3.72	39/124
June 2023	Mathematics	8	85	1.23	0.13	0.97	1.60	62/85	1.86	0.74	0.85	4.26	20/85
June 2023	Mathematics	Algebra I	149	1.22	0.13	0.89	1.53	109/149	1.88	0.66	0.79	4.19	28/149
June 2023	Mathematics	Geometry	45	1.23	0.14	0.98	1.52	30/45	2.18	0.96	0.86	5.71	5/45
June 2023	Mathematics	Algebra II	45	1.23	0.14	0.98	1.55	31/45	2.01	0.72	1.02	4.82	7/45
June 2023	Reading	K	18	0.98	0.15	0.82	1.37	17/18	0.97	0.21	0.71	1.48	16/18
June 2023	Reading	1	30	1.01	0.14	0.82	1.31	29/30	1.03	0.22	0.74	1.55	26/30
June 2023	Reading	2	30	1.00	0.13	0.79	1.31	29/30	1.02	0.22	0.72	1.62	26/30
June 2023	Reading	3	126	1.02	0.15	0.76	1.53	119/126	1.03	0.23	0.60	1.77	106/126
June 2023	Reading	4	101	1.06	0.17	0.74	1.61	91/101	1.09	0.26	0.57	2.02	80/101
June 2023	Reading	5	107	1.05	0.15	0.75	1.46	103/107	1.09	0.28	0.58	2.46	86/107
June 2023	Reading	6	132	1.03	0.15	0.79	1.56	127/132	1.07	0.26	0.59	2.30	104/132
June 2023	Reading	7	132	1.06	0.17	0.78	1.78	122/132	1.14	0.42	0.54	4.19	104/132

**Table 8–9 (continued). Summary of Infit and Outfit Mean Square Statistics**

Date	Content Area	Grade/Course	Number of Items	Infit Mean	Infit SD	Infit Min	Infit Max	Infit [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit [0.7,1.3]
June 2023	Reading	8	185	1.03	0.16	0.76	1.76	176/185	1.07	0.32	0.50	2.63	143/185
June 2023	Reading	Literature	187	1.06	0.15	0.75	1.65	176/187	1.10	0.26	0.58	2.33	152/187
June 2023	Science	K-2 grade span	9	1.12	0.10	0.95	1.25	9/9	1.38	0.33	0.91	1.92	4/9
June 2023	Science	3	9	1.13	0.09	1.00	1.24	9/9	1.23	0.15	0.97	1.41	5/9
June 2023	Science	4	4	1.15	0.13	0.99	1.32	3/4	1.46	0.43	1.09	2.08	2/4
June 2023	Science	5	13	1.08	0.13	0.88	1.29	13/13	1.22	0.30	0.77	1.69	7/13
June 2023	Science	6	4	1.04	0.08	0.94	1.13	4/4	1.04	0.13	0.87	1.17	4/4
June 2023	Science	7	11	1.18	0.12	0.95	1.37	10/11	1.44	0.37	0.90	2.42	5/11
June 2023	Science	8	28	1.14	0.12	0.93	1.37	25/28	1.40	0.34	0.94	2.08	15/28
June 2023	Science	Biology	20	1.15	0.10	1.00	1.34	18/20	1.39	0.19	1.03	1.72	7/20
June 2023	Science	Chemistry	0										
June 2023	Writing	K	2	0.91	0.11	0.83	0.98	2/2	0.84	0.11	0.76	0.91	2/2
June 2023	Writing	1	3	0.95	0.10	0.86	1.05	3/3	0.89	0.16	0.73	1.04	3/3
June 2023	Writing	2	5	1.22	0.18	1.02	1.44	3/5	1.41	0.35	1.07	1.87	2/5
June 2023	Writing	3	20	1.18	0.12	0.92	1.34	17/20	1.44	0.39	0.79	2.27	8/20
June 2023	Writing	4	25	1.09	0.15	0.82	1.35	24/25	1.25	0.59	0.55	3.67	15/25
June 2023	Writing	5	35	1.01	0.10	0.84	1.24	35/35	1.00	0.21	0.61	1.48	30/35
June 2023	Writing	6	35	1.01	0.15	0.76	1.34	33/35	1.02	0.38	0.52	2.14	21/35
June 2023	Writing	7	40	1.08	0.15	0.84	1.43	37/40	1.23	0.40	0.69	2.38	24/40
June 2023	Writing	8	33	1.06	0.18	0.81	1.42	28/33	1.30	0.79	0.63	4.60	19/33
June 2023	Writing	Eng. Comp.	20	1.16	0.15	0.84	1.41	17/20	1.44	0.41	0.71	2.17	8/20
April 2024	Science	K-2 grade span	6	1.14	0.09	1.01	1.24	6/6	1.31	0.15	1.16	1.49	3/6
April 2024	Science	3	5	1.19	0.18	0.98	1.43	4/5	1.31	0.30	0.96	1.68	2/5
April 2024	Science	4	5	1.10	0.15	0.96	1.32	4/5	1.20	0.34	0.89	1.77	4/5
April 2024	Science	5	5	1.13	0.13	0.95	1.28	5/5	1.52	0.38	1.02	2.00	2/5
April 2024	Science	6	5	1.02	0.08	0.91	1.14	5/5	1.11	0.12	0.92	1.23	5/5
April 2024	Science	7	4	1.12	0.13	1.00	1.24	4/4	1.77	0.96	1.19	3.20	2/4
April 2024	Science	8	6	1.08	0.12	0.98	1.31	5/6	1.38	0.23	1.14	1.76	2/6
April 2024	Science	Biology	25	1.08	0.10	0.86	1.31	24/25	1.23	0.28	0.79	1.96	16/25
April 2024	Science	Chemistry	36	1.07	0.09	0.87	1.20	36/36	1.23	0.25	0.80	1.81	24/36

## RASCH ITEM STATISTICS

As noted earlier, the Rasch model expresses item difficulty (and student ability) in units referred to as *logits*, rather than on the percent-correct metric. In the simplest case, a logit is a transformed  $p$ -value with the average  $p$ -value becoming a logit of zero. In this form, logits resemble  $z$ -scores or standard normal deviates; a very difficult item might have a logit of +4.0 and a very easy item might have a logit of -4.0. However, they have no formal relationship to the normal distribution.

The logit metric has several mathematical advantages over  $p$ -values. Logits have an interval scale, meaning that two items with logits of 0.0 and +1.0, respectively, are the same distance apart as two items with logits of +3.0 and +4.0. Logits are not dependent on the ability level of the students. For example, a test form can have a mean logit of zero, whether the average item  $p$ -value for the student sample is 0.8 or 0.3.

The standard Rasch calibration procedure arbitrarily sets the mean difficulty of the items in any calibration at zero. For each CDT stand-alone field-test event and content area, all grades and courses were calibrated separately with the exception of grade 11 items in Mathematics and Science. As a result, items in each grade or course were centered at zero. See Chapter Nine for a description of how item parameters within a content area were re-scaled across grades and courses to build a single (vertical) scale.

For each CDT embedded field-test event and content area, field-test items were calibrated anchoring on operational items' parameters. As a result, the embedded field-test items were placed on operational vertical scale. Rasch item difficulty measure on the vertical scale and associated standard error for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Statistics for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year's technical report. Statistics for the 2023–2024 embedded field test are in Appendix B of this report.

## CHAPTER NINE: VERTICAL LINKING

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The Classroom Diagnostic Tools (CDT) is designed to enable educators to identify students' academic strengths and areas of need. As such, it is necessary for some students to take items out of grade or course level. In order to do this, all items within a content area must be on a common (vertical) scale.

As previously mentioned in Chapter Eight, items from the first stand-alone field-test event for each CDT content area and grade or course were calibrated separately and centered at zero. This chapter outlines the procedures used for vertically linking CDT items across grades and courses within a content area. The end results are four separate vertical scales—one for each content area.

Also mentioned in Chapter Eight, for each content area, the items from all embedded field-test events and the second stand-alone field-test event were calibrated anchoring on operational items' parameters. As a result, all field-test items after the first stand-alone field-test events were placed on the operational vertical scale.

### VERTICAL LINKING DESIGN

The first CDT stand-alone field tests were designed to build vertical scales across all grades and courses within a content area. In order to accomplish this, some field-test forms had items from one grade above or below in addition to on-grade or course-level items.

Stand-alone field tests in each content area had two types of forms:

1. Vertical linking form
2. On-grade-only form

Students who received vertical linking forms took a set of on-grade items and a set of items either one grade above or one grade below. Students who received on-grade-only forms took just on-grade items.

All items in the pool were field tested on one or more forms. In Mathematics, on-grade items were chained across adjacent forms to provide a horizontal link across forms within a grade. There were eight to ten horizontal links across adjacent forms. In all other content areas, 10 on-grade items appeared on each form within a grade or course. These common items provide a horizontal link across forms within a grade.<sup>1</sup>

Items used in vertical linking were administered to students one grade above or one grade below in order to link the forms across grades. DRC test development specialists selected items to be administered off-grade level with the following guidelines:

- There are two types of linking sets.
  - Items administered one grade below (e.g., grade 7 items administered to grade 6 students).
  - Items administered one grade above (e.g., grade 7 items administered to grade 8 students).
- Linking sets span the diagnostic categories.
- Linking sets span the estimated difficulty range (item developers estimate easy, medium, or hard).
- Students have a reasonable chance of correctly answering a linking item based on the instruction received.
  - For items administered in the grade above, students should have received instruction the previous year.
  - For items administered in the grade below, they should be extensions of concepts the students have already covered, not something completely new.

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<sup>1</sup> The change in horizontal linking design after the Mathematics field test was in response to lower-than-expected participation. Using the same horizontal links on all forms within a grade results in higher *n*-counts.

In Mathematics, each set of linking items appeared on two forms, once located at the beginning and once located at the end to counterbalance possible position effect. In all other content areas, vertical linking items were co-mingled throughout the form with on-grade items.<sup>2</sup>

See Tables 6–1 through 6–4 in Chapter Six for details on the stand-alone field tests including number of items, number of forms, and number of vertical linking forms.

## VERTICAL LINKING – MATHEMATICS

Links were made between adjacent grades, grade 8 to Algebra I, Algebra I to Algebra II, and grade 8 to Geometry. Table 9–1 below shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 30 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The 30 grade 5 items were in two sets of 15, while the 20 grade 6 items were in two sets of 10. The number of linking items differs across grades because forms in grades 3, 4, and 5 had 25 items total while all of the others had 35. There was no overlap of linking items among the sets.

**Table 9–1. Mathematics Linking Item Detail**

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	30	20	50
Grade 6 to Grade 7	30	30	60
Grade 8 to Grade 7	30	30	60
Algebra I to Grade 8	30	30	60
Algebra II to Algebra I	30	30	60
Geometry to Grade 8	30	30	60

A visual representation of the vertical linking design is provided in Table 9–2. Rows are item level and columns are forms. For example, looking at the second row, you can see grade 4 items were on grades 3, 4, and 5 forms. Grade 4 items on grade 4 forms were on-grade items. Grade 4 items on grade 3 and grade 5 forms were vertical linking items. These items also appeared on grade 4 forms and were used to calculate the vertical linking shift parameter.

In linking grades 4 and 5, look at the four cells in Table 9–2 where grade 4 and grade 5 rows and columns cross. There were 86 grade 4 items, and of those 86 items, 20 items were also given to grade 5 as linking items. Similarly, there were 85 grade 5 items, and 20 out of the 85 items were given to grade 4 students as linking items.

Items used to link to a lower grade were different from items used to link to an upper grade. For example, the 30 grade 7 items administered on grade 6 forms were not the same as the 30 grade 7 items administered on grade 8 forms.

<sup>2</sup> The change in vertical linking design after the Mathematics field test was in response to lower-than-expected participation.

**Table 9–2. Mathematics Vertical Linking Design of Forms**

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Alg I Forms	Geo Forms	Alg II Forms
Gr. 3 Items (86)	Gr. 3 Items (20)							
Gr. 4 Items (20)	Gr. 4 Items (86)	Gr. 4 Items (20)						
	Gr. 5 Items (20)	Gr. 5 Items (85)	Gr. 5 Items (30)					
		Gr. 6 Items (20)	Gr. 6 Items (259)	Gr. 6 Items (30)				
			Gr. 7 Items (30)	Gr. 7 Items (258)	Gr. 7 Items (30)			
				Gr. 8 Items (30)	Gr. 8 Items (257)	Gr. 8 Items (30)	Gr. 8 Items (30)	
					Gr. 11 Items (30)	Gr. 11 Items (50)	Gr. 11 Items (50)	Gr. 11 Items (50)
					Alg I Items (15)	Alg I Items (256)		Alg I Items (30)
					Geo Items (15)		Geo Items (257)	
						Alg II Items (30)		Alg II Items (256)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

**VERTICAL LINKING – READING**

Links were made between adjacent grades and grade 8 to Literature. Table 9–3 shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

**Table 9–3. Reading Linking Item Detail**

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
Literature to Grade 8	20	20	40

A visual representation of the vertical linking design is provided in Table 9–4.

**Table 9–4. Reading Vertical Linking Design of Forms**

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Lit Forms
Gr. 3 Items (86)	Gr. 3 Items (20)					
Gr. 4 Items (20)	Gr. 4 Items (87)	Gr. 4 Items (20)				
	Gr. 5 Items (20)	Gr. 5 Items (86)	Gr. 5 Items (20)			
		Gr. 6 Items (20)	Gr. 6 Items (210)	Gr. 6 Items (20)		
			Gr. 7 Items (20)	Gr. 7 Items (192)	Gr. 7 Items (20)	
				Gr. 8 Items (20)	Gr. 8 Items (192)	Gr. 8 Items (20)
					Lit Items (20)	Lit Items (348)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

### VERTICAL LINKING – SCIENCE

Links were made between adjacent grades, grade 8 to Biology, and grade 8 to Chemistry. Table 9–5 below shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

**Table 9–5. Science Linking Item Detail**

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
Biology to Grade 8	20	20	40
Chemistry to Grade 8	20	20	40



A visual representation of the vertical linking design is provided in Table 9–6.

**Table 9–6. Science Vertical Linking Design of Forms**

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Bio Forms	Chem Forms
Gr. 3 Items (91)	Gr. 3 Items (20)						
Gr. 4 Items (20)	Gr. 4 Items (123)	Gr. 4 Items (20)					
	Gr. 5 Items (20)	Gr. 5 Items (102)	Gr. 5 Items (20)				
		Gr. 6 Items (20)	Gr. 6 Items (178)	Gr. 6 Items (20)			
			Gr. 7 Items (20)	Gr. 7 Items (327)	Gr. 7 Items (20)		
				Gr. 8 Items (20)	Gr. 8 Items (377)	Gr. 8 Items (20)	Gr. 8 Items (20)
					Gr. 11 Items (115)		
					Bio Items (20)	Bio Items (390)	
					Chem Items (20)		Chem Items (335)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

### VERTICAL LINKING – WRITING

Links were made between adjacent grades and grade 8 to English Composition. Table 9–7 shows the number of linking items from the lower grade and the upper grade for each link. There were two sets of linking items for each link and direction. For example, in linking grade 5 to grade 6, there were 20 grade 5 items (lower grade) and 20 grade 6 items (upper grade). The number of linking items was the same across grades.

**Table 9–7. Writing Linking Item Detail**

Link	Lower Grade	Upper Grade	Total
Grade 3 to Grade 4	20	20	40
Grade 4 to Grade 5	20	20	40
Grade 5 to Grade 6	20	20	40
Grade 6 to Grade 7	20	20	40
Grade 8 to Grade 7	20	20	40
English Composition to Grade 8	20	20	40

A visual representation of the vertical linking design is provided in Table 9–8.

**Table 9–8. Writing Vertical Linking Design of Forms**

Gr. 3 Forms	Gr. 4 Forms	Gr. 5 Forms	Gr. 6 Forms	Gr. 7 Forms	Gr. 8 Forms	Eng Forms
Gr. 3 Items (140)	Gr. 3 Items (20)					
Gr. 4 Items (20)	Gr. 4 Items (149)	Gr. 4 Items (20)				
	Gr. 5 Items (20)	Gr. 5 Items (165)	Gr. 5 Items (20)			
		Gr. 6 Items (20)	Gr. 6 Items (193)	Gr. 6 Items (20)		
			Gr. 7 Items (20)	Gr. 7 Items (176)	Gr. 7 Items (20)	
				Gr. 8 Items (20)	Gr. 8 Items (195)	Gr. 8 Items (20)
					Eng Items (20)	Eng Items (365)

See Appendix C for details related to vertical linking items such as *n*-counts, Eligible Content, and diagnostic categories.

## THE VERTICAL LINKING PROCEDURE

Each of the CDT content area vertical scales was centered at grade 7. Adjacent-grade shift parameters were calculated and applied such that all items were vertically linked to grade 7. For example, grade 4 science items were placed on the science vertical scale by applying three shift parameters:

- shift between grades 4 and 5 science
- shift between grades 5 and 6 science
- shift between grades 6 and 7 science

The steps used to calculate adjacent-grade shift parameters are described below. All item calibrations were done with WINSTEPS software version 3.71 (Linacre, 2009). The grade 4 to grade 5 link is provided as an example for the steps.

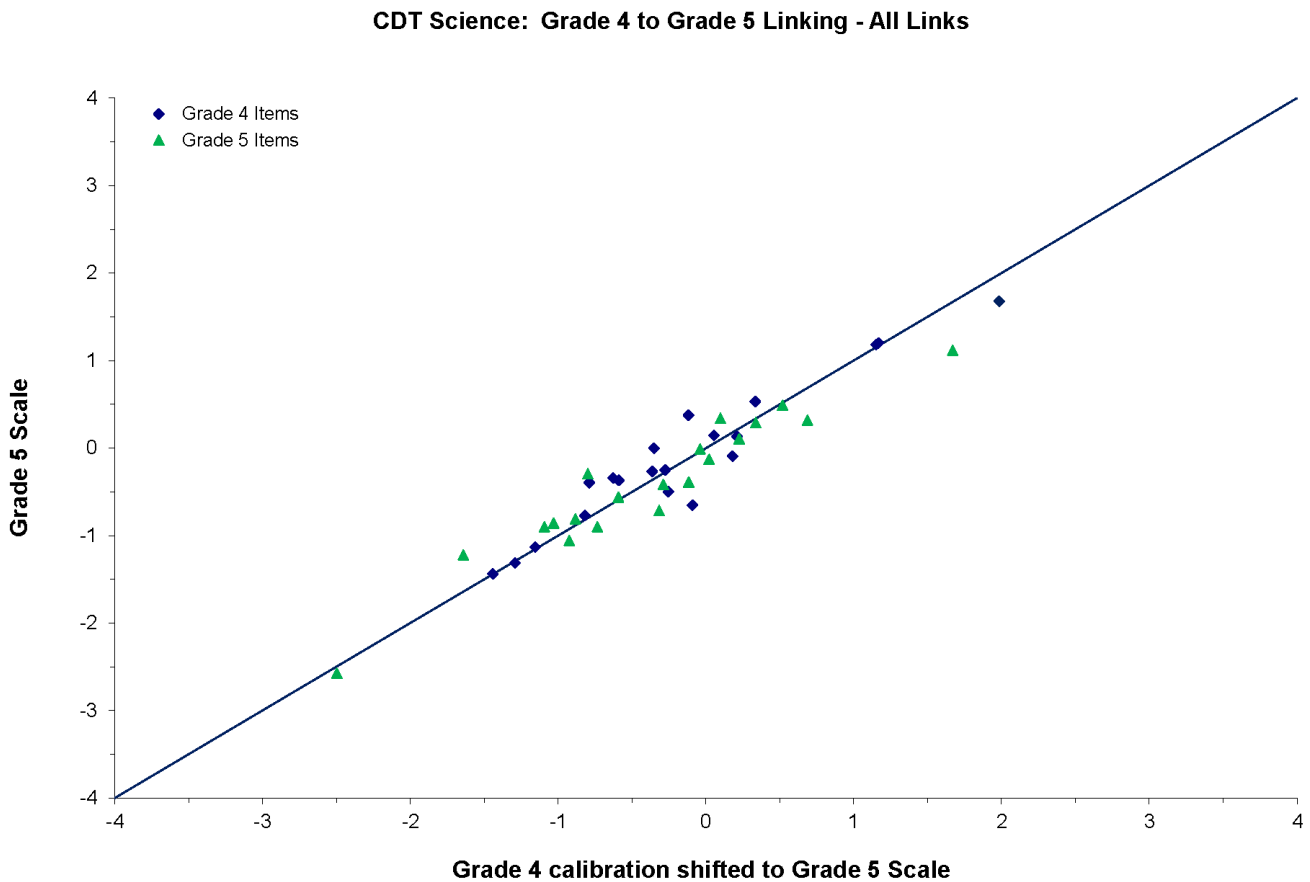
1. Calibrate all on-grade items.
  - Calibrate grade 4 items on grade 4 forms.
  - Calibrate grade 5 items on grade 5 forms.
2. Calibrate off-grade items anchoring on the on-grade items. Anchor values come from step 1.
  - Calibrate grade 5 items on grade 4 forms anchoring on item parameters determined in grade 4 calibration in step 1.
  - Calibrate grade 4 items on grade 5 forms anchoring on item parameters determined in grade 5 calibration in step 1.

Note: For the linking between grades 4 and 5, the calibration of off-grade items on grade 4 forms includes only grade 5 items. It does not include grade 3 items that appeared on grade 4 forms. That is, grade 3 and grade 5 items that appeared on grade 4 forms are not calibrated together.

For each of the linking items, there are two estimates of item difficulty—one from each of the two calibrations. Correlation between these should be high. If not, vertical linking will be problematic.

3. Calculate the difference between the two estimates of item difficulty from step 2 for each linking item. The average of these differences is the adjacent grade shift parameter.
  - If grade is less than 7, determine the shift parameter needed to place items on upper grade scale.
  - If grade is greater than 7, determine the shift parameter needed to place items on lower grade scale.
  - Calculate the difference in item difficulty estimates between step 2, bullet 1 (grade 4 scale) and step 2, bullet 2 (grade 5 scale). An example of an Excel table used for calculations can be found in Appendix C.
4. Apply the adjacent grade shift parameter and plot the linking items along with a 45° line. Figure 9–1 below is an example. The 45° line is for visual reference only. Outliers are NOT identified by comparing to the line. See step 5 for details.

**Figure 9–1. Sample of Linking Items Plot**



Plots for all adjacent grade links can be found in Appendix C.

5. Determine if any items should be removed from the vertical linking process. Identify potential outliers using a combination of correlation, ratio of standard deviation, and robust Z. Discuss these items with test development specialists to determine if they should be removed. An item may be removed from the linking process and still remain in the item pool. In this case, the item is not removed from the on-grade calibrations. That is, do not re-run calibrations in step 1. Repeat steps 2 through 4.

6. Calculate the final shift parameter to the base grade (center of scale) by chaining together adjacent grade shift parameters
  - Grade 7 is the base grade. The final shift parameter for grade 4 items is the shift parameter between grades 4 and 5 plus the shift parameter between grades 5 and 6 plus the shift parameter between grades 6 and 7.
7. Apply the final shift parameters in step 6 to the item parameters calibrated in step 1.

## VERTICAL LINKING RESULTS

Table 9–9 shows the number of links, correlation, and shift parameter for the both the initial and final vertical linking for each content area. Initial vertical linking includes all items. Final values were determined after some links were dropped after consultation with test development specialists.

**Table 9–9. Vertical Linking Summary**

Content Area	Link	Number of Links Initial	Number of Links Final	Correlation Initial	Correlation Final	Shift Parameter Initial	Shift Parameter Final
Mathematics	Grade 3 to Grade 4	40	39	0.960	0.964	-1.245	-1.212
Mathematics	Grade 4 to Grade 5	40	40	0.892	0.892	-0.622	-0.622
Mathematics	Grade 5 to Grade 6	50	49	0.914	0.910	-0.416	-0.395
Mathematics	Grade 6 to Grade 7	60	60	0.935	0.935	-0.782	-0.782
Mathematics	Grade 8 to Grade 7	60	60	0.887	0.887	0.301	0.301
Mathematics	Algebra I to Grade 8	60	58	0.933	0.941	0.766	0.808
Mathematics	Algebra II to Algebra I	60	59	0.880	0.905	0.516	0.544
Mathematics	Geometry to Grade 8	60	60	0.907	0.907	1.022	1.022
Reading	Grade 3 to Grade 4	40	40	0.956	0.956	-0.257	-0.257
Reading	Grade 4 to Grade 5	40	38	0.940	0.954	-0.410	-0.348
Reading	Grade 5 to Grade 6	40	39	0.948	0.965	-0.419	-0.389
Reading	Grade 6 to Grade 7	40	37	0.914	0.945	-0.066	-0.092
Reading	Grade 8 to Grade 7	40	40	0.934	0.934	0.352	0.352
Reading	Literature to Grade 8	40	40	0.929	0.929	0.383	0.383
Science	Grade 3 to Grade 4	40	40	0.952	0.952	-0.570	-0.570
Science	Grade 4 to Grade 5	40	40	0.956	0.956	-0.773	-0.773
Science	Grade 5 to Grade 6	40	40	0.968	0.968	-0.211	-0.211
Science	Grade 6 to Grade 7	40	39	0.938	0.945	-0.135	-0.111
Science	Grade 8 to Grade 7	40	40	0.973	0.973	0.140	0.140
Science	Biology to Grade 8	40	38	0.858	0.904	0.815	0.821
Science	Chemistry to Grade 8	40	37	0.882	0.932	1.172	1.136
Writing	Grade 3 to Grade 4	40	40	0.957	0.957	-0.597	-0.597
Writing	Grade 4 to Grade 5	40	40	0.954	0.954	-0.221	-0.221
Writing	Grade 5 to Grade 6	40	40	0.967	0.967	-0.305	-0.305
Writing	Grade 6 to Grade 7	40	40	0.950	0.950	-0.237	-0.237
Writing	Grade 8 to Grade 7	40	40	0.967	0.967	0.221	0.221
Writing	English Composition to Grade 8	40	40	0.961	0.961	0.176	0.176

Recall that for each content area the vertical scale is centered at grade 7. If the item's grade is less than 7, the shift parameter is the value that is added to place the item on the upper grade scale. For example, -1.212 is added to each grade 3 mathematics item's difficulty to place them on the grade 4 scale. The negative sign indicates that grade 3 items are less difficult than grade 4 items. If the item's grade is greater than 7, the shift parameter is the value added to place the item on the lower grade scale. For example, 0.301 is added to each grade 8 mathematics item's difficulty to place them on the grade 7 scale. The positive sign indicates that grade 8 items are more difficult than grade 7 items.

Items dropped from vertical linking are shown in Table 9–10. Linking plots in Appendix C show all linking items with dropped items in red.

**Table 9–10. Items Dropped from Vertical Linking**

Content Area	Link	Linking Items Removed
Mathematics	Grade 3 to Grade 4	603609 (gr. 4 item)
Mathematics	Grade 4 to Grade 5	None
Mathematics	Grade 5 to Grade 6	602104 (gr. 6 item)
Mathematics	Grade 6 to Grade 7	None
Mathematics	Grade 8 to Grade 7	None
Mathematics	Algebra I to Grade 8	601126 (gr. 8 item) and 602644 (gr. 11 item*)
Mathematics	Algebra II to Algebra I	603086 (Alg II item)
Mathematics	Geometry to Grade 8	None
Reading	Grade 3 to Grade 4	None
Reading	Grade 4 to Grade 5	611272 (gr. 5 item) and 611274 (gr. 5 item)
Reading	Grade 5 to Grade 6	610309 (gr. 6 item)
Reading	Grade 6 to Grade 7	610135 (gr. 6 item), 609022 (gr. 6 item), and 609023 (gr. 6 item)
Reading	Grade 8 to Grade 7	None
Reading	Literature to Grade 8	None
Science	Grade 3 to Grade 4	None
Science	Grade 4 to Grade 5	None
Science	Grade 5 to Grade 6	None
Science	Grade 6 to Grade 7	615238 (gr. 7 item)
Science	Grade 8 to Grade 7	None
Science	Biology to Grade 8	617395 (Bio item) and 617880 (Bio item)
Science	Chemistry to Grade 8	618699 (Chem item), 616511 (Chem item), and 616365 (Chem item)
Writing	Grade 3 to Grade 4	None
Writing	Grade 4 to Grade 5	None
Writing	Grade 5 to Grade 6	None
Writing	Grade 6 to Grade 7	None
Writing	Grade 8 to Grade 7	None
Writing	English Composition to Grade 8	None

\*The grade 11 item was embedded on an Algebra I form

The final shift parameters were calculated by summing adjacent grade shift parameters. For example, grade 4 items were placed on the vertical scale by applying the grade 4 to grade 5 shift, the grade 5 to grade 6 shift, and the grade 6 to grade 7 shift. Similarly, Algebra I items were placed on the vertical scale by applying the Algebra I to grade 8 shift and the grade 8 to grade 7 shift. Table 9–11 shows the final shift parameters for each content area.

**Table 9–11. Final Vertical Linking Shift Parameters**

<b>Content Area</b>	<b>Grade/Course</b>	<b>Shift</b>
Mathematics	Grade 3	-3.011
Mathematics	Grade 4	-1.799
Mathematics	Grade 5	-1.177
Mathematics	Grade 6	-0.782
Mathematics	Grade 7	0.000
Mathematics	Grade 8	0.301
Mathematics	Algebra I	1.109
Mathematics	Geometry	1.323
Mathematics	Algebra II	1.653
Reading	Grade 3	-1.086
Reading	Grade 4	-0.829
Reading	Grade 5	-0.481
Reading	Grade 6	-0.092
Reading	Grade 7	0.000
Reading	Grade 8	0.352
Reading	Literature	0.735
Science	Grade 3	-1.665
Science	Grade 4	-1.095
Science	Grade 5	-0.322
Science	Grade 6	-0.111
Science	Grade 7	0.000
Science	Grade 8	0.140
Science	Biology	0.961
Science	Chemistry	1.276
Writing	Grade 3	-1.360
Writing	Grade 4	-0.763
Writing	Grade 5	-0.542
Writing	Grade 6	-0.237
Writing	Grade 7	0.000
Writing	Grade 8	0.221
Writing	English Composition	0.397

The final vertical linking shift parameters for grade 7 in each content area is zero because it is the base grade. The final vertical linking parameter applied to grade 11 items in mathematics and science is based on the grade or course where the items were field tested. For example, the Algebra I vertical linking constant is applied to grade 11 mathematics items which appeared on Algebra I forms.

## BANKED ITEM PARAMETERS FROM STAND-ALONE FIELD TESTS

Table 9–12 provides summary information based on the first stand-alone field-test events which were used to establish the content area vertical scales. The table shows the mean, standard deviation, minimum, and maximum of the item parameter estimates for each grade or course level on the content area vertical scales.

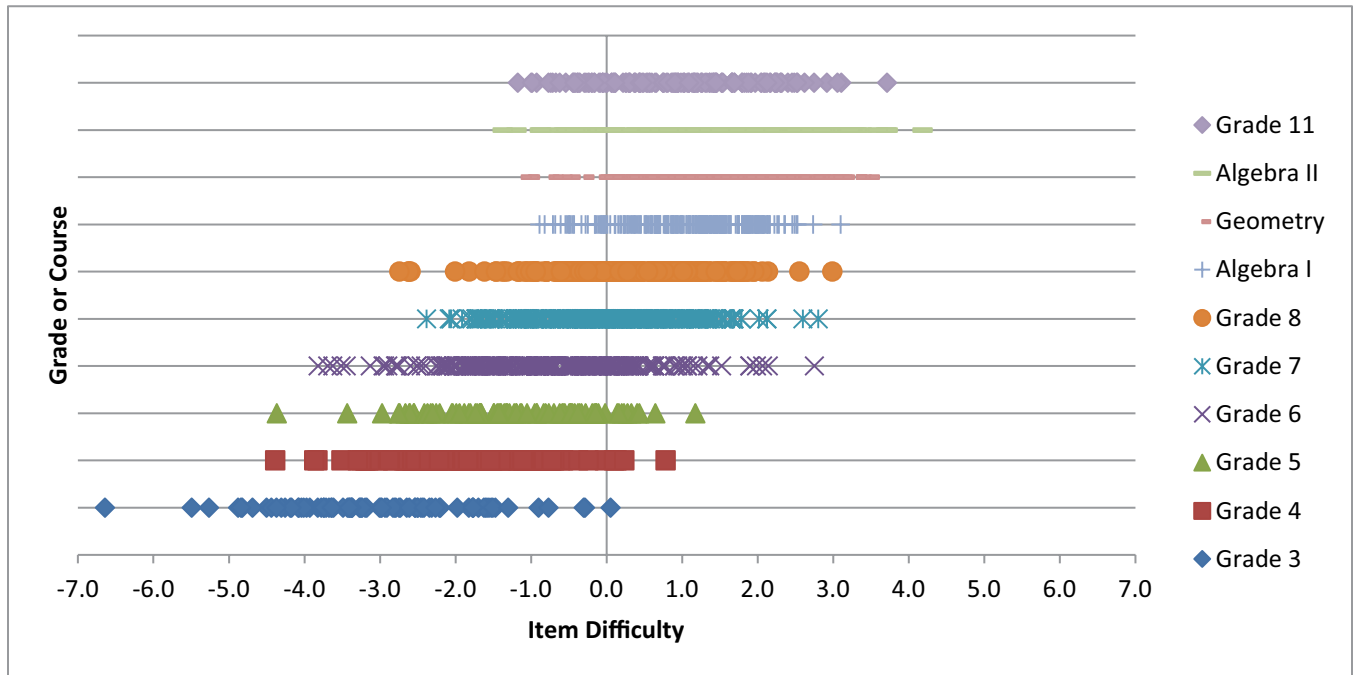
**Table 9–12. Summary Statistics for Vertically Scaled Item Parameters from Stand-alone Field Test**

Content Area	Grade/Course	Mean	SD	Min	Max
Mathematics	Grade 3	-3.011	1.222	-6.641	0.052
Mathematics	Grade 4	-1.799	1.008	-4.388	0.781
Mathematics	Grade 5	-1.177	1.031	-4.367	1.172
Mathematics	Grade 6	-0.782	1.122	-3.821	2.748
Mathematics	Grade 7	0.000	0.979	-2.385	2.800
Mathematics	Grade 8	0.301	0.939	-2.743	2.985
Mathematics	Grade 11	0.939	1.014	-1.175	3.713
Mathematics	Algebra I	1.109	0.763	-0.888	3.099
Mathematics	Geometry	1.323	0.865	-1.125	3.482
Mathematics	Algebra II	1.653	0.955	-1.377	4.181
Reading	Grade 3	-1.086	1.045	-3.761	1.855
Reading	Grade 4	-0.829	0.944	-3.242	2.177
Reading	Grade 5	-0.481	1.039	-3.201	1.964
Reading	Grade 6	-0.092	1.060	-2.653	3.580
Reading	Grade 7	0.000	1.077	-3.744	3.259
Reading	Grade 8	0.352	1.039	-3.127	3.093
Reading	Literature	0.735	0.929	-2.115	3.313
Science	Grade 3	-1.665	1.302	-5.319	0.813
Science	Grade 4	-1.095	1.145	-4.453	1.663
Science	Grade 5	-0.322	0.948	-2.899	1.683
Science	Grade 6	-0.111	0.971	-2.347	2.546
Science	Grade 7	0.000	0.910	-2.531	2.532
Science	Grade 8	0.140	1.035	-2.654	3.309
Science	Grade 11	0.773	0.892	-2.216	2.377
Science	Biology	0.961	0.867	-1.331	3.731
Science	Chemistry	1.276	0.688	-1.101	3.064
Writing	Grade 3	-1.360	1.196	-4.536	2.958
Writing	Grade 4	-0.763	1.140	-3.608	1.899
Writing	Grade 5	-0.542	1.073	-3.780	2.462
Writing	Grade 6	-0.237	1.052	-2.724	4.390
Writing	Grade 7	0.000	1.132	-2.866	3.593
Writing	Grade 8	0.221	1.120	-3.234	2.883
Writing	English Composition	0.397	1.087	-2.531	3.617

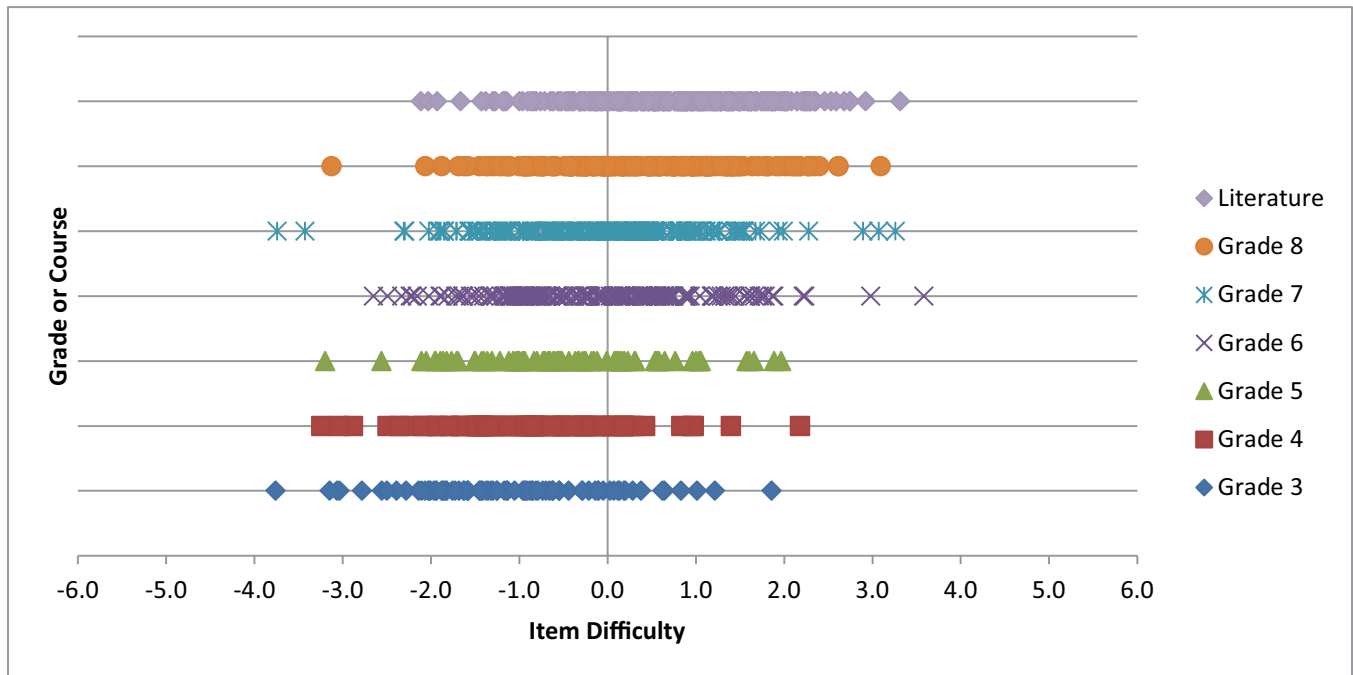


Figures 9–2 through 9–5 show the banked item parameter estimates following the first stand-alone field-test events for each grade or course on the content area vertical scales.

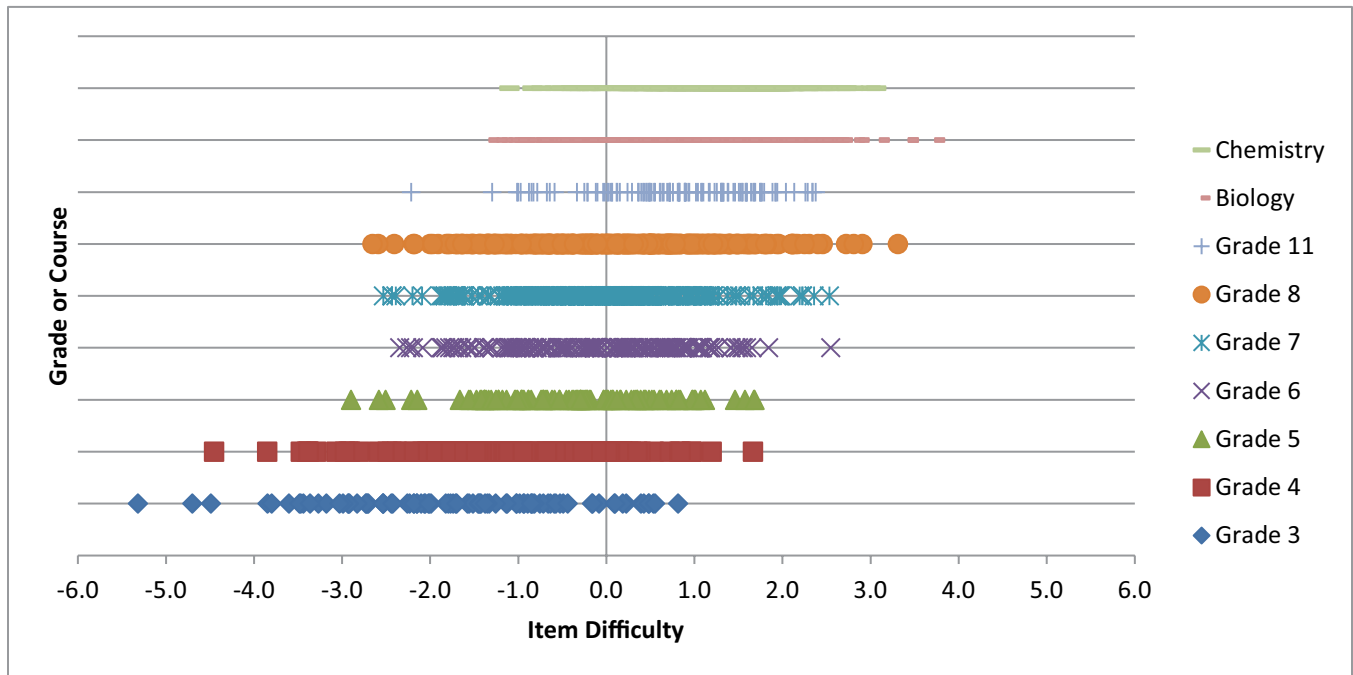
**Figure 9–2. Mathematics Item Parameters Estimates from Stand-alone Field Test**



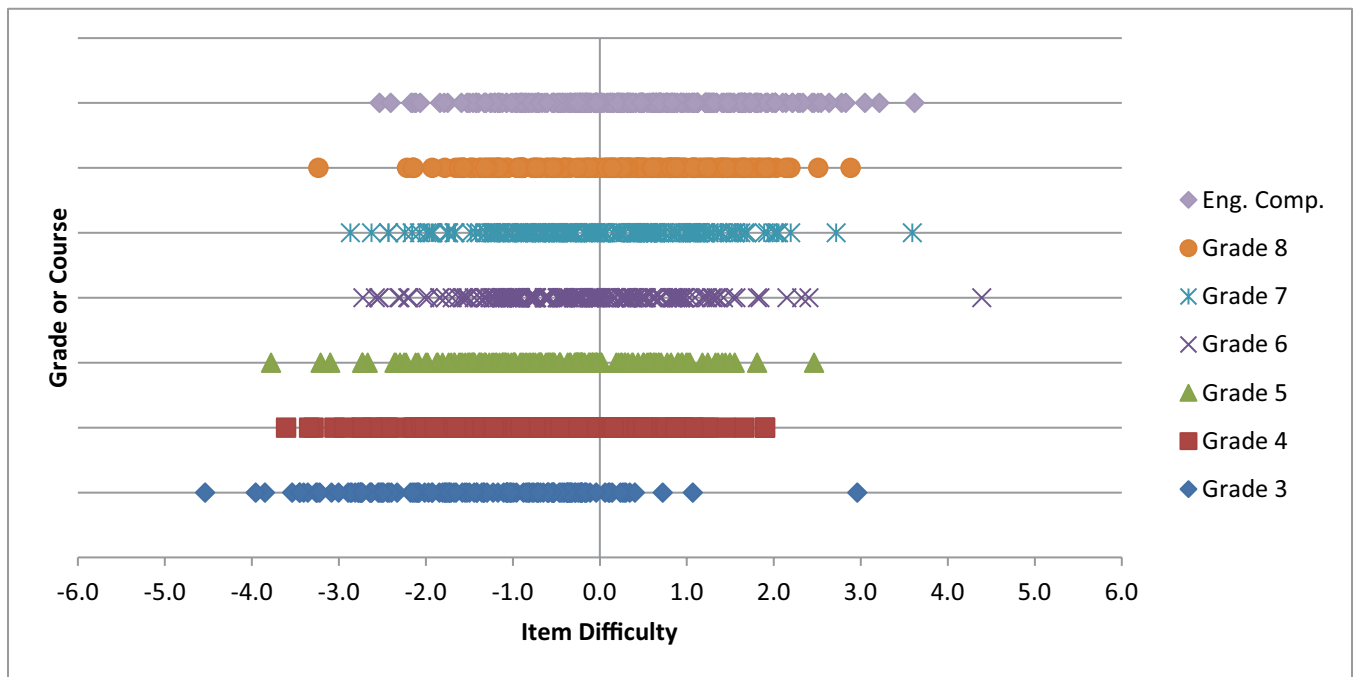
**Figure 9–3. Reading Item Parameters Estimates from Stand-alone Field Test**



**Figure 9–4. Science Item Parameters Estimates from Stand-alone Field Test**



**Figure 9–5. Writing Item Parameters Estimates from Stand-alone Field Test**



Rasch item difficulty measure on the vertical scale and associated standard error for all items from the initial stand-alone field tests are presented in Appendix B of the 2017–2018 technical report.

## BANKED ITEM PARAMETERS FOR THE 2023–2024 OPERATIONAL ITEM POOLS

A number of changes to the CDT item pools have occurred since the initial stand-alone field-test events and creation of the content area vertical scales. For example, there have been embedded field test events to augment the item pools as well as introduce items in kindergarten, grade 1, and grade 2. (See Chapter Six for details on the various field-test events.) Additionally, prior to the 2013–2014 school year CDT items in mathematics, reading, and writing were re-aligned to the new Pennsylvania Core Standards. Table 9–13 provides summary information based on the operational item pools for the 2023–2024 school year. The table shows the mean, standard deviation, minimum, and maximum of the item parameter estimates for each grade or course level on the content area vertical scales.

**Table 9–13. Summary Statistics for Vertically Scaled Item Parameters for 2023–2024 School Year**

Content Area	Grade/Course	Mean	SD	Min	Max
Mathematics	Kindergarten	-3.959	1.341	-6.433	-0.611
Mathematics	Grade 1	-3.689	1.067	-5.955	-0.610
Mathematics	Grade 2	-3.004	1.315	-5.987	0.402
Mathematics	Grade 3	-1.921	1.230	-5.632	2.158
Mathematics	Grade 4	-1.354	1.211	-6.641	2.748
Mathematics	Grade 5	-0.872	1.022	-4.021	2.139
Mathematics	Grade 6	-0.188	1.115	-3.821	3.389
Mathematics	Grade 7	0.232	0.918	-2.882	2.893
Mathematics	Grade 8	0.517	0.829	-1.702	3.651
Mathematics	Algebra I	0.815	0.786	-1.624	3.264
Mathematics	Geometry	1.154	0.926	-2.058	3.662
Mathematics	Algebra II	1.647	0.899	-1.377	4.181
Reading	Kindergarten	-2.112	1.044	-4.352	0.020
Reading	Grade 1	-1.507	0.951	-4.780	0.831
Reading	Grade 2	-1.143	0.772	-3.869	0.618
Reading	Grade 3	-0.734	0.889	-4.500	1.855
Reading	Grade 4	-0.303	0.912	-3.608	2.464
Reading	Grade 5	-0.009	0.839	-3.201	2.101
Reading	Grade 6	0.135	0.868	-2.653	2.578
Reading	Grade 7	0.323	0.860	-3.744	3.259
Reading	Grade 8	0.501	0.856	-3.127	2.799
Reading	Literature	0.782	0.793	-2.115	2.859
Science	Grades K-2 span	-2.261	1.133	-5.446	1.864
Science	Grade 3	-1.691	1.220	-5.319	0.878
Science	Grade 4	-1.096	1.124	-7.111	1.689
Science	Grade 5	-0.519	0.846	-3.108	2.463
Science	Grade 6	-0.242	0.877	-2.723	2.071
Science	Grade 7	-0.091	0.837	-2.531	2.532
Science	Grade 8	0.001	0.914	-2.654	3.309

**Table 9–13 (continued). Summary Statistics for Vertically Scaled Item Parameters for 2023–2024 School Year**

Content Area	Grade/Course	Mean	SD	Min	Max
Science	Grade 11	0.672	0.944	-2.216	2.391
Science	Biology	0.728	0.799	-1.408	3.731
Science	Chemistry	1.192	0.690	-1.101	3.064
Writing	Kindergarten	-3.130	0.993	-5.685	0.047
Writing	Grade 1	-2.478	1.040	-5.107	0.693
Writing	Grade 2	-1.859	0.866	-4.436	-0.064
Writing	Grade 3	-1.135	1.206	-4.536	2.958
Writing	Grade 4	-0.892	1.191	-4.075	2.137
Writing	Grade 5	-0.740	1.026	-3.780	1.929
Writing	Grade 6	-0.400	0.980	-3.095	3.006
Writing	Grade 7	-0.144	0.884	-2.625	2.194
Writing	Grade 8	-0.034	0.961	-3.234	2.192
Writing	English Composition	0.260	0.990	-3.507	3.214

Figures 9–6 through 9–9 show the banked item parameter estimates for the operational item pools for the 2023–2024 school year for each grade or course on the content area vertical scales.

**Figure 9–6. Mathematics Item Parameters Estimates for 2023–2024 School Year**

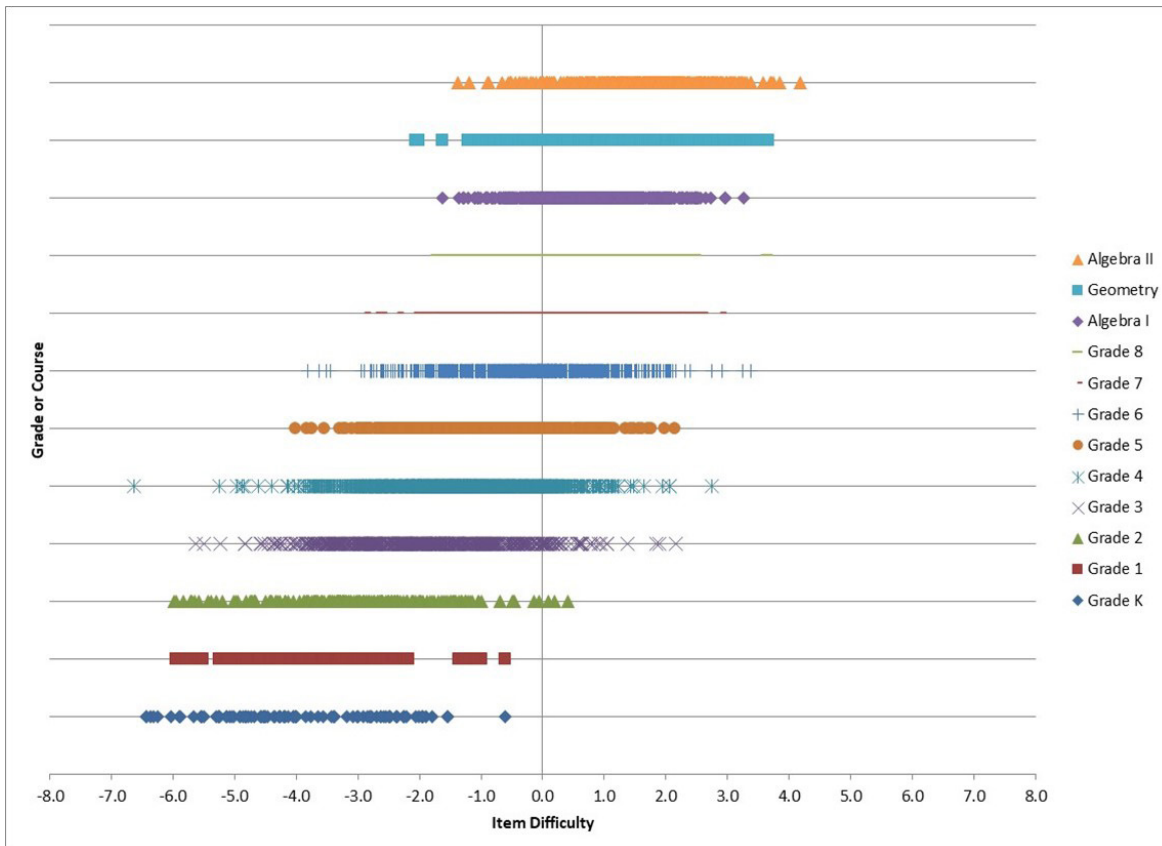


Figure 9–7. Reading Item Parameters Estimates for 2023–2024 School Year

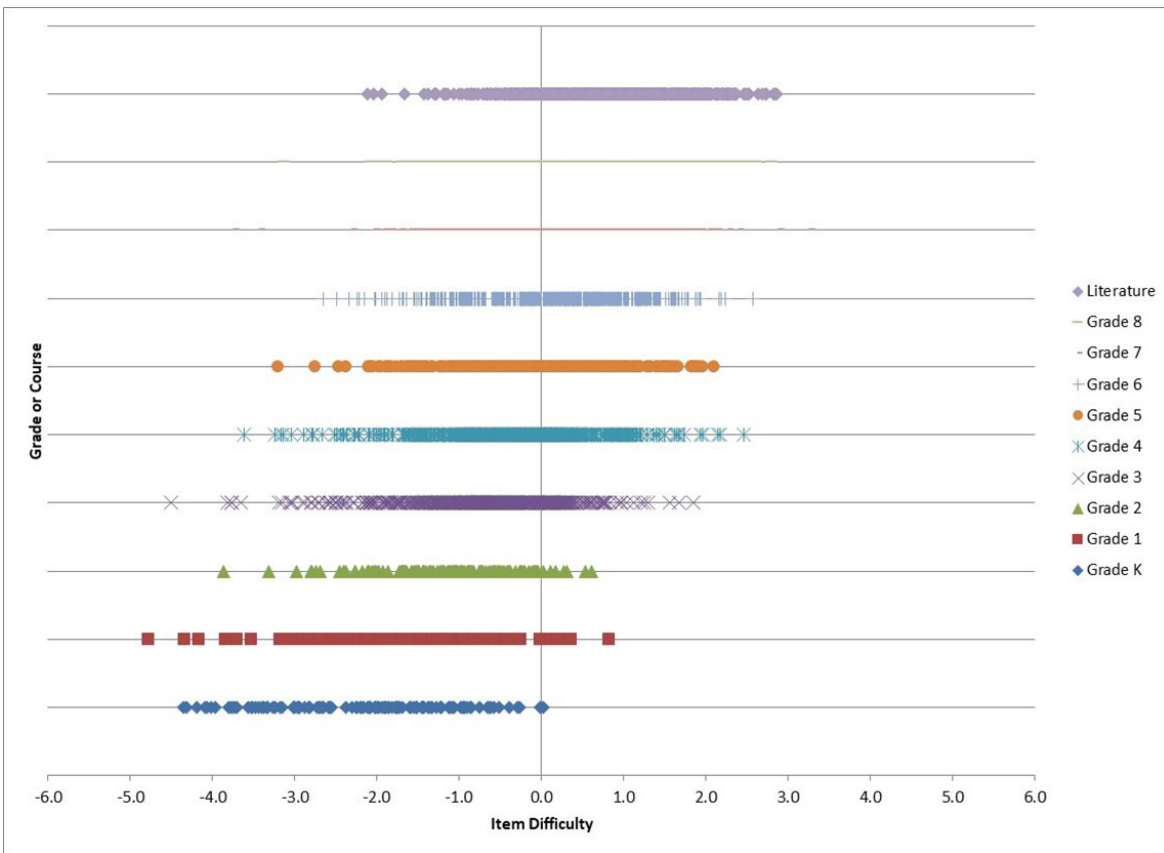
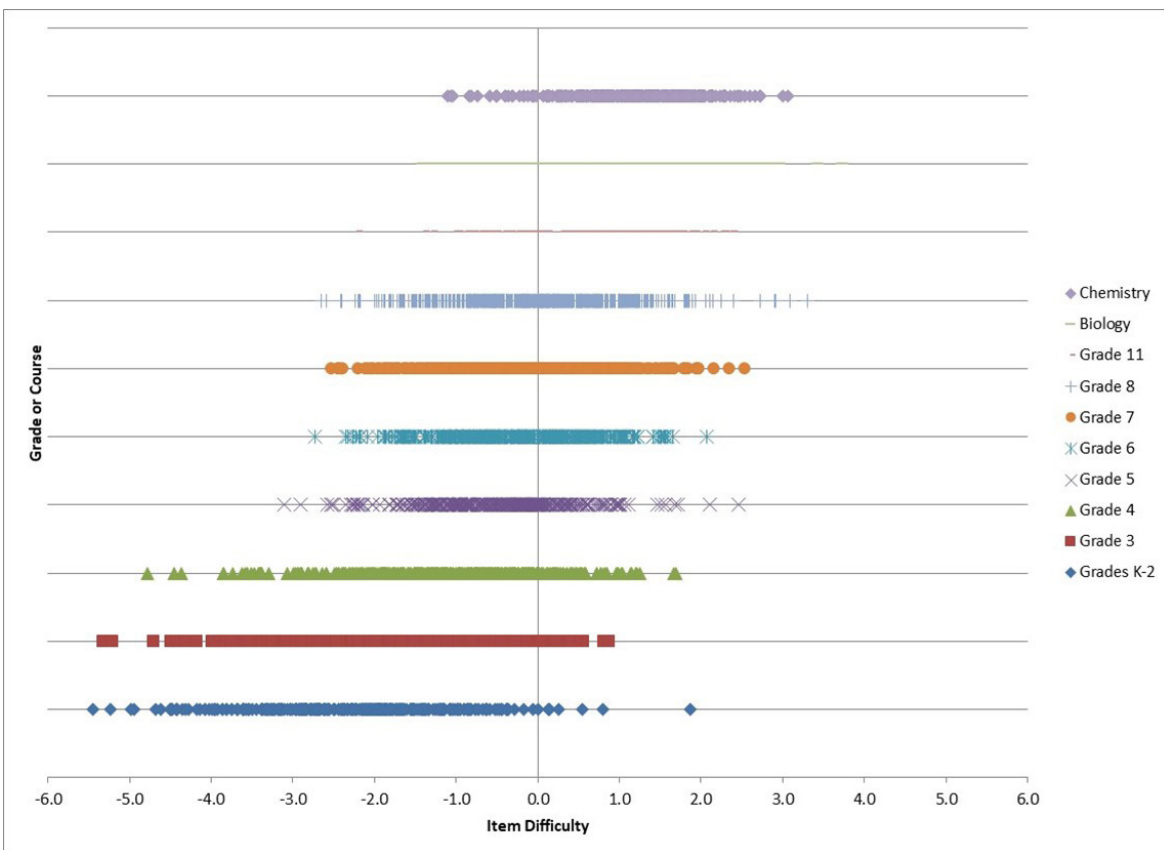
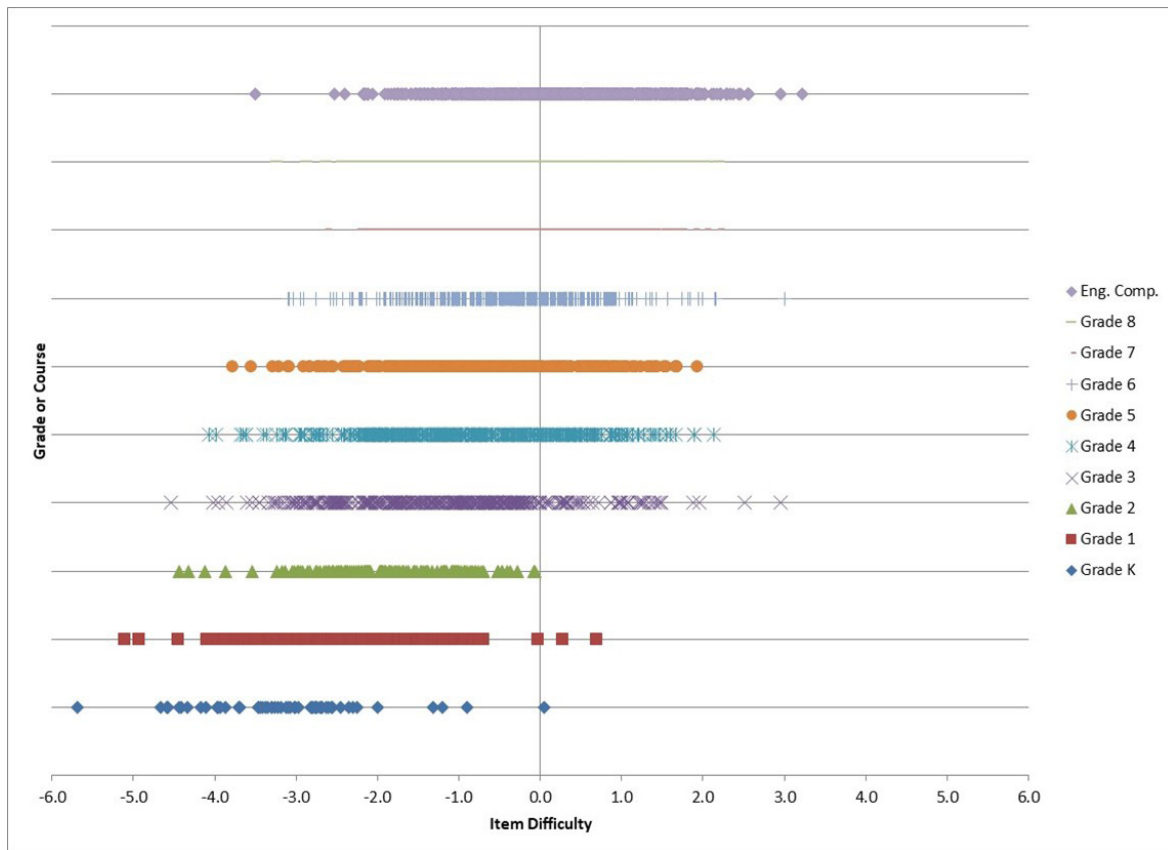


Figure 9–8. Science Item Parameters Estimates for 2023–2024 School Year



**Figure 9–9. Writing Item Parameters Estimates for 2023–2024 School Year**



Rasch item difficulty measure on the vertical scale and associated standard error for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Statistics for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year’s technical report.

## CHAPTER TEN: BENCHMARKING

As described in Chapter Fourteen, CDT scores are placed along a continuum from “Areas of Need” to “Strengths to Build On.” These are represented in the dynamic reporting suite with colors red, green, and blue. “Areas of Need” are depicted in the red range, while “Strengths to Build On” are depicted in the green and blue ranges. The center of the green range is the point that separates students into two categories: solidly ready for the next grade or course and not solidly ready for the next grade or course. In each content area, the center of the green range for grades 5 and above was established by panels of Pennsylvania educators during benchmarking activities<sup>1</sup>.

### BENCHMARKING ACTIVITIES

Table 10–1 below presents general information about the preliminary benchmarking activities for mathematics, reading, science, and writing. The cut points established are considered preliminary because they were set prior to the first operational administration of the CDT. This was necessary so teachers and students would have access to immediate scores and reports following operational administration. As operational data become available, preliminary cut points are reevaluated and possibly revised (see Chapter Nineteen for details including the benchmark cuts in place for the 2023–2024 school year).

**Table 10–1. General Information about CDT Benchmarking Activities**

Category	Information
Event Date	Mathematics: August 12–13, 2010
Event Date	Reading: January 27–28, 2011
Event Date	Science: January 27–28, 2011
Event Date	Writing: August 4–5, 2011
Grades/Courses	Mathematics: Grades 5–8, High School, Algebra I, Geometry, Algebra II
Grades/Courses	Reading: Grades 5–8, Literature
Grades/Courses	Science: Grades 5–8, High School, Biology, Chemistry
Grades/Courses	Writing: Grades 5–8, English Composition
Methodology	Randomly Ordered Item Booklet (ROIB) Angoff (Yes/No) Method
Categories	Not solidly ready for the next grade or course
Categories	Solidly ready for the next grade or course
Number of Panelists	Mathematics: 28
Number of Panelists	Reading: 23
Number of Panelists	Science: 20
Number of Panelists	Writing: 46
Rounds	Two

There were three separate CDT benchmarking events because the operational CDT was rolled out in phases by content area. Each benchmarking event followed the initial stand-alone field-test event for that content area.

When initially launched, the CDT was available to students in grades 6 and above. However, cut points were established for grades 5 and above. This is because CDT is available throughout the school year. Early in the school year it may be more appropriate to evaluate a student’s scores based on the prior grade cut. For example, in October, a teacher may choose to evaluate a grade 6 student’s scores relative to the grade 5 cut.

<sup>1</sup> The center of the green range for grades 2 through 4 was extrapolated from grades 5 and above prior to the launch of each CDT for students in grades 3 through 5 in spring of 2014. See Chapter Nineteen for details.

The Randomly Ordered Item Booklet (ROIB) Angoff (Yes/No) method was used to set CDT benchmark cut points. Panels of educators worked in grade/course groups to establish cut points for grades 5 through 8, high school, and content area courses Algebra I, Geometry, Algebra II, Literature, Biology, Chemistry, and English Composition. After a training session describing the process and definition of roles, a discussion was held in which panelists were asked to describe what “solidly ready for the next grade or course” means. Thereafter, panelists were asked to review approximately 40 test questions and make individual yes/no judgments as to whether a “solidly ready” student would be successful in answering each question. The judgments were made over two iterations or rounds with a sequence of Round 1 judgments, show and verification of Round 1 results, group discussion, and Round 2 judgments.

After cut points were set for each grade and course within a content area, the vertical articulation of cut points across grades and courses was reviewed. Given that each content area is vertically scaled, it was expected that cut points would increase as grade increased. For example, the grade 8 cut point would not be lower than the grade 7 cut point on the vertical scale. In some cases, post-smoothing was required to ensure increasing cut points across grades/courses and smooth transitions.

Complete descriptions of each benchmarking activity including post-smoothing are available in TAC documents:

- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Mathematics
- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Reading and Science
- Classroom Diagnostic Tools—Results for Preliminary Benchmarking Activity—Writing

**BENCHMARKING RESULTS**

Preliminary cut points in the logit metric for each content area are shown in Figures 10–1 through 10–4. In general, the difference between cut points is greater in the lower grades and then levels off.

**Figure 10–1. Preliminary Benchmark Cut Points for Mathematics**

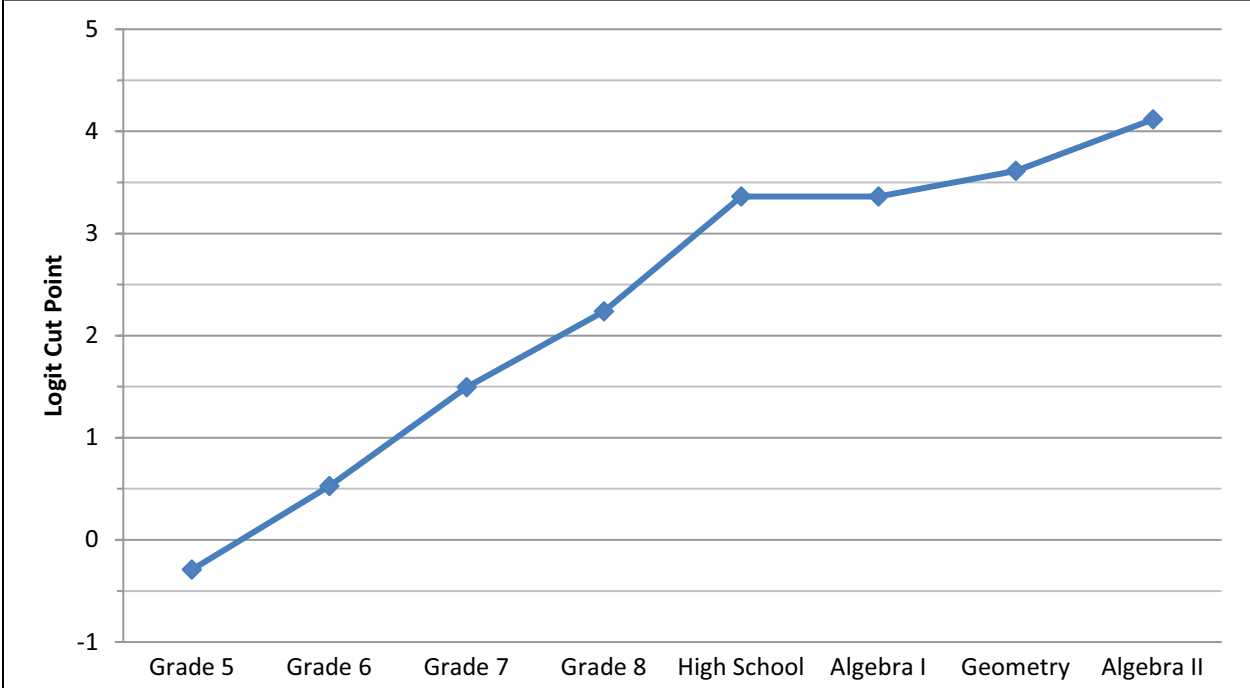




Figure 10–2. Preliminary Benchmark Cut Points for Reading

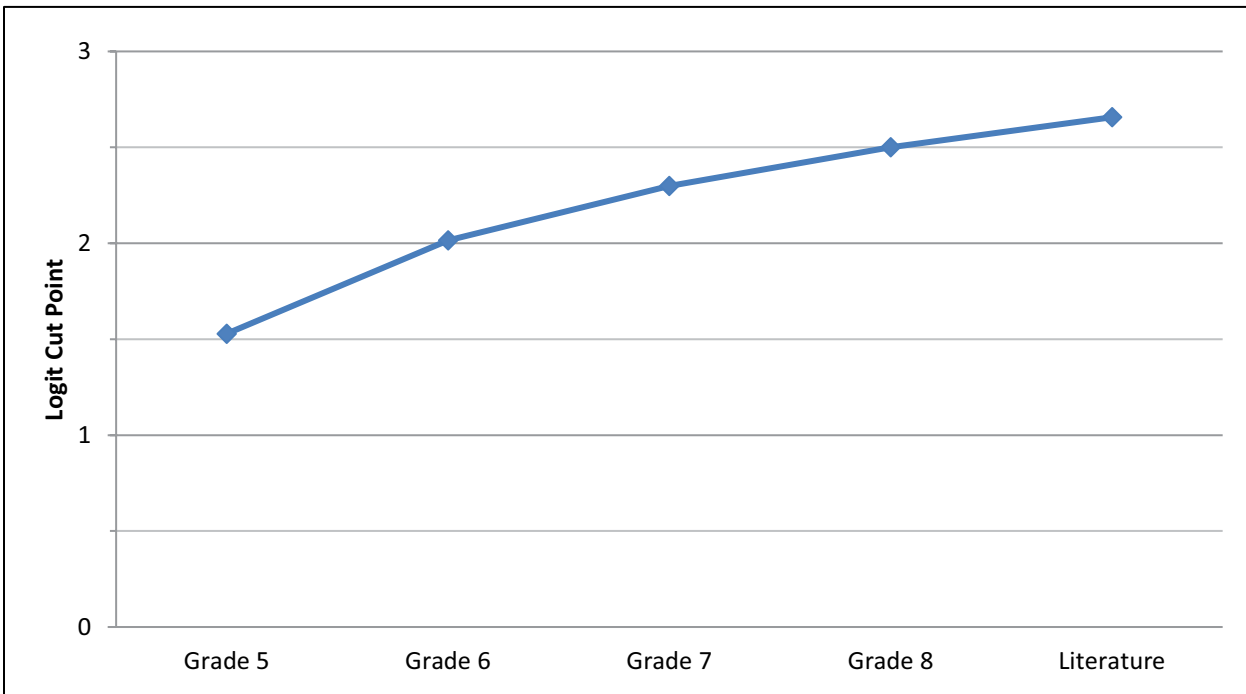
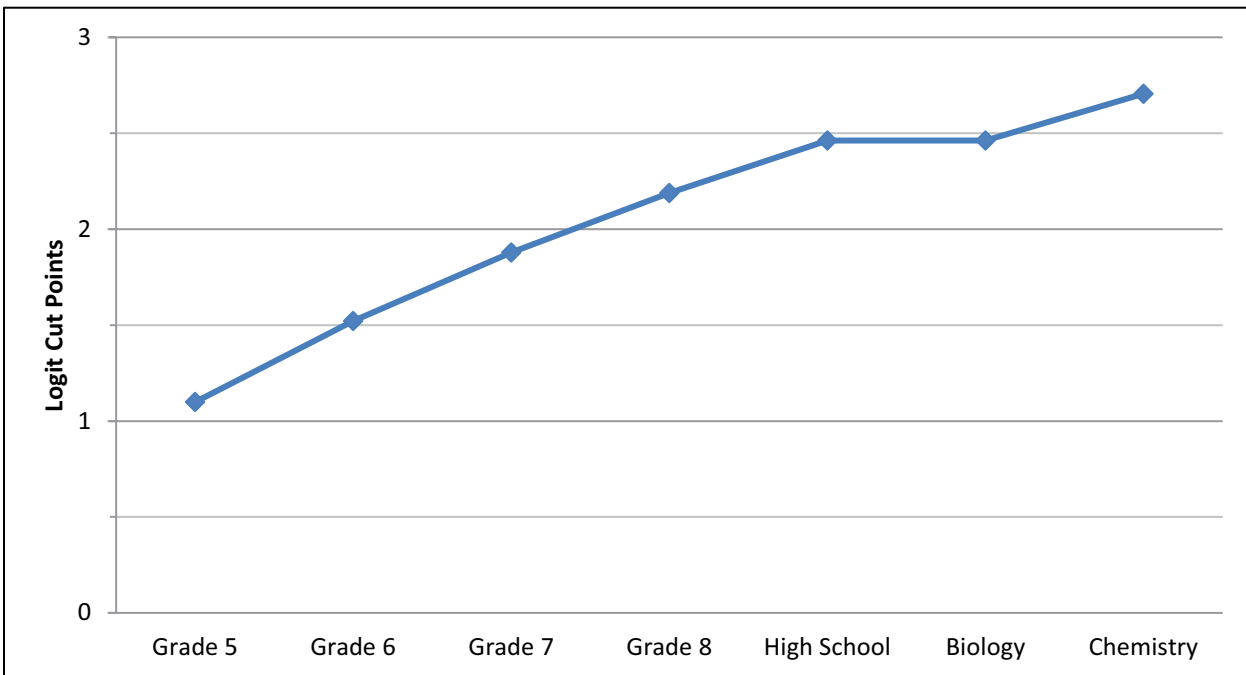


Figure 10–3. Preliminary Benchmark Cut Points for Science



**Figure 10–4. Preliminary Benchmark Cut Points for Writing**

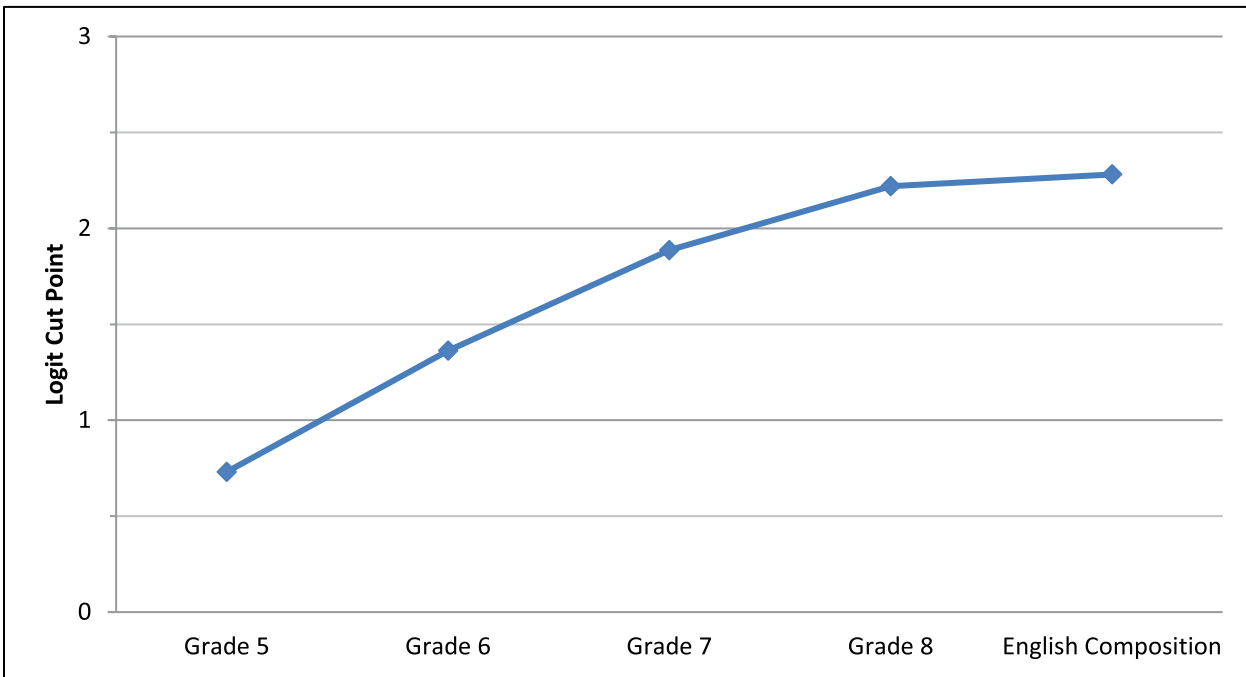


Table 10–2 shows the preliminary benchmark cuts in the logit metric for each content area. Also presented are the scale score ranges for each color on the CDT reports.

**Table 10–2. Preliminary Benchmark Cuts and Scale Score Ranges**

Content Area	Grade or Course	Logit Cut Point (Center of Green)	Red Scale Score Range	Green Scale Score Range	Blue Scale Score Range
Mathematics	Grade 5	-0.292	400 - 895	896 - 1058	1059 - 2000
Mathematics	Grade 6	0.526	400 - 997	998 - 1160	1161 - 2000
Mathematics	Grade 7	1.495	400 - 1118	1119 - 1281	1282 - 2000
Mathematics	Grade 8	2.238	400 - 1211	1212 - 1374	1375 - 2000
Mathematics	High School	3.363	400 - 1351	1352 - 1514	1515 - 2000
Mathematics	Algebra I	3.363	400 - 1351	1352 - 1514	1515 - 2000
Mathematics	Geometry	3.614	400 - 1383	1384 - 1546	1547 - 2000
Mathematics	Algebra II	4.117	400 - 1446	1447 - 1609	1610 - 2000
Reading	Grade 5	1.529	400 - 982	983 - 1197	1198 - 2000
Reading	Grade 6	2.015	400 - 1051	1052 - 1266	1267 - 2000
Reading	Grade 7	2.299	400 - 1092	1093 - 1307	1308 - 2000
Reading	Grade 8	2.500	400 - 1121	1122 - 1336	1337 - 2000
Reading	Literature	2.657	400 - 1143	1144 - 1358	1359 - 2000
Science	Grade 5	1.099	400 - 1009	1010 - 1182	1183 - 2000
Science	Grade 6	1.522	400 - 1066	1067 - 1239	1240 - 2000
Science	Grade 7	1.879	400 - 1113	1114 - 1286	1287 - 2000
Science	Grade 8	2.189	400 - 1154	1155 - 1327	1328 - 2000
Science	High School	2.462	400 - 1190	1191 - 1363	1364 - 2000
Science	Biology	2.462	400 - 1190	1191 - 1363	1364 - 2000
Science	Chemistry	2.706	400 - 1223	1224 - 1396	1397 - 2000
Writing	Grade 5	0.731	400 - 959	960 - 1132	1133 - 2000
Writing	Grade 6	1.363	400 - 1043	1044 - 1216	1217 - 2000
Writing	Grade 7	1.886	400 - 1113	1114 - 1286	1287 - 2000
Writing	Grade 8	2.219	400 - 1157	1158 - 1330	1331 - 2000
Writing	English Composition	2.281	400 - 1166	1167 - 1339	1340 - 2000

## CHAPTER ELEVEN: SCALING

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Scaling is used to transform test score values onto a scale that can be interpreted by users easily and correctly. Raw scores cannot be used to compare students' achievement on the CDT because they depend on the difficulty of the test items administered. Given the adaptive nature of the CDT, each student receives test items targeted at his or her level of achievement. Therefore, two students may have taken very different sets of items in terms of difficulty but have the same raw score. This makes use of raw scores for comparison across students, across administrations, or to a specific standard (cut point) meaningless. Rasch ability estimates in the logit metric do take into consideration the difficulty of the items administered. Therefore, they may be used to make comparisons. However, scale scores are introduced to report CDT results since scale scores may be easier to understand and interpret than logits.

Essentially, CDT scale scores are derived through a two-step process. First, there is a nonlinear transformation that converts an individual raw score on a unique set of items to Rasch ability (in logits). Second, a linear transformation is used to convert logits to scale scores. These and some additional considerations (e.g., rounding rules) are discussed in more detail below.

### RAW SCORES TO RASCH ABILITY ESTIMATES

For each CDT test, the calibrated item difficulties associated with the unique set of items administered were used to obtain Rasch person ability estimates and asymptotic standard errors of measurement for the overall test, as well as each diagnostic category. Calibrated item difficulties were based on the field tests and vertical linking (further discussed in Chapter Eight and Chapter Nine).

Raw scores (total and diagnostic category) on the unique set of items that makes up an individual CDT test were mapped to Rasch ability estimates using unconditional, joint-maximum likelihood estimation. In the case of zero or perfect raw scores, a fractional raw score (a value less than one) was added to zero scores and subtracted from perfect scores to determine the corresponding logit values for these extreme scores. The Rasch ability estimates were then transformed to scale scores as discussed in the next section.

### RASCH ABILITY ESTIMATES TO SCALE SCORES

Generally, scale scores are preferred over Rasch ability estimates for reporting purposes. One issue is that Rasch ability estimates are on a scale that includes negative and decimal values. By transforming the Rasch ability estimates to scale scores, all reported values can become positive integers, which makes more sense to teachers, parents, and students. Since Rasch ability estimates are comparative, the transformed scale scores have a common scale across administrations.

Scale scores are usually obtained through some linear transformation of Rasch ability estimates. Before the linear equation was established for each content area, a few points were considered for the CDT:

- Avoid scales that might be confused with scores for other types of assessment; for example:
  - Scale scores ranging from 0 to 100 (because this might be confused with percent correct scores or percentile ranks)
  - Scale scores ranging from 200 to 800 (because this might be confused with SAT scores)
  - Scale scores with similar ranges as the ones for the Pennsylvania System of School Assessment (PSSA) or Keystone Exams
- Avoid scales similar to raw scores.
- Avoid scales that might suggest the scores are more precise than they actually are (in other words, suggesting more precision than can be supported by the test scores).
- Avoid scales with negative numbers and decimals.

In terms of industry standard practice, a common perspective is that scale scores should facilitate score interpretation while at the same time minimize misinterpretation and unwarranted inferences. Often this is done by incorporating some kind of meaning to the scores<sup>1</sup> (Peterson, Kolen, and Hoover, 1989). The incorporation of content meaning is one way to facilitate score interpretation. This might be done in several different ways. For example, PSSA scaled scores, like those of many other state assessments, try to input some content meaning by having the PSSA performance level cut scores have known values on the scaled score metric. Such an approach appears to make good sense given the purposes of the criterion-reference test like the PSSA.

For CDT, the scale must be sufficiently large to cover the entire vertical scale. As a result, an initial scale score range of 400 to 2000 was established for each content area. When CDT was expanded in spring of 2014 and made available to students in grades 3 through 5, the scale score range was expanded to 200 to 2000 for those students. Initially, the grade 7 benchmark logit cut point was mapped to a scale score of 1200 for all content areas. It is worth noting that, although careful consideration was given to the selection of these values, they are completely arbitrary. For example, the label of 1200 could have been called 100 or any other value without affecting any of the relationships among schools, administrations, students, or items. In other words, changing the scale would simply be changing the labels on the axis of a graph without moving any of the points.

**LINEAR TRANSFORMATION FORMULAS**

The scale scores for the CDT for each content area are obtained through a linear transformation of the Rasch ability estimates ( $\hat{\beta}$ ). Specifically,

$$SS = m\hat{\beta} + b,$$

where  $m$  is the slope and  $b$  is the intercept. The linear transformation for each CDT content area was derived by anchoring the grade 7 benchmark cut (i.e., Rasch ability estimate) to the scale score 1200 and a Rasch ability estimate of 7.9 to the scale score of 2000. The slopes of the scaling equations influence the variability of the scale scores. It is important that the slopes are sufficiently large to cover the full range of the vertical scale. The CDT scaling equations produce scale score distributions with standard deviations of approximately 150 scale score points and cover logit ranges of approximately -6.5 to 7.9. The final slopes and intercepts for deriving scale scores for the CDT are provided in Table 11–1.

**Table 11–1. Scaling Constants by Content Area**

Content Area	Slope	Intercept
Mathematics	124.90	1013.30
Reading	142.83	871.63
Science	132.87	950.34
Writing	133.02	949.12

**ROUNDING**

The linearly transformed scale scores are rounded to the nearest integer value for reporting purposes. Values greater than or equal to 0.50 are rounded up. Values less than 0.50 are rounded down.

<sup>1</sup> Not everyone agrees with this sentiment. Some have argued the opposite point—that is, any attempt to add meaning to test scores actually predisposes the scores to be misinterpreted (see Angoff, 1984).

## **LOWEST OBTAINABLE SCALE SCORES**

Each general content area CDT (mathematics, reading, science, and writing) has a lowest obtainable scale score (LOSS) of 200. Course specific CDTs (Algebra I, Geometry, Algebra II, Biology, and Chemistry) have a lowest obtainable scale score (LOSS) of 400. Any derived scale score less than LOSS is truncated to this minimum value. The selection of a LOSS is mainly based on two considerations:

1. Extremely low scale scores may have an impact on the average of the scale scores if CDT data is summarized at school, district, or state level.
2. Score truncation makes sense from a score precision perspective given measurement errors at the extremes are large.

## **HIGHEST OBTAINABLE SCALE SCORES**

A highest obtainable scale score (HOSS), 2000, is set for the CDT for the same reasons as described for the LOSS value.

## CHAPTER TWELVE: EQUATING

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Equating is a statistical process that is used to adjust scores on test forms so that scores on the forms can be used interchangeably (Kolen & Brennan, 2004), even though the test forms consist of different items. In the case of the CDT, the adaptive nature of the test means that each student takes a unique test form with items targeted at his or her level of achievement.

To make meaningful comparisons of test scores across administrations, various equating models and procedures have been developed in the literature. For example, in terms of design, there are randomly equivalent groups design and common-item non-equivalent groups design. In terms of testing model, the model can be classified as either classical test theory based equating model or modern test theory (e.g., Rasch model or item response theory) based equating model. In terms of when the equating is conducted in the assessment cycle, the model can be classified as pre-equating or post-equating.

Given the requirements of adaptive testing and immediate score reporting, CDT is pre-equated. Also, it was based on the Rasch model. The following sections will focus on the discussion of pre-equating and the equating design for the CDT.

### PRE-EQUATING VERSUS POST-EQUATING

Like other Pennsylvania assessment programs, the CDT uses the Rasch model to guide test design, calibration, scaling, and equating. The key element of equating test forms using the Rasch model is to place the item parameters on the same scale. Once this is done, raw scores can be converted to Rasch ability estimates and then to scale scores as described in Chapter Eleven. As a result, the scale scores can be compared across forms and administrations with different items.

A common practice in many K–12 large-scale assessment programs is to have all the items field tested before they are administered in an operational setting. Once the field-test items' difficulties are placed on the base scale or common metric, in theory, one should not expect the Rasch item difficulties for these items to change, except within a reasonable range of measurement error, after they are administered in an operational test, providing the Rasch model fits the data. Based on this theoretical advantage of using Rasch models, equating can be conducted using the item parameters calibrated from field-test data. This statistical procedure is referred to as pre-equating. In contrast, post-equating involves the use of Rasch item difficulties calibrated from the data of the operational test to be equated.

Although, in theory, the two equating procedures should provide identical results when the model fits the data, each of them has its own advantages and disadvantages. The use of pre-equating can facilitate the operational process in terms of adaptive item selection, rapid or immediate score reporting, and more flexibility in the assessment. However, a variety of issues need to be considered when using pre-equating in practice. For example, students may not be motivated to take the field tests, especially stand-alone field tests, which may make the items appear harder in the field test than in the operational test (Eignor, 1985; Eignor and Stocking, 1986; Stocking and Eignor, 1986; Kolen and Harris, 1990). Other concerns for the field-test items include item context, item position, and sample size. In contrast, the use of post-equating, when applicable, does not have the same motivational concerns because students cannot distinguish between operational and field-test items. Also, post-equating is sometimes considered to yield more accurate analysis results given the large number of students who take the operational tests. On the other hand, post-equating does not allow for adaptive item selection or immediate score reporting as required of the CDT.

## **EQUATING DESIGN FOR THE CDT**

The CDT is an adaptive test, meaning that the test items selected are tailored to each student's achievement as the test progresses. This requires that all items in the pool be on the same scale and known at the time of testing. For CDT, this is accomplished by vertical linking the entire item pool within a content area based on the field-test events. See Chapter Eight and Chapter Nine for details. The known (pre-equated) item parameters are used in selecting items targeted for the student and to provide immediate scores to teachers and students.

In implementing the pre-equating model for the CDT, efforts were made to enhance the accuracy of pre-equating results. To address the concerns on students' motivation to take field tests, records were excluded from item calibrations if the student did not answer at least 5 questions. Also, records with high person outfit mean-squares values were excluded following the WINSTEPS suggestion that these may be the result of a few random responses by low performers. To address concerns of sample sizes, windows for field testing were scheduled so they did not overlap other testing in an attempt to increase volunteer participation. Also, field-test windows were extended in cases where schools were unable to complete testing in the allotted time. A small study of mathematics vertical linking items revealed no position effects. However, it should be noted that with adaptive tests students do not take the same items. Even if two students do take the same item, it will likely not be in the same test position.

## **EVALUATION OF ITEM PARAMETER STABILITY**

After each school year, item parameter stability studies are conducted for each content area. If the differences between the newly estimated Rasch item difficulties and the estimates based on the field-test events are not statistically significant, the pre-equating results should be valid. See Chapter Eighteen for results of item parameter stability studies based on operational data from the 2023–2024 school year.

## **EQUATING ADDITIONAL FIELD-TEST ITEMS**

Over time, additional items have been, and will continue to be, needed to replenish the CDT item pools. Plans to field test additional items must include an equating plan. Equating is needed to place the new items onto the existing vertical scale. In the case of stand-alone field-test events, common-item equating was used. That is, field-test forms included items from the current CDT item pool. In the case of embedded field-test events, field-test items were included within an operational administration such that students did not know which items were field test. With both stand-alone and embedded field test, equating was accomplished by running the calibration of field-test items with item parameters of operational items fixed/anchored to the bank values using WINSTEPS. For each content area, the entire item pool, including field-test items, was calibrated using WINSTEPS with operational items anchored on the banked values.



## CHAPTER THIRTEEN: OPERATIONAL TEST DESIGN AND CAT CONFIGURATIONS

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The Pennsylvania Classroom Diagnostic Tools (CDT) was initially developed to support teachers and students in grades 6 through 12. In spring 2014, CDT was made available to students in grades 3 through 5 as well. The tools are fully integrated and aligned in the Standards Aligned System (SAS) and enable educators to identify students' academic strengths and areas of need as well as provide links to classroom resources. The assessment is voluntary and administered completely online using a computer adaptive test (CAT) model.

The CDT features a number of tests. Tests in Mathematics, Algebra I, Geometry, and Algebra II were introduced in October 2010 for students in grades 6 and above. Tests in Reading/Literature, Science, Biology, and Chemistry were first available in April 2011 for students in grades 6 and above. Tests in Writing /English Composition began in October 2011 for students in grades 6 and above. Tests in Mathematics, Reading, Science, and Writing for students in grades 3 through 5 started in April 2014.

This chapter details the operational CDT test design and configuration of the CAT algorithm. Test design elements include the number of diagnostic categories, the number of operational items to administer per diagnostic category, and the number of embedded field-test items. CAT algorithm elements include entry point, item selection criteria, test navigation, and termination.

### OPERATIONAL TEST DESIGN

#### NUMBER OF DIAGNOSTIC CATEGORIES

The CDT tests include multiple-choice (MC), technology-enhanced (TE), and evidence-based selected-response (EBSR) items. All items in the content areas of mathematics, reading, and writing are aligned to the Pennsylvania Core Standards. All items in the content area of science are aligned to the Pennsylvania Academic Standards. Each CDT is broken into four or five diagnostic categories and the items in the pool are grouped by these diagnostic categories based on the Assessment Anchors and Eligible Content. The diagnostic categories for each of the CDT tests are listed below.

##### Math Grades 3–5 and Math Grades 6–HS

- Numbers & Operations
- Algebraic Concepts
- Geometry
- Measurement, Data, and Probability

##### Algebra I

- Operations with Real Numbers and Expressions
- Linear Equations & Inequalities
- Functions & Coordinate Geometry
- Data Analysis

##### Geometry

- Geometric Properties
- Congruence, Similarity, & Proofs
- Coordinate Geometry & Right Triangles
- Measurement

## Algebra II

- Operations with Complex Numbers
- Non-Linear Expressions & Equations
- Functions
- Data Analysis

## Reading Grades 3–5 and Reading/Lit Grades 6–HS

- Key Ideas and Details—Literature Text
- Key Ideas and Details—Informational Text
- Craft and Structure/Integration of Knowledge and Ideas—Literature Text
- Craft and Structure/Integration of Knowledge and Ideas—Informational Text
- Vocabulary Acquisition and Use

## Science Grades 3–5 and Science Grades 6–HS

- The Nature of Science
- Biological Sciences
- Physical Sciences
- Earth/Space Sciences

## Biology

- Basic Biological Principles/Chemical Basis for Life
- Bioenergetics/Homeostasis & Transport
- Cell Growth & Reproduction/Genetics
- Theory of Evolution/Ecology

## Chemistry

- Properties & Classification of Matter
- Atomic Structure & The Periodic Table
- The Mole & Chemical Bonding
- Chemical Relationships & Reactions

## Writing Grades 3–5 and Writing/Eng Comp Grades 6–HS

- Quality of Writing: Focus and Organization
- Quality of Writing: Content and Style
- Quality of Writing: Editing
- Conventions: Punctuation, Capitalization, and Spelling
- Conventions: Grammar and Sentence Formation

## NUMBER OF ITEMS PER DIAGNOSTIC CATEGORY

There were various factors considered when determining the number of operational items to administer per diagnostic category. The goal of the CDT is to provide diagnostic information. Therefore, the test must include a sufficient number of items to provide meaningful scores with low standard errors. However, testing time is limited and the item pools are finite. A very long test may produce lower standard errors, but if it is considered to be “too long” will teachers use it? Also, the longer the test, the more the items are exposed.

Prior to the launch of the first operational CDT in fall of 2010, simulations were run of various test lengths. Table 13–1 shows the average conditional standard error of measurement (CSEM) for total test and each diagnostic category<sup>1</sup> (DC) for five test lengths in simulations of CDT Mathematics. Also included is the theoretical minimum standard error that is possible for each test length. This is the standard error if the ability is known and there are sufficient items to administer where the item’s difficulty is equal to the known ability and the test constraints are met.

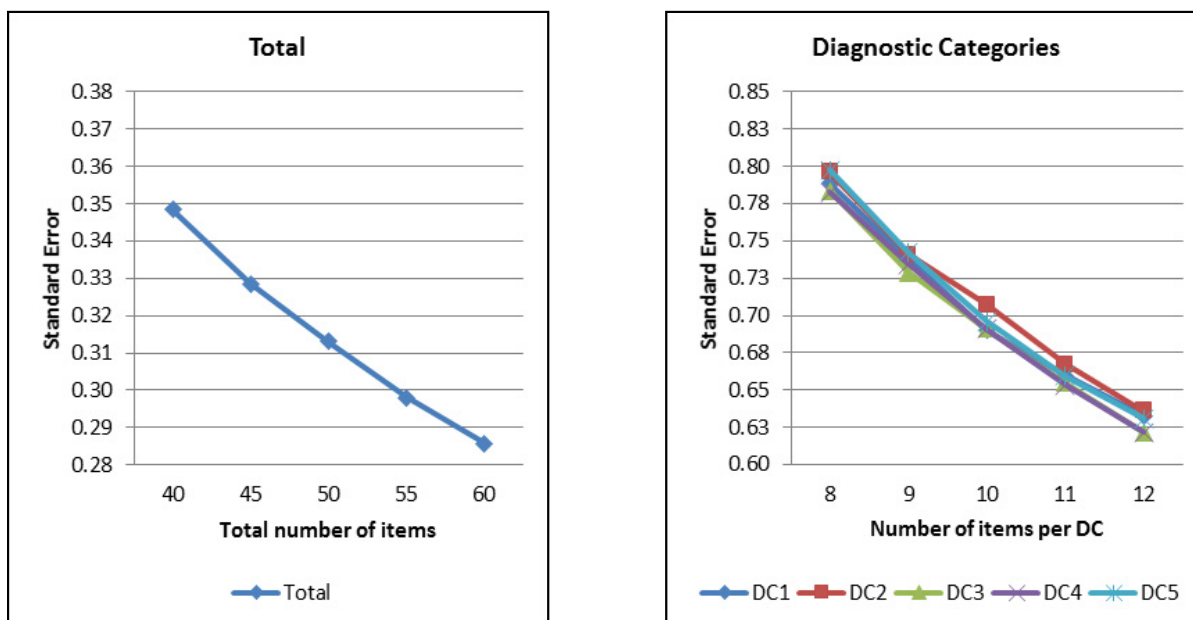
**Table 13–1. Average Standard Errors for Various Test Lengths – Mathematics**

Total Number of Points	Total Min Error	Total Avg Error	Diagnostic Categories Number of Points	Diagnostic Categories Min Error	Diagnostic Categories DC1 Avg Error	Diagnostic Categories DC2 Avg Error	Diagnostic Categories DC3 Avg Error	Diagnostic Categories DC4 Avg Error	Diagnostic Categories DC5 Avg Error
40	0.316	0.348	8	0.707	0.789	0.796	0.784	0.783	0.798
45	0.298	0.329	9	0.667	0.738	0.741	0.729	0.734	0.742
50	0.283	0.313	10	0.632	0.690	0.707	0.691	0.691	0.696
55	0.270	0.298	11	0.603	0.660	0.667	0.655	0.653	0.659
60	0.258	0.286	12	0.577	0.633	0.636	0.622	0.622	0.631

As expected, increasing the number of items decreases the standard error. Differences in standard errors at the diagnostic category level for the same number of items are a reflection of differences in the diagnostic category item pools.

Figure 13–1 shows average standard errors as a function of test length.

**Figure 13–1. Average Standard Errors for Various Test Lengths – Mathematics**



<sup>1</sup> At that time, there were five diagnostic categories in CDT Mathematics.

Considering test time factors and simulation results for various test lengths, it was determined that CDT tests with four diagnostic categories would have 12–15 items per category (48–60 items total) and CDT tests with five diagnostic categories would have 10–12 items per category (50–60 items total).

## NUMBER OF EMBEDDED FIELD-TEST ITEMS

Over time, additional items will be needed to replenish the CDT item pools. Embedding field-test items within an operational CDT test is advantageous for two reasons. First, sufficient item level data can be gathered without the time and expense of a separate stand-alone administration. Second, it allows the new items to be placed on the existing operational scale. See Chapter Twelve for details.

As detailed in Chapter Six, there have been seven embedded field-test events. Starting on February 14, 2013, field-test items were embedded within CDT Mathematics and Reading/Literature tests. Starting on August 26, 2013, items were embedded within CDT Mathematics, Reading/Literature, Science, and Writing/English Composition tests for students in grade 6. Starting on August 24, 2015, items were embedded within seven of the thirteen CDTs: Math Grades 6–HS, Algebra I, Reading Grades 3–5, Reading/Lit Grades 6–HS, Science Grades 6–HS, Biology, and Writing/Eng Comp Grades 6–HS. Starting on August 20, 2018, items were embedded within all thirteen of the CDTs. Starting on August 19, 2019, items were embedded within all CDTs in the science content area except Chemistry. Starting on August 24, 2022, items were embedded within all CDTs except Chemistry. Starting on August 14, 2023, items were embedded within all Science CDTs.

For each embedded field-test event, the factors considered when determining the number of field-test items to embed included the number of items to be field tested, the expected number of students testing, and the desired n-count per item for field-test analyses. In mathematics, science, and writing, field-test items were randomly assigned to fixed positions spread throughout the operational test. In reading, a field-test passage was randomly assigned near the middle of the test and students took all of the items associated with the passage. In all content areas, the positions of field-test items were unknown to students. Field-test items were not clustered at the end of the test in an effort to avoid any fatigue effect when placing the items on the operational scale.

## CAT ALGORITHM

This section covers elements of the CAT algorithm including entry point, item selection criteria, test navigation, and termination.

### ENTRY POINT

All CDT tests other than Reading Grades 3–5 and Reading/Lit Grades 6–HS begin with a small “locator” section in which one or two items per diagnostic category are administered. The order of the diagnostic categories is random. The two CDT tests in the reading content area are slightly different because they are passage-based. Those, too, have a small “locator” section, but they may not contain one or two items for each diagnostic category because not all passages have an item for each diagnostic category.

The CAT algorithm is designed to administer items targeted for the individual student based on performance. However, student performance in the current test setting is not known at the beginning of the test. With no prior information about a student, the starting point in each diagnostic category is an item of average difficulty. For CDT tests that are not course-specific (Math Grades 3–5, Math Grades 6–HS, Reading Grades 3–5, Reading/Lit Grades 6–HS, Science Grades 3–5, Science Grades 6–HS, Writing Grades 3–5, and Writing/Eng Comp Grades 6–HS), the student’s grade is considered in selecting an item of average difficulty. For example, a grade 7 student taking CDT Math Grades 6–HS will start with an item near the average difficulty of grade 7 items in the pool. For CDT tests that are course-specific (Algebra I, Geometry, Algebra II, Biology, and Chemistry), an average item will be selected regardless of the student’s grade. For example, a grade 7 student taking CDT Algebra I will start with an item near the average difficulty of Algebra I items in the pool.

If a student has previously taken the CDT, the prior CDT scores are used to give the CAT algorithm a “head start.” In this case, the first item in each diagnostic category is selected to match the characteristics of the prior information rather than an average item. For example, if a student previously took the CDT Math Grades 6–HS test and scored very high in “Measurement, Data, and Probability,” then the first item selected in that diagnostic category will be more difficult than the grade level average.

The CAT algorithm includes a randomization component when selecting items to control item exposure. That is, one item is selected from among a set of items that are near the targeted item difficulty. This is especially important at the beginning of the CDT when no prior information is available. Randomization of items and diagnostic categories ensure that students will not see the same set of items in the same order even when all of the students are assigned items of average difficulty.

## **ITEM SELECTION CRITERIA**

Once the initial set of items has been administered, the CAT algorithm is designed to administer items targeted for the individual student based on performance. In targeting items, the CAT algorithm uses Rasch ability estimates from the current test session and considers a number of factors including test blueprint, response probability, item pool refinement, and passage-related concerns. Each of these is discussed in detail on the following pages.

## RASCH ABILITY ESTIMATES

As described in Chapter Eight and Chapter Nine, CDT item pools are scaled using the Rasch partial credit model (Wright & Masters, 1982) and vertically linked across grades and courses. The CAT algorithm has access to all item parameters in the item pool. After each item response, Rasch ability estimates and standard errors are calculated via maximum likelihood estimation (MLE) for the total test and each diagnostic category. In the case of zero (all items incorrect) and perfect (all items correct) scores, a correction factor is applied before computing the relevant maximum likelihood estimates. A fractional value is added to a zero score and subtracted from a perfect score before estimation.

After the locator section of the CDT, but before a student has taken many items in each diagnostic category, the total Rasch ability estimate is used in item selection. This is because total and diagnostic category ability estimates tend to be highly correlated, and the total estimate does not change as dramatically as diagnostic category estimates given one additional item. Using the total estimate at this point prevents students from experiencing extreme fluctuations in the difficulty of items.

While use of the total Rasch ability estimate makes sense early in the test, the goal of the CDT is to be diagnostic, and some students exhibit clear strengths and areas of need in different diagnostic categories. Therefore, after four or five items have been administered in a diagnostic category, the corresponding Rasch ability estimate for that diagnostic category is used in item selection. This ensures, for example, that a student struggling in “Biological Sciences” while at the same time excelling in “Earth and Space Sciences” will be administered easier “Biological Sciences” items and more challenging “Earth and Space Sciences” items.

## TEST BLUEPRINT

The CAT algorithm closely resembles a modified constrained CAT (MCCAT) design (Leung, Chang, & Hau, 2003). The general idea is that the CAT algorithm is configured with upper and lower bounds that specify the minimum and maximum numbers of items that will be administered to students for both total and diagnostic categories.

## RESPONSE PROBABILITY

No matter which Rasch ability estimate is used in selecting an item, total or diagnostic category estimate, the CAT algorithm targets items where the student has response probability (RP) of answering correctly, based on the Rasch ability estimate and item’s difficulty. The most efficient way to run a CAT is to select items where RP is 0.5. That is, select items where the student has a 50% chance of getting the item correct. This response probability produces the smallest standard error for any given number of items.

Prior to the launch of the first operational CDT in fall of 2010, simulations were run for various response probabilities. Table 13–2 shows the average person standard errors for total test and each diagnostic category<sup>2</sup> for seven response probabilities in simulations of CDT Mathematics with 50 items. Figure 13–2 shows average standard errors as a function of response probability.

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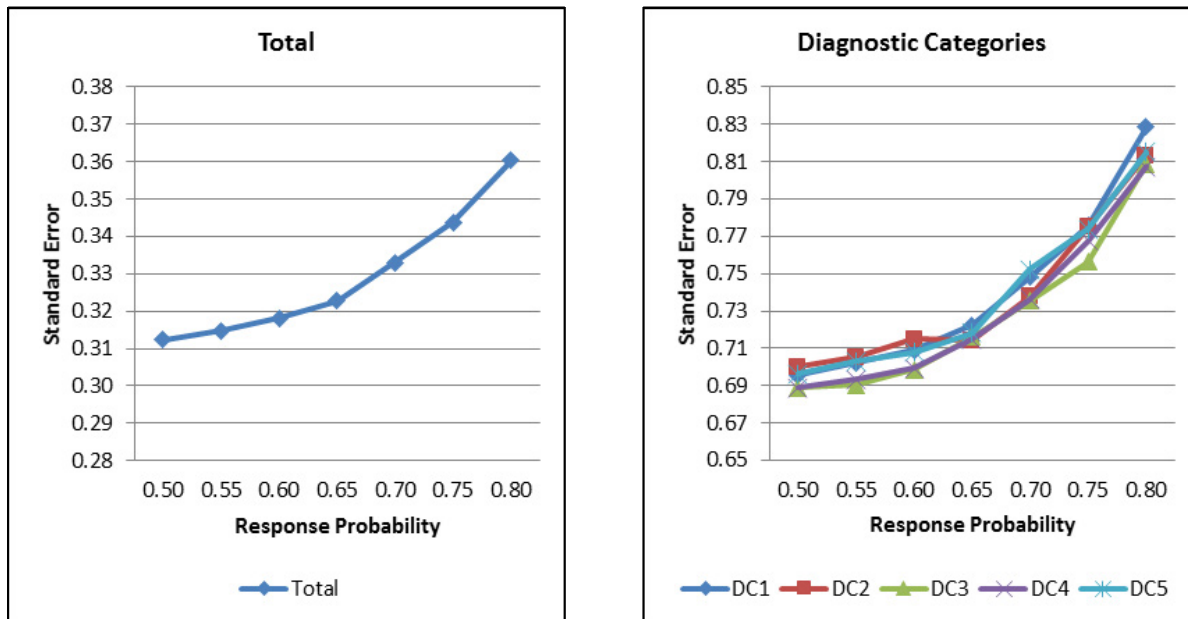
<sup>2</sup> At that time, there were five diagnostic categories in CDT Mathematics.

**Table 13–2. Average Standard Errors for Various Response Probabilities – Mathematics**

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
50 total (10 per DC)	0.50	0.312	0.696	0.700	0.689	0.689	0.696
50 total (10 per DC)	0.55	0.315	0.702	0.705	0.690	0.693	0.703
50 total (10 per DC)	0.60	0.318	0.709	0.715	0.699	0.699	0.708
50 total (10 per DC)	0.65	0.323	0.722	0.714	0.716	0.715	0.719
50 total (10 per DC)	0.70	0.333	0.748	0.738	0.735	0.736	0.752
50 total (10 per DC)	0.75	0.344	0.776	0.775	0.756	0.767	0.774
50 total (10 per DC)	0.80	0.360	0.829	0.813	0.809	0.807	0.815

As expected, increasing the response probability increases the standard error. Differences in standard errors at the diagnostic category level for the same response probability are a reflection of differences in the diagnostic category item pools.

**Figure 13–2. Average Standard Errors for Various Response Probabilities – Mathematics**



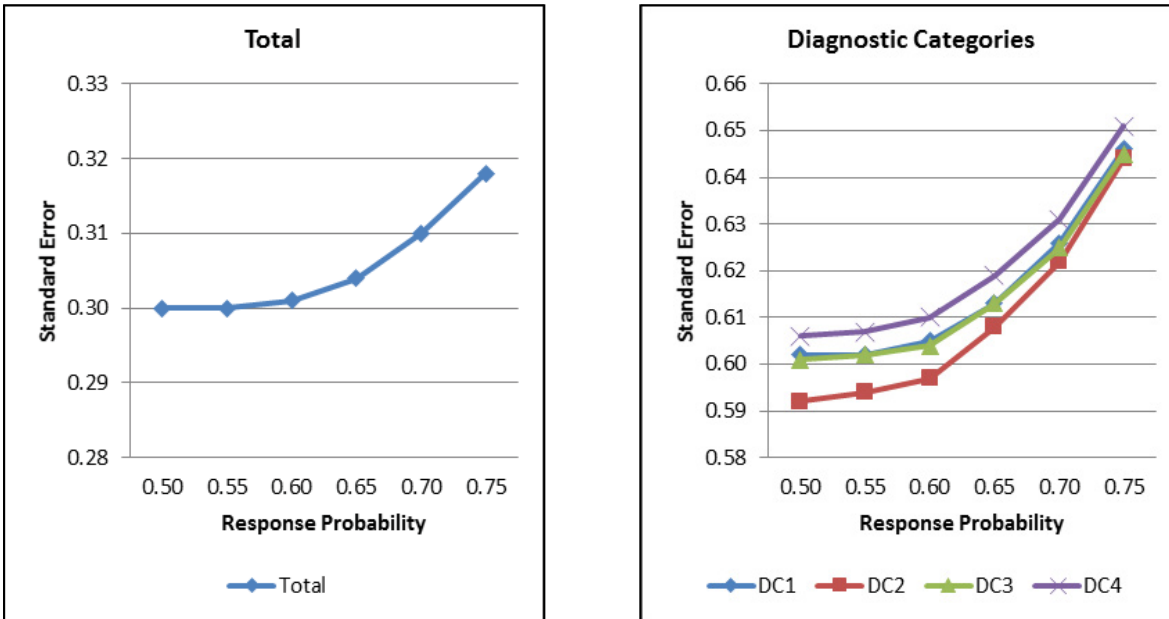
As can be seen in Figure 13–2, increasing response probability incrementally from 0.50 leads to increases in standard error. The increase in standard error is gradual at first and becomes more pronounced around 0.65.

Prior to the launch of the CDT for students in grades 3 through 5, the topic of response probability was revisited for each content area. Simulations for various response probabilities were run with fixed length tests equal to average test length. Results for each content area are presented in Tables 13–3 through 13–6 and Figures 13–3 through 13–6.

**Table 13–3. Average Standard Errors for Various Response Probabilities – Mathematics**

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4
52 total (13 per DC)	0.50	0.300	0.602	0.592	0.601	0.606
52 total (13 per DC)	0.55	0.300	0.602	0.594	0.602	0.607
52 total (13 per DC)	0.60	0.301	0.605	0.597	0.604	0.610
52 total (13 per DC)	0.65	0.304	0.613	0.608	0.613	0.619
52 total (13 per DC)	0.70	0.310	0.626	0.622	0.625	0.631
52 total (13 per DC)	0.75	0.318	0.646	0.644	0.645	0.651

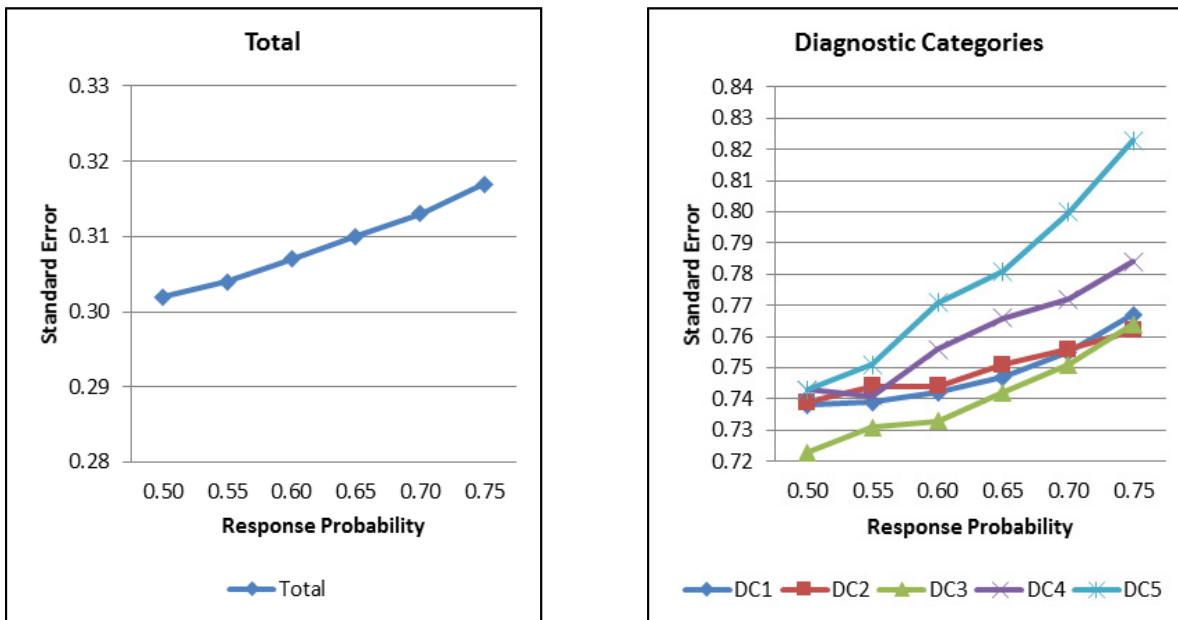
**Figure 13–3. Average Standard Errors for Various Response Probabilities – Mathematics**



**Table 13–4. Average Standard Errors for Various Response Probabilities – Reading**

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
55 total (11 per DC)	0.50	0.302	0.738	0.739	0.723	0.743	0.743
55 total (11 per DC)	0.55	0.304	0.739	0.744	0.731	0.741	0.751
55 total (11 per DC)	0.60	0.307	0.742	0.744	0.733	0.756	0.771
55 total (11 per DC)	0.65	0.310	0.747	0.751	0.742	0.766	0.781
55 total (11 per DC)	0.70	0.313	0.755	0.756	0.751	0.772	0.800
55 total (11 per DC)	0.75	0.317	0.767	0.762	0.764	0.784	0.823

**Figure 13–4. Average Standard Errors for Various Response Probabilities – Reading**

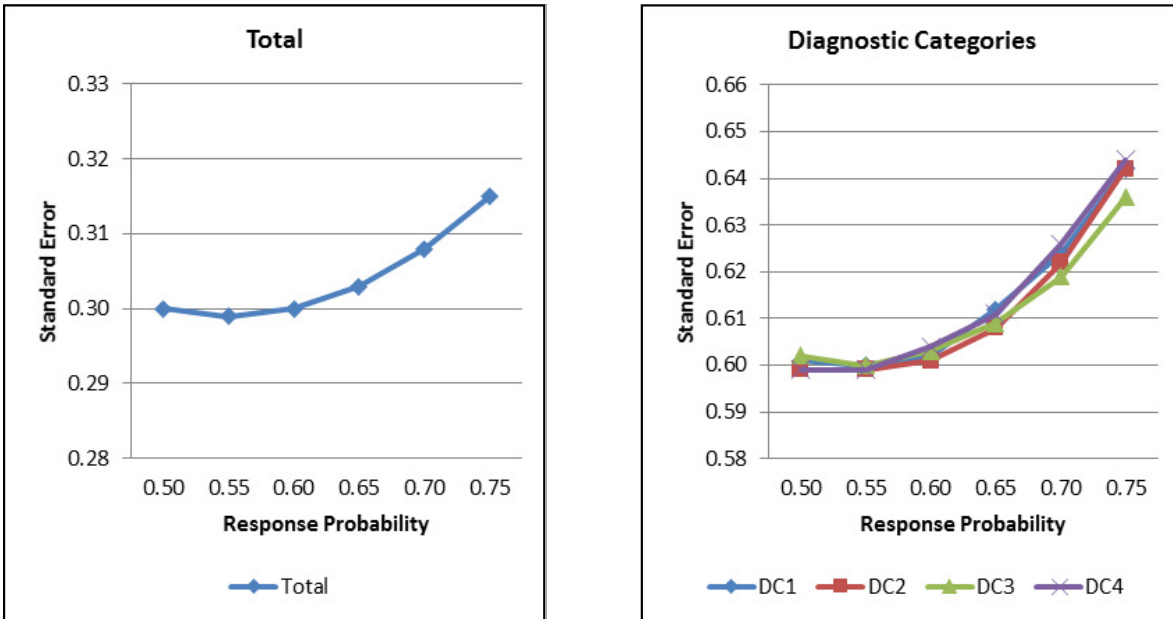




**Table 13–5. Average Standard Errors for Various Response Probabilities – Science**

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4
52 total (13 per DC)	0.50	0.300	0.601	0.599	0.602	0.599
52 total (13 per DC)	0.55	0.299	0.600	0.599	0.600	0.599
52 total (13 per DC)	0.60	0.300	0.602	0.601	0.603	0.604
52 total (13 per DC)	0.65	0.303	0.612	0.608	0.609	0.611
52 total (13 per DC)	0.70	0.308	0.624	0.622	0.619	0.626
52 total (13 per DC)	0.75	0.315	0.642	0.642	0.636	0.644

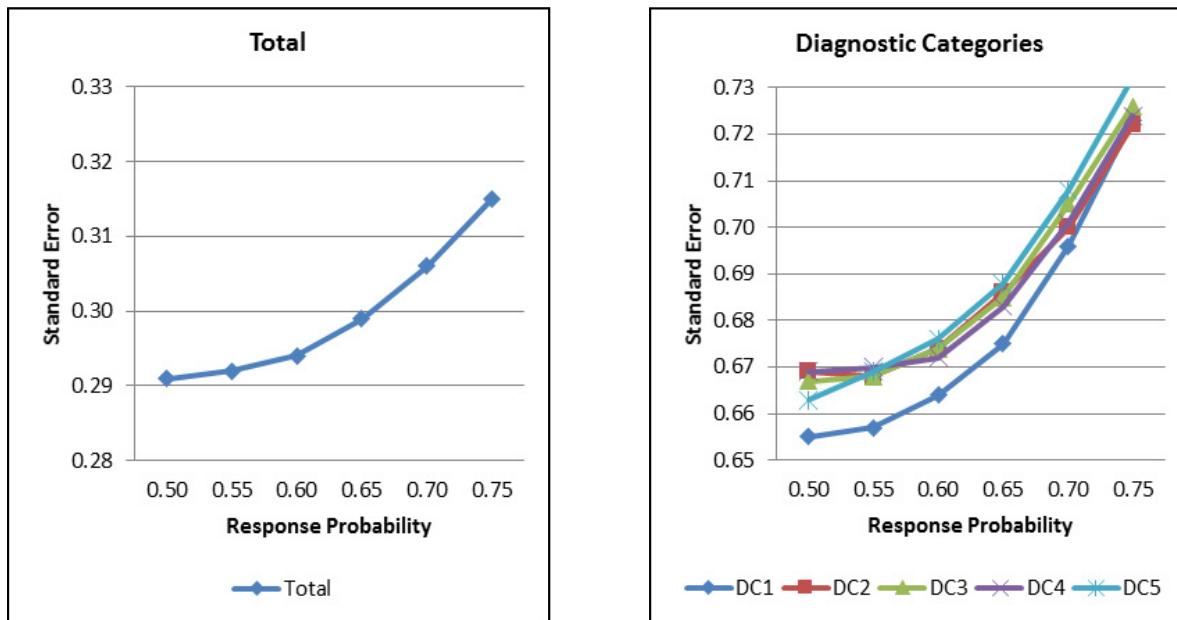
**Figure 13–5. Average Standard Errors for Various Response Probabilities – Science**



**Table 13–6. Average Standard Errors for Various Response Probabilities – Writing**

Number of Items	Response Probability	Total	DC 1	DC 2	DC 3	DC 4	DC 5
52 total (13 per DC)	0.50	0.291	0.655	0.669	0.667	0.669	0.663
52 total (13 per DC)	0.55	0.292	0.657	0.668	0.668	0.670	0.669
52 total (13 per DC)	0.60	0.294	0.664	0.674	0.674	0.672	0.676
52 total (13 per DC)	0.65	0.299	0.675	0.686	0.685	0.683	0.688
52 total (13 per DC)	0.70	0.306	0.696	0.700	0.705	0.701	0.708
52 total (13 per DC)	0.75	0.315	0.723	0.722	0.726	0.724	0.732

**Figure 13–6. Average Standard Errors for Various Response Probabilities – Writing**



Again, increasing response probability incrementally from 0.50 leads to increases in standard error. The increase in standard error is gradual at first and becomes more pronounced around 0.65.

For CDT tests designed for students in grade 6 and above, the response probability is set at 0.5. This is based on the desire for low standard errors at the diagnostic category level and the grade level of students testing. As part of the CDT training, students are told that the test is computer adaptive and designed to challenge them.

For CDT tests designed for students in grades 3 through 5, the response probability is set at 0.65. This response probability results in higher standard errors for the same number of items. However, there was concern that younger students may not have much experience with tests designed to be so challenging and could conceivably give up on a test that is perceived to be “too hard.”

## ITEM POOL REFINEMENT

The CAT algorithm has configurable elements that allow for refinement of the item pool used in item selection. The two configurable elements are:

- **Restrict pool**—The ability to restrict the available item pool by grade/course at various points in the test.

For example, Chemistry items are not available for the first 20 items of CDT Science Grades 6–HS test.

- **Favor items**—The ability to favor items that are close to the student’s grade when evaluating items near a student’s estimated score.

For example, if a student is in grade 8 and the item selection routine finds appropriate items (in terms of difficulty) in grades 4, 5, 6, 7, and 8, item selection can favor items at or close to grade 8. It is possible that no items near a student’s grade are appropriate in terms of difficulty. In such a case, the CAT algorithm will select items further away from the student’s grade but appropriate based on item difficulty.

The difference between restricting the pool and favoring items is that when the pool is restricted, some items may NOT be selected. With favoring, all non-restricted items are eligible for administration, but they are made more or less LIKELY to be selected based on closeness to student grade.

## PASSAGE RELATED CONCERNS

As previously mentioned, the CDT tests in the reading content area are passage-based. CDT passages have between one and seven associated items. The CAT algorithm does not require that all items associated with a passage be administered. Instead, it evaluates all possible combinations of items within a passage. Item sequencing within a passage is preserved when items are presented to the student. For example, if a six-item passage is selected and items 1 and 4 are NOT administered, then the items administered in order will be 2, 3, 5, and 6.

The configurable elements of passage-based CAT include:

- **Passage minimum percent**—Define the minimum percentage of the items associated with a passage to be used.

For example, if the passage minimum percent is set at 80, then the selection routine will consider combinations such as 1 of 1 (100%), 4 of 5 (80%), 5 of 6 (83%), and 6 of 6 (100%). It will not consider combinations such as 1 of 2 (50%), 3 of 4 (75%), 3 of 5 (60%), etc. Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints such as number of items per diagnostic category.

- **Passage evaluation criteria**—Multiple factors are considered when evaluating and ranking each passage combination to determine the best combination to administer to a student. They include:

- Percent of items associated with the passage used; the higher the percent, the higher the combination is ranked
- Number of items associated with the passage used; the higher the number, the higher the combination is ranked
- Distance between items’ difficulties and student’s estimated score; the smaller the distance, the higher the combination is ranked
- Distance between the items’ grade levels and the student’s grade level; the smaller the distance, the higher the combination is ranked

Different weights may be assigned to each of the factors. For example, if all of the weight is put on number of items used, then the algorithm will select the passages with the most associated items and administer all of them until the maximum number of items is reached.

## TEST NAVIGATION

Many versions of computer adaptive tests do not allow students to skip items in the test or back up to previously answered items and change answers due to some complicating factors.

If students are allowed to skip items, the CAT algorithm would need to select additional items without any additional information (no change to Rasch ability estimates). Taken to the extreme, a student with no prior CDT scores who skipped every item starting with the first would receive an entire test of average items. It would not be adaptive at all.

If students are allowed to back up and change answers, Rasch ability estimates are re-calculated when answered are changed. This additional information can be used to select additional items but would not change previously selected items. For example, suppose a student is on item twenty-five and goes back to change the answer to item eleven from wrong to right. The total and corresponding diagnostic category Rasch ability estimates would go up. That additional information can be used in selection of items twenty-six and beyond. However, items twelve through twenty-five are not reselected even though different items may have been selected if item eleven was initially answered correctly. When it comes to items twelve through twenty-five, “the train has left the station.”

Also, if students are allowed to back up in the test, additional considerations must be put in place to ensure that the answer to one item does not cue another.

Currently all CDT tests except Reading Grades 3–5 and Reading/Lit Grades 6–HS do not allow skipping items or backing up and changing answers. On CDT tests in the reading content area, students are allowed to skip items within a passage. For example, when presented with a passage and five associated items, the student does not have to answer questions one through five in that order without skipping. If a student tries to navigate to the next passage without answering all of the items associated with a passage, the test engine will prompt the student to answer all items and will not move on to the next passage until all are answered.

## TERMINATION

The CAT algorithm allows for both a fixed- or variable-length test.

With fixed length, the test ends when a student has taken a predefined number of items total and in each diagnostic category.

With variable length, the algorithm stops administering items from a diagnostic category when one of two conditions is satisfied:

- A student has taken at least a predefined minimum number of items in that diagnostic category and the standard error is below a predefined threshold

OR

- A student has taken a predefined maximum number of items in that diagnostic category

The test ends when one of the two conditions above is satisfied for each of the diagnostic categories.

Note that with both fixed- and variable-length tests, there is no requirement that the predefined number of items in diagnostic categories be equal.

## CAT CONFIGURATION – MATH GRADES 3–5

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.62, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no grade 7 items will be administered in the first 5 items,
- no grade 8 items will be administered in the first 10 items,
- no Algebra I items will be administered in the first 20 items, and
- no Geometry or Algebra II items will be administered.

Simulations were run with this configuration. On average:

- a total of 52 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.62.

## DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Math Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

## CAT CONFIGURATION – MATH GRADES 6–HS

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student's grade. The pool restrictions are:

- no Algebra I items will be administered in the first 5 items,
- no Geometry items will be administered in the first 10 items, and
- no Algebra II items will be administered in the first 20 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.61.

### **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Math Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

### **CAT CONFIGURATION – ALGEBRA I**

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to Algebra I. The pool restriction is that no Algebra II items will be administered in the first 16 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.63

### **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Algebra I. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

### **CAT CONFIGURATION – GEOMETRY**

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Geometry. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 54 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.60 to 0.61.

### **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Geometry. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

### **CAT CONFIGURATION – ALGEBRA II**

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Algebra II. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 54 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.66.

### **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Algebra II. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

### **CAT CONFIGURATION – READING GRADES 3–5**

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.77, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to run CAT with passages and favor items close to student's grade. The pool is restricted so that students will not receive passages associated with a grade that is more than four grades above the student's grade.

Passage minimum percent is set at 66%. That is, whenever possible, only passage combinations that use 66% or more of the associated items are used. (Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints.) Many simulations were run to arrive at this percent. On the one hand, testing time and reading load should be minimized. Therefore, students should not have to read long passages for only one or two items. On the other hand, using all items associated with a passage may not be desirable since some items are far from a student's estimated score. Given a limited number of items, those that are either too easy or too hard should not be used.

In evaluating and ranking passages, percent of items associated with the passage is not used. Simulation results indicate that if it is factored into evaluations, students take many short passages because 1 of 1 (100%) and 2 of 2 (100%) are ranked higher than 5 of 6 (83%) and 4 of 5 (80%), for example.

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- a total of 14 passages are administered,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.73 to 0.78.

## DIAGNOSTIC CATEGORY TESTS

Diagnostic category tests in the reading content area are different than the other content areas because items are passage-based. Testing a single diagnostic category would result in students reading full passages for only one or two items. Instead, diagnostic category tests associated with Reading Grades 3–5 are separated by text type – literature text or informational text. Each of the two tests have three diagnostic categories<sup>3</sup>. Students take between 10 and 12 operational items per diagnostic category for a total test of 30 to 36 operational items. Diagnostic category tests were first available on January 28, 2019.

## CAT CONFIGURATION – READING/LIT GRADES 6–HS

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.75, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to run CAT with passages and favor items close to student's grade. There are no pool restrictions.

Passage minimum percent is set at 66%. That is, whenever possible, only passage combinations that use 66% or more of the associated items are used. (Near the end of a test, the passage minimum percent constraint may need to be loosened in order to meet content constraints.) Many simulations were run to arrive at this percent. On the one hand, testing time and reading load should be minimized. Therefore, students should not have to read long passages for only one or two items. On the other hand, using all items associated with a passage may not be desirable since some items are far from a student's estimated score. Given a limited number of items, those that are either too easy or too hard should not be used.

In evaluating and ranking passages, percent of items associated with the passage is not used. Simulation results indicate that if it is factored into evaluations, students take many short passages because 1 of 1 (100%) and 2 of 2 (100%) are ranked higher than 5 of 6 (83%) and 4 of 5 (80%), for example.

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<sup>3</sup> Key Ideas and Details, Craft and Structure/Integration of Knowledge and Ideas, Vocabulary



Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- a total of 13 passages are administered,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.72 to 0.77.
- Note that the standard error is higher for in reading than the other content areas. This is because Reading Grades 3–5 and Reading/Lit Grades 6–HS are passage-based. Rather than selecting one targeted item at a time, the item selection routine evaluates and selects multiple items associated with a given passage. In general, items selected in this manner are not as close to the targeted response probability as stand-alone items selected one by one.

### **DIAGNOSTIC CATEGORY TESTS**

Diagnostic category tests in the reading content area are different than the other content areas because items are passage-based. Testing a single diagnostic category would result in students reading full passages for only one or two items. Instead, diagnostic category tests associated with Reading/Literature Grades 6–HS are separated by text type – literature text or informational text. Each of the two tests have three diagnostic categories<sup>4</sup>. Students take between 10 and 12 operational items per diagnostic category for a total test of 30 to 36 operational items. Diagnostic category tests were first available on January 28, 2019.

### **CAT CONFIGURATION – SCIENCE GRADES 3–5**

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.62, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student’s grade. The pool restrictions are:

- no grade 11 items will be administered in the first 40 items, and
- no Biology or Chemistry items will be administered.

Simulations were run with this configuration. On average:

- a total of 52 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.62 to 0.63.

### **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Science Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

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<sup>4</sup> Key Ideas and Details, Craft and Structure/Integration of Knowledge and Ideas, Vocabulary

## CAT CONFIGURATION – SCIENCE GRADES 6–HS

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to restrict the pool and to favor items close to a student’s grade. The pool restrictions are:

- no grade 11 items will be administered in the first 20 items UNLESS the student is in grade 11 or 12,
- no Biology or Chemistry items will be administered in the first 20 items.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.62.

## CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Science Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

## CAT CONFIGURATION – BIOLOGY

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Biology. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 53 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.62 to 0.63.

## DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Biology. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

## CAT CONFIGURATION – CHEMISTRY

The test has four diagnostic categories. Each student will take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 12 operational items in that diagnostic category and the standard error is below 0.60, or
- a student has taken 15 operational items in that diagnostic category.

Functionality is used to favor items close to Chemistry. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 54 operational items are administered—about 13 per diagnostic category,
- standard error for the total score is 0.31, and
- standard errors for the diagnostic categories are in the range of 0.61 to 0.65.

## DIAGNOSTIC CATEGORY TESTS

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the four diagnostic categories associated with Chemistry. Given that the content is limited to a single diagnostic category, the number of items is increased from 12 to 15 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

## CAT CONFIGURATION – WRITING GRADES 3–5

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 4 student will start with an item near the average difficulty of grade 4 items. Items are selected where the response probability is 0.65, meaning a student has a 65% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.67, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to favor items close to the student's grade. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- standard error for the total score is 0.30, and
- standard errors for the diagnostic categories are in the range of 0.68 to 0.73.

## **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the five diagnostic categories associated with Writing Grades 3–5. Given that the content is limited to a single diagnostic category, the number of items is increased from 10 to 12 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

## **CAT CONFIGURATION – WRITING/ENG COMP GRADES 6–HS**

The test has five diagnostic categories. Each student will take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. With no prior information about a student, the starting point in each diagnostic category will be an item of average difficulty by grade level. For example, a grade 7 student will start with an item near the average difficulty of grade 7 items. Items are selected where the response probability is 0.5, meaning a student has a 50% chance of answering correctly. The CAT algorithm will stop administering items in a diagnostic category when one of two conditions is satisfied:

- a student has taken at least 10 operational items in that diagnostic category and the standard error is below 0.65, or
- a student has taken 12 operational items in that diagnostic category.

Functionality is used to favor items close to the student’s grade. There are no pool restrictions.

Simulations were run with this configuration. On average:

- a total of 56 operational items are administered—about 11 per diagnostic category,
- standard error for the total score is 0.29, and
- standard errors for the diagnostic categories are in the range of 0.66 to 0.72.

## **DIAGNOSTIC CATEGORY TESTS**

Starting on January 28, 2019, CDTs were available that allowed students to take a single one of the five diagnostic categories associated with Writing/English Composition Grades 6–HS. Given that the content is limited to a single diagnostic category, the number of items is increased from 10 to 12 per diagnostic category to 15 to 18. This allows for more precise estimates (lower standard error) than the full test in which all diagnostic categories are tested.

Tables 13–7 through 13–12 summarize CAT configurations by content area.

**Table 13–7. CAT Configuration Summary – Mathematics**

	Math Grades 3–5	Math Grades 6–HS
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	Items 1–5: no Grade 7	Items 1–5: no Algebra I
Item Selection: Pool Restriction	Items 1–10: no Grade 8	Items 1–10: no Geometry
Item Selection: Pool Restriction	Items 1–20: no Algebra I	Items 1–20: no Algebra II
Item Selection: Pool Restriction	No Geometry	
Item Selection: Pool Restriction	No Algebra II	
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.62 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

**Table 13–8. CAT Configuration Summary – Algebra I, Geometry, and Algebra II**

	Algebra I	Geometry	Algebra II
Number of DCs	4	4	4
Number of OP Items per DC	12–15	12–15	12–15
Number of OP Items Total	48–60	48–60	48–60
Number of FT Items Total	0	0	0
Entry Point: No Prior CDT	average item	average item	average item
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.50	0.50	0.50
Item Selection: Favor Items	close to Algebra I	close to Geometry	close to Algebra II
Item Selection: Pool Restriction	Items 1–16: no Algebra II	None	None
Navigation	no skip; no backtrack	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

**Table 13–9. CAT Configuration Summary – Reading**

	Reading Grades 3–5	Reading/Lit Grades 6–HS
Number of DCs	5	5
Number of OP Items per DC	10–12	10–12
Number of OP Items Total	50–60	50–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	No items from grades more than four above student grade	None
Passage Min %	66	66
Navigation	skip items within passage	skip items within passage
Termination	10 items per DC, SE < 0.77 OR 12 items per DC	10 items per DC, SE < 0.75 OR 12 items per DC

DC = Diagnostic Category

**Table 13–10. CAT Configuration Summary – Science**

	Science Grades 3–5	Science Grades 6–HS
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	5	5
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	Items 1–40: no grade 11	Students in grades 6–10 Items 1–20: no grade 11, Biology, or Chemistry
Item Selection: Pool Restriction	No Biology	Students in grades 11–12 Items 1–20: no Biology, or Chemistry
Item Selection: Pool Restriction	No Chemistry	
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.62 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

**Table 13–11. CAT Configuration Summary – Biology and Chemistry**

	<b>Biology</b>	<b>Chemistry</b>
Number of DCs	4	4
Number of OP Items per DC	12–15	12–15
Number of OP Items Total	48–60	48–60
Number of FT Items Total	5	5
Entry Point: No Prior CDT	average item	average item
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.50	0.50
Item Selection: Favor Items	close to Biology	close to Chemistry
Item Selection: Pool Restriction	None	None
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	12 items per DC, SE < 0.60 OR 15 items per DC	12 items per DC, SE < 0.60 OR 15 items per DC

DC = Diagnostic Category

**Table 13–12. CAT Configuration Summary – Writing**

	<b>Writing Grades 3–5</b>	<b>Writing/Eng Comp Gr 6–HS</b>
Number of DCs	5	5
Number of OP Items per DC	10–12	10–12
Number of OP Items Total	50–60	50–60
Number of FT Items Total	0	0
Entry Point: No Prior CDT	average item by grade	average item by grade
Entry Point: Prior CDT	prior diagnostic scores	prior diagnostic scores
Item Selection: Rasch Ability Estimates	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate	After locator, use total estimate until the fifth item in a DC; then switch to DC estimate
Item Selection: Response Probability	0.65	0.50
Item Selection: Favor Items	close to student grade	close to student grade
Item Selection: Pool Restriction	None	None
Navigation	no skip; no backtrack	no skip; no backtrack
Termination	10 items per DC, SE < 0.67 OR 12 items per DC	10 items per DC, SE < 0.65 OR 12 items per DC

DC = Diagnostic Category

# CHAPTER FOURTEEN: SCORES AND SCORE REPORTS

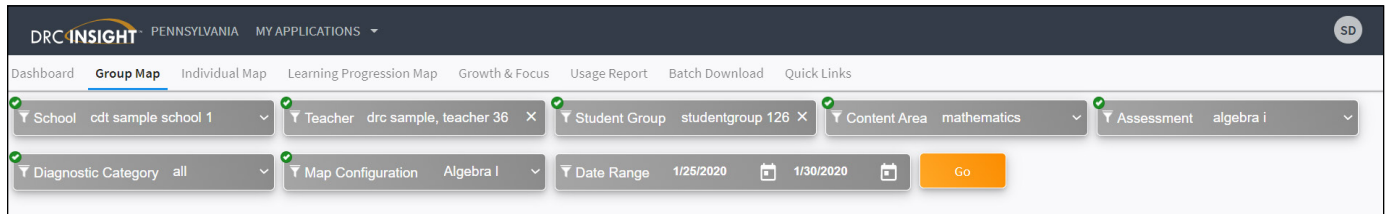
Teachers will receive immediate and usable data to be used for targeting instruction to meet the needs of individual students. The CDT Interactive Reports provide direct links to resources in SAS, including specific lesson plans, interventions, and other resources. The reports can also show the progress of students across test administrations. This overview summarizes the steps in accessing the interactive reports, as well as the types of information available for each type of report.

## ACCESSING INTERACTIVE REPORTS

Any user with the role of District, School, or Teacher has the ability to view CDT Interactive Reports accessed through the DRC INSIGHT Portal. Once the user is logged in, Report Delivery can be selected under MY APPLICATIONS, at the top of the screen. Next, the user selects CDT Interactive Reports. The user is presented general information on the Dashboard with separate tabs for each report. Once a report is selected, the user will begin to make selections within the available pre-filters to generate the report to be displayed.

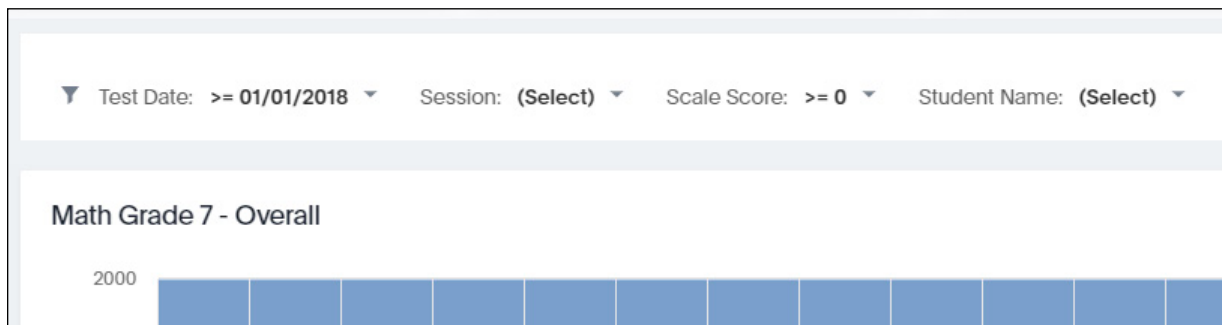
The pre-filters include: District, School, Teacher, Student Group, Content Area, Assessment, Diagnostic Category, Map Configuration, Date Range. The filters are smart filters. This means the filter will pre-populate based on the data the user has access to or based on the previous filter selections made.

Figure 14–1. Pre-Filter Screen



A secondary set of filters is available within each report to further refine the data reported on the page. Each reporting table and map has its own filters and selections to sort the data in a way that maximizes the ability for teachers to evaluate performance for a group or sub-set of students. The secondary filters enable teachers to view a subset of the data displayed. In the example below, filters include test date, test session selection(s), scale score range, and student name selection(s).

Figure 14–2. Secondary-Filter Screen



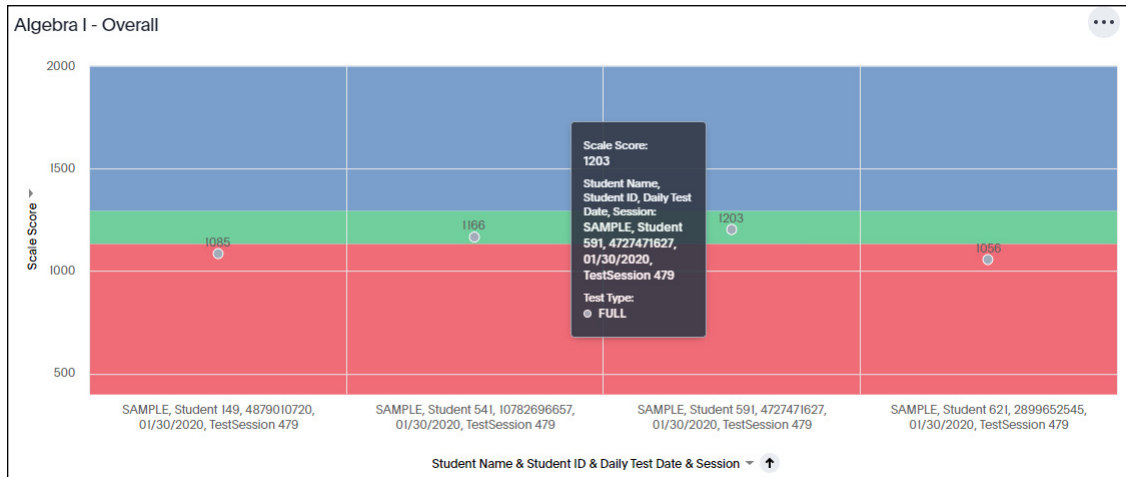
There are four types of interactive reports for the CDT: Group Map, Individual Map, Learning Progression Map, and Growth and Focus Map.



## GROUP MAP

The group-level reports provide teachers insightful information and data about classroom performance, including students' strengths to build on and areas of need. The group maps allow users to view overall classroom performance on a given assessment; to view eligible content associated with student scores; and to sort the data in various ways to make smaller student groups for targeted instruction. The group map is made up of several different data displays, which are discussed below.

**Figure 14–3. Sample Overall Group Map**



The Interactive Reports use colors to indicate relative **Strengths to Build On** and **Areas of Need**. Each descriptor correlates with a color range on the scale: Green/Blue = Strengths to Build On; Red = Areas of Need.

- Each gray dot on the Group Map represents a single student score.
- Additional information displays when the user hovers over the dot: student name, test date, and score.
- Only students within the Student Group with scores will have a gray dot appear on the map.
- All dots represent the assessment score(s) during the administration window, identified using the Date Range filter.
- The Group Map is intended to provide general assessment information based on a group of student scores within a full CDT assessment and/or Diagnostic Category CDT.
- The Diagnostic Category maps, found below the Group Map, provide all scores associated with the Diagnostic Categories tested within the full assessment, as well as for all individual Diagnostic Category CDT assessments completed. The scores are represented with yellow plotted dots.
- The data is also displayed in a grid that provides a complete list of the students within the selected student group with accompanying score information. The data from the grid can be exported as a CSV file.

Initially, the Group Map shows the entire vertical scale (representing scores from 200 to 2000 for Lower Grades Mathematics, Lower Grades Reading, Lower Grades Science, and Lower Grades Writing; representing scores from 400 to 2000 for Mathematics, Algebra I, Algebra II, Geometry, Reading/Literature, Science, Biology, Chemistry, and Writing/English Composition). The **Scale Score** filter provides the user the ability to narrow the reported set of students down to those falling in similar ranges.

If a user chooses one diagnostic category from the prefilters then additional detail is displayed at an eligible content level, including a description of the eligible content, links to a sample item, and links to instructional resources found on the SAS website.

**Figure 14–4. Eligible Content and Sample Items**

Diagnostic Category	Eligible Content Code	Eligible Content	Sample Item	Eligible Content Description
Geometry	M03.C-G.1.1.3	<a href="#">M03.C-G.1.1.3</a>	<a href="#">sample item</a>	Partition shapes into parts with
NUMBERS AND OPERATIONS	M03.A-T.1.1.1	<a href="#">M03.A-T.1.1.1</a>	<a href="#">sample item</a>	Round two- and three-digit wh
ALGEBRAIC CONCEPTS	M03.B-O.3.1.7	<a href="#">M03.B-O.3.1.7</a>	<a href="#">sample item</a>	Identify the missing symbol (+,

**Materials & Resources**

Materials & Resources provides a way to locate standards-aligned content through a targeted search. Locate educational resources by Keyword, Subject Area/Grade Level, Course, or by one or more specific Content Types. Please select from the appropriate filters.

The Standards Aligned System includes content from several outstanding community, cultural, and educational institutions. [Click here to view our content collectors.](#)

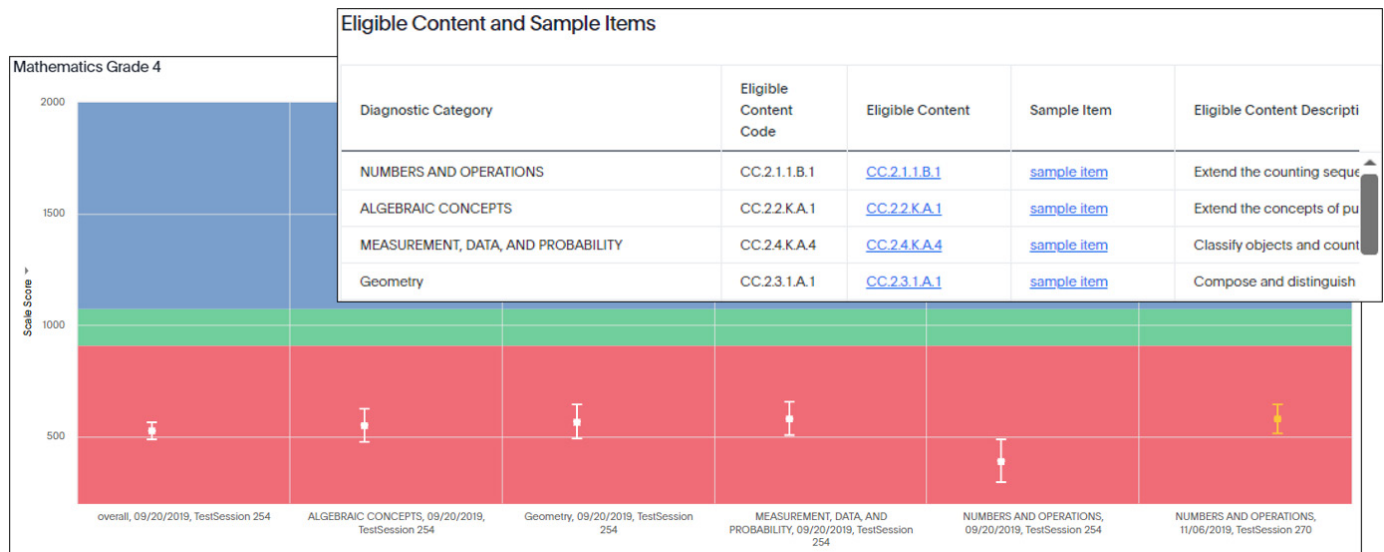
Title	Type	Grade(s)
<a href="#">Fractions Describe Parts of a Whole</a>	Unit Plan	3rd Grade
<a href="#">Fraction Strips</a>	Lesson Plan	3rd Grade
<a href="#">Math Design Collaborative: Attributes of Shapes</a>	Web-based Resource	

## INDIVIDUAL MAP

The CDT Individual Map shows how an individual student performed on a given assessment, with scores plotted on the CDT scale. The columns in the Individual Map represent the individual tests taken by the student. In adherence reporting guidelines outlined in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), a standard error band is displayed for each score. This interval represents the range where the student would likely score if tested again without additional instruction. The use of error bands supports more-accurate interpretation of scores (i.e., not over-interpreting scores) since error bands that overlap indicate that scores are not significantly different.

Similar to the Group Map, the Individual Map provides Eligible Content and Sample Items at the student level. This display contains sample items, eligible content descriptions, and links to materials and resources on SAS.

**Figure 14–5. Sample Individual Map and Eligible Content Associated with a Student’s Score**



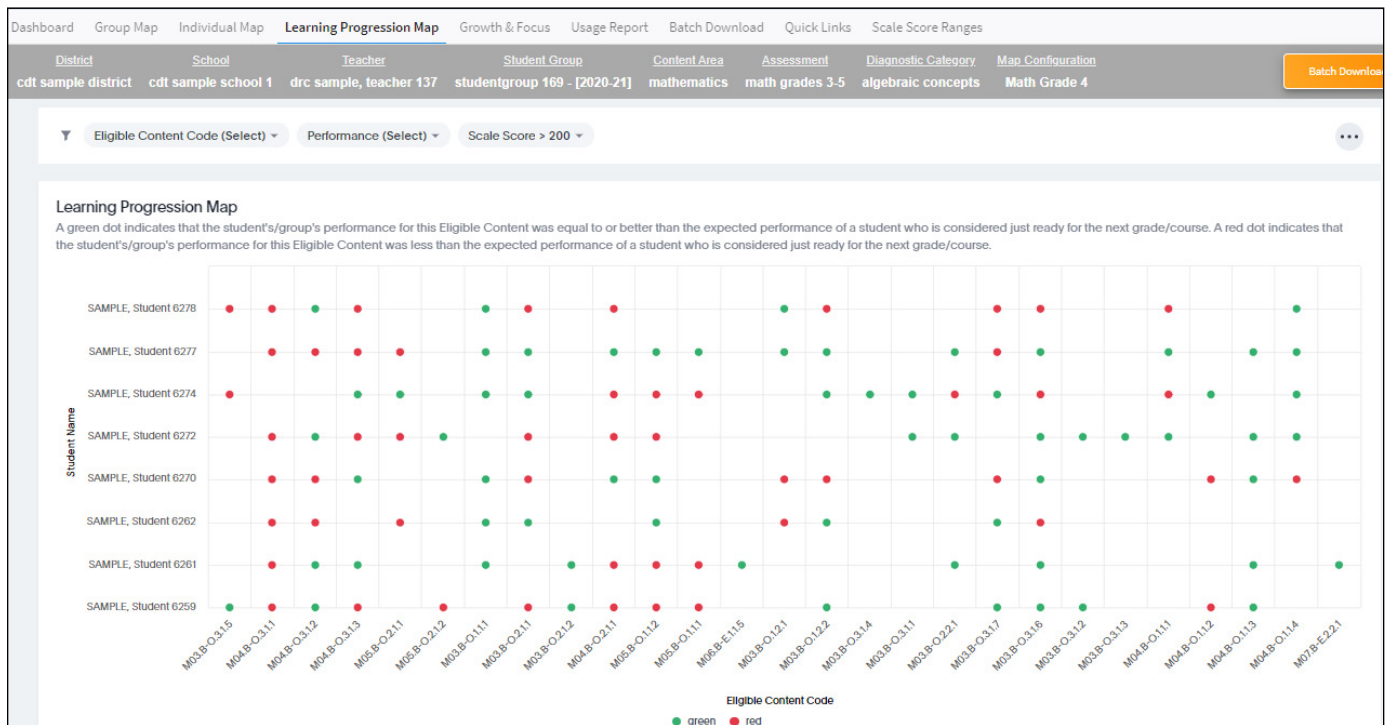
The Individual Map has the ability to show the all assessments that apply to the preliminary filter selections for an individual student. The Individual Map is intended to provide general Instructional Enrichment (a set of Eligible Content) based on a student’s score within a Diagnostic Category. Additional data displays on the Individual Map include hover overs and a grid view.

## GROUP AND INDIVIDUAL LEARNING PROGRESSION MAP

The Group and Individual Learning Progression Map is a graphical representation about how learning may typically move toward increased understanding over time based on Eligible Content. Each column represents the Eligible Content in a subject’s domain and subdomain and for a specific grade level or course. Each row represents student performance on the eligible content.

- A **green** dot indicates that the student was presented with at least one test item for the Eligible Content and performed as well or better than the expected performance of a student who is considered just ready for the next grade/course.
- A **red** dot indicates that the student was presented with at least one test item from the Eligible Content and the student’s performance was less than the expected performance of a student who is considered just ready for the next grade/course.
- An empty box represents Eligible Content that is available, but the student was not presented with any test items from that Eligible Content.

Figure 14–6. Sample Learning Progression Map



Additional data displays within the Learning Progression map include a summary by eligible content code, a grade-level summary, and information in a grid format.

## GROWTH AND FOCUS REPORT

The Growth and Focus report is designed to aid teachers in goal-setting with students by identifying students that fall in the “all” group or a “focus” group.

Students within the “all” group have an overall score higher or equal to the score at the bottom of the green area of the Group Map for the previous grade level. Students within the “focus” group are students who have an overall score that is less than the bottom of green of the previous grade level. These are students who could benefit from individual or small-group interventions.

The table is designed to allow educators to view one test event or compare two test events to determine if a student had significant growth between test sessions. The calculations that generate this report use the standard error information found in the Individual Maps to determine if there was significant growth.

**Figure 14–7. Growth and Focus Report**

Growth & Focus - Math Grade 4								
Student Name ↑	Test Session 1	Scale Score 1	Test Session 2	Scale Score 2	Change in Score	SEM	Significant Growth	Group
SAMPLE, Student 6259	TestSession 192	773	TestSession 489	1022	249	72	yes	all
SAMPLE, Student 6261	TestSession 192	940	TestSession 489	1115	175	74	yes	all
SAMPLE, Student 6270	TestSession 192	762	TestSession 489	709	-53	72	no	focus
SAMPLE, Student 6272	TestSession 192	985	TestSession 489	1063	78	81	no	all
SAMPLE, Student 6274	TestSession 192	772	TestSession 489	813	41	77	no	focus
SAMPLE, Student 6277	TestSession 192	967	TestSession 489	885	-82	76	no	all
SAMPLE, Student 6278	TestSession 192	583	TestSession 489	756	173	74	yes	focus

## OTHER CDT REPORTING COMPONENTS

**STUDENT CONFERENCING REPORT:** Data gives educators a comprehensive student-level report that compares recent test events for the same content area tested. This can include full CDT events, as well as individual Diagnostic Category CDT results. Teachers frequently use this report during one-on-one conferences with students and during conversations with parents because it provides a clear picture of student performance that can be easily printed or distributed via email.

**DISTRICT STUDENT DATA FILE:** District-level data is easily accessible using the District Data File download feature. This file is updated nightly and can be downloaded at any time throughout the CDT testing window. It includes student-level data for all schools within the district that have completed test events.

**USAGE REPORT:** DRC provides CDT usage reports in a variety of user-friendly formats (pie charts, bar graphs, CSV export files) that will allow administrators at SDP to easily view a summary of CDT usage by school. Users can filter the report content to best match their intended use.

## CHAPTER FIFTEEN: OPERATIONAL ADMINISTRATION 2023–2024

This chapter contains summary information about the operational administration of the Classroom Diagnostic Tools (CDT) during the 2023–2024 school year. Two types of CDTs were available—full CDTs and diagnostic category CDTs. Full CDTs test four or five diagnostic categories in one test session. Diagnostic category CDTs focus on a single diagnostic category in math, science and writing, or a single text type with three diagnostic categories in reading. Results in this chapter focus on full CDTs except where specifically noted.

### FREQUENCIES

Tables 15–1 through 15–3 present information related to the number of students who were administered one or more CDT tests in the 2023–2024 school year. Tables 15–1a and 15–1b show the number of students who have taken each CDT. Some of these students have taken the same CDT test multiple times or have taken multiple CDT tests. Tables 15–1a and 15–1b count only the first administration of each CDT test. Data about multiple administrations of the same test and multiple CDT tests are presented in Tables 15–2 and 15–3, respectively.

**Table 15–1a. Number of Students Taking the First Administration of a Full CDT by Grade Level**

CDT	3	4	5	6	7	8	9	10	11	12	TOTAL
Math Grades 3–5	17,343	18,673	22,318	-	-	-	-	-	-	-	58,334
Math Grades 6–HS	-	-	-	27,795	30,467	26,772	458	153	116	35	85,796
Algebra I	-	-	-	78	1,400	6,543	28,920	12,481	4,442	862	54,726
Geometry	-	-	-	1	13	145	765	1,790	1,104	175	3,993
Algebra II	-	-	-	1	13	66	1,288	2,230	1,655	340	5,593
Reading Grades 3–5	14,755	15,859	18,296	-	-	-	-	-	-	-	48,910
Reading/Lit Grades 6–HS	-	-	-	22,533	26,377	26,395	22,706	36,575	5,984	1,472	142,042
Science Grades 3–5	2,344	13,388	5,692	-	-	-	-	-	-	-	21,424
Science Grades 6–HS	-	-	-	13,383	21,806	31,906	1,367	172	155	156	68,945
Biology	-	-	-	0	151	266	24,500	28,155	4,031	685	57,788
Chemistry	-	-	-	0	0	8	293	1,037	1,197	142	2,677
Writing Grades 3–5	2,618	3,083	3,637	-	-	-	-	-	-	-	9,338
Writing/Eng Comp Grades 6–HS	-	-	-	4,502	6,614	6,372	2,383	2,313	1,037	215	23,436

**Table 15–1b. Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level**

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Math Grades 3–5	Numbers and Operations	1,353	1,714	1,636	-	-	-	-	-	-	-	4,703
Math Grades 3–5	Algebraic Concepts	657	1,161	686	-	-	-	-	-	-	-	2,504
Math Grades 3–5	Geometry	430	555	373	-	-	-	-	-	-	-	1,358
Math Grades 3–5	Measurement, Data, and Probability	757	359	654	-	-	-	-	-	-	-	1,770
Math Grades 6–HS	Numbers and Operations	-	-	-	2,715	3,586	2,818	75	8	7	0	9,209
Math Grades 6–HS	Algebraic Concepts	-	-	-	1,828	3,318	3,695	62	9	1	0	8,913
Math Grades 6–HS	Geometry	-	-	-	1,127	1,271	1,680	1	0	0	0	4,079
Math Grades 6–HS	Measurement, Data, and Probability	-	-	-	585	792	708	40	3	1	0	2,129
Algebra I	Operations with Real Numbers and Expressions	-	-	-	4	63	340	2,218	770	231	75	3,701
Algebra I	Linear Equations & Inequalities	-	-	-	0	131	524	3,094	1,289	408	97	5,543
Algebra I	Functions & Coordinate Geometry	-	-	-	0	75	256	2,193	661	145	39	3,369
Algebra I	Data Analysis	-	-	-	0	0	117	901	359	141	32	1,550
Geometry	Geometric Properties	-	-	-	0	0	0	4	33	7	3	47
Geometry	Congruence, Similarity, and Proofs	-	-	-	0	0	0	34	110	8	4	156
Geometry	Coordinate Geometry and Right Triangles	-	-	-	0	0	0	28	81	8	4	121
Geometry	Measurement	-	-	-	0	0	0	28	115	27	4	174
Algebra II	Operations with Complex Numbers	-	-	-	0	0	14	92	82	26	13	227
Algebra II	Non-Linear Expressions & Equations	-	-	-	0	0	0	2	25	9	8	44

**Table 15–1b (continued). Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level**

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Algebra II	Functions	-	-	-	0	0	0	8	57	25	8	98
Algebra II	Data Analysis	-	-	-	0	0	0	1	5	71	37	114
Reading Grades 3–5	Informational Text	1,337	1,336	1,091	-	-	-	-	-	-	-	3,764
Reading Grades 3–5	Literature Text	658	773	917	-	-	-	-	-	-	-	2,348
Reading/Lit Grades 6–HS	Informational Text	-	-	-	1,288	1,371	1,503	1,836	4,080	526	157	10,761
Reading/Lit Grades 6–HS	Literature Text	-	-	-	1,998	1,343	1,365	2,652	4,454	264	132	12,208
Science Grades 3–5	The Nature of Science	575	886	791	-	-	-	-	-	-	-	2,252
Science Grades 3–5	Biological Sciences	198	864	617	-	-	-	-	-	-	-	1,679
Science Grades 3–5	Physical Sciences	127	1,114	160	-	-	-	-	-	-	-	1,401
Science Grades 3–5	Earth and Space Sciences	203	509	499	-	-	-	-	-	-	-	1,211
Science Grades 6–HS	The Nature of Science	-	-	-	2,118	2,273	3,101	178	12	0	53	7,735
Science Grades 6–HS	Biological Sciences	-	-	-	183	3,358	850	205	12	0	1	4,609
Science Grades 6–HS	Physical Sciences	-	-	-	781	967	2,368	762	33	8	5	4,924
Science Grades 6–HS	Earth and Space Sciences	-	-	-	1,856	1,397	880	11	39	12	8	4,203
Biology	Basic Biological Principles/ Chemical Basis for Life	-	-	-	0	0	5	3,267	3,551	559	59	7,441
Biology	Bioenergetics/ Homeostasis and Transport	-	-	-	0	0	1	2,058	2,966	520	50	5,595
Biology	Cell Growth and Reproduction/ Genetics	-	-	-	0	0	4	877	1,609	354	85	2,929
Biology	Theory of Evolution/Ecology	-	-	-	0	1	54	1,257	736	135	31	2,214

**Table 15–1b (continued). Number of Students Taking the First Administration of a Diagnostic Category CDT by Grade Level**

CDT	Diagnostic Category	3	4	5	6	7	8	9	10	11	12	TOTAL
Chemistry	Properties and Classification of Matter	-	-	-	0	0	0	2	51	153	17	223
Chemistry	Atomic Structure and The Periodic Table	-	-	-	0	0	0	3	137	224	26	390
Chemistry	The Mole and Chemical Bonding	-	-	-	0	0	0	1	134	114	13	262
Chemistry	Chemical Relationships and Reactions	-	-	-	0	0	0	2	70	89	30	191
Writing Grades 3–5	Quality of Writing: Focus and Organization	0	33	131	-	-	-	-	-	-	-	164
Writing Grades 3–5	Quality of Writing: Content and Style	24	65	39	-	-	-	-	-	-	-	128
Writing Grades 3–5	Quality of Writing: Editing	170	36	62	-	-	-	-	-	-	-	268
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	524	607	701	-	-	-	-	-	-	-	1,832
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	625	518	795	-	-	-	-	-	-	-	1,938
Writing/Eng Comp Grades 6–HS	Quality of Writing: Focus and Organization	-	-	-	0	164	204	4	10	81	9	472
Writing/Eng Comp Grades 6–HS	Quality of Writing: Content and Style	-	-	-	93	686	127	8	25	74	12	1,025
Writing/Eng Comp Grades 6–HS	Quality of Writing: Editing	-	-	-	0	333	10	6	41	83	11	484
Writing/Eng Comp Grades 6–HS	Conventions: Punctuation, Capitalization, and Spelling	-	-	-	1,102	1,221	959	125	290	53	3	3,753
Writing/Eng Comp Grades 6–HS	Conventions: Grammar and Sentence Formation	-	-	-	1,118	1,190	901	155	216	74	3	3,657



**Table 15–2a. Multiple Administrations of the Same Full CDT Test**

<b>CDT</b>	<b>Students with 1 Administration</b>	<b>Students with 2 Administrations</b>	<b>Students with 3 Administrations</b>	<b>Students with 4 Administrations</b>	<b>Students with 5 Administrations</b>
Math Grades 3–5	58,334	46,819	25,074	981	6
Math Grades 6–HS	85,796	67,634	29,990	1,220	26
Algebra I	54,726	35,599	14,105	1,404	13
Geometry	3,993	2,878	1,425	191	0
Algebra II	5,593	3,893	1,893	399	0
Reading Grades 3–5	48,910	39,699	21,553	777	10
Reading/Lit Grades 6–HS	142,042	103,369	37,028	1,848	42
Science Grades 3–5	21,424	16,489	9,411	10	0
Science Grades 6–HS	68,945	46,779	21,222	893	96
Biology	57,788	37,851	14,250	925	33
Chemistry	2,677	1,798	767	31	0
Writing Grades 3–5	9,338	6,991	2,316	16	0
Writing/Eng Comp Gr 6–HS	23,436	13,883	5,536	171	0

**Table 15–2b. Multiple Administrations of the Same Diagnostic Category CDT Test**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>Students with 1 Administration</b>	<b>Students with 2 Administrations</b>	<b>Students with 3 Administrations</b>	<b>Students with 4 Administrations</b>	<b>Students with 5 Administrations</b>
Math Grades 3–5	Numbers and Operations	4,703	1,896	880	15	0
Math Grades 3–5	Algebraic Concepts	2,504	301	55	0	0
Math Grades 3–5	Geometry	1,358	186	17	0	0
Math Grades 3–5	Measurement, Data, and Probability	1,770	410	280	0	0
Math Grades 6–HS	Numbers and Operations	9,209	2,671	440	1	0
Math Grades 6–HS	Algebraic Concepts	8,913	1,888	428	0	0
Math Grades 6–HS	Geometry	4,079	737	36	0	0
Math Grades 6–HS	Measurement, Data, and Probability	2,129	626	222	0	0
Algebra I	Operations with Real Numbers and Expressions	3,701	958	74	5	0
Algebra I	Linear Equations & Inequalities	5,543	1,184	199	59	0
Algebra I	Functions & Coordinate Geometry	3,369	662	21	2	0
Algebra I	Data Analysis	1,550	249	0	0	0
Geometry	Geometric Properties	47	18	0	0	0
Geometry	Congruence, Similarity, and Proofs	156	90	0	0	0
Geometry	Coordinate Geometry and Right Triangles	121	18	0	0	0
Geometry	Measurement	174	62	0	0	0
Algebra II	Operations with Complex Numbers	227	44	0	0	0
Algebra II	Non-Linear Expressions & Equations	44	11	0	0	0
Algebra II	Functions	98	39	0	0	0
Algebra II	Data Analysis	114	79	25	0	0
Reading Grades 3–5	Informational Text	3,764	729	533	0	0
Reading Grades 3–5	Literature Text	2,348	532	310	1	0

**Table 15–2b (continued). Multiple Administrations of the Same Diagnostic Category CDT Test**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>Students with 1 Administration</b>	<b>Students with 2 Administrations</b>	<b>Students with 3 Administrations</b>	<b>Students with 4 Administrations</b>	<b>Students with 5 Administrations</b>
Reading/Lit Grades 6–HS	Informational Text	10,761	2,682	471	0	0
Reading/Lit Grades 6–HS	Literature Text	12,208	3,279	320	4	0
Science Grades 3–5	The Nature of Science	2,252	1,142	340	1	0
Science Grades 3–5	Biological Sciences	1,679	200	92	0	0
Science Grades 3–5	Physical Sciences	1,401	343	0	0	0
Science Grades 3–5	Earth and Space Sciences	1,211	350	53	0	0
Science Grades 6–HS	The Nature of Science	7,735	4,889	696	2	0
Science Grades 6–HS	Biological Sciences	4,609	2,418	503	0	0
Science Grades 6–HS	Physical Sciences	4,924	2,292	986	0	0
Science Grades 6–HS	Earth and Space Sciences	4,203	2,023	676	0	0
Biology	Basic Biological Principles/ Chemical Basis for Life	7,441	658	72	0	0
Biology	Bioenergetics/ Homeostasis and Transport	5,595	194	64	0	0
Biology	Cell Growth and Reproduction/ Genetics	2,929	449	1	0	0
Biology	Theory of Evolution/Ecology	2,214	560	110	0	0
Chemistry	Properties and Classification of Matter	223	105	1	1	0
Chemistry	Atomic Structure and The Periodic Table	390	222	1	1	0
Chemistry	The Mole and Chemical Bonding	262	118	10	0	0
Chemistry	Chemical Relationships and Reactions	191	73	1	0	0
Writing Grades 3–5	Quality of Writing: Focus and Organization	164	0	0	0	0

**Table 15–2b (continued). Multiple Administrations of the Same Diagnostic Category CDT Test**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>Students with 1 Administration</b>	<b>Students with 2 Administrations</b>	<b>Students with 3 Administrations</b>	<b>Students with 4 Administrations</b>	<b>Students with 5 Administrations</b>
Writing Grades 3–5	Quality of Writing: Content and Style	128	0	0	0	0
Writing Grades 3–5	Quality of Writing: Editing	268	0	0	0	0
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	1,832	803	0	0	0
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	1,938	1,199	279	0	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	472	11	0	0	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	1,025	138	83	0	0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	484	13	0	0	0
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	3,753	1,170	16	0	0
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	3,657	1,556	311	0	0

**Table 15–3a. Number of Students in Grades 3 through 5 Taking Multiple Full CDT Tests**

<b>Grades 3 through 5</b>	<b>Math</b>	<b>Reading</b>	<b>Science</b>	<b>Writing</b>
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	44,623	-	-	-
Science Grades 3–5	13,811	12,002	-	-
Writing Grades 3–5	7,928	7,602	3,179	-

**Table 15–3b. Number of Students in Grades 6 and above Taking Multiple Full CDT Tests**

Grades 6 and above	Math	Algebra I	Geometry	Algebra II	Reading/ Literature	Science	Biology	Chemistry	Writing/ English Comp.
Math Grades 6–HS	-	-	-	-	-	-	-	-	-
Algebra I	3,093	-	-	-	-	-	-	-	-
Geometry	26	150	-	-	-	-	-	-	-
Algebra II	8	253	235	-	-	-	-	-	-
Reading/Lit Grades 6–HS	66,065	28,820	1,960	2,446	-	-	-	-	-
Science Grades 6–HS	39,357	5,261	158	210	39,272	-	-	-	-
Biology	156	20,034	1,417	1,790	29,198	207	-	-	-
Chemistry	3	361	662	561	1,341	19	49	-	-
Writing/Eng Comp Grades 6–HS	14,507	3,346	400	252	17,424	10,327	2,817	162	-

Further demographic information about students tested with the CDT is found in the next section.

## DEMOGRAPHIC CHARACTERISTICS

### COMPOSITION OF SAMPLE USED IN SUBSEQUENT TABLES

To avoid double counting of students, the following demographic tables are based on students' first administration for a given CDT test. Students taking only diagnostic category tests are counted with the parent test<sup>1</sup>. For example, a student taking Math Grades 3–5 Numbers and Operations is counted under Math Grades 3–5. Students who took the same test multiple times are counted only once. Students who took different tests are counted for each test. For example, if a student took CDT Algebra I twice, he or she is counted only once in the Algebra I counts; if a student took Algebra I once and Biology once, he or she is counted in both Algebra I and Biology counts.

### COLLECTION OF STUDENT DEMOGRAPHIC INFORMATION

Data for analyses of demographic characteristics were obtained primarily from information supplied by school district personnel through the Pennsylvania Information Management System (PIMS) and subsequently transmitted to DRC. However, teachers may assign CDT tests to students who do not have data in PIMS at the time of testing. This may result in CDT records with incomplete demographic information.

### DEMOGRAPHIC CHARACTERISTICS

Frequency data for various demographic categories are presented in Tables 15–4 through 15–16. Shown at the bottom of the appropriate table is the number of students with a total test score on which the column percentages are based. Percentages in some categories may sum to a quantity below 100 percent due to missing data.

Analyses are broken out by grade level. However, in the case of course-specific CDT tests (Algebra I, Geometry, Algebra II, Biology, and Chemistry), students across multiple grades may be enrolled in the course.

Caution should be used in interpreting CDT demographic data, since participation is voluntary and complete demographic data via PIMS is not required for testing. This is especially true for rows in the lower half of the tables (e.g., IEP, Migrant, and Economically Disadvantaged) because these typically have more than ninety-five percent blank responses.

<sup>1</sup> Approximately 6% of students take only diagnostic category tests.

**Table 15–4. Demographic Characteristics of Students Taking CDT Math Grades 3–5**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 3</b>	<b>Gr. 4</b>	<b>Gr. 5</b>	<b>Total</b>
Female (N)	9,075	9,556	11,286	29,917
Female (Pct)	49.78%	48.76%	49.19%	49.23%
Male (N)	9,156	10,041	11,660	30,857
Male (Pct)	50.22%	51.24%	50.81%	50.77%
American Indian or Alaskan Native (N)	41	34	42	117
American Indian or Alaskan Native (Pct)	0.22%	0.17%	0.18%	0.19%
Black/African American non-Hispanic (N)	2,351	2,561	2,723	7,635
Black/African American non-Hispanic (Pct)	12.90%	13.07%	11.87%	12.56%
Hispanic (N)	1,861	1,994	2,205	6,060
Hispanic (Pct)	10.21%	10.18%	9.61%	9.97%
White/Caucasian non-Hispanic (N)	12,412	13,279	15,910	41,601
White/Caucasian non-Hispanic (Pct)	68.08%	67.76%	69.34%	68.45%
Multi-Racial non-Hispanic (N)	1,037	1,106	1,206	3,349
Multi-Racial non-Hispanic (Pct)	5.69%	5.64%	5.26%	5.51%
Asian non-Hispanic (N)	511	599	835	1,945
Asian non-Hispanic (Pct)	2.80%	3.06%	3.64%	3.20%
Native Hawaiian or Pacific Islander (N)	18	24	25	67
Native Hawaiian or Pacific Islander (Pct)	0.10%	0.12%	0.11%	0.11%
IEP (N)	2,034	2,313	2,843	7,190
IEP (Pct)	11.16%	11.80%	12.39%	11.83%
Migrant student (N)	126	93	112	331
Migrant student (Pct)	0.69%	0.47%	0.49%	0.54%
Economically disadvantaged (N)	4,771	5,147	5,851	15,769
Economically disadvantaged (Pct)	26.17%	26.26%	25.50%	25.95%
Number of students	18,231	19,597	22,946	60,774

**Table 15–5. Demographic Characteristics of Students Taking CDT Math Grades 6–HS**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	14,239	16,320	14,182	173	46	39	17	45,016
Female (Pct)	49.26%	49.25%	47.96%	35.67%	29.30%	31.71%	48.57%	48.71%
Male (N)	14,665	16,819	15,389	312	111	84	18	47,398
Male (Pct)	50.74%	50.75%	52.04%	64.33%	70.70%	68.29%	51.43%	51.29%
American Indian or Alaskan Native (N)	57	232	190	1	1	4	5	490
American Indian or Alaskan Native (Pct)	0.20%	0.70%	0.64%	0.21%	0.64%	3.25%	14.29%	0.53%
Black/African American non-Hispanic (N)	2,938	3,293	3,077	123	33	57	6	9,527
Black/African American non-Hispanic (Pct)	10.16%	9.94%	10.41%	25.36%	21.02%	46.34%	17.14%	10.31%
Hispanic (N)	2,795	3,398	3,187	34	16	7	4	9,441
Hispanic (Pct)	9.67%	10.25%	10.78%	7.01%	10.19%	5.69%	11.43%	10.22%
White/Caucasian non-Hispanic (N)	20,517	23,553	20,761	278	92	45	19	65,265
White/Caucasian non-Hispanic (Pct)	70.98%	71.07%	70.21%	57.32%	58.60%	36.59%	54.29%	70.62%
Multi-Racial non-Hispanic (N)	1,430	1,648	1,493	43	13	7	0	4,634
Multi-Racial non-Hispanic (Pct)	4.95%	4.97%	5.05%	8.87%	8.28%	5.69%	0.00%	5.01%
Asian non-Hispanic (N)	1,135	987	820	2	2	3	1	2,950
Asian non-Hispanic (Pct)	3.93%	2.98%	2.77%	0.41%	1.27%	2.44%	2.86%	3.19%
Native Hawaiian or Pacific Islander (N)	32	28	43	4	0	0	0	107
Native Hawaiian or Pacific Islander (Pct)	0.11%	0.08%	0.15%	0.82%	0.00%	0.00%	0.00%	0.12%
IEP (N)	3,011	3,413	3,320	130	55	43	22	9,994
IEP (Pct)	10.42%	10.30%	11.23%	26.80%	35.03%	34.96%	62.86%	10.81%
Migrant student (N)	141	158	318	1	1	0	0	619
Migrant student (Pct)	0.49%	0.48%	1.08%	0.21%	0.64%	0.00%	0.00%	0.67%
Economically disadvantaged (N)	6,389	7,522	6,916	121	48	20	14	21,030
Economically disadvantaged (Pct)	22.10%	22.70%	23.39%	24.95%	30.57%	16.26%	40.00%	22.76%
Number of students	28,904	33,139	29,571	485	157	123	35	92,414

**Table 15–6. Demographic Characteristics of Students Taking CDT Algebra I**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	34	670	3,414	14,745	6,067	2,150	431	27,511
Female (Pct)	41.46%	44.14%	49.31%	48.38%	45.66%	44.57%	45.32%	47.38%
Male (N)	48	848	3,509	15,732	7,219	2,674	520	30,550
Male (Pct)	58.54%	55.86%	50.69%	51.62%	54.34%	55.43%	54.68%	52.62%
American Indian or Alaskan Native (N)	0	1	27	154	104	22	5	313
American Indian or Alaskan Native (Pct)	0.00%	0.07%	0.39%	0.51%	0.78%	0.46%	0.53%	0.54%
Black/African American non-Hispanic (N)	3	72	373	3,925	2,231	846	163	7,613
Black/African American non-Hispanic (Pct)	3.66%	4.74%	5.39%	12.88%	16.79%	17.54%	17.14%	13.11%
Hispanic (N)	3	109	562	4,639	2,206	972	214	8,705
Hispanic (Pct)	3.66%	7.18%	8.12%	15.22%	16.60%	20.15%	22.50%	14.99%
White/Caucasian non-Hispanic (N)	57	1,160	5,412	19,313	7,755	2,632	498	36,827
White/Caucasian non-Hispanic (Pct)	69.51%	76.42%	78.17%	63.37%	58.37%	54.56%	52.37%	63.43%
Multi-Racial non-Hispanic (N)	4	60	238	1,632	718	243	47	2,942
Multi-Racial non-Hispanic (Pct)	4.88%	3.95%	3.44%	5.35%	5.40%	5.04%	4.94%	5.07%
Asian non-Hispanic (N)	15	115	301	779	262	100	23	1,595
Asian non-Hispanic (Pct)	18.29%	7.58%	4.35%	2.56%	1.97%	2.07%	2.42%	2.75%
Native Hawaiian or Pacific Islander (N)	0	1	10	35	10	9	1	66
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.07%	0.14%	0.11%	0.08%	0.19%	0.11%	0.11%
IEP (N)	1	66	210	3,248	2,202	910	209	6,846
IEP (Pct)	1.22%	4.35%	3.03%	10.66%	16.57%	18.86%	21.98%	11.79%
Migrant student (N)	0	25	35	86	69	46	2	263
Migrant student (Pct)	0.00%	1.65%	0.51%	0.28%	0.52%	0.95%	0.21%	0.45%
Economically disadvantaged (N)	0	167	920	8,249	4,130	1,668	351	15,485
Economically disadvantaged (Pct)	0.00%	11.00%	13.29%	27.07%	31.09%	34.58%	36.91%	26.67%
Number of students	82	1,518	6,923	30,477	13,286	4,824	951	58,061



**Table 15–7. Demographic Characteristics of Students Taking CDT Geometry**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	1	2	61	375	990	538	71	2,038
Female (Pct)	100.00%	15.38%	42.07%	48.39%	52.52%	47.65%	39.89%	49.39%
Male (N)	0	11	84	400	895	591	107	2,088
Male (Pct)	0.00%	84.62%	57.93%	51.61%	47.48%	52.35%	60.11%	50.61%
American Indian or Alaskan Native (N)	0	0	0	0	26	63	2	91
American Indian or Alaskan Native (Pct)	0.00%	0.00%	0.00%	0.00%	1.38%	5.58%	1.12%	2.21%
Black/African American non-Hispanic (N)	0	0	10	115	291	157	40	613
Black/African American non-Hispanic (Pct)	0.00%	0.00%	6.90%	14.84%	15.44%	13.91%	22.47%	14.86%
Hispanic (N)	0	0	2	57	145	187	56	447
Hispanic (Pct)	0.00%	0.00%	1.38%	7.35%	7.69%	16.56%	31.46%	10.83%
White/Caucasian non-Hispanic (N)	1	4	108	511	1,235	645	72	2,576
White/Caucasian non-Hispanic (Pct)	100.00%	30.77%	74.48%	65.94%	65.52%	57.13%	40.45%	62.43%
Multi-Racial non-Hispanic (N)	0	1	11	37	113	52	6	220
Multi-Racial non-Hispanic (Pct)	0.00%	7.69%	7.59%	4.77%	5.99%	4.61%	3.37%	5.33%
Asian non-Hispanic (N)	0	8	13	53	74	24	2	174
Asian non-Hispanic (Pct)	0.00%	61.54%	8.97%	6.84%	3.93%	2.13%	1.12%	4.22%
Native Hawaiian or Pacific Islander (N)	0	0	1	2	1	1	0	5
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.00%	0.69%	0.26%	0.05%	0.09%	0.00%	0.12%
IEP (N)	0	0	2	42	190	125	34	393
IEP (Pct)	0.00%	0.00%	1.38%	5.42%	10.08%	11.07%	19.10%	9.52%
Migrant student (N)	0	0	0	11	0	0	0	11
Migrant student (Pct)	0.00%	0.00%	0.00%	1.42%	0.00%	0.00%	0.00%	0.27%
Economically disadvantaged (N)	0	0	15	216	544	293	86	1,154
Economically disadvantaged (Pct)	0.00%	0.00%	10.34%	27.87%	28.86%	25.95%	48.31%	27.97%
Number of students	1	13	145	775	1,885	1,129	178	4,126

**Table 15–8. Demographic Characteristics of Students Taking CDT Algebra II**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	0	4	28	717	1,144	862	191	2,946
Female (Pct)	0.00%	30.77%	36.36%	52.49%	49.85%	49.29%	50.13%	50.09%
Male (N)	1	9	49	649	1,151	887	190	2,936
Male (Pct)	100.00%	69.23%	63.64%	47.51%	50.15%	50.71%	49.87%	49.91%
American Indian or Alaskan Native (N)	0	0	0	5	17	11	2	35
American Indian or Alaskan Native (Pct)	0.00%	0.00%	0.00%	0.37%	0.74%	0.63%	0.52%	0.60%
Black/African American non-Hispanic (N)	0	0	0	80	269	337	101	787
Black/African American non-Hispanic (Pct)	0.00%	0.00%	0.00%	5.86%	11.72%	19.27%	26.51%	13.38%
Hispanic (N)	0	0	2	103	353	278	114	850
Hispanic (Pct)	0.00%	0.00%	2.60%	7.54%	15.38%	15.89%	29.92%	14.45%
White/Caucasian non-Hispanic (N)	0	5	57	1,019	1,410	965	133	3,589
White/Caucasian non-Hispanic (Pct)	0.00%	38.46%	74.03%	74.60%	61.44%	55.17%	34.91%	61.02%
Multi-Racial non-Hispanic (N)	0	1	3	39	98	87	22	250
Multi-Racial non-Hispanic (Pct)	0.00%	7.69%	3.90%	2.86%	4.27%	4.97%	5.77%	4.25%
Asian non-Hispanic (N)	1	7	15	117	145	68	9	362
Asian non-Hispanic (Pct)	100.00%	53.85%	19.48%	8.57%	6.32%	3.89%	2.36%	6.15%
Native Hawaiian or Pacific Islander (N)	0	0	0	3	3	3	0	9
Native Hawaiian or Pacific Islander (Pct)	0.00%	0.00%	0.00%	0.22%	0.13%	0.17%	0.00%	0.15%
IEP (N)	0	0	1	22	106	131	36	296
IEP (Pct)	0.00%	0.00%	1.30%	1.61%	4.62%	7.49%	9.45%	5.03%
Migrant student (N)	0	0	0	1	20	16	9	46
Migrant student (Pct)	0.00%	0.00%	0.00%	0.07%	0.87%	0.91%	2.36%	0.78%
Economically disadvantaged (N)	0	0	2	226	617	585	128	1,558
Economically disadvantaged (Pct)	0.00%	0.00%	2.60%	16.54%	26.88%	33.45%	33.60%	26.49%
Number of students	1	13	77	1,366	2,295	1,749	381	5,882

**Table 15–9. Demographic Characteristics of Students Taking CDT Reading Grades 3–5**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 3</b>	<b>Gr. 4</b>	<b>Gr. 5</b>	<b>Total</b>
Female (N)	7,659	8,094	9,285	25,038
Female (Pct)	49.54%	48.93%	49.37%	49.28%
Male (N)	7,802	8,447	9,522	25,771
Male (Pct)	50.46%	51.07%	50.63%	50.72%
American Indian or Alaskan Native (N)	37	31	36	104
American Indian or Alaskan Native (Pct)	0.24%	0.19%	0.19%	0.20%
Black/African American non-Hispanic (N)	2,116	2,316	2,415	6,847
Black/African American non-Hispanic (Pct)	13.69%	14.00%	12.84%	13.48%
Hispanic (N)	1,795	1,917	2,144	5,856
Hispanic (Pct)	11.61%	11.59%	11.40%	11.53%
White/Caucasian non-Hispanic (N)	10,187	10,816	12,629	33,632
White/Caucasian non-Hispanic (Pct)	65.89%	65.39%	67.15%	66.19%
Multi-Racial non-Hispanic (N)	943	988	1,022	2,953
Multi-Racial non-Hispanic (Pct)	6.10%	5.97%	5.43%	5.81%
Asian non-Hispanic (N)	369	451	546	1,366
Asian non-Hispanic (Pct)	2.39%	2.73%	2.90%	2.69%
Native Hawaiian or Pacific Islander (N)	14	22	15	51
Native Hawaiian or Pacific Islander (Pct)	0.09%	0.13%	0.08%	0.10%
IEP (N)	1,717	1,931	2,313	5,961
IEP (Pct)	11.11%	11.67%	12.30%	11.73%
Migrant student (N)	69	54	68	191
Migrant student (Pct)	0.45%	0.33%	0.36%	0.38%
Economically disadvantaged (N)	4,325	4,579	5,338	14,242
Economically disadvantaged (Pct)	27.97%	27.68%	28.38%	28.03%
Number of students	15,461	16,541	18,807	50,809

**Table 15–10. Demographic Characteristics of Students Taking CDT Reading/Lit Grades 6–HS**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	11,560	13,471	13,142	12,256	19,631	2,784	670	73,514
Female (Pct)	49.17%	49.37%	47.75%	48.54%	48.87%	43.34%	42.16%	48.44%
Male (N)	11,949	13,816	14,383	12,995	20,539	3,639	919	78,240
Male (Pct)	50.83%	50.63%	52.25%	51.46%	51.13%	56.66%	57.84%	51.56%
American Indian or Alaskan Native (N)	48	159	128	138	189	93	41	796
American Indian or Alaskan Native (Pct)	0.20%	0.58%	0.47%	0.55%	0.47%	1.45%	2.58%	0.52%
Black/African American non-Hispanic (N)	2,471	2,788	2,754	3,049	3,963	1,264	361	16,650
Black/African American non-Hispanic (Pct)	10.51%	10.22%	10.01%	12.07%	9.87%	19.68%	22.72%	10.97%
Hispanic (N)	2,172	2,748	2,832	3,099	4,598	919	163	16,531
Hispanic (Pct)	9.24%	10.07%	10.29%	12.27%	11.45%	14.31%	10.26%	10.89%
White/Caucasian non-Hispanic (N)	16,688	19,359	19,498	16,538	28,108	3,676	933	104,800
White/Caucasian non-Hispanic (Pct)	70.99%	70.95%	70.84%	65.49%	69.97%	57.23%	58.72%	69.06%
Multi-Racial non-Hispanic (N)	1,203	1,343	1,395	1,409	1,871	347	75	7,643
Multi-Racial non-Hispanic (Pct)	5.12%	4.92%	5.07%	5.58%	4.66%	5.40%	4.72%	5.04%
Asian non-Hispanic (N)	903	868	877	994	1,393	116	16	5,167
Asian non-Hispanic (Pct)	3.84%	3.18%	3.19%	3.94%	3.47%	1.81%	1.01%	3.40%
Native Hawaiian or Pacific Islander (N)	24	22	41	24	48	8	0	167
Native Hawaiian or Pacific Islander (Pct)	0.10%	0.08%	0.15%	0.10%	0.12%	0.12%	0.00%	0.11%
IEP (N)	2,649	3,148	3,163	2,572	3,948	971	376	16,827
IEP (Pct)	11.27%	11.54%	11.49%	10.19%	9.83%	15.12%	23.66%	11.09%
Migrant student (N)	42	134	97	59	274	73	11	690
Migrant student (Pct)	0.18%	0.49%	0.35%	0.23%	0.68%	1.14%	0.69%	0.45%
Economically disadvantaged (N)	5,795	6,904	6,651	6,122	8,746	1,936	475	36,629
Economically disadvantaged (Pct)	24.65%	25.30%	24.16%	24.24%	21.77%	30.14%	29.89%	24.14%
Number of students	23,509	27,287	27,525	25,251	40,170	6,423	1,589	151,754

**Table 15–11. Demographic Characteristics of Students Taking CDT Science Grades 3–5**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 3</b>	<b>Gr. 4</b>	<b>Gr. 5</b>	<b>Total</b>
Female (N)	1,329	7,324	3,112	11,765
Female (Pct)	49.50%	49.32%	48.08%	49.00%
Male (N)	1,356	7,527	3,360	12,243
Male (Pct)	50.50%	50.68%	51.92%	51.00%
American Indian or Alaskan Native (N)	12	25	17	54
American Indian or Alaskan Native (Pct)	0.45%	0.17%	0.26%	0.22%
Black/African American non-Hispanic (N)	660	2,704	1,252	4,616
Black/African American non-Hispanic (Pct)	24.58%	18.21%	19.34%	19.23%
Hispanic (N)	197	2,379	1,272	3,848
Hispanic (Pct)	7.34%	16.02%	19.65%	16.03%
White/Caucasian non-Hispanic (N)	1,543	8,436	3,373	13,352
White/Caucasian non-Hispanic (Pct)	57.47%	56.80%	52.12%	55.61%
Multi-Racial non-Hispanic (N)	200	905	368	1,473
Multi-Racial non-Hispanic (Pct)	7.45%	6.09%	5.69%	6.14%
Asian non-Hispanic (N)	70	387	183	640
Asian non-Hispanic (Pct)	2.61%	2.61%	2.83%	2.67%
Native Hawaiian or Pacific Islander (N)	3	15	7	25
Native Hawaiian or Pacific Islander (Pct)	0.11%	0.10%	0.11%	0.10%
IEP (N)	320	1,885	1,033	3,238
IEP (Pct)	11.92%	12.69%	15.96%	13.49%
Migrant student (N)	1	5	0	6
Migrant student (Pct)	0.04%	0.03%	0.00%	0.02%
Economically disadvantaged (N)	864	5,206	3,148	9,218
Economically disadvantaged (Pct)	32.18%	35.05%	48.64%	38.40%
Number of students	2,685	14,851	6,472	24,008

**Table 15–12. Demographic Characteristics of Students Taking CDT Science Grades 6–HS**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	8,056	12,710	17,375	997	57	64	100	39,359
Female (Pct)	48.97%	49.23%	48.21%	42.90%	24.15%	36.57%	45.05%	48.43%
Male (N)	8,394	13,106	18,666	1,327	179	111	122	41,905
Male (Pct)	51.03%	50.77%	51.79%	57.10%	75.85%	63.43%	54.95%	51.57%
American Indian or Alaskan Native (N)	37	202	194	62	8	0	0	503
American Indian or Alaskan Native (Pct)	0.22%	0.78%	0.54%	2.67%	3.39%	0.00%	0.00%	0.62%
Black/African American non-Hispanic (N)	2,503	3,371	4,019	317	36	41	66	10,353
Black/African American non-Hispanic (Pct)	15.22%	13.06%	11.15%	13.64%	15.25%	23.43%	29.73%	12.74%
Hispanic (N)	2,118	3,205	4,430	739	40	39	50	10,621
Hispanic (Pct)	12.88%	12.41%	12.29%	31.80%	16.95%	22.29%	22.52%	13.07%
White/Caucasian non-Hispanic (N)	10,195	16,647	24,389	1,035	129	84	84	52,563
White/Caucasian non-Hispanic (Pct)	61.98%	64.48%	67.67%	44.54%	54.66%	48.00%	37.84%	64.68%
Multi-Racial non-Hispanic (N)	1,013	1,433	1,819	119	21	10	19	4,434
Multi-Racial non-Hispanic (Pct)	6.16%	5.55%	5.05%	5.12%	8.90%	5.71%	8.56%	5.46%
Asian non-Hispanic (N)	561	931	1,142	48	2	1	3	2,688
Asian non-Hispanic (Pct)	3.41%	3.61%	3.17%	2.07%	0.85%	0.57%	1.35%	3.31%
Native Hawaiian or Pacific Islander (N)	23	27	48	4	0	0	0	102
Native Hawaiian or Pacific Islander (Pct)	0.14%	0.10%	0.13%	0.17%	0.00%	0.00%	0.00%	0.13%
IEP (N)	2,029	2,862	4,033	405	66	50	32	9,477
IEP (Pct)	12.33%	11.09%	11.19%	17.43%	27.97%	28.57%	14.41%	11.66%
Migrant student (N)	11	63	73	0	0	0	0	147
Migrant student (Pct)	0.07%	0.24%	0.20%	0.00%	0.00%	0.00%	0.00%	0.18%
Economically disadvantaged (N)	5,320	7,479	9,604	946	64	12	32	23,457
Economically disadvantaged (Pct)	32.34%	28.97%	26.65%	40.71%	27.12%	6.86%	14.41%	28.87%
Number of students	16,450	25,816	36,041	2,324	236	175	222	81,264

**Table 15–13. Demographic Characteristics of Students Taking CDT Biology**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	0	81	160	13,151	14,205	1,932	348	29,877
Female (Pct)	N/A	53.29%	50.00%	49.85%	47.93%	45.86%	45.91%	48.61%
Male (N)	0	71	160	13,229	15,430	2,281	410	31,581
Male (Pct)	N/A	46.71%	50.00%	50.15%	52.07%	54.14%	54.09%	51.39%
American Indian or Alaskan Native (N)	0	0	0	99	152	14	0	265
American Indian or Alaskan Native (Pct)	N/A	0.00%	0.00%	0.38%	0.51%	0.33%	0.00%	0.43%
Black/African American non-Hispanic (N)	0	2	50	2,683	3,264	533	155	6,687
Black/African American non-Hispanic (Pct)	N/A	1.32%	15.63%	10.17%	11.01%	12.65%	20.45%	10.88%
Hispanic (N)	0	5	7	2,663	4,469	1,225	234	8,603
Hispanic (Pct)	N/A	3.29%	2.19%	10.09%	15.08%	29.08%	30.87%	14.00%
White/Caucasian non-Hispanic (N)	0	129	248	18,588	19,363	2,107	315	40,750
White/Caucasian non-Hispanic (Pct)	N/A	84.87%	77.50%	70.46%	65.34%	50.01%	41.56%	66.31%
Multi-Racial non-Hispanic (N)	0	12	10	1,262	1,362	205	33	2,884
Multi-Racial non-Hispanic (Pct)	N/A	7.89%	3.13%	4.78%	4.60%	4.87%	4.35%	4.69%
Asian non-Hispanic (N)	0	4	5	1,067	1,003	123	19	2,221
Asian non-Hispanic (Pct)	N/A	2.63%	1.56%	4.04%	3.38%	2.92%	2.51%	3.61%
Native Hawaiian or Pacific Islander (N)	0	0	0	18	22	6	2	48
Native Hawaiian or Pacific Islander (Pct)	N/A	0.00%	0.00%	0.07%	0.07%	0.14%	0.26%	0.08%
IEP (N)	0	20	25	2,074	3,644	626	135	6,524
IEP (Pct)	N/A	13.16%	7.81%	7.86%	12.30%	14.86%	17.81%	10.62%
Migrant student (N)	0	0	3	151	112	63	10	339
Migrant student (Pct)	N/A	0.00%	0.94%	0.57%	0.38%	1.50%	1.32%	0.55%
Economically disadvantaged (N)	0	65	69	5,985	7,926	1,434	338	15,817
Economically disadvantaged (Pct)	N/A	42.76%	21.56%	22.69%	26.75%	34.04%	44.59%	25.74%
Number of students	0	152	320	26,380	29,635	4,213	758	61,458

**Table 15–14. Demographic Characteristics of Students Taking CDT Chemistry**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	0	0	4	147	698	687	101	1,637
Female (Pct)	N/A	N/A	50.00%	49.49%	56.66%	49.75%	53.72%	52.70%
Male (N)	0	0	4	150	534	694	87	1,469
Male (Pct)	N/A	N/A	50.00%	50.51%	43.34%	50.25%	46.28%	47.30%
American Indian or Alaskan Native (N)	0	0	0	2	13	55	1	71
American Indian or Alaskan Native (Pct)	N/A	N/A	0.00%	0.67%	1.06%	3.98%	0.53%	2.29%
Black/African American non-Hispanic (N)	0	0	0	18	80	246	20	364
Black/African American non-Hispanic (Pct)	N/A	N/A	0.00%	6.06%	6.49%	17.81%	10.64%	11.72%
Hispanic (N)	0	0	0	18	155	221	56	450
Hispanic (Pct)	N/A	N/A	0.00%	6.06%	12.58%	16.00%	29.79%	14.49%
White/Caucasian non-Hispanic (N)	0	0	8	235	896	765	96	2,000
White/Caucasian non-Hispanic (Pct)	N/A	N/A	100.00%	79.12%	72.73%	55.39%	51.06%	64.39%
Multi-Racial non-Hispanic (N)	0	0	0	6	47	70	13	136
Multi-Racial non-Hispanic (Pct)	N/A	N/A	0.00%	2.02%	3.81%	5.07%	6.91%	4.38%
Asian non-Hispanic (N)	0	0	0	18	40	24	2	84
Asian non-Hispanic (Pct)	N/A	N/A	0.00%	6.06%	3.25%	1.74%	1.06%	2.70%
Native Hawaiian or Pacific Islander (N)	0	0	0	0	1	0	0	1
Native Hawaiian or Pacific Islander (Pct)	N/A	N/A	0.00%	0.00%	0.08%	0.00%	0.00%	0.03%
IEP (N)	0	0	4	26	33	108	26	197
IEP (Pct)	N/A	N/A	50.00%	8.75%	2.68%	7.82%	13.83%	6.34%
Migrant student (N)	0	0	0	0	0	0	0	0
Migrant student (Pct)	N/A	N/A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	0	0	0	100	225	307	58	690
Economically disadvantaged (Pct)	N/A	N/A	0.00%	33.67%	18.26%	22.23%	30.85%	22.22%
Number of students	0	0	8	297	1,232	1,381	188	3,106



**Table 15–15. Demographic Characteristics of Students Taking CDT Writing Grades 3–5**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 3</b>	<b>Gr. 4</b>	<b>Gr. 5</b>	<b>Total</b>
Female (N)	1,546	1,771	2,090	5,407
Female (Pct)	49.58%	49.17%	49.32%	49.34%
Male (N)	1,572	1,831	2,148	5,551
Male (Pct)	50.42%	50.83%	50.68%	50.66%
American Indian or Alaskan Native (N)	4	6	4	14
American Indian or Alaskan Native (Pct)	0.13%	0.17%	0.09%	0.13%
Black/African American non-Hispanic (N)	492	546	593	1,631
Black/African American non-Hispanic (Pct)	15.78%	15.16%	13.99%	14.88%
Hispanic (N)	529	505	561	1,595
Hispanic (Pct)	16.97%	14.02%	13.24%	14.56%
White/Caucasian non-Hispanic (N)	1,809	2,253	2,757	6,819
White/Caucasian non-Hispanic (Pct)	58.02%	62.55%	65.05%	62.23%
Multi-Racial non-Hispanic (N)	227	218	236	681
Multi-Racial non-Hispanic (Pct)	7.28%	6.05%	5.57%	6.21%
Asian non-Hispanic (N)	53	71	80	204
Asian non-Hispanic (Pct)	1.70%	1.97%	1.89%	1.86%
Native Hawaiian or Pacific Islander (N)	4	3	7	14
Native Hawaiian or Pacific Islander (Pct)	0.13%	0.08%	0.17%	0.13%
IEP (N)	314	456	476	1,246
IEP (Pct)	10.07%	12.66%	11.23%	11.37%
Migrant student (N)	0	0	0	0
Migrant student (Pct)	0.00%	0.00%	0.00%	0.00%
Economically disadvantaged (N)	638	935	987	2,560
Economically disadvantaged (Pct)	20.46%	25.96%	23.29%	23.36%
Number of students	3,118	3,602	4,238	10,958

**Table 15–16. Demographic Characteristics of Students Taking CDT Writing/Eng Comp Grades 6–HS**

<b>Demographic or Educational Characteristic</b>	<b>Gr. 6</b>	<b>Gr. 7</b>	<b>Gr. 8</b>	<b>Gr. 9</b>	<b>Gr. 10</b>	<b>Gr. 11</b>	<b>Gr. 12</b>	<b>Total</b>
Female (N)	2,747	4,276	3,613	1,295	1,286	520	130	13,867
Female (Pct)	49.09%	49.56%	47.89%	50.76%	48.62%	45.65%	56.77%	48.94%
Male (N)	2,849	4,352	3,932	1,256	1,359	619	99	14,466
Male (Pct)	50.91%	50.44%	52.11%	49.24%	51.38%	54.35%	43.23%	51.06%
American Indian or Alaskan Native (N)	8	13	9	5	2	2	0	39
American Indian or Alaskan Native (Pct)	0.14%	0.15%	0.12%	0.20%	0.08%	0.18%	0.00%	0.14%
Black/African American non-Hispanic (N)	656	812	756	278	230	211	51	2,994
Black/African American non-Hispanic (Pct)	11.72%	9.41%	10.02%	10.90%	8.70%	18.53%	22.27%	10.57%
Hispanic (N)	636	824	843	286	277	205	35	3,106
Hispanic (Pct)	11.37%	9.55%	11.17%	11.21%	10.47%	18.00%	15.28%	10.96%
White/Caucasian non-Hispanic (N)	3,921	6,378	5,386	1,786	1,991	665	126	20,253
White/Caucasian non-Hispanic (Pct)	70.07%	73.92%	71.39%	70.01%	75.27%	58.38%	55.02%	71.48%
Multi-Racial non-Hispanic (N)	252	387	372	157	119	48	16	1,351
Multi-Racial non-Hispanic (Pct)	4.50%	4.49%	4.93%	6.15%	4.50%	4.21%	6.99%	4.77%
Asian non-Hispanic (N)	120	200	172	39	23	5	1	560
Asian non-Hispanic (Pct)	2.14%	2.32%	2.28%	1.53%	0.87%	0.44%	0.44%	1.98%
Native Hawaiian or Pacific Islander (N)	3	14	7	0	3	3	0	30
Native Hawaiian or Pacific Islander (Pct)	0.05%	0.16%	0.09%	0.00%	0.11%	0.26%	0.00%	0.11%
IEP (N)	555	761	693	238	313	144	61	2,765
IEP (Pct)	9.92%	8.82%	9.18%	9.33%	11.83%	12.64%	26.64%	9.76%
Migrant student (N)	2	30	25	0	0	33	0	90
Migrant student (Pct)	0.04%	0.35%	0.33%	0.00%	0.00%	2.90%	0.00%	0.32%
Economically disadvantaged (N)	1,311	1,701	1,759	341	583	190	41	5,926
Economically disadvantaged (Pct)	23.43%	19.71%	23.31%	13.37%	22.04%	16.68%	17.90%	20.92%
Number of students	5,596	8,628	7,545	2,551	2,645	1,139	229	28,333

## SUMMARY STATISTICS—TEST LENGTH

The analyses from here until the section titled “Multiple Administrations of the Same CDT Test” include all records in the full CDT operational assessments. When a student took CDT Math Grades 6–HS twice, for example, both records were used in the analyses.

As noted in Chapter Thirteen, full CDT tests have either four or five diagnostic categories. On tests with five diagnostic categories (Reading Grades 3–5, Reading/Lit Grades 6–HS, Writing Grades 3–5, and Writing/Eng Comp Grades 6–HS), students take between 10 and 12 operational items per diagnostic category for a total test of 50 to 60 operational items. On tests with four diagnostic categories (Math Grades 3–5, Math Grades 6–HS, Algebra I, Geometry, Algebra II, Science Grades 3–5, Science Grades 6–HS, Biology, and Chemistry), students take between 12 and 15 operational items per diagnostic category for a total test of 48 to 60 operational items.

Tables 15–17a and 15–17b show the summary statistics for the test length for each assessment. Summary statistics are based on the number of operational items presented to the student and include minimum, maximum, quartiles 1 and 3, mean, and median.

**Table 15–17a. Summary Statistics for Full CDT Test Length (Number of Operational Items Administered)**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	131,214	48	50	51	51.55	53	60
Math Grades 6–HS	184,666	48	50	52	52.05	54	60
Algebra I	105,847	48	50	52	52.90	55	60
Geometry	8,487	48	51	53	53.06	55	60
Algebra II	11,778	48	51	53	53.14	55	60
Reading Grades 3–5	110,949	50	54	55	55.25	57	60
Reading/Lit Grades 6–HS	284,329	50	54	55	55.23	57	60
Science Grades 3–5	47,334	48	50	51	51.42	53	60
Science Grades 6–HS	137,935	48	50	52	52.37	54	60
Biology	110,847	48	50	52	52.71	55	60
Chemistry	5,273	48	51	53	53.14	56	60
Writing Grades 3–5	18,661	50	53	55	54.75	56	60
Writing/Eng Comp Gr 6–HS	43,026	50	54	56	55.72	57	60

The minimum number of operational items was quite similar, ranging from 48 to 50. The mean and median were higher for tests in the reading and writing content areas, which have five diagnostic categories. The maximum number of operational items administered was fixed at 60 for all CDT tests.

**Table 15–17b. Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	Numbers and Operations	7,494	15	15	16	16.23	17	18
Math Grades 3–5	Algebraic Concepts	2,860	15	15	16	16.34	18	18
Math Grades 3–5	Geometry	1,561	15	15	16	16.50	18	18
Math Grades 3–5	Measurement, Data, and Probability	2,460	15	15	16	16.23	17	18
Math Grades 6–HS	Numbers and Operations	12,321	15	15	16	16.26	17	18
Math Grades 6–HS	Algebraic Concepts	11,229	15	15	16	16.31	17	18
Math Grades 6–HS	Geometry	4,852	15	15	16	16.31	17	18
Math Grades 6–HS	Measurement, Data, and Probability	2,977	15	15	16	16.26	17	18
Algebra I	Operations with Real Numbers and Expressions	4,738	15	16	16	16.57	18	18
Algebra I	Linear Equations & Inequalities	6,985	15	15	16	16.43	18	18
Algebra I	Functions & Coordinate Geometry	4,054	15	16	16	16.48	18	18
Algebra I	Data Analysis	1,799	15	16	16	16.55	18	18
Geometry	Geometric Properties	65	15	16	17	17.08	18	18
Geometry	Congruence, Similarity, and Proofs	246	15	16	16	16.59	18	18
Geometry	Coordinate Geometry and Right Triangles	139	15	16	17	16.72	18	18
Geometry	Measurement	236	15	16	17	16.76	18	18
Algebra II	Operations with Complex Numbers	271	15	16	16	16.66	18	18
Algebra II	Non-Linear Expressions & Equations	55	15	16	16	16.49	18	18
Algebra II	Functions	137	15	16	16	16.53	18	18
Algebra II	Data Analysis	218	15	16	17	16.69	18	18

**Table 15–17b (continued). Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Reading Grades 3–5	Informational Text	5,026	30	32	33	32.79	34	36
Reading Grades 3–5	Literature Text	3,191	30	32	33	32.80	34	36
Reading/Lit Grades 6–HS	Informational Text	13,914	30	32	32	32.60	34	36
Reading/Lit Grades 6–HS	Literature Text	15,811	30	32	33	32.90	34	36
Science Grades 3–5	The Nature of Science	3,735	15	15	16	16.19	17	18
Science Grades 3–5	Biological Sciences	1,971	15	15	16	16.16	17	18
Science Grades 3–5	Physical Sciences	1,744	15	15	16	16.27	17	18
Science Grades 3–5	Earth and Space Sciences	1,614	15	15	16	16.04	17	18
Science Grades 6–HS	The Nature of Science	13,322	15	15	16	16.20	17	18
Science Grades 6–HS	Biological Sciences	7,530	15	15	16	16.26	17	18
Science Grades 6–HS	Physical Sciences	8,202	15	15	16	16.37	17	18
Science Grades 6–HS	Earth and Space Sciences	6,902	15	15	16	16.21	17	18
Biology	Basic Biological Principles/ Chemical Basis for Life	8,171	15	15	16	16.46	18	18
Biology	Bioenergetics/ Homeostasis and Transport	5,853	15	15	16	16.44	18	18
Biology	Cell Growth and Reproduction/ Genetics	3,379	15	15	16	16.49	18	18
Biology	Theory of Evolution/ Ecology	2,884	15	15	16	16.31	17	18
Chemistry	Properties and Classification of Matter	330	15	16	17	16.95	18	18
Chemistry	Atomic Structure and The Periodic Table	614	15	16	17	16.90	18	18

**Table 15–17b (continued). Summary Statistics for Diagnostic Category CDT Test Length (Number of Operational Items Administered)**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Chemistry	The Mole and Chemical Bonding	390	15	16	16	16.51	18	18
Chemistry	Chemical Relationships and Reactions	265	15	16	17	16.89	18	18
Writing Grades 3–5	Quality of Writing: Focus and Organization	164	15	15	16	16.17	17	18
Writing Grades 3–5	Quality of Writing: Content and Style	128	15	15	16	16.14	17	18
Writing Grades 3–5	Quality of Writing: Editing	268	15	15	16	16.37	18	18
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	2,635	15	15	16	16.34	18	18
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	3,416	15	15	16	16.41	18	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	483	15	15	16	16.55	18	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	1,246	15	15	16	16.46	18	18
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	497	15	15	16	16.14	17	18
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	4,939	15	16	16	16.58	18	18
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	5,524	15	15	16	16.47	18	18

All diagnostic category CDTs in the math, science and writing content areas focus on a single diagnostic category. Tests range from 15 to 18 operational items. Diagnostic category CDTs in the reading content area focus on a single text type with three diagnostic categories. Tests range from 30 to 36 operational items.

## SUMMARY STATISTICS—SCALE SCORES AND CONDITIONAL STANDARD ERRORS

Tables 15–18a and 15–18b show the summary statistics for the scale scores. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts. Tests that are course-specific are not broken down.

**Table 15–18a. Summary Statistics for Scale Score Based on Full CDT**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	39,689	200	586	701	691.56	801	1427
Math – G4	42,378	282	680	790	780.64	885	1634
Math – G5	49,147	209	741	851	838.15	945	1672
Math – G6	61,085	410	815	920	913.14	1016	1669
Math – G7	66,490	420	846	956	945.34	1052	1810
Math – G8	55,899	431	857	978	963.58	1075	1830
Math – HS	1,192	454	722	825	834.95	952	1220
Algebra I	105,847	412	862	992	972.00	1087	1814
Geometry	8,487	400	913	1035	1015.21	1129	1671
Algebra II	11,778	557	973	1094	1079.77	1192	1888
Reading – G3	33,621	284	570	664	689.18	795	1282
Reading – G4	36,314	323	621	750	757.94	881	1319
Reading – G5	41,014	342	693	829	827.32	953	1345
Reading – G6	49,798	431	760	886	878.72	993	1398
Reading – G7	57,221	389	762	898	889.81	1010	1494
Reading – G8	54,925	413	785	923	914.72	1038	1448
Literature	122,385	401	814	969	950.07	1080	1586
Science – G3	5,228	200	548	689	664.18	795	1110
Science – G4	29,725	200	594	742	714.00	842	1218
Science – G5	12,381	299	624	762	744.18	872	1190
Science – G6	27,416	339	687	810	799.17	909	1355
Science – G7	43,555	414	707	838	824.59	940	1396
Science – G8	63,573	420	730	866	848.57	966	1411
Science – HS	3,391	417	656	795	797.83	933	1331
Biology	110,847	400	809	934	922.95	1028	1549
Chemistry	5,273	555	882	962	955.07	1030	1433
Writing – G3	4,984	220	531	699	677.32	816	1149
Writing – G4	6,285	267	601	761	737.65	878	1289
Writing – G5	7,392	294	670	818	791.27	927	1276
Writing – G6	9,278	322	716	861	839.79	966	1276
Writing – G7	12,496	383	740	894	867.88	1003	1367
Writing – G8	11,506	412	720	880	858.76	997	1418
English Composition	9,746	200	770	943	903.92	1044	1405

**Table 15–18b. Summary Statistics for Scale Score Based on Diagnostic Category CDT**

CDT	Diagnostic Category	N	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	Numbers and Operations	2,353	200	544	658	655.00	765	1417
Math – G3	Algebraic Concepts	772	200	606	738	724.57	849	1177
Math – G3	Geometry	514	200	637	751	744.70	840	1366
Math – G3	Measurement, Data, and Probability	1,047	200	633	776	758.60	877	1317
Math – G4	Numbers and Operations	2,672	200	699	803	797.38	896	1627
Math – G4	Algebraic Concepts	1,315	200	724	829	825.00	940	1241
Math – G4	Geometry	673	331	684	765	774.23	862	1312
Math – G4	Measurement, Data, and Probability	576	305	777	868	853.72	955	1352
Math – G5	Numbers and Operations	2,469	317	749	853	850.53	963	1536
Math – G5	Algebraic Concepts	773	327	758	862	848.26	952	1603
Math – G5	Geometry	374	502	821	905	900.83	992	1335
Math – G5	Measurement, Data, and Probability	837	200	778	873	856.80	953	1498
Math – G6	Numbers and Operations	3,634	404	841	950	945.20	1063	1545
Math – G6	Algebraic Concepts	2,023	333	900	993	985.26	1088	1623
Math – G6	Geometry	1,259	357	883	972	963.81	1058	1415
Math – G6	Measurement, Data, and Probability	827	362	870	962	964.71	1060	1616
Math – G7	Numbers and Operations	4,969	200	881	993	977.46	1089	1717
Math – G7	Algebraic Concepts	4,061	200	893	996	978.62	1083	1823
Math – G7	Geometry	1,496	423	921	1019	1009.36	1104	1426
Math – G7	Measurement, Data, and Probability	1,102	407	906	1022	1005.74	1114	1438
Math – G8	Numbers and Operations	3,584	200	916	1036	1017.82	1136	1570
Math – G8	Algebraic Concepts	5,030	405	905	1014	1002.59	1100	1656



**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Math – G8	Geometry	2,095	499	922	1017	1011.63	1108	1467
Math – G8	Measurement, Data, and Probability	1,003	434	948	1035	1024.75	1110	1639
Math – HS	Numbers and Operations	134	507	795	880	888.66	1001	1276
Math – HS	Algebraic Concepts	115	541	837	913	903.76	1000	1135
Math – HS	Geometry	2	729	729	798	797.50	0	866
Math – HS	Measurement, Data, and Probability	45	639	819	932	910.98	993	1160
Algebra I	Operations with Real Numbers and Expressions	4,738	400	893	1039	1013.38	1152	1603
Algebra I	Linear Equations & Inequalities	6,985	434	915	1034	1023.06	1127	1799
Algebra I	Functions & Coordinate Geometry	4,054	459	944	1046	1038.66	1143	1812
Algebra I	Data Analysis	1,799	441	914	1038	1021.93	1145	1520
Geometry	Geometric Properties	65	645	814	923	912.88	979	1246
Geometry	Congruence, Similarity, and Proofs	246	400	970	1076	1072.07	1198	1548
Geometry	Coordinate Geometry and Right Triangles	139	585	902	1018	1003.48	1134	1305
Geometry	Measurement	236	455	903	992	988.45	1116	1324
Algebra II	Operations with Complex Numbers	271	720	996	1080	1100.82	1188	1678
Algebra II	Non-Linear Expressions & Equations	55	650	997	1087	1070.35	1196	1395
Algebra II	Functions	137	775	1037	1114	1112.72	1179	1398
Algebra II	Data Analysis	218	435	941	1090	1048.76	1181	1447
Reading – G3	Informational Text	1,692	269	604	725	727.90	836	1235
Reading – G3	Literature Text	1,024	250	568	658	667.78	763	1119

**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Reading – G4	Informational Text	1,759	361	690	819	806.73	925	1252
Reading – G4	Literature Text	1,119	307	660	791	785.69	910	1476
Reading – G5	Informational Text	1,575	378	765	892	874.34	989	1406
Reading – G5	Literature Text	1,048	407	672	797	804.07	930	1332
Reading – G6	Informational Text	1,673	469	815	923	907.50	1007	1368
Reading – G6	Literature Text	2,150	444	753	880	870.78	988	1393
Reading – G7	Informational Text	1,687	472	817	942	924.07	1042	1387
Reading – G7	Literature Text	1,609	443	719	854	852.18	980	1332
Reading – G8	Informational Text	2,223	466	844	976	951.43	1063	1435
Reading – G8	Literature Text	1,815	372	787	924	914.43	1040	1390
Literature	Informational Text	8,331	349	829	989	959.08	1089	1562
Literature	Literature Text	10,237	408	835	992	963.92	1095	1570
Science – G3	The Nature of Science	950	200	536	673	658.57	786	1128
Science – G3	Biological Sciences	286	278	648	742	732.77	830	1043
Science – G3	Physical Sciences	199	223	645	735	728.65	842	1155
Science – G3	Earth and Space Sciences	203	200	493	680	653.14	801	1018
Science – G4	The Nature of Science	1,352	200	698	803	788.69	898	1207
Science – G4	Biological Sciences	1,057	200	699	798	787.60	902	1204
Science – G4	Physical Sciences	1,269	253	749	835	819.54	912	1301
Science – G4	Earth and Space Sciences	768	311	713	809	795.92	892	1143
Science – G5	The Nature of Science	1,433	209	672	799	785.98	909	1254
Science – G5	Biological Sciences	628	239	694	824	800.99	916	1282
Science – G5	Physical Sciences	276	268	717	836	816.39	936	1129
Science – G5	Earth and Space Sciences	643	321	694	794	787.85	899	1146

**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Science – G6	The Nature of Science	4,169	200	737	863	841.29	960	1245
Science – G6	Biological Sciences	184	332	672	800	791.55	908	1186
Science – G6	Physical Sciences	1,414	200	739	850	835.38	932	1364
Science – G6	Earth and Space Sciences	3,091	350	782	878	864.40	955	1256
Science – G7	The Nature of Science	4,195	200	757	885	859.39	980	1288
Science – G7	Biological Sciences	5,957	200	778	897	879.18	993	1442
Science – G7	Physical Sciences	1,346	298	802	904	894.96	992	1271
Science – G7	Earth and Space Sciences	2,577	200	757	864	848.92	948	1221
Science – G8	The Nature of Science	4,704	200	822	940	912.31	1024	1482
Science – G8	Biological Sciences	1,114	200	784	925	901.17	1036	1381
Science – G8	Physical Sciences	3,785	200	826	924	910.39	1009	1354
Science – G8	Earth and Space Sciences	1,077	239	778	894	870.97	978	1280
Science – HS	The Nature of Science	254	200	676	856	832.02	983	1264
Science – HS	Biological Sciences	275	329	779	886	861.74	964	1189
Science – HS	Physical Sciences	1,657	200	679	807	796.99	925	1383
Science – HS	Earth and Space Sciences	157	460	751	878	860.44	974	1536
Biology	Basic Biological Principles/ Chemical Basis for Life	8,171	400	877	985	977.84	1086	1780
Biology	Bioenergetics/ Homeostasis and Transport	5,853	400	901	1007	1004.60	1108	1738
Biology	Cell Growth and Reproduction/ Genetics	3,379	400	912	1026	1017.63	1116	1751
Biology	Theory of Evolution/ Ecology	2,884	400	841	981	946.49	1070	1396

**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Chemistry	Properties and Classification of Matter	330	400	760	906	887.09	1008	1586
Chemistry	Atomic Structure and The Periodic Table	614	479	893	967	971.15	1042	1365
Chemistry	The Mole and Chemical Bonding	390	686	913	1002	999.08	1079	1343
Chemistry	Chemical Relationships and Reactions	265	427	857	949	951.74	1046	1337
Writing – G3	Quality of Writing: Focus and Organization	0	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G3	Quality of Writing: Content and Style	24	481	791	846	815.17	901	978
Writing – G3	Quality of Writing: Editing	170	288	586	750	719.86	853	1155
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	756	200	484	557	591.98	686	1186
Writing – G3	Conventions: Grammar and Sentence Formation	1,094	200	446	672	658.08	862	1291
Writing – G4	Quality of Writing: Focus and Organization	33	532	740	803	832.52	908	1165
Writing – G4	Quality of Writing: Content and Style	65	359	731	837	814.86	920	1053
Writing – G4	Quality of Writing: Editing	36	545	753	890	874.61	989	1108
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	879	200	528	654	669.31	803	1234
Writing – G4	Conventions: Grammar and Sentence Formation	1,011	200	532	761	722.27	915	1332

**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Writing – G5	Quality of Writing: Focus and Organization	131	200	704	876	838.11	965	1234
Writing – G5	Quality of Writing: Content and Style	39	519	665	835	801.62	894	1058
Writing – G5	Quality of Writing: Editing	62	200	710	870	847.55	972	1272
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	1,000	200	549	660	688.74	819	1239
Writing – G5	Conventions: Grammar and Sentence Formation	1,311	200	586	767	742.44	911	1224
Writing – G6	Quality of Writing: Focus and Organization	0	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G6	Quality of Writing: Content and Style	93	496	787	897	902.12	1042	1254
Writing – G6	Quality of Writing: Editing	0	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	1,413	340	652	815	796.45	936	1304
Writing – G6	Conventions: Grammar and Sentence Formation	1,658	200	688	861	823.13	966	1275
Writing – G7	Quality of Writing: Focus and Organization	164	200	689	869	826.38	951	1256
Writing – G7	Quality of Writing: Content and Style	876	380	852	980	954.40	1082	1458
Writing – G7	Quality of Writing: Editing	333	415	869	961	942.62	1028	1210
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	1,598	200	689	878	856.40	1016	1546

**Table 15–18b (continued). Summary Statistics for Scale Score Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Writing – G7	Conventions: Grammar and Sentence Formation	1,780	200	688	872	834.65	986	1374
Writing – G8	Quality of Writing: Focus and Organization	204	200	669	880	848.80	1021	1280
Writing – G8	Quality of Writing: Content and Style	128	533	750	922	900.97	1029	1242
Writing – G8	Quality of Writing: Editing	10	583	624	707	728.70	786	974
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	1,339	202	670	876	858.10	1029	1558
Writing – G8	Conventions: Grammar and Sentence Formation	1,489	250	675	874	847.37	1022	1568
English Composition	Quality of Writing: Focus and Organization	115	436	807	952	926.91	1058	1229
English Composition	Quality of Writing: Content and Style	149	481	807	949	923.57	1044	1266
English Composition	Quality of Writing: Editing	154	200	846	963	931.86	1038	1324
English Composition	Conventions: Punctuation, Capitalization, and Spelling	589	200	649	824	811.46	955	1381
English Composition	Conventions: Grammar and Sentence Formation	597	231	643	829	796.33	951	1373

Tables 15–19a and 15–19b show the summary statistics for the conditional standard errors of measurement (CSEMs) in the scale score metric. The final column in the table shows the theoretical minimum CSEM that is possible for a test length equal to the mean number of points. This is the standard error if the student’s ability is known and there are sufficient items in the operational pool to administer where the item’s difficulty is equal to the known ability and the test constraints are met.

**Table 15–19a. Summary Statistics for Conditional Standard Errors Based on Full CDT**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Math – G3	39,689	35	37	38	38.19	39	76	36.31
Math – G4	42,378	34	37	38	38.14	39	91	36.31
Math – G5	49,147	35	37	38	38.09	38	90	36.67
Math – G6	61,085	34	37	37	37.22	38	90	34.64
Math – G7	66,490	34	37	37	37.25	38	126	34.64
Math – G8	55,899	34	37	37	37.34	38	126	34.64
Math – HS	1,192	35	37	37	38.15	39	52	33.68
Algebra I	105,847	34	37	37	37.81	38	127	34.31
Geometry	8,487	35	37	37	37.75	38	75	34.31
Algebra II	11,778	35	37	37	37.90	38	126	34.31
Reading – G3	33,621	38	41	42	42.96	44	76	39.32
Reading – G4	36,314	38	41	42	42.64	44	76	39.32
Reading – G5	41,014	37	40	42	42.41	44	76	39.32
Reading – G6	49,798	37	40	41	41.77	43	76	37.51
Reading – G7	57,221	38	40	41	42.01	43	86	37.84
Reading – G8	54,925	37	40	41	41.93	43	76	37.51
Literature	122,385	37	40	41	42.18	43	105	37.51
Science – G3	5,228	37	40	40	40.52	41	66	38.63
Science – G4	29,725	37	40	40	40.44	41	67	39.01
Science – G5	12,381	37	40	40	40.37	41	52	39.01
Science – G6	27,416	36	39	39	39.56	40	64	36.85
Science – G7	43,555	36	39	39	39.60	40	58	36.85
Science – G8	63,573	36	39	39	39.63	40	59	36.85
Science – HS	3,391	37	39	40	40.21	41	55	36.16
Biology	110,847	36	39	39	39.89	40	136	36.50
Chemistry	5,273	37	39	39	40.42	41	66	36.50
Writing – G3	4,984	36	39	39	39.52	40	60	37.60
Writing – G4	6,285	36	39	39	39.36	40	59	37.60
Writing – G5	7,392	36	39	39	39.31	40	55	37.60
Writing – G6	9,278	36	38	38	38.46	39	64	35.55
Writing – G7	12,496	36	38	38	38.48	39	58	35.55
Writing – G8	11,506	36	38	38	38.65	39	58	35.55
English Composition	9,746	36	38	38	38.65	39	135	35.55

**Table 15–19b. Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>	<b>Theoretical Minimum</b>
Math – G3	Numbers and Operations	2,353	65	66	67	67.90	68	132	65.47
Math – G3	Algebraic Concepts	772	65	67	68	68.16	68	129	65.47
Math – G3	Geometry	514	65	67	68	68.19	68	97	63.51
Math – G3	Measurement, Data, and Probability	1,047	65	66	67	67.88	68	131	65.47
Math – G4	Numbers and Operations	2,672	65	66	67	67.90	68	230	65.47
Math – G4	Algebraic Concepts	1,315	64	67	67	67.89	68	132	65.47
Math – G4	Geometry	673	64	67	68	68.17	68	87	65.47
Math – G4	Measurement, Data, and Probability	576	65	66	68	67.88	68	97	65.47
Math – G5	Numbers and Operations	2,469	65	66	67	67.76	68	129	65.47
Math – G5	Algebraic Concepts	773	65	66	67	67.85	68	129	65.47
Math – G5	Geometry	374	65	66	68	67.89	68	82	63.51
Math – G5	Measurement, Data, and Probability	837	65	66	67	67.72	68	131	65.47
Math – G6	Numbers and Operations	3,634	63	65	65	65.58	66	130	62.45
Math – G6	Algebraic Concepts	2,023	63	65	65	65.59	66	130	62.45
Math – G6	Geometry	1,259	63	65	65	65.52	66	129	62.45
Math – G6	Measurement, Data, and Probability	827	63	65	65	65.60	66	131	62.45
Math – G7	Numbers and Operations	4,969	63	65	65	65.84	66	231	62.45
Math – G7	Algebraic Concepts	4,061	63	65	65	65.93	66	231	62.45
Math – G7	Geometry	1,496	63	65	65	65.55	66	95	62.45
Math – G7	Measurement, Data, and Probability	1,102	63	65	65	65.85	66	133	62.45



**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Math – G8	Numbers and Operations	3,584	63	65	65	65.92	66	232	62.45
Math – G8	Algebraic Concepts	5,030	63	65	65	66.07	66	136	62.45
Math – G8	Geometry	2,095	63	65	65	65.61	66	95	62.45
Math – G8	Measurement, Data, and Probability	1,003	63	65	65	65.78	66	135	62.45
Math – HS	Numbers and Operations	134	63	65	65	65.52	66	73	62.45
Math – HS	Algebraic Concepts	115	63	65	65	66.05	66	86	60.59
Math – HS	Geometry	2	65	65	65	65.14	0	66	60.59
Math – HS	Measurement, Data, and Probability	45	64	65	65	65.44	66	74	60.59
Algebra I	Operations with Real Numbers and Expressions	4,738	63	65	65	66.73	66	131	60.59
Algebra I	Linear Equations & Inequalities	6,985	63	65	65	67.08	66	231	62.45
Algebra I	Functions & Coordinate Geometry	4,054	63	65	65	66.48	66	231	62.45
Algebra I	Data Analysis	1,799	63	65	65	66.66	66	135	60.59
Geometry	Geometric Properties	65	63	65	66	67.23	69	82	60.59
Geometry	Congruence, Similarity, and Proofs	246	63	65	66	67.57	66	140	60.59
Geometry	Coordinate Geometry and Right Triangles	139	63	65	66	67.20	68	87	60.59
Geometry	Measurement	236	63	65	66	66.87	67	100	60.59
Algebra II	Operations with Complex Numbers	271	63	65	66	68.06	67	130	60.59
Algebra II	Non-Linear Expressions & Equations	55	63	65	65	67.29	66	98	62.45
Algebra II	Functions	137	63	65	65	66.13	66	84	60.59
Algebra II	Data Analysis	218	63	65	66	67.63	67	131	60.59

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Reading – G3	Informational Text	1,692	48	52	54	54.70	56	105	52.13
Reading – G3	Literature Text	1,024	48	52	54	55.43	57	91	52.13
Reading – G4	Informational Text	1,759	48	52	53	54.44	56	79	52.13
Reading – G4	Literature Text	1,119	47	52	54	54.69	56	146	52.13
Reading – G5	Informational Text	1,575	48	52	53	54.16	56	105	52.13
Reading – G5	Literature Text	1,048	48	51	53	54.66	57	105	52.13
Reading – G6	Informational Text	1,673	48	51	52	53.19	54	88	50.50
Reading – G6	Literature Text	2,150	47	51	52	53.61	55	106	49.73
Reading – G7	Informational Text	1,687	48	51	53	53.66	55	89	49.73
Reading – G7	Literature Text	1,609	47	51	53	54.27	56	83	49.73
Reading – G8	Informational Text	2,223	48	51	53	53.65	55	88	50.50
Reading – G8	Literature Text	1,815	47	51	53	54.04	55	109	49.73
Literature	Informational Text	8,331	47	52	53	54.76	56	146	49.73
Literature	Literature Text	10,237	47	52	53	54.60	56	147	49.73
Science – G3	The Nature of Science	950	68	71	72	72.49	73	151	69.64
Science – G3	Biological Sciences	286	68	71	72	71.89	73	87	69.64
Science – G3	Physical Sciences	199	69	71	72	72.65	73	104	69.64
Science – G3	Earth and Space Sciences	203	69	71	72	72.52	73	139	69.64
Science – G4	The Nature of Science	1,352	68	71	72	72.05	73	263	69.64
Science – G4	Biological Sciences	1,057	68	71	72	72.07	73	138	69.64
Science – G4	Physical Sciences	1,269	67	71	72	71.91	73	103	69.64
Science – G4	Earth and Space Sciences	768	66	71	72	71.77	72	92	69.64

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>	<b>Theoretical Minimum</b>
Science – G5	The Nature of Science	1,433	65	71	72	72.48	73	126	69.64
Science – G5	Biological Sciences	628	67	70	72	72.06	72	105	69.64
Science – G5	Physical Sciences	276	68	71	72	71.83	72	104	69.64
Science – G5	Earth and Space Sciences	643	69	71	72	71.77	72	92	69.64
Science – G6	The Nature of Science	4,169	65	69	69	70.04	70	245	66.44
Science – G6	Biological Sciences	184	67	69	69	70.54	70	105	64.45
Science – G6	Physical Sciences	1,414	66	69	69	70.77	70	247	66.44
Science – G6	Earth and Space Sciences	3,091	66	69	69	69.97	70	107	66.44
Science – G7	The Nature of Science	4,195	67	69	69	70.26	70	245	66.44
Science – G7	Biological Sciences	5,957	65	69	69	70.26	70	246	66.44
Science – G7	Physical Sciences	1,346	67	69	69	70.19	70	140	66.44
Science – G7	Earth and Space Sciences	2,577	66	69	69	70.16	70	245	66.44
Science – G8	The Nature of Science	4,704	66	69	69	70.09	70	246	66.44
Science – G8	Biological Sciences	1,114	64	69	69	70.47	70	255	66.44
Science – G8	Physical Sciences	3,785	67	69	69	70.30	70	246	66.44
Science – G8	Earth and Space Sciences	1,077	67	69	69	70.91	70	246	66.44

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Science – HS	The Nature of Science	254	67	69	70	72.27	71	245	64.45
Science – HS	Biological Sciences	275	67	69	69	70.29	70	111	66.44
Science – HS	Physical Sciences	1,657	67	69	70	72.45	71	149	64.45
Science – HS	Earth and Space Sciences	157	67	69	69	70.95	70	141	66.44
Biology	Basic Biological Principles/ Chemical Basis for Life	8,171	64	69	69	70.74	70	247	66.44
Biology	Bioenergetics/ Homeostasis and Transport	5,853	65	69	69	71.13	70	246	66.44
Biology	Cell Growth and Reproduction/ Genetics	3,379	66	69	69	71.24	70	246	66.44
Biology	Theory of Evolution/ Ecology	2,884	66	69	69	70.97	70	245	66.44
Chemistry	Properties and Classification of Matter	330	67	69	70	72.86	73	142	64.45
Chemistry	Atomic Structure and The Periodic Table	614	67	69	70	74.19	76	246	64.45
Chemistry	The Mole and Chemical Bonding	390	67	69	69	71.08	70	102	64.45
Chemistry	Chemical Relationships and Reactions	265	67	69	70	74.49	73	246	64.45

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G3	Quality of Writing: Focus and Organization	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G3	Quality of Writing: Content and Style	24	70	70	72	71.59	72	73	69.72
Writing – G3	Quality of Writing: Editing	170	69	71	72	73.32	73	102	69.72
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	756	69	71	72	75.52	76	245	67.64
Writing – G3	Conventions: Grammar and Sentence Formation	1,094	69	71	72	74.76	73	246	67.64
Writing – G4	Quality of Writing: Focus and Organization	33	69	71	72	72.50	73	86	69.72
Writing – G4	Quality of Writing: Content and Style	65	69	70	72	72.22	73	90	69.72
Writing – G4	Quality of Writing: Editing	36	69	71	72	71.98	72	77	69.72
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	879	69	71	72	74.62	73	245	69.72
Writing – G4	Conventions: Grammar and Sentence Formation	1,011	69	71	72	73.61	73	138	69.72

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G5	Quality of Writing: Focus and Organization	131	69	71	72	73.87	73	246	69.72
Writing – G5	Quality of Writing: Content and Style	39	69	71	72	71.74	73	76	69.72
Writing – G5	Quality of Writing: Editing	62	69	70	71	72.90	73	138	69.72
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	1,000	69	71	72	74.26	73	246	69.72
Writing – G5	Conventions: Grammar and Sentence Formation	1,311	69	71	72	73.01	73	246	69.72
Writing – G6	Quality of Writing: Focus and Organization	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G6	Quality of Writing: Content and Style	93	67	69	70	70.87	70	102	64.52
Writing – G6	Quality of Writing: Editing	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	1,413	67	69	70	71.96	70	138	64.52
Writing – G6	Conventions: Grammar and Sentence Formation	1,658	67	69	70	70.87	70	141	66.51

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

CDT	Diagnostic Category	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum	Theoretical Minimum
Writing – G7	Quality of Writing: Focus and Organization	164	68	69	70	73.87	70	246	66.51
Writing – G7	Quality of Writing: Content and Style	876	67	69	70	71.23	70	139	66.51
Writing – G7	Quality of Writing: Editing	333	67	69	70	69.66	70	104	66.51
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	1,598	67	69	70	72.44	71	245	64.52
Writing – G7	Conventions: Grammar and Sentence Formation	1,780	67	69	70	70.95	70	246	66.51
Writing – G8	Quality of Writing: Focus and Organization	204	67	69	70	73.26	71	247	64.52
Writing – G8	Quality of Writing: Content and Style	128	67	69	70	70.24	70	86	66.51
Writing – G8	Quality of Writing: Editing	10	68	69	71	72.08	75	79	62.71
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	1,339	67	69	70	72.53	71	246	64.52
Writing – G8	Conventions: Grammar and Sentence Formation	1,489	67	69	70	71.64	70	140	66.51

**Table 15–19b (continued). Summary Statistics for Conditional Standard Errors Based on Diagnostic Category CDT**

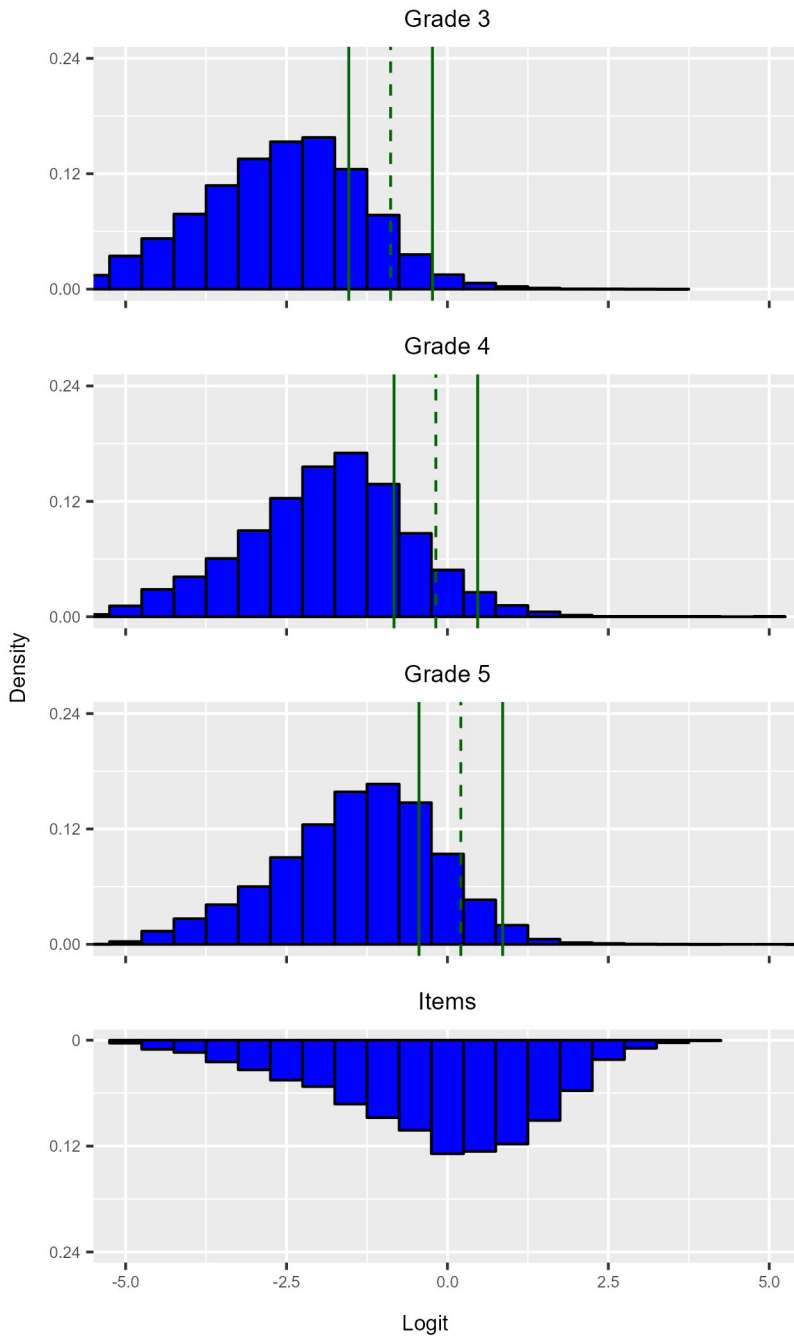
<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>	<b>Theoretical Minimum</b>
Eng. Comp.	Quality of Writing: Focus and Organization	115	67	69	70	70.63	70	101	66.51
Eng. Comp.	Quality of Writing: Content and Style	149	67	69	69	70.51	70	102	66.51
Eng. Comp.	Quality of Writing: Editing	154	67	69	70	71.53	70	248	66.51
Eng. Comp.	Conventions: Punctuation, Capitalization, and Spelling	589	67	69	70	72.92	72	245	64.52
Eng. Comp.	Conventions: Grammar and Sentence Formation	597	67	69	70	72.28	71	140	64.52



Values in the “Minimum” column that are less than the “Theoretical Minimum” are due to students taking more than the mean number of points. Recall that calculation of “Theoretical Minimum” is based on the mean number of points.

Figures 15–1 through 15–8 show the scale score distributions for the total test for the content areas mathematics, reading, science, and writing. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts while tests that are course-specific are not broken down. The benchmark cuts in place during the 2023–2024 school year are shown in green<sup>2</sup>. The bottom plot in each figure represents the distribution of items in the content area pools.

**Figure 15–1. Scale Score Distribution – Math Grades 3–5 Total Scores**



<sup>2</sup> For details on benchmark cuts, see Chapter Ten and Chapter Nineteen.

**Figure 15–2. Scale Score Distribution – Math Total Scores**

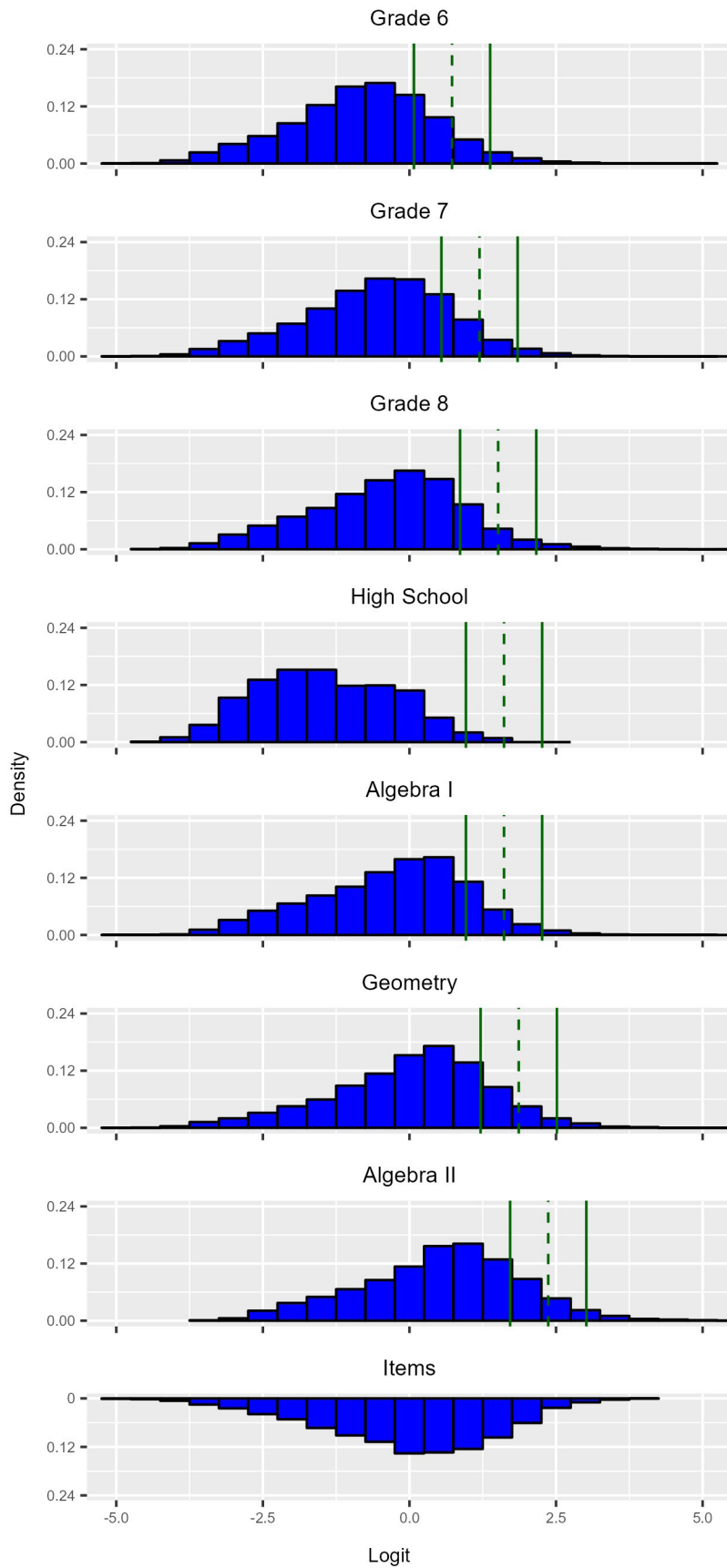
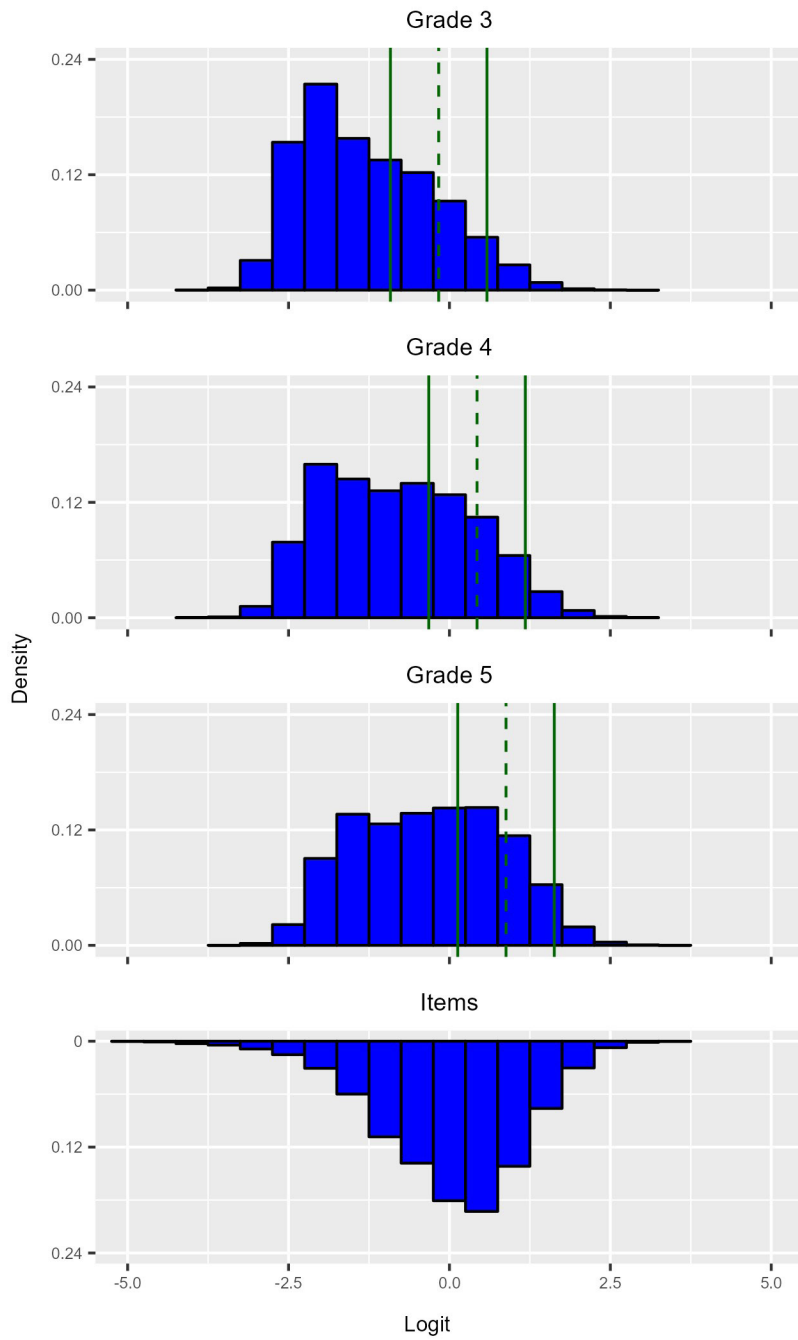


Figure 15–3. Scale Score Distribution – Reading Grades 3–5 Total Scores



**Figure 15–4. Scale Score Distribution – Reading/Literature Total Scores**

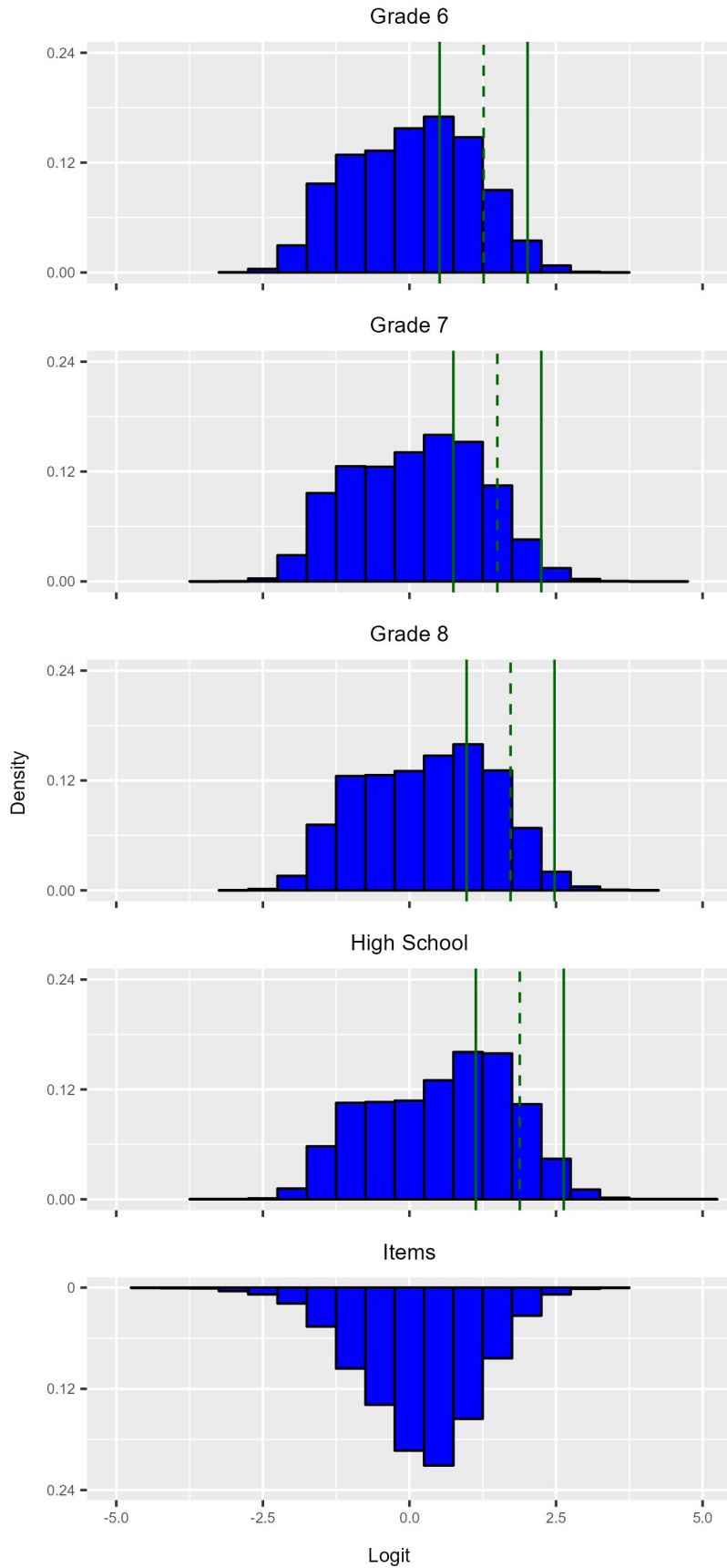
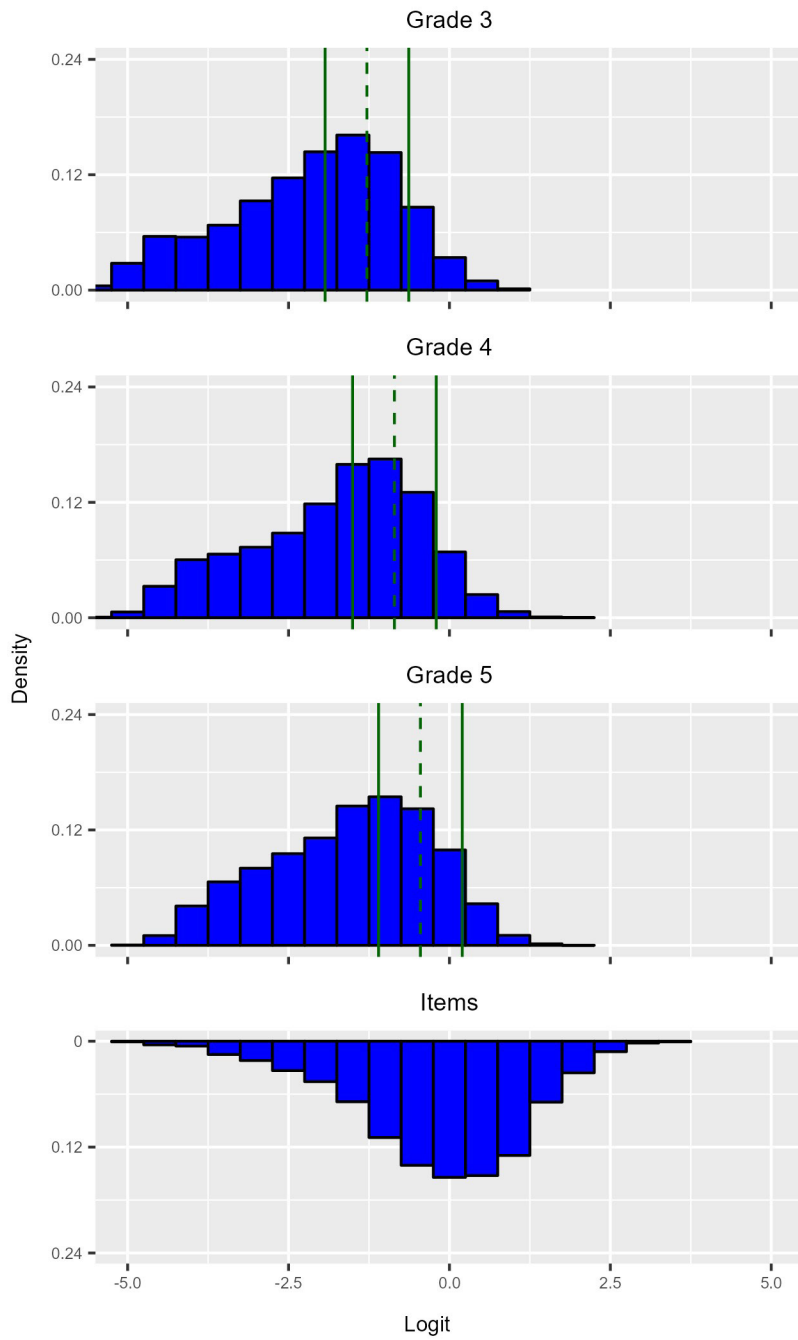


Figure 15–5. Scale Score Distribution – Science Grades 3–5 Total Scores



**Figure 15–6. Scale Score Distribution – Science Total Scores**

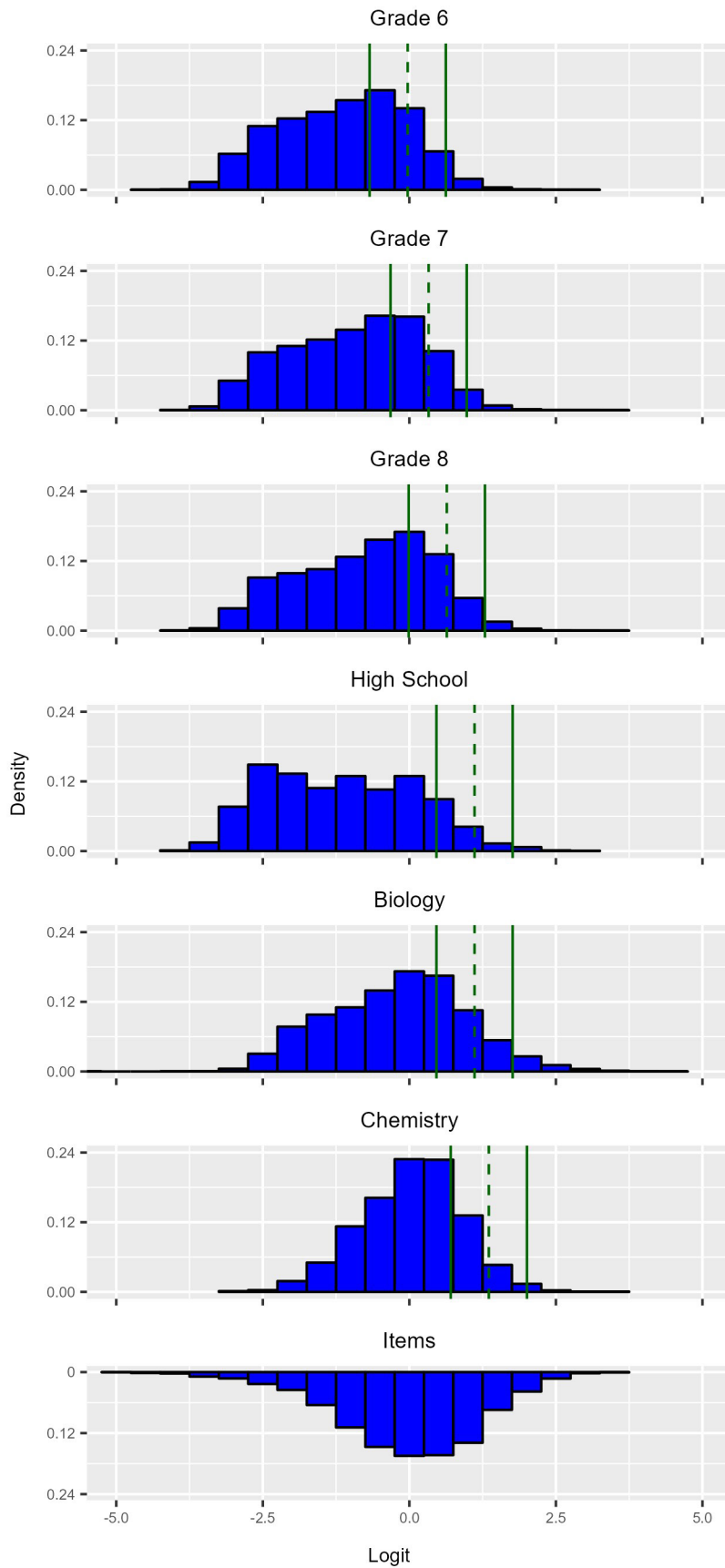


Figure 15–7. Scale Score Distribution – Writing Grades 3–5 Total Scores

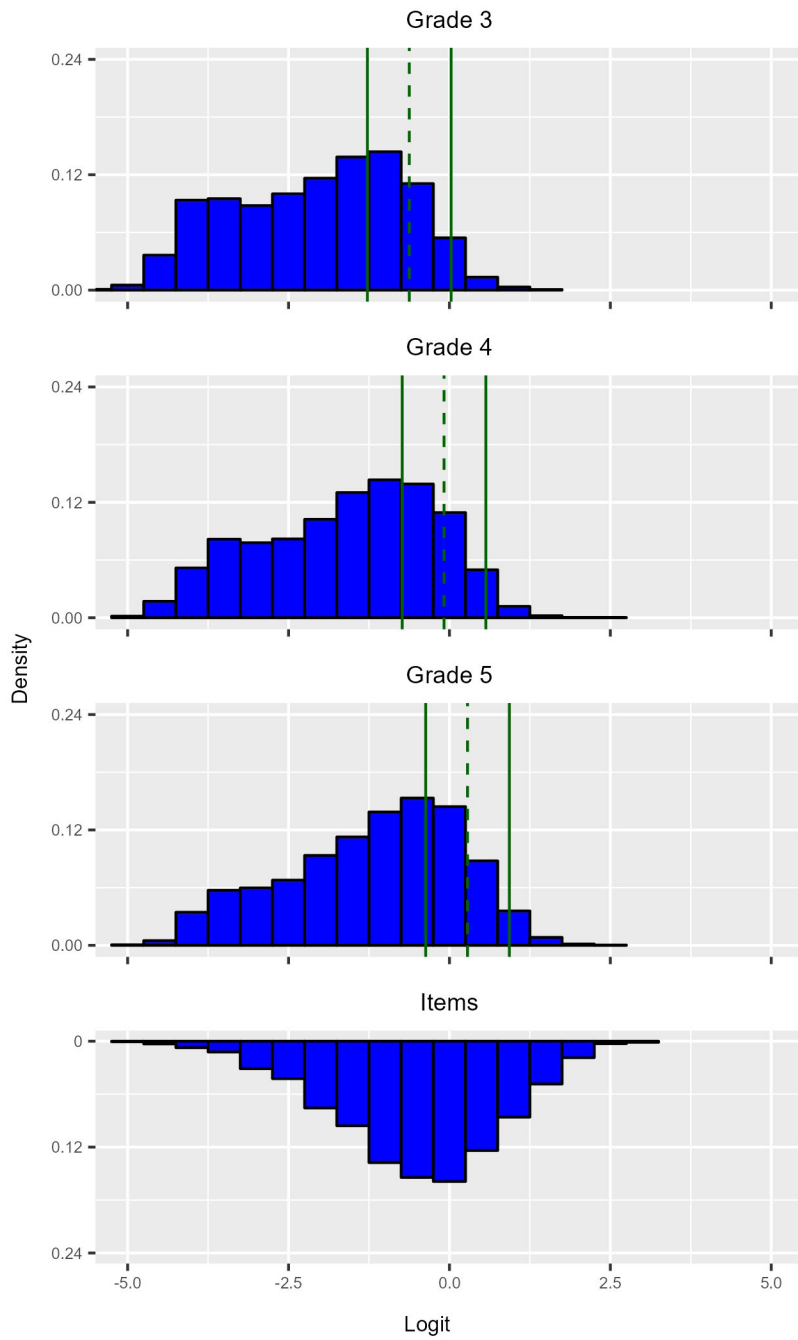
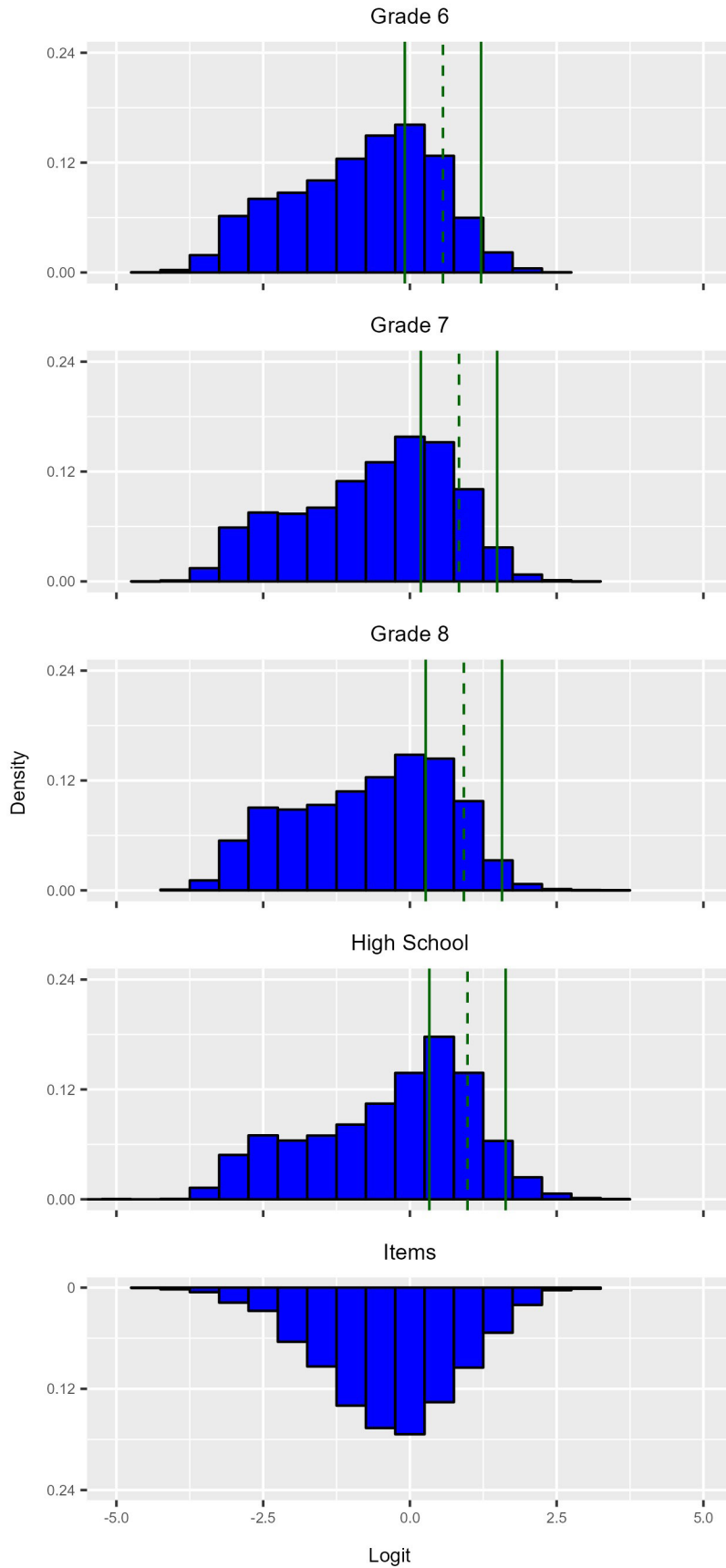


Figure 15–8. Scale Score Distribution – Writing/English Composition Total Scores





## SUMMARY STATISTICS – SCALE SCORES AND CONDITIONAL STANDARD ERRORS FOR DIAGNOSTIC CATEGORY SUB-SCORES FROM FULL CDT

Earlier in this chapter, tables 15–18b and 15–19b show summary statistics for the diagnostic category scale scores and conditional standard errors from diagnostic category CDT tests. In this section, tables Table 15–20 and Table 15–21 show summary statistics for diagnostic categories from full CDT tests. Diagnostic category sub-scores from full CDTs are presented here because N-counts are significantly higher. For example, there are only 218 tests of Algebra II Data Analysis while there are 11,778 tests of Algebra II which includes the sub-score Data Analysis. To be consistent with previous tables, tests with multiple benchmark cuts are broken down to match the grade level of the cuts, while tests that are course-specific are not broken down.

**Table 15–20. Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

CDT	Diagnostic Category	N	Minimum	Q1	Median	Mean	Q3	Maximum
Math – G3	Numbers and Operations	39,689	200	554	677	669.64	784	1645
Math – G3	Algebraic Concepts	39,689	200	586	720	710.99	838	1453
Math – G3	Geometry	39,689	200	575	684	675.92	780	1570
Math – G3	Measurement, Data, and Probability	39,689	200	575	708	699.95	829	1540
Math – G4	Numbers and Operations	42,378	200	662	782	775.85	885	1666
Math – G4	Algebraic Concepts	42,378	200	681	807	796.41	920	1702
Math – G4	Geometry	42,378	200	658	751	756.19	850	1538
Math – G4	Measurement, Data, and Probability	42,378	200	662	803	782.91	911	1726
Math – G5	Numbers and Operations	49,147	200	730	854	848.40	974	1681
Math – G5	Algebraic Concepts	49,147	200	731	847	831.82	948	1742
Math – G5	Geometry	49,147	200	720	823	824.90	941	1753
Math – G5	Measurement, Data, and Probability	49,147	200	739	852	837.12	952	1612
Math – G6	Numbers and Operations	61,085	200	807	931	926.36	1057	1722
Math – G6	Algebraic Concepts	61,085	200	799	924	910.30	1032	1795
Math – G6	Geometry	61,085	200	818	925	915.46	1020	1764
Math – G6	Measurement, Data, and Probability	61,085	200	799	904	903.69	1017	1791
Math – G7	Numbers and Operations	66,490	200	840	973	958.62	1092	1722
Math – G7	Algebraic Concepts	66,490	200	849	972	951.14	1070	1818
Math – G7	Geometry	66,490	200	849	952	946.66	1052	1812
Math – G7	Measurement, Data, and Probability	66,490	200	814	931	927.91	1050	1804
Math – G8	Numbers and Operations	55,899	200	841	993	966.84	1114	1742
Math – G8	Algebraic Concepts	55,899	200	857	987	971.45	1086	1826

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Math – G8	Geometry	55,899	225	855	967	963.93	1075	1859
Math – G8	Measurement, Data, and Probability	55,899	200	831	967	956.04	1083	1818
Math – HS	Numbers and Operations	1,192	200	673	820	820.58	965	1352
Math – HS	Algebraic Concepts	1,192	236	715	843	839.30	973	1622
Math – HS	Geometry	1,192	268	742	851	854.16	965	1354
Math – HS	Measurement, Data, and Probability	1,192	206	692	827	828.37	978	1311
Algebra I	Operations with Real Numbers and Expressions	105,847	400	835	1010	964.63	1115	1809
Algebra I	Linear Equations & Inequalities	105,847	403	865	993	984.25	1100	1790
Algebra I	Functions & Coordinate Geometry	105,847	400	873	1002	986.61	1103	1805
Algebra I	Data Analysis	105,847	400	835	981	958.81	1091	1831
Geometry	Geometric Properties	8,487	400	902	1040	1013.03	1144	1621
Geometry	Congruence, Similarity, and Proofs	8,487	400	918	1049	1020.25	1137	1800
Geometry	Coordinate Geometry and Right Triangles	8,487	400	913	1043	1025.80	1159	1789
Geometry	Measurement	8,487	400	878	1028	1004.87	1144	1809
Algebra II	Operations with Complex Numbers	11,778	556	1004	1107	1134.62	1239	1847
Algebra II	Non-Linear Expressions & Equations	11,778	400	948	1095	1063.34	1203	1892
Algebra II	Functions	11,778	400	967	1100	1085.53	1211	1872
Algebra II	Data Analysis	11,778	400	927	1074	1044.55	1179	1858
Reading – G3	Key Ideas – Lit text	33,621	200	562	672	687.03	813	1470
Reading – G3	Key Ideas – Info text	33,621	200	556	673	681.35	811	1492
Reading – G3	Craft & Structure – Lit text	33,621	200	591	689	697.66	805	1495
Reading – G3	Craft & Structure – Info text	33,621	200	571	673	683.29	798	1488
Reading – G3	Vocabulary	33,621	200	533	680	677.56	820	1481
Reading – G4	Key Ideas – Lit text	36,314	200	609	743	751.38	893	1500
Reading – G4	Key Ideas – Info text	36,314	200	615	747	749.15	887	1566

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Reading – G4	Craft & Structure – Lit text	36,314	200	652	768	775.41	902	1532
Reading – G4	Craft & Structure – Info text	36,314	200	624	747	754.33	890	1524
Reading – G4	Vocabulary	36,314	200	594	762	746.93	894	1509
Reading – G5	Key Ideas – Lit text	41,014	200	684	829	825.85	970	1583
Reading – G5	Key Ideas – Info text	41,014	200	698	826	823.99	955	1599
Reading – G5	Craft & Structure – Lit text	41,014	200	725	840	844.98	969	1587
Reading – G5	Craft & Structure – Info text	41,014	200	664	820	811.00	961	1555
Reading – G5	Vocabulary	41,014	200	672	839	819.81	965	1551
Reading – G6	Key Ideas – Lit text	49,798	200	756	889	882.74	1010	1600
Reading – G6	Key Ideas – Info text	49,798	200	758	883	878.90	1004	1587
Reading – G6	Craft & Structure – Lit text	49,798	246	761	886	880.94	1004	1588
Reading – G6	Craft & Structure – Info text	49,798	200	738	884	868.42	1007	1601
Reading – G6	Vocabulary	49,798	200	743	893	872.66	1007	1580
Reading – G7	Key Ideas – Lit text	57,221	200	758	896	890.63	1023	1647
Reading – G7	Key Ideas – Info text	57,221	200	765	903	896.23	1030	1638
Reading – G7	Craft & Structure – Lit text	57,221	238	763	893	889.32	1017	1620
Reading – G7	Craft & Structure – Info text	57,221	201	738	894	878.12	1023	1650
Reading – G7	Vocabulary	57,221	200	748	904	884.81	1025	1594
Reading – G8	Key Ideas – Lit text	54,925	210	772	916	910.45	1050	1601
Reading – G8	Key Ideas – Info text	54,925	200	778	930	914.79	1056	1645
Reading – G8	Craft & Structure – Lit text	54,925	246	798	930	922.52	1051	1642
Reading – G8	Craft & Structure – Info text	54,925	219	775	920	907.56	1046	1692
Reading – G8	Vocabulary	54,925	200	768	927	908.42	1052	1623
Literature	Key Ideas – Lit text	122,385	200	799	955	941.38	1086	1651
Literature	Key Ideas – Info text	122,385	200	813	974	951.49	1095	1647
Literature	Craft & Structure – Lit text	122,385	264	826	967	956.32	1089	1657
Literature	Craft & Structure – Info text	122,385	230	809	969	949.23	1091	1724
Literature	Vocabulary	122,385	200	805	972	950.07	1097	1630

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Science – G3	The Nature of Science	5,228	200	524	677	656.53	795	1245
Science – G3	Biological Sciences	5,228	200	535	691	665.59	805	1268
Science – G3	Physical Sciences	5,228	200	545	694	669.95	811	1204
Science – G3	Earth and Space Sciences	5,228	200	532	673	658.38	796	1205
Science – G4	The Nature of Science	29,725	200	573	730	706.92	845	1454
Science – G4	Biological Sciences	29,725	200	578	731	709.40	850	1569
Science – G4	Physical Sciences	29,725	200	597	753	718.19	854	1641
Science – G4	Earth and Space Sciences	29,725	200	587	732	714.29	843	1415
Science – G5	The Nature of Science	12,381	200	604	752	737.35	875	1413
Science – G5	Biological Sciences	12,381	200	607	751	735.40	879	1279
Science – G5	Physical Sciences	12,381	200	638	774	751.55	879	1321
Science – G5	Earth and Space Sciences	12,381	200	619	761	745.04	873	1440
Science – G6	The Nature of Science	27,416	200	657	807	791.76	928	1443
Science – G6	Biological Sciences	27,416	200	668	811	797.13	925	1678
Science – G6	Physical Sciences	27,416	200	699	817	809.13	921	1675
Science – G6	Earth and Space Sciences	27,416	200	696	812	801.57	918	1469
Science – G7	The Nature of Science	43,555	200	680	836	816.49	958	1522
Science – G7	Biological Sciences	43,555	200	682	831	819.17	954	1538
Science – G7	Physical Sciences	43,555	200	728	850	840.82	957	1563
Science – G7	Earth and Space Sciences	43,555	200	712	835	824.94	940	1483
Science – G8	The Nature of Science	63,573	200	702	867	843.46	984	1573
Science – G8	Biological Sciences	63,573	200	712	866	847.51	985	1593
Science – G8	Physical Sciences	63,573	200	744	875	861.77	982	1597
Science – G8	Earth and Space Sciences	63,573	200	730	860	844.04	964	1440
Science – HS	The Nature of Science	3,391	200	609	782	781.07	947	1451
Science – HS	Biological Sciences	3,391	200	651	795	800.54	948	1536
Science – HS	Physical Sciences	3,391	254	687	817	820.61	952	1368
Science – HS	Earth and Space Sciences	3,391	200	647	790	788.52	929	1525

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Biology	Basic Biological Principles/Chemical Basis for Life	110,847	400	801	934	919.09	1043	1795
Biology	Bioenergetics/Homeostasis and Transport	110,847	400	831	933	936.32	1040	1725
Biology	Cell Growth and Reproduction/Genetics	110,847	400	827	943	937.00	1045	1778
Biology	Theory of Evolution/Ecology	110,847	400	763	930	902.14	1045	1740
Chemistry	Properties and Classification of Matter	5,273	400	796	946	911.07	1048	1456
Chemistry	Atomic Structure and The Periodic Table	5,273	485	912	990	988.59	1068	1550
Chemistry	The Mole and Chemical Bonding	5,273	412	889	977	968.79	1055	1570
Chemistry	Chemical Relationships and Reactions	5,273	425	869	962	959.70	1047	1744
Writing – G3	Quality of Writing: Focus and Organization	4,984	200	521	692	676.01	834	1329
Writing – G3	Quality of Writing: Content and Style	4,984	200	542	707	680.43	827	1356
Writing – G3	Quality of Writing: Editing	4,984	200	543	696	681.34	815	1210
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	4,984	200	547	663	672.18	809	1313
Writing – G3	Conventions: Grammar and Sentence Formation	4,984	200	516	688	667.42	823	1291
Writing – G4	Quality of Writing: Focus and Organization	6,285	200	578	746	731.86	895	1376
Writing – G4	Quality of Writing: Content and Style	6,285	200	600	754	736.64	880	1398
Writing – G4	Quality of Writing: Editing	6,285	200	593	753	733.84	879	1422

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	6,285	200	597	752	738.76	875	1298
Writing – G4	Conventions: Grammar and Sentence Formation	6,285	200	603	764	736.10	885	1637
Writing – G5	Quality of Writing: Focus and Organization	7,392	200	627	798	775.34	930	1560
Writing – G5	Quality of Writing: Content and Style	7,392	200	659	813	791.69	930	1576
Writing – G5	Quality of Writing: Editing	7,392	200	659	810	790.10	932	1570
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	7,392	200	656	802	796.05	941	1584
Writing – G5	Conventions: Grammar and Sentence Formation	7,392	200	674	824	792.05	933	1336
Writing – G6	Quality of Writing: Focus and Organization	9,278	200	684	852	830.97	981	1543
Writing – G6	Quality of Writing: Content and Style	9,278	236	706	859	848.91	989	1580
Writing – G6	Quality of Writing: Editing	9,278	200	708	859	835.59	979	1595
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	9,278	218	711	871	851.23	987	1471
Writing – G6	Conventions: Grammar and Sentence Formation	9,278	200	709	857	828.56	966	1326
Writing – G7	Quality of Writing: Focus and Organization	12,496	200	708	888	858.26	1018	1570
Writing – G7	Quality of Writing: Content and Style	12,496	229	726	892	877.11	1027	1630
Writing – G7	Quality of Writing: Editing	12,496	200	734	892	868.17	1016	1392

**Table 15–20 (continued). Summary Statistics for Diagnostic Category Scale Score Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Minimum</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Maximum</b>
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	12,496	210	739	902	879.28	1026	1712
Writing – G7	Conventions: Grammar and Sentence Formation	12,496	200	730	886	851.33	994	1512
Writing – G8	Quality of Writing: Focus and Organization	11,506	200	694	873	850.10	1011	1468
Writing – G8	Quality of Writing: Content and Style	11,506	247	708	872	860.11	1015	1608
Writing – G8	Quality of Writing: Editing	11,506	211	715	878	856.45	1007	1553
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	11,506	200	721	887	867.93	1021	1713
Writing – G8	Conventions: Grammar and Sentence Formation	11,506	200	720	880	851.95	1000	1501
English Composition	Quality of Writing: Focus and Organization	9,746	200	751	941	901.58	1069	1614
English Composition	Quality of Writing: Content and Style	9,746	244	748	937	904.56	1066	1598
English Composition	Quality of Writing: Editing	9,746	200	751	934	896.02	1049	1546
English Composition	Conventions: Punctuation, Capitalization, and Spelling	9,746	200	772	940	912.55	1066	1716
English Composition	Conventions: Grammar and Sentence Formation	9,746	200	777	938	898.13	1044	1680

Table 15–21 shows the summary statistics for the conditional standard errors of measurement (CSEMs) for diagnostic categories in the scale score metric based on full CDT. The final column in the table shows the theoretical minimum CSEM that is possible for a test length equal to the mean number of points. Minimum values in the table that are less than the theoretical minimum are due to students taking more than the mean number of points.

**Table 15–21. Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Max</b>	<b>Theoretical Minimum</b>
Math – G3	Numbers and Operations	39,689	72	74	76	75.98	77	232	72.63
Math – G3	Algebraic Concepts	39,689	71	74	76	76.06	77	233	72.63
Math – G3	Geometry	39,689	72	75	76	75.94	77	234	72.63
Math – G3	Measurement, Data, and Probability	39,689	71	74	76	76.21	77	233	72.63
Math – G4	Numbers and Operations	42,378	72	74	76	75.95	77	232	72.63
Math – G4	Algebraic Concepts	42,378	72	74	76	75.75	77	232	72.63
Math – G4	Geometry	42,378	71	74	76	75.72	77	238	72.63
Math – G4	Measurement, Data, and Probability	42,378	71	74	76	75.87	77	233	72.63
Math – G5	Numbers and Operations	49,147	72	74	75	75.85	77	231	72.63
Math – G5	Algebraic Concepts	49,147	71	74	75	75.66	77	233	72.63
Math – G5	Geometry	49,147	71	74	76	75.70	77	243	72.63
Math – G5	Measurement, Data, and Probability	49,147	72	74	76	75.72	77	233	72.63
Math – G6	Numbers and Operations	61,085	69	73	74	73.96	74	232	69.28
Math – G6	Algebraic Concepts	61,085	69	73	74	74.15	74	238	69.28
Math – G6	Geometry	61,085	69	73	74	73.86	74	232	69.28
Math – G6	Measurement, Data, and Probability	61,085	69	73	74	74.18	74	233	69.28
Math – G7	Numbers and Operations	66,490	69	73	74	74.17	74	233	69.28
Math – G7	Algebraic Concepts	66,490	69	73	74	74.36	74	233	69.28
Math – G7	Geometry	66,490	69	73	74	73.82	74	235	69.28
Math – G7	Measurement, Data, and Probability	66,490	69	73	74	74.51	74	234	69.28
Math – G8	Numbers and Operations	55,899	69	73	74	74.30	74	235	69.28
Math – G8	Algebraic Concepts	55,899	69	73	74	74.72	74	239	69.28
Math – G8	Geometry	55,899	69	73	74	74.07	74	239	69.28
Math – G8	Measurement, Data, and Probability	55,899	69	73	74	74.80	74	235	69.28
Math – HS	Numbers and Operations	1,192	70	73	74	76.54	75	233	66.76
Math – HS	Algebraic Concepts	1,192	70	73	74	77.64	76	235	66.76
Math – HS	Geometry	1,192	70	73	74	75.97	75	233	66.76
Math – HS	Measurement, Data, and Probability	1,192	70	73	74	77.19	75	232	66.76



**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

CDT	Diagnostic Category	N	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Algebra I	Operations with Real Numbers and Expressions	105,847	69	73	74	74.86	75	232	69.28
Algebra I	Linear Equations & Inequalities	105,847	69	73	74	76.09	75	232	69.28
Algebra I	Functions & Coordinate Geometry	105,847	69	73	74	75.48	75	239	69.28
Algebra I	Data Analysis	105,847	69	73	74	75.47	75	237	69.28
Geometry	Geometric Properties	8,487	69	73	74	74.47	74	232	69.28
Geometry	Congruence, Similarity, and Proofs	8,487	69	73	74	75.77	75	248	69.28
Geometry	Coordinate Geometry and Right Triangles	8,487	69	73	74	75.25	75	233	69.28
Geometry	Measurement	8,487	70	73	74	74.98	75	232	69.28
Algebra II	Operations with Complex Numbers	11,778	69	73	74	78.55	75	231	69.28
Algebra II	Non-Linear Expressions & Equations	11,778	69	73	74	75.51	75	236	69.28
Algebra II	Functions	11,778	69	73	74	75.17	74	250	69.28
Algebra II	Data Analysis	11,778	69	73	74	75.31	75	237	69.28
Reading – G3	Key Ideas – Lit text	33,621	73	88	94	98.14	101	275	86.44
Reading – G3	Key Ideas – Info text	33,621	75	91	96	100.72	102	275	90.29
Reading – G3	Craft & Structure – Lit text	33,621	77	94	99	104.51	106	279	90.29
Reading – G3	Craft & Structure – Info text	33,621	73	90	96	101.38	102	279	86.44
Reading – G3	Vocabulary	33,621	78	93	98	103.38	103	278	90.29
Reading – G4	Key Ideas – Lit text	36,314	73	88	93	97.52	100	278	86.44
Reading – G4	Key Ideas – Info text	36,314	75	90	95	99.53	101	284	86.44
Reading – G4	Craft & Structure – Lit text	36,314	73	93	98	102.48	104	279	90.29
Reading – G4	Craft & Structure – Info text	36,314	70	90	95	99.81	101	282	86.44
Reading – G4	Vocabulary	36,314	75	93	98	102.95	103	278	90.29
Reading – G5	Key Ideas – Lit text	41,014	72	89	94	98.45	101	283	86.44
Reading – G5	Key Ideas – Info text	41,014	74	89	94	97.65	100	279	86.44

**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

CDT	Diagnostic Category	N	Min	Q1	Median	Mean	Q3	Max	Theoretical Minimum
Reading – G5	Craft & Structure – Lit text	41,014	71	89	95	98.67	101	283	86.44
Reading – G5	Craft & Structure – Info text	41,014	72	90	95	99.92	101	276	86.44
Reading – G5	Vocabulary	41,014	77	94	99	103.14	103	277	90.29
Reading – G6	Key Ideas – Lit text	49,798	69	87	92	97.23	99	273	82.46
Reading – G6	Key Ideas – Info text	49,798	72	88	93	97.32	100	275	82.46
Reading – G6	Craft & Structure – Lit text	49,798	71	89	94	97.32	100	272	86.13
Reading – G6	Craft & Structure – Info text	49,798	72	88	93	97.25	100	277	82.46
Reading – G6	Vocabulary	49,798	78	94	97	101.89	102	279	86.13
Reading – G7	Key Ideas – Lit text	57,221	71	87	92	96.82	99	274	82.46
Reading – G7	Key Ideas – Info text	57,221	73	88	93	97.92	100	271	82.46
Reading – G7	Craft & Structure – Lit text	57,221	74	90	94	98.13	100	272	86.13
Reading – G7	Craft & Structure – Info text	57,221	74	89	94	98.48	101	271	86.13
Reading – G7	Vocabulary	57,221	81	94	98	102.41	103	279	86.13
Reading – G8	Key Ideas – Lit text	54,925	72	88	94	98.30	100	275	82.46
Reading – G8	Key Ideas – Info text	54,925	73	89	94	98.89	100	274	86.13
Reading – G8	Craft & Structure – Lit text	54,925	72	88	93	96.86	99	274	82.46
Reading – G8	Craft & Structure – Info text	54,925	71	87	92	96.53	99	275	82.46
Reading – G8	Vocabulary	54,925	78	95	98	102.62	103	283	86.13
Literature	Key Ideas – Lit text	122,385	72	89	94	99.38	101	275	82.46
Literature	Key Ideas – Info text	122,385	74	90	95	99.93	101	290	86.13
Literature	Craft & Structure – Lit text	122,385	72	88	93	96.67	99	274	82.46
Literature	Craft & Structure – Info text	122,385	71	87	92	96.85	99	274	82.46
Literature	Vocabulary	122,385	76	95	100	105.80	105	276	86.13
Science – G3	The Nature of Science	5,228	71	79	80	81.10	82	247	77.26
Science – G3	Biological Sciences	5,228	74	79	80	80.90	82	247	77.26
Science – G3	Physical Sciences	5,228	76	79	80	81.11	82	247	77.26
Science – G3	Earth and Space Sciences	5,228	75	79	80	80.91	82	246	77.26
Science – G4	The Nature of Science	29,725	70	79	80	81.32	82	266	77.26

**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Max</b>	<b>Theoretical Minimum</b>
Science – G4	Biological Sciences	29,725	73	79	80	81.00	82	247	77.26
Science – G4	Physical Sciences	29,725	73	79	80	80.91	82	248	77.26
Science – G4	Earth and Space Sciences	29,725	71	79	80	80.97	82	250	77.26
Science – G5	The Nature of Science	12,381	71	79	80	81.57	82	272	77.26
Science – G5	Biological Sciences	12,381	73	79	80	81.19	82	249	77.26
Science – G5	Physical Sciences	12,381	73	79	80	81.17	82	253	77.26
Science – G5	Earth and Space Sciences	12,381	74	79	80	80.87	82	250	77.26
Science – G6	The Nature of Science	27,416	70	77	78	79.44	79	279	73.70
Science – G6	Biological Sciences	27,416	71	77	78	79.69	79	250	73.70
Science – G6	Physical Sciences	27,416	71	77	78	79.93	79	248	73.70
Science – G6	Earth and Space Sciences	27,416	73	77	78	79.61	79	249	73.70
Science – G7	The Nature of Science	43,555	73	77	78	79.58	79	246	73.70
Science – G7	Biological Sciences	43,555	71	77	78	79.93	79	247	73.70
Science – G7	Physical Sciences	43,555	73	77	78	79.67	79	249	73.70
Science – G7	Earth and Space Sciences	43,555	73	77	78	79.52	79	246	73.70
Science – G8	The Nature of Science	63,573	73	77	78	79.70	79	246	73.70
Science – G8	Biological Sciences	63,573	71	77	78	79.93	79	256	73.70
Science – G8	Physical Sciences	63,573	74	77	78	79.72	79	249	73.70
Science – G8	Earth and Space Sciences	63,573	73	77	78	79.56	79	250	73.70
Science – HS	The Nature of Science	3,391	74	77	79	81.85	80	247	71.02
Science – HS	Biological Sciences	3,391	73	78	79	81.95	80	252	71.02
Science – HS	Physical Sciences	3,391	74	77	79	81.32	80	246	71.02
Science – HS	Earth and Space Sciences	3,391	74	77	79	81.44	80	248	73.70

**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Max</b>	<b>Theoretical Minimum</b>
Biology	Basic Biological Principles/Chemical Basis for Life	110,847	69	77	78	80.21	79	252	73.70
Biology	Bioenergetics/ Homeostasis and Transport	110,847	69	77	79	80.29	79	246	73.70
Biology	Cell Growth and Reproduction/ Genetics	110,847	72	77	79	80.88	79	246	73.70
Biology	Theory of Evolution/ Ecology	110,847	72	77	78	80.58	79	247	73.70
Chemistry	Properties and Classification of Matter	5,273	74	77	79	80.26	79	255	73.70
Chemistry	Atomic Structure and The Periodic Table	5,273	74	78	79	81.81	79	246	73.70
Chemistry	The Mole and Chemical Bonding	5,273	74	77	79	80.66	79	246	73.70
Chemistry	Chemical Relationships and Reactions	5,273	74	77	79	81.33	80	246	73.70
Writing – G3	Quality of Writing: Focus and Organization	4,984	82	86	87	89.98	89	248	84.09
Writing – G3	Quality of Writing: Content and Style	4,984	82	86	87	90.07	89	254	84.09
Writing – G3	Quality of Writing: Editing	4,984	82	86	87	89.75	89	247	84.09
Writing – G3	Conventions: Punctuation, Capitalization, and Spelling	4,984	82	86	87	90.86	89	246	84.09
Writing – G3	Conventions: Grammar and Sentence Formation	4,984	82	86	87	90.02	89	248	84.09
Writing – G4	Quality of Writing: Focus and Organization	6,285	82	86	87	89.59	89	249	84.09
Writing – G4	Quality of Writing: Content and Style	6,285	82	86	87	89.54	89	249	84.09
Writing – G4	Quality of Writing: Editing	6,285	82	86	87	88.93	89	247	84.09

**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b>N</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Max</b>	<b>Theoretical Minimum</b>
Writing – G4	Conventions: Punctuation, Capitalization, and Spelling	6,285	82	86	87	89.78	89	247	84.09
Writing – G4	Conventions: Grammar and Sentence Formation	6,285	82	86	87	88.74	89	249	84.09
Writing – G5	Quality of Writing: Focus and Organization	7,392	82	86	87	89.37	89	249	84.09
Writing – G5	Quality of Writing: Content and Style	7,392	82	86	87	89.11	89	251	84.09
Writing – G5	Quality of Writing: Editing	7,392	82	86	87	88.38	88	247	84.09
Writing – G5	Conventions: Punctuation, Capitalization, and Spelling	7,392	82	86	87	89.14	89	247	84.09
Writing – G5	Conventions: Grammar and Sentence Formation	7,392	82	86	87	88.30	89	247	84.09
Writing – G6	Quality of Writing: Focus and Organization	9,278	81	84	85	88.18	86	248	80.21
Writing – G6	Quality of Writing: Content and Style	9,278	81	84	85	89.12	86	248	80.21
Writing – G6	Quality of Writing: Editing	9,278	81	83	85	86.52	86	250	80.21
Writing – G6	Conventions: Punctuation, Capitalization, and Spelling	9,278	81	84	85	87.54	86	247	80.21
Writing – G6	Conventions: Grammar and Sentence Formation	9,278	81	83	85	86.51	86	250	80.21
Writing – G7	Quality of Writing: Focus and Organization	12,496	81	84	85	88.41	86	249	80.21
Writing – G7	Quality of Writing: Content and Style	12,496	81	84	85	88.55	86	248	80.21
Writing – G7	Quality of Writing: Editing	12,496	81	84	85	86.63	86	248	80.21

**Table 15–21 (continued). Summary Statistics for Diagnostic Category Conditional Standard Errors Based on Full CDT**

<b>CDT</b>	<b>Diagnostic Category</b>	<b><i>N</i></b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Mean</b>	<b>Q3</b>	<b>Max</b>	<b>Theoretical Minimum</b>
Writing – G7	Conventions: Punctuation, Capitalization, and Spelling	12,496	81	84	85	87.66	86	247	80.21
Writing – G7	Conventions: Grammar and Sentence Formation	12,496	81	84	85	86.74	86	249	80.21
Writing – G8	Quality of Writing: Focus and Organization	11,506	80	84	85	88.77	86	249	80.21
Writing – G8	Quality of Writing: Content and Style	11,506	81	84	85	89.39	87	249	80.21
Writing – G8	Quality of Writing: Editing	11,506	81	84	85	87.63	86	248	80.21
Writing – G8	Conventions: Punctuation, Capitalization, and Spelling	11,506	81	84	85	88.16	86	248	80.21
Writing – G8	Conventions: Grammar and Sentence Formation	11,506	80	84	85	87.11	86	248	80.21
Eng. Comp.	Quality of Writing: Focus and Organization	9,746	81	84	85	88.49	86	249	80.21
Eng. Comp.	Quality of Writing: Content and Style	9,746	81	84	85	89.13	86	248	80.21
Eng. Comp.	Quality of Writing: Editing	9,746	81	84	85	87.50	86	252	80.21
Eng. Comp.	Conventions: Punctuation, Capitalization, and Spelling	9,746	81	84	85	88.06	86	249	80.21
Eng. Comp.	Conventions: Grammar and Sentence Formation	9,746	81	84	85	86.99	86	250	80.21

## DIAGNOSTIC CATEGORY SCORE DIFFERENCES

As described in Chapter Fourteen, the CDT reports that are available to teachers display scale scores and probable score ranges for each diagnostic category. The probable score range is the scale score  $\pm$  one standard error. Probable score range differences—ranges that do not overlap—may indicate to teachers a meaningful difference between two diagnostic category scores. Tables 15–22a through 15–34a show the number of students with score range differences (non-overlapping probable score ranges) between pairs of diagnostic categories for each full<sup>3</sup> CDT test. For example, according to Table 15–22a, 28,479 students who took the Math Grades 3–5 assessment had score range differences between diagnostic categories 1 and 2 while 102,735 students did not. Tables 15–22b through 15–34b show the total number of score range differences. For example, 24,195 students had two pairs of diagnostic categories with score range differences, which was 18.4% of the total students who took Math Grades 3–5.

**Table 15–22a. Diagnostic Category Score Range Differences – Math Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	28,479	102,735	21.7%	78.3%
DC1	DC3	34,178	97,036	26.0%	74.0%
DC1	DC4	29,032	102,182	22.1%	77.9%
DC2	DC3	35,502	95,712	27.1%	72.9%
DC2	DC4	27,253	103,961	20.8%	79.2%
DC3	DC4	34,160	97,054	26.0%	74.0%

**Table 15–22b. Total Number of Diagnostic Category Score Range Differences – Math Grades 3–5**

Number of Score Range Differences	Number of Students	Percent of Students
0	48,313	36.8%
1	23,290	17.7%
2	24,195	18.4%
3	26,246	20.0%
4	7,683	5.9%
5	1,468	1.1%
6	19	0.0%

**Table 15–23a. Diagnostic Category Score Range Differences – Math Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	45,860	138,806	24.8%	75.2%
DC1	DC3	50,922	133,744	27.6%	72.4%
DC1	DC4	49,428	135,238	26.8%	73.2%
DC2	DC3	48,273	136,393	26.1%	73.9%
DC2	DC4	48,916	135,750	26.5%	73.5%
DC3	DC4	48,755	135,911	26.4%	73.6%

<sup>3</sup> Score differences between diagnostic categories are based on full CDTs because scores are based on the same test event. Comparisons are not made based on diagnostic category CDTs which may be taken at very different times.

**Table 15–23b. Total Number of Diagnostic Category Score Range Differences – Math Grades 6–HS**

Number of Score Range Differences	Number of Students	Percent of Students
0	61,905	33.5%
1	31,412	17.0%
2	34,038	18.4%
3	39,893	21.6%
4	14,155	7.7%
5	3,211	1.7%
6	52	0.0%

**Table 15–24a. Diagnostic Category Score Range Differences – Algebra I**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	35,683	70,164	33.7%	66.3%
DC1	DC3	34,477	71,370	32.6%	67.4%
DC1	DC4	34,968	70,879	33.0%	67.0%
DC2	DC3	27,546	78,301	26.0%	74.0%
DC2	DC4	31,515	74,332	29.8%	70.2%
DC3	DC4	29,898	75,949	28.2%	71.8%

**Table 15–24b. Total Number of Diagnostic Category Score Range Differences – Algebra I**

Number of Score Range Differences	Number of Students	Percent of Students
0	30,230	28.6%
1	16,211	15.3%
2	18,610	17.6%
3	25,922	24.5%
4	11,540	10.9%
5	3,274	3.1%
6	60	0.1%

**Table 15–25a. Diagnostic Category Score Range Differences – Geometry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,410	6,077	28.4%	71.6%
DC1	DC3	2,401	6,086	28.3%	71.7%
DC1	DC4	2,468	6,019	29.1%	70.9%
DC2	DC3	2,537	5,950	29.9%	70.1%
DC2	DC4	2,722	5,765	32.1%	67.9%
DC3	DC4	2,591	5,896	30.5%	69.5%



**Table 15–25b. Total Number of Diagnostic Category Score Range Differences – Geometry**

Number of Score Range Differences	Number of Students	Percent of Students
0	2,519	29.7%
1	1,348	15.9%
2	1,477	17.4%
3	2,009	23.7%
4	880	10.4%
5	244	2.9%
6	10	0.1%

**Table 15–26a. Diagnostic Category Score Range Differences – Algebra II**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	4,466	7,312	37.9%	62.1%
DC1	DC3	4,227	7,551	35.9%	64.1%
DC1	DC4	5,197	6,581	44.1%	55.9%
DC2	DC3	3,337	8,441	28.3%	71.7%
DC2	DC4	3,620	8,158	30.7%	69.3%
DC3	DC4	3,607	8,171	30.6%	69.4%

**Table 15–26b. Total Number of Diagnostic Category Score Range Differences – Algebra II**

Number of Score Range Differences	Number of Students	Percent of Students
0	2,856	24.2%
1	1,611	13.7%
2	2,028	17.2%
3	3,063	26.0%
4	1,531	13.0%
5	660	5.6%
6	29	0.2%

**Table 15–27a. Diagnostic Category Score Range Differences – Reading Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	21,894	89,055	19.7%	80.3%
DC1	DC3	19,720	91,229	17.8%	82.2%
DC1	DC4	22,102	88,847	19.9%	80.1%
DC1	DC5	20,907	90,042	18.8%	81.2%
DC2	DC3	21,906	89,043	19.7%	80.3%
DC2	DC4	20,946	90,003	18.9%	81.1%
DC2	DC5	21,548	89,401	19.4%	80.6%
DC3	DC4	21,691	89,258	19.6%	80.4%
DC3	DC5	22,328	88,621	20.1%	79.9%
DC4	DC5	21,003	89,946	18.9%	81.1%

**Table 15–27b. Total Number of Diagnostic Category Score Range Differences – Reading Grades 3–5**

Number of Score Range Differences	Number of Students	Percent of Students
0	35,150	31.7%
1	17,180	15.5%
2	18,336	16.5%
3	14,888	13.4%
4	16,037	14.5%
5	5,272	4.8%
6	3,640	3.3%
7	387	0.3%
8	59	0.1%
9	0	0.0%
10	0	0.0%

**Table 15–28a. Diagnostic Category Score Range Differences – Reading/Lit Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	57,276	227,053	20.1%	79.9%
DC1	DC3	52,323	232,006	18.4%	81.6%
DC1	DC4	58,453	225,876	20.6%	79.4%
DC1	DC5	57,472	226,857	20.2%	79.8%
DC2	DC3	56,094	228,235	19.7%	80.3%
DC2	DC4	53,575	230,754	18.8%	81.2%
DC2	DC5	57,772	226,557	20.3%	79.7%
DC3	DC4	56,749	227,580	20.0%	80.0%
DC3	DC5	57,520	226,809	20.2%	79.8%
DC4	DC5	56,659	227,670	19.9%	80.1%

**Table 15–28b. Total Number of Diagnostic Category Score Range Differences – Reading/Lit Grades 6–HS**

Number of Score Range Differences	Number of Students	Percent of Students
0	88,687	31.2%
1	42,902	15.1%
2	46,314	16.3%
3	37,635	13.2%
4	42,315	14.9%
5	14,459	5.1%
6	10,421	3.7%
7	1,393	0.5%
8	201	0.1%
9	2	0.0%
10	0	0.0%

**Table 15–29a. Diagnostic Category Score Range Differences – Science Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	8,837	38,497	18.7%	81.3%
DC1	DC3	8,937	38,397	18.9%	81.1%
DC1	DC4	9,253	38,081	19.5%	80.5%
DC2	DC3	9,087	38,247	19.2%	80.8%
DC2	DC4	9,355	37,979	19.8%	80.2%
DC3	DC4	9,209	38,125	19.5%	80.5%

**Table 15–29b. Total Number of Diagnostic Category Score Range Differences – Science Grades 3–5**

Number of Score Range Differences	Number of Students	Percent of Students
0	21,520	45.5%
1	8,627	18.2%
2	7,955	16.8%
3	7,093	15.0%
4	1,835	3.9%
5	302	0.6%
6	2	0.0%

**Table 15–30a. Diagnostic Category Score Range Differences – Science Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	32,125	105,810	23.3%	76.7%
DC1	DC3	33,228	104,707	24.1%	75.9%
DC1	DC4	33,292	104,643	24.1%	75.9%
DC2	DC3	32,650	105,285	23.7%	76.3%
DC2	DC4	32,001	105,934	23.2%	76.8%
DC3	DC4	30,769	107,166	22.3%	77.7%

**Table 15–30b. Total Number of Diagnostic Category Score Range Differences – Science Grades 6–HS**

Number of Score Range Differences	Number of Students	Percent of Students
0	53,041	38.5%
1	23,970	17.4%
2	24,556	17.8%
3	26,202	19.0%
4	8,472	6.1%
5	1,675	1.2%
6	19	0.0%

**Table 15–31a. Diagnostic Category Score Range Differences – Biology**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	26,921	83,926	24.3%	75.7%
DC1	DC3	27,516	83,331	24.8%	75.2%
DC1	DC4	28,462	82,385	25.7%	74.3%
DC2	DC3	25,538	85,309	23.0%	77.0%
DC2	DC4	31,972	78,875	28.8%	71.2%
DC3	DC4	29,914	80,933	27.0%	73.0%

**Table 15–31b. Total Number of Diagnostic Category Score Range Differences – Biology**

Number of Score Range Differences	Number of Students	Percent of Students
0	38,583	34.8%
1	18,769	16.9%
2	20,452	18.5%
3	23,176	20.9%
4	8,230	7.4%
5	1,620	1.5%
6	17	0.0%

**Table 15–32a. Diagnostic Category Score Range Differences – Chemistry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	1,841	3,432	34.9%	65.1%
DC1	DC3	1,630	3,643	30.9%	69.1%
DC1	DC4	1,694	3,579	32.1%	67.9%
DC2	DC3	1,171	4,102	22.2%	77.8%
DC2	DC4	1,280	3,993	24.3%	75.7%
DC3	DC4	1,136	4,137	21.5%	78.5%

**Table 15–32b. Total Number of Diagnostic Category Score Range Differences – Chemistry**

Number of Score Range Differences	Number of Students	Percent of Students
0	1,712	32.5%
1	865	16.4%
2	909	17.2%
3	1,206	22.9%
4	455	8.6%
5	125	2.4%
6	1	0.0%

**Table 15–33a. Diagnostic Category Score Range Differences – Writing Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	3,437	15,224	18.4%	81.6%
DC1	DC3	3,504	15,157	18.8%	81.2%
DC1	DC4	4,339	14,322	23.3%	76.7%
DC1	DC5	3,861	14,800	20.7%	79.3%
DC2	DC3	3,375	15,286	18.1%	81.9%
DC2	DC4	4,222	14,439	22.6%	77.4%
DC2	DC5	3,759	14,902	20.1%	79.9%
DC3	DC4	3,720	14,941	19.9%	80.1%
DC3	DC5	3,445	15,216	18.5%	81.5%
DC4	DC5	4,127	14,534	22.1%	77.9%

**Table 15–33b. Total Number of Diagnostic Category Score Range Differences – Writing Grades 3–5**

Number of Score Range Differences	Number of Students	Percent of Students
0	5,696	30.5%
1	2,797	15.0%
2	3,048	16.3%
3	2,405	12.9%
4	2,908	15.6%
5	951	5.1%
6	722	3.9%
7	110	0.6%
8	24	0.1%
9	0	0.0%
10	0	0.0%

**Table 15–34a. Diagnostic Category Score Range Differences – Writing/Eng Comp Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	10,064	32,962	23.4%	76.6%
DC1	DC3	9,903	33,123	23.0%	77.0%
DC1	DC4	11,065	31,961	25.7%	74.3%
DC1	DC5	10,413	32,613	24.2%	75.8%
DC2	DC3	9,992	33,034	23.2%	76.8%
DC2	DC4	10,946	32,080	25.4%	74.6%
DC2	DC5	10,869	32,157	25.3%	74.7%
DC3	DC4	10,237	32,789	23.8%	76.2%
DC3	DC5	9,628	33,398	22.4%	77.6%
DC4	DC5	10,364	32,662	24.1%	75.9%

**Table 15–34b. Total Number of Diagnostic Category Score Range Differences – Writing/Eng Comp Grades 6–HS**

Number of Score Range Differences	Number of Students	Percent of Students
0	10,741	25.0%
1	5,789	13.5%
2	6,610	15.4%
3	5,799	13.5%
4	7,592	17.6%
5	3,105	7.2%
6	2,691	6.3%
7	561	1.3%
8	133	0.3%
9	5	0.0%
10	0	0.0%

Significant differences among diagnostic categories were tested based on t-test. Using the diagnostic category scale scores and the conditional standard errors for each student, the differences between pairs of diagnostic category scores were examined based on t-test for each student. A Bonferroni correction for multiple comparisons was performed to keep the family wise Type I error rate at 0.32. This results in the number of significant differences being smaller than the number of score range differences (non-overlapping probable score ranges) presented above. Tables 15–35a through 15–47a show the number of students who had significant differences between pairs of diagnostic categories for each assessment. Tables 15–35b through 15–47b show the total number of significant differences.

**Table 15–35a. Diagnostic Category Significant Differences – Math Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,623	128,591	2.0%	98.0%
DC1	DC3	4,345	126,869	3.3%	96.7%
DC1	DC4	2,858	128,356	2.2%	97.8%
DC2	DC3	4,476	126,738	3.4%	96.6%
DC2	DC4	2,661	128,553	2.0%	98.0%
DC3	DC4	4,143	127,071	3.2%	96.8%

Note: Z value is 1.94

**Table 15–35b. Total Number of Diagnostic Category Significant Differences – Math Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	116,445	88.7%
1	9,868	7.5%
2	3,542	2.7%
3	1,285	1.0%
4	71	0.1%
5	3	0.0%
6	0	0.0%

**Table 15–36a. Diagnostic Category Significant Differences – Math Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	5,954	178,712	3.2%	96.8%
DC1	DC3	7,226	177,440	3.9%	96.1%
DC1	DC4	6,937	177,729	3.8%	96.2%
DC2	DC3	6,448	178,218	3.5%	96.5%
DC2	DC4	6,758	177,908	3.7%	96.3%
DC3	DC4	6,777	177,889	3.7%	96.3%

Note: Z value is 1.94

**Table 15–36b. Total Number of Diagnostic Category Significant Differences – Math Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	158,206	85.7%
1	16,198	8.8%
2	7,196	3.9%
3	2,759	1.5%
4	302	0.2%
5	5	0.0%
6	0	0.0%

**Table 15–37a. Diagnostic Category Significant Differences – Algebra I**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	7,761	98,086	7.3%	92.7%
DC1	DC3	6,918	98,929	6.5%	93.5%
DC1	DC4	7,365	98,482	7.0%	93.0%
DC2	DC3	3,327	102,520	3.1%	96.9%
DC2	DC4	4,957	100,890	4.7%	95.3%
DC3	DC4	4,745	101,102	4.5%	95.5%

Note: Z value is 1.94



**Table 15–37b. Total Number of Diagnostic Category Significant Differences – Algebra I**

Number of Significant Differences	Number of Students	Percent of Students
0	83,770	79.1%
1	12,477	11.8%
2	6,549	6.2%
3	2,716	2.6%
4	325	0.3%
5	10	0.0%
6	0	0.0%

**Table 15–38a. Diagnostic Category Significant Differences – Geometry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	420	8,067	4.9%	95.1%
DC1	DC3	451	8,036	5.3%	94.7%
DC1	DC4	434	8,053	5.1%	94.9%
DC2	DC3	460	8,027	5.4%	94.6%
DC2	DC4	541	7,946	6.4%	93.6%
DC3	DC4	499	7,988	5.9%	94.1%

Note: Z value is 1.94

**Table 15–38b. Total Number of Diagnostic Category Significant Differences – Geometry**

Number of Significant Differences	Number of Students	Percent of Students
0	6,794	80.1%
1	900	10.6%
2	521	6.1%
3	225	2.7%
4	47	0.6%
5	0	0.0%
6	0	0.0%

**Table 15–39a. Diagnostic Category Significant Differences – Algebra II**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	1,248	10,530	10.6%	89.4%
DC1	DC3	951	10,827	8.1%	91.9%
DC1	DC4	1,724	10,054	14.6%	85.4%
DC2	DC3	542	11,236	4.6%	95.4%
DC2	DC4	690	11,088	5.9%	94.1%
DC3	DC4	636	11,142	5.4%	94.6%

Note: Z value is 1.94

**Table 15–39b. Total Number of Diagnostic Category Significant Differences – Algebra II**

Number of Significant Differences	Number of Students	Percent of Students
0	8,497	72.1%
1	1,574	13.4%
2	1,016	8.6%
3	590	5.0%
4	90	0.8%
5	11	0.1%
6	0	0.0%

**Table 15–40a. Diagnostic Category Significant Differences – Reading Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	255	110,694	0.2%	99.8%
DC1	DC3	230	110,719	0.2%	99.8%
DC1	DC4	298	110,651	0.3%	99.7%
DC1	DC5	230	110,719	0.2%	99.8%
DC2	DC3	287	110,662	0.3%	99.7%
DC2	DC4	242	110,707	0.2%	99.8%
DC2	DC5	286	110,663	0.3%	99.7%
DC3	DC4	283	110,666	0.3%	99.7%
DC3	DC5	457	110,492	0.4%	99.6%
DC4	DC5	315	110,634	0.3%	99.7%

Note: Z value is 2.15

**Table 15–40b. Total Number of Diagnostic Category Significant Differences – Reading Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	108,629	97.9%
1	1,866	1.7%
2	362	0.3%
3	76	0.1%
4	15	0.0%
5	1	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table 15–41a. Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	803	283,526	0.3%	99.7%
DC1	DC3	599	283,730	0.2%	99.8%
DC1	DC4	789	283,540	0.3%	99.7%
DC1	DC5	982	283,347	0.3%	99.7%
DC2	DC3	749	283,580	0.3%	99.7%
DC2	DC4	593	283,736	0.2%	99.8%
DC2	DC5	1,180	283,149	0.4%	99.6%
DC3	DC4	690	283,639	0.2%	99.8%
DC3	DC5	1,446	282,883	0.5%	99.5%
DC4	DC5	1,033	283,296	0.4%	99.6%

Note: Z value is 2.15

**Table 15–41b. Total Number of Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	277,283	97.5%
1	5,577	2.0%
2	1,172	0.4%
3	245	0.1%
4	52	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table 15–42a. Diagnostic Category Significant Differences – Science Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	728	46,606	1.5%	98.5%
DC1	DC3	739	46,595	1.6%	98.4%
DC1	DC4	722	46,612	1.5%	98.5%
DC2	DC3	785	46,549	1.7%	98.3%
DC2	DC4	764	46,570	1.6%	98.4%
DC3	DC4	732	46,602	1.5%	98.5%

Note: Z value is 1.94

**Table 15–42b. Total Number of Diagnostic Category Significant Differences – Science Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	44,144	93.3%
1	2,182	4.6%
2	749	1.6%
3	247	0.5%
4	11	0.0%
5	1	0.0%
6	0	0.0%

**Table 15–43a. Diagnostic Category Significant Differences – Science Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	3,733	134,202	2.7%	97.3%
DC1	DC3	3,968	133,967	2.9%	97.1%
DC1	DC4	3,786	134,149	2.7%	97.3%
DC2	DC3	3,853	134,082	2.8%	97.2%
DC2	DC4	3,555	134,380	2.6%	97.4%
DC3	DC4	3,228	134,707	2.3%	97.7%

Note: Z value is 1.94

**Table 15–43b. Total Number of Diagnostic Category Significant Differences – Science Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	123,173	89.3%
1	9,176	6.7%
2	3,951	2.9%
3	1,495	1.1%
4	140	0.1%
5	0	0.0%
6	0	0.0%

**Table 15–44a. Diagnostic Category Significant Differences – Biology**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	3,131	107,716	2.8%	97.2%
DC1	DC3	3,294	107,553	3.0%	97.0%
DC1	DC4	3,681	107,166	3.3%	96.7%
DC2	DC3	2,297	108,550	2.1%	97.9%
DC2	DC4	4,098	106,749	3.7%	96.3%
DC3	DC4	3,816	107,031	3.4%	96.6%

Note: Z value is 1.94

**Table 15–44b. Total Number of Diagnostic Category Significant Differences – Biology**

Number of Significant Differences	Number of Students	Percent of Students
0	96,935	87.4%
1	8,915	8.0%
2	3,709	3.3%
3	1,168	1.1%
4	120	0.1%
5	0	0.0%
6	0	0.0%

**Table 15–45a. Diagnostic Category Significant Differences – Chemistry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	499	4,774	9.5%	90.5%
DC1	DC3	371	4,902	7.0%	93.0%
DC1	DC4	371	4,902	7.0%	93.0%
DC2	DC3	66	5,207	1.3%	98.7%
DC2	DC4	86	5,187	1.6%	98.4%
DC3	DC4	80	5,193	1.5%	98.5%

Note: Z value is 1.94

**Table 15–45b. Total Number of Diagnostic Category Significant Differences – Chemistry**

Number of Significant Differences	Number of Students	Percent of Students
0	4,325	82.0%
1	537	10.2%
2	301	5.7%
3	106	2.0%
4	4	0.1%
5	0	0.0%
6	0	0.0%

**Table 15–46a. Diagnostic Category Significant Differences – Writing Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	110	18,551	0.6%	99.4%
DC1	DC3	120	18,541	0.6%	99.4%
DC1	DC4	195	18,466	1.0%	99.0%
DC1	DC5	197	18,464	1.1%	98.9%
DC2	DC3	102	18,559	0.5%	99.5%
DC2	DC4	185	18,476	1.0%	99.0%
DC2	DC5	136	18,525	0.7%	99.3%
DC3	DC4	135	18,526	0.7%	99.3%
DC3	DC5	116	18,545	0.6%	99.4%
DC4	DC5	172	18,489	0.9%	99.1%

Note: Z value is 2.15

**Table 15–46b. Total Number of Diagnostic Category Significant Differences – Writing Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	17,668	94.7%
1	670	3.6%
2	211	1.1%
3	74	0.4%
4	36	0.2%
5	2	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table 15–47a. Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	476	42,550	1.1%	98.9%
DC1	DC3	541	42,485	1.3%	98.7%
DC1	DC4	668	42,358	1.6%	98.4%
DC1	DC5	660	42,366	1.5%	98.5%
DC2	DC3	526	42,500	1.2%	98.8%
DC2	DC4	610	42,416	1.4%	98.6%
DC2	DC5	579	42,447	1.3%	98.7%
DC3	DC4	586	42,440	1.4%	98.6%
DC3	DC5	580	42,446	1.3%	98.7%
DC4	DC5	627	42,399	1.5%	98.5%

Note: Z value is 2.15

**Table 15–47b. Total Number of Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	39,339	91.4%
1	2,262	5.3%
2	872	2.0%
3	385	0.9%
4	155	0.4%
5	6	0.0%
6	7	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

Low numbers of significant differences across diagnostic categories, along with the high disattenuated correlations between categories and exploratory factor analyses discussed in Chapter Seventeen, suggest that some diagnostic categories might be measuring essentially the same construct. While this may be the case in general, when looking at group summary information, diagnostic category scores for individual students can provide useful information to teachers. For example, while 79.1% of students showed no significant differences between Algebra I diagnostic categories, 20.9% of students did. CDT diagnostic category scores for these students along with links to instructional resources are a valuable tool for teachers.

The tables in Appendix D show the significant differences with the familywise Type I error rate at 0.10.

## DISTRIBUTION OF BENCHMARK RANGES

As described in Chapter Ten, committees of Pennsylvania educators established preliminary CDT cut scores for grade 5 and above prior to the first operational use. Following the 2010–2011 school year, the preliminary cut scores were revised for the mathematics content-area tests. See Chapter Nineteen of the 2010–2011 technical report for details. Following the 2011–2012 school year, the preliminary cut scores were revised for the reading, science, and writing content-area tests. See Chapter Nineteen of the 2011–2012 technical report for details. Cut points for grades 2 through 4 were interpolated from existing cuts in grade 5 and above prior to the first operational use of CDT tests for grades 3 through 5. See Chapter Nineteen of the 2013–2014 technical report for details. Following the 2014–2015 school year, the cut scores were revised for the mathematics, reading, and writing content-area tests based on the revised PSSA tests. See Chapter Nineteen of the 2015–2016 technical report for details.

The benchmark cuts in place during the 2023–2024 school year determine the color ranges (red/green/blue) in the CDT dynamic reporting suite. The cut scores and standard errors (SE)<sup>4</sup> were used to define ranges as follows: The green range is defined as the scale score cut  $\pm$  one SE. The red range is defined as the scale minimum (200 for all CDTs except Algebra I, Geometry, Algebra II, Biology, and Chemistry which are 400) to the lower bound of the green range. The blue range is defined as the upper bound of the green range to the scale maximum (2000).

Table 15–48 shows the number and percentage of students in each benchmark range for each full CDT test. Tests with multiple benchmark cuts are broken down to match the grade level of the cuts. Tests that are course-specific are not broken down. All results are based on the cut points in place for the 2023–2024 school year.

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<sup>4</sup> The standard error was estimated based on simulations using the operational configuration of the CAT in terms of the content constraints and stopping rules.



**Table 15–48. Number and Percent of Students in Each CDT Score Range**

<b>CDT</b>	<b>Red <i>N</i></b>	<b>Red Percent</b>	<b>Green <i>N</i></b>	<b>Green Percent</b>	<b>Blue <i>N</i></b>	<b>Blue Percent</b>
Math – G3	31,581	79.6%	7,128	18.0%	980	2.5%
Math – G4	33,969	80.2%	7,114	16.8%	1,295	3.1%
Math – G5	38,303	77.9%	9,756	19.9%	1,088	2.2%
Math – G6	46,745	76.5%	12,291	20.1%	2,049	3.4%
Math – G7	54,228	81.6%	10,836	16.3%	1,426	2.1%
Math – G8	47,447	84.9%	7,223	12.9%	1,229	2.2%
Math – HS	1,174	98.5%	18	1.5%	0	0.0%
Algebra I	90,407	85.4%	13,990	13.2%	1,450	1.4%
Geometry	7,020	82.7%	1,290	15.2%	177	2.1%
Algebra II	9,653	82.0%	1,816	15.4%	309	2.6%
Reading – G3	21,819	64.9%	10,105	30.1%	1,697	5.0%
Reading – G4	23,478	64.7%	11,309	31.1%	1,527	4.2%
Reading – G5	25,427	62.0%	14,225	34.7%	1,362	3.3%
Reading – G6	31,753	63.8%	17,108	34.4%	937	1.9%
Reading – G7	38,862	67.9%	17,366	30.3%	993	1.7%
Reading – G8	37,784	68.8%	16,490	30.0%	651	1.2%
Literature	78,243	63.9%	41,893	34.2%	2,249	1.8%
Science – G3	2,669	51.1%	2,005	38.4%	554	10.6%
Science – G4	15,489	52.1%	11,526	38.8%	2,710	9.1%
Science – G5	7,371	59.5%	4,222	34.1%	788	6.4%
Science – G6	17,073	62.3%	9,384	34.2%	959	3.5%
Science – G7	29,023	66.6%	13,503	31.0%	1,029	2.4%
Science – G8	44,804	70.5%	17,662	27.8%	1,107	1.7%
Science – HS	3,017	89.0%	345	10.2%	29	0.9%
Biology	78,473	70.8%	27,714	25.0%	4,660	4.2%
Chemistry	4,166	79.0%	1,066	20.2%	41	0.8%
Writing – G3	3,328	66.8%	1,476	29.6%	180	3.6%
Writing – G4	4,350	69.2%	1,780	28.3%	155	2.5%
Writing – G5	5,043	68.2%	2,140	29.0%	209	2.8%
Writing – G6	6,275	67.6%	2,733	29.5%	270	2.9%
Writing – G7	8,485	67.9%	3,723	29.8%	288	2.3%
Writing – G8	8,301	72.1%	3,014	26.2%	191	1.7%
English Composition	6,011	61.7%	3,326	34.1%	409	4.2%

## MULTIPLE ADMINISTRATIONS OF THE SAME CDT TEST

As previously indicated, there are a number of students who took the same full CDT test multiple times. This section focuses on the number of days between administrations and both changes in scale score and benchmark range across a student's first and last administrations.

Table 15–49 shows the summary statistics for the number of days from the first to last administration.

**Table 15–49. Summary Statistics for Number of Days between Administrations**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	46,819	0	125	160	167.43	223	280
Math Grades 6–HS	67,634	0	124	158	165.84	208	279
Algebra I	35,599	0	121	160	161.29	200	278
Geometry	2,878	14	134	190	187.74	244	275
Algebra II	3,893	32	146	194	184.61	237	273
Reading Grades 3–5	39,699	0	126	154	164.44	198	275
Reading/Lit Grades 6–HS	103,369	0	117	147	152.86	186	277
Science Grades 3–5	16,489	0	128	165	166.63	197	274
Science Grades 6–HS	46,779	0	127	162	164.87	197	276
Biology	37,851	0	113	170	160.80	208	273
Chemistry	1,798	56	111	162	166.97	229	278
Writing Grades 3–5	6,991	0	128	143	150.07	177	264
Writing/Eng Comp Gr 6–HS	13,883	0	119	151	158.57	190	273

Table 15–50 shows the summary statistics for the change in total scale score from the first to last administration.

**Table 15–50. Summary Statistics for Change in Total Scale Score between Administrations**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	46,819	-596	26	82	84.57	142	717
Math Grades 6–HS	67,634	-547	-9	48	46.94	106	661
Algebra I	35,599	-561	-34	39	32.22	104	724
Geometry	2,878	-600	-15	64	55.36	134	756
Algebra II	3,893	-525	-12	60	54.92	129	559
Reading Grades 3–5	39,699	-491	-16	43	44.14	103	517
Reading/Lit Grades 6–HS	103,369	-651	-49	10	9.34	70	637
Science Grades 3–5	16,489	-577	-12	48	49.99	109	634
Science Grades 6–HS	46,779	-538	-40	20	17.36	76	710
Biology	37,851	-633	-14	56	54.40	123	840
Chemistry	1,798	-346	-14	52	45.98	111	423
Writing Grades 3–5	6,991	-533	-14	46	48.52	110	534
Writing/Eng Comp Gr 6–HS	13,883	-573	-44	19	19.05	83	639

Tables 15–51a through 15–51m show the changes in benchmark range from the first to last administration. For example, 8,855 students who scored in the red range on the first administration of the Math Grades 3–5 test scored in the green range on the last administration.

**Table 15–51a. Change in Benchmark Range between First and Last Administrations – Math Grades 3–5**

	Red–last test	Green – last test	Blue – last test
Red–first test	32,355	8,855	527
Green–first test	472	3,085	1,189
Blue–first test	0	37	299

**Table 15–51b. Change in Benchmark Range between First and Last Administrations – Math Grades 6–HS**

	Red – last test	Green – last test	Blue – last test
Red–first test	49,260	8,990	364
Green–first test	1,114	5,278	1,743
Blue–first test	0	135	750

**Table 15–51c. Change in Benchmark Range between First and Last Administrations – Algebra I**

	Red – last test	Green – last test	Blue – last test
Red–first test	27,333	4,971	263
Green–first test	549	1,828	530
Blue–first test	2	14	109

**Table 15–51d. Change in Benchmark Range between First and Last Administrations – Geometry**

	Red – last test	Green – last test	Blue – last test
Red–first test	2,085	523	18
Green–first test	25	127	86
Blue–first test	0	1	13

**Table 15–51e. Change in Benchmark Range between First and Last Administrations – Algebra II**

	Red – last test	Green – last test	Blue – last test
Red–first test	2,762	716	50
Green–first test	38	204	90
Blue–first test	0	1	32

**Table 15–51f. Change in Benchmark Range between First and Last Administrations – Reading Grades 3–5**

	Red – last test	Green – last test	Blue – last test
Red–first test	21,873	5,767	80
Green–first test	1,215	8,266	1,545
Blue–first test	1	261	691

**Table 15–51g. Change in Benchmark Range between First and Last Administrations – Reading/Lit Grades 6–HS**

	Red – last test	Green – last test	Blue – last test
Red–first test	58,764	10,145	26
Green–first test	6,196	25,290	1,463
Blue–first test	6	800	679

**Table 15–51h. Change in Benchmark Range between First and Last Administrations – Science Grades 3–5**

	Red – last test	Green – last test	Blue – last test
Red–first test	7,237	2,674	102
Green–first test	638	3,789	1,142
Blue–first test	4	198	705

**Table 15–51i. Change in Benchmark Range between First and Last Administrations – Science Grades 6–HS**

	Red – last test	Green – last test	Blue – last test
Red–first test	27,710	5,542	85
Green–first test	2,438	9,379	947
Blue–first test	9	211	458

**Table 15–51j. Change in Benchmark Range between First and Last Administrations – Biology**

	Red – last test	Green – last test	Blue – last test
Red–first test	21,957	7,731	740
Green–first test	844	4,323	1,927
Blue–first test	6	32	291

**Table 15–51k. Change in Benchmark Range between First and Last Administrations – Chemistry**

	Red – last test	Green – last test	Blue – last test
Red–first test	1,176	409	11
Green–first test	33	147	20
Blue–first test	0	0	2

**Table 15–51l. Change in Benchmark Range between First and Last Administrations – Writing Grades 3–5**

	Red – last test	Green – last test	Blue – last test
Red–first test	4,198	1,045	21
Green–first test	219	1,218	184
Blue–first test	1	31	74

**Table 15–51m. Change in Benchmark Range between First and Last Administrations – Writing/Eng Comp Grades 6–HS**

	<b>Red – last test</b>	<b>Green – last test</b>	<b>Blue – last test</b>
Red–first test	8,239	1,582	15
Green–first test	735	2,746	303
Blue–first test	0	92	171

## CHAPTER SIXTEEN: RELIABILITY

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This chapter addresses the reliability of Classroom Diagnostic Tools (CDT) test scores. According to the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), the general notion of reliability/precision refers to

the consistency of scores across replications of a testing procedure, regardless of how this consistency is estimated or reported (p.33).

Frisbie (2005) highlighted several elements of reliability. First, reliability is a property of test scores, not of a test itself. Many may appreciate this distinction, but in casual usage, individuals frequently make reference to a “reliable test.” While reliability concerns test scores (and not the test specifically), it’s important to appreciate the fact that test scores can be affected by characteristics of the instrument. For example, all other things being equal, tests with more items/points tend to be more reliable than tests with fewer items/points. Second, reliability coefficients are group specific. Reliabilities tend to be higher in populations that are more heterogeneous and lower in populations that are more homogeneous. Consequently, both test length and population heterogeneity should be considered when evaluating reliability.

There are other reliability considerations that may be less evident from the *Standards’* definition yet are still important for test users to understand. While freedom from measurement error is very important, reliability is specifically concerned with random sources of error. Indeed, the degree of inconsistency due to random error sources is what determines reliability: less consistency is associated with lower reliability and more consistency is associated with higher reliability. Of course, systematic error sources also exist. These can artificially increase reliability and decrease validity. Validity is further discussed in Chapter Seventeen.

Another noteworthy issue is that multiple sources of error exist (e.g., the day of testing, the items used). However, most widely used reliability indices only reflect a single type of error. Consequently, it is important for test users to understand what specific type of error is being considered in a reliability study, and equally, if not more importantly, what types are not.

Understanding the distinction between relative error and absolute error is also important, as many reliability indices only reflect relative error. Relative error is of interest whenever the relative ordering of individuals with respect to their test performance is of interest. Understanding examinee rank-order stability is important; however, such stability might be well achieved even when the specific score values are considerably different. When specific score values are considered important (e.g., if cut scores are used), then absolute error is of interest, too. Generally, there is more error variance when considering the absolute scores of examinees, which, in turn, suggests lower reliability.

As the above discussion suggests, reliability is a complex, nonunitary notion that cannot be adequately represented by a single number. There are several reliability indices available, and these may not provide the same results (Frisbie, 2005). The remainder of this chapter covers the following:

- Reliability coefficients and their interpretation
- Unconditional and conditional standard errors of measurement (SEMs and CSEMs)
- Decision consistency

### RELIABILITY INDICES

As shown below, the reliability coefficient expresses the consistency of test scores as the ratio of true score variance to total score variance. The total variance contains two components: 1) variance in true scores and 2) variance due to the imperfections in the measurement process. Put differently, total variance equals true score variance plus error variance.<sup>1</sup>

$$\rho_X^2 = \frac{\sigma_T^2}{\sigma_X^2} = \frac{\sigma_T^2}{\sigma_T^2 + \sigma_E^2}$$

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<sup>1</sup> A covariance term is not required, as true scores and error are assumed to be uncorrelated in classical test theory.

Reliability coefficients indicate the degree to which differences in test scores reflect true differences in the attribute being tested rather than random fluctuations. Total test score variance (i.e., individual differences) is partly due to real differences in the attribute (true variance) and partly due to random error in the measurement process (error variance).

Reliability coefficients range from 0.0 to 1.0. If all test score variance were true, the index would equal 1.0. The index would be 0.0 if none of the test score variance were true. Such scores would be pure random noise (i.e., all measurement error). If the index had a value of 1.0, scores would be perfectly consistent (i.e., contain no measurement error). Although values of 1.0 are never achieved in practice, it is clear that larger coefficients are more desirable, as they indicate that test scores are less influenced by random error. “How big is big enough?” and “how small is too small?” are issues considered in a later section.

As noted in the introduction, there are several different indices that can be used to estimate this ratio. One approach is referred to as internal consistency, which is derived from analyzing the performance consistency of individuals over the items within a test. As discussed below, these internal consistency indices do not take into account other sources of error, such as day-to-day variations (student health, testing environment, etc.).

## COEFFICIENT ALPHA

Although a number of reliability indices exist, one of the most frequently reported for achievement tests is coefficient alpha. For example, both PSSA and Keystone programs report alpha.

### FORMULA FOR ALPHA

Consider the following data matrix representing the scores of persons (rows) on items (columns):

**Table 16–1. Person × Item Score ( $X_{pi}$ ) Infinite (Population-Universe) Matrix**

Person	Item 1	Item 2	...	Item $i$	...	Item $k$
Person 1	$Y_{11}$	$Y_{12}$	...	$Y_{1i}$	...	$X_{1k}$
Person 2	$Y_{21}$	$Y_{22}$	...	$Y_{2i}$	...	$X_{2k}$
....	...	...	...	...	...	...
Person $p$	$Y_{p1}$	$Y_{p2}$	...	$Y_{pi}$	...	$X_{pk}$
....	...	...	...	...	...	...
Person $N$	$Y_{N1}$	$Y_{N2}$	...	$Y_{Ni}$	...	$X_{Nk}$

Note: Adapted from Cronbach and Shavelson (2004).

Then, a general computational formula for alpha is as follows:

$$\alpha = \frac{N}{N-1} \left( 1 - \frac{\sum_{i=1}^N \sigma_{Y_i}^2}{\sigma_X^2} \right),$$

where  $N$  is the number of parts (items or testlets),  $\sigma_X^2$  is the variance of the observed total test scores, and  $\sigma_{Y_i}^2$  is the variance of part  $i$ .

Examination of the formula for alpha indicates why the coefficient is not appropriate for CDT. In the case of CDT, tests are adaptive. Each student takes a unique set of test items rather than the same fixed form. A person item score matrix for CDT analogous to Table 16–1 would include all items in the available item pool (over 5,000 in some cases). Each student takes only a small subset of items (48–60) from the available pool. Summing the variance of more than 5,000 item scores and dividing by the variance of test scores based on 48–60 items is not appropriate. Therefore, a measure of reliability other than alpha must be used for CDT.

## SPLIT-HALF RELIABILITY

Like alpha, split-half is an internal consistency index. It can be conceptualized as the extent to which an exchangeable set of items from the same domain would result in a similar rank ordering of students. Note that relative error is reflected in this index. Variation in student performance from one sample of items to the next should be of particular concern for any test user. Consider two hypothetical vocabulary tests intended for the same group of students. Each test contains different sets of unique words that are believed to be randomly equivalent, perhaps like the ones shown below:

**Table 16–2. Two Hypothetical Vocabulary Tests**

Test One	Test Two
Abase	Abate
Boon	Bilk
Capricious	Circuitous
Deface	Debase
....	....
Zealous	Zenith

If a representative group of students could take both of these tests, the correlation between the scores obtained would represent the parallel forms reliability of the test scores. However, such data-collection designs are impractical in large-scale settings and experimental confounds like fatigue and practice effects are likely to affect the results. Internal-consistency reliability indices arose in part to provide reliability measures using the data from just a single test administration. So, if students only took Test One and the split-half reliability index for those test scores was high, this would suggest that Test Two would provide a very similar rank ordering of the students if they had taken it instead. If split-half reliability was low, dissimilar rank orderings would likely be observed—again, relative-error variance is reflected.

### CALCULATION OF SPLIT-HALF RELIABILITY

To determine split-half reliability for a given CDT test, such as Biology, each administration of the test was split into two halves. Each item’s difficulty was considered in the split so the halves represent approximately equivalent alternative forms. Rasch ability estimates were then calculated for each of the two halves. Then, Pearson correlation was computed between the Rasch ability estimates from the two halves. Finally, the Pearson correlation was adjusted for test length using the Spearman-Brown prediction formula as described below.

$$\text{Split-Half reliability} = \frac{2r}{1+r} \quad \text{where } r = \text{Pearson correlation}$$

Split-half reliability is related to coefficient alpha in that alpha is often interpreted as the mean of all possible split-half coefficients.

### FURTHER INTERPRETATIONS

What reliability value is considered high enough? What values are considered too low? Although frequently asked for, any rules of thumb for interpreting the magnitude of reliability indices are mostly arbitrary. One approach is to research the reliabilities from similar testing instruments to see what values are commonly observed. For 2024 PSSA tests in Mathematics, English Language Arts (ELA), and Science, reliability coefficients ranged from 0.84 to 0.92. For spring 2024 Keystone exams in Algebra I, Biology, and Literature reliability coefficients were 0.93, 0.93, and 0.92, respectively. For many other state assessment programs, reliabilities in the low 0.90s are usually the highest observed, and reliabilities in the high 0.80s are very common.

The lower a given reliability coefficient, the greater the potential for over-interpretation of the associated results. As suggested earlier, there is no firm guideline regarding how low is too low. However, as an informative point of reference, a reliability coefficient of 0.50 would mean that there is as much error variance as true-score variance in the scores.

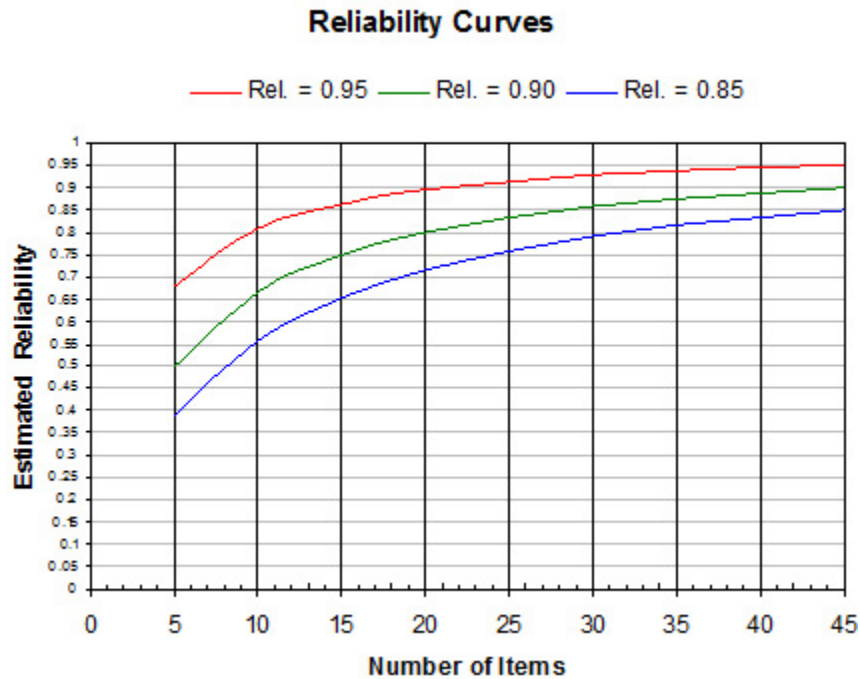


## DIAGNOSTIC CATEGORY SCORE RELIABILITY

$$SEM = SD\sqrt{1 - \text{reliability}}$$

As noted in the introduction, reliabilities tend to be higher with an increase in test length and lower with a decrease in test length. Figure 16–1 illustrates this relationship for a hypothetical 45-item test with three total score reliabilities: 0.95, 0.90, and 0.85. As an example, the curve for reliability equal to 0.90 suggests that a 10-item diagnostic category score would be expected to have a score reliability of just over 0.65. The use of the Spearman-Brown prediction formula assumes all items are exchangeable, which, in practice, they may not be. While such a chart may not perfectly model actual diagnostic category reliability, the intent is to illustrate the substantial impact that limited numbers of items can have on diagnostic category score reliability.

Figure 16–1. Example of the Relationship between Test Length and Reliability



## STANDARD ERROR OF MEASUREMENT

The reliability coefficient is a unit-free indicator that reflects the degree to which scores are free of measurement error. It always ranges between 0.0 and 1.0 regardless of the test’s scale. Reliability coefficients best reflect the extent to which measurement inconsistencies may be present or absent in a group. However, they are not that useful for helping users interpret test scores. The standard error of measurement (SEM) is another indicator of test score precision that is better suited for determining the effect of measurement inconsistencies on the scores obtained by individual examinees. This is particularly so for conditional SEMs (CSEM) discussed further below.

### TRADITIONAL STANDARD ERROR OF MEASUREMENT

A precise, theoretical interpretation of the SEM is somewhat unwieldy. A beginning point for understanding the concept is as follows. If everyone being tested had the same true score,<sup>2</sup> there would still be some variation in observed scores due to imperfections in the measurement process, such as random differences in attention during instruction or concentration during testing, the sampling of test items, etc. The standard error is defined as the standard deviation<sup>3</sup> of the distribution of observed scores for students with identical true scores. Because the SEM is an index of the random variability in test scores in actual score units, it represents very important information for test score users.

<sup>2</sup> True score is the score the person would receive if the measurement process were perfect.

<sup>3</sup> The standard deviation of a distribution is a measure of the dispersion of the observations. For the normal distribution, about 16 percent of the observations are more than one standard deviation above the mean.

The SEM formula is provided below:

It indicates that the value of the SEM depends on both the reliability coefficient and the standard deviation of test scores. If the reliability were equal to 0.00 (the lowest possible value), the SEM would be equal to the standard deviation of the test scores. If test reliability were equal to 1.00 (the highest possible value), the SEM would be 0.0. In other words, a perfectly reliable test has no measurement error (Harvill, 1991). Additionally, the value of the SEM takes the group variation (i.e., score standard deviation) into account.

## **TRADITIONAL SEM CONFIDENCE INTERVALS**

The SEM is an index of the random variability in test scores in actual score units, which is why it has such great utility for test score users. SEMs allow statements regarding the precision of individual tests scores. SEMs help place reasonable limits (Gulliksen, 1950) around observed scores through construction of an approximate score band. Often referred to as confidence intervals, these bands are constructed by taking the observed scores,  $X$ , and adding and subtracting a multiplicative factor of the SEM. As an example, students with a given true score will have observed scores that fall between  $\pm 1$  SEM about two-thirds of the time.<sup>4</sup> For  $\pm 2$  SEM confidence intervals, the percentage increases to about 95 percent.

## **FURTHER INTERPRETATIONS**

### ONE SEM FOR ALL TEST SCORES

The SEM approach described above only provides a single numerical estimate for constructing the confidence intervals for examinees regardless of their score levels. In reality, however, such confidence intervals vary according to one's score. Consequently, care should be taken when using the SEM for students with extreme scores. An alternate approach is described in the next section that conditions the SEM on a student's score estimate.

### GROUP SPECIFIC

As noted in the introduction, reliabilities are group specific. The same is true for SEMs because both score reliabilities and score standard deviations vary across groups.

### SCALE SCORE METRIC

The SEM approach is calculated using scale scores, and as such, the resulting confidence interval bands are in the scale score metric.

### TYPE OF ERROR REFLECTED

The interpretation of the SEM should be driven by the type of score reliability that underpins it. So, the CDT SEMs involve the same source of error relevant to internal consistency indices. As noted earlier, a precise technical explanation of the SEM (and resulting confidence intervals) can be unwieldy. Because of this, score users are often provided less complex interpretations.

One simpler description sometimes used is that a confidence interval represents the possible score range that one would observe if a student could be tested twice with the same instrument. Taking the same test on a different day implies the only source of random error being considered is related to the occasion of testing—such as a student might be sleepier one day than another, might be sick, or might not have eaten a good breakfast. There is a reliability index that captures this source of random error and it is referred to as the test-retest reliability coefficient. This is not the type of reliability computed for the CDT. When internal consistency reliability estimates are used, such an explanation blurs the fact that random error based on the occasion of testing is not considered.

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<sup>4</sup> Some prefer the following interpretation: if a student were tested an infinite number of times, the  $\pm 1$  SEM confidence intervals constructed for each score would capture the student's true score 68 percent of the time.

When SEMs are derived from internal consistency reliability estimates, a better approach is to describe the confidence interval as providing reasonable bounds for the range of scores that a student might receive if he or she took an equivalent version of the test. That is, the student took a test that covered exactly the same content, but included a different set of items. As an example, if the Algebra I score was 1078 and the SEM band was 1038 to 1118, then a student would be likely to receive a score somewhere between 1038 and 1118 if he or she took a different version of the test without additional instruction.

## RESULTS AND OBSERVATIONS

Split-half reliability coefficients and associated (traditional) SEMs for CDT tests are presented in Table 16–3. Values were derived using the operational data from the 2023–2024 school year. The results are presented for total scores and each diagnostic category score. The statistics reported include number of students tested (*N*), mean scale score, standard deviation of scale score, split-half reliability, and traditional standard error of measurement (SEM) in the scale score metric.

**Table 16–3. CDT Reliabilities**

CDT	Score	Average Number of Points	<i>N</i>	Scale Score Mean	Scale Score SD	Split-Half Reliability	SEM in Scale Score Metric
<b>Math Grades 3–5</b>	<b>Total</b>	51.5	131,214	775.234	167.952	0.944	39.7
Math Grades 3–5	Numbers and Operations	12.9	131,214	770.898	194.507	0.827	81.0
Math Grades 3–5	Algebraic Concepts	12.9	131,214	783.835	183.136	0.802	81.5
Math Grades 3–5	Geometry	12.9	131,214	757.646	173.037	0.778	81.6
Math Grades 3–5	Measurement, Data, and Probability	12.9	131,214	778.120	189.056	0.816	81.1
<b>Math Grades 6–HS</b>	<b>Total</b>	52.0	184,666	939.498	158.702	0.941	38.6
Math Grades 6–HS	Numbers and Operations	13.0	184,666	949.546	192.004	0.839	77.0
Math Grades 6–HS	Algebraic Concepts	13.0	184,666	943.055	179.703	0.813	77.8
Math Grades 6–HS	Geometry	13.0	184,666	940.972	162.497	0.775	77.1
Math Grades 6–HS	Measurement, Data, and Probability	13.1	184,666	927.769	182.532	0.817	78.2
<b>Algebra I</b>	<b>Total</b>	52.9	105,847	971.995	162.109	0.939	40.0
Algebra I	Operations with Real Numbers and Expressions	13.2	105,847	964.630	212.418	0.865	78.1
Algebra I	Linear Equations & Inequalities	13.2	105,847	984.249	163.826	0.764	79.6
Algebra I	Functions & Coordinate Geometry	13.2	105,847	986.613	175.339	0.796	79.2
Algebra I	Data Analysis	13.3	105,847	958.806	190.024	0.824	79.7
<b>Geometry</b>	<b>Total</b>	53.1	8,487	1015.206	169.256	0.944	40.0
Geometry	Geometric Properties	13.1	8,487	1013.027	181.280	0.812	78.5
Geometry	Congruence, Similarity, & Proofs	13.3	8,487	1020.253	187.475	0.808	82.2
Geometry	Coordinate Geometry and Right Triangles	13.3	8,487	1025.800	203.827	0.849	79.2
Geometry	Measurement	13.3	8,487	1004.869	200.720	0.844	79.2

**Table 16–3 (continued). CDT Reliabilities**

<b>CDT</b>	<b>Score</b>	<b>Average Number of Points</b>	<b>N</b>	<b>Scale Score Mean</b>	<b>Scale Score SD</b>	<b>Split-Half Reliability</b>	<b>SEM in Scale Score Metric</b>
<b>Algebra II</b>	<b>Total</b>	53.1	11,778	1079.773	169.583	0.945	39.9
Algebra II	Operations with Complex Numbers	13.4	11,778	1134.615	195.102	0.829	80.7
Algebra II	Non-linear Expressions & Equations	13.2	11,778	1063.337	206.545	0.856	78.4
Algebra II	Functions	13.2	11,778	1085.527	183.008	0.817	78.2
Algebra II	Data Analysis	13.3	11,778	1044.549	203.811	0.847	79.7
<b>Reading Grades 3–5</b>	<b>Total</b>	57.7	110,949	762.750	166.557	0.927	44.9
Reading Grades 3–5	Key Ideas and Details-Literature Text	12.0	110,949	759.411	202.381	0.736	104.0
Reading Grades 3–5	Key Ideas and Details-Informational Text	11.6	110,949	756.272	196.862	0.716	104.9
Reading Grades 3–5	Craft and Structure-Literature Text	11.5	110,949	777.567	188.071	0.664	109.0
Reading Grades 3–5	Craft and Structure-Informational Text	11.6	110,949	753.751	199.002	0.717	105.8
Reading Grades 3–5	Vocabulary Acquisition and Use	11.0	110,949	752.851	215.709	0.759	105.9
<b>Reading/Lit Grades 6–HS</b>	<b>Total</b>	57.5	284,329	918.619	162.341	0.927	43.9
Reading/Lit Grades 6–HS	Key Ideas and Details-Literature Text	11.8	284,329	914.923	196.215	0.722	103.4
Reading/Lit Grades 6–HS	Key Ideas and Details-Informational Text	11.5	284,329	920.567	197.000	0.719	104.4
Reading/Lit Grades 6–HS	Craft and Structure-Literature Text	11.6	284,329	923.104	182.776	0.682	103.1
Reading/Lit Grades 6–HS	Craft and Structure-Informational Text	11.8	284,329	912.717	200.119	0.734	103.2
Reading/Lit Grades 6–HS	Vocabulary Acquisition and Use	10.8	284,329	915.330	214.876	0.748	107.9
<b>Science Grades 3–5</b>	<b>Total</b>	51.4	47,334	716.391	171.844	0.940	42.0
Science Grades 3–5	The Nature of Science	12.9	47,334	709.312	192.986	0.793	87.9
Science Grades 3–5	Biological Sciences	12.9	47,334	711.362	191.614	0.798	86.0
Science Grades 3–5	Physical Sciences	12.9	47,334	721.584	187.123	0.787	86.3
Science Grades 3–5	Earth and Space Sciences	12.8	47,334	716.160	179.354	0.764	87.1
<b>Science Grades 6–HS</b>	<b>Total</b>	52.4	137,935	829.930	150.178	0.925	41.1
Science Grades 6–HS	The Nature of Science	13.1	137,935	823.134	186.035	0.800	83.3
Science Grades 6–HS	Biological Sciences	13.1	137,935	827.392	182.680	0.790	83.7
Science Grades 6–HS	Physical Sciences	13.1	137,935	843.680	163.435	0.736	83.9
Science Grades 6–HS	Earth and Space Sciences	13.1	137,935	828.201	160.509	0.728	83.7

**Table 16–3 (continued). CDT Reliabilities**

<b>CDT</b>	<b>Score</b>	<b>Average Number of Points</b>	<b>N</b>	<b>Scale Score Mean</b>	<b>Scale Score SD</b>	<b>Split-Half Reliability</b>	<b>SEM in Scale Score Metric</b>
<b>Biology</b>	<b>Total</b>	52.8	110,847	922.951	154.269	0.928	41.5
Biology	Basic Biological Principles/ Chemical Basis for Life	13.2	110,847	919.085	189.757	0.804	83.9
Biology	Bioenergetics/Homeostasis and Transport	13.2	110,847	936.318	158.177	0.714	84.5
Biology	Cell Growth and Reproduction/ Genetics	13.2	110,847	936.999	168.441	0.746	85.0
Biology	Theory of Evolution/Ecology	13.2	110,847	902.143	193.990	0.814	83.6
<b>Chemistry</b>	<b>Total</b>	53.1	5,273	955.073	112.743	0.850	43.6
Chemistry	Properties and Classification of Matter	13.3	5,273	911.069	187.744	0.804	83.2
Chemistry	Atomic Structure and the Periodic Table	13.3	5,273	988.589	123.430	0.518	85.7
Chemistry	The Mole and Chemical Bonding	13.2	5,273	968.787	128.333	0.552	85.9
Chemistry	Chemical Relationships and Reactions	13.4	5,273	959.701	132.835	0.575	86.6
<b>Writing Grades 3–5</b>	<b>Total</b>	54.8	18,661	742.777	182.847	0.950	40.7
Writing Grades 3–5	Quality of Writing: Focus and Organization	11.0	18,661	734.167	212.364	0.802	94.5
Writing Grades 3–5	Quality of Writing: Content and Style	11.0	18,661	743.434	202.394	0.785	93.8
Writing Grades 3–5	Quality of Writing: Editing	10.9	18,661	742.105	200.534	0.787	92.5
Writing Grades 3–5	Conventions: Punctuation, Capitalization, and Spelling	10.9	18,661	743.674	195.974	0.769	94.2
Writing Grades 3–5	Conventions: Grammar and Sentence Formation	11.0	18,661	739.918	210.688	0.807	92.6
<b>Writing/Eng Comp Gr 6–HS</b>	<b>Total</b>	55.7	43,026	867.547	174.566	0.948	40.0
Writing/Eng Comp Gr 6–HS	Quality of Writing: Focus and Organization	11.2	43,026	860.006	209.763	0.804	92.8
Writing/Eng Comp Gr 6–HS	Quality of Writing: Content and Style	11.2	43,026	872.699	201.504	0.786	93.1
Writing/Eng Comp Gr 6–HS	Quality of Writing: Editing	11.1	43,026	864.322	198.102	0.792	90.4
Writing/Eng Comp Gr 6–HS	Conventions: Punctuation, Capitalization, and Spelling	11.1	43,026	877.734	203.969	0.800	91.3
Writing/Eng Comp Gr 6–HS	Conventions: Grammar and Sentence Formation	11.1	43,026	857.188	199.642	0.797	90.0

The overall test score reliability values are high and similar to those reported for PSSA and Keystone Exams. The reliabilities at the diagnostic category level are lower due to the fact that each diagnostic category contains fewer items.

## RASCH CONDITIONAL STANDARD ERRORS OF MEASUREMENT

The CSEM also indicates the degree of measurement error in scale score units, but varies as a function of a student's actual scale score. Therefore, the CSEM may be especially useful in characterizing measurement precision in the neighborhood of a score level used for decision-making—such as cut scores for identifying students who meet a performance standard.

Technically, when a Rasch model is applied, the CSEM at any given point on the ability continuum is defined as the reciprocal of the square root of the test information function derived from the Rasch scaling model:

$$CSEM(\hat{\beta}_n) = \frac{1}{\sqrt{I(\hat{\beta}_n)}},$$

where  $CSEM(\hat{\beta}_n)$  is the conditional standard error of measurement and  $I(\hat{\beta}_n)$  is the test information function. Test information depends on the sum of the corresponding information functions for the test items. Item information depends on each item's difficulty and conditional item score variance. The formula above utilizes the Rasch ability ( $\hat{\beta}_n$ ) metric. The conditional standard error on the scale score (SS) metric is determined simply by multiplying the  $CSEM(\hat{\beta}_n)$  by the slope (multiplicative constant,  $m$ ) of the linear transformation equation used to convert the Rasch ability estimates to scale scores:

$$CSEM(SS) = CSEM(\hat{\beta}_n) * m$$

Chapter Eleven provides the linear transformation formulas for each of the CDT content areas.

## RASCH CSEM CONFIDENCE INTERVALS

CSEMs also allow statements regarding the precision of individual tests scores. And like SEMs, they help place reasonable limits around observed scale scores through construction of an approximate score band. The confidence intervals are constructed by adding and subtracting a multiplicative factor of the CSEM and may be interpreted as described in the earlier section.

## FURTHER INTERPRETATIONS

### DIFFERENT CSEMS FOR DIFFERENT TEST SCORES

The CSEM approach provides different numerical estimates for constructing the confidence intervals for examinees depending on their specific score. On fixed form tests, the magnitude of the CSEM values is often “U” shaped, with larger CSEM values associated with lower and higher scores. With a fixed set of items, there is less information for students scoring at the extremes, and CSEM is inversely related to the information function (the more information, the lower the CSEM). Given that CDT tests are adaptive, this “U” shape tends to be less pronounced as students are presented with items targeted at their level. While there is some “U” shape at the extreme ends of the vertical scale, there is a much larger area on the scale where CSEMs are relatively flat compared to fixed form tests. The adaptive tests allow for greater information and, therefore, lower CSEMs across a wide range of the vertical scale.

### GROUP SPECIFIC

Assuming reasonable model-data fit—as explored in Chapter Eight—the Rasch based CSEMs (conditioned on score level) should not vary across groups.

### SCALE SCORE METRIC

The CSEM and associated confidence interval bands are in the scale score metric.

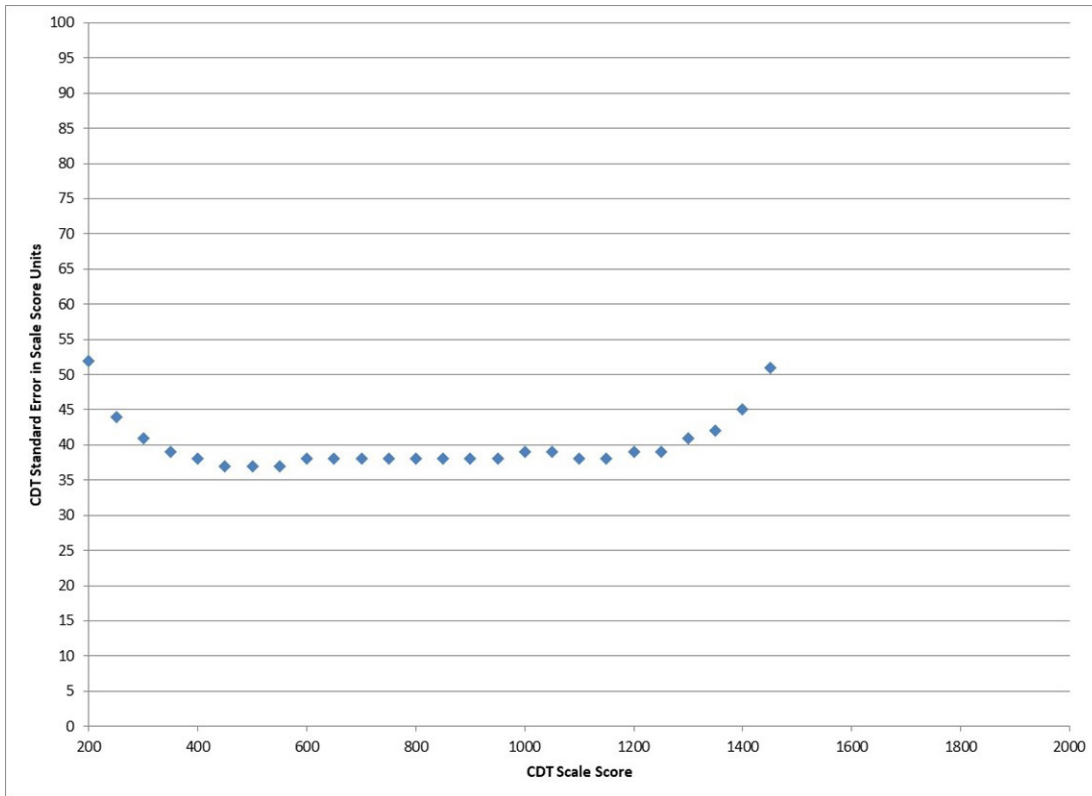
## TYPE OF ERROR REFLECTED

The CSEMs reported in the dynamic reporting suite are the Rasch-based conditional standard errors of measurement described above. Score report content is considered in greater detail in Chapter Fourteen.

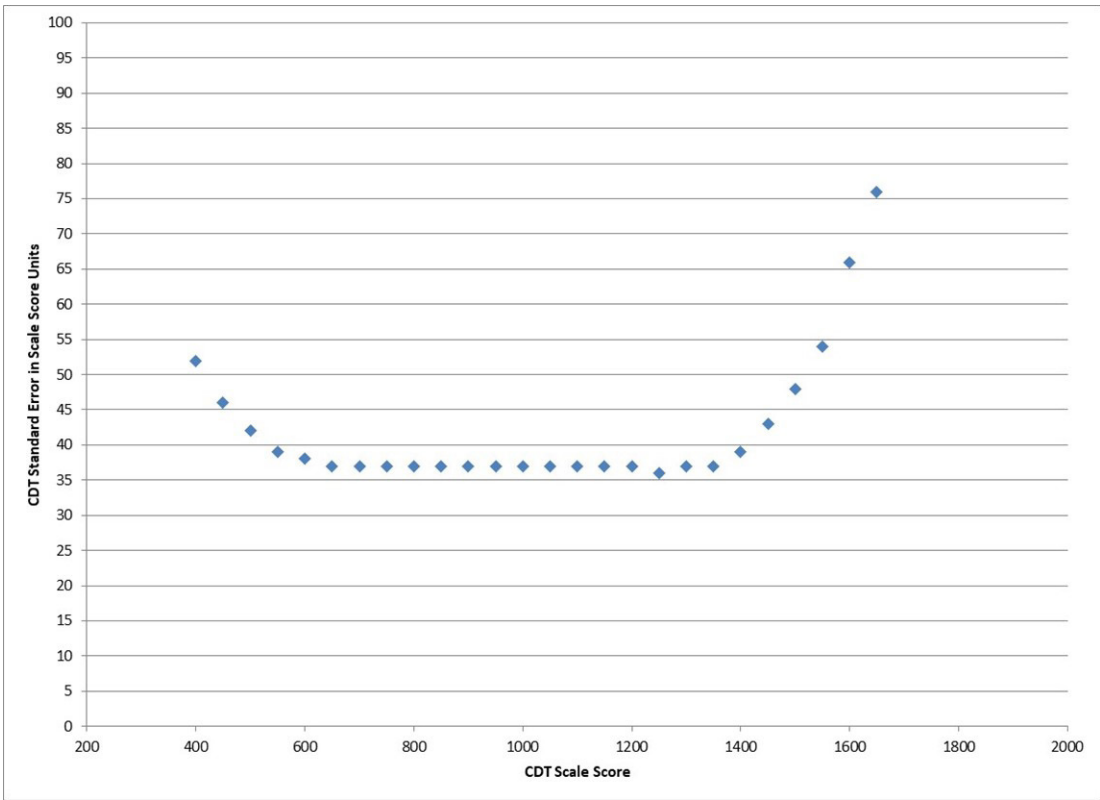
## RESULTS AND OBSERVATIONS

Figures 16–2 through 16–14 show the average Rasch CSEMs associated with various scale score ranges based on operational data from the 2023–2024 school year. The values are fairly consistent across a large range of scores on the vertical scale. The values increase at the low and high ends of the scale score range.

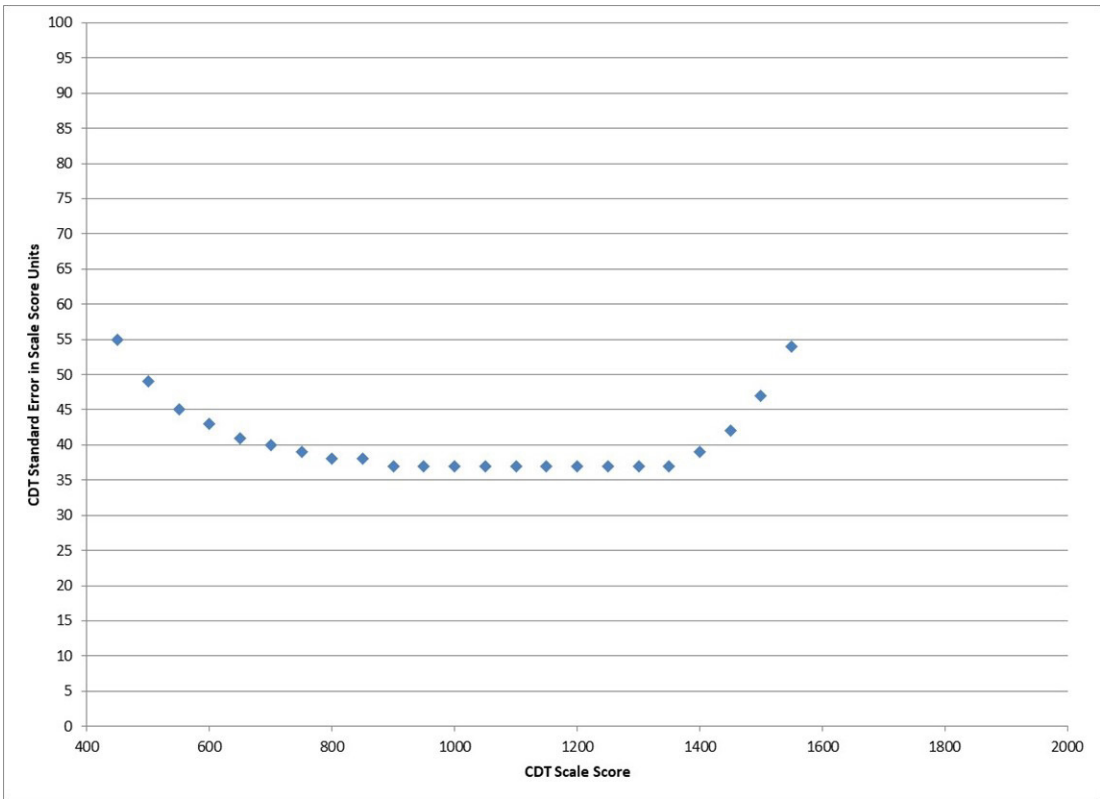
**Figure 16–2. Average Conditional Standard Errors for Math Grades 3–5**



**Figure 16–3. Average Conditional Standard Errors for Math Grades 6–HS**

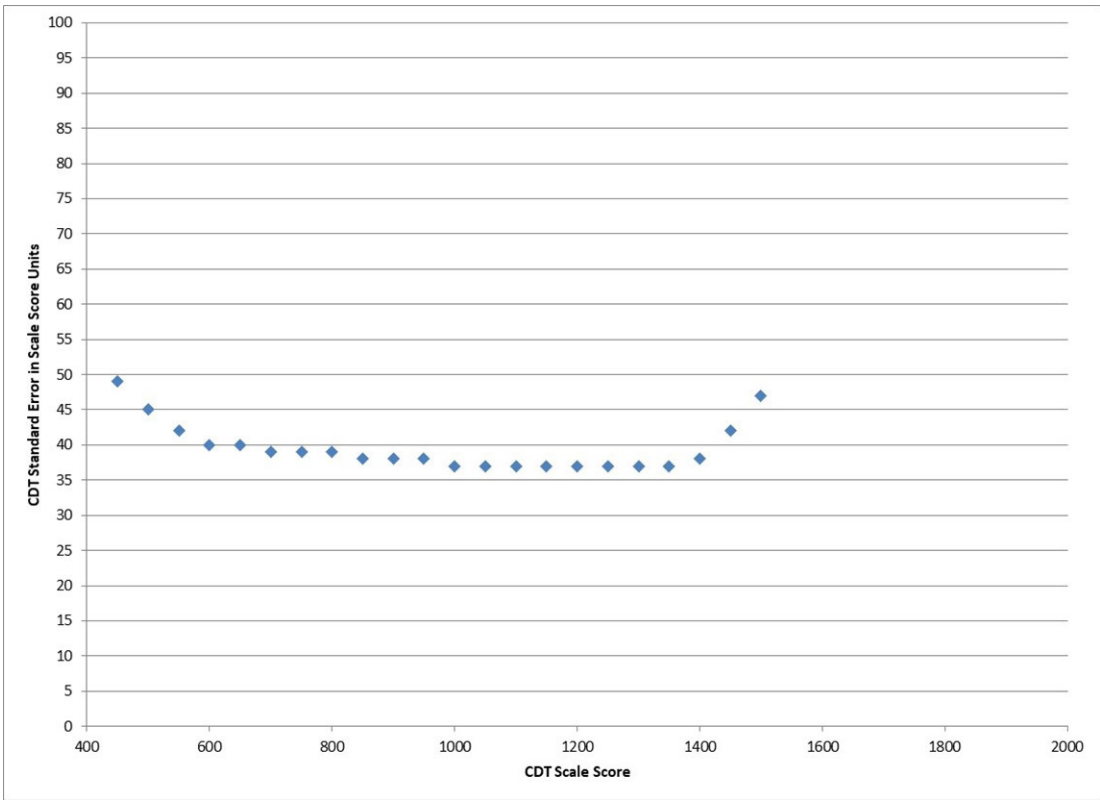


**Figure 16–4. Average Conditional Standard Errors for Algebra I**

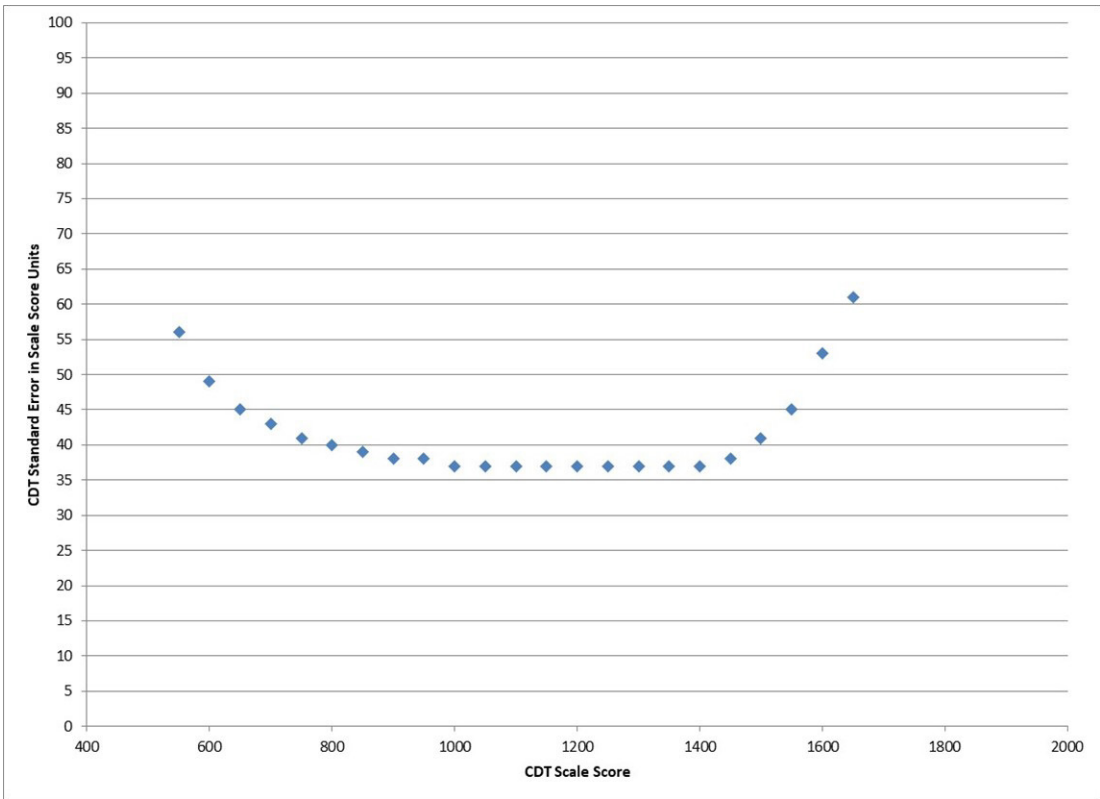




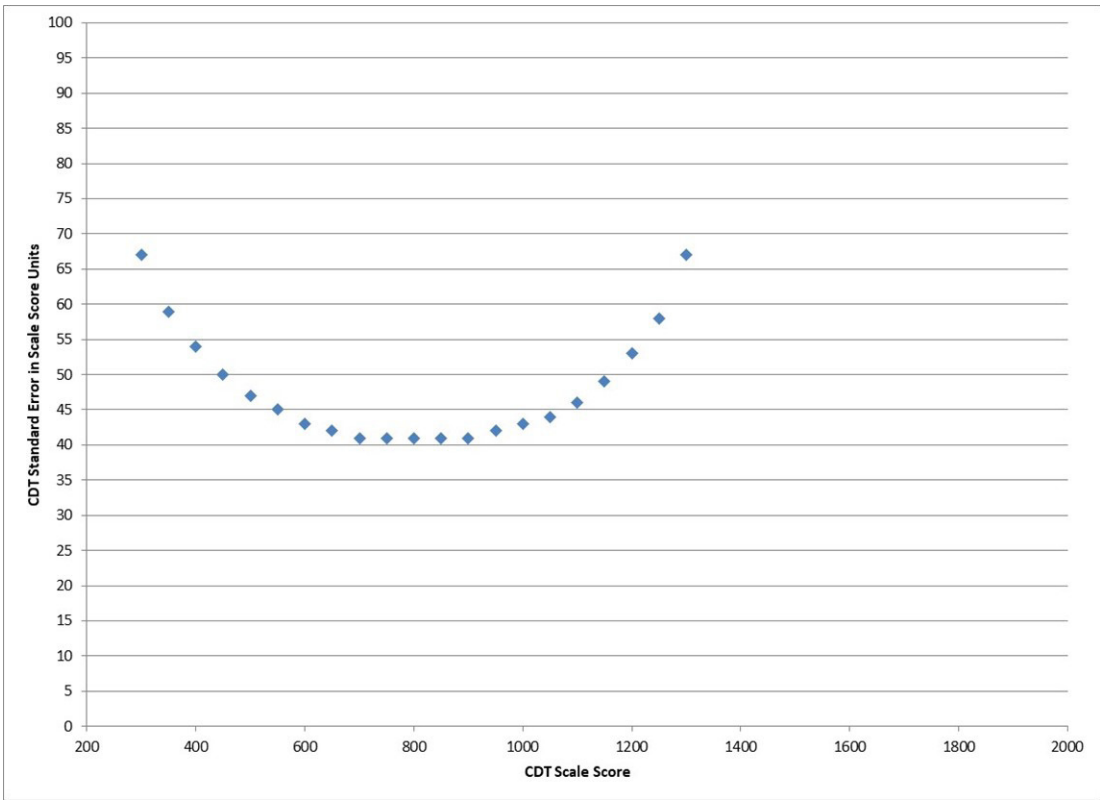
**Figure 16–5. Average Conditional Standard Errors for Geometry**



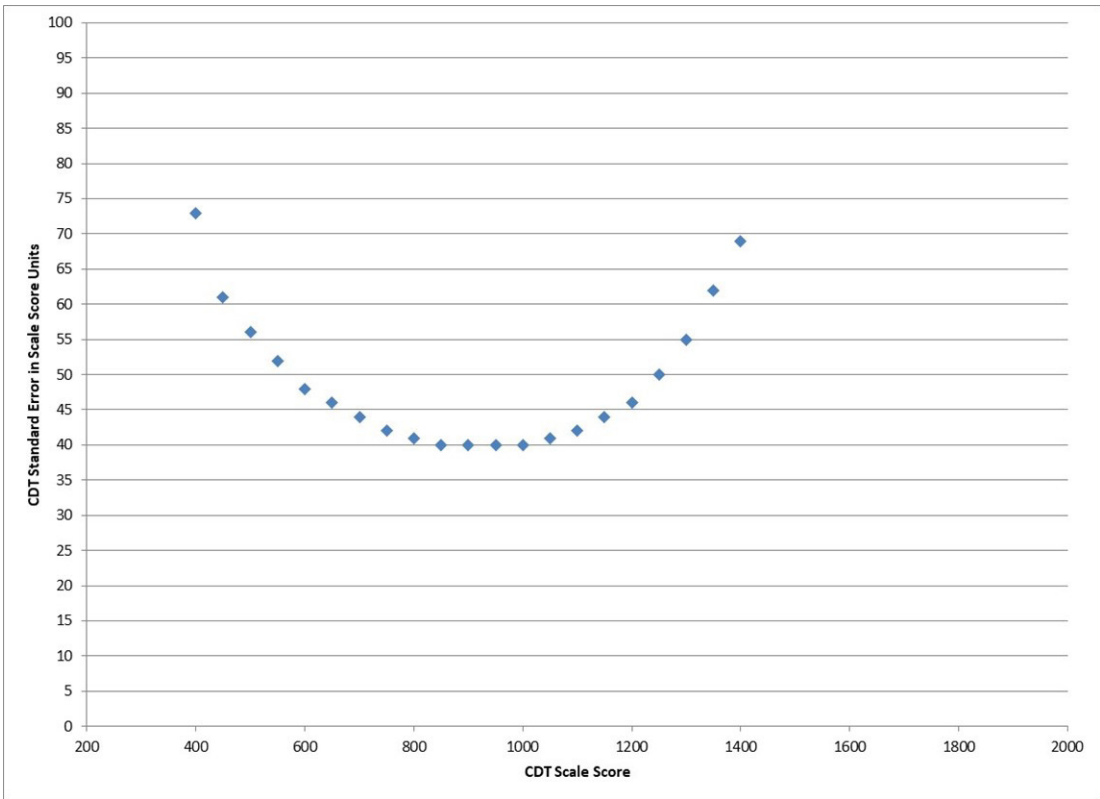
**Figure 16–6. Average Conditional Standard Errors for Algebra II**



**Figure 16–7. Average Conditional Standard Errors for Reading Grades 3–5**

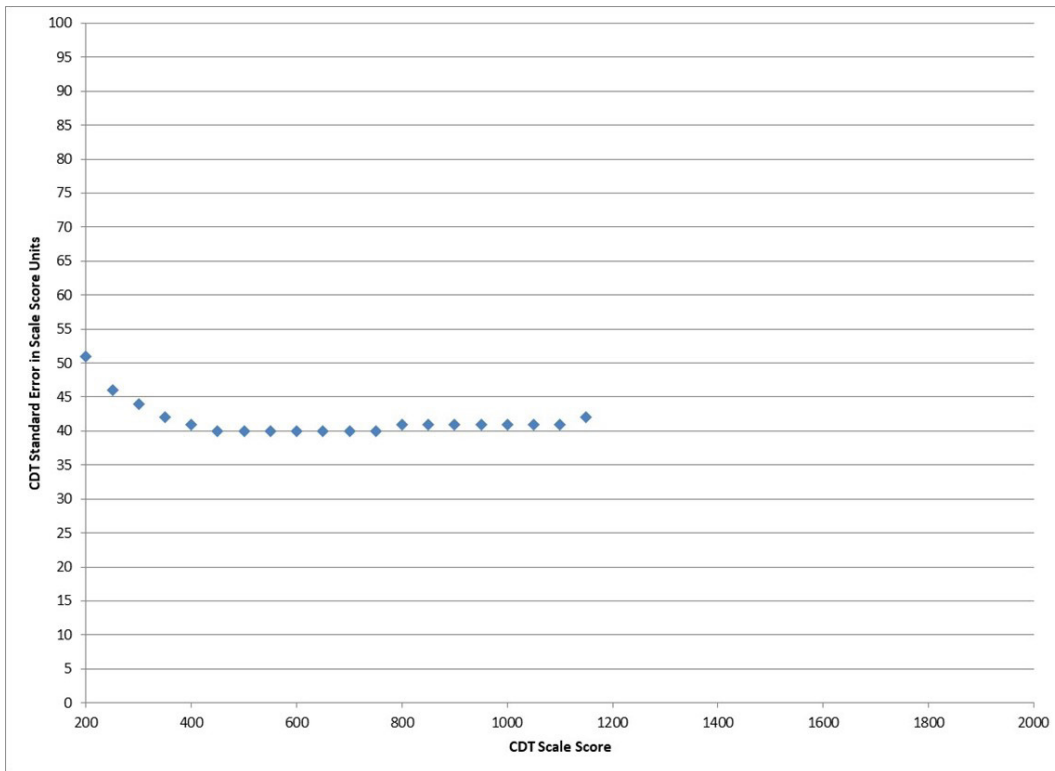


**Figure 16–8. Average Conditional Standard Errors for Reading/Lit Grades 6–HS**

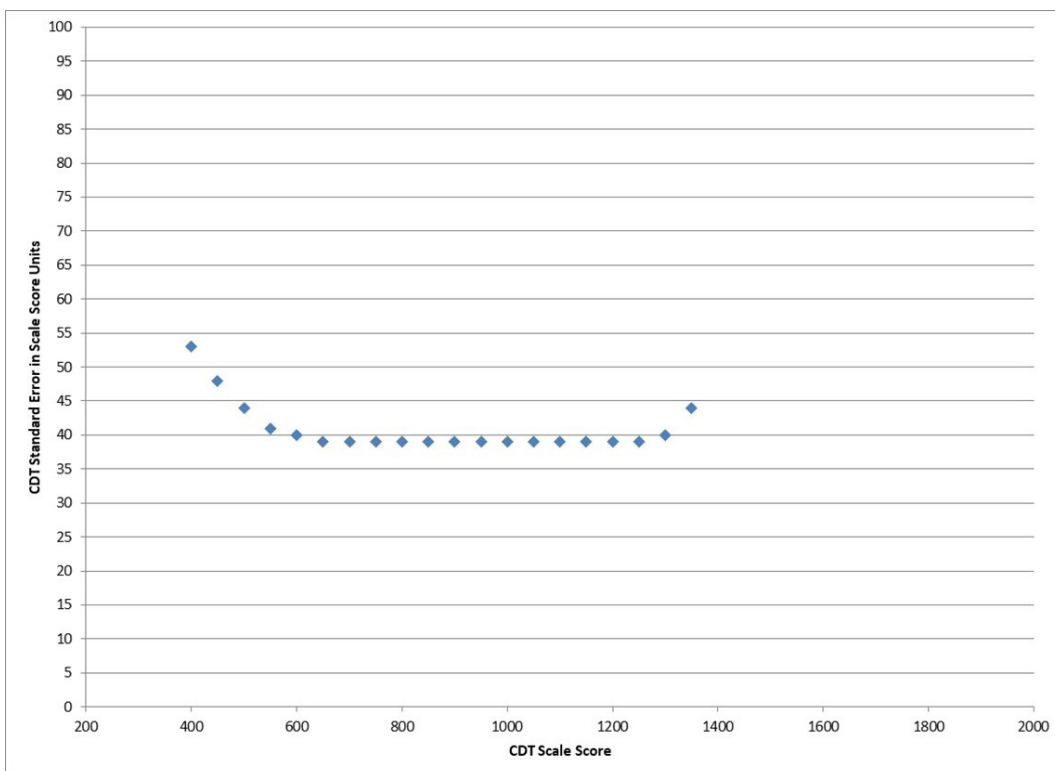


CSEMs tend to be higher in the reading content area. This is due to the fact that CDT Reading Grades 3–5 and CDT Reading/Lit Grades 6–HS are passage-based. The items from a selected passage may not be as closely targeted to the student’s level as when individual items are selected one at a time. For more information on adaptive selection of passages, see Chapter Thirteen.

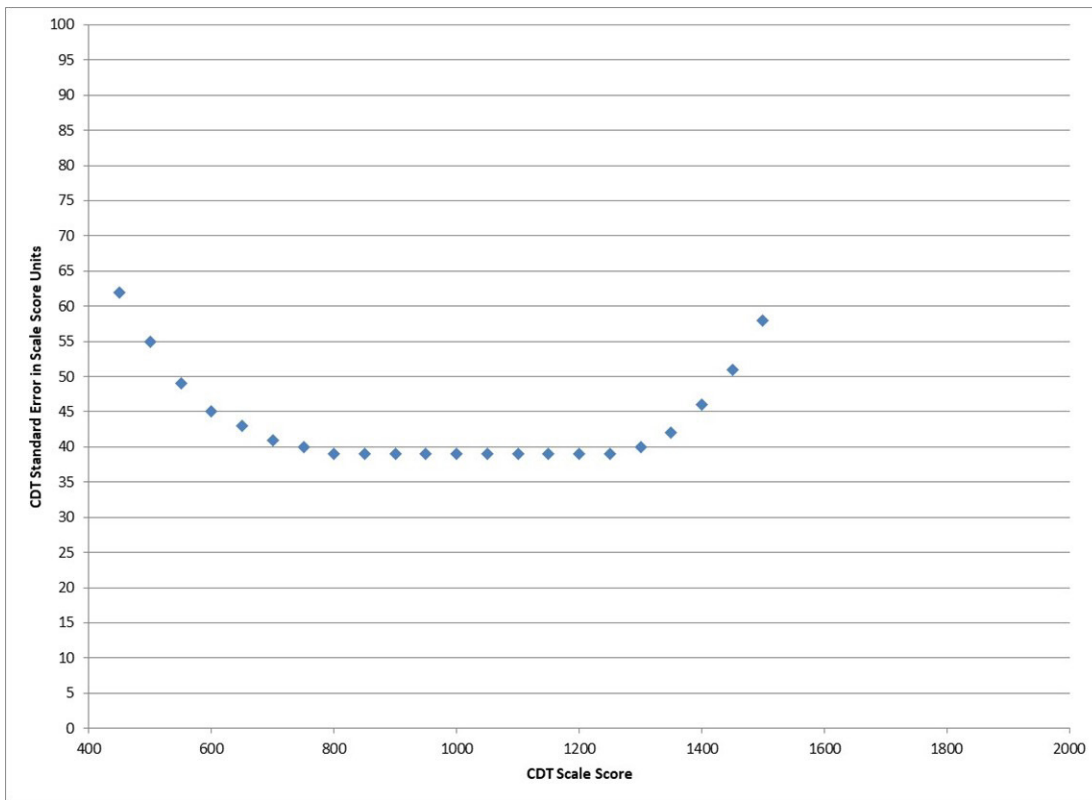
**Figure 16–9. Average Conditional Standard Errors for Science Grades 3–5**



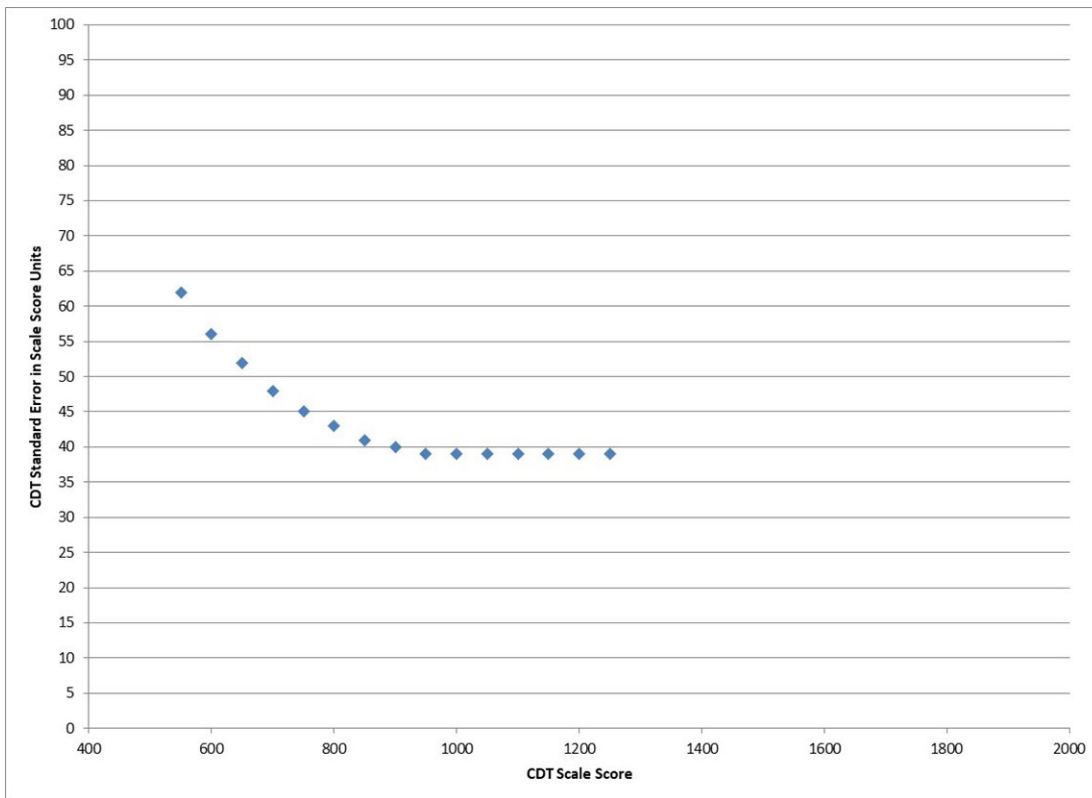
**Figure 16–10. Average Conditional Standard Errors for Science Grades 6–HS**



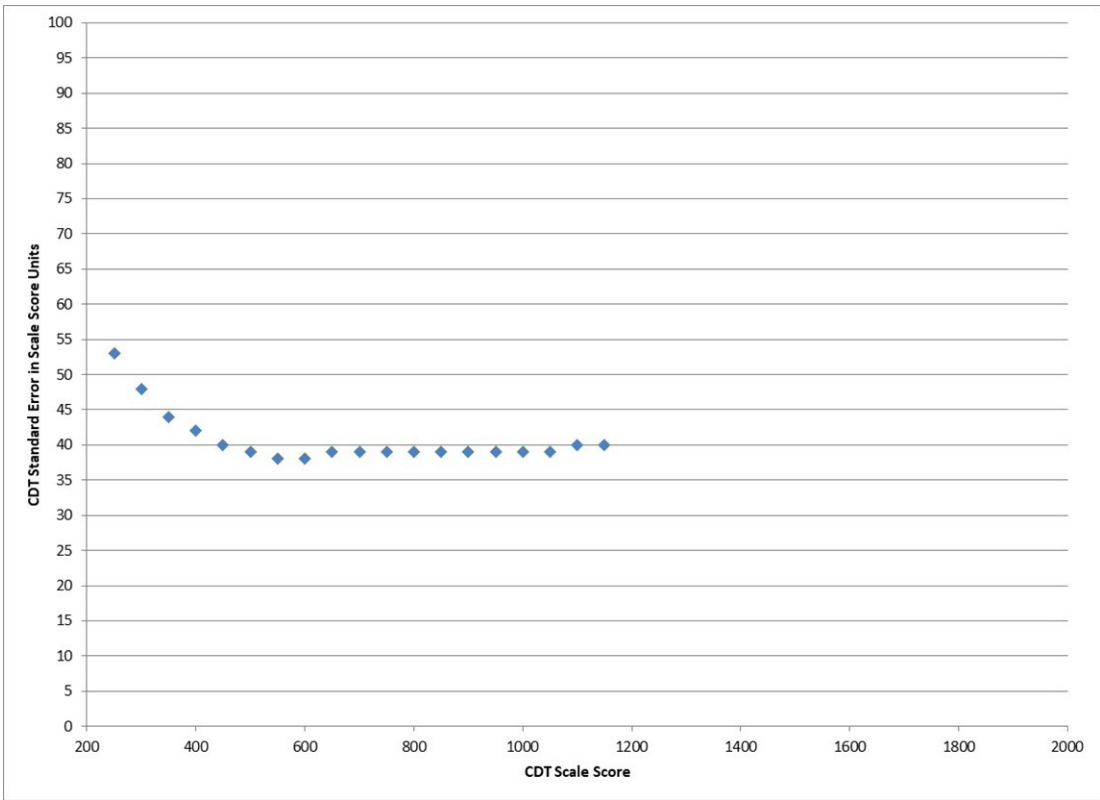
**Figure 16–11. Average Conditional Standard Errors for Biology**



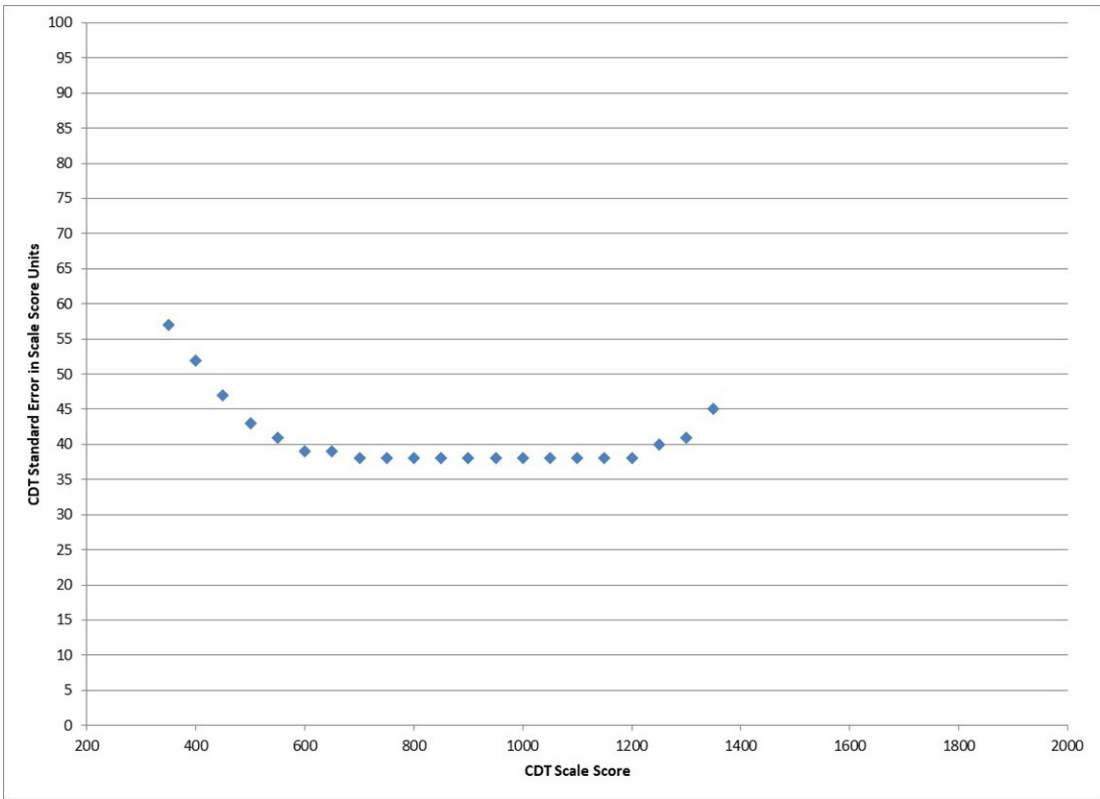
**Figure 16–12. Average Conditional Standard Errors for Chemistry**



**Figure 16–13. Average Conditional Standard Errors for Writing Grades 3–5**



**Figure 16–14. Average Conditional Standard Errors for Writing/Eng Comp Grades 6–HS**



## DECISION CONSISTENCY

Classification decision consistency refers to the degree to which the achievement level for each student can be replicated upon retesting using an equivalent form (Huynh, 1976). While CDT is designed to be administered multiple times in the school year to gauge progress following instruction, retesting in the context of decision consistency refers to retesting shortly after testing without additional instruction.

In a standards-based testing program, there should be great interest in knowing how accurately students are classified into performance categories. In contrast to reliability, which is concerned with the relative rank-ordering of students, it is the absolute values of student scores that are important in decision consistency.

Decision consistency answers the question “What is the agreement between the classifications based on two non-overlapping, equally difficult forms of the test?” If two parallel forms of the test were given to the same students (without additional instruction), the consistency of the measure would be reflected by the extent to which the classification decisions made based on the first set of test scores matched the decisions based on the second set of test scores. Consider Table 16–4:

**Table 16–4. Pseudo-Decision Table for Three Hypothetical Categories**

Test Level	Test One – Level I	Test One – Level II	Test One – Level III	Test One – Marginal
Test Two – Level I	$\phi_{11}$	$\phi_{12}$	$\phi_{13}$	$\phi_{1\bullet}$
Test Two – Level II	$\phi_{21}$	$\phi_{22}$	$\phi_{23}$	$\phi_{2\bullet}$
Test Two – Level III	$\phi_{31}$	$\phi_{32}$	$\phi_{33}$	$\phi_{3\bullet}$
Test Two – Marginal	$\phi_{\bullet 1}$	$\phi_{\bullet 2}$	$\phi_{\bullet 3}$	1

If a student is classified as in one category based on Test One’s score, how probable would it be that the student would be reclassified in the same category if he or she took Test Two (a non-overlapping, equally difficult form of the test)?

The proportions of correct decisions,  $\phi$ , for three categories is computed as:

$$\tilde{O} = \phi_{11} + \phi_{22} + \phi_{33}$$

It is the sum of the diagonal entries—that is, the proportion of students classified by the two forms into exactly the same level—that would signify the overall consistency.

Since it is not feasible to repeat CDT tests one right after the other with no additional instruction in order to estimate the proportion of students who would be reclassified in the same performance levels, a statistical model needs to be imposed on the data in order to project the consistency of classifications solely using data from the available administration (Hambleton and Novick, 1973). Two well-known methods were developed by Hanson and Brennan (1990) and Livingston and Lewis (1995) utilizing specific true score models. While both measures are reported for PSSA and Keystone Exams, the statistical models imposed on the data depend upon a beta binomial distribution of raw scores. Given that the CDT is adaptive (i.e., raw scores using a response probability of 0.5 are generally equal to one-half of test length), these measures are not reported for CDT. Instead, decision consistency measures in this section are a Rasch-based index that relies on conditional standard errors (CSEMs). Also reported are results based on simulations and kappa.

The decision consistency measures reported in the section are based on the Rasch model and conditional standard errors (Stearns and Smith, 2007). Each person’s scale score has an associated conditional standard error. Each of the performance levels on the test has an established benchmark cut in the scale score metric. Given these three pieces of information, the assumption of a normal distribution of measurement error allows one to calculate the probability that a student would receive the same classification on retesting. Using the statistic:

$$z = \frac{SS_n - SSBC}{SE_{SS_n}}$$

where  $SS_n$  is the scale score estimate for person  $n$ ,  $SSBC$  is the scale score benchmark cut, and  $SE_{ss}$  is the asymptotic standard error of the person scale score estimate. Using cumulative normal probabilities, the probability that a retest would produce the same performance level classification and the probability of a different performance level classification were calculated. The process was repeated for each cut score which results in a probability of classification in each of the performance levels. The total classification rate for the entire sample is the average of the probabilities of the same classification on retesting.

Table 16–5 provides an example based on CDT Algebra I operational data from the 2023–2024 school year. Recall that in the dynamic reporting suite, scores are classified into one of three color ranges—red, green, or blue. The benchmark cut points used for the analyses are the cut points in place during the 2023–2024 school year.

**Table 16–5. Retest Classification Probability – Algebra I**

	Red – retest	Green – retest	Blue – retest
Red – test	0.961	0.039	0.000
Green – test	0.163	0.803	0.035
Blue – test	0.000	0.175	0.825

Consider students with scores in the green range: The probability of scoring in the red range if retested is 0.163. The probability of scoring in the green range again is 0.803. The probability of scoring in the blue range is 0.035.

The total classification rate is determined by taking the weighted average of the diagonal probabilities where the weights are the number of students in the corresponding range. There are 105,847 students in the sample: 90,407 with total scores in the red range, 13,990 in the green range, and 1,450 in the blue range. The total classification rate is  $[(0.961)(90,407)+(0.803)(13,990)+(0.825)(1,450)]/105,847 = 0.938$ .

In addition to the exact agreement rate, Cohen’s kappa<sup>5</sup> was also calculated as 0.763.

In cases with multiple categories, an alternative to kappa, which treats every misclassification as equally important, is a weighted kappa that considers differences that are non-adjacent as more “off.” While relevant, given there are three categories, weighted kappa is the same as kappa in this case because both the red/blue and blue/red cells in Table 16–5 are zero.

3 X 3 retest classification probability tables for all CDT tests and benchmark cuts comparable to Table 16–5 are presented in Appendix E.

Stearns and Smith (2007) point out that one advantage of this method is that each student can understand how likely it is that he or she would be classified in the same range if the student took the test over without additional instruction. In addition, each student can learn the probability with which he or she would be reclassified in any of the ranges. A student scoring right at the cut score will have a lower rate of consistent classification than a student scoring in the middle of a performance level band. This can be seen in Table 16–6, which is based on the same Algebra I data set and cut points and shows for various scale scores the percent chance of scoring in each color range if retested.

<sup>5</sup> Kappa,  $\kappa$ , takes into account the agreement occurring by chance.

**Table 16–6. Retest Classification Percent for Various Scale Score Ranges – Algebra I**

<b>Scale Score Range</b>	<b>Number of Students</b>	<b>Red (% Chance in Category if Retested*)</b>	<b>Green (% Chance in Category if Retested*)</b>	<b>Blue (% Chance in Category if Retested*)</b>	<b>% Chance in Same Category if Retested*</b>
< 400	0	N/A	N/A	N/A	N/A
400 to 449	2	>99.9%	0.0%	0.0%	>99.9%
450 to 499	15	>99.9%	0.0%	0.0%	>99.9%
500 to 549	174	>99.9%	0.0%	0.0%	>99.9%
550 to 599	856	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,241	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,639	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,888	>99.9%	0.0%	0.0%	>99.9%
750 to 799	5,830	>99.9%	0.0%	0.0%	>99.9%
800 to 849	6,917	>99.9%	0.0%	0.0%	>99.9%
850 to 899	8,197	>99.9%	0.0%	0.0%	>99.9%
900 to 949	9,921	>99.9%	0.0%	0.0%	>99.9%
950 to 999	12,075	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	13,873	99.7%	0.3%	0.0%	99.7%
1050 to 1099	13,994	93.1%	6.9%	0.0%	93.1%
1100 to 1149 (Red/Green cut = 1134)	10,715	60.2%	39.8%	0.0%	65.0%
1150 to 1199	6,305	16.3%	83.6%	0.1%	83.6%
1200 to 1249	3,187	1.2%	96.0%	2.8%	96.0%
1250 to 1299 (Green/Blue cut = 1297)	1,646	0.0%	73.7%	26.3%	73.7%
1300 to 1349	775	0.0%	26.4%	73.6%	73.6%
1350 to 1399	354	0.0%	3.0%	97.0%	97.0%
1400 to 1449	144	0.0%	0.1%	99.9%	99.9%
1450 to 1499	54	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	27	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	12	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	4	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	1	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
<b>TOTAL</b>	<b>105,847</b>				

\* Retest assuming no additional instruction



Tables for all CDT tests and benchmark cuts comparable to Table 16–6 are presented in Appendix E.

As previously mentioned, it is not feasible to repeat CDT tests one right after the other with no additional instruction in order to estimate decision consistency. However, simulations were run as a validation of the results based on the Stearns and Smith method. The reported Algebra I scores from 2023–2024 were used as true scores in order to simulate retest results. Table 16–7 repeats the Algebra I results from Table 16–5, shows the simulation results, and displays the differences.

**Table 16–7. Compare Stearns and Smith Results to Simulation Retest Classification Probability – Algebra I**

	<b>Red – retest</b>	<b>Green – retest</b>	<b>Blue – retest</b>
Red – Stearns & Smith	0.961	0.039	0.000
Green – Stearns & Smith	0.163	0.803	0.035
Blue – Stearns & Smith	0.000	0.175	0.825

Exact Agreement Rate = 0.938

Kappa = 0.763

	<b>Red – retest</b>	<b>Green – retest</b>	<b>Blue – retest</b>
Red – Simulated test	0.960	0.040	0.000
Green – Simulated test	0.164	0.802	0.034
Blue – Simulated test	0.000	0.170	0.830

Exact Agreement Rate = 0.937

Kappa = 0.761

	<b>Red – retest</b>	<b>Green – retest</b>	<b>Blue – retest</b>
Red – Difference	0.001	-0.001	0.000
Green – Difference	-0.001	0.001	0.001
Blue – Difference	0.000	0.005	-0.005

Exact Agreement Rate = 0.001

Kappa = 0.002

Based on results of the simulation validation, Stearns and Smith methodology was applied to all CDT tests and benchmark cut points using data from the 2023–2024 school year. Results are presented in Table 16–8.

**Table 16–8. Decision Consistency for All CDT Tests**

<b>CDT</b>	<b>Benchmark Cut</b>	<b>N-count</b>	<b>Exact Agreement Rate</b>	<b>Kappa</b>
Mathematics Grades 3–5	Grade 3	39,689	0.925	0.780
Mathematics Grades 3–5	Grade 4	42,378	0.927	0.784
Mathematics Grades 3–5	Grade 5	49,147	0.919	0.774
Mathematics Grades 6–HS	Grade 6	61,085	0.921	0.792
Mathematics Grades 6–HS	Grade 7	66,490	0.931	0.781
Mathematics Grades 6–HS	Grade 8	55,899	0.939	0.776
Mathematics Grades 6–HS	High School	1,192	0.988	0.661
Algebra I	Algebra I	105,847	0.938	0.763
Geometry	Geometry	8,487	0.936	0.786
Algebra II	Algebra II	11,778	0.937	0.798
Reading Grades 3–5	Grade 3	33,621	0.915	0.825
Reading Grades 3–5	Grade 4	36,314	0.913	0.822
Reading Grades 3–5	Grade 5	41,014	0.910	0.818
Reading/Lit Grades 6–HS	Grade 6	49,798	0.908	0.808
Reading/Lit Grades 6–HS	Grade 7	57,221	0.915	0.810
Reading/Lit Grades 6–HS	Grade 8	54,925	0.917	0.811
Reading/Lit Grades 6–HS	Literature	122,385	0.910	0.810
Science Grades 3–5	Grade 3	5,228	0.879	0.794
Science Grades 3–5	Grade 4	29,725	0.879	0.788
Science Grades 3–5	Grade 5	12,381	0.890	0.791
Science Grades 6–HS	Grade 6	27,416	0.897	0.792
Science Grades 6–HS	Grade 7	43,555	0.904	0.792
Science Grades 6–HS	Grade 8	63,573	0.907	0.782
Science Grades 6–HS	High School	3,391	0.951	0.760
Biology	Biology	110,847	0.905	0.783
Chemistry	Chemistry	5,273	0.906	0.727
Writing Grades 3–5	Grade 3	4,984	0.908	0.803
Writing Grades 3–5	Grade 4	6,285	0.912	0.802
Writing Grades 3–5	Grade 5	7,392	0.907	0.793
Writing/Eng Comp Gr 6–HS	Grade 6	9,278	0.908	0.800
Writing/Eng Comp Gr 6–HS	Grade 7	12,496	0.909	0.800
Writing/Eng Comp Gr 6–HS	Grade 8	11,506	0.918	0.800
Writing/Eng Comp Gr 6–HS	English Composition	9,746	0.900	0.802

See Appendix E for the 3 X 3 retest classification probability tables.

## CHAPTER SEVENTEEN: VALIDITY

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As defined in the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), validity refers to “the degree to which evidence and theory support the interpretations of test scores for proposed uses of tests” (p. 11). The *Standards* provides a framework for describing the sources of evidence that should be considered when evaluating validity. These sources include evidence based on 1) test content, 2) response processes, 3) the internal structure of the test, 4) the relationships between test scores and other variables, and 5) the consequences of testing. In addition, when Item Response Theory (IRT) models are used to analyze assessment data, validity considerations related to those processes should also be explored.

The validity process involves the collection of a variety of evidence to support the proposed test score interpretations and uses. The entire technical report describes the technical aspects of the Classroom Diagnostic Tools (CDT) in support of its score interpretations and uses. Each of the previous chapters contributes important evidence components that pertain to score validation: test development, test administration, test scoring, item analysis, Rasch calibration, scaling, equating, score reporting, and reliability. This chapter is used to summarize and synthesize the evidence based on the framework of the *Standards*. The purposes and intended use of the CDT is reviewed first, and then each type of validity evidence is addressed in turn.

### PURPOSES AND INTENDED USES OF THE CDT

The *Standards* emphasize that validity pertains to how test scores are used. To help contextualize the evidence that will be presented below, the purposes of the CDT will be reviewed first. The CDT was developed to support teachers and students in grades 3 through 12. These tools, available at no cost to districts, are fully integrated and aligned in the Standards Aligned System (SAS) and enable educators to identify students’ academic strengths and areas of need, as well as provide links to classroom resources. The assessment is administered completely online using a computer adaptive test (CAT) model, and participation is voluntary. CDT scores are available immediately after testing in the dynamic reporting suite. In addition to the scores, this suite includes links to instructional resources. The CDT may be used multiple times throughout the school year.

### EVIDENCE BASED ON TEST CONTENT

Test content validity evidence for the CDT rests greatly on establishing a link between each piece of the assessment (i.e., the items) and what students should know and be able to do as prescribed by the Assessment Anchors and Eligible Content. The CDT is intended to measure the knowledge and skills described in the Assessment Anchors and Eligible Content for grades 3 through 8 and high school in mathematics, reading, science, and writing, and courses Algebra I, Geometry, Algebra II, Literature, Biology, Chemistry, and English Composition.

Lane (1999) suggests taking the following steps to support the content validity of an assessment. In the case of the operational CDT, one should:

- evaluate the degree to which the test specifications represent and align with the knowledge and skills described in the corresponding Assessment Anchors and Eligible Content.
- evaluate the alignment between the CDT items and test specifications to ensure representativeness.
- evaluate the extent to which the curriculum aligns with the Assessment Anchors and Eligible Content.
- conduct content reviews of the CDT items using a panel of content experts to see whether items measure the intended construct or are the sources of construct-irrelevant variance.
- conduct fairness reviews of the items to avoid issues related to a specific subpopulation.
- evaluate procedures for administration and scoring such as the appropriateness of instructions to examinees, practice/training with online tools and tests, and time limits for the assessments.
- submit operational tests to third-party independent reviews.

Chapters Two through Five of this report present a considerable amount of evidence related to test content. As described in these chapters, all the items were developed and aligned with the Assessment Anchors and Eligible Content. After development and prior to field testing, items were reviewed for content and bias issues. After being field tested, items were reviewed with respect to their statistical properties and alignment with the learning progressions. Items selected for inclusion in the operational pools had to pass content, psychometric, and PDE reviews. Tests were administered according to standardized procedures with allowable accommodations.

Some of the efforts made to ensure content validity are summarized below.

- DRC used Webb’s (1999) Depth of Knowledge (DOK) model to ensure the CDT items aligned with the Assessment Anchors and Eligible Content and the Academic Content Standards in terms of both content and cognitive levels.
- DRC established detailed test and item/passage development specifications and ensured the items were sufficient in number and adequately distributed across content, levels of cognitive complexity, and levels of difficulty.
- DRC selected qualified item writers and provided training to help ensure they wrote high-quality items.
- All newly developed items were first reviewed by content specialists and editors at DRC to make sure they measured the intended Assessment Anchors and Eligible Content. Appropriateness for the intended students was also considered, as well as depth of knowledge, graphics, grammar/punctuation, language demand, and distractor reasonableness.
- Prior to field testing, the test items were submitted to content committees (composed of Pennsylvania educators) for review using, but not limited to, the following categories:
  - Overall quality and clarity
  - Anchor, Eligible Content, and/or standard alignment
  - Grade-level appropriateness
  - Difficulty level
  - Depth of knowledge
  - Appropriate sources of challenge (e.g., unintended content and skills)
  - Correct answer
  - Quality of distractors
  - Graphics
  - Appropriate language demand
  - Freedom from bias
- The items were also submitted to a Bias, Fairness, and Sensitivity Committee for review. This committee reviewed items for issues related to diversity, gender, and other pertinent factors.
- Items passing all prior hurdles were tried out in a stand-alone or embedded field-test event. Several statistical analyses were conducted on the field-test data including classical item analyses, distractor analyses, and differential item functioning (DIF) analyses. Items were again carefully reviewed by DRC staff and a committee of Pennsylvania teachers with respect to their statistical characteristics. DIF was used to detect test items that might bias test scores for particular groups. Empirical investigation of DIF strengthens the validity evidence related to score interpretations for students in particular groups by eliminating potential sources of construct-irrelevant variance.
- Following field testing, the items were submitted to content committees (composed of Pennsylvania educators) for review and alignment with the learning progressions.
- The CDT was administered according to standardized procedures with allowable accommodations. Students were given ample time to complete the tests (i.e., there were no speediness issues).

## EVIDENCE BASED ON RESPONSE PROCESS

Response-process evidence is used to examine the extent to which the cognitive skills and processes employed by students match those identified in the test developer’s defined construct domains for all students and for each subgroup. Think-aloud procedures or “cognitive labs” can be used to collect this type of evidence.

For the operational 2023–2024 CDT, no cognitive lab studies were conducted to collect the response process evidence.

## EVIDENCE BASED ON INTERNAL STRUCTURE

As described in the *Standards* (2014), internal-structure evidence refers to the degree to which the relationships among test items and test components conform to the construct on which the proposed test interpretations are based. For each CDT, one total test score as well as diagnostic category scores were reported (see Chapter Fourteen for more information about CDT scores). Several dimensionality studies were conducted in order to provide internal-structure evidence relating to the use of both types of scores.

## ITEM-TEST CORRELATIONS

Item-test correlations are discussed in Chapter Seven and provided in Appendix B of various technical reports. Specifically, item-test correlations for all items field tested prior to 2018–2019 can be found in Appendix B of the 2017–2018 technical report. Item-test correlations for items field tested in 2018–2019 or later can be found in Appendix B of the corresponding year’s technical report. All items in the final operational pools had values that were positive and of acceptable magnitude.

## DIMENSIONALITY

Dimensionality analyses were conducted for the CDT using WINSTEPS’s principal components analyses on response residuals for each content area. Results are shown in Chapter Eight. The principal component analysis results provided evidence that each CDT test was essentially unidimensional, supporting the validity of using the total scores to estimate a student’s overall ability.

## DIAGNOSTIC CATEGORY CORRELATIONS

Correlations and disattenuated correlations among diagnostic category scores for the CDT are presented below. Values were derived from the CDT operational data from the 2023–2024 school year. This data can also provide information on score dimensionality that is part of internal-structure evidence. Each CDT has either four or five diagnostic categories. Full diagnostic category names can be found in Chapter Thirteen.

**Table 17–1. Correlations among Diagnostic Categories — Math Grades 3–5**

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.781	-	-	-
Geo.	0.724	0.703	-	-
Meas.	0.779	0.777	0.721	-

**Table 17–2. Correlations among Diagnostic Categories — Math Grades 6–HS**

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.741	-	-	-
Geo.	0.699	0.683	-	-
Meas.	0.730	0.708	0.685	-

**Table 17–3. Correlations among Diagnostic Categories – Algebra I**

Diagnostic Category	Operations.	Linear.	Functions.	Data.
Operations.	-	-	-	-
Linear.	0.646	-	-	-
Functions.	0.677	0.660	-	-
Data.	0.674	0.651	0.687	-

**Table 17–4. Correlations among Diagnostic Categories – Geometry**

Diagnostic Category	Properties.	Congruence.	Coordinate.	Measure.
Properties.	-	-	-	-
Congruence.	0.670	-	-	-
Coordinate.	0.700	0.685	-	-
Measure.	0.696	0.657	0.706	-

**Table 17–5. Correlations among Diagnostic Categories – Algebra II**

Diagnostic Category	Complex.	Non-Linear.	Functions.	Data.
Complex.	-	-	-	-
Non-Linear.	0.600	-	-	-
Functions.	0.571	0.719	-	-
Data.	0.518	0.707	0.707	-

**Table 17–6. Correlations among Diagnostic Categories – Reading Grades 3–5**

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.679	-	-	-	-
Craft – Lit.	0.684	0.647	-	-	-
Craft – Info.	0.676	0.676	0.650	-	-
Vocab.	0.708	0.689	0.667	0.694	-

**Table 17–7. Correlations among Diagnostic Categories – Reading/Lit Grades 6–HS**

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.658	-	-	-	-
Craft – Lit.	0.666	0.646	-	-	-
Craft – Info.	0.665	0.684	0.656	-	-
Vocab.	0.675	0.671	0.661	0.686	-

**Table 17–8. Correlations among Diagnostic Categories — Science Grades 3–5**

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.781	-	-	-
Phys.	0.778	0.772	-	-
Earth/Space.	0.762	0.759	0.756	-

**Table 17–9. Correlations among Diagnostic Categories — Science Grades 6–HS**

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.712	-	-	-
Phys.	0.684	0.675	-	-
Earth/Space.	0.677	0.675	0.647	-

**Table 17–10. Correlations among Diagnostic Categories — Biology**

Diagnostic Category	Basic.	Bioenerg.	Cell Growth.	Evol./Ecol.
Basic.	-	-	-	-
Bioenerg.	0.674	-	-	-
Cell Growth.	0.678	0.640	-	-
Evol./Ecol.	0.705	0.646	0.677	-

**Table 17–11. Correlations among Diagnostic Categories — Chemistry**

Diagnostic Category	Matter.	Atomic.	Mole.	Chem.
Matter.	-	-	-	-
Atomic.	0.437	-	-	-
Mole.	0.525	0.423	-	-
Chem.	0.493	0.406	0.458	-

**Table 17–12. Correlations among Diagnostic Categories — Writing Grades 3–5**

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.775	-	-	-	-
Edit.	0.768	0.764	-	-	-
Punct.	0.717	0.710	0.738	-	-
Gram.	0.757	0.756	0.774	0.727	-

**Table 17–13. Correlations among Diagnostic Categories — Writing/Eng Comp Grades 6–HS**

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.714	-	-	-	-
Edit.	0.719	0.702	-	-	-
Punct.	0.696	0.682	0.705	-	-
Gram.	0.705	0.683	0.714	0.706	-

The correlations in Tables 17–1 through 17–13 are based on the observed diagnostic category scores. These observed-score correlations are weakened by existing measurement error contained within each diagnostic category. As a result, disattenuated correlations could provide an estimate of the relationships among diagnostic categories if there were no measurement error. (An important caveat is explained further below.) The disattenuated correlation coefficients ( $R_{12}$ ) can be computed by using the formula (Spearman 1904, 1910) below:

$$R_{12} = \frac{r_{12}}{\sqrt{r_{11}r_{22}}},$$

where  $r_{12}$  is the observed correlation, and  $r_{11}$  and  $r_{22}$  are the reliabilities for diagnostic categories 1 and 2. Disattenuated correlations very near 1.00 suggest that the same or very similar constructs are being measured. Values somewhat less than 1.00 suggest that different diagnostic categories are measuring slightly different aspects of the same construct. Values markedly less than 1.00 suggest the diagnostic categories reflect different constructs.

Tables 17–14 through 17–26 show the corresponding disattenuated correlations. Given that none of these diagnostic categories had perfect reliabilities (see Chapter Sixteen), the disattenuated correlations are higher than their observed score counterparts.

**Table 17–14. Disattenuated Correlations among Diagnostic Categories — Math Grades 3–5**

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.959	-	-	-
Geo.	0.903	0.891	-	-
Meas.	0.948	0.960	0.905	-

**Table 17–15. Disattenuated Correlations among Diagnostic Categories — Math Grades 6–HS**

Diagnostic Category	Numbers.	Alg. Con	Geo.	Meas.
Numbers.	-	-	-	-
Alg. Con.	0.897	-	-	-
Geo.	0.867	0.861	-	-
Meas.	0.882	0.869	0.861	-



**Table 17–16. Disattenuated Correlations among Diagnostic Categories – Algebra I**

Diagnostic Category	Operations.	Linear.	Functions.	Data.
Operations.	-	-	-	-
Linear.	0.795	-	-	-
Functions.	0.816	0.846	-	-
Data.	0.799	0.820	0.848	-

**Table 17–17. Disattenuated Correlations among Diagnostic Categories – Geometry**

Diagnostic Category	Properties.	Congruence.	Coordinate.	Measure.
Properties.	-	-	-	-
Congruence.	0.827	-	-	-
Coordinate.	0.843	0.827	-	-
Measure.	0.840	0.796	0.834	-

**Table 17–18. Disattenuated Correlations among Diagnostic Categories – Algebra II**

Diagnostic Category	Complex.	Non-Linear.	Functions.	Data.
Complex.	-	-	-	-
Non-Linear.	0.713	-	-	-
Functions.	0.694	0.860	-	-
Data.	0.618	0.830	0.849	-

**Table 17–19. Disattenuated Correlations among Diagnostic Categories – Reading Grades 3–5**

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.935	-	-	-	-
Craft – Lit.	0.979	0.938	-	-	-
Craft – Info.	0.931	0.943	0.942	-	-
Vocab.	0.947	0.935	0.940	0.941	-

**Table 17–20. Disattenuated Correlations among Diagnostic Categories – Reading/Lit Grades 6–HS**

Diagnostic Category	Key – Lit.	Key – Info.	Craft – Lit.	Craft – Info.	Vocab.
Key – Lit.	-	-	-	-	-
Key – Info.	0.913	-	-	-	-
Craft – Lit.	0.949	0.923	-	-	-
Craft – Info.	0.913	0.941	0.928	-	-
Vocab.	0.918	0.915	0.926	0.926	-

**Table 17–21. Disattenuated Correlations among Diagnostic Categories — Science Grades 3–5**

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.982	-	-	-
Phys.	0.985	0.974	-	-
Earth/Space.	0.979	0.972	0.975	-

**Table 17–22. Disattenuated Correlations among Diagnostic Categories — Science Grades 6–HS**

Diagnostic Category	Nature.	Bio.	Phys.	Earth/Space.
Nature.	-	-	-	-
Bio.	0.896	-	-	-
Phys.	0.891	0.885	-	-
Earth/Space.	0.887	0.890	0.884	-

**Table 17–23. Disattenuated Correlations among Diagnostic Categories — Biology**

Diagnostic Category	Basic.	Bioenerg.	Cell Growth.	Evol./Ecol.
Basic.	-	-	-	-
Bioenerg.	0.889	-	-	-
Cell Growth.	0.876	0.877	-	-
Evol./Ecol.	0.872	0.846	0.869	-

**Table 17–24. Disattenuated Correlations among Diagnostic Categories — Chemistry**

Diagnostic Category	Matter.	Atomic.	Mole.	Chem.
Matter.	-	-	-	-
Atomic.	0.677	-	-	-
Mole.	0.788	0.791	-	-
Chem.	0.725	0.744	0.813	-

**Table 17–25. Disattenuated Correlations among Diagnostic Categories — Writing Grades 3–5**

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.977	-	-	-	-
Edit.	0.966	0.972	-	-	-
Punct.	0.913	0.914	0.949	-	-
Gram.	0.941	0.950	0.972	0.923	-

**Table 17–26. Disattenuated Correlations among Diagnostic Categories – Writing/Eng Comp Grades 6–HS**

Diagnostic Category	Focus.	Content.	Edit.	Punct.	Gram.
Focus.	-	-	-	-	-
Content.	0.897	-	-	-	-
Edit.	0.900	0.890	-	-	-
Punct.	0.868	0.860	0.886	-	-
Gram.	0.881	0.863	0.899	0.885	-

In reviewing the differences between the simple correlations and the disattenuated ones, it is clear that the impact of the “less than perfect” reliabilities on the disattenuated correlations is large for most of the tests. For example, Science Grades 3–5 found virtually no differences between any pair of disattenuated correlations. This indicates that, for the majority of students, the diagnostic category scores are merely shorter versions of what the total scores are measuring. Note that, while the theoretical maximum for observed correlations is 1.00, disattenuated correlations can exceed this value when high observed correlations are combined with low reliabilities. The other tests’ disattenuated correlations are somewhat lower, generally in the range of .82 to .95. The test with the lowest disattenuated correlations is Algebra II, with Complex Numbers showing the most uniqueness.

As a practical consideration, and despite these results, diagnostic category scores for individual students may still provide useful information to the teacher. For example, a student may still have statistically significant differences between pairs of diagnostic scores (“areas of needs” versus “strengths to build on”) with large observed scale score differences. The diagnostic reporting suite shows these differences in a graphic that includes the level of precision for each scale score in the form of an “error band.” The error band is the scale score  $\pm$  one conditional standard error. Any two pairs of scores can be interpreted as statistically different if their respective error bands do not overlap. More details about the use and interpretation of error bands may be found in Chapter Fourteen. Additionally, Chapter Fifteen provides summary information about conditional standard errors for each diagnostic category and tables that indicate the incidence of non-overlapping error bands in the 2023–2024 operational testing population.

### EXPLORATORY FACTOR ANALYSIS

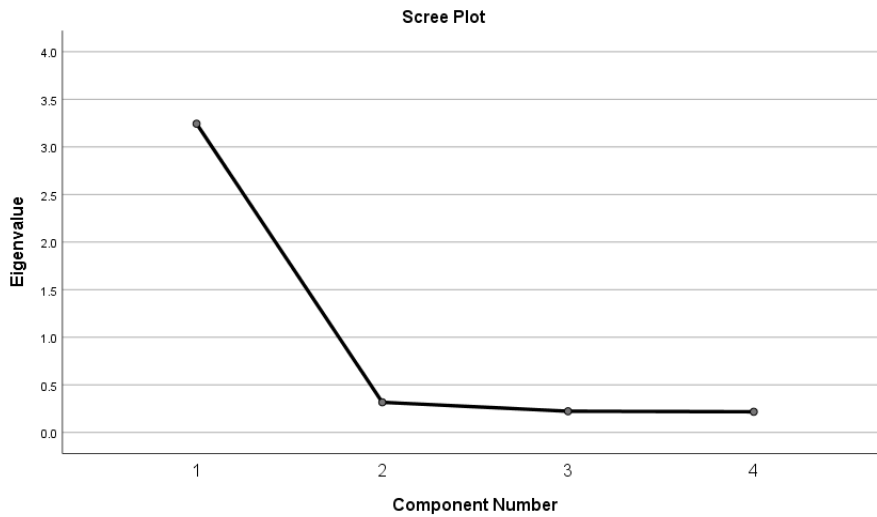
In order to further explore the internal structure of each CDT, an exploratory factor analysis (EFA) of the diagnostic category scores was conducted. Operational data from the 2023–2024 school year was used to create the observed correlation matrices shown in Tables 17–1 through 17–13. These, in turn, were used in the EFA. In the *Statistical Package for the Social Sciences (SPSS)*, Principal Axis Factor extraction was utilized with an oblique rotation (Promax) of the initial factor solution to improve interpretability. Oblique rotations allow for correlated factors.

Tables 17–27 through 17–39 present the eigenvalues and the explained variance for the extracted factors. Figures 17–1 through 17–13 are scree plot graphs of the eigenvalues against the factor number. In general, the first factor accounts for approximately 76% of the total variance for all CDT tests except Chemistry, while the second factor accounts for approximately 8% of the total variance. For Chemistry, the first factor accounts for 59% of the total variance, while the second factor accounts for 15%. For each CDT, only the first factor had an eigenvalue greater than 1.0, typically suggesting a one-factor solution using the Kaiser criterion.

**Table 17–27. Eigenvalues and Explained Variance for Math Grades 3–5 Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.24	81.09
2	0.32	7.91
3	0.22	5.57
4	0.22	5.43

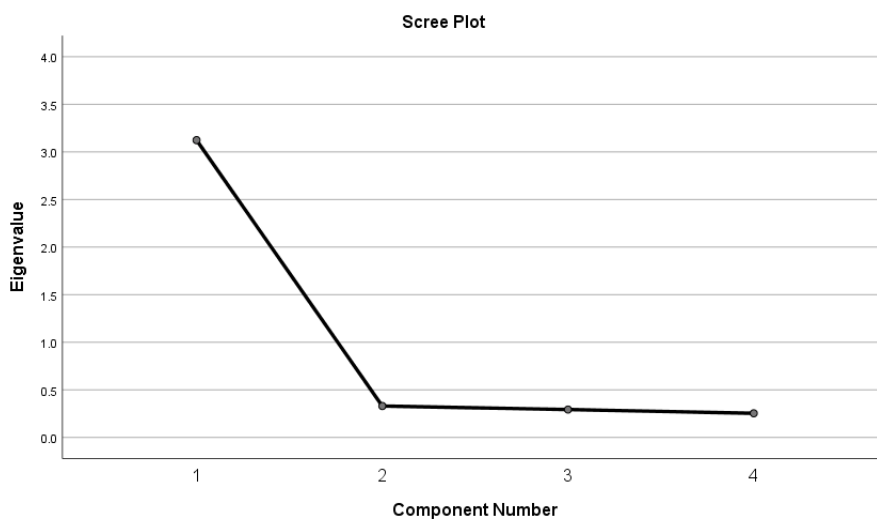
**Figure 17–1. Scree Plot for Math Grades 3–5 Diagnostic Categories**



**Table 17–28. Eigenvalues and Explained Variance for Math Grades 6–HS Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.12	78.09
2	0.33	8.24
3	0.29	7.32
4	0.25	6.35

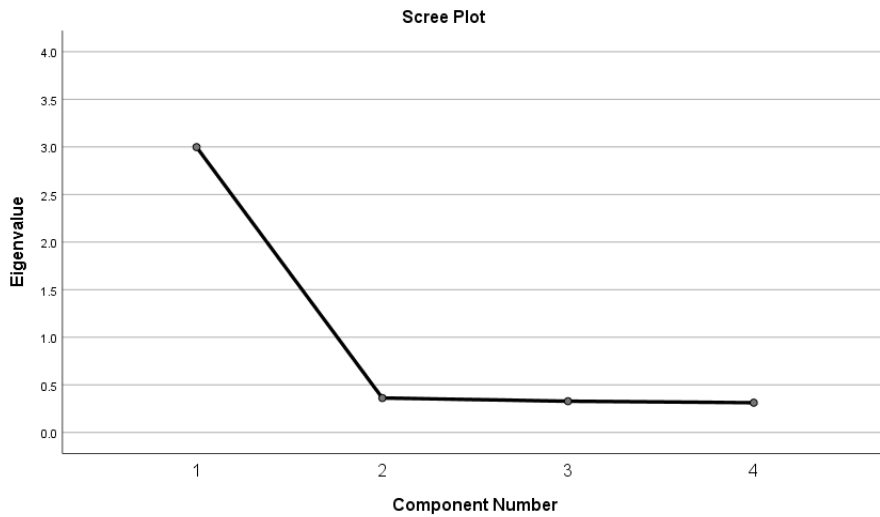
**Figure 17–2. Scree Plot for Math Grades 6–HS Diagnostic Categories**



**Table 17–29. Eigenvalues and Explained Variance for Algebra I Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.00	74.94
2	0.36	9.05
3	0.33	8.20
4	0.31	7.80

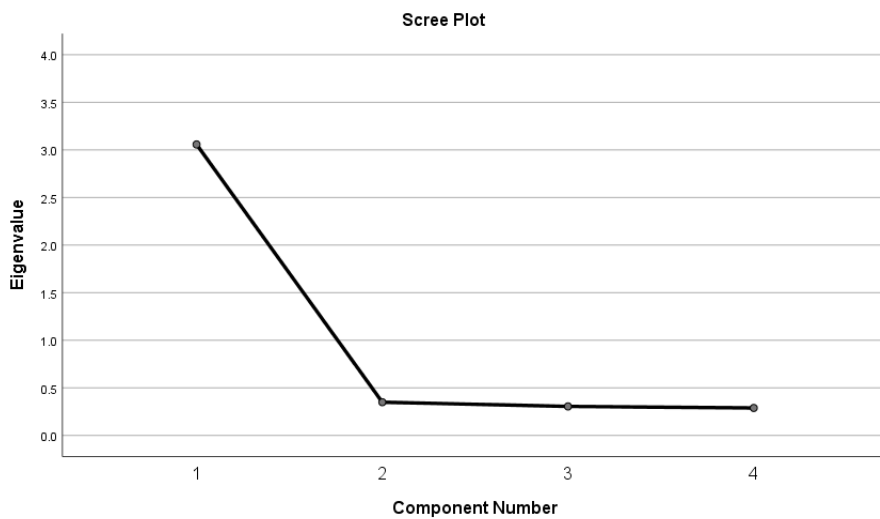
**Figure 17–3. Scree Plot for Algebra I Diagnostic Categories**



**Table 17–30. Eigenvalues and Explained Variance for Geometry Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.06	76.43
2	0.35	8.73
3	0.30	7.62
4	0.29	7.22

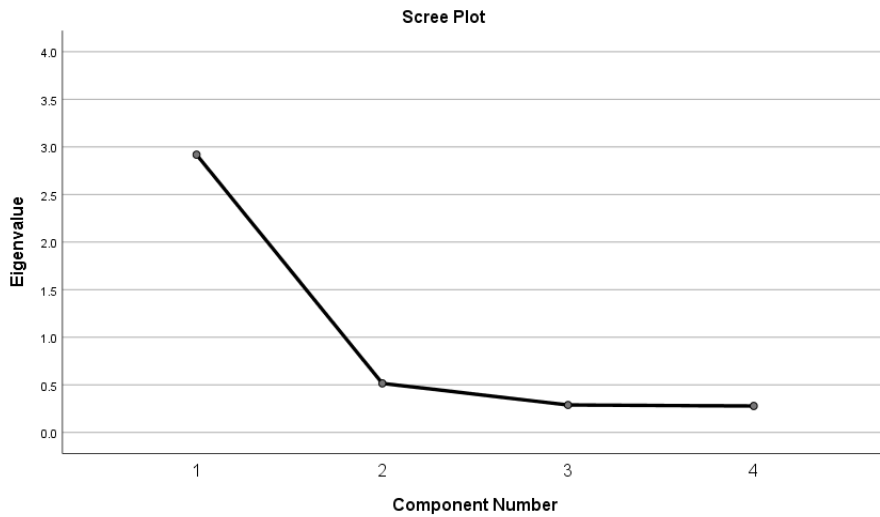
**Figure 17–4. Scree Plot for Geometry Diagnostic Categories**



**Table 17–31. Eigenvalues and Explained Variance for Algebra II Diagnostic Categories**

Factor	Eigenvalue	Percent
1	2.92	72.96
2	0.52	12.89
3	0.29	7.21
4	0.28	6.95

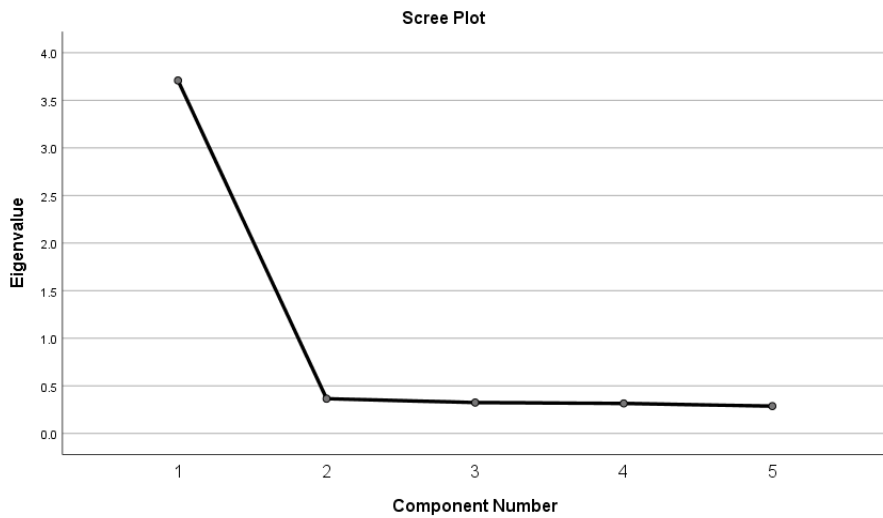
**Figure 17–5. Scree Plot for Algebra II Diagnostic Categories**



**Table 17–32. Eigenvalues and Explained Variance for Reading Grades 3–5 Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.71	74.17
2	0.36	7.30
3	0.32	6.49
4	0.32	6.30
5	0.29	5.74

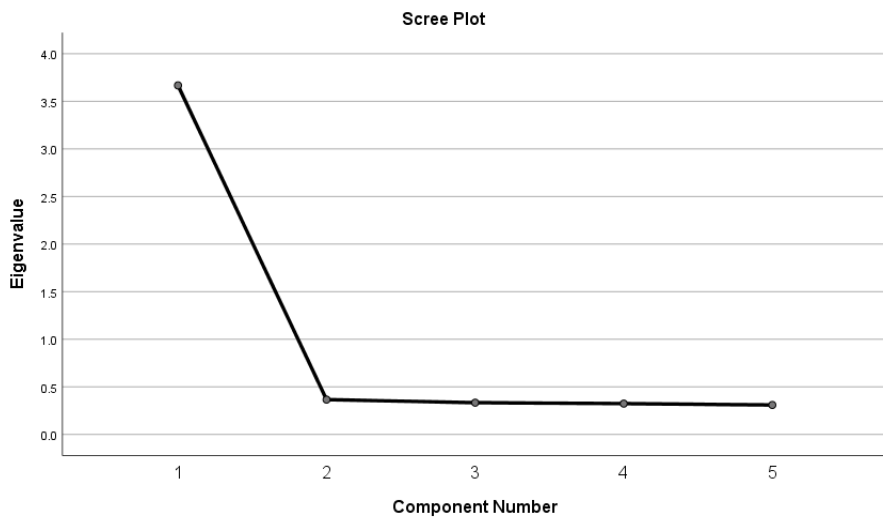
**Figure 17–6. Scree Plot for Reading Grades 3–5 Diagnostic Categories**



**Table 17–33. Eigenvalues and Explained Variance for Reading/Lit Grades 6–HS Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.67	73.35
2	0.37	7.31
3	0.33	6.67
4	0.32	6.48
5	0.31	6.19

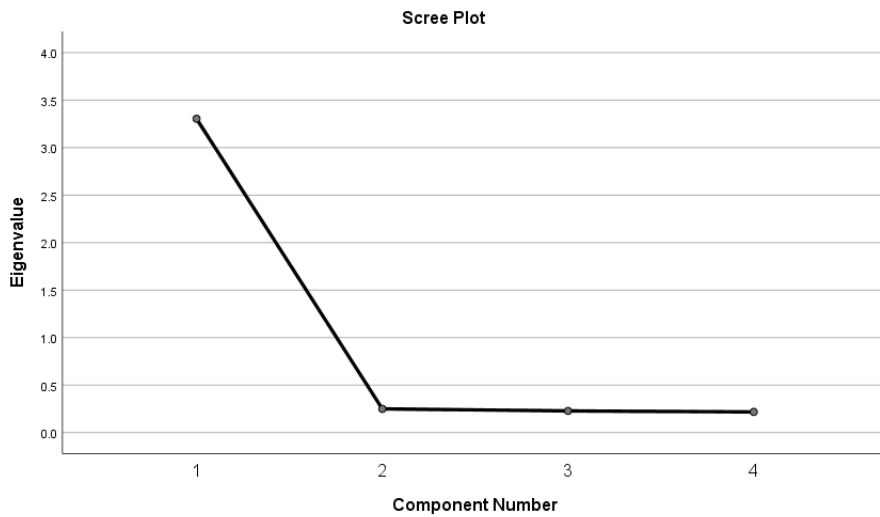
**Figure 17–7. Scree Plot for Reading/Lit Grades 6–HS Diagnostic Categories**



**Table 17–34. Eigenvalues and Explained Variance for Science Grades 3–5 Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.30	82.60
2	0.25	6.25
3	0.23	5.70
4	0.22	5.44

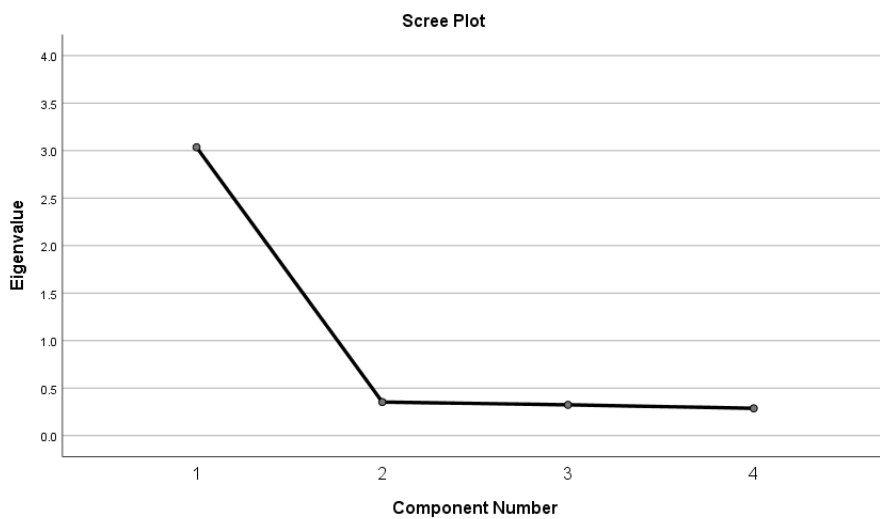
**Figure 17–8. Scree Plot for Science Grades 3–5 Diagnostic Categories**



**Table 17–35. Eigenvalues and Explained Variance for Science Grades 6–HS Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.04	75.88
2	0.35	8.83
3	0.32	8.10
4	0.29	7.18

**Figure 17–9. Scree Plot for Science Grades 6–HS Diagnostic Categories**

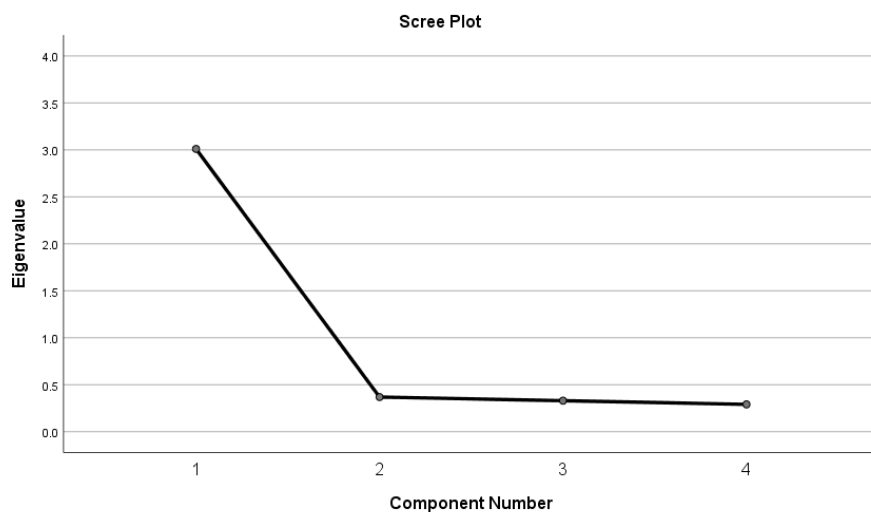




**Table 17–36. Eigenvalues and Explained Variance for Biology Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.01	75.26
2	0.37	9.21
3	0.33	8.25
4	0.29	7.27

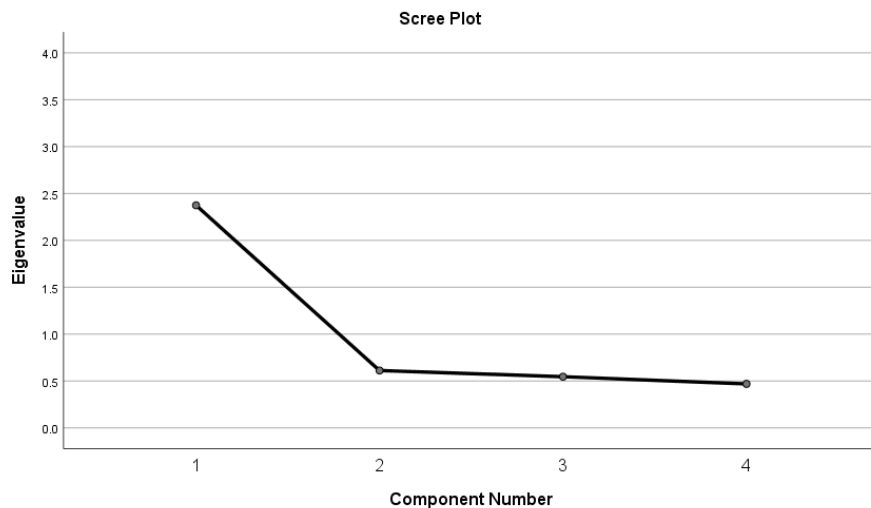
**Figure 17–10. Scree Plot for Biology Diagnostic Categories**



**Table 17–37. Eigenvalues and Explained Variance for Chemistry Diagnostic Categories**

Factor	Eigenvalue	Percent
1	2.37	59.34
2	0.61	15.29
3	0.55	13.65
4	0.47	11.72

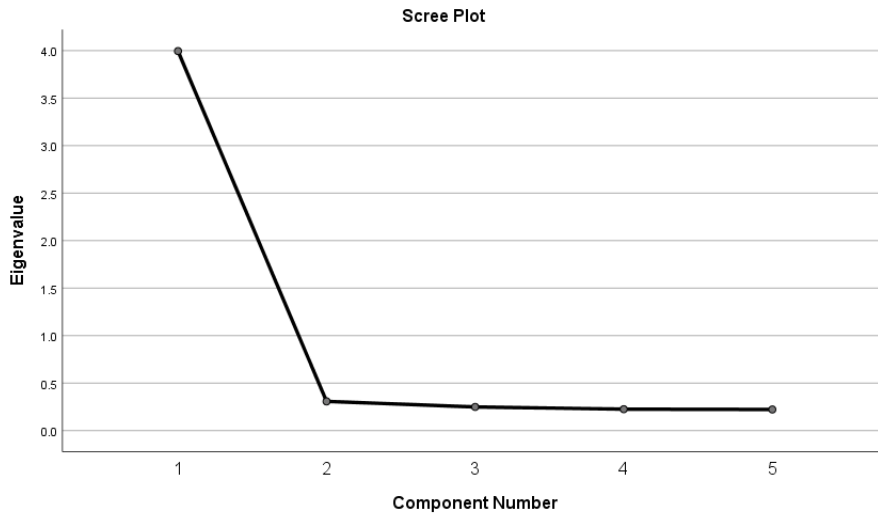
**Figure 17–11. Scree Plot for Chemistry Diagnostic Categories**



**Table 17–38. Eigenvalues and Explained Variance for Writing Grades 3–5 Diagnostic Categories**

Factor	Eigenvalue	Percent
1	4.00	79.90
2	0.31	6.15
3	0.25	4.98
4	0.23	4.52
5	0.22	4.45

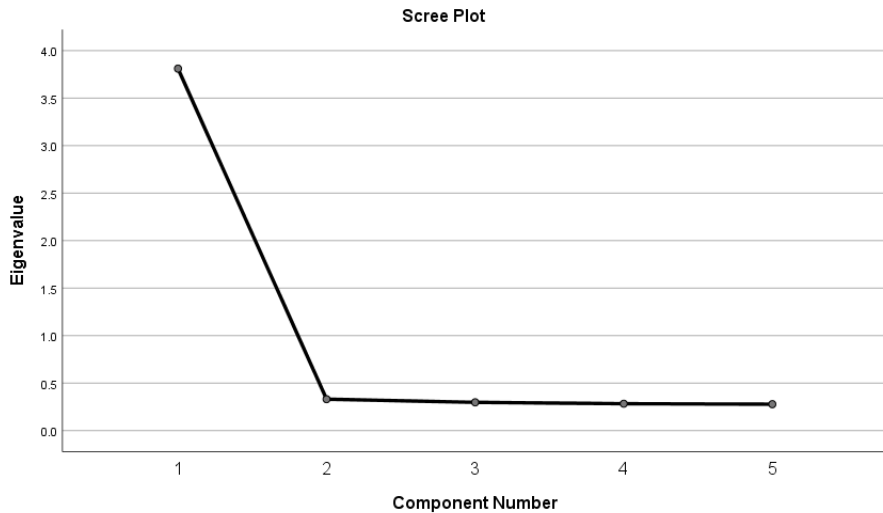
**Figure 17–12. Scree Plot for Writing Grades 3–5 Diagnostic Categories**



**Table 17–39. Eigenvalues and Explained Variance for Writing/Eng Comp Grades 6–HS Diagnostic Categories**

Factor	Eigenvalue	Percent
1	3.81	76.21
2	0.33	6.62
3	0.30	5.95
4	0.28	5.66
5	0.28	5.56

**Figure 17–13. Scree Plot for Writing/Eng Comp Grades 6–HS Diagnostic Categories**



Taken as a whole, the internal structure evidence presented generally indicates that related elements of each of the CDT tests are correlated in the intended manner. This further supports using a total score to report students’ performances in the different content areas.

The diagnostic category scores present more of a mixed message. Since the diagnostic categories in each of the CDT tests were designed to measure distinct components, it is reasonable to expect that the diagnostic category correlations should be positive and strong but, ideally, not extremely high. However, the disattenuated correlations imply that some diagnostic categories are essentially measuring the same constructs. While there is content rationale underlying the creation of the diagnostic category scores, the empirical correlations illustrate that caution is required when using these scores when identifying an individual student’s areas of need and strengths to build on.

## **EVIDENCE BASED ON RELATIONSHIPS WITH OTHER VARIABLES**

As described in the *Standards* (AERA, APA, & NCME, 2014), “. . . Evidence based on relationships with other variables provides evidence about the degree to which these relationships are consistent with the construct underlying the proposed test score interpretations” (p. 16). This category of evidence refers to “external structure evidence” and has been classified as three types of evidence: *convergent*, *discriminant*, and *criterion-related*. *Convergent evidence* is provided by relationships among students’ performances on different assessments intended to measure a similar construct. *Discriminant evidence* is provided by relationships among students’ performances on different tests intended to measure different constructs. *Criterion-related evidence*, either predictive or concurrent, is provided by relationships between students’ test scores and their performances on a criterion measure (Cronbach, 1971; Messick, 1989).

Correlations and disattenuated correlations among students’ test scores across different CDT content areas provide some discriminant validity evidence. These are provided in Tables 17–40 and 17–41.

**Table 17–40a. Correlations among CDT Grades 3–5 Tests**

<b>CDT</b>	<b>Math Grades 3–5</b>	<b>Reading Grades 3–5</b>	<b>Science Grades 3–5</b>	<b>Writing Grades 3–5</b>
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	0.770	-	-	-
Science Grades 3–5	0.780	0.783	-	-
Writing Grades 3–5	0.750	0.832	0.800	-

**Table 17–40b. Correlations among CDT Tests**

<b>CDT</b>	<b>Math Gr 6–HS</b>	<b>Algebra I</b>	<b>Geometry</b>	<b>Algebra II</b>	<b>Read/Lit Gr 6–HS</b>	<b>Science Gr 6–HS</b>	<b>Biology</b>	<b>Chemistry</b>	<b>Writing/ Eng Comp Gr 6–HS</b>
Math Gr 6–HS	-	-	-	-	-	-	-	-	-
Algebra I	0.813	-	-	-	-	-	-	-	-
Geometry	0.878	0.840	-	-	-	-	-	-	-
Algebra II	-	0.834	0.782	-	-	-	-	-	-
Read/Lit Gr 6–HS	0.731	0.667	0.671	0.658	-	-	-	-	-
Science Gr 6–HS	0.722	0.709	0.757	0.771	0.751	-	-	-	-
Biology	0.854	0.637	0.687	0.707	0.713	0.705	-	-	-
Chemistry	-	0.607	0.664	0.670	0.638	0.496	0.578	-	-
Writing Gr 6–HS	0.711	0.648	0.589	0.625	0.800	0.700	0.690	0.665	-

**Table 17–41a. Disattenuated Correlations among CDT Grades 3–5 Tests**

<b>CDT</b>	<b>Math Grades 3–5</b>	<b>Reading Grades 3–5</b>	<b>Science Grades 3–5</b>	<b>Writing Grades 3–5</b>
Math Grades 3–5	-	-	-	-
Reading Grades 3–5	0.823	-	-	-
Science Grades 3–5	0.827	0.838	-	-
Writing Grades 3–5	0.792	0.886	0.846	-

**Table 17–41b. Disattenuated Correlations among CDT Tests**

CDT	Math Gr 6–HS	Algebra I	Geometry	Algebra II	Read/Lit Gr 6–HS	Science Gr 6–HS	Biology	Chemistry	Writing/Eng Comp Gr 6–HS
Math Gr 6–HS	-	-	-	-	-	-	-	-	-
Algebra I	0.865	-	-	-	-	-	-	-	-
Geometry	0.931	0.892	-	-	-	-	-	-	-
Algebra II	-	0.886	0.828	-	-	-	-	-	-
Read/Lit Gr 6–HS	0.782	0.715	0.717	0.703	-	-	-	-	-
Science Gr 6–HS	0.774	0.761	0.810	0.824	0.811	-	-	-	-
Biology	0.914	0.683	0.734	0.755	0.769	0.762	-	-	-
Chemistry	-	0.679	0.741	0.747	0.719	0.559	0.651	-	-
Writing Gr 6–HS	0.753	0.686	0.623	0.661	0.853	0.747	0.736	0.741	-

Each CDT test measures a different construct, so the correlations among them were not expected to be extremely high. The values in the tables are consistent with this expectation. Correlations among the CDT tests ranged from 0.496 to 0.878. Correlations across tests within a content area tend to be more highly correlated than across content areas. For example, the correlation between Algebra I and Geometry is 0.840, whereas the correlation between Algebra I and Biology is 0.637.

External evidence for the CDT is examined by using students’ scores on the 2024 Pennsylvania System of School Assessment (PSSA) and/or 2024 Keystone Exams as external criteria. For each content area, CDT results from the 2023–2024 school year were matched to spring 2024 PSSA in the corresponding content area using the PA secure ID. Similarly, CDT tests in Algebra I, Biology, and Reading/Literature were matched to corresponding spring 2024 Keystone Exams. The correlations between students’ total scale scores on the CDT and PSSA or Keystone are calculated as one piece of external evidence. Table 17–42 summarizes the sample sizes and correlations.

**Table 17–42. Correlation between CDT and PSSA or Keystone Exams Scores**

<b>Student Grade</b>	<b>CDT</b>	<b>PSSA or Keystone Test</b>	<b><i>N</i></b>	<b>Correlation of Total Scale Scores</b>
3	Math Grades 3–5	PSSA Math Grade 3	16,263	0.809
4	Math Grades 3–5	PSSA Math Grade 4	17,611	0.827
5	Math Grades 3–5	PSSA Math Grade 5	21,070	0.817
6	Math Grades 6–HS	PSSA Math Grade 6	25,994	0.831
7	Math Grades 6–HS	PSSA Math Grade 7	28,168	0.815
8	Math Grades 6–HS	PSSA Math Grade 8	24,432	0.794
3	Reading Grades 3–5	PSSA ELA Grade 3	13,878	0.803
4	Reading Grades 3–5	PSSA ELA Grade 4	14,988	0.812
5	Reading Grades 3–5	PSSA ELA Grade 5	17,350	0.822
6	Reading/Lit Grades 6–HS	PSSA ELA Grade 6	21,270	0.797
7	Reading/Lit Grades 6–HS	PSSA ELA Grade 7	24,788	0.791
8	Reading/Lit Grades 6–HS	PSSA ELA Grade 8	24,578	0.758
4	Science Grades 3–5	PSSA Science Grade 4	12,426	0.785
8	Science Grades 6–HS	PSSA Science Grade 8	29,426	0.776
3	Writing Grades 3–5	PSSA ELA Grade 3	2,452	0.777
4	Writing Grades 3–5	PSSA ELA Grade 4	2,886	0.779
5	Writing Grades 3–5	PSSA ELA Grade 5	3,430	0.783
6	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 6	4,263	0.775
7	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 7	6,167	0.765
8	Writing/Eng Comp Gr 6–HS	PSSA ELA Grade 8	5,910	0.720
6–12	Algebra I	Keystone Algebra I	35,527	0.764
6–12	Biology	Keystone Biology	47,267	0.788
6–12	Reading/Literature	Keystone Literature	36,809	0.731

These results provide external evidence in support of CDT as a valid measure of students’ achievement.

The collection of external evidence related to the CDT is an ongoing process. As more CDT data become available, other criterion-related evidence will be evaluated. In addition to examining the relationship between CDT and PSSA or Keystone Exams, other criterion variables such as Scholastic Aptitude Test (SAT) scores, American College Test (ACT) scores, or student grade point average (GPA) may be considered.

## EVIDENCE BASED ON CONSEQUENCES OF TESTS

According to the *Standards* (AERA, APA, & NCME, 2014), evidence of the consequences of implementing an assessment program is an additional source of validity information. Both positive and negative (intended and unintended) consequences of score-based inferences must be investigated to fully evaluate the pool of validity evidence.

Lane and Stone (2002) summarized the general *intended* consequences for state assessments and accountability programs:

- Student, teacher, and administrator motivation and effort
- Curriculum and instruction practices (including content and strategies)
- Improved learning for all students
- Content and format of classroom assessments
- Professional development support
- Use and nature of test preparation activities
- Student, teacher, administrator, and public awareness and beliefs about the assessment, criteria for judging performance, and the use of assessment results

Evidence for the improvement of student learning can be seen by looking at the changes in scale scores for students who took the same CDT test multiple times. Table 17–43 below summarizes scale score changes between the first and last administrations of the CDT.

**Table 17–43. Summary of Scale Score Changes between CDT Administrations**

CDT	<i>N</i>	Minimum	Q1	Median	Mean	Q3	Maximum
Math Grades 3–5	46,819	-596	26	82	84.57	142	717
Math Grades 6–HS	67,634	-547	-9	48	46.94	106	661
Algebra I	35,599	-561	-34	39	32.22	104	724
Geometry	2,878	-600	-15	64	55.36	134	756
Algebra II	3,893	-525	-12	60	54.92	129	559
Reading Grades 3–5	39,699	-491	-16	43	44.14	103	517
Reading/Lit Grades 6–HS	103,369	-651	-49	10	9.34	70	637
Science Grades 3–5	16,489	-577	-12	48	49.99	109	634
Science Grades 6–HS	46,779	-538	-40	20	17.36	76	710
Biology	37,851	-633	-14	56	54.40	123	840
Chemistry	1,798	-346	-14	52	45.98	111	423
Writing Grades 3–5	6,991	-533	-14	46	48.52	110	534
Writing/Eng Comp Gr 6–HS	13,883	-573	-44	19	19.05	83	639

Lane and Stone (2002) also summarized the possible *unintended* outcomes:

- Narrowing of curriculum and instruction to focus only on the specific standards assessed and ignoring the broader construct reflected in the specified standards
- Use of test preparation materials that are closely linked to the assessment without making changes to instruction
- Use of unethical test preparation materials or administration procedures
- Differential performance gains for subgroups of students
- Inappropriate or unfair uses of test scores, such as questionable practices in reassignment of teachers or principals
- For some students, decreased confidence and motivation to learn and to perform well on the assessment because of past experiences with assessments

As noted above, one important piece of consequential evidence pertains to the use of assessment results. As shown in Chapter Fourteen, CDT offers a dynamic suite of reports. The extent to which various groups of users (e.g., students and teachers) interpret these reports appropriately affects the validity of subsequent uses of these results. As noted in Chapter Fourteen, there are report training scenarios for each content area. The intent is that the scenarios will help users avoid unintended uses and interpretations of the CDT results.

## **EVIDENCE RELATED TO USE OF THE RASCH MODEL**

Since the Rasch model is the basis of all calibration, scaling, and equating analyses associated with the CDT, the validity of the inferences from these results depends on the degree to which the assumptions of the model are met, as well as the fit between the model and the test data. As discussed in Chapter Eight, the underlying assumptions of Rasch models were essentially met for all the CDT data, indicating the appropriateness of using Rasch models to analyze the CDT data.

## **VALIDITY EVIDENCE SUMMARY**

Validity evidence related to test content was reviewed earlier in this chapter. On the whole, the early chapters of this technical report show that a strong link can be established between each CDT item and its associated Eligible Content. Detailed information regarding educator reviews are presented in Chapter Six.

Diagnostic category score intercorrelations were also presented in this chapter. They provide some favorable evidence regarding the internal relationships between the tests' components.

Validity of score inferences is bolstered when test scores are consistent. Here, the reliabilities of the total test scores (presented in Chapter Sixteen) were very good, with many in the low 0.90s.

Reported in Chapter Six, differential item functioning (DIF) with respect to gender and ethnicity helps address construct-irrelevant variance, which represents an important threat to the validity of inferences made from achievement test scores. As noted in that chapter, field-test items are screened and reviewed for DIF. Only items approved by teacher committees are eligible for operational use.



## CHAPTER EIGHTEEN: PARAMETER STABILITY

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The Classroom Diagnostic Tools (CDT) features a number of tests. Tests in Mathematics, Algebra I, Geometry, and Algebra II have been available since October 2010 for students in grades 6 and above. Tests in Reading/Literature, Science, Biology, and Chemistry have been available since April 2011 for students in grades 6 and above. Tests in Writing /English Composition have been available since October 2011 for students in grades 6 and above. Tests in Mathematics, Reading, Science, and Writing have been available since April 2014 for students in grades 3 through 5. During the 2023–2024 school year, CAT item selection and Rasch ability estimates were based on banked item parameters. Following the 2023–2024 school year, item parameter stability was checked for all items in the banks.

### METHODOLOGY

In the first two years of CDT, four separate methods were investigated to evaluate the stability of the item parameters in the CDT operational administration

1. Calibrate the entire bank within a content area in a single concurrent calibration. Do not anchor item parameters on banked values. Compare new parameter estimates to the banked values.
2. Calibrate the entire bank within a content area in a single concurrent calibration. Anchor item parameters on banked values. Examine displacements.
3. Calibrate each grade/course level item with students in that grade/course. Do not anchor item parameters on banked values. Compare new parameter estimates to the banked values.
4. Calibrate each grade/course level item with students in that grade/course. Anchor item parameters on banked values. Examine displacements.

As noted in Chapter Twelve, CDT tests are pre-equated. Immediate score reports are based on banked item parameters. Therefore, this chapter focuses on anchored calibrations and examination of displacement values to evaluate item parameter stability<sup>1</sup>.

### ANCHORED CONCURRENT CALIBRATION WITHIN CONTENT AREA ACROSS GRADES/COURSES

One method used to evaluate the stability of the item parameters in the operational administration was to calibrate the entire bank within a content area anchoring on the banked item parameters and examine the displacements. For each item, the displacement value is the size of the change in the parameter estimate that would be estimated if the parameter for the item was unanchored and all other parameters were anchored at their current value. Given that the banked values were developed into a single, vertical scale, all items within a content area were calibrated in a single concurrent calibration using WINSTEPS software version 3.71 (Linacre, 2009).

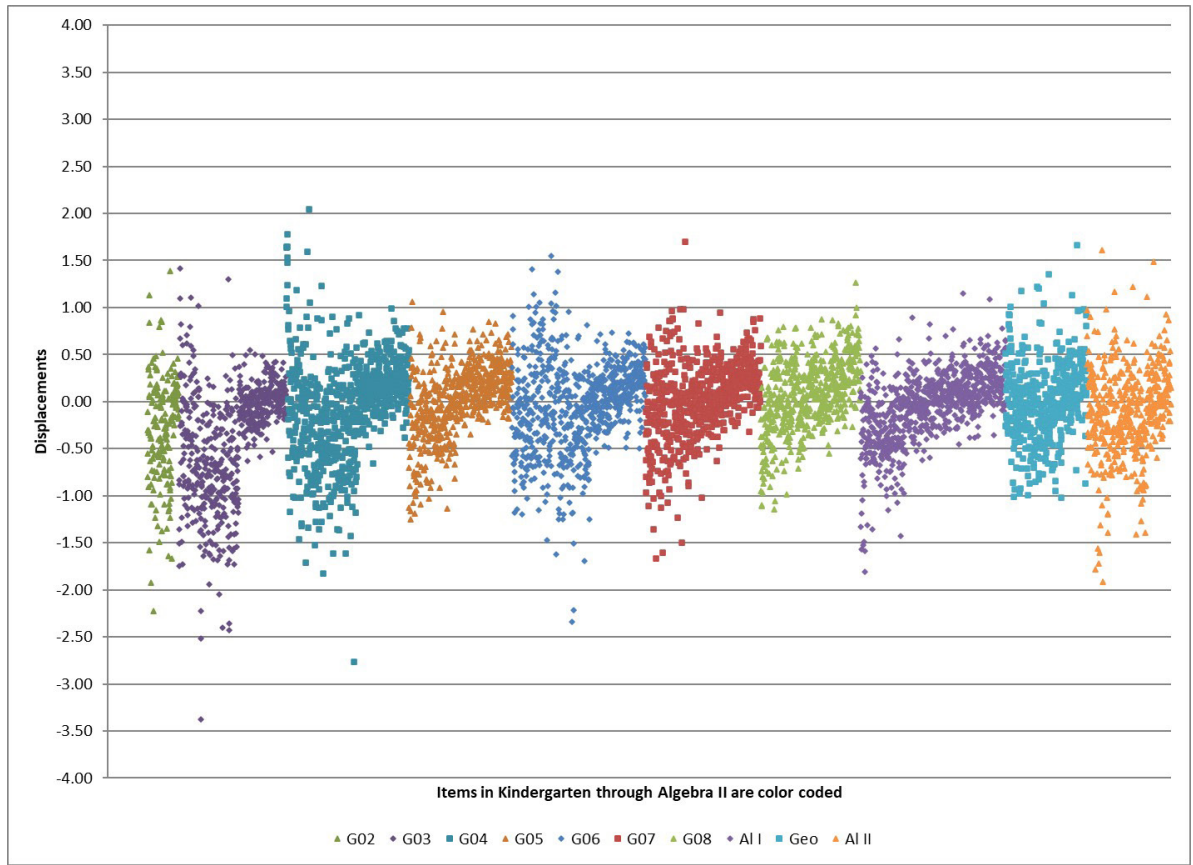
### MATHEMATICS

Figure 18–1 shows the displacements from a concurrent anchored calibration of all mathematics items using the operational data set. Items are color-coded by grade/course.

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<sup>1</sup> For results of all four methods for the 2011–2012 school year, see Chapter Eighteen of the 2011–2012 technical report.

**Figure 18–1. Anchored Calibration Displacements — All Items**



Note: Many kindergarten and grade 1 items were not estimated by WINSTEPS software due to insufficient counts.

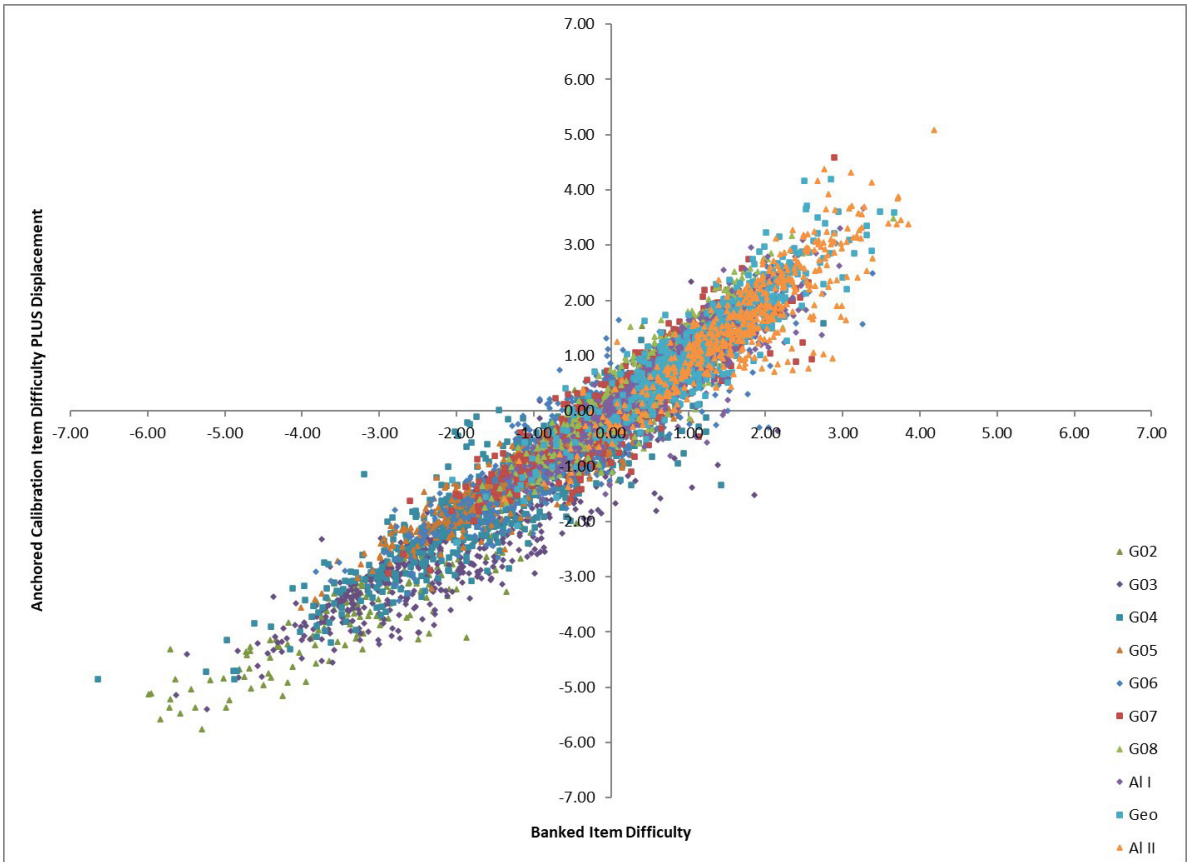
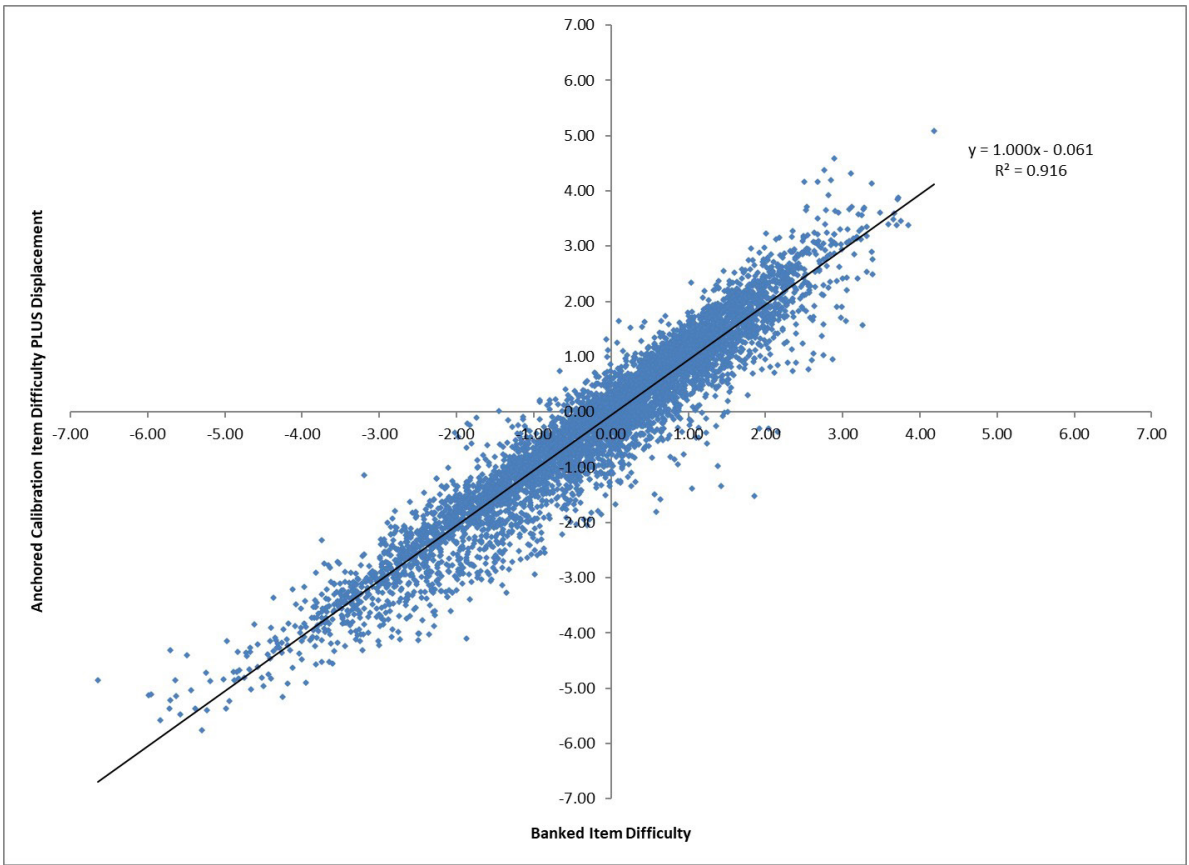
Table 18–1 summarizes the data in Figure 18–1. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Seventy-seven percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–1).

**Table 18–1. Number of Mathematics Items by Grade/Course and Displacement Interval**

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. ≤ -1.0	0	0	19	102	35	8	22	11	4	14	2	16	233
-1.0 < Disp. ≤ -0.9	0	0	5	25	13	6	9	3	4	6	5	4	80
-0.9 < Disp. ≤ -0.8	0	0	6	24	18	9	14	6	2	5	6	7	97
-0.8 < Disp. ≤ -0.7	0	0	10	26	23	8	12	9	8	10	10	18	134
-0.7 < Disp. ≤ -0.6	0	0	7	28	19	9	33	13	9	19	11	10	158
-0.6 < Disp. ≤ -0.5	0	0	11	15	37	14	31	20	9	27	10	20	194
-0.5 < Disp. ≤ -0.4	0	0	8	18	21	23	29	23	16	50	27	28	243
-0.4 < Disp. ≤ -0.3	0	0	14	30	37	26	48	29	20	46	27	47	324
-0.3 < Disp. ≤ -0.2	0	0	12	42	31	31	55	46	40	51	34	47	389
-0.2 < Disp. ≤ -0.1	0	0	13	62	58	47	53	51	57	73	46	41	501
-0.1 < Disp. ≤ 0.0	0	0	12	65	54	67	70	65	56	100	44	50	583
0.0 < Disp. ≤ 0.1	0	0	21	62	60	70	70	77	65	114	52	41	632
0.1 < Disp. ≤ 0.2	0	0	16	48	92	65	78	82	49	119	50	38	637
0.2 < Disp. ≤ 0.3	0	0	8	31	62	82	79	73	60	71	42	33	541
0.3 < Disp. ≤ 0.4	0	0	8	15	40	52	47	54	53	48	25	22	364
0.4 < Disp. ≤ 0.5	0	0	5	9	31	37	37	38	41	28	21	22	269
0.5 < Disp. ≤ 0.6	0	0	1	4	24	16	24	23	29	18	26	11	176
0.6 < Disp. ≤ 0.7	0	0	0	3	14	13	20	13	18	12	6	8	107
0.7 < Disp. ≤ 0.8	0	0	1	2	12	8	10	8	19	2	2	5	69
0.8 < Disp. ≤ 0.9	0	0	3	1	8	2	8	8	5	2	5	1	43
0.9 < Disp. ≤ 1.0	0	0	0	0	3	1	5	4	2	0	6	4	25
1.0 < Disp.	0	0	2	5	14	1	10	1	1	2	8	5	49
TOTAL	0	0	182	617	706	595	764	657	567	817	465	478	5848

Figure 18–2 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the mathematics item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

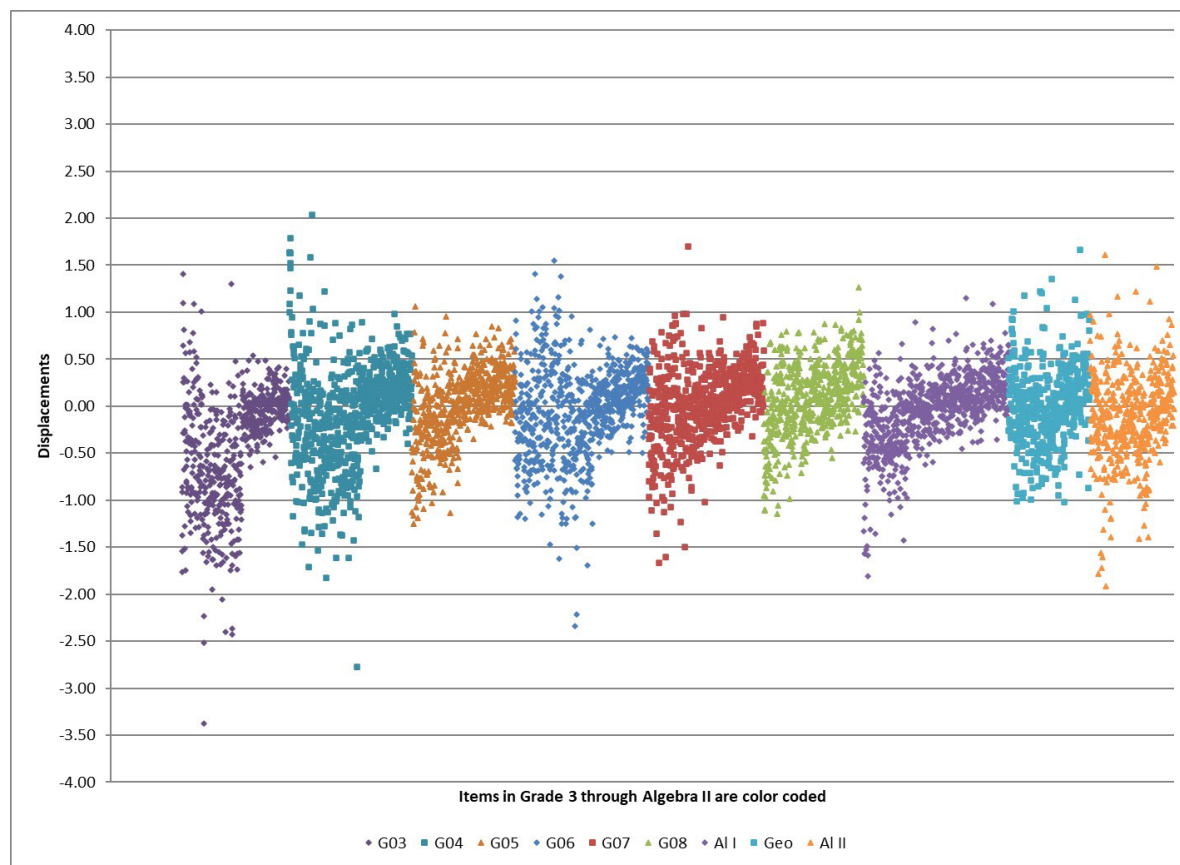
Figure 18–2. Mathematics Banked Item Parameters vs. Anchored Calibration — All Items



Based on Figure 18–2, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower-performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–3 and Table 18–2 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Seventy-seven percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–2). Figure 18–4 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

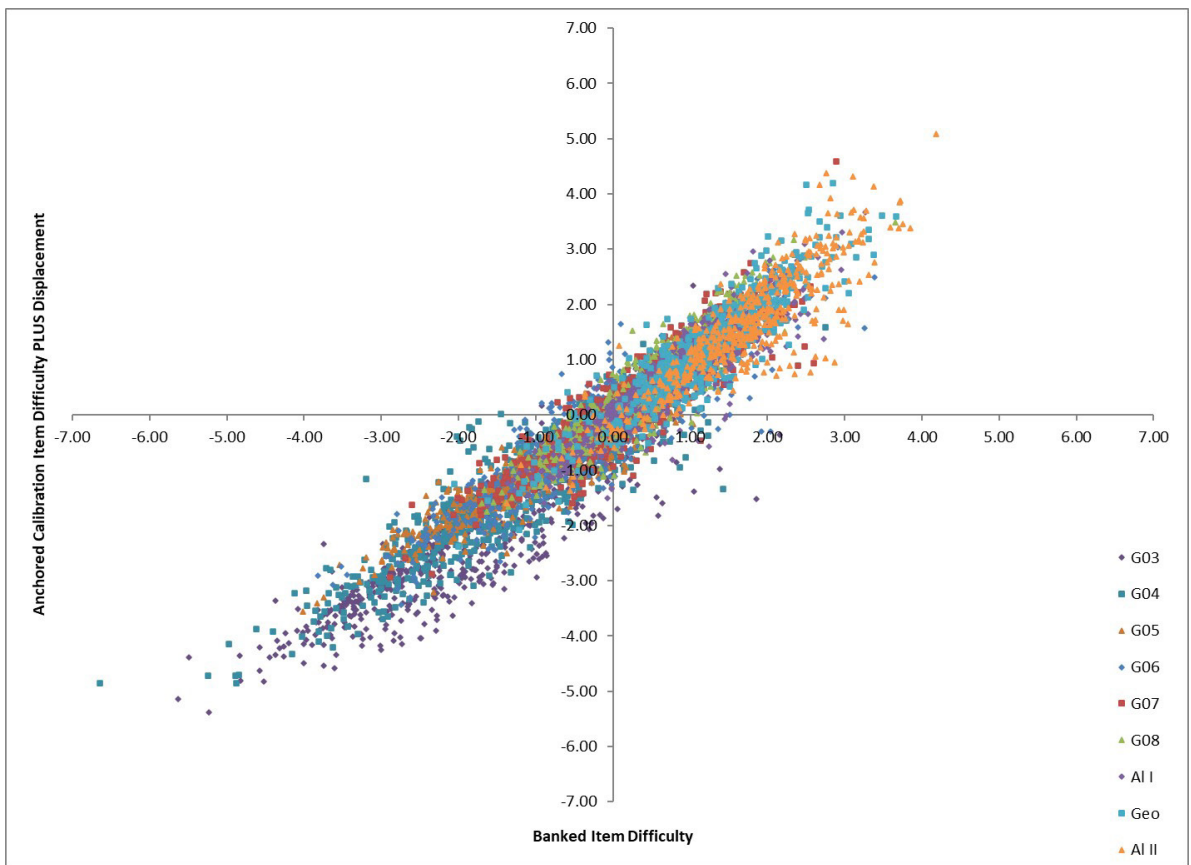
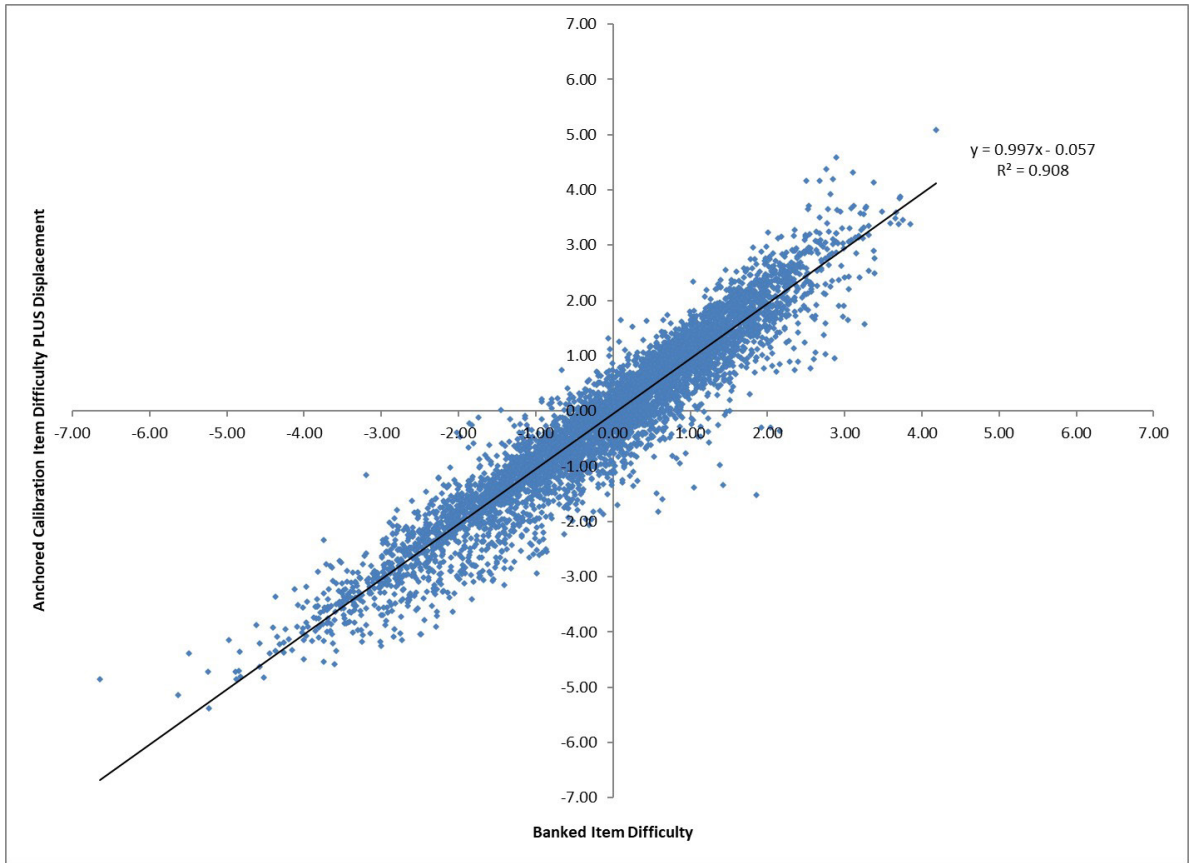
**Figure 18–3. Mathematics Anchored Calibration Displacements — All Items in Grade 3 and Above**



**Table 18–2. Number of Mathematics Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. $\leq$ -1.0	106	35	8	22	11	4	14	2	16	218
-1.0 < Disp. $\leq$ -0.9	28	15	6	9	3	4	6	5	4	80
-0.9 < Disp. $\leq$ -0.8	25	19	9	14	6	2	5	6	7	93
-0.8 < Disp. $\leq$ -0.7	22	21	9	12	9	8	10	10	18	119
-0.7 < Disp. $\leq$ -0.6	26	23	8	33	13	9	19	11	10	152
-0.6 < Disp. $\leq$ -0.5	18	34	14	31	20	9	27	10	20	183
-0.5 < Disp. $\leq$ -0.4	20	22	23	29	23	16	50	27	28	238
-0.4 < Disp. $\leq$ -0.3	36	36	26	49	29	20	46	27	47	316
-0.3 < Disp. $\leq$ -0.2	38	36	31	54	46	40	51	34	47	377
-0.2 < Disp. $\leq$ -0.1	67	54	47	53	51	57	73	46	41	489
-0.1 < Disp. $\leq$ 0.0	62	54	67	70	65	56	100	44	50	568
0.0 < Disp. $\leq$ 0.1	70	68	70	70	77	65	114	52	41	627
0.1 < Disp. $\leq$ 0.2	40	89	65	78	82	49	119	50	38	610
0.2 < Disp. $\leq$ 0.3	24	59	82	79	73	60	71	42	33	523
0.3 < Disp. $\leq$ 0.4	15	36	52	47	54	53	48	25	22	352
0.4 < Disp. $\leq$ 0.5	6	32	37	37	38	41	28	21	22	262
0.5 < Disp. $\leq$ 0.6	5	27	16	24	23	29	18	26	11	179
0.6 < Disp. $\leq$ 0.7	2	10	13	20	13	18	12	6	8	102
0.7 < Disp. $\leq$ 0.8	1	12	8	10	8	19	2	2	5	67
0.8 < Disp. $\leq$ 0.9	1	8	2	8	8	5	2	5	1	40
0.9 < Disp. $\leq$ 1.0	0	3	1	5	4	2	0	6	4	25
1.0 < Disp.	5	13	1	10	1	1	2	8	5	46
TOTAL	617	706	595	764	657	567	817	465	478	5666

**Figure 18–4. Mathematics Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above**



It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–3 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

**Table 18–3. Summary of Robust Z across Anchored Calibrations in Mathematics**

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	182	48	26%	0	0	N/A
Grade 3	617	200	32%	617	204	33%
Grade 4	706	137	19%	706	139	20%
Grade 5	595	55	9%	595	55	9%
Grade 6	764	122	16%	764	124	16%
Grade 7	657	63	10%	657	64	10%
Grade 8	567	56	10%	567	57	10%
Algebra I	817	56	7%	817	57	7%
Geometry	465	52	11%	465	53	11%
Algebra II	478	70	15%	478	70	15%
Total	5848	859	15%	5666	823	15%
	Correlation = 0.957			Correlation = 0.953		
	Additive Constant = -0.060			Additive Constant = -0.057		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.648 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.645 to 0.648, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.645 have absolute value of robust Z greater than 1.645.



## READING/LITERATURE

Figure 18–5 shows the displacements from a concurrent anchored calibration of all reading items using the operational data set. Items are color-coded by grade/course.

**Figure 18–5. Reading Anchored Calibration Displacements — All Items**

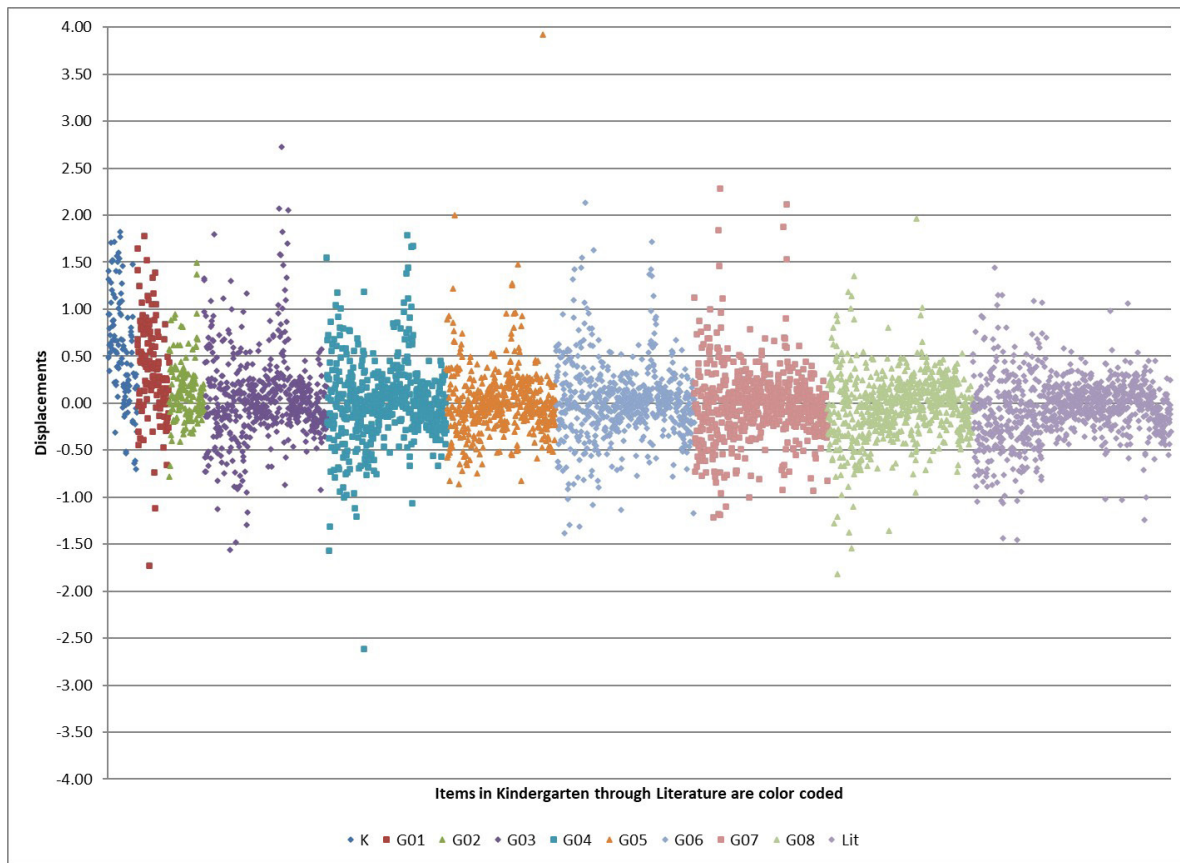


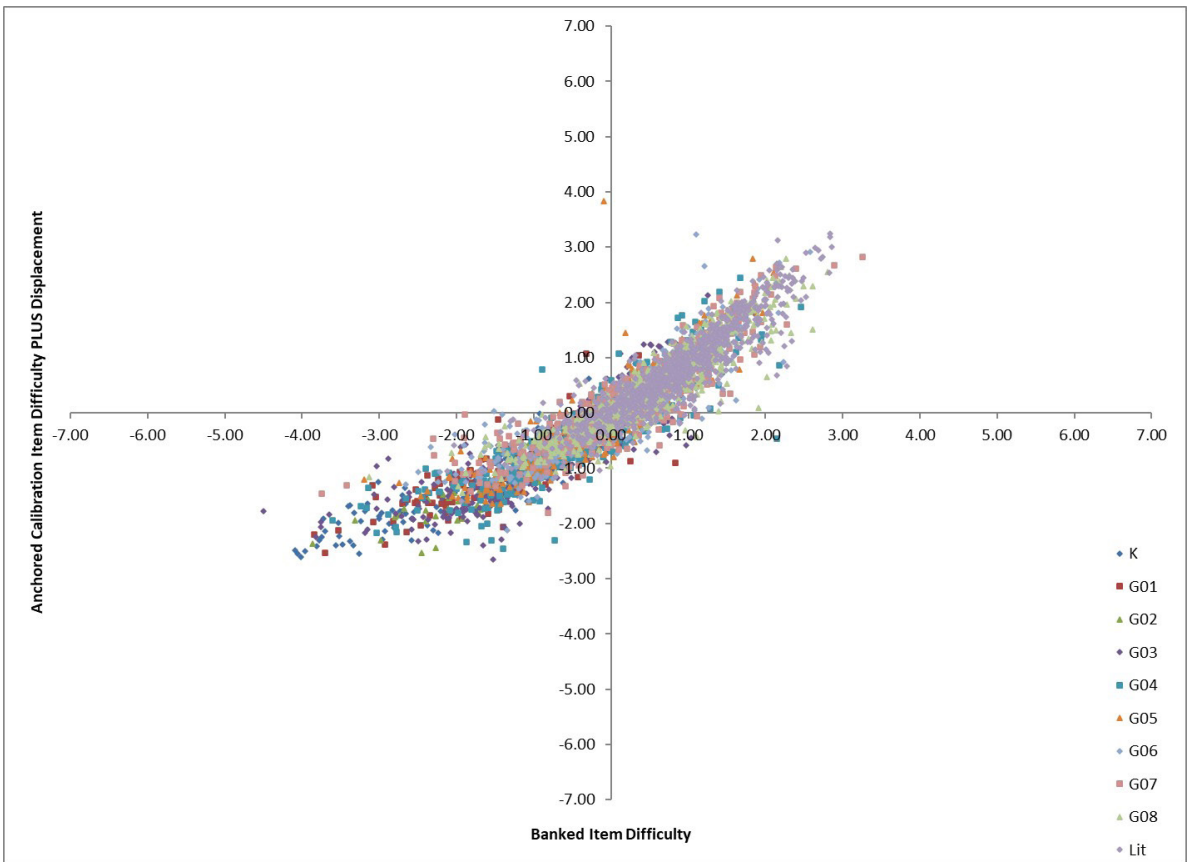
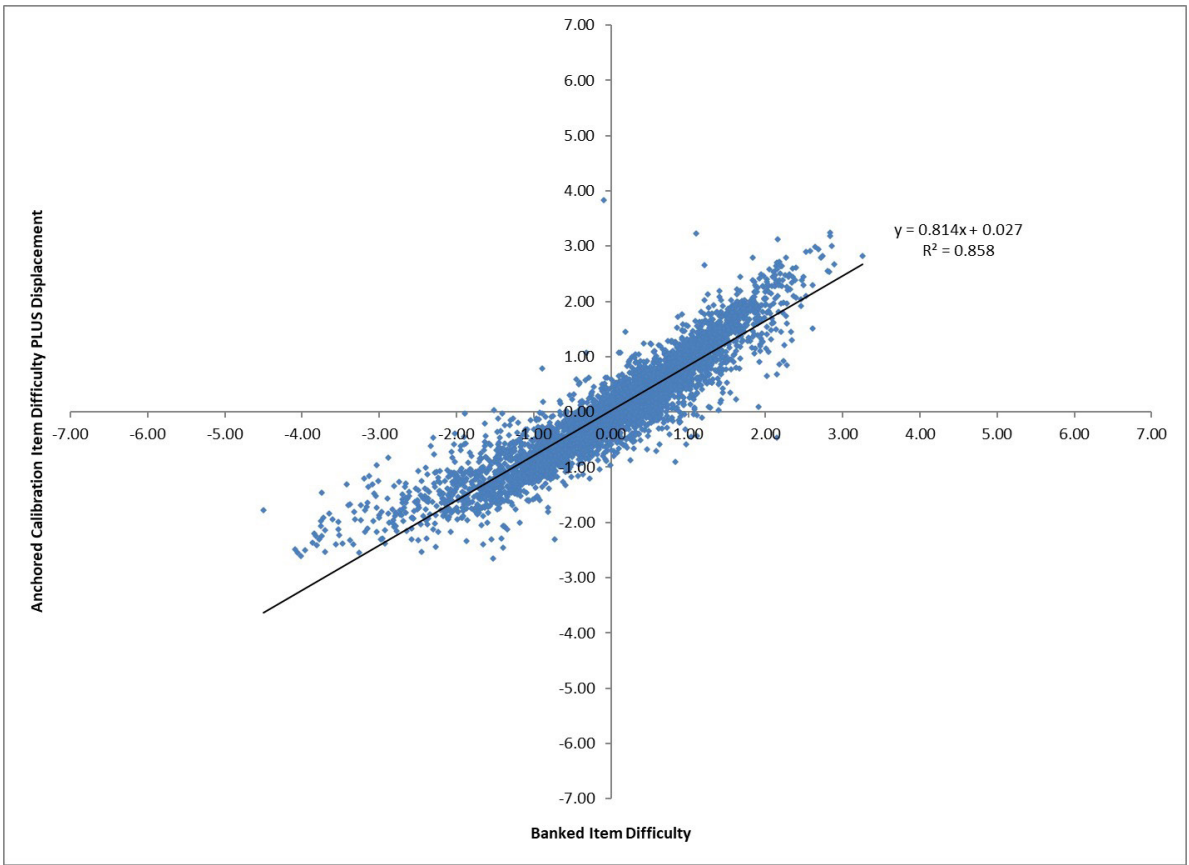
Table 18–4 summarizes the data in Figure 18–5. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-four percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–4).

**Table 18–4. Number of Reading Items by Grade/Course and Displacement Interval**

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	0	2	0	5	7	0	7	5	7	10	43
-1.0 < Disp. ≤ -0.9	0	0	0	3	4	0	1	3	2	2	15
-0.9 < Disp. ≤ -0.8	0	0	0	6	0	3	5	3	1	7	25
-0.8 < Disp. ≤ -0.7	1	1	1	6	8	2	8	16	9	16	68
-0.7 < Disp. ≤ -0.6	2	1	1	7	13	5	9	5	17	9	69
-0.6 < Disp. ≤ -0.5	2	0	0	13	16	15	14	17	16	24	117
-0.5 < Disp. ≤ -0.4	0	2	1	13	16	16	21	20	29	40	158
-0.4 < Disp. ≤ -0.3	2	3	5	25	26	22	29	32	50	68	262
-0.3 < Disp. ≤ -0.2	2	6	5	41	47	42	47	59	64	74	387
-0.2 < Disp. ≤ -0.1	4	6	19	77	62	75	66	71	63	109	552
-0.1 < Disp. ≤ 0.0	5	7	31	76	73	83	110	82	87	146	700
0.0 < Disp. ≤ 0.1	5	9	24	63	81	67	99	93	95	139	675
0.1 < Disp. ≤ 0.2	10	15	15	72	55	49	62	64	74	106	522
0.2 < Disp. ≤ 0.3	7	14	16	46	34	46	46	40	64	55	368
0.3 < Disp. ≤ 0.4	8	8	17	12	27	22	28	26	28	37	213
0.4 < Disp. ≤ 0.5	6	14	3	14	15	10	17	21	22	20	142
0.5 < Disp. ≤ 0.6	9	6	4	17	10	9	17	12	8	12	104
0.6 < Disp. ≤ 0.7	12	9	6	12	11	4	14	8	4	6	86
0.7 < Disp. ≤ 0.8	7	9	1	9	9	3	5	5	1	3	52
0.8 < Disp. ≤ 0.9	4	7	3	7	5	4	3	5	3	2	43
0.9 < Disp. ≤ 1.0	6	4	3	5	3	5	5	1	2	3	37
1.0 < Disp.	28	13	2	21	13	6	14	9	6	7	119
TOTAL	120	136	157	550	535	488	627	597	652	895	4757

Figure 18–6 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the reading item bank. A line of best fit is included in the upper plot. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

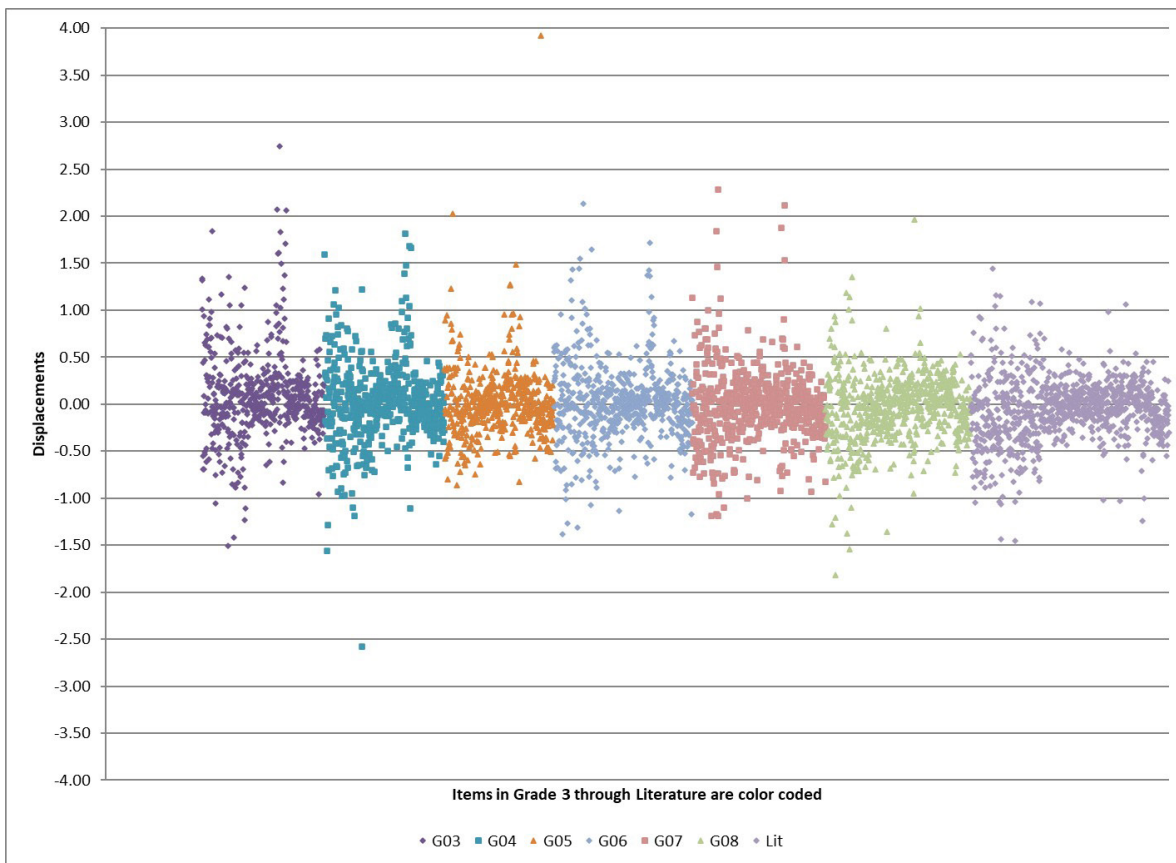
Figure 18–6. Reading Banked Item Parameters vs. Anchored Calibration — All Items



Based on Figure 18–6, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–7 and Table 18–5 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-five percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–5). Figure 18–8 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

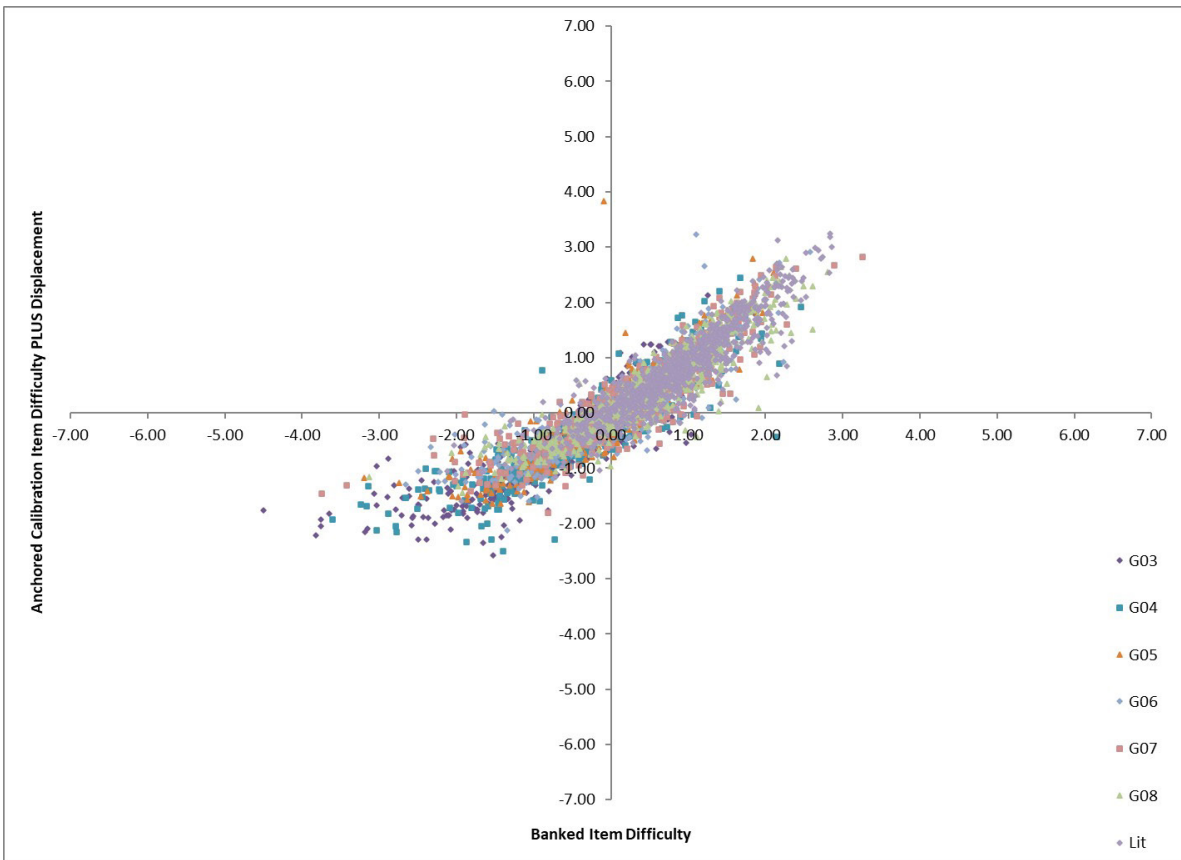
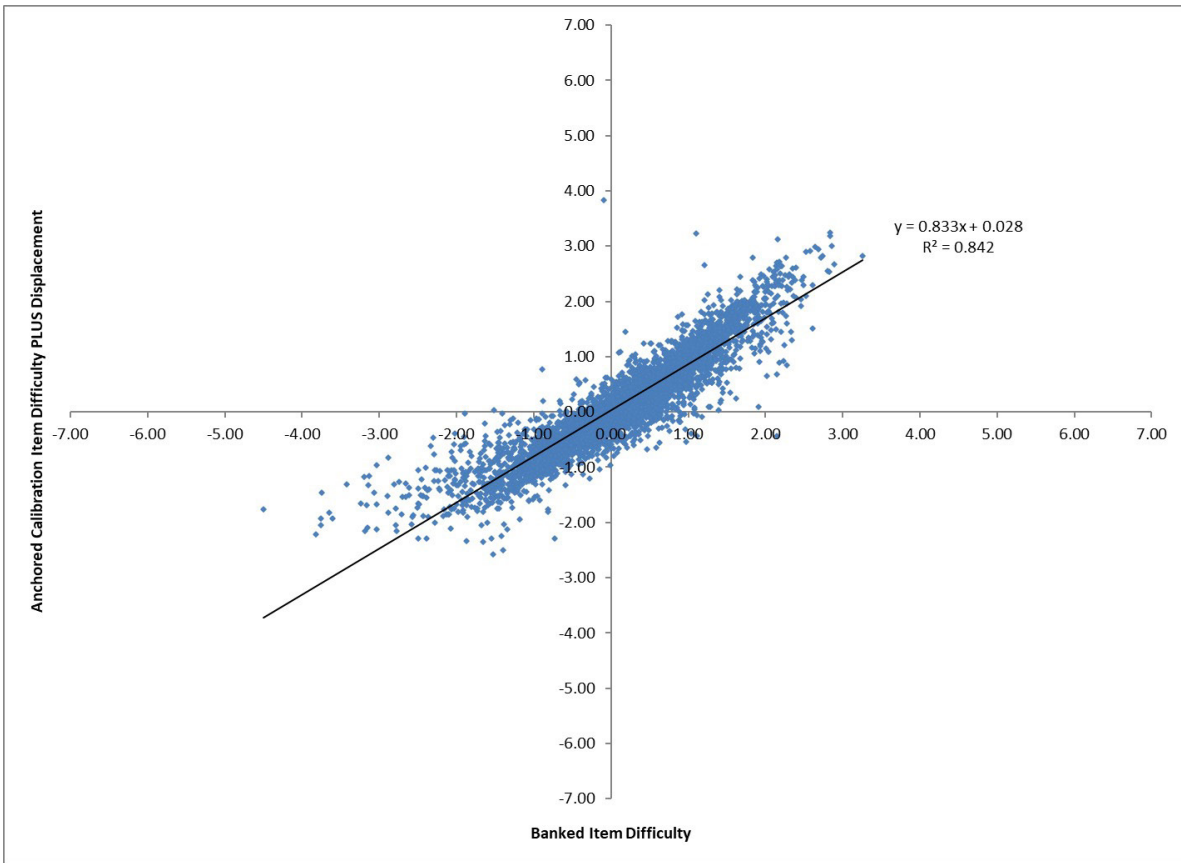
**Figure 18–7. Reading Anchored Calibration Displacements — All Items in Grade 3 and Above**



**Table 18–5. Number of Reading Items by Grade/Course and Displacement Interval**

<b>Interval</b>	<b>G03</b>	<b>G04</b>	<b>G05</b>	<b>G06</b>	<b>G07</b>	<b>G08</b>	<b>LIT</b>	<b>Total</b>
Disp. ≤ -1.0	5	6	0	7	5	7	10	40
-1.0 < Disp. ≤ -0.9	1	4	0	1	3	2	2	13
-0.9 < Disp. ≤ -0.8	6	1	3	5	3	1	7	26
-0.8 < Disp. ≤ -0.7	4	6	2	8	16	9	16	61
-0.7 < Disp. ≤ -0.6	10	13	4	9	5	17	9	67
-0.6 < Disp. ≤ -0.5	8	16	15	14	17	16	24	110
-0.5 < Disp. ≤ -0.4	16	15	16	21	20	29	40	157
-0.4 < Disp. ≤ -0.3	17	22	22	29	32	50	68	240
-0.3 < Disp. ≤ -0.2	30	47	40	46	59	64	74	360
-0.2 < Disp. ≤ -0.1	64	58	71	63	71	63	108	498
-0.1 < Disp. ≤ 0.0	94	72	86	108	82	87	147	676
0.0 < Disp. ≤ 0.1	65	82	68	104	92	95	139	645
0.1 < Disp. ≤ 0.2	68	61	53	63	65	74	106	490
0.2 < Disp. ≤ 0.3	56	34	44	43	39	64	55	335
0.3 < Disp. ≤ 0.4	18	31	23	29	27	28	37	193
0.4 < Disp. ≤ 0.5	15	16	10	16	20	22	20	119
0.5 < Disp. ≤ 0.6	15	10	9	20	12	8	12	86
0.6 < Disp. ≤ 0.7	12	9	4	14	9	4	6	58
0.7 < Disp. ≤ 0.8	9	8	3	5	5	1	3	34
0.8 < Disp. ≤ 0.9	9	7	4	3	5	3	2	33
0.9 < Disp. ≤ 1.0	5	4	5	5	1	2	3	25
1.0 < Disp.	23	13	6	14	9	6	7	78
<b>TOTAL</b>	<b>550</b>	<b>535</b>	<b>488</b>	<b>627</b>	<b>597</b>	<b>652</b>	<b>895</b>	<b>4344</b>

Figure 18–8. Reading Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above



It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. Table 18–6 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

**Table 18–6. Summary of Robust Z across Anchored Calibrations in Reading**

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	120	73	61%	0	0	N/A
Grade 1	136	56	41%	0	0	N/A
Grade 2	157	23	15%	0	0	N/A
Grade 3	550	120	22%	550	124	23%
Grade 4	535	107	20%	535	112	21%
Grade 5	488	62	13%	488	73	15%
Grade 6	627	115	18%	627	119	19%
Grade 7	597	101	17%	597	112	19%
Grade 8	652	93	14%	652	100	15%
Literature	895	119	13%	895	130	15%
Total	4757	869	18%	4344	770	18%
	Correlation = 0.926			Correlation = 0.918		
	Additive Constant = 0.023			Additive Constant = 0.000		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.469 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.468 to 0.469, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.468 have absolute value of robust Z greater than 1.645.

## SCIENCE

Figure 18–9 shows the displacements from a concurrent anchored calibration of all science items using the operational data set. Items are color-coded by grade/course.

**Figure 18–9. Science Anchored Calibration Displacements — All Items**

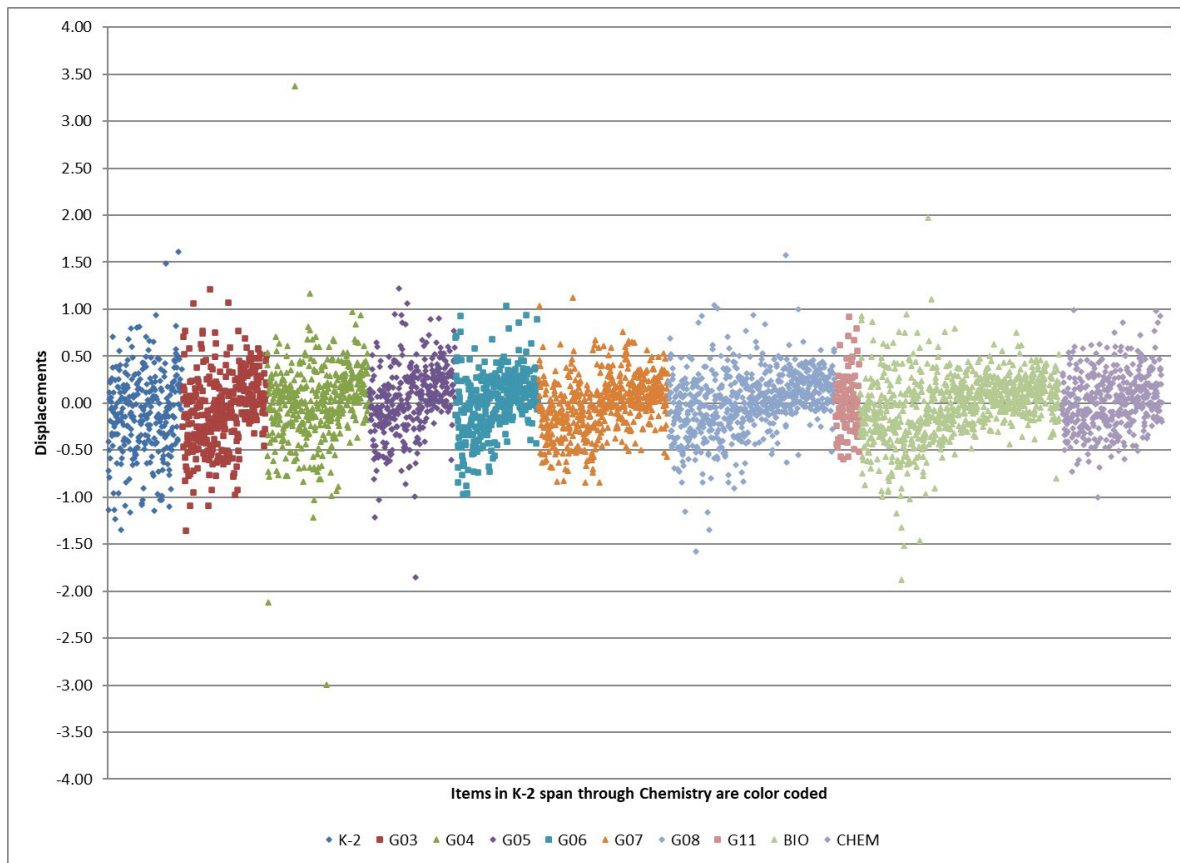


Table 18–7 summarizes the data in Figure 18–9. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-seven percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–7).

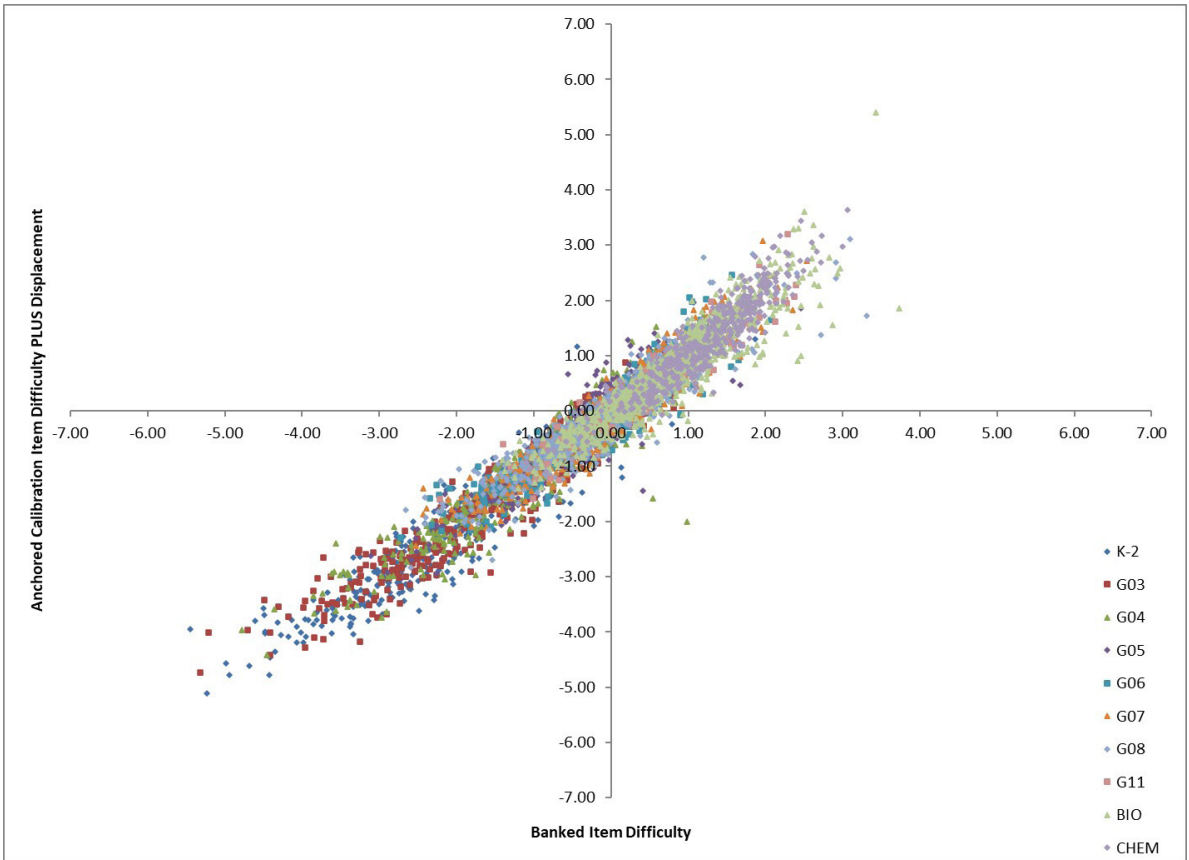
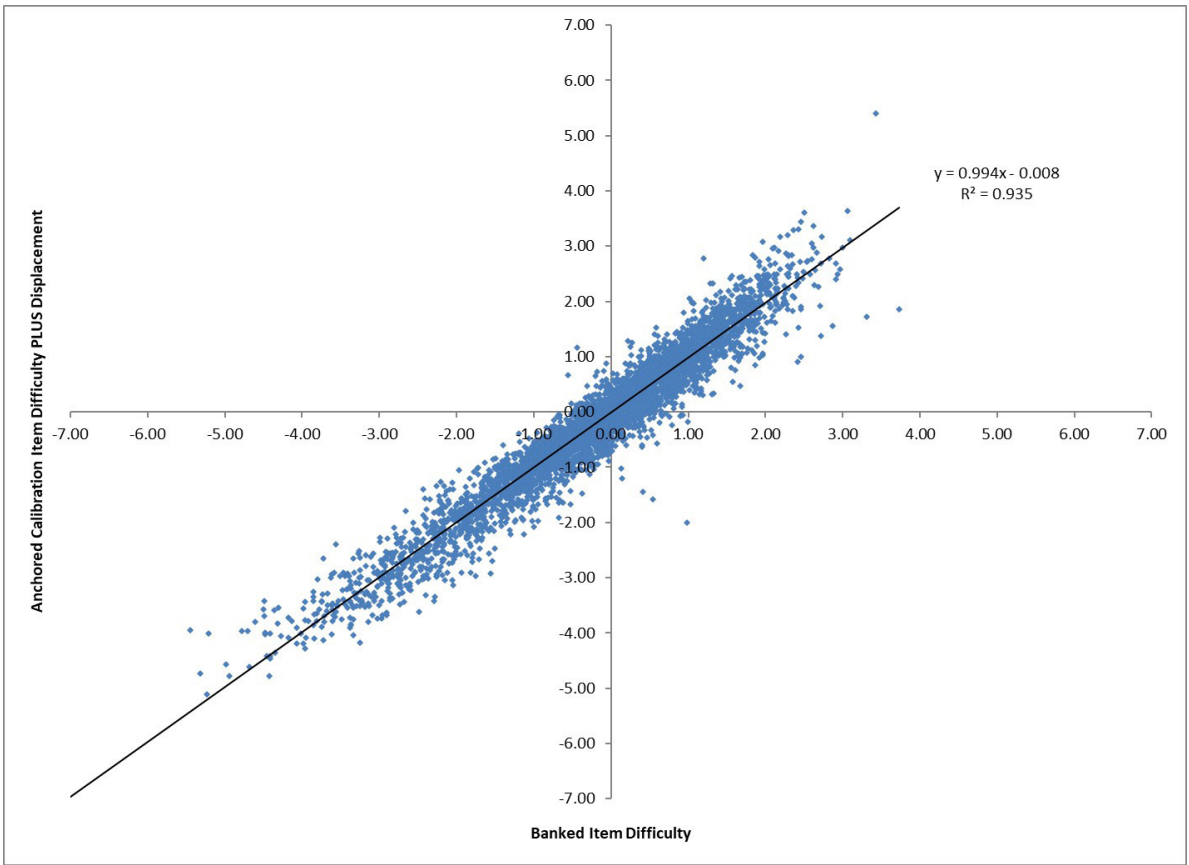


**Table 18–7. Number of Science Items by Grade/Course and Displacement Interval**

Interval	K-2	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	13	3	4	3	0	0	4	0	6	0	33
-1.0 < Disp. ≤ -0.9	6	4	2	1	2	0	1	0	8	1	25
-0.9 < Disp. ≤ -0.8	2	1	4	2	2	4	4	0	2	0	21
-0.8 < Disp. ≤ -0.7	8	9	9	2	5	4	6	0	9	1	53
-0.7 < Disp. ≤ -0.6	8	9	8	6	6	10	7	0	18	4	76
-0.6 < Disp. ≤ -0.5	15	21	12	15	7	19	18	4	15	5	131
-0.5 < Disp. ≤ -0.4	23	18	12	13	20	28	32	6	34	18	204
-0.4 < Disp. ≤ -0.3	25	26	23	7	15	27	35	6	52	26	242
-0.3 < Disp. ≤ -0.2	18	24	28	28	22	56	42	10	70	33	331
-0.2 < Disp. ≤ -0.1	38	41	40	26	35	47	63	15	86	56	447
-0.1 < Disp. ≤ 0.0	23	34	46	46	40	86	97	14	101	50	537
0.0 < Disp. ≤ 0.1	27	45	56	44	50	74	111	16	117	58	598
0.1 < Disp. ≤ 0.2	33	33	61	44	49	71	88	10	129	58	576
0.2 < Disp. ≤ 0.3	21	27	38	47	48	51	76	10	82	38	438
0.3 < Disp. ≤ 0.4	15	18	32	26	17	33	54	1	46	28	270
0.4 < Disp. ≤ 0.5	18	16	24	18	14	14	30	4	30	20	188
0.5 < Disp. ≤ 0.6	4	11	9	13	3	11	12	1	6	16	86
0.6 < Disp. ≤ 0.7	4	3	12	6	3	9	5	2	9	3	56
0.7 < Disp. ≤ 0.8	3	6	3	2	3	1	2	2	6	3	31
0.8 < Disp. ≤ 0.9	3	0	2	4	2	0	2	0	2	2	17
0.9 < Disp. ≤ 1.0	1	0	2	2	2	0	2	1	2	3	15
1.0 < Disp.	2	3	2	2	1	2	4	0	2	0	18
TOTAL	310	352	429	357	346	547	695	102	832	423	4393

Figure 18–10 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the science item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.

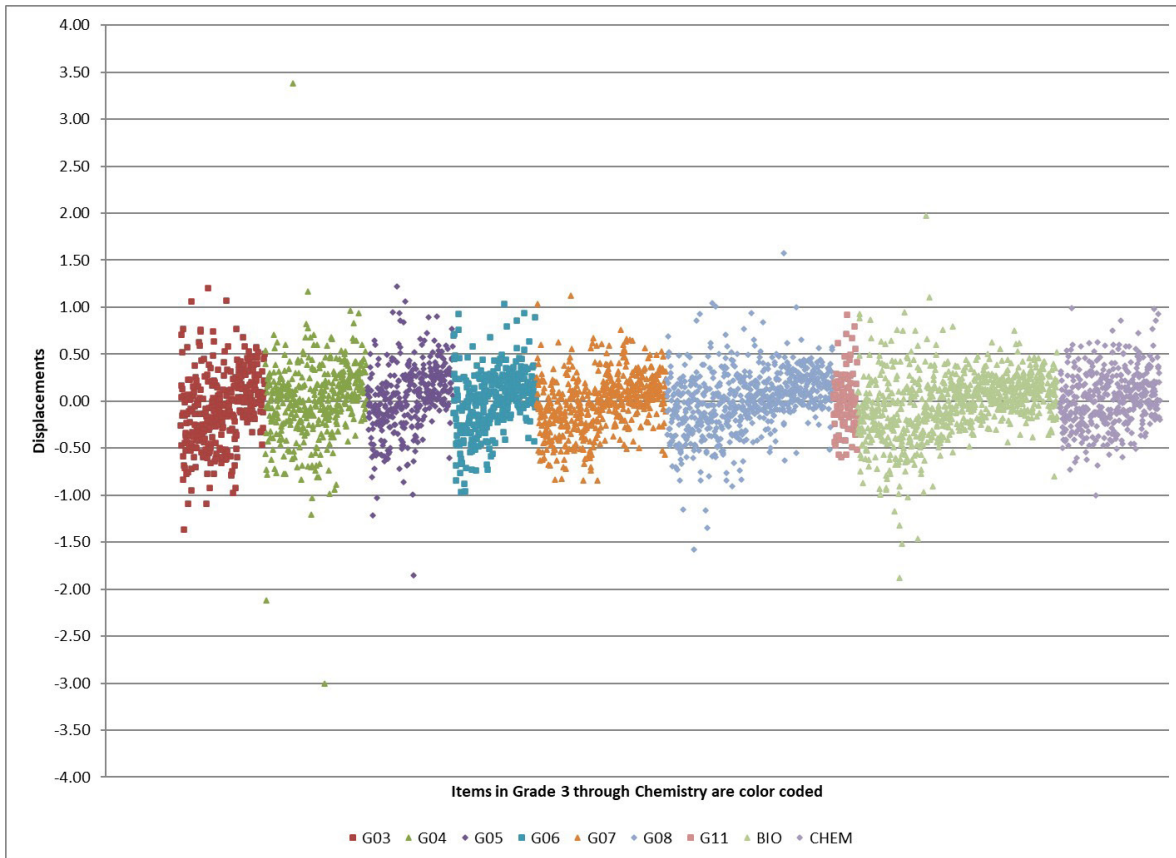
Figure 18–10. Science Banked Item Parameters vs. Anchored Calibration — All Items



Based on Figure 18–10, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in the K–2 span. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in the K–2 span to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–11 and Table 18–8 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-eight percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–8). Figure 18–12 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

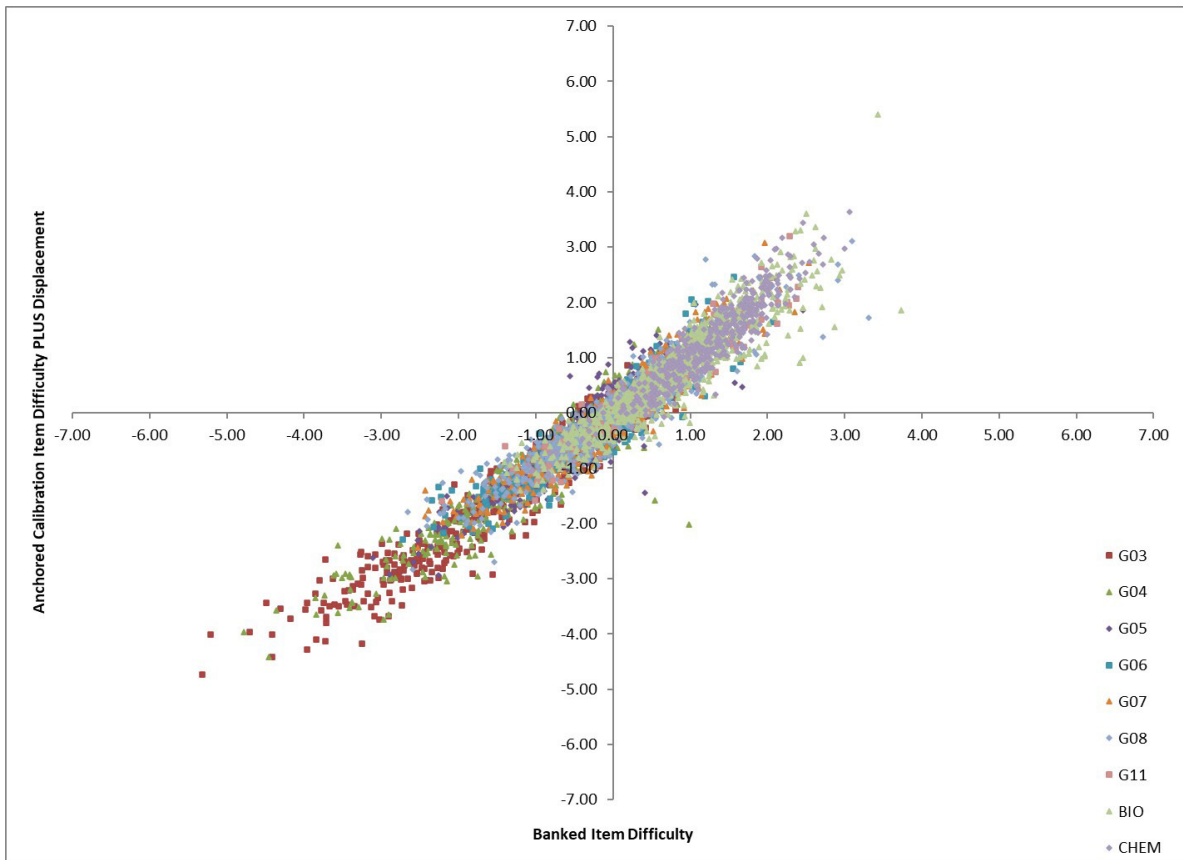
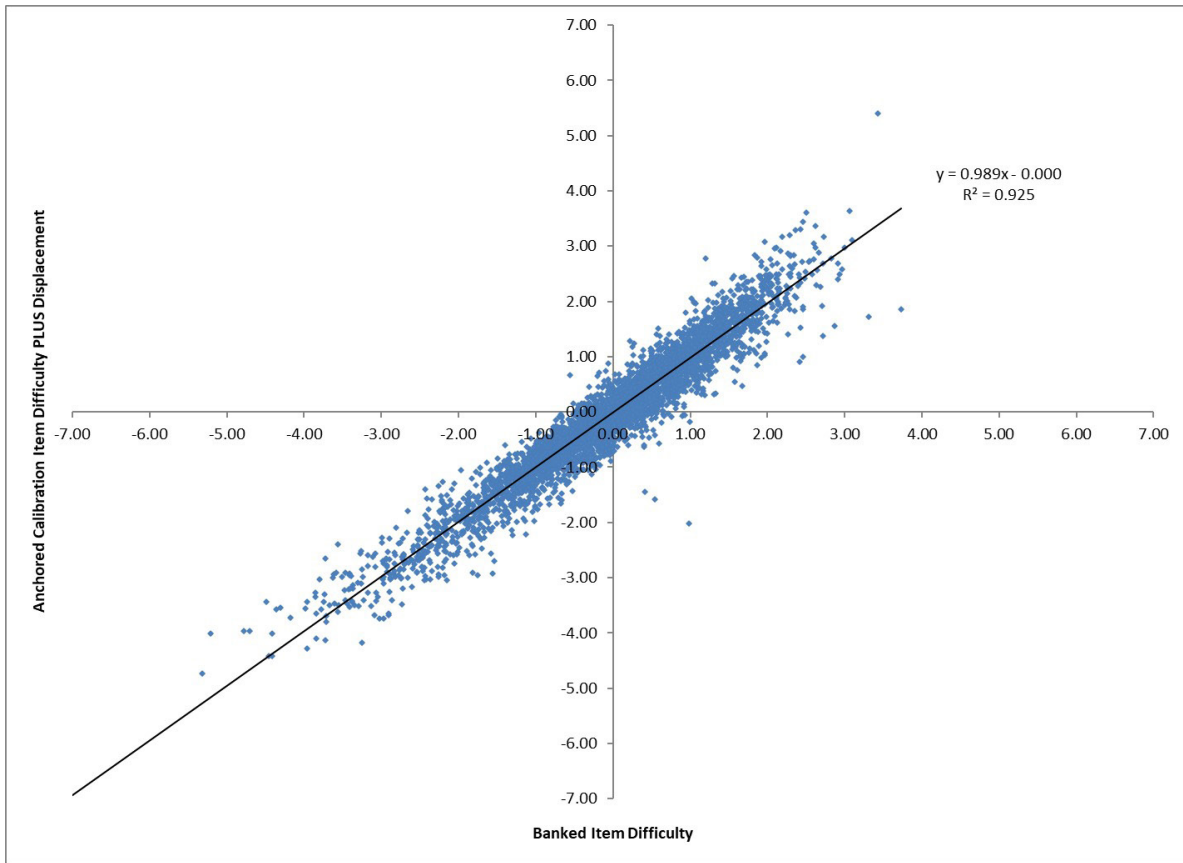
**Figure 18–11. Science Anchored Calibration Displacements — All Items in Grade 3 and Above**



**Table 18–8. Number of Science Items by Grade/Course and Displacement Interval**

<b>Interval</b>	<b>G03</b>	<b>G04</b>	<b>G05</b>	<b>G06</b>	<b>G07</b>	<b>G08</b>	<b>G11</b>	<b>BIO</b>	<b>CHEM</b>	<b>Total</b>
Disp. ≤ -1.0	3	4	3	0	0	4	0	6	0	20
-1.0 < Disp. ≤ -0.9	4	2	1	2	0	1	0	8	1	19
-0.9 < Disp. ≤ -0.8	1	4	2	2	4	4	0	2	0	19
-0.8 < Disp. ≤ -0.7	10	10	2	5	4	6	0	9	1	47
-0.7 < Disp. ≤ -0.6	9	7	6	6	10	7	0	18	4	67
-0.6 < Disp. ≤ -0.5	22	12	15	7	19	18	4	15	5	117
-0.5 < Disp. ≤ -0.4	19	12	13	20	28	32	6	34	18	182
-0.4 < Disp. ≤ -0.3	23	23	7	15	27	35	6	52	26	214
-0.3 < Disp. ≤ -0.2	24	28	28	22	56	42	10	70	33	313
-0.2 < Disp. ≤ -0.1	44	43	26	35	47	63	15	86	56	415
-0.1 < Disp. ≤ 0.0	33	45	46	40	86	97	14	101	50	512
0.0 < Disp. ≤ 0.1	46	57	44	50	74	111	16	117	58	573
0.1 < Disp. ≤ 0.2	31	62	44	49	71	88	10	129	58	542
0.2 < Disp. ≤ 0.3	26	39	47	48	51	76	10	82	38	417
0.3 < Disp. ≤ 0.4	20	29	26	17	33	54	1	46	28	254
0.4 < Disp. ≤ 0.5	14	23	18	14	14	30	4	30	20	167
0.5 < Disp. ≤ 0.6	11	9	13	3	11	12	1	6	16	82
0.6 < Disp. ≤ 0.7	3	11	6	3	9	5	2	9	3	51
0.7 < Disp. ≤ 0.8	6	3	2	3	1	2	2	6	3	28
0.8 < Disp. ≤ 0.9	0	2	4	2	0	2	0	2	2	14
0.9 < Disp. ≤ 1.0	0	2	2	2	0	2	1	2	3	14
1.0 < Disp.	3	2	2	1	2	4	0	2	0	16
<b>TOTAL</b>	<b>352</b>	<b>429</b>	<b>357</b>	<b>346</b>	<b>547</b>	<b>695</b>	<b>102</b>	<b>832</b>	<b>423</b>	<b>4083</b>

Figure 18–12. Science Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above



It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–9 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

**Table 18–9. Summary of Robust Z across Anchored Calibrations in Science**

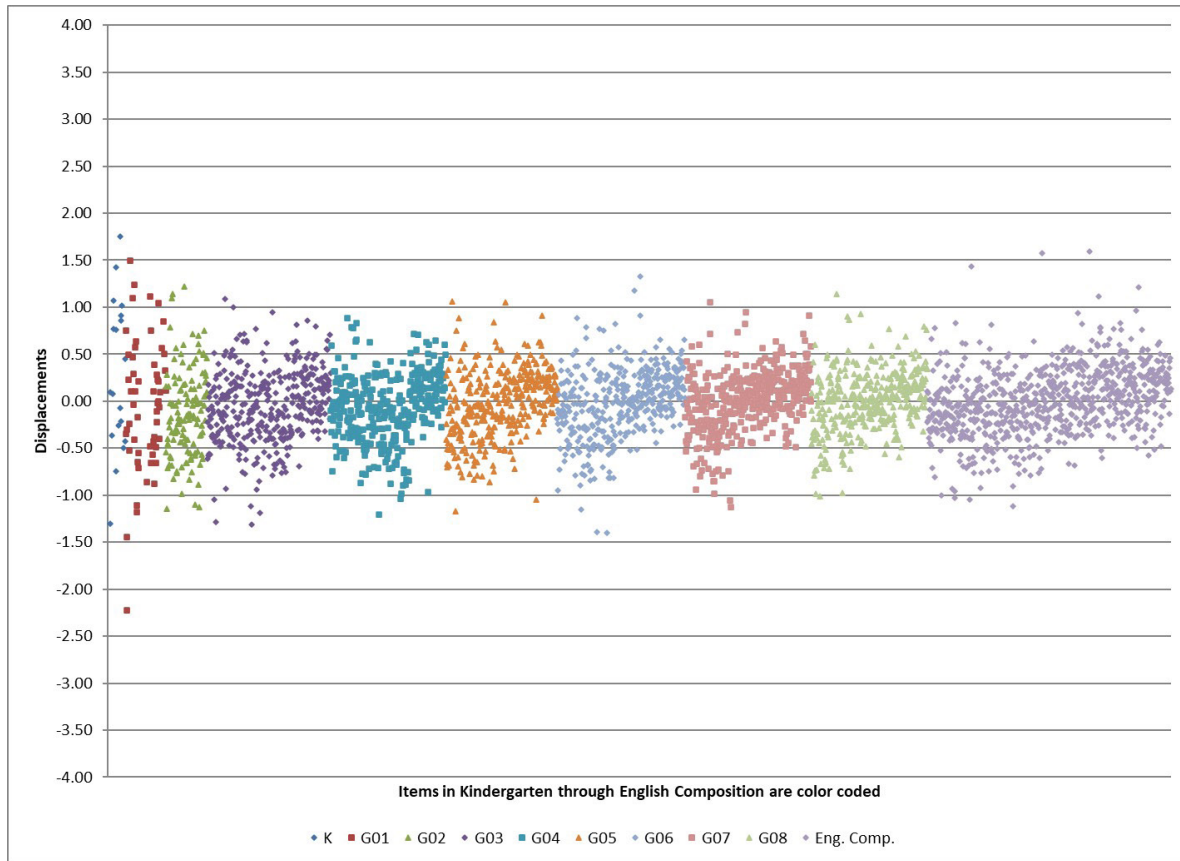
Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
K–2 span	310	74	24%	0	0	#DIV/0!
Grade 3	352	73	21%	352	77	22%
Grade 4	429	69	16%	429	71	17%
Grade 5	357	58	16%	357	61	17%
Grade 6	346	36	10%	346	39	11%
Grade 7	547	65	12%	547	69	13%
Grade 8	695	69	10%	695	76	11%
Grade 11	102	11	11%	102	12	12%
Biology	832	89	11%	832	94	11%
Chemistry	423	37	9%	423	41	10%
Total	4393	581	13%	4083	540	13%
	Correlation = 0.967			Correlation = 0.962		
	Additive Constant = -0.007			Additive Constant = 0.000		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.512 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.481 to 0.512, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.481 have absolute value of robust Z greater than 1.645.

## WRITING/ENGLISH COMPOSITION

Figure 18–13 shows the displacements from a concurrent anchored calibration of all writing items using the operational data set. Items are color-coded by grade/course.

**Figure 18–13. Writing Anchored Calibration Displacements — All Items**



Note: Many kindergarten items were not estimated by WINSTEPS software due to insufficient counts.

Table 18–10 summarizes the data in Figure 18–13. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-four percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–10).

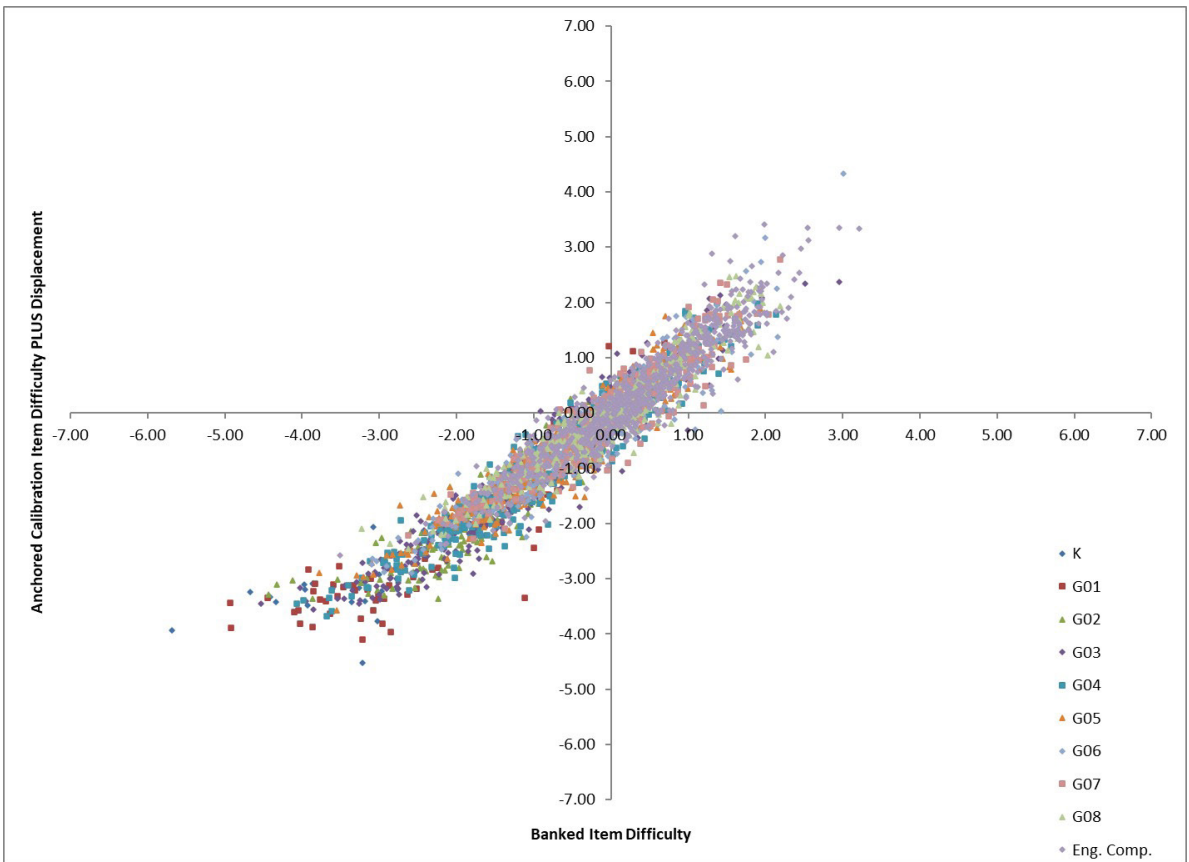
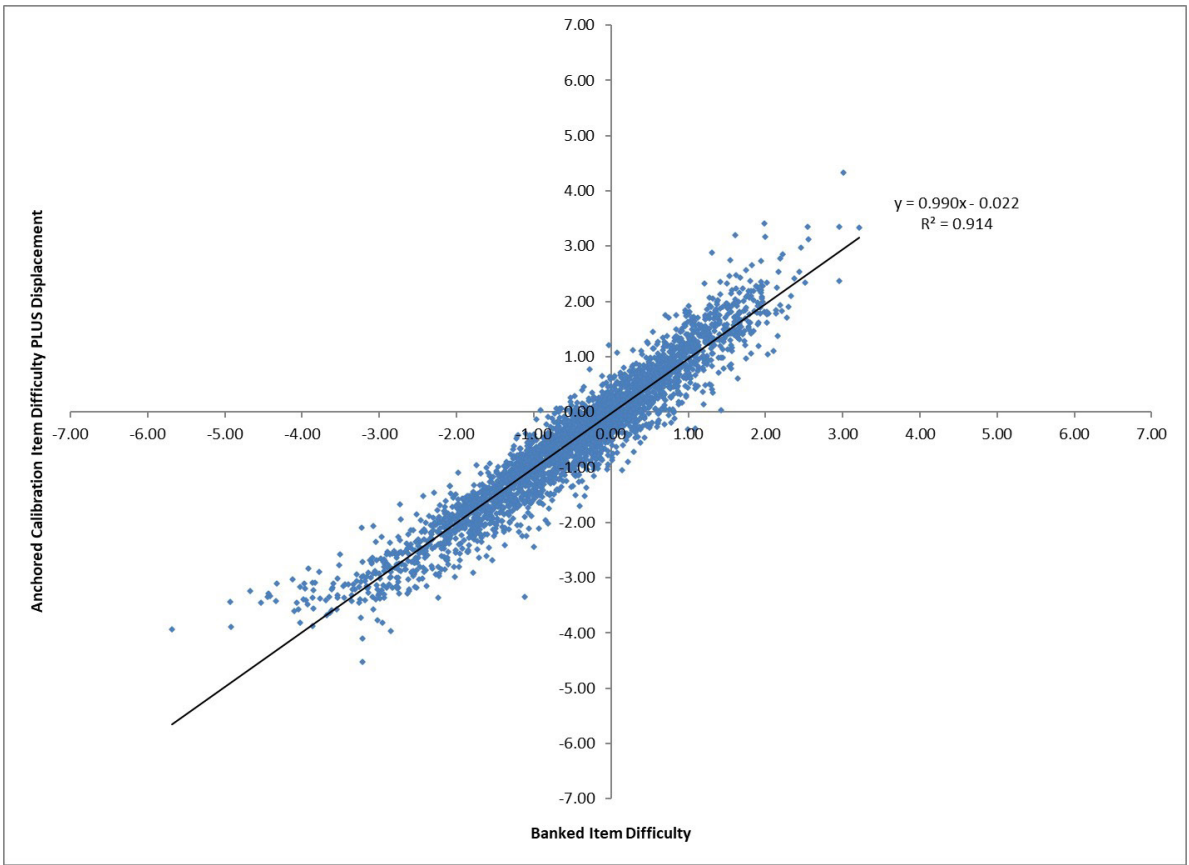
**Table 18–10. Number of Writing Items by Grade/Course and Displacement Interval**

Interval	K	G01	G02	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	1	4	3	5	2	2	3	2	1	4	27
-1.0 < Disp. ≤ -0.9	0	0	1	2	2	0	1	2	2	4	14
-0.9 < Disp. ≤ -0.8	0	2	3	1	6	3	6	2	0	1	24
-0.8 < Disp. ≤ -0.7	1	1	4	7	11	7	7	8	6	11	63
-0.7 < Disp. ≤ -0.6	0	3	10	12	6	10	5	4	6	15	71
-0.6 < Disp. ≤ -0.5	0	3	8	10	15	15	17	5	8	19	100
-0.5 < Disp. ≤ -0.4	2	5	9	20	17	15	18	20	15	23	144
-0.4 < Disp. ≤ -0.3	1	3	9	46	24	21	22	25	19	56	226
-0.3 < Disp. ≤ -0.2	2	2	11	25	31	27	26	24	27	78	253
-0.2 < Disp. ≤ -0.1	0	2	13	46	39	39	40	27	40	81	327
-0.1 < Disp. ≤ 0.0	1	3	10	32	47	33	51	48	40	82	347
0.0 < Disp. ≤ 0.1	2	2	8	34	36	30	53	54	49	81	349
0.1 < Disp. ≤ 0.2	0	4	11	45	31	46	41	55	48	83	364
0.2 < Disp. ≤ 0.3	0	6	7	36	39	39	40	55	40	70	332
0.3 < Disp. ≤ 0.4	0	2	2	16	23	25	32	27	21	56	204
0.4 < Disp. ≤ 0.5	1	2	7	17	8	16	13	12	21	36	133
0.5 < Disp. ≤ 0.6	0	3	4	9	5	5	10	10	5	23	74
0.6 < Disp. ≤ 0.7	0	1	2	8	6	5	3	2	2	12	41
0.7 < Disp. ≤ 0.8	2	2	3	5	4	1	3	3	3	7	33
0.8 < Disp. ≤ 0.9	1	1	0	2	2	2	2	1	1	4	16
0.9 < Disp. ≤ 1.0	1	0	0	2	0	1	1	2	2	2	11
1.0 < Disp.	4	5	3	1	0	2	2	1	1	5	24
TOTAL	19	56	128	381	354	344	396	389	357	753	3177

Figure 18–14 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored concurrent calibration of operational data for the writing item bank. A line of best fit is included in the upper plot. If item difficulties from the operational calibration are close to the banked values, the line will approach an intercept of zero and a slope of one. The lower plot displays the same data as the upper, but color codes items by grade/course in an attempt to lend insight into the possible causes for the deviations.



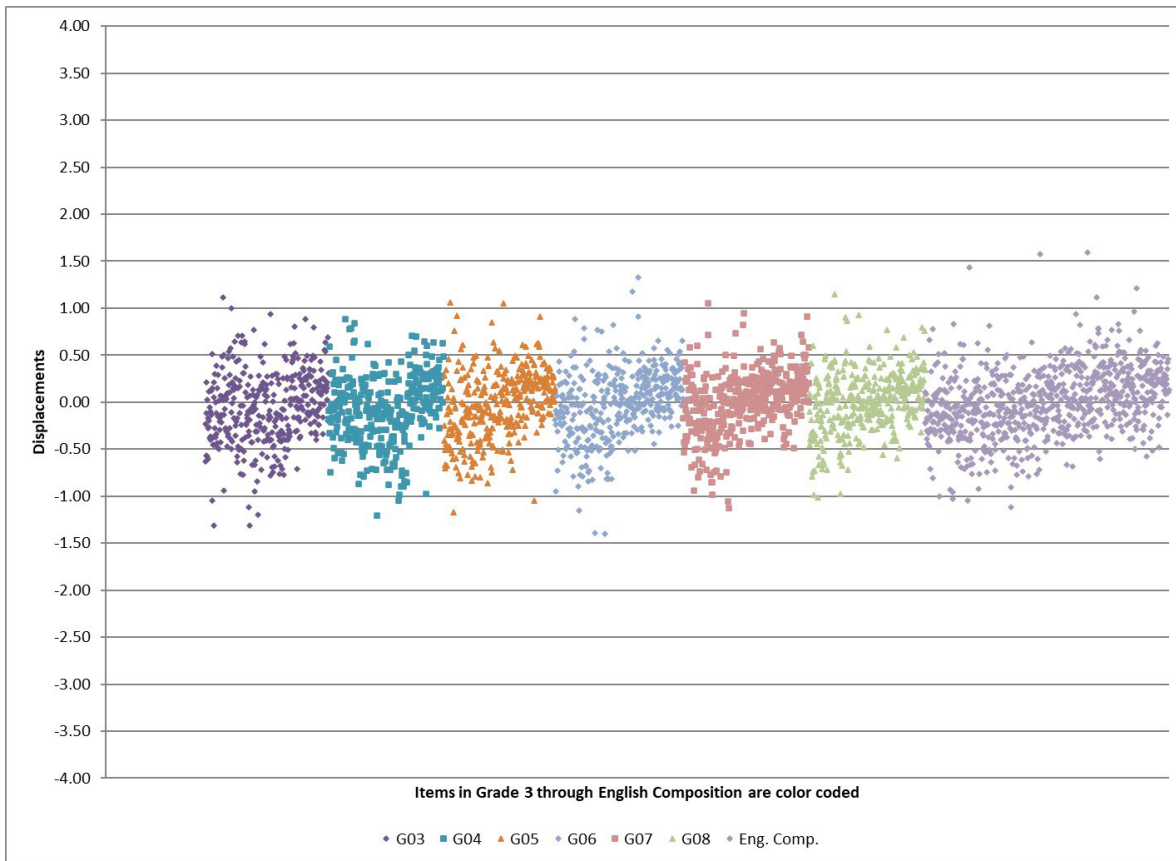
Figure 18–14. Writing Banked Item Parameters vs. Anchored Calibration — All Items



Based on Figure 18–14, one can see that there are a number of items with operational estimates that differ from their banked values. Some of these are in kindergarten through grade 2. Recall that the operational CDT is available to students in grade 3 and above. While items were developed to sample content in kindergarten through grade 2 to provide better diagnostic information for lower performing students, the data from the operational administration did not include students below grade 3. To investigate whether this had an impact on the stability of the item parameter estimates, a concurrent anchored calibration of all items in grade 3 and above was run.

Figure 18–15 and Table 18–11 summarize the displacements from a concurrent anchored calibration of all items in grade 3 and above. Eighty-six percent of the items in the calibration have displacement less than 0.5 in magnitude (gray shaded in Table 18–11). Figure 18–16 shows banked item difficulties plotted against the item difficulties plus displacement. Again, a line of best fit is included in the upper plot.

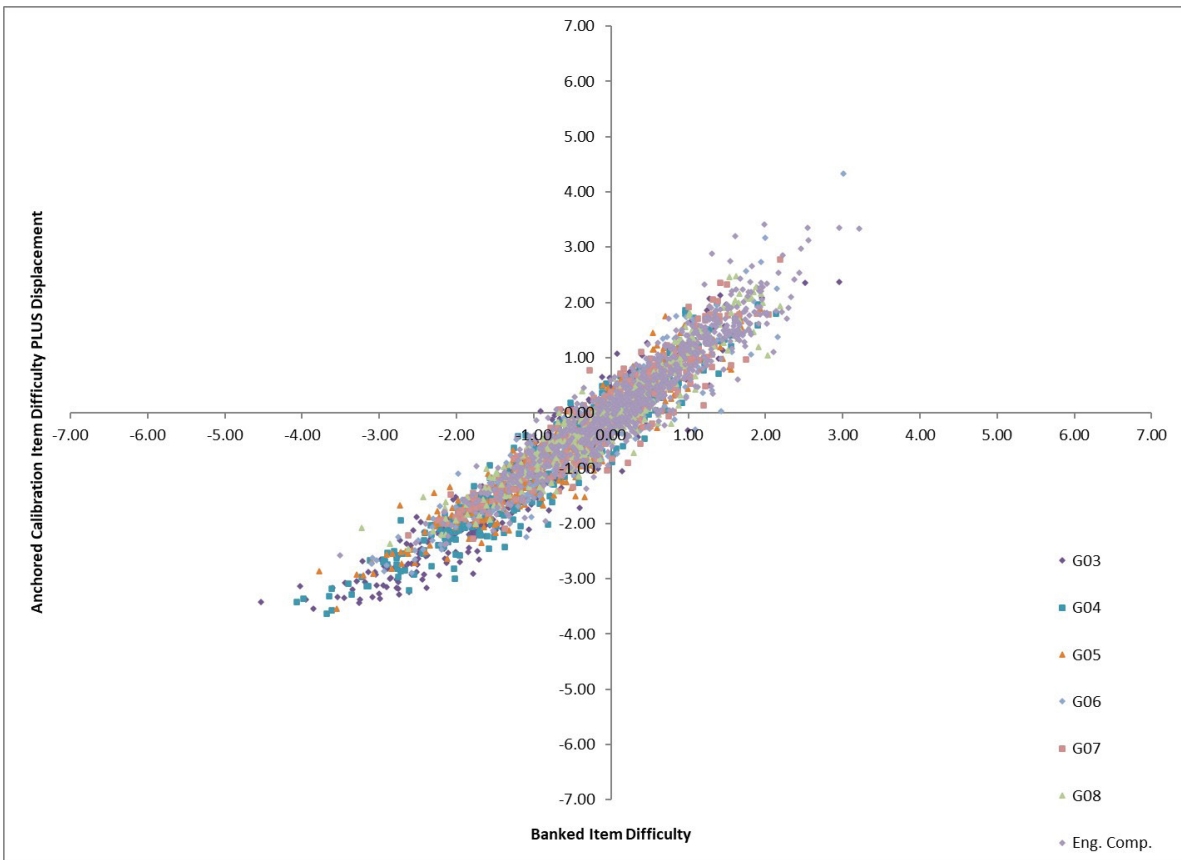
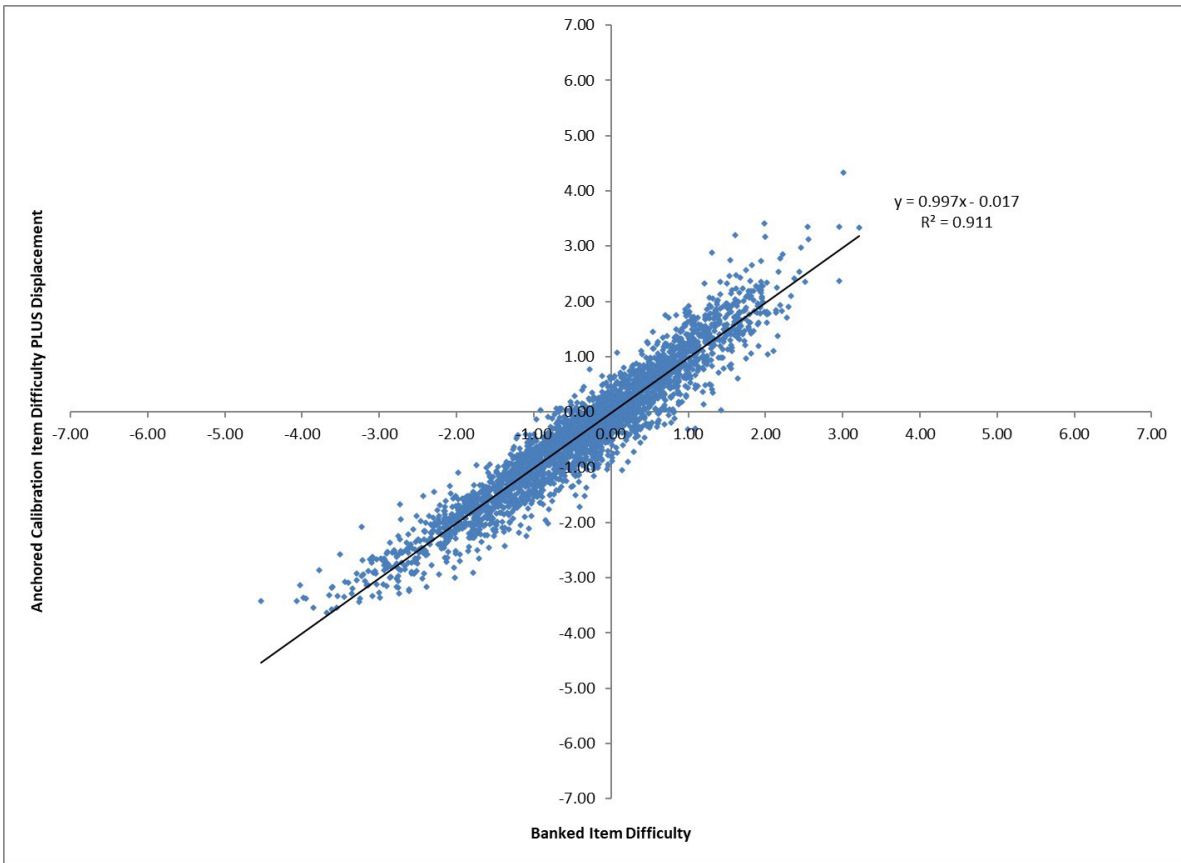
**Figure 18–15. Writing Anchored Calibration Displacements — All Items in Grade 3 and Above**



**Table 18–11. Number of Writing Items by Grade/Course and Displacement Interval**

<b>Interval</b>	<b>G03</b>	<b>G04</b>	<b>G05</b>	<b>G06</b>	<b>G07</b>	<b>G08</b>	<b>COMP</b>	<b>Total</b>
Disp. ≤ -1.0	5	2	2	3	2	1	4	19
-1.0 < Disp. ≤ -0.9	2	2	0	1	2	2	4	13
-0.9 < Disp. ≤ -0.8	1	6	3	6	2	0	1	19
-0.8 < Disp. ≤ -0.7	9	11	7	7	8	6	11	59
-0.7 < Disp. ≤ -0.6	11	6	10	5	4	6	15	57
-0.6 < Disp. ≤ -0.5	12	15	15	17	5	8	19	91
-0.5 < Disp. ≤ -0.4	22	19	15	17	20	15	23	131
-0.4 < Disp. ≤ -0.3	41	23	21	23	25	19	56	208
-0.3 < Disp. ≤ -0.2	29	31	27	26	24	27	78	242
-0.2 < Disp. ≤ -0.1	46	43	38	40	27	40	81	315
-0.1 < Disp. ≤ 0.0	28	43	32	52	48	40	82	325
0.0 < Disp. ≤ 0.1	34	37	31	52	54	49	81	338
0.1 < Disp. ≤ 0.2	44	31	46	41	55	48	83	348
0.2 < Disp. ≤ 0.3	39	39	39	40	54	40	70	321
0.3 < Disp. ≤ 0.4	14	20	25	32	28	21	56	196
0.4 < Disp. ≤ 0.5	20	10	17	13	12	21	36	129
0.5 < Disp. ≤ 0.6	6	3	5	10	10	5	23	62
0.6 < Disp. ≤ 0.7	9	7	5	3	2	2	12	40
0.7 < Disp. ≤ 0.8	4	4	1	3	3	3	7	25
0.8 < Disp. ≤ 0.9	2	2	1	2	1	1	4	13
0.9 < Disp. ≤ 1.0	2	0	2	1	2	2	2	11
1.0 < Disp.	1	0	2	2	1	1	5	12
<b>TOTAL</b>	<b>381</b>	<b>354</b>	<b>344</b>	<b>396</b>	<b>389</b>	<b>357</b>	<b>753</b>	<b>2974</b>

Figure 18–16. Writing Banked Item Parameters vs. Anchored Calibration — All Items in Grade 3 and Above



It is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

For both of the anchored calibrations described in this section, banked item parameters were compared to the banked item parameters plus the displacements by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–12 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in each of the calibrations.

**Table 18–12. Summary of Robust Z across Anchored Calibrations in Writing**

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	19	10	53%	0	0	N/A
Grade 1	56	20	36%	0	0	N/A
Grade 2	128	31	24%	0	0	N/A
Grade 3	381	46	12%	381	53	14%
Grade 4	354	44	12%	354	46	13%
Grade 5	344	38	11%	344	41	12%
Grade 6	396	36	9%	396	39	10%
Grade 7	389	31	8%	389	32	8%
Grade 8	357	27	8%	357	31	9%
English Comp	753	74	10%	753	78	10%
Total	3177	357	11%	2974	320	11%
	Correlation = 0.956			Correlation = 0.955		
	Additive Constant = -0.018			Additive Constant = -0.015		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.578 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.573 to 0.578, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.573 have absolute value of robust Z greater than 1.645.

## ANCHORED GRADE LEVEL CALIBRATIONS

While the CDT content area item banks are vertically scaled with items from Kindergarten through high school courses, the assessments themselves are first made available in grade 3. Also, while the items are selected adaptively, most students take a large number of items at grade level. Given these conditions, item parameters were also evaluated by running anchored grade level item calibrations—grade 3 items calibrated with grade 3 students, and so on. This is similar to how field-test items were calibrated. Table 18–13 shows the number of students in each grade level calibration.

**Table 18–13. Number of Students in Grade Level Calibrations**

<b>Content Area</b>	<b>Grade/Course</b>	<b>Number of Students</b>
Mathematics	Grade 3	44,375
Mathematics	Grade 4	47,614
Mathematics	Grade 5	53,600
Mathematics	Grade 6	68,828
Mathematics	Grade 7	78,118
Mathematics	Grade 8	67,611
Mathematics	Algebra I	123,423
Mathematics	Geometry	9,173
Mathematics	Algebra II	12,459
Reading	Grade 3	36,337
Reading	Grade 4	39,192
Reading	Grade 5	43,637
Reading	Grade 6	53,621
Reading	Grade 7	60,517
Reading	Grade 8	58,963
Reading	Reading/Literature	140,953
Science	Grade 3	6,866
Science	Grade 4	34,171
Science	Grade 5	15,361
Science	Grade 6	36,274
Science	Grade 7	57,630
Science	Grade 8	74,253
Science	High School	5,734
Science	Biology	131,134
Science	Chemistry	6,872
Writing	Grade 3	7,028
Writing	Grade 4	8,309
Writing	Grade 5	9,935
Writing	Grade 6	12,442
Writing	Grade 7	17,247
Writing	Grade 8	14,676
Writing	Writing/English Composition	11,350

## MATHEMATICS

Figure 18–17 shows the displacements from the anchored grade level calibrations of operational data for the mathematics item bank. Items are color-coded by grade/course.

**Figure 18–17. Mathematics Anchored Grade Level Calibrations Displacements – All Items in Grade 3 and Above**

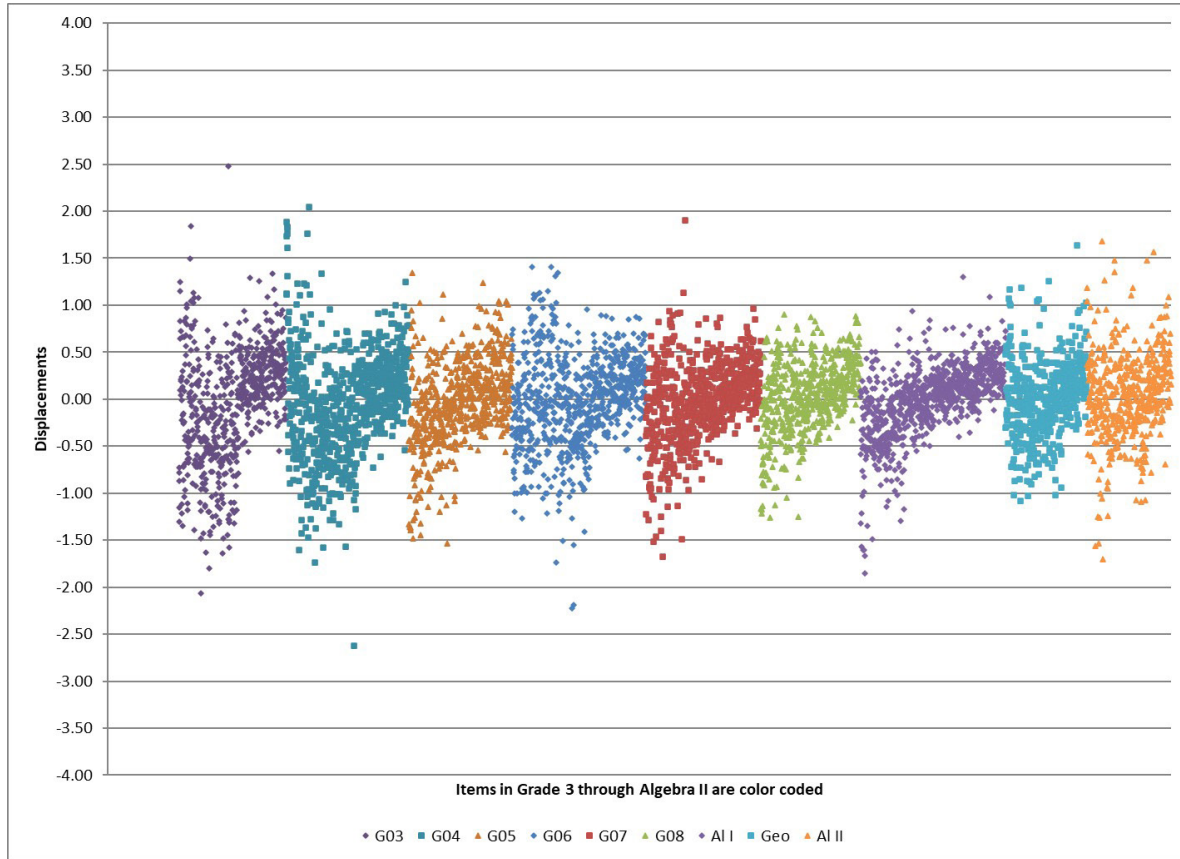


Table 18–14 summarizes the data in Figure 18–17. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Seventy-six percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–14).

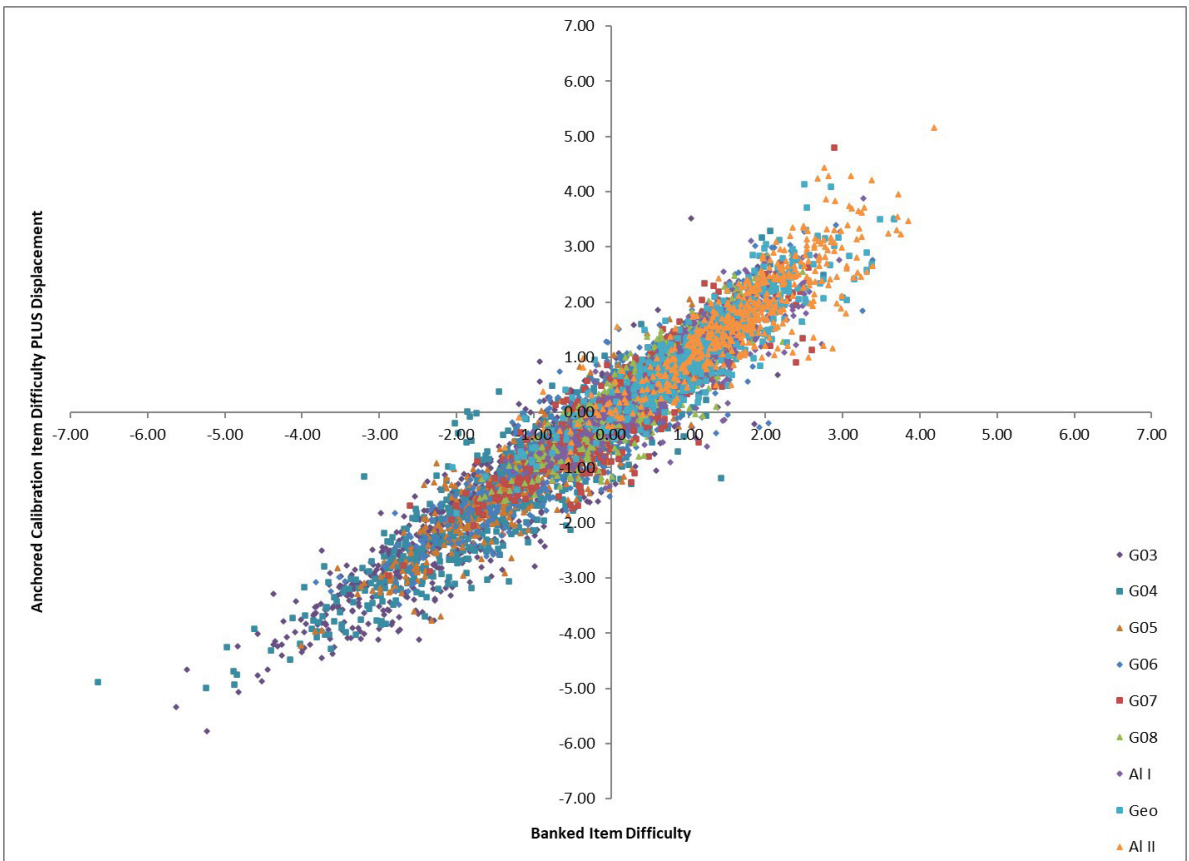
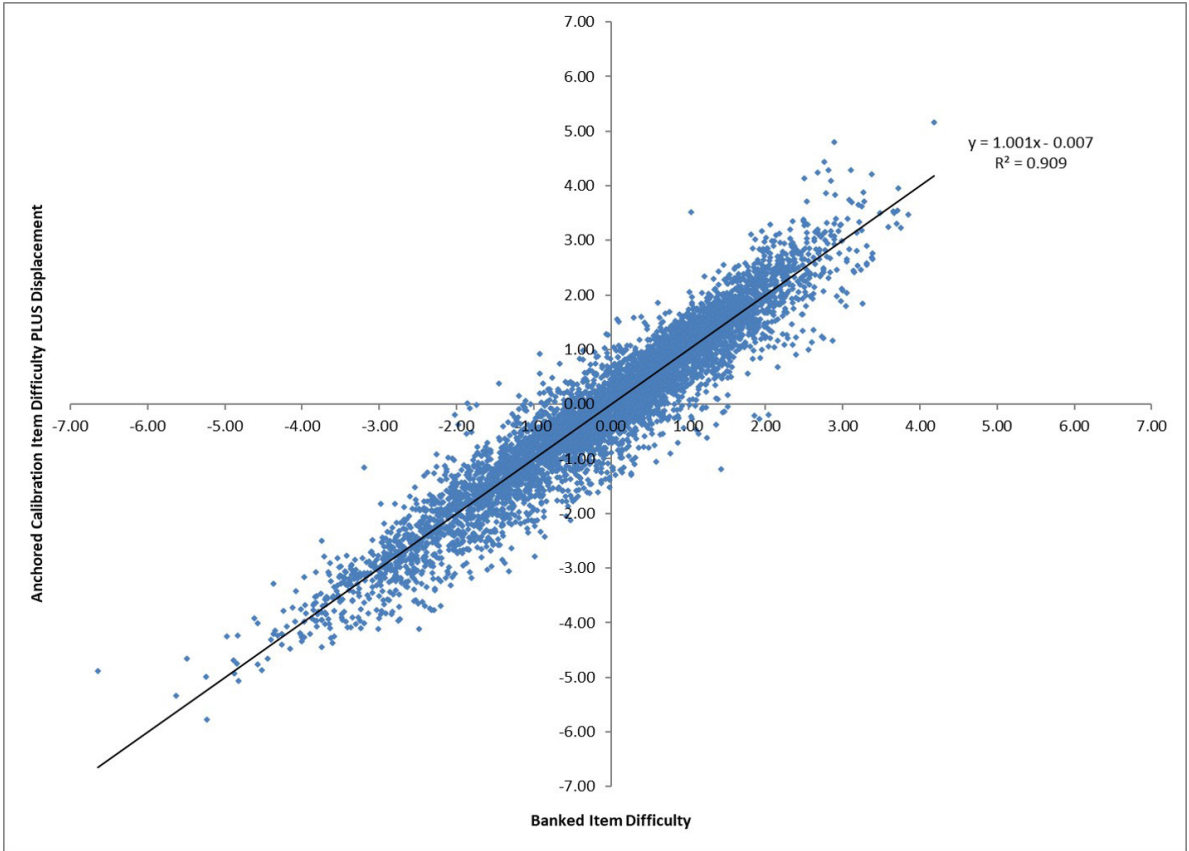
**Table 18–14. Number of Mathematics Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	ALI	GEO	ALII	Total
Disp. $\leq$ -1.0	49	35	22	18	12	8	15	4	10	173
-1.0 < Disp. $\leq$ -0.9	8	13	4	16	8	3	3	2	3	60
-0.9 < Disp. $\leq$ -0.8	13	17	6	9	11	6	5	6	3	76
-0.8 < Disp. $\leq$ -0.7	18	23	11	16	8	6	11	7	5	105
-0.7 < Disp. $\leq$ -0.6	26	26	7	20	16	9	11	14	16	145
-0.6 < Disp. $\leq$ -0.5	26	29	17	32	21	11	32	15	13	196
-0.5 < Disp. $\leq$ -0.4	30	31	34	44	22	24	45	19	11	260
-0.4 < Disp. $\leq$ -0.3	18	39	43	43	36	24	31	26	27	287
-0.3 < Disp. $\leq$ -0.2	27	38	55	48	43	46	45	35	40	377
-0.2 < Disp. $\leq$ -0.1	34	55	57	53	59	47	65	40	41	451
-0.1 < Disp. $\leq$ 0.0	34	50	53	69	78	62	85	46	54	531
0.0 < Disp. $\leq$ 0.1	50	60	59	76	74	64	116	53	37	589
0.1 < Disp. $\leq$ 0.2	50	55	56	57	65	68	122	53	52	578
0.2 < Disp. $\leq$ 0.3	54	59	43	74	67	57	87	37	40	518
0.3 < Disp. $\leq$ 0.4	43	50	28	49	47	41	69	41	41	409
0.4 < Disp. $\leq$ 0.5	38	29	38	40	33	36	34	25	27	300
0.5 < Disp. $\leq$ 0.6	28	30	24	26	23	28	22	14	16	211
0.6 < Disp. $\leq$ 0.7	24	20	12	31	14	13	5	8	15	142
0.7 < Disp. $\leq$ 0.8	14	14	9	10	6	6	9	6	6	80
0.8 < Disp. $\leq$ 0.9	10	7	3	15	8	7	2	0	6	58
0.9 < Disp. $\leq$ 1.0	6	7	6	6	4	1	1	4	3	38
1.0 < Disp.	17	19	8	12	2	0	2	10	12	82
TOTAL	617	706	595	764	657	567	817	465	478	5666

Figure 18–18 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.



**Figure 18–18. Mathematics Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above**



For the anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–15 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

**Table 18–15. Summary of Robust Z across Anchored Grade Level Calibrations in Mathematics**

<b>Grade/ Course</b>	<b>Cal 1: Number of Items</b>	<b>Cal 1: Number of Items with ABS(Z) &gt; 1.645</b>	<b>Cal 1: Percent of Items with ABS(Z) &gt; 1.645</b>
Kindergarten	0	0	N/A
Grade 1	0	0	N/A
Grade 2	0	0	N/A
Grade 3	617	153	25%
Grade 4	706	176	25%
Grade 5	595	76	13%
Grade 6	764	118	15%
Grade 7	657	71	11%
Grade 8	567	44	8%
Algebra I	817	54	7%
Geometry	465	50	11%
Algebra II	478	63	13%
Total	5666	805	14%
	Correlation = 0.954		
	Additive Constant = -0.007		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, all items with absolute displacement greater than 0.686 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.632 to 0.686, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.632 have absolute value of robust Z greater than 1.645.

## READING/LITERATURE

Figure 18–19 shows the displacements from the anchored grade level calibrations of operational data for the reading item bank. Items are color-coded by grade/course.

**Figure 18–19. Reading Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above**

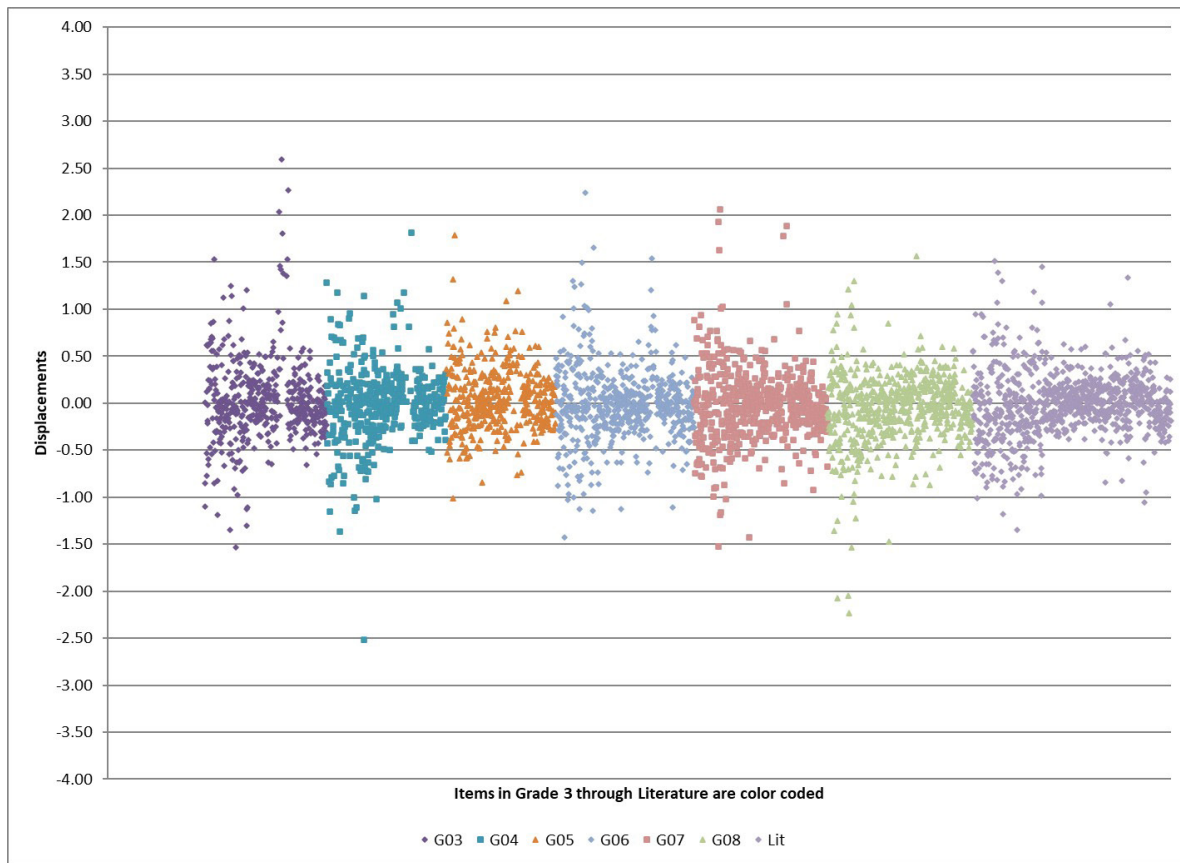


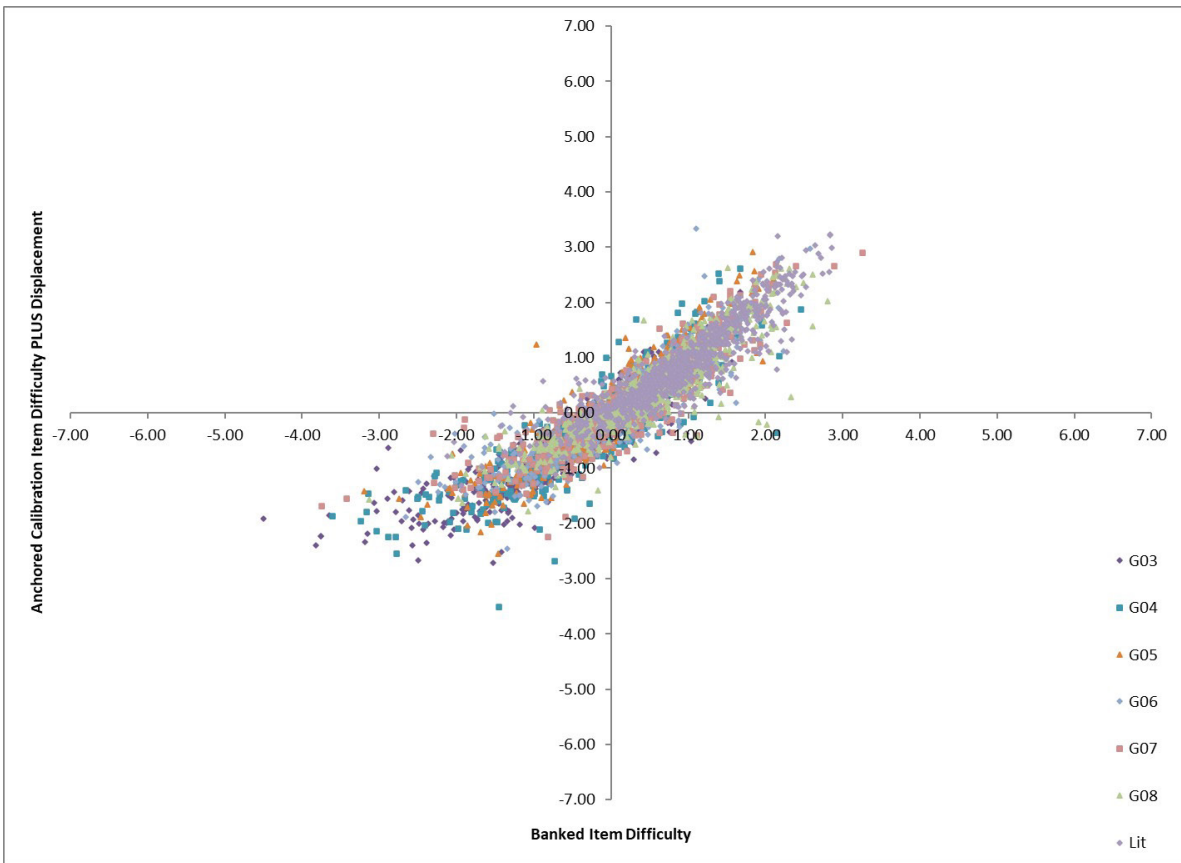
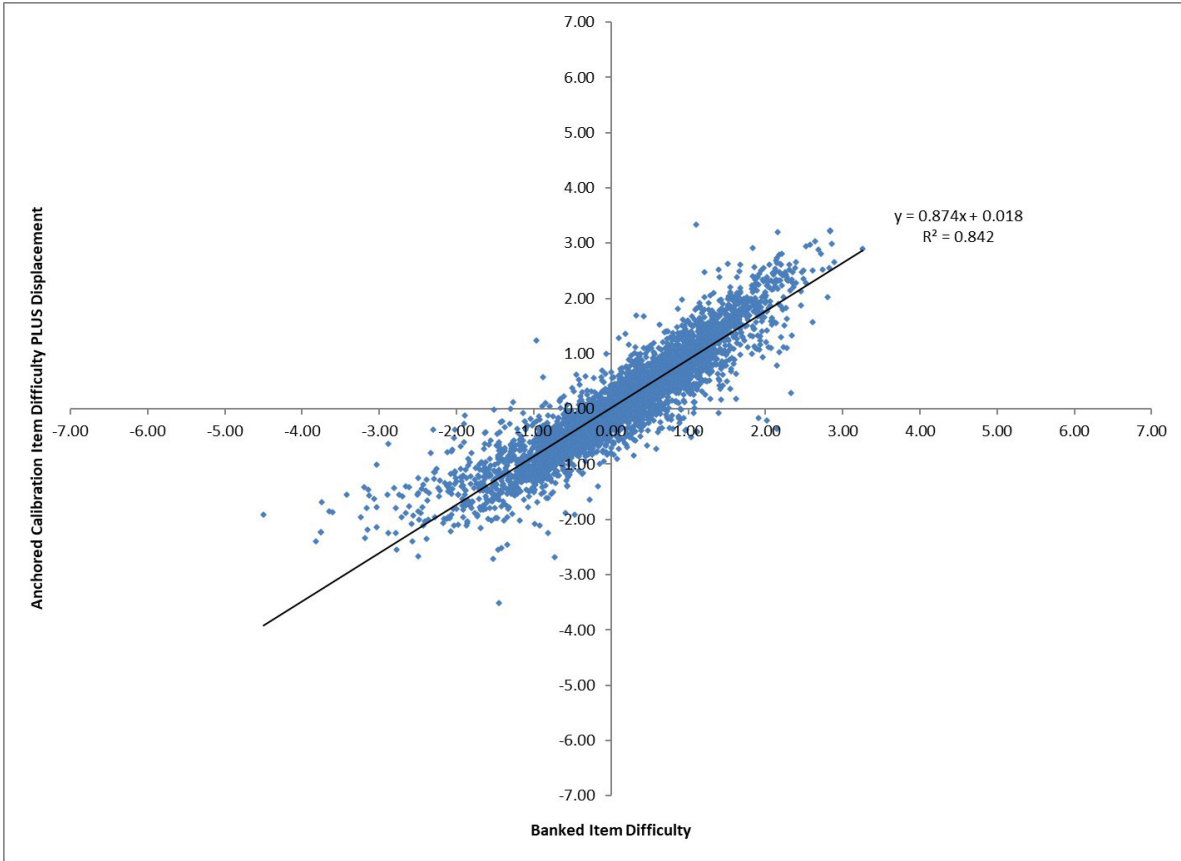
Table 18–16 summarizes the data in Figure 18–19. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-five percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–16).

**Table 18–16. Number of Reading Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	8	13	2	7	6	10	4	50
-1.0 < Disp. ≤ -0.9	3	0	0	2	3	3	4	15
-0.9 < Disp. ≤ -0.8	4	5	2	5	4	4	9	33
-0.8 < Disp. ≤ -0.7	2	7	3	9	5	12	10	48
-0.7 < Disp. ≤ -0.6	14	10	3	13	14	14	13	81
-0.6 < Disp. ≤ -0.5	8	16	11	15	16	21	22	109
-0.5 < Disp. ≤ -0.4	21	10	18	20	24	32	24	149
-0.4 < Disp. ≤ -0.3	29	31	22	29	39	38	45	233
-0.3 < Disp. ≤ -0.2	38	49	45	62	54	53	82	383
-0.2 < Disp. ≤ -0.1	74	54	53	77	66	74	112	510
-0.1 < Disp. ≤ 0.0	76	70	64	107	87	78	133	615
0.0 < Disp. ≤ 0.1	68	67	66	89	94	91	139	614
0.1 < Disp. ≤ 0.2	54	61	59	55	64	86	118	497
0.2 < Disp. ≤ 0.3	37	46	36	45	34	46	63	307
0.3 < Disp. ≤ 0.4	29	31	31	26	26	48	45	236
0.4 < Disp. ≤ 0.5	20	10	25	19	24	16	22	136
0.5 < Disp. ≤ 0.6	21	12	15	14	12	10	20	104
0.6 < Disp. ≤ 0.7	13	9	8	6	8	3	11	58
0.7 < Disp. ≤ 0.8	4	7	11	9	4	2	4	41
0.8 < Disp. ≤ 0.9	7	6	5	2	4	3	3	30
0.9 < Disp. ≤ 1.0	1	6	1	3	1	2	3	17
1.0 < Disp.	19	12	6	12	8	6	9	72
TOTAL	550	532	486	626	597	652	895	4338

Figure 18–20 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

**Figure 18–20. Reading Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above**



An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low  $n$ -counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger  $n$ -counts were run. Figure 18–21 shows the displacements from these calibrations. Items are color-coded by grade/course.

**Figure 18–21. Reading Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above with  $N > 100$**

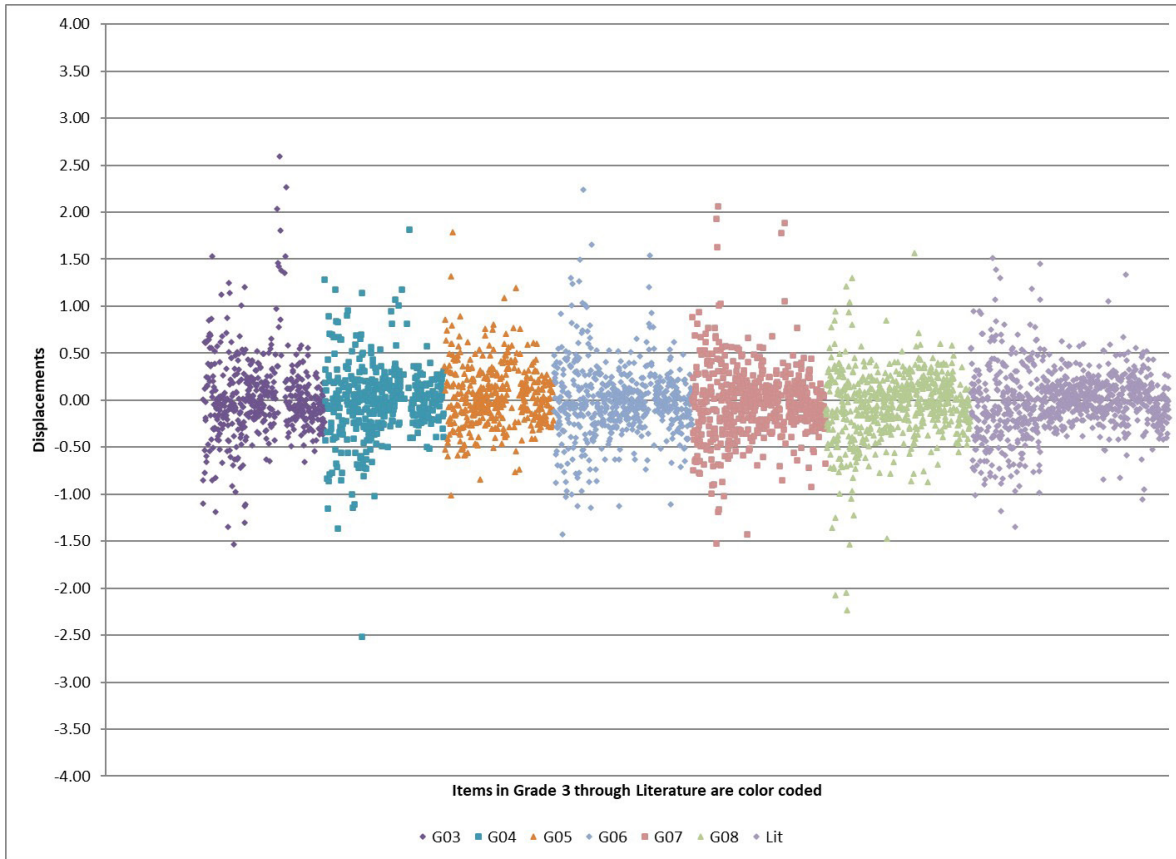


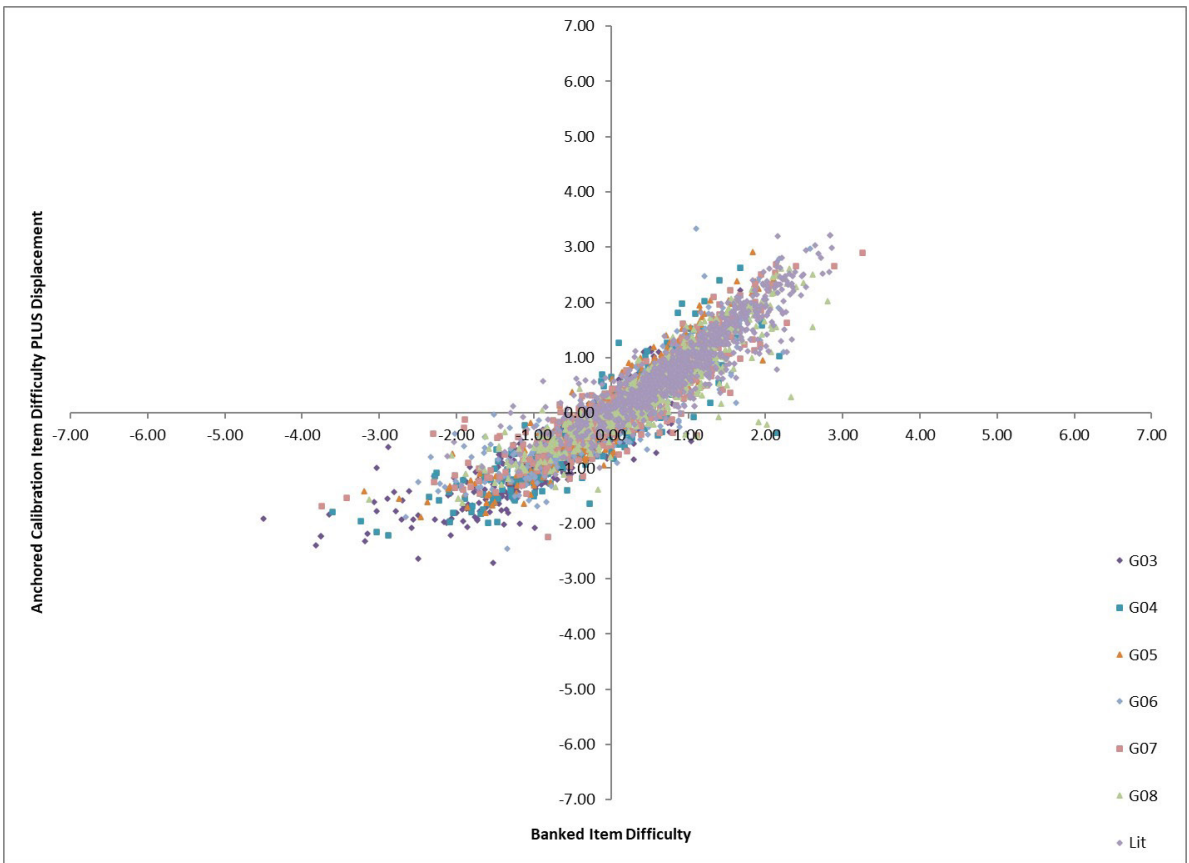
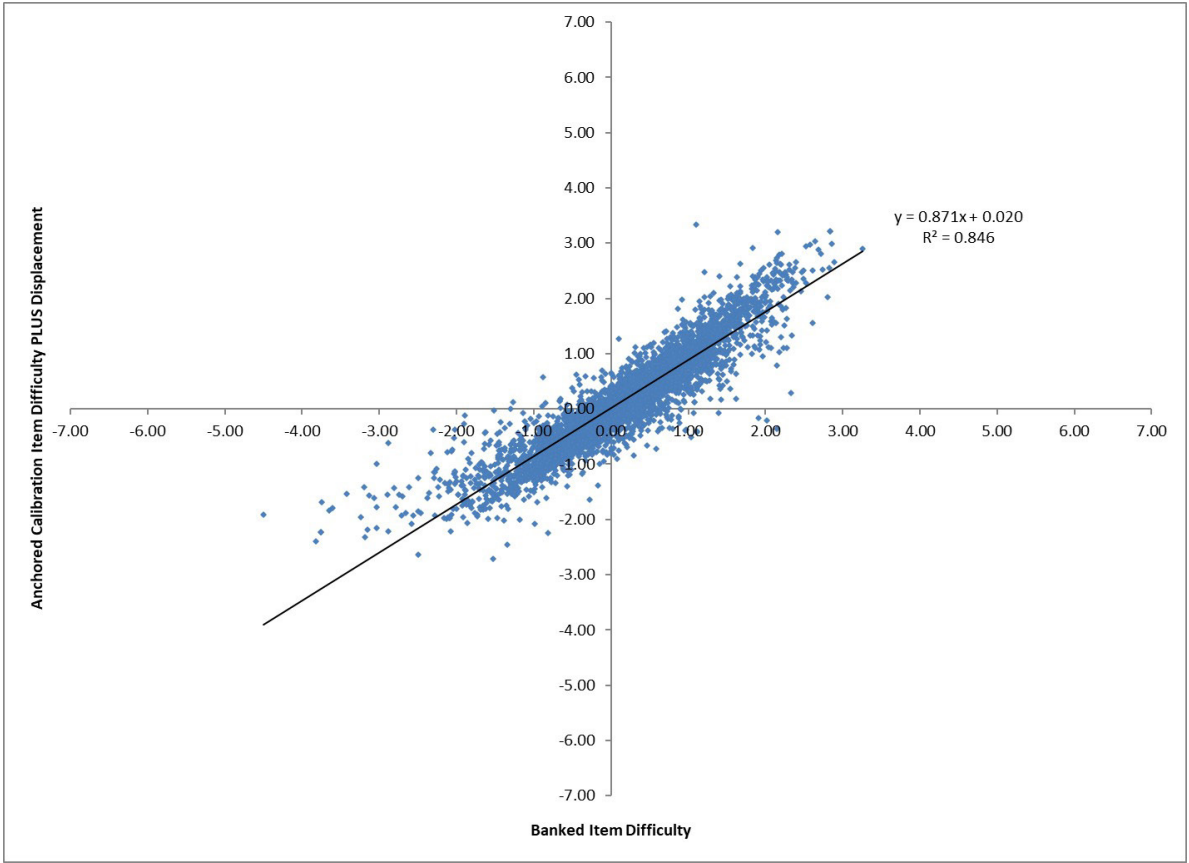
Table 18–17 summarizes the data in Figure 18–21. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-six percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–17).

**Table 18–17. Number of Reading Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	LIT	Total
Disp. ≤ -1.0	7	7	1	7	5	9	4	40
-1.0 < Disp. ≤ -0.9	2	0	0	2	3	2	4	13
-0.9 < Disp. ≤ -0.8	3	4	1	5	3	3	9	28
-0.8 < Disp. ≤ -0.7	2	7	2	8	5	11	10	45
-0.7 < Disp. ≤ -0.6	11	6	0	11	14	11	13	66
-0.6 < Disp. ≤ -0.5	8	10	11	15	15	18	21	98
-0.5 < Disp. ≤ -0.4	17	12	13	18	22	30	24	136
-0.4 < Disp. ≤ -0.3	29	20	18	27	37	34	44	209
-0.3 < Disp. ≤ -0.2	38	43	43	56	53	47	82	362
-0.2 < Disp. ≤ -0.1	70	43	46	73	64	74	111	481
-0.1 < Disp. ≤ 0.0	72	61	59	105	82	72	133	584
0.0 < Disp. ≤ 0.1	63	58	59	88	92	88	138	586
0.1 < Disp. ≤ 0.2	45	53	51	53	62	78	118	460
0.2 < Disp. ≤ 0.3	35	39	30	43	33	44	63	287
0.3 < Disp. ≤ 0.4	24	25	27	25	23	45	45	214
0.4 < Disp. ≤ 0.5	18	7	24	17	22	13	23	124
0.5 < Disp. ≤ 0.6	16	7	15	13	11	7	19	88
0.6 < Disp. ≤ 0.7	12	8	5	5	8	2	11	51
0.7 < Disp. ≤ 0.8	3	1	7	7	4	3	4	29
0.8 < Disp. ≤ 0.9	4	6	3	2	2	2	3	22
0.9 < Disp. ≤ 1.0	1	2	0	3	1	2	3	12
1.0 < Disp.	15	7	4	11	8	4	9	58
TOTAL	495	426	419	594	569	599	891	3993

Figure 18–22 mirrors Figure 18–20, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

**Figure 18–22. Reading Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with N>100**





For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–18 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

**Table 18–18. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Reading**

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	0	0	N/A	0	0	N/A
Grade 3	550	103	19%	495	98	20%
Grade 4	532	105	20%	426	71	17%
Grade 5	486	76	16%	419	57	14%
Grade 6	626	103	16%	594	100	17%
Grade 7	597	101	17%	569	101	18%
Grade 8	652	98	15%	599	90	15%
Literature	895	124	14%	891	127	14%
Total	4338	710	16%	3993	644	16%
	Correlation = 0.918			Correlation = 0.920		
	Additive Constant = -0.004			Additive Constant = -0.007		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.476 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.456 to 0.476, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.456 have absolute value of robust Z greater than 1.645.

## SCIENCE

Figure 18–23 shows the displacements from the anchored grade level calibrations of operational data for the science item bank. Items are color-coded by grade/course.

**Figure 18–23. Science Anchored Grade Level Calibrations Displacements – All Items in Grade 3 and Above**

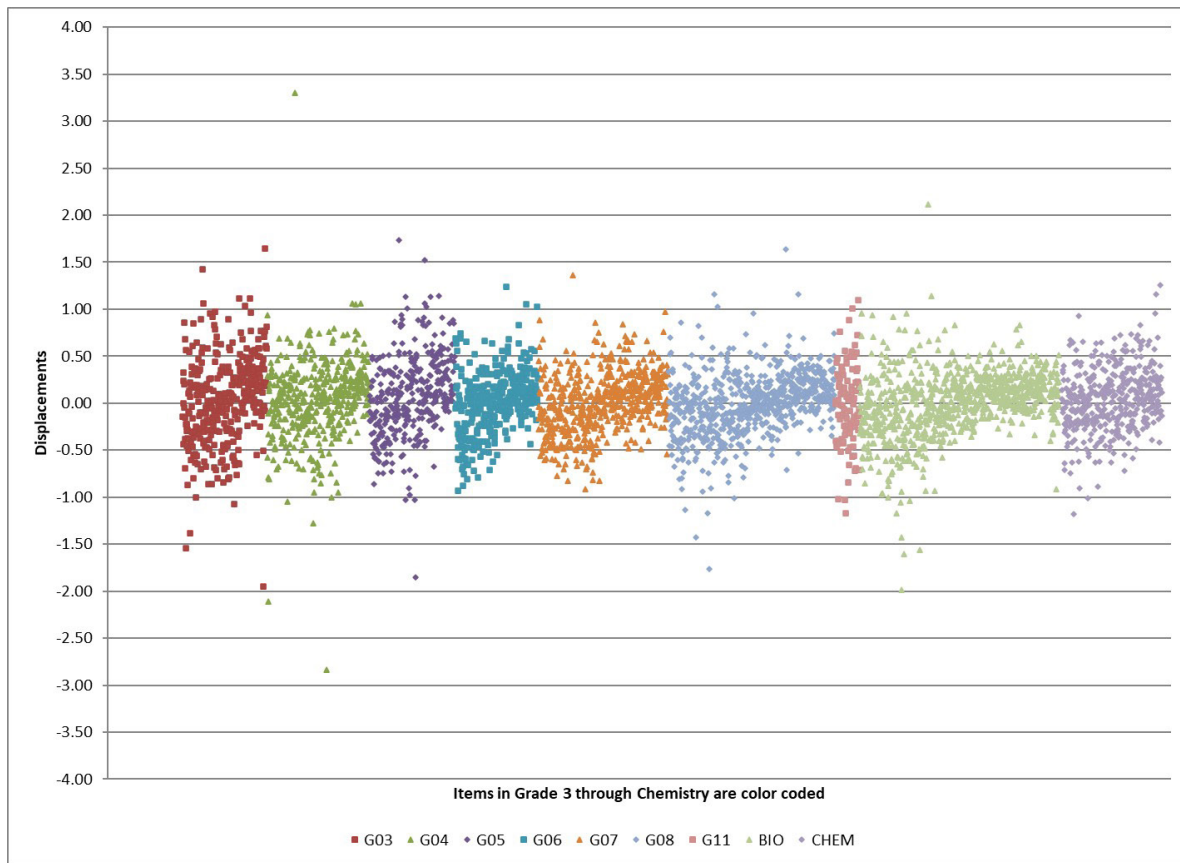


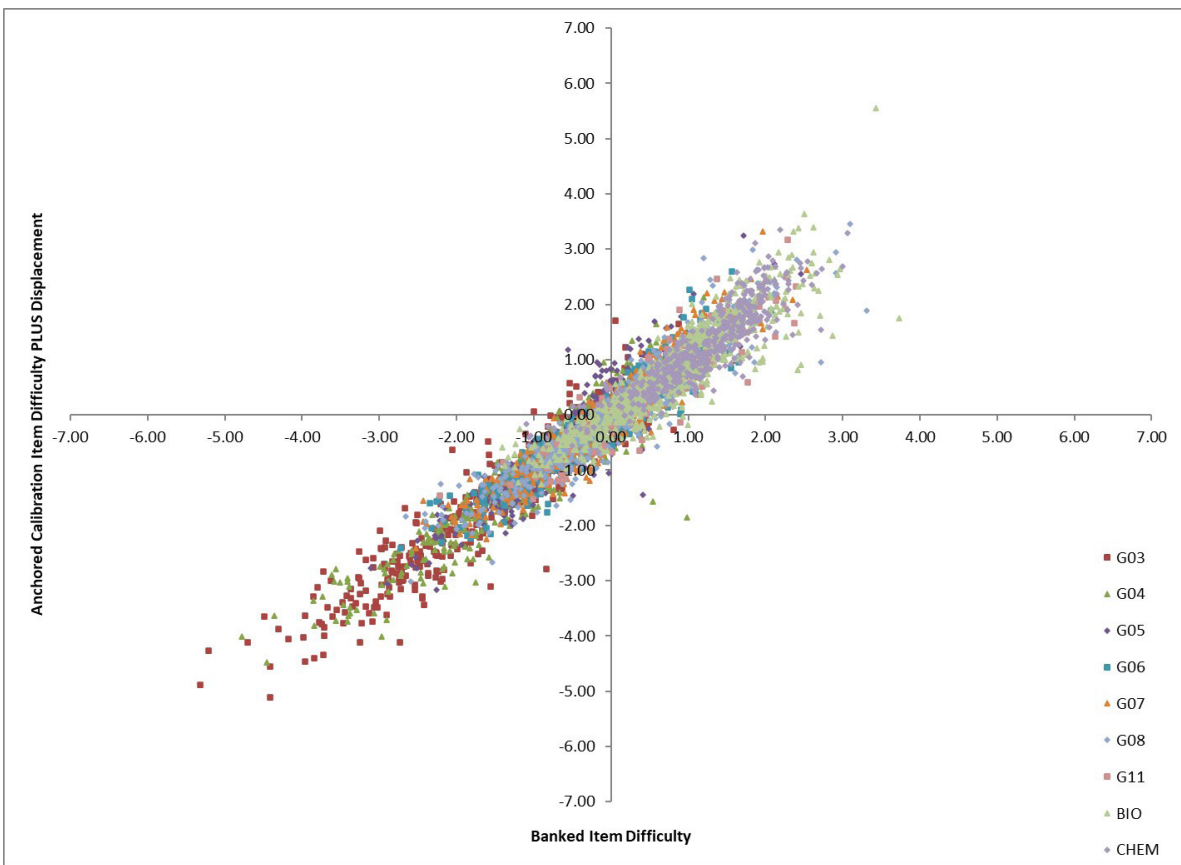
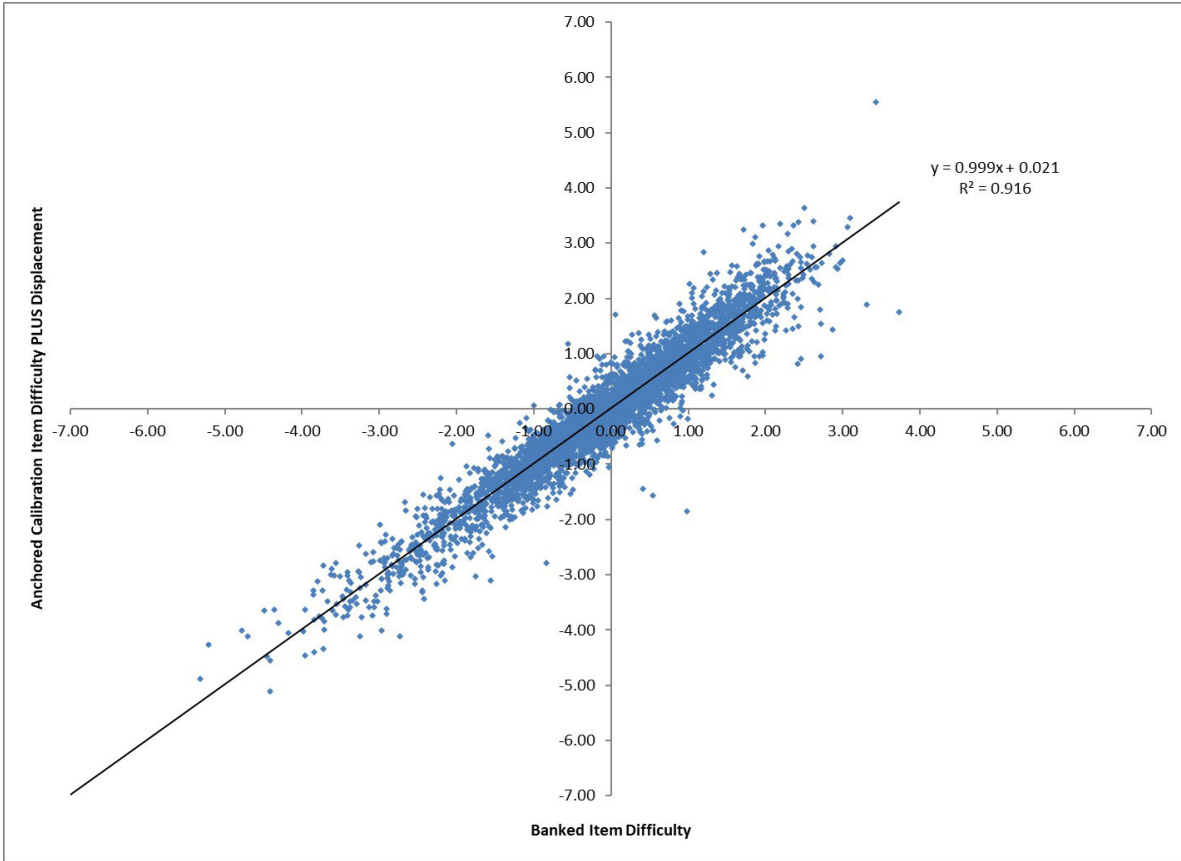
Table 18–19 summarizes the data in Figure 18–23. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-six percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–19).

**Table 18–19. Number of Science Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	5	5	3	0	0	5	3	7	2	30
-1.0 < Disp. ≤ -0.9	0	2	2	1	1	3	0	7	1	17
-0.9 < Disp. ≤ -0.8	5	4	1	2	3	3	1	4	1	24
-0.8 < Disp. ≤ -0.7	8	7	6	5	3	6	2	6	3	46
-0.7 < Disp. ≤ -0.6	16	11	6	6	9	10	2	13	6	79
-0.6 < Disp. ≤ -0.5	10	6	8	9	13	14	4	18	5	87
-0.5 < Disp. ≤ -0.4	18	13	21	17	36	27	9	29	15	185
-0.4 < Disp. ≤ -0.3	14	22	17	18	19	43	4	43	21	201
-0.3 < Disp. ≤ -0.2	27	27	17	24	49	56	9	61	42	312
-0.2 < Disp. ≤ -0.1	21	39	39	24	57	66	9	78	51	384
-0.1 < Disp. ≤ 0.0	30	43	27	40	76	105	8	109	45	483
0.0 < Disp. ≤ 0.1	35	51	47	56	65	105	10	101	54	524
0.1 < Disp. ≤ 0.2	38	58	32	55	75	86	11	142	56	553
0.2 < Disp. ≤ 0.3	29	53	30	28	48	65	8	93	39	393
0.3 < Disp. ≤ 0.4	32	29	26	31	39	49	7	53	28	294
0.4 < Disp. ≤ 0.5	12	22	23	8	25	23	6	30	20	169
0.5 < Disp. ≤ 0.6	20	11	19	8	9	14	3	15	11	110
0.6 < Disp. ≤ 0.7	9	10	7	9	11	4	1	7	15	73
0.7 < Disp. ≤ 0.8	7	11	2	1	4	4	2	7	3	41
0.8 < Disp. ≤ 0.9	6	0	13	1	3	2	1	2	1	29
0.9 < Disp. ≤ 1.0	4	1	3	0	1	1	0	5	2	17
1.0 < Disp.	6	4	8	3	1	4	2	2	2	32
TOTAL	352	429	357	346	547	695	102	832	423	4083

Figure 18–24 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

**Figure 18–24. Science Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above**



An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low  $n$ -counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger  $n$ -counts were run. Figure 18–25 shows the displacements from these calibrations. Items are color-coded by grade/course.

**Figure 18–25. Science Anchored Grade Level Calibrations Displacements – All Items in Grade 3 and Above with  $N > 100$**

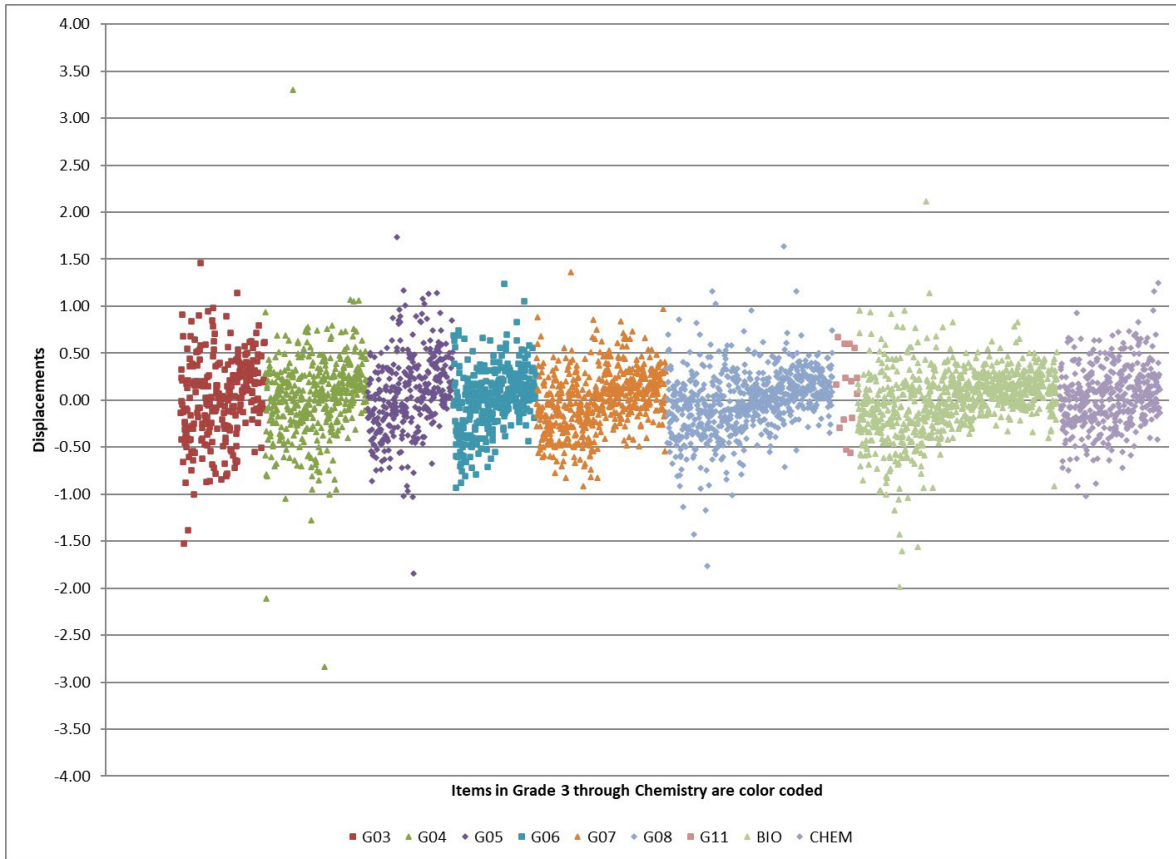


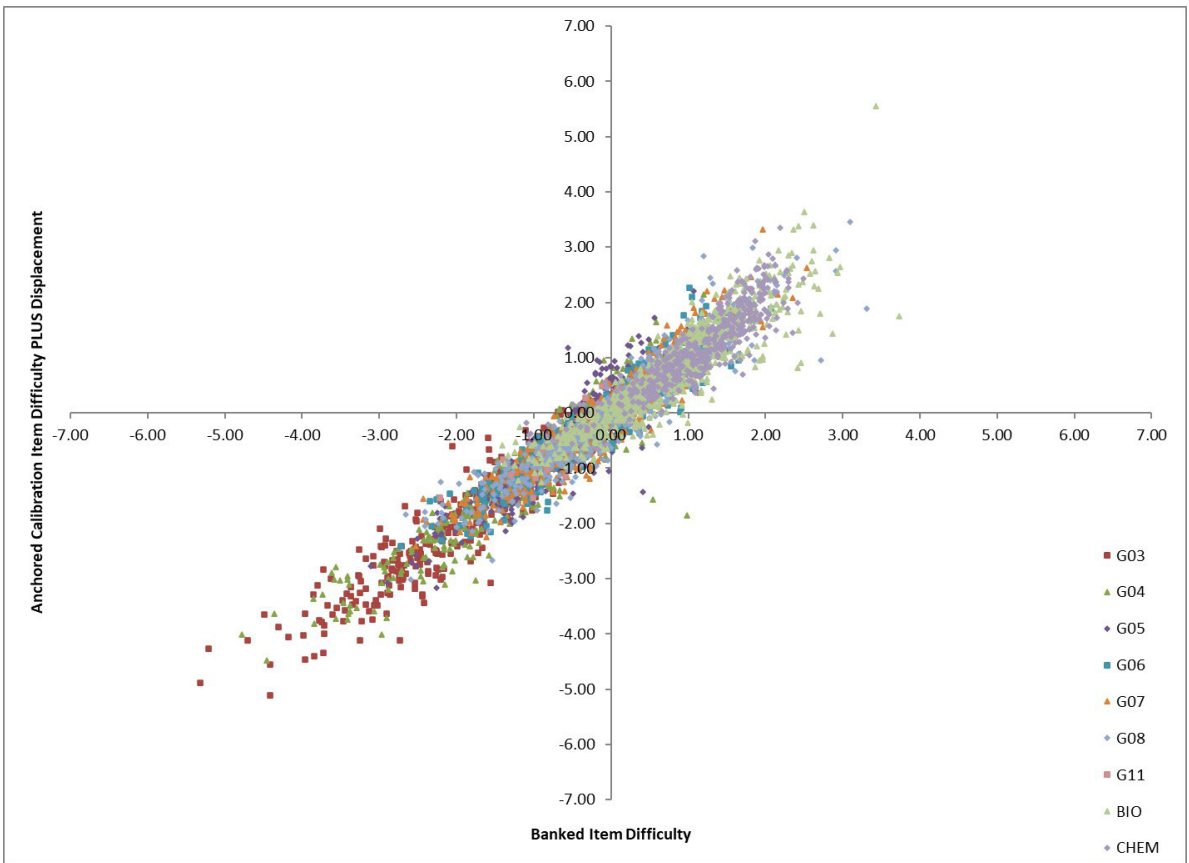
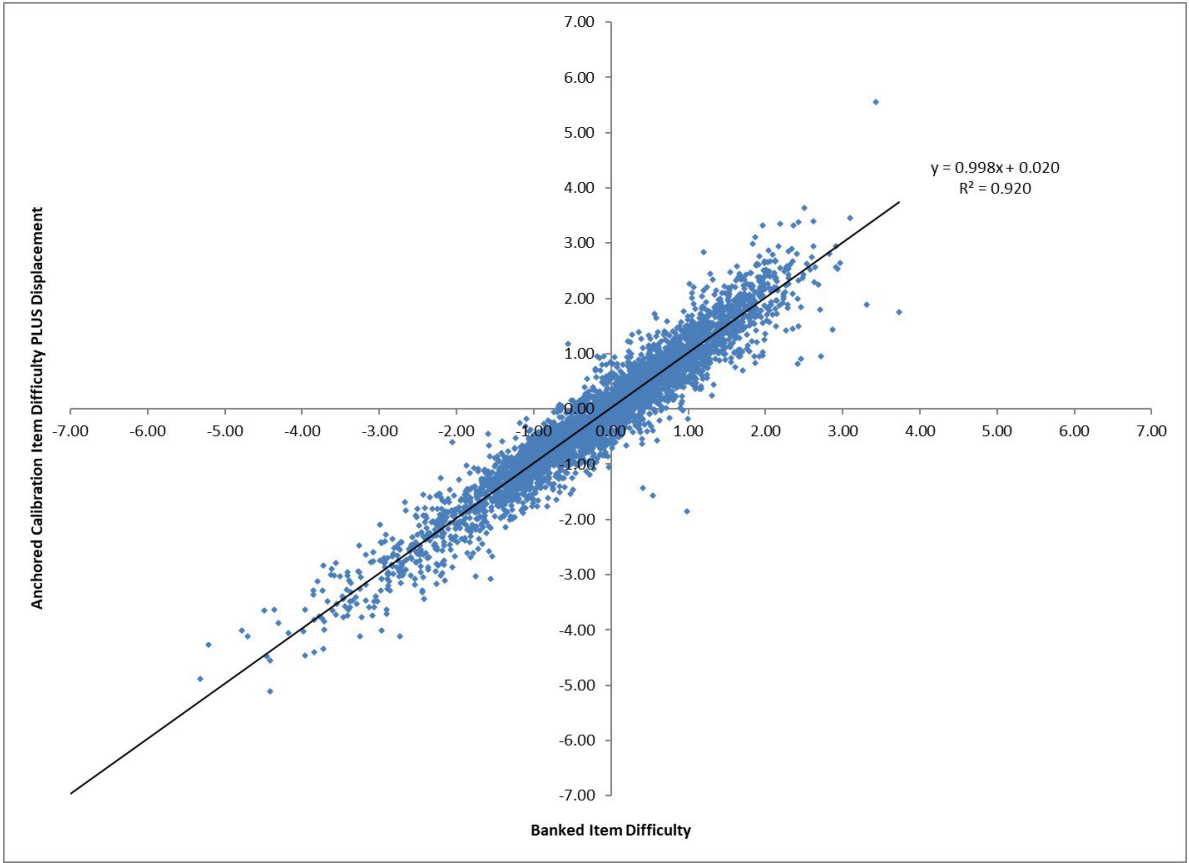
Table 18–20 summarizes the data in Figure 18–25. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-six percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–20).

**Table 18–20. Number of Science Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	G11	BIO	CHEM	Total
Disp. ≤ -1.0	3	5	3	0	0	5	0	7	1	24
-1.0 < Disp. ≤ -0.9	0	2	2	1	1	3	0	7	1	17
-0.9 < Disp. ≤ -0.8	6	4	1	2	3	3	0	4	1	24
-0.8 < Disp. ≤ -0.7	5	7	6	5	3	6	0	6	3	41
-0.7 < Disp. ≤ -0.6	9	11	5	6	9	10	0	13	6	69
-0.6 < Disp. ≤ -0.5	9	6	8	9	13	14	2	18	5	84
-0.5 < Disp. ≤ -0.4	15	13	17	17	36	27	0	29	16	170
-0.4 < Disp. ≤ -0.3	10	22	19	18	19	43	0	43	20	194
-0.3 < Disp. ≤ -0.2	21	27	17	24	49	56	2	61	40	297
-0.2 < Disp. ≤ -0.1	21	39	35	24	57	66	1	78	52	373
-0.1 < Disp. ≤ 0.0	24	42	28	40	76	105	0	109	42	466
0.0 < Disp. ≤ 0.1	23	51	42	55	65	105	1	101	55	498
0.1 < Disp. ≤ 0.2	28	58	32	55	75	86	2	142	55	533
0.2 < Disp. ≤ 0.3	26	51	31	28	48	65	2	93	36	380
0.3 < Disp. ≤ 0.4	20	29	26	31	39	49	0	53	27	274
0.4 < Disp. ≤ 0.5	14	22	19	8	25	23	0	30	19	160
0.5 < Disp. ≤ 0.6	12	11	20	8	9	14	1	15	12	102
0.6 < Disp. ≤ 0.7	9	10	5	9	11	4	3	7	15	73
0.7 < Disp. ≤ 0.8	5	11	3	1	3	4	0	7	3	37
0.8 < Disp. ≤ 0.9	4	0	10	1	3	2	0	2	1	23
0.9 < Disp. ≤ 1.0	3	1	3	0	1	1	0	5	2	16
1.0 < Disp.	2	4	7	2	1	4	0	2	2	24
TOTAL	269	426	339	344	546	695	14	832	414	3879

Figure 18–26 mirrors Figure 18–24, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

**Figure 18–26. Science Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with N>100**



For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–21 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

**Table 18–21. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Science**

Grade/ Course	Cal 1: Number of Items	Cal 1: Number of Items with ABS(Z) > 1.645	Cal 1: Percent of Items with ABS(Z) > 1.645	Cal 2: Number of Items	Cal 2: Number of Items with ABS(Z) > 1.645	Cal 2: Percent of Items with ABS(Z) > 1.645
K–2 span	0	0	N/A	0	0	N/A
Grade 3	352	94	27%	269	66	25%
Grade 4	429	68	16%	426	68	16%
Grade 5	357	65	18%	339	64	19%
Grade 6	346	43	12%	344	44	13%
Grade 7	547	64	12%	546	65	12%
Grade 8	695	68	10%	695	69	10%
Grade 11	102	19	19%	14	6	43%
Biology	832	87	10%	832	90	11%
Chemistry	423	51	12%	414	53	13%
Total	4083	559	14%	3879	525	14%
	Correlation = 0.957			Correlation = 0.959		
	Additive Constant = 0.021			Additive Constant = 0.021		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.554 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.471 to 0.554, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.471 have absolute value of robust Z greater than 1.645.



## WRITING/ENGLISH COMPOSITION

Figure 18–27 shows the displacements from the anchored grade level calibrations of operational data for the writing item bank. Items are color-coded by grade/course.

**Figure 18–27. Writing Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above**

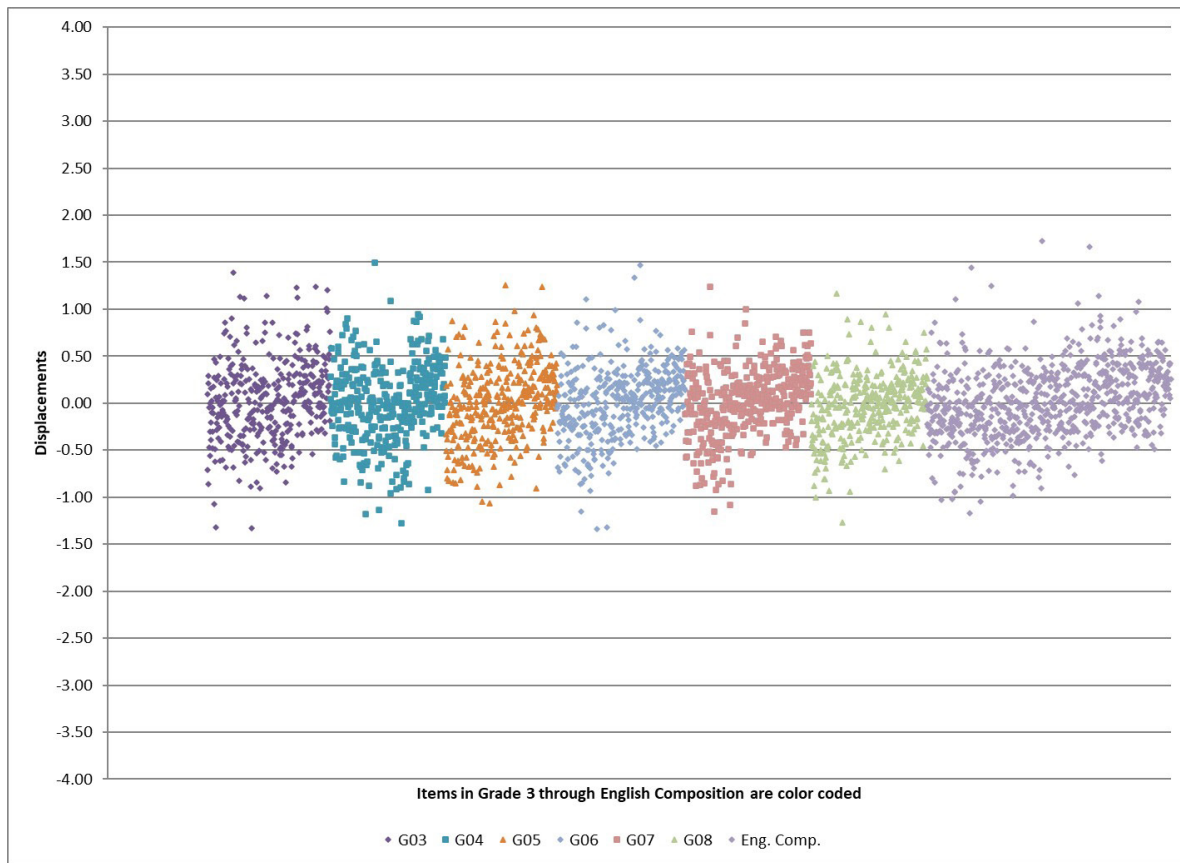


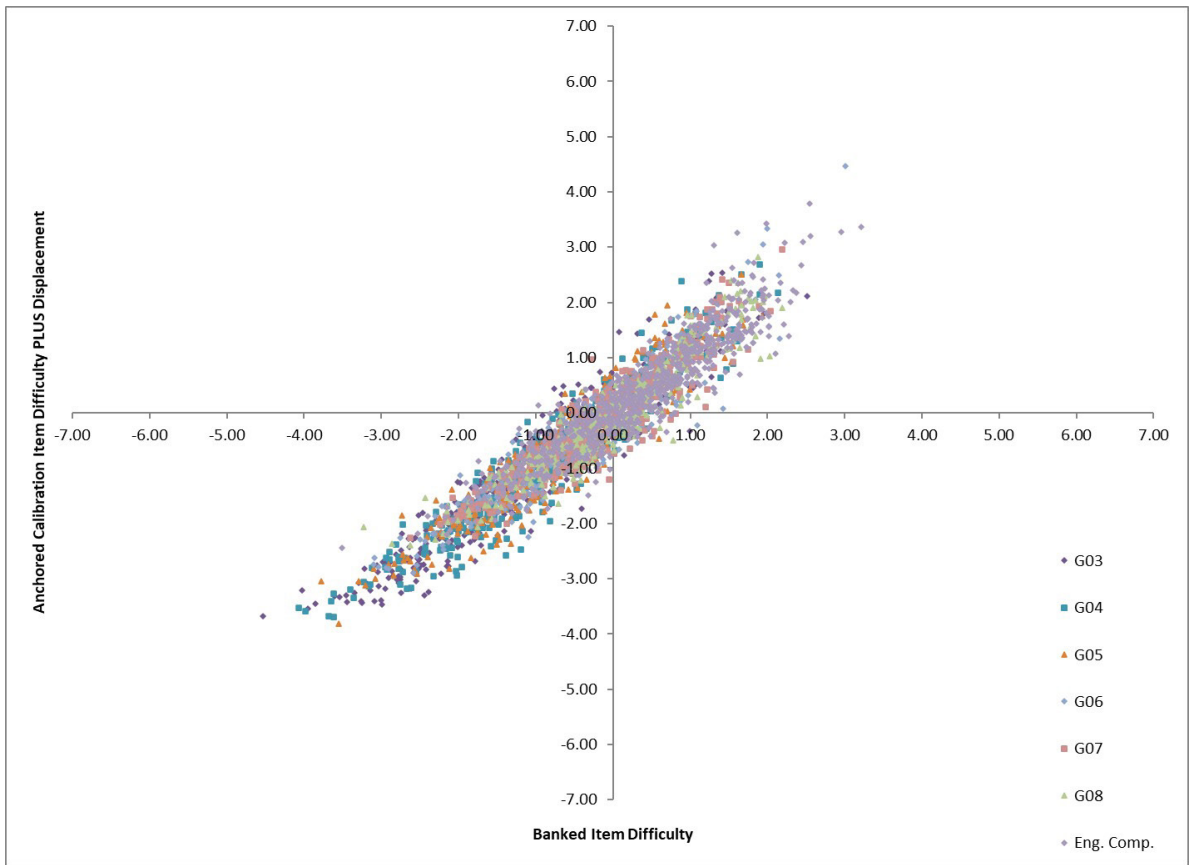
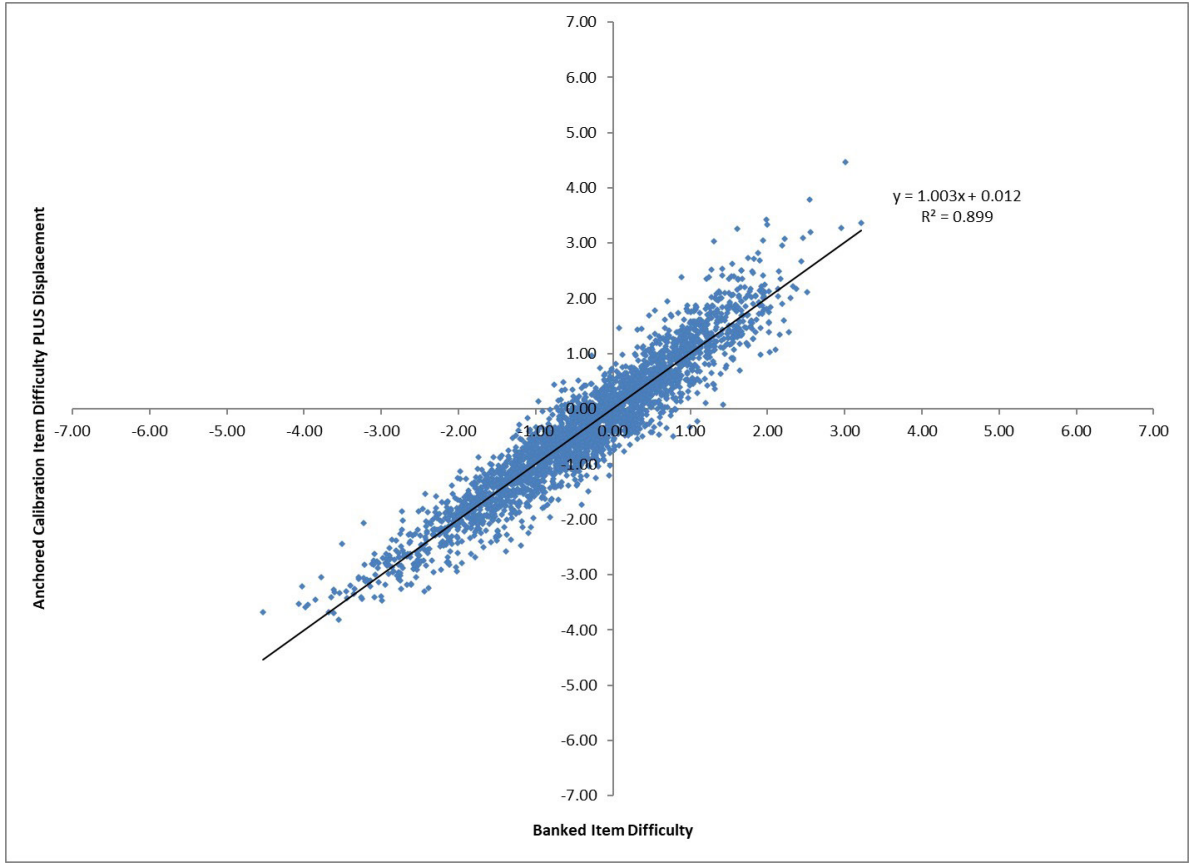
Table 18–22 summarizes the data in Figure 18–27. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-three percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–22).

**Table 18–22. Number of Writing Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	3	3	2	3	2	2	4	19
-1.0 < Disp. ≤ -0.9	1	3	1	1	1	2	4	13
-0.9 < Disp. ≤ -0.8	5	7	7	3	6	3	3	34
-0.8 < Disp. ≤ -0.7	2	5	6	5	5	3	12	38
-0.7 < Disp. ≤ -0.6	12	9	10	11	4	9	12	67
-0.6 < Disp. ≤ -0.5	12	12	12	13	16	9	15	89
-0.5 < Disp. ≤ -0.4	24	15	15	15	17	22	33	141
-0.4 < Disp. ≤ -0.3	23	19	22	26	20	18	55	183
-0.3 < Disp. ≤ -0.2	30	25	28	31	24	37	80	255
-0.2 < Disp. ≤ -0.1	28	36	27	33	32	29	65	250
-0.1 < Disp. ≤ 0.0	37	37	38	42	53	44	86	337
0.0 < Disp. ≤ 0.1	42	46	38	42	48	52	77	345
0.1 < Disp. ≤ 0.2	33	23	30	46	51	44	63	290
0.2 < Disp. ≤ 0.3	43	30	33	47	37	34	75	299
0.3 < Disp. ≤ 0.4	18	31	16	28	32	18	56	199
0.4 < Disp. ≤ 0.5	23	18	21	19	18	15	42	156
0.5 < Disp. ≤ 0.6	10	10	9	15	6	6	31	87
0.6 < Disp. ≤ 0.7	8	12	9	4	9	2	20	64
0.7 < Disp. ≤ 0.8	10	5	11	4	5	3	3	41
0.8 < Disp. ≤ 0.9	5	3	5	4	1	3	7	28
0.9 < Disp. ≤ 1.0	2	3	2	1	1	1	2	12
1.0 < Disp.	9	2	2	3	1	1	8	26
TOTAL	380	354	344	396	389	357	753	2973

Figure 18–28 shows banked item difficulties plotted against the item difficulties plus displacement from the anchored grade level calibrations of all items using the operational data set. Again, a line of best fit is included in the upper plot.

**Figure 18–28. Writing Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above**



An examination of the items with larger differences between banked values and operational estimates revealed that a number of these have low  $n$ -counts in the operational calibration. To investigate whether this had an impact on the stability of the item parameter estimates, anchored grade level calibrations of all items in grade 3 and above with larger  $n$ -counts were run. Figure 18–29 shows the displacements from these calibrations. Items are color-coded by grade/course.

**Figure 18–29. Writing Anchored Grade Level Calibrations Displacements — All Items in Grade 3 and Above with  $N > 100$**

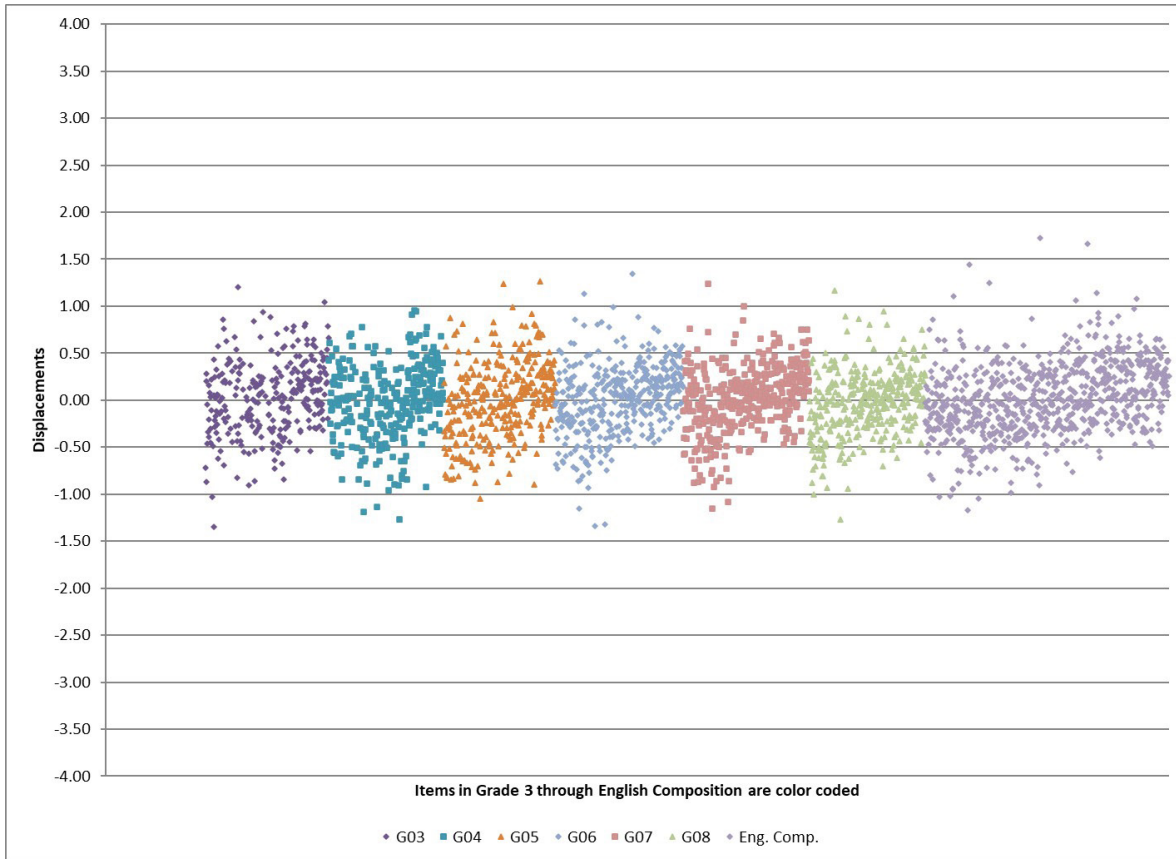


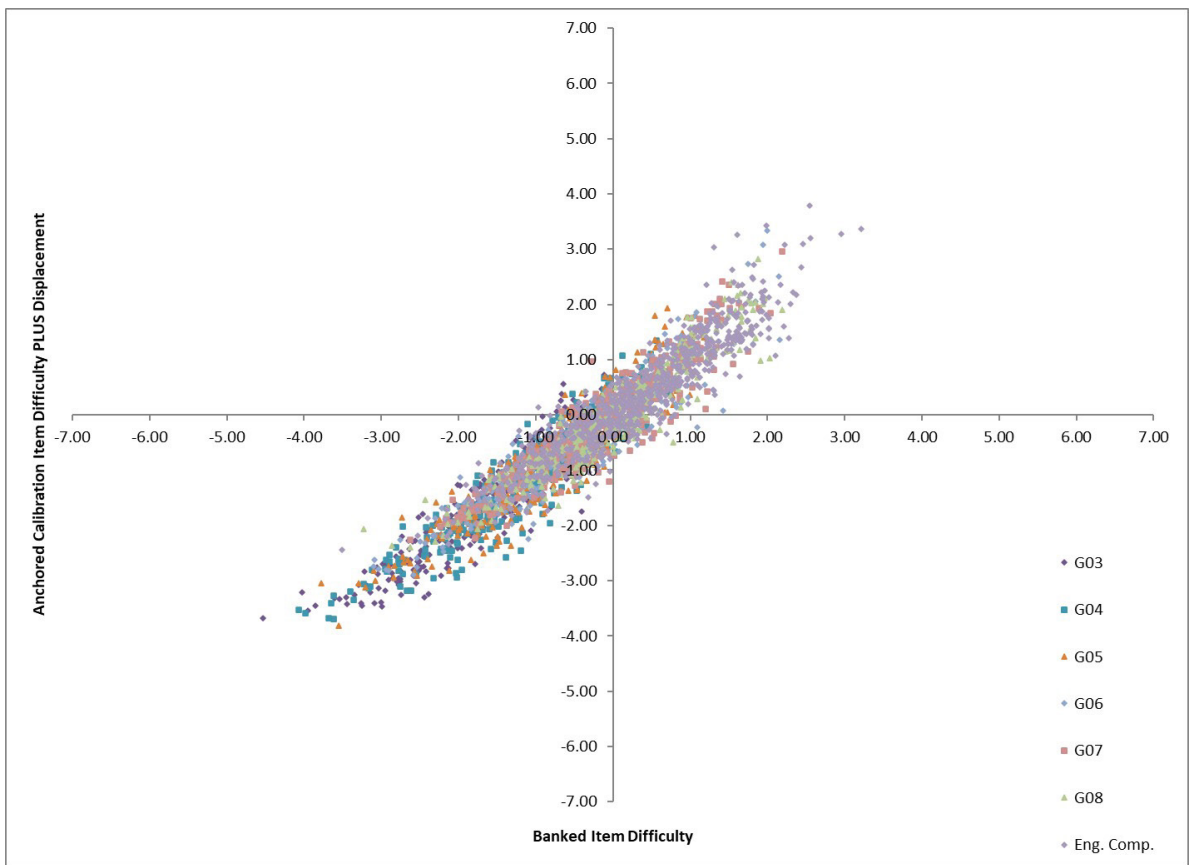
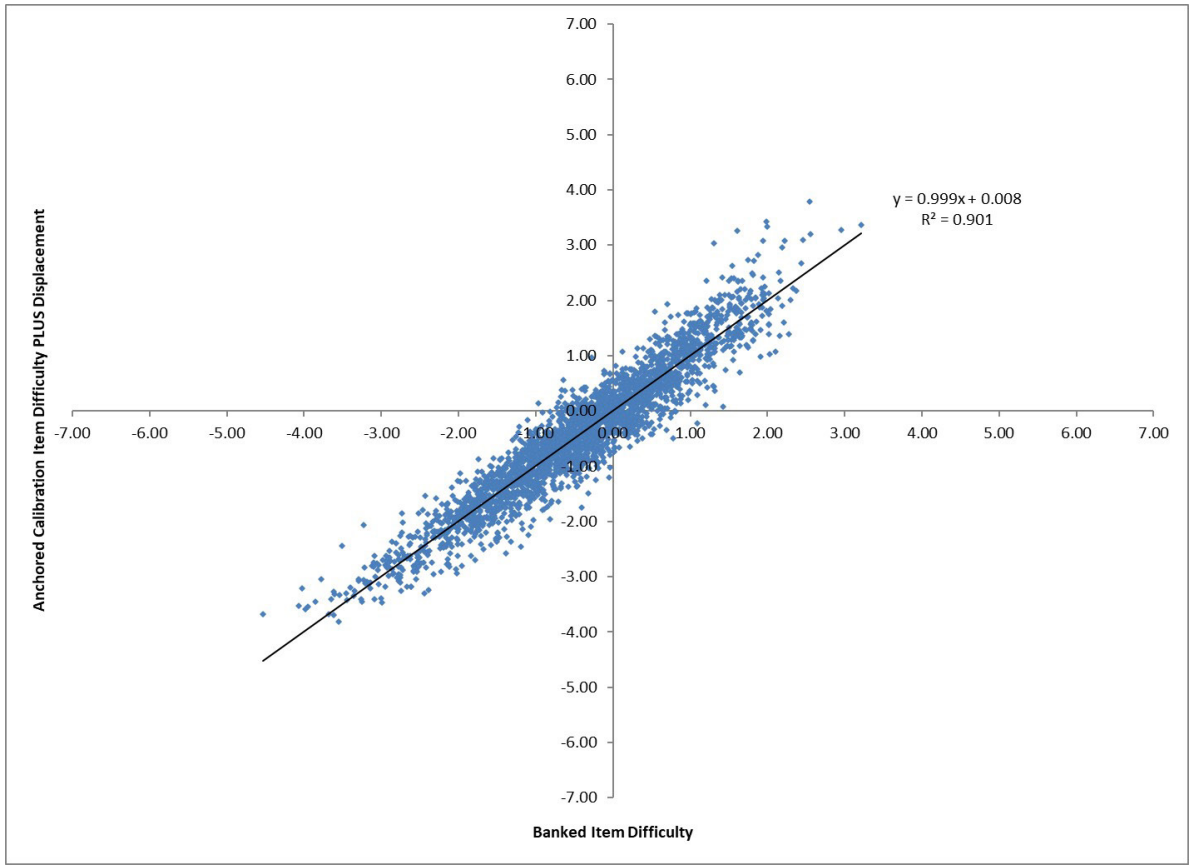
Table 18–23 summarizes the data in Figure 18–29. It contains item counts by grade/course and displacements in intervals of 0.1 logits. According to the WINSTEPS manual, in an anchored calibration, half of the displacements are expected to be negative and half positive. Displacements less than 0.5 in magnitude are considered small (unlikely to have much impact). Eighty-three percent of the items in the bank have a displacement less than 0.5 in magnitude (gray shaded in Table 18–23).

**Table 18–23. Number of Writing Items by Grade/Course and Displacement Interval**

Interval	G03	G04	G05	G06	G07	G08	COMP	Total
Disp. ≤ -1.0	2	3	1	3	2	2	4	17
-1.0 < Disp. ≤ -0.9	1	3	0	1	1	2	4	12
-0.9 < Disp. ≤ -0.8	4	7	8	3	6	3	3	34
-0.8 < Disp. ≤ -0.7	2	2	5	5	5	3	12	34
-0.7 < Disp. ≤ -0.6	4	9	10	11	4	9	12	59
-0.6 < Disp. ≤ -0.5	9	11	12	13	16	9	15	85
-0.5 < Disp. ≤ -0.4	16	13	13	15	17	22	33	129
-0.4 < Disp. ≤ -0.3	20	17	20	26	20	18	55	176
-0.3 < Disp. ≤ -0.2	28	22	26	31	24	37	80	248
-0.2 < Disp. ≤ -0.1	21	26	24	33	32	29	65	230
-0.1 < Disp. ≤ 0.0	22	30	31	42	53	44	86	308
0.0 < Disp. ≤ 0.1	28	40	41	42	48	52	77	328
0.1 < Disp. ≤ 0.2	30	23	29	46	51	44	63	286
0.2 < Disp. ≤ 0.3	34	25	29	47	37	34	75	281
0.3 < Disp. ≤ 0.4	17	25	18	28	32	18	56	194
0.4 < Disp. ≤ 0.5	16	15	19	19	18	15	42	144
0.5 < Disp. ≤ 0.6	11	10	9	15	6	6	31	88
0.6 < Disp. ≤ 0.7	7	9	8	4	9	2	20	59
0.7 < Disp. ≤ 0.8	7	4	8	4	5	3	3	34
0.8 < Disp. ≤ 0.9	4	0	4	4	1	3	7	23
0.9 < Disp. ≤ 1.0	1	3	2	1	1	1	2	11
1.0 < Disp.	2	0	2	2	1	1	8	16
<b>TOTAL</b>	<b>286</b>	<b>297</b>	<b>319</b>	<b>395</b>	<b>389</b>	<b>357</b>	<b>753</b>	<b>2796</b>

Figure 18–30 mirrors Figure 18–28, except the calibrations exclude items with fewer than 100 administrations. Again, a line of best fit is included in the upper plot.

**Figure 18–30. Writing Banked Item Parameters vs. Anchored Grade Level Calibrations — All Items in Grade 3 and Above with  $N > 100$**



For the two sets of anchored grade level calibrations described above, banked item parameters were compared to the newly calibrated values by calculating a robust Z statistic for each item pairing. If item difficulties from the operational calibration are close to the banked values, the correlation will be high and the additive constant near zero. Table 18–24 shows the number of items in each grade/course and the number and percent of items with absolute value of robust Z greater than 1.645 in the calibrations.

**Table 18–24. Summary of Robust Z across Two Sets of Anchored Grade Level Calibrations in Writing**

<b>Grade/ Course</b>	<b>Cal 1: Number of Items</b>	<b>Cal 1: Number of Items with ABS(Z) &gt; 1.645</b>	<b>Cal 1: Percent of Items with ABS(Z) &gt; 1.645</b>	<b>Cal 2: Number of Items</b>	<b>Cal 2: Number of Items with ABS(Z) &gt; 1.645</b>	<b>Cal 2: Percent of Items with ABS(Z) &gt; 1.645</b>
Kindergarten	0	0	N/A	0	0	N/A
Grade 1	0	0	N/A	0	0	N/A
Grade 2	0	0	N/A	0	0	N/A
Grade 3	380	55	14%	286	34	12%
Grade 4	354	53	15%	297	42	14%
Grade 5	344	51	15%	319	48	15%
Grade 6	396	40	10%	395	41	10%
Grade 7	389	33	8%	389	37	10%
Grade 8	357	29	8%	357	31	9%
English Comp	753	75	10%	753	75	10%
Total	2973	336	11%	2796	308	11%
	Correlation = 0.948			Correlation = 0.949		
	Additive Constant = 0.012			Additive Constant = 0.009		

For the most part, whether high absolute displacement values or robust Z was used to identify items with operational estimates that differ from banked values, the same items were identified. For example, in calibration 1, all items with absolute displacement greater than 0.614 have an absolute value of robust Z greater than 1.645. In the displacement range of 0.585 to 0.614, some items have absolute value of robust Z greater than 1.645 while others do not. No items with absolute displacement less than 0.585 have absolute value of robust Z greater than 1.645.

For each of the content areas, it is evident from this series of plots that the item parameter estimates are reasonably stable for the items in grade 3 and above.

## **CHAPTER NINETEEN: REVISION OF BENCHMARK CUTS**

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As described in Chapter Fourteen, CDT scores are placed along a continuum from “Areas of Need” to “Strengths to Build On.” These are represented in the dynamic reporting suite with colors red, green, and blue. “Areas of Need” are depicted in the red range, while “Strengths to Build On” are depicted in the green and blue ranges. The center of the green range for grades 5 and above was established by panels of Pennsylvania educators during preliminary benchmarking activities (see Chapter Ten for details). The center of the green range for grades 2 through 4 was extrapolated from grades 5 and above prior to the launch of the CDT tests for students in grades 3 through 5 in spring of 2014.

The preliminary benchmarking activities took place prior to the first operational administration in each content area so that, once operational, immediate score reports would be available to students and teachers. Given that the preliminary benchmark cuts were set prior to the operational administration and based on field-test data, it was planned at that time to revisit the location of the cut scores after enough operational data had been collected. The preliminary benchmark cut points in the mathematics content area were analyzed and revised based on operational data following the 2010–2011 school year. The preliminary benchmark cut points in the reading, science, and writing content areas were analyzed and revised based on operational data following the 2011–2012 school year.

The introduction of CDT tests for students in grades 3 through 5 in spring 2014 required benchmark cuts for grades 2 through 4. For each content area, the benchmark cuts in place for the 2013–2014 school year in grades 5 and above were used to extrapolate cuts in grades 2 through 4.

Prior to the start of the 2015–2016 school year, the benchmark cut points in mathematics, reading, and writing were revised based on the revised Pennsylvania System of School Assessments (PSSA) tests and cut points established in spring 2015.

This chapter summarizes changes to the benchmark cuts.

### **FIRST REVISION OF BENCHMARK CUTS BASED ON OPERATIONAL DATA**

In each content area, the benchmark cut points set during preliminary benchmarking activities were analyzed based on matched data sets – operational CDT with PSSA and Keystone Exams (Keystone). CDT benchmark cuts were not revised to exactly match PSSA and Keystone cuts or be predictive. However, CDT, PSSA, and Keystone are based on the same eligible content. As such, it is reasonable to expect that students who do well on CDT will do well on PSSA/Keystone and vice versa. In looking at CDT results matched to PSSA and Keystone results it was determined that many students who scored in the CDT red range scored Proficient or Advanced on PSSA or Keystone suggesting that CDT benchmark cuts were set too high. Therefore, CDT benchmark cuts were lowered to make CDT red/green/blue classifications more consistent with PSSA and Keystone results. See Chapter Nineteen of the 2010–2011 and 2011–2012 technical reports for details. Table 19–1 provides a summary of the first revisions to the benchmark cut points.



**Table 19–1. Summary of First Revision to Benchmark Cuts**

Content Area	Course /Grade	Benchmarking Logit Cut Point	First Revision to Logit Cut Point	Difference in Logit Cut Point	Difference in Scale Score
Mathematics	Grade 5	-0.292	-0.792	-0.500	-63
Mathematics	Grade 6	0.526	0.026	-0.500	-62
Mathematics	Grade 7	1.495	0.495	-1.000	-125
Mathematics	Grade 8	2.238	0.838	-1.400	-175
Mathematics	High School	3.363	1.613	-1.750	-218
Mathematics	Algebra I	3.363	1.613	-1.750	-218
Mathematics	Geometry	3.614	1.864	-1.750	-219
Mathematics	Algebra II	4.117	2.367	-1.750	-219
Reading	Grade 5	1.529	0.529	-1.000	-143
Reading	Grade 6	2.015	1.015	-1.000	-142
Reading	Grade 7	2.299	1.299	-1.000	-143
Reading	Grade 8	2.500	1.500	-1.000	-143
Reading	Literature	2.657	1.657	-1.000	-143
Science	Grade 5	1.099	-0.451	-1.550	-206
Science	Grade 6	1.522	-0.028	-1.550	-206
Science	Grade 7	1.879	0.329	-1.550	-206
Science	Grade 8	2.189	0.639	-1.550	-206
Science	High School	2.462	1.112	-1.350	-179
Science	Biology	2.462	1.112	-1.350	-179
Science	Chemistry	2.706	1.356	-1.350	-179
Writing	Grade 5	0.731	-0.569	-1.300	-173
Writing	Grade 6	1.363	0.063	-1.300	-172
Writing	Grade 7	1.886	0.586	-1.300	-173
Writing	Grade 8	2.219	0.919	-1.300	-173
Writing	English Composition	2.281	0.981	-1.300	-173

### EXTRAPOLATION OF BENCHMARK CUTS FOR GRADES 2 THROUGH 4

The introduction of CDT tests for students in grades 3 through 5 in spring 2014 required benchmark cuts for grades 2 through 4<sup>1</sup>. For each content area, the benchmark cuts in place for the 2013–2014 school year in grades 5 and above were used to extrapolate cuts in grades 2 through 4. See Chapter Nineteen of the 2013–2014 technical report for details.

<sup>1</sup> It is not expected that students in grade 2 will use the CDT. However, teachers may want to use a grade 2 benchmark when looking at reports for students in grade 3, especially early in the school year.

## REVISION OF BENCHMARK CUTS BASED ON CHANGES TO PSSA

In spring 2015, changes were made to PSSA test designs and cut points in mathematics and English language arts. In light of these changes, CDT benchmark cuts were analyzed again using matched data sets - operational CDT with PSSA and Keystone. The new PSSA cut points approved in July 2015 represented higher, more rigorous, standards. Therefore, CDT benchmark cuts in mathematics, reading, and writing were raised to make CDT red/green/blue classifications more consistent with PSSA. See Chapter Nineteen of the 2015–2016 technical report for details. Table 19–2 provides a summary of the revisions to the benchmark cut points based on changes to PSSA.

**Table 19–2. Summary of Second Revision to Benchmark Cuts**

CDT	Course /Grade	2014–2015 Logit Cut Point	2015–2016 Logit Cut Point	Difference in Logit Cut Point	Difference in Scale Score
Math Grades 3–5	Grade 2	-2.828	-1.628	1.200	150
Math Grades 3–5	Grade 3	-2.083	-0.883	1.200	150
Math Grades 3–5	Grade 4	-1.380	-0.180	1.200	150
Math Grades 3–5	Grade 5	-0.792	0.208	1.000	125
Math Gr 6–HS	Grade 6	0.026	0.726	0.700	87
Math Gr 6–HS	Grade 7	0.495	1.195	0.700	88
Math Gr 6–HS	Grade 8	0.838	1.513	0.675	84
Math Gr 6–HS	High School	1.613	1.613	0.000	0
Algebra I	Algebra I	1.613	1.613	0.000	0
Geometry	Geometry	1.864	1.864	0.000	0
Algebra II	Algebra II	2.367	2.367	0.000	0
Reading Grades 3–5	Grade 2	-1.136	-0.936	0.200	29
Reading Grades 3–5	Grade 3	-0.367	-0.167	0.200	29
Reading Grades 3–5	Grade 4	0.179	0.429	0.250	36
Reading Grades 3–5	Grade 5	0.529	0.879	0.350	50
Read/Lit Grades 6–HS	Grade 6	1.015	1.265	0.250	35
Read/Lit Grades 6–HS	Grade 7	1.299	1.499	0.200	29
Read/Lit Grades 6–HS	Grade 8	1.500	1.725	0.225	32
Read/Lit Grades 6–HS	Literature	1.657	1.882	0.225	32
Writing Grades 3–5	Grade 2	-2.989	-1.739	1.250	166
Writing Grades 3–5	Grade 3	-1.874	-0.624	1.250	166
Writing Grades 3–5	Grade 4	-1.084	-0.084	1.000	133
Writing Grades 3–5	Grade 5	-0.569	0.281	0.850	113
Writing/Eng Comp Gr 6–HS	Grade 6	0.063	0.563	0.500	66
Writing/Eng Comp Gr 6–HS	Grade 7	0.586	0.836	0.250	33
Writing/Eng Comp Gr 6–HS	Grade 8	0.919	0.919	0.000	0
Writing/Eng Comp Gr 6–HS	English Composition	0.981	0.981	0.000	0

## BENCHMARK CUTS FOR ALL GRADES AND COURSES FOR THE 2023–2024 SCHOOL YEAR

Table 19–3 shows the benchmark cuts used for student reporting during the 2023–2024 school year in the logit metric for each content area. Also presented are the scale score ranges for each color on the CDT reports.

**Table 19–3. Benchmark Cuts and Scale Score Ranges for the 2023–2024 School Year**

CDT	Course/Grade	Logit Cut Point (Center of Green)	Red Scale Score Range	Green Scale Score Range	Blue Scale Score Range
Math Grades 3–5	Grade 2	-1.628	200 - 728	729 - 891	892 - 2000
Math Grades 3–5	Grade 3	-0.883	200 - 821	822 - 984	985 - 2000
Math Grades 3–5	Grade 4	-0.180	200 - 909	910 - 1072	1073 - 2000
Math Grades 3–5	Grade 5	0.208	200 - 957	958 - 1120	1121 - 2000
Math Gr 6–HS	Grade 6	0.726	200 - 1022	1023 - 1185	1186 - 2000
Math Gr 6–HS	Grade 7	1.195	200 - 1081	1082 - 1244	1245 - 2000
Math Gr 6–HS	Grade 8	1.513	200 - 1120	1121 - 1283	1284 - 2000
Math Gr 6–HS	High School	1.613	400 - 1133	1134 - 1296	1297 - 2000
Algebra I	Algebra I	1.613	400 - 1133	1134 - 1296	1297 - 2000
Geometry	Geometry	1.864	400 - 1164	1165 - 1327	1328 - 2000
Algebra II	Algebra II	2.367	400 - 1227	1228 - 1390	1391 - 2000
Reading Grades 3–5	Grade 2	-0.936	200 - 630	631 - 845	846 - 2000
Reading Grades 3–5	Grade 3	-0.167	200 - 740	741 - 955	956 - 2000
Reading Grades 3–5	Grade 4	0.429	200 - 825	826 - 1040	1041 - 2000
Reading Grades 3–5	Grade 5	0.879	200 - 889	890 - 1104	1105 - 2000
Read/Lit Grades 6–HS	Grade 6	1.265	200 - 944	945 - 1159	1160 - 2000
Read/Lit Grades 6–HS	Grade 7	1.499	200 - 978	979 - 1193	1194 - 2000
Read/Lit Grades 6–HS	Grade 8	1.725	200 - 1010	1011 - 1225	1226 - 2000
Read/Lit Grades 6–HS	Literature	1.882	200 - 1032	1033 - 1247	1248 - 2000
Science Grades 3–5	Grade 2	-1.723	200 - 634	635 - 807	808 - 2000
Science Grades 3–5	Grade 3	-1.282	200 - 693	694 - 866	867 - 2000
Science Grades 3–5	Grade 4	-0.855	200 - 750	751 - 923	924 - 2000
Science Grades 3–5	Grade 5	-0.451	200 - 803	804 - 976	977 - 2000
Science Gr 6–HS	Grade 6	-0.028	200 - 860	861 - 1033	1034 - 2000
Science Gr 6–HS	Grade 7	0.329	200 - 907	908 - 1080	1081 - 2000
Science Gr 6–HS	Grade 8	0.639	200 - 948	949 - 1121	1122 - 2000
Science Gr 6–HS	High School	1.112	400 - 1011	1012 - 1184	1185 - 2000
Biology	Biology	1.112	400 - 1011	1012 - 1184	1185 - 2000
Chemistry	Chemistry	1.356	400 - 1044	1045 - 1217	1218 - 2000
Writing Grades 3–5	Grade 2	-1.739	200 - 631	632 - 804	805 - 2000
Writing Grades 3–5	Grade 3	-0.624	200 - 779	780 - 952	953 - 2000
Writing Grades 3–5	Grade 4	-0.084	200 - 851	852 - 1024	1025 - 2000
Writing Grades 3–5	Grade 5	0.281	200 - 899	900 - 1072	1073 - 2000
Writing/Eng Comp Gr 6–HS	Grade 6	0.563	200 - 937	938 - 1110	1111 - 2000

**Table 19–3 (continued). Benchmark Cuts and Scale Score Ranges for the 2023–2024 School Year**

<b>CDT</b>	<b>Course/Grade</b>	<b>Logit Cut Point (Center of Green)</b>	<b>Red Scale Score Range</b>	<b>Green Scale Score Range</b>	<b>Blue Scale Score Range</b>
Writing/Eng Comp Gr 6–HS	Grade 7	0.836	200 - 973	974 - 1146	1147 - 2000
Writing/Eng Comp Gr 6–HS	Grade 8	0.919	200 - 984	985 - 1157	1158 - 2000
Writing/Eng Comp Gr 6–HS	English Composition	0.981	200 - 993	994 - 1166	1167 - 2000

## APPENDIX A: GENERAL DEVELOPMENT AND FIELD TEST CYCLE FOR THE CLASSROOM DIAGNOSTIC TOOLS

Table A-1. General Development and Field Test Cycle for the Classroom Diagnostic Tools

	Mathematics	Reading/Literature	Science	Writing/English Composition
<b>Summer/Fall 2009</b>	Item Development and Internal Reviews			
<b>Winter 2009/2010</b>	Item Review by Pennsylvania Educators	Item Development and Internal Reviews	Item Development and Internal Reviews	
<b>Spring 2010</b>	Stand-alone Field Test	Item Development and Internal Reviews	Item Development and Internal Reviews	
<b>Summer 2010</b>	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Item Review by Pennsylvania Educators	Item Review by Pennsylvania Educators	Item Development and Internal Reviews
<b>Fall 2010</b>	Operational Assessments Available	Stand-alone Field Test	Stand-alone Field Test	Item Development and Internal Reviews
<b>Winter 2010/2011</b>	Operational Assessments Available	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Data Review, Items Aligned to the Learning Progression Map, and Benchmarking	Item Review by Pennsylvania Educators
<b>Spring 2011</b>	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Stand-alone Field Test
<b>Summer 2011</b>				Data Review, Items Aligned to the Learning Progression Map, and Benchmarking
<b>Fall 2011</b>	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
<b>Winter 2011/2012</b>	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
<b>Spring 2012</b>	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available	Operational Assessments Available
<b>Summer 2012</b>	Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards Begins	Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards Begins		
<b>Fall 2012</b>	Operational Assessments Available and Completion of Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards	Operational Assessments Available and Completion of Item Development and Internal Reviews of Items Aligned to Pennsylvania Core Standards	Operational Assessments Available	Operational Assessments Available

**Table A–1 (continued). General Development and Field Test Cycle for the Classroom Diagnostic Tools**

	<b>Mathematics</b>	<b>Reading/Literature</b>	<b>Science</b>	<b>Writing/English Composition</b>
<b>Winter 2012/2013</b>	Operational Assessments Available  and  Item Review by Pennsylvania Educators for Items Aligned to Pennsylvania Core Standards	Operational Assessments Available  and  Item Review by Pennsylvania Educators for Items Aligned to Pennsylvania Core Standards	Operational Assessments Available	Operational Assessments Available
<b>Spring 2013</b>	Operational Assessments with Embedded Field Test Items Aligned to the Pennsylvania Core Standards Available and Item Development and Internal Reviews of Items for Lower Grades CDT	Operational Assessments with Embedded Field Test Items Aligned to the Pennsylvania Core Standards Available and Item Development and Internal Reviews of Items for Lower Grades CDT	Operational Assessments Available and Item Development and Internal Reviews of Items for Lower Grades CDT	Operational Assessments Available and Item Development and Internal Reviews of Items for Lower Grades CDT
<b>Summer 2013</b>	Data Review and Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators for Items for Lower Grades	Data Review and Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators for Items for Lower Grades	Item Review by Pennsylvania Educators for Items for Lower Grades	Item Review by Pennsylvania Educators for Items for Lower Grades
<b>Fall 2013</b>	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades	Operational Assessments Aligned to PCS Including Embedded Field Test Items at Grade 6 Available and Stand-alone Field Test for Lower Grades
<b>Winter 2013/2014</b>	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT	Operational Assessments Aligned to PCS Available and Data Review and Items Aligned to the Learning Progression Map for Items for Lower Grades CDT
<b>Spring 2014</b>	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available
<b>Winter 2014/2015</b>	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS and EBSR items for all grade levels CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT	Item Development and Internal Reviews of Replenishment Items for Grades 6–HS CDT
<b>Spring 2015</b>	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available

**Table A–1 (continued). General Development and Field Test Cycle for the Classroom Diagnostic Tools**

	<b>Mathematics</b>	<b>Reading/Literature</b>	<b>Science</b>	<b>Writing/English Composition</b>
<b>Spring 2016</b>	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available	Data Review of Items Aligned to the Learning Progression Map for Items Aligned to the Pennsylvania Core Standards and Item Review by Pennsylvania Educators and Operational Assessments, including Lower Grades, Available
<b>Spring 2017</b>	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available	Operational Assessments, including Lower Grades, Available
<b>Winter 2017/2018</b>	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.
<b>Fall 2018</b>	Operational Assessments Aligned to PCS Including Embedded Field Test Items	Operational Assessments Aligned to PCS Including Embedded Field Test Items	Operational Assessments Aligned to PCS Including Embedded Field Test Items. Item Development and Internal Reviews of Technology-Enhanced Items.	Operational Assessments Aligned to PCS Including Embedded Field Test Items
<b>Spring 2019</b>	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.	Data Review by Pennsylvania Educators.
<b>Summer 2019</b>	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS
<b>Spring 2020</b>			Data Review of Technology-Enhanced Items by Pennsylvania Educators.	
<b>Summer 2020</b>			Operational Assessments of full CDT assessments and Diagnostic Category Assessments Aligned to PCS	
<b>Spring 2022</b>	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.	Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators.
<b>Summer 2022</b>	Embedded Field Test Items	Embedded Field Test Items	Embedded Field Test Items	Embedded Field Test Items

**Table A–1 (continued). General Development and Field Test Cycle for the Classroom Diagnostic Tools**

	<b>Mathematics</b>	<b>Reading/Literature</b>	<b>Science</b>	<b>Writing/English Composition</b>
<b>Spring 2023</b>			Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review and Data Review of Items by Pennsylvania Educators.	
<b>Summer 2023</b>			Embedded Field Test Items and updated Operational Assessments of full CDT assessments and Diagnostic Category Assessments	
<b>Spring 2024</b>			Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review and Data Review of Items by Pennsylvania Educators.	
<b>Summer 2024</b>			Item Development and Internal Reviews of Replenishment Items for Grades K–HS. Item Review by Pennsylvania Educators. Data Review of Items by Pennsylvania Educators. Embedded Field Test Items and updated Operational Assessments of full CDT assessments and Diagnostic Category Assessments	



## APPENDIX B: FIELD TEST ITEM STATISTICS

This appendix contains classical item statistics for all items that were field tested during the 2023–2024 school year.

**Table B–1. Multiple-Choice Item Statistics**

Column Heading	Definition
ID	Item ID
Grade	Item grade or course alignment
<i>N</i>	Number of students
PVal	Item mean score ( <i>P</i> -Value)
P()	Proportion selecting given response (- = blank)
PtBis	Point biserial (item-total correlation)
PT()	Point biserial of given response
Meas	Rasch item difficulty measure estimate
MSE	Standard error of Rasch item difficulty measure estimate
Z-in	Z-standardized infit statistic
MS-in	Mean square infit statistic
Z-out	Z-standardized outfit statistic
MS-out	Mean square outfit statistic
M/F	Male/female DIF statistic
W/B	White/black DIF statistic
W/H	White/Hispanic DIF statistic

## SCIENCE MULTIPLE-CHOICE ITEMS

Table B–2. Science Multiple-Choice Item Statistics

ID	Grade	N	PVal	P(A)	P(B)	P(C)	P(D)	P(-)	PtBis	PT(A)	PT(B)	PT(C)	PT(D)	Meas	MSE	Z-in	MS-in	Z-out	MS-out	M/F	W/B	W/H
1140660	2	2359	.492	.136	.252	.492	.120	.000	.282	-.180	-.033	.282	-.200	-2.098	0.048	9.9	1.2	9.9	1.5	A-	A+	A+
1140661	2	2341	.410	.310	.171	.109	.410	.000	.327	-.051	-.200	-.199	.327	-1.668	0.048	6.7	1.1	7.9	1.3	A+	A+	A+
1140662	2	2317	.457	.232	.166	.457	.145	.000	.266	-.034	-.110	.266	-.220	-1.933	0.048	9.9	1.2	9.9	1.5	A+	A+	A-
1143724	3	15361	.418	.314	.189	.418	.080	.000	.283	-.014	-.195	.283	-.209	-1.329	0.019	9.9	1.2	9.9	1.4	A+	A+	A+
1143726	3	15203	.607	.106	.233	.607	.054	.000	.437	-.301	-.189	.437	-.181	-2.348	0.019	6.3	1.1	3.4	1.1	A-	A-	A-
1143728	3	15489	.594	.089	.594	.152	.166	.000	.492	-.205	.492	-.287	-.216	-2.278	0.019	-2.2	1.0	-3.4	1.0	A+	A+	A+
1141077	4	12979	.748	.748	.093	.108	.051	.000	.479	.479	-.271	-.270	-.208	-2.999	0.023	-2.8	1.0	-5.4	0.9	A-	A+	A-
1141079	4	13048	.529	.170	.115	.186	.529	.000	.479	-.226	-.249	-.192	.479	-1.664	0.020	-4.5	1.0	-0.5	1.0	A-	A-	A-
1141081	4	12148	.365	.365	.358	.193	.084	.000	.135	.135	.040	-.119	-.134	-0.828	0.021	9.9	1.3	9.9	1.8	A+	A-	A-
1139402	5	16383	.282	.178	.282	.251	.289	.000	.075	.000	.075	-.133	.053	-0.034	0.019	9.9	1.3	9.9	1.7	A-	A+	A+
1139404	5	17237	.410	.198	.201	.191	.410	.000	.427	-.158	-.139	-.233	.427	-0.706	0.017	-6.8	1.0	1.9	1.0	A+	A-	A+
1138696	6	28771	.562	.120	.160	.562	.158	.000	.306	-.018	-.167	.306	-.233	-1.294	0.013	9.9	1.1	9.9	1.2	A+	A+	A+
1138698	6	28565	.459	.459	.184	.140	.217	.000	.487	.487	-.153	-.315	-.180	-0.761	0.013	-9.9	0.9	-9.9	0.9	A+	A-	A-
1138699	6	29756	.326	.326	.167	.318	.189	.000	.339	.339	-.135	-.138	-.114	-0.039	0.014	5.0	1.0	9.9	1.2	A-	A-	A-
1139405	7	43378	.443	.230	.158	.443	.169	.000	.209	-.052	-.178	.209	-.046	-0.461	0.011	9.9	1.2	9.9	1.4	A+	A-	A-
1141082	7	42277	.102	.102	.340	.295	.263	.000	-.068	-.068	.325	-.218	-.077	1.840	0.017	9.9	1.2	9.9	3.2	A-	A-	A+
1141084	8	17528	.282	.253	.259	.206	.282	.000	.271	-.050	-.160	-.073	.271	0.501	0.019	9.9	1.1	9.9	1.4	A-	A+	A-
1141085	8	16666	.318	.318	.228	.155	.300	.000	.103	.103	-.002	-.285	.122	0.264	0.019	9.9	1.3	9.9	1.8	A-	A-	A-
1137542	Bio	19995	.214	.271	.285	.230	.214	.000	.203	-.067	-.068	-.054	.203	1.327	0.019	9.9	1.1	9.9	1.6	A+	A+	A+
1137543	Bio	19877	.467	.131	.223	.467	.179	.000	.320	-.167	-.122	.320	-.137	-0.100	0.016	9.9	1.1	9.9	1.2	A+	A+	A+
1141163	Bio	24300	.497	.153	.231	.497	.119	.000	.277	-.210	-.058	.277	-.119	-0.169	0.014	9.9	1.2	9.9	1.3	A+	A-	A+
1141164	Bio	24373	.424	.154	.256	.424	.166	.000	.234	-.133	-.035	.234	-.140	0.201	0.015	9.9	1.2	9.9	1.4	A+	A-	A-
1141168	Bio	22808	.473	.155	.186	.473	.187	.000	.328	-.131	-.191	.328	-.108	-0.045	0.015	9.9	1.1	9.9	1.2	A+	A-	A-
1143185	Bio	24215	.382	.382	.240	.207	.172	.000	.265	.265	-.108	-.137	-.073	0.421	0.015	9.9	1.1	9.9	1.4	A+	A-	A+
1143846	Bio	19777	.318	.318	.226	.181	.274	.000	.265	.265	-.246	-.117	.055	0.687	0.017	9.9	1.1	9.9	1.4	A-	A+	A+
1144367	Bio	19437	.514	.171	.224	.514	.091	.000	.403	-.249	-.166	.403	-.134	-0.357	0.016	1.7	1.0	2.5	1.0	A+	A-	A-
1144370	Bio	19375	.477	.127	.477	.155	.241	.000	.279	-.146	.279	-.254	.003	-0.156	0.016	9.9	1.2	9.9	1.2	A+	A+	A-
1144371	Bio	19565	.325	.231	.295	.325	.150	.000	.205	-.127	-.032	.205	-.079	0.638	0.017	9.9	1.2	9.9	1.5	A+	A-	A-
1144373	Bio	19608	.328	.193	.218	.262	.328	.000	.270	.040	-.142	-.191	.270	0.599	0.017	9.9	1.1	9.9	1.3	A-	A-	A-
1144374	Bio	19644	.327	.327	.199	.268	.206	.000	.419	.419	-.145	-.207	-.117	0.603	0.017	-7.7	0.9	2.5	1.0	A+	A-	A-
1144376	Bio	19784	.387	.387	.124	.251	.238	.000	.389	.389	-.163	-.105	-.213	0.289	0.016	1.1	1.0	7.8	1.1	A+	A-	A-

**Table B-2 (continued). Science Multiple-Choice Item Statistics**

ID	Grade	N	PVal	P(A)	P(B)	P(C)	P(D)	P(-)	PtBis	PT(A)	PT(B)	PT(C)	PT(D)	Meas	MSE	Z-in	MS-in	Z-out	MS-out	M/F	W/B	W/H
1139590	Chem	691	.337	.217	.161	.337	.285	.000	.076	.056	-.046	.076	-.093	0.710	0.086	4.1	1.1	7.6	1.5	A+	A+	A-
1139593	Chem	681	.507	.095	.326	.507	.072	.000	.225	-.130	-.076	.225	-.150	-0.133	0.082	1.9	1.1	1.6	1.1	A+	A+	B-
1140683	Chem	692	.288	.296	.288	.269	.147	.000	-.005	.125	-.005	-.087	-.046	0.965	0.089	4.9	1.2	6.2	1.5	A+	A-	A-
1140684	Chem	685	.302	.128	.234	.336	.302	.000	.177	-.036	-.033	-.117	.177	0.911	0.088	1.9	1.1	2.8	1.2	A-	A-	A-
1140686	Chem	695	.151	.151	.271	.272	.306	.000	.072	.072	-.034	-.084	.058	1.922	0.111	1.1	1.1	3.7	1.5	A-	A+	A+
1140687	Chem	714	.318	.172	.178	.332	.318	.000	.205	-.129	-.130	.007	.205	0.815	0.085	0.7	1.0	2.5	1.1	A+	A-	A+
1140912	Chem	726	.328	.328	.216	.230	.226	.000	.307	.307	-.133	-.140	-.073	0.803	0.084	-1.1	1.0	0.5	1.0	A-	A+	A-
1140914	Chem	649	.173	.206	.365	.256	.173	.000	.048	-.016	.041	-.072	.048	1.766	0.108	1.3	1.1	3.1	1.3	A-	A-	A-
1140915	Chem	698	.331	.203	.261	.205	.331	.000	.368	-.254	-.062	-.109	.368	0.772	0.085	-2.6	0.9	-1.6	0.9	A+	A-	A+
1140916	Chem	682	.403	.282	.132	.403	.183	.000	.092	.100	-.210	.092	-.050	0.422	0.084	5.7	1.2	5.8	1.3	A-	A+	A+
1140918	Chem	671	.353	.192	.353	.255	.200	.000	.018	-.042	.018	-.054	.078	0.648	0.086	5.6	1.2	5.5	1.3	A+	A+	B-
1140919	Chem	699	.278	.236	.269	.278	.217	.000	.048	-.080	-.105	.048	.143	1.069	0.089	3.6	1.2	3.8	1.2	A+	A-	A+
1140920	Chem	683	.357	.164	.334	.357	.145	.000	.049	-.101	.062	.049	-.044	0.678	0.085	4.8	1.2	6.0	1.3	A+	A-	A-
1145436	Chem	669	.377	.203	.235	.185	.377	.000	.401	-.231	-.126	-.124	.401	0.527	0.085	-3.2	0.9	-2.5	0.9	A+	A-	C-
1145440	Chem	727	.421	.421	.230	.199	.150	.000	.355	.355	-.146	-.166	-.133	0.374	0.080	-2.8	0.9	-1.7	0.9	A-	A+	A-
1145441	Chem	694	.308	.219	.378	.308	.095	.000	.043	-.140	.150	.043	-.118	0.870	0.087	4.5	1.2	4.0	1.2	A+	A+	A+
1145442	Chem	666	.161	.188	.341	.311	.161	.000	-.058	-.016	.056	.003	-.058	1.891	0.110	2.0	1.1	6.4	1.8	A-	A-	A+
1145443	Chem	697	.330	.225	.303	.330	.142	.000	.071	.047	-.102	.071	-.018	0.813	0.085	4.1	1.1	4.9	1.3	A+	A+	A+
1145446	Chem	650	.169	.195	.283	.352	.169	.000	.067	-.061	.004	-.006	.067	1.777	0.109	1.0	1.1	3.6	1.4	A+	A-	A-
1145447	Chem	660	.347	.203	.347	.312	.138	.000	.169	-.105	.169	-.040	-.057	0.632	0.087	2.5	1.1	2.2	1.1	A-	A-	A-

## SCIENCE TECHNOLOGY-ENHANCED ITEMS

Table B–3. Technology-Enhanced Item Statistics

Column Heading	Definition
ID	Item ID
Grade	Item grade or course alignment
<i>Max Points</i>	Maximum possible item score
N	Number of students
PVal	Item mean score/Maximum possible item score
P( )	Proportion gaining given point (- = blank)
PtBis	Point biserial (item-total correlation)
PT( )	Point biserial of given score point
Meas	Rasch item difficulty measure estimate
MSE	Standard error of Rasch item difficulty measure estimate
Z-in	Z-standardized infit statistic
MS-in	Mean square infit statistic
Z-out	Z-standardized outfit statistic
MS-out	Mean square outfit statistic
M/F	Male/female DIF statistic
W/B	White/black DIF statistic
W/H	White/Hispanic DIF statistic

**Table B-4. Science Technology-Enhanced Item Statistics**

ID	Grade	Max Points	N	PVal	P(0)	P(1)	P(2)	P(3)	P(-)	PtBis	PT(0)	PT(1)	PT(2)	PT(3)	Meas	MSE	Z-in	MS-in	Z-out	MS-out	W/F	W/B	W/H
1140663	2	1	2169	.742	.258	.742			.000	.359	-.359	.359			-3.531	0.057	4.9	1.2	2.9	1.2	A-	C-	A-
1140664	2	1	2152	.456	.544	.456			.000	.387	-.387	.387			-1.867	0.050	3.1	1.1	6.0	1.2	A-	A-	A-
1140665	2	1	2112	.102	.898	.102			.000	.239	-.239	.239			0.573	0.076	0.3	1.0	1.3	1.2	A-	A+	A-
1143725	3	1	15022	.822	.178	.822			.000	.113	-.113	.113			-3.783	0.024	9.9	1.4	9.9	1.7	A-	A-	A+
1143727	3	1	15330	.624	.377	.623			.000	.271	-.271	.271			-2.460	0.019	9.9	1.3	9.9	1.4	A+	A-	A+
1141078	4	1	12864	.388	.612	.388			.000	.335	-.335	.335			-0.933	0.020	9.9	1.1	9.9	1.2	A-	A-	A-
1141080	4	1	12396	.690	.310	.690			.000	.358	-.358	.358			-2.614	0.022	9.9	1.2	7.6	1.1	A+	C-	C-
1139400	5	1	16693	.291	.709	.291			.000	.274	-.274	.274			-0.105	0.019	9.6	1.1	9.9	1.3	A-	A-	A-
1139401	5	1	16656	.210	.790	.210			.000	.099	-.099	.099			0.428	0.021	9.9	1.2	9.9	1.6	A+	A+	A-
1139403	5	1	17072	.165	.835	.165			.000	.125	-.125	.125			0.786	0.022	8.1	1.1	9.9	2.0	A+	A+	A+
1138697	6	1	28623	.444	.556	.444			.000	.386	-.386	.386			-0.699	0.013	5.3	1.0	7.3	1.1	A-	A-	A-
1138700	6	1	27649	.232	.768	.232			.000	.311	-.311	.311			0.496	0.015	1.3	1.0	9.9	1.2	A+	A-	A-
1141083	7	1	41140	.121	.879	.121			.000	.233	-.233	.233			1.611	0.016	0.9	1.0	9.9	1.3	A-	A-	A-
1141169	7	1	40933	.188	.812	.188			.000	.294	-.294	.294			1.025	0.014	0.6	1.0	9.9	1.2	A+	A-	A-
1139406	8	1	17563	.417	.583	.417			.000	.359	-.359	.359			-0.259	0.017	9.9	1.1	9.9	1.2	A+	A+	A+
1139407	8	1	19472	.019	.981	.019			.000	.122	-.122	.122			3.809	0.054	-0.2	1.0	3.9	1.3	A-	A-	A+
1139540	8	1	17415	.109	.891	.109			.000	.233	-.233	.233			1.842	0.026	1.2	1.0	3.6	1.1	A+	A-	A-
1141086	8	1	16693	.052	.948	.052			.000	.180	-.180	.180			2.690	0.036	-0.6	1.0	6.8	1.5	A-	A-	A-
1137541	Bio	1	19888	.313	.687	.313			.000	.099	-.099	.099			0.710	0.017	9.9	1.3	9.9	1.6	A-	A-	A-
1137544	Bio	1	19809	.088	.912	.088			.000	.111	-.111	.111			2.542	0.026	5.8	1.1	9.9	2.0	A-	A-	A-
1141166	Bio	1	22781	.567	.433	.567			.000	.438	-.438	.438			-0.515	0.015	-4.0	1.0	-5.7	1.0	B-	A-	A-
1141167	Bio	1	22868	.103	.897	.103			.000	.331	-.331	.331			2.463	0.023	-4.7	0.9	-1.4	1.0	A-	A-	A+
1143842	Bio	1	19783	.115	.885	.115			.000	.314	-.314	.314			2.199	0.024	-1.3	1.0	-4.0	0.9	A-	A-	A-
1143843	Bio	1	19982	.302	.698	.302			.000	.151	-.151	.151			0.772	0.017	9.9	1.2	9.9	1.7	A-	A-	A-
1143845	Bio	1	19966	.141	.859	.141			.000	.365	-.365	.365			1.941	0.022	-4.4	0.9	-5.5	0.9	A-	A+	A+
1144368	Bio	1	19331	.294	.706	.294			.000	.276	-.276	.276			0.799	0.017	9.9	1.1	9.9	1.3	B-	A-	A-
1144369	Bio	1	19587	.327	.673	.327			.000	.353	-.353	.353			0.609	0.017	5.3	1.0	7.5	1.1	A+	A-	A-
1144372	Bio	1	19599	.200	.800	.200			.000	.333	-.333	.333			1.417	0.019	0.9	1.0	1.1	1.0	A-	A-	A-
1144375	Bio	1	19640	.255	.745	.255			.000	.281	-.281	.281			1.049	0.018	9.9	1.1	9.9	1.2	A-	A-	A-
1144377	Bio	1	19583	.318	.682	.318			.000	.509	-.509	.509			0.667	0.017	-9.9	0.9	-9.9	0.8	A-	A-	A-
1139591	Chem	1	675	.199	.801	.199			.000	.218	-.218	.218			1.516	0.101	0.3	1.0	0.4	1.0	A-	B-	A-
1139592	Chem	1	743	.213	.787	.213			.000	.208	-.208	.208			1.471	0.094	-0.1	1.0	2.5	1.2	A-	A-	B+

**Table B–4 (continued). Science Technology-Enhanced Item Statistics**

ID	Grade	Max Points	N	PVal	P(0)	P(1)	P(2)	P(3)	P(-)	PtBis	PT(0)	PT(1)	PT(2)	PT(3)	Meas	MSE	Z-in	MS-in	Z-out	MS-out	W/F	W/B	W/H
1140685	Chem	1	694	.614	.386	.614			.000	.414	-.414	.414			-0.625	0.084	-3.0	0.9	-3.2	0.9	A-	A-	A-
1140688	Chem	1	722	.277	.723	.277			.000	.243	-.243	.243			1.107	0.088	0.3	1.0	0.8	1.1	A+	A-	A-
1140689	Chem	1	732	.398	.602	.398			.000	.041	-.041	.041			0.429	0.081	6.2	1.2	6.8	1.3	A+	A-	A-
1140913	Chem	1	727	.274	.726	.274			.000	.161	-.161	.161			1.091	0.088	1.9	1.1	1.7	1.1	B-	A-	A-
1140917	Chem	1	699	.176	.824	.176			.000	.226	-.226	.226			1.743	0.104	-0.1	1.0	0.3	1.0	A-	A-	A-
1140921	Chem	1	703	.320	.680	.320			.000	.434	-.434	.434			0.822	0.086	-3.9	0.9	-3.4	0.8	A-	B-	A-
1140922	Chem	1	670	.155	.845	.155			.000	.009	-.009	.009			1.829	0.110	1.4	1.1	3.8	1.4	A+	A-	A-
1145437	Chem	1	714	.375	.625	.375			.000	.195	-.195	.195			0.507	0.083	2.5	1.1	3.2	1.2	A-	B-	C-
1145438	Chem	1	728	.069	.931	.069			.000	.249	-.249	.249			2.859	0.151	-0.3	1.0	-1.2	0.8	A+	A-	B+
1145439	Chem	1	746	.105	.895	.105			.000	.083	-.083	.083			2.393	0.124	0.4	1.0	4.3	1.7	A+	B+	B-
1145444	Chem	1	661	.106	.894	.106			.000	.054	-.054	.054			2.369	0.130	0.6	1.1	3.1	1.5	A-	A-	A+
1145445	Chem	1	717	.219	.781	.219			.000	.022	-.022	.022			1.453	0.095	2.4	1.1	5.0	1.4	B-	A+	B+
1145448	Chem	1	681	.194	.806	.194			.000	-.025	.025	-.025			1.510	0.101	2.9	1.2	4.4	1.4	A-	A+	A-
1145449	Chem	1	634	.118	.882	.118			.000	-.054	.054	-.054			2.176	0.127	1.5	1.1	3.8	1.6	A-	B-	C-

## APPENDIX C: VERTICAL LINKING ITEM DETAILS

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This appendix provides details on the items used to build the vertical scales in each content area. Information such as grade, n-count, eligible content code, and diagnostic category is provided for each of the vertical linking items. This information is based on the academic standards in place at the time each of the content area vertical scale was established<sup>1</sup>. Summary tables indicate the number of linking items in each diagnostic category. A sample of the vertical linking Excel file is provided as well as plots of the vertical linking items.

### MATHEMATICS

Tables C–1 through C–8 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 600869 is a grade 3 item used to link grades 3 and 4. It was administered 1,280 times on the lower grade forms (grade 3) and 964 times on the upper grade forms (grade 4).

Diagnostic categories for Algebra I, Geometry, and Algebra II are different than diagnostic categories for grades 3 through 8 and 11 Mathematics. Items may fall into both a Mathematics diagnostic category and an Algebra I, Geometry, or Algebra II diagnostic category. This is shown in Tables C–6, C–7, and C–8. For example, item 601329 is in the Mathematics diagnostic category “Geometry” and the Geometry diagnostic category “Coordinate Geometry and Right Triangles”.

The Mathematics diagnostic categories are<sup>2</sup>:

- Numbers and Operations
- Measurement
- Geometry
- Algebraic Concepts
- Data Analysis and Probability

The Algebra I diagnostic categories are:

- Operations with Real Numbers and Expressions
- Linear Equations & Inequalities
- Functions & Coordinate Geometry
- Data Analysis

The Geometry diagnostic categories are:

- Geometric Properties
- Congruence, Similarity, & Proofs
- Coordinate Geometry and Right Triangles
- Measurement

The Algebra II diagnostic categories are:

- Operations with Complex Numbers
- Non-linear Expressions & Equations
- Functions
- Data Analysis

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<sup>1</sup> Before the 2013–2014 school year items in mathematics, reading, and writing were re-aligned to the new Pennsylvania Core Standards.

<sup>2</sup> Mathematics diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.

**Table C–1. Mathematics Items Used to Link Grade 3 to Grade 4**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
600869	3	Grade 3 to Grade 4	1280	964	M3.B.1.1.1	Measure.
600871	3	Grade 3 to Grade 4	1275	964	M3.B.2.2.1	Measure.
601980	3	Grade 3 to Grade 4	1280	964	M3.B.1.2.1	Measure.
604352	3	Grade 3 to Grade 4	1281	964	M3.D.2.1.1	Alg. Con.
600442	3	Grade 3 to Grade 4	1280	964	M3.C.2.1.1	Geo.
600431	3	Grade 3 to Grade 4	1274	964	M3.A.1.1.1	Numbers & Op.
601975	3	Grade 3 to Grade 4	1281	964	M3.A.2.1.1	Numbers & Op.
600865	3	Grade 3 to Grade 4	1279	964	M3.A.1.3.1	Numbers & Op.
601985	3	Grade 3 to Grade 4	1285	963	M3.E.1.1.1	Data & Prob.
601897	3	Grade 3 to Grade 4	1282	964	M3.A.1.2.1	Numbers & Op.
601437	3	Grade 3 to Grade 4	1274	963	M3.A.1.1.4	Numbers & Op.
600438	3	Grade 3 to Grade 4	1277	963	M3.A.1.2.2	Numbers & Op.
600427	3	Grade 3 to Grade 4	1282	963	M3.C.1.1.1	Geo.
600877	3	Grade 3 to Grade 4	1283	963	M3.E.1.2.1	Data & Prob.
601587	3	Grade 3 to Grade 4	1276	963	M3.A.2.1.3	Numbers & Op.
600440	3	Grade 3 to Grade 4	639	963	M3.B.2.1.1	Measure.
600921	3	Grade 3 to Grade 4	1271	963	M3.A.1.3.2	Numbers & Op.
601589	3	Grade 3 to Grade 4	639	962	M3.D.1.1.1	Alg. Con.
601440	3	Grade 3 to Grade 4	1272	962	M3.B.1.1.3	Measure.
601984	3	Grade 3 to Grade 4	1278	962	M3.D.2.1.2	Alg. Con.
604193	4	Grade 3 to Grade 4	1283	959	M4.D.1.1.2	Alg. Con.
602015	4	Grade 3 to Grade 4	1284	481	M4.E.1.2.1	Data & Prob.
601993	4	Grade 3 to Grade 4	1282	1447	M4.C.1.1.1	Geo.
603609	4	Grade 3 to Grade 4	1284	959	M4.B.2.1.1	Measure.
604189	4	Grade 3 to Grade 4	1280	962	M4.B.1.1.3	Measure.
602010	4	Grade 3 to Grade 4	1285	961	M4.C.1.1.2	Geo.
601646	4	Grade 3 to Grade 4	1283	960	M4.D.2.2.2	Alg. Con.
604186	4	Grade 3 to Grade 4	1279	965	M4.A.3.1.1	Numbers & Op.
601958	4	Grade 3 to Grade 4	1281	961	M4.A.1.1.2	Numbers & Op.
604488	4	Grade 3 to Grade 4	1279	958	M4.A.1.2.2	Numbers & Op.
603744	4	Grade 3 to Grade 4	1279	481	M4.B.2.2.1	Measure.
602009	4	Grade 3 to Grade 4	1279	963	M4.C.1.1.2	Geo.
604514	4	Grade 3 to Grade 4	1280	481	M4.C.2.1.1	Geo.
604492	4	Grade 3 to Grade 4	1278	961	M4.A.3.1.2	Numbers & Op.
601972	4	Grade 3 to Grade 4	1281	965	M4.E.1.2.2	Data & Prob.
601962	4	Grade 3 to Grade 4	1278	962	M4.A.1.3.2	Numbers & Op.
601987	4	Grade 3 to Grade 4	1278	961	M4.A.1.1.4	Numbers & Op.



**Table C–1 (continued). Mathematics Items Used to Link Grade 3 to Grade 4**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Mathematics Diagnostic Category</b>
604195	4	Grade 3 to Grade 4	1279	481	M4.D.2.1.1	Alg. Con.
604501	4	Grade 3 to Grade 4	1279	959	M4.E.1.1.1	Data & Prob.
604493	4	Grade 3 to Grade 4	1279	1443	M4.B.1.1.4	Measure.

**Table C–2. Mathematics Items Used to Link Grade 4 to Grade 5**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601646	4	Grade 4 to Grade 5	960	1187	M4.D.2.2.2	Alg. Con.
601987	4	Grade 4 to Grade 5	961	1186	M4.A.1.1.4	Numbers & Op.
604493	4	Grade 4 to Grade 5	1443	1183	M4.B.1.1.4	Measure.
601961	4	Grade 4 to Grade 5	965	1184	M4.A.1.3.2	Numbers & Op.
604499	4	Grade 4 to Grade 5	962	1188	M4.E.1.1.1	Data & Prob.
602889	4	Grade 4 to Grade 5	962	1187	M4.E.1.2.2	Data & Prob.
602885	4	Grade 4 to Grade 5	965	1186	M4.B.2.2.1	Measure.
602887	4	Grade 4 to Grade 5	962	1187	M4.C.3.1.1	Geo.
601639	4	Grade 4 to Grade 5	960	1184	M4.A.3.1.3	Numbers & Op.
604969	4	Grade 4 to Grade 5	480	1184	M4.C.1.2.2	Geo.
601994	4	Grade 4 to Grade 5	479	1185	M4.D.1.2.2	Alg. Con.
601998	4	Grade 4 to Grade 5	960	1191	M4.E.3.1.1	Data & Prob.
602000	4	Grade 4 to Grade 5	959	1190	M4.C.1.1.1	Geo.
601991	4	Grade 4 to Grade 5	959	1189	M4.A.2.1.2	Numbers & Op.
604879	4	Grade 4 to Grade 5	1441	1188	M4.D.1.1.3	Alg. Con.
601964	4	Grade 4 to Grade 5	961	1188	M4.A.3.2.2	Numbers & Op.
602971	4	Grade 4 to Grade 5	480	1187	M4.B.2.1.1	Measure.
604486	4	Grade 4 to Grade 5	481	1186	M4.E.1.2.1	Data & Prob.
604967	4	Grade 4 to Grade 5	962	1187	M4.A.1.2.2	Numbers & Op.
602973	4	Grade 4 to Grade 5	964	1186	M4.C.2.1.1	Geo.
600853	5	Grade 4 to Grade 5	964	1790	M5.B.2.1.1	Measure.
604790	5	Grade 4 to Grade 5	964	586	M5.C.2.1.2	Geo.
604956	5	Grade 4 to Grade 5	959	1175	M5.A.2.1.1	Numbers & Op.
604862	5	Grade 4 to Grade 5	960	1182	M5.D.1.2.1	Alg. Con.
604783	5	Grade 4 to Grade 5	961	1179	M5.A.1.2.1	Numbers & Op.
606159	5	Grade 4 to Grade 5	960	1190	M5.A.1.5.1	Numbers & Op.
604848	5	Grade 4 to Grade 5	961	1784	M5.E.3.1.1	Data & Prob.
604843	5	Grade 4 to Grade 5	959	1186	M5.C.1.1.2	Geo.
604966	5	Grade 4 to Grade 5	961	596	M5.E.1.1.1	Data & Prob.
606163	5	Grade 4 to Grade 5	961	1188	M5.B.1.1.1	Measure.
601532	5	Grade 4 to Grade 5	956	2369	M5.A.1.1.1	Numbers & Op.
606160	5	Grade 4 to Grade 5	958	1190	M5.A.3.1.1	Numbers & Op.
604960	5	Grade 4 to Grade 5	957	594	M5.B.2.2.3	Measure.
600852	5	Grade 4 to Grade 5	958	1178	M5.D.1.1.1	Alg. Con.
604834	5	Grade 4 to Grade 5	954	1189	M5.A.1.3.1	Numbers & Op.
604959	5	Grade 4 to Grade 5	956	1183	M5.B.1.2.2	Measure.
604961	5	Grade 4 to Grade 5	956	1193	M5.C.1.2.1	Geo.

**Table C–2 (continued). Mathematics Items Used to Link Grade 4 to Grade 5**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Mathematics Diagnostic Category</b>
606278	5	Grade 4 to Grade 5	954	1177	M5.D.2.1.2	Alg. Con.
604965	5	Grade 4 to Grade 5	957	1190	M5.E.1.1.1	Data & Prob.
604865	5	Grade 4 to Grade 5	956	1192	M5.A.1.6.2	Numbers & Op.

**Table C–3. Mathematics Items Used to Link Grade 5 to Grade 6**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
606277	5	Grade 5 to Grade 6	1175	1225	M5.D.2.1.2	Alg. Con.
606153	5	Grade 5 to Grade 6	590	1225	M5.A.1.4.2	Numbers & Op.
604796	5	Grade 5 to Grade 6	1194	1224	M5.B.1.3.2	Measure.
606154	5	Grade 5 to Grade 6	1195	1223	M5.A.2.1.3	Numbers & Op.
604962	5	Grade 5 to Grade 6	1192	1222	M5.C.1.2.1	Geo.
606826	5	Grade 5 to Grade 6	593	1221	M5.A.1.3.2	Numbers & Op.
604859	5	Grade 5 to Grade 6	1766	1223	M5.C.1.1.1	Geo.
604860	5	Grade 5 to Grade 6	1184	1215	M5.D.1.2.1	Alg. Con.
606167	5	Grade 5 to Grade 6	1181	1216	M5.E.3.1.1	Data & Prob.
604836	5	Grade 5 to Grade 6	1176	1216	M5.A.1.6.1	Numbers & Op.
606162	5	Grade 5 to Grade 6	593	1216	M5.B.1.1.1	Measure.
604841	5	Grade 5 to Grade 6	594	1215	M5.B.2.2.1	Measure.
606155	5	Grade 5 to Grade 6	1193	1215	M5.C.2.1.2	Geo.
601592	5	Grade 5 to Grade 6	595	1214	M5.E.2.1.1	Data & Prob.
601590	5	Grade 5 to Grade 6	2372	1214	M5.A.1.1.1	Numbers & Op.
604953	5	Grade 5 to Grade 6	1171	1226	M5.A.1.3.3	Numbers & Op.
604853	5	Grade 5 to Grade 6	1175	1227	M5.A.1.5.1	Numbers & Op.
604784	5	Grade 5 to Grade 6	1178	1227	M5.A.1.2.1	Numbers & Op.
604868	5	Grade 5 to Grade 6	1176	1225	M5.B.1.2.1	Measure.
604964	5	Grade 5 to Grade 6	1190	1226	M5.E.1.1.1	Data & Prob.
601542	5	Grade 5 to Grade 6	1189	1225	M5.B.2.1.1	Measure.
606276	5	Grade 5 to Grade 6	590	1223	M5.C.2.1.1	Geo.
604856	5	Grade 5 to Grade 6	1180	1219	M5.A.3.1.1	Numbers & Op.
606166	5	Grade 5 to Grade 6	1181	1220	M5.D.2.1.1	Alg. Con.
604958	5	Grade 5 to Grade 6	1176	1219	M5.A.2.1.1	Numbers & Op.
604842	5	Grade 5 to Grade 6	1182	1219	M5.C.1.1.2	Geo.
606157	5	Grade 5 to Grade 6	1188	1219	M5.D.1.1.2	Alg. Con.
604794	5	Grade 5 to Grade 6	1177	1217	M5.E.2.1.2	Data & Prob.
604869	5	Grade 5 to Grade 6	1191	1216	M5.B.2.2.2	Measure.
606279	5	Grade 5 to Grade 6	1196	1219	M5.E.3.1.2	Data & Prob.
601040	6	Grade 5 to Grade 6	1190	609	M6.E.3.1.1	Data & Prob.
602096	6	Grade 5 to Grade 6	1190	1213	M6.B.2.1.1	Measure.
601730	6	Grade 5 to Grade 6	1191	1223	M6.B.2.2.1	Measure.
602081	6	Grade 5 to Grade 6	1188	1199	M6.E.1.1.3	Data & Prob.
599668	6	Grade 5 to Grade 6	1186	608	M6.A.1.3.1	Numbers & Op.
600989	6	Grade 5 to Grade 6	1184	1223	M6.D.1.1.1	Alg. Con.
602070	6	Grade 5 to Grade 6	1184	614	M6.E.1.1.1	Data & Prob.

**Table C-3 (continued). Mathematics Items Used to Link Grade 5 to Grade 6**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Mathematics Diagnostic Category</b>
601689	6	Grade 5 to Grade 6	1185	609	M6.C.1.2.2	Geo.
601031	6	Grade 5 to Grade 6	1185	1206	M6.D.2.1.2	Alg. Con.
602174	6	Grade 5 to Grade 6	1181	1210	M6.A.3.2.1	Numbers & Op.
601249	6	Grade 5 to Grade 6	1186	600	M6.C.3.1.1	Geo.
599670	6	Grade 5 to Grade 6	1181	1199	M6.A.1.3.2	Numbers & Op.
600978	6	Grade 5 to Grade 6	1184	615	M6.D.2.2.1	Alg. Con.
601706	6	Grade 5 to Grade 6	1186	1209	M6.E.2.1.1	Data & Prob.
601024	6	Grade 5 to Grade 6	1183	608	M6.D.1.2.1	Alg. Con.
602176	6	Grade 5 to Grade 6	1183	1213	M6.B.1.1.1	Measure.
602071	6	Grade 5 to Grade 6	1184	1210	M6.E.1.1.2	Data & Prob.
602104	6	Grade 5 to Grade 6	1179	607	M6.B.2.1.2	Measure.
599667	6	Grade 5 to Grade 6	1181	1226	M6.A.1.2.1	Numbers & Op.
601260	6	Grade 5 to Grade 6	1181	610	M6.C.1.1.1	Geo.

**Table C–4. Mathematics Items Used to Link Grade 6 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
599606	6	Grade 6 to Grade 7	1224	792	M6.A.1.2.1	Numbers & Op.
601257	6	Grade 6 to Grade 7	1214	792	M6.C.3.1.1	Geo.
601026	6	Grade 6 to Grade 7	614	790	M6.D.1.2.1	Alg. Con.
601705	6	Grade 6 to Grade 7	1221	786	M6.E.1.1.1	Data & Prob.
601811	6	Grade 6 to Grade 7	1220	785	M6.A.2.1.1	Numbers & Op.
601714	6	Grade 6 to Grade 7	1203	786	M6.C.1.2.1	Geo.
601032	6	Grade 6 to Grade 7	1210	783	M6.D.2.1.2	Alg. Con.
599590	6	Grade 6 to Grade 7	2447	783	M6.A.1.1.1	Numbers & Op.
602095	6	Grade 6 to Grade 7	606	784	M6.B.2.1.3	Measure.
601700	6	Grade 6 to Grade 7	1230	785	M6.C.1.1.3	Geo.
601277	6	Grade 6 to Grade 7	1223	785	M6.E.3.1.1	Data & Prob.
602073	6	Grade 6 to Grade 7	603	784	M6.E.1.1.3	Data & Prob.
599643	6	Grade 6 to Grade 7	1217	778	M6.A.1.3.2	Numbers & Op.
602177	6	Grade 6 to Grade 7	1217	778	M6.B.1.1.1	Measure.
601220	6	Grade 6 to Grade 7	1205	778	M6.B.2.3.1	Measure.
601030	6	Grade 6 to Grade 7	1217	789	M6.D.2.1.1	Alg. Con.
601275	6	Grade 6 to Grade 7	592	786	M6.E.2.1.1	Data & Prob.
601678	6	Grade 6 to Grade 7	1220	785	M6.D.1.1.1	Alg. Con.
601301	6	Grade 6 to Grade 7	1220	785	M6.E.1.1.2	Data & Prob.
601245	6	Grade 6 to Grade 7	1225	783	M6.E.3.1.2	Data & Prob.
599593	6	Grade 6 to Grade 7	1221	784	M6.A.1.1.2	Numbers & Op.
601664	6	Grade 6 to Grade 7	600	780	M6.C.1.1.4	Geo.
599609	6	Grade 6 to Grade 7	1207	776	M6.A.1.3.1	Numbers & Op.
601799	6	Grade 6 to Grade 7	1211	778	M6.A.1.4.1	Numbers & Op.
602101	6	Grade 6 to Grade 7	612	775	M6.B.2.1.1	Measure.
602175	6	Grade 6 to Grade 7	614	773	M6.A.3.2.1	Numbers & Op.
601044	6	Grade 6 to Grade 7	1210	773	M6.D.2.2.1	Alg. Con.
601694	6	Grade 6 to Grade 7	1211	773	M6.C.1.1.2	Geo.
602088	6	Grade 6 to Grade 7	1226	772	M6.B.2.2.1	Measure.
601702	6	Grade 6 to Grade 7	605	771	M6.C.1.2.2	Geo.
601287	7	Grade 6 to Grade 7	1222	395	M7.D.2.1.1	Alg. Con.
601050	7	Grade 6 to Grade 7	1223	399	M7.E.2.1.1	Data & Prob.
601772	7	Grade 6 to Grade 7	1222	793	M7.D.1.1.1	Alg. Con.
602215	7	Grade 6 to Grade 7	1222	765	M7.B.2.1.3	Measure.
601132	7	Grade 6 to Grade 7	1221	764	M7.E.4.1.1	Data & Prob.
599720	7	Grade 6 to Grade 7	1221	757	M7.A.2.1.1	Numbers & Op.
602190	7	Grade 6 to Grade 7	1219	788	M7.B.1.1.1	Measure.

**Table C–4 (continued). Mathematics Items Used to Link Grade 6 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601273	7	Grade 6 to Grade 7	1215	762	M7.D.2.2.1	Alg. Con.
599734	7	Grade 6 to Grade 7	1215	792	M7.A.1.2.1	Numbers & Op.
601784	7	Grade 6 to Grade 7	1216	373	M7.C.1.1.2	Geo.
601278	7	Grade 6 to Grade 7	1213	401	M7.D.3.1.1	Alg. Con.
601704	7	Grade 6 to Grade 7	1214	788	M7.C.3.1.1	Geo.
602189	7	Grade 6 to Grade 7	1212	780	M7.A.3.2.2	Numbers & Op.
601123	7	Grade 6 to Grade 7	1209	385	M7.E.3.1.1	Data & Prob.
599633	7	Grade 6 to Grade 7	1209	797	M7.A.2.2.4	Numbers & Op.
601099	7	Grade 6 to Grade 7	1218	777	M7.E.1.1.1	Data & Prob.
599685	7	Grade 6 to Grade 7	1214	400	M7.A.2.2.2	Numbers & Op.
601124	7	Grade 6 to Grade 7	1216	785	M7.E.3.1.2	Data & Prob.
602193	7	Grade 6 to Grade 7	1214	792	M7.B.2.1.1	Measure.
601827	7	Grade 6 to Grade 7	1211	772	M7.C.1.1.3	Geo.
601067	7	Grade 6 to Grade 7	1208	781	M7.D.2.1.1	Alg. Con.
601379	7	Grade 6 to Grade 7	1212	793	M7.E.2.1.2	Data & Prob.
599708	7	Grade 6 to Grade 7	1206	563	M7.A.1.1.1	Numbers & Op.
601771	7	Grade 6 to Grade 7	1202	767	M7.D.1.1.1	Alg. Con.
601271	7	Grade 6 to Grade 7	1206	761	M7.D.2.2.1	Alg. Con.
599715	7	Grade 6 to Grade 7	1206	781	M7.A.1.2.2	Numbers & Op.
599650	7	Grade 6 to Grade 7	1193	798	M7.A.3.2.1	Numbers & Op.
602180	7	Grade 6 to Grade 7	1199	789	M7.B.1.1.1	Measure.
601355	7	Grade 6 to Grade 7	1190	399	M7.D.3.1.1	Alg. Con.
602202	7	Grade 6 to Grade 7	1194	795	M7.C.1.1.1	Geo.

**Table C–5. Mathematics Items Used to Link Grade 8 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601054	7	Grade 8 to Grade 7	745	312	M7.E.3.1.1	Data & Prob.
601365	7	Grade 8 to Grade 7	746	312	M7.D.3.1.1	Alg. Con.
601117	7	Grade 8 to Grade 7	747	311	M7.E.1.1.1	Data & Prob.
601835	7	Grade 8 to Grade 7	748	310	M7.C.1.1.3	Geo.
601677	7	Grade 8 to Grade 7	749	312	M7.C.1.2.2	Geo.
602155	7	Grade 8 to Grade 7	750	312	M7.A.3.2.2	Numbers & Op.
602142	7	Grade 8 to Grade 7	751	312	M7.B.2.1.3	Measure.
601300	7	Grade 8 to Grade 7	752	312	M7.D.2.1.2	Alg. Con.
601130	7	Grade 8 to Grade 7	753	312	M7.E.3.1.3	Data & Prob.
599682	7	Grade 8 to Grade 7	754	311	M7.A.2.2.1	Numbers & Op.
602144	7	Grade 8 to Grade 7	755	309	M7.B.2.2.2	Measure.
599732	7	Grade 8 to Grade 7	756	309	M7.A.2.2.6	Numbers & Op.
599727	7	Grade 8 to Grade 7	757	309	M7.A.1.2.1	Numbers & Op.
599686	7	Grade 8 to Grade 7	758	309	M7.A.2.2.3	Numbers & Op.
601687	7	Grade 8 to Grade 7	759	307	M7.C.3.1.2	Geo.
601218	7	Grade 8 to Grade 7	760	315	M7.C.3.1.1	Geo.
599722	7	Grade 8 to Grade 7	761	314	M7.A.2.1.1	Numbers & Op.
599684	7	Grade 8 to Grade 7	762	313	M7.A.2.2.2	Numbers & Op.
602141	7	Grade 8 to Grade 7	763	311	M7.B.2.1.2	Measure.
601051	7	Grade 8 to Grade 7	764	314	M7.E.2.1.2	Data & Prob.
599712	7	Grade 8 to Grade 7	765	314	M7.A.3.2.1	Numbers & Op.
602234	7	Grade 8 to Grade 7	766	314	M7.C.1.1.1	Geo.
602146	7	Grade 8 to Grade 7	767	314	M7.C.1.2.1	Geo.
601773	7	Grade 8 to Grade 7	768	313	M7.D.2.1.1	Alg. Con.
599711	7	Grade 8 to Grade 7	769	313	M7.A.2.2.5	Numbers & Op.
602143	7	Grade 8 to Grade 7	770	313	M7.B.2.2.1	Measure.
601110	7	Grade 8 to Grade 7	771	313	M7.E.3.1.2	Data & Prob.
601272	7	Grade 8 to Grade 7	772	312	M7.D.2.2.1	Alg. Con.
601357	7	Grade 8 to Grade 7	773	313	M7.D.3.1.2	Alg. Con.
601086	7	Grade 8 to Grade 7	774	313	M7.E.4.1.1	Data & Prob.
601263	8	Grade 8 to Grade 7	775	309	M8.C.3.1.1	Geo.
601757	8	Grade 8 to Grade 7	776	158	M8.D.1.1.2	Alg. Con.
601069	8	Grade 8 to Grade 7	777	308	M8.E.4.1.2	Data & Prob.
599651	8	Grade 8 to Grade 7	778	318	M8.A.3.1.2	Numbers & Op.
601073	8	Grade 8 to Grade 7	779	314	M8.D.2.1.3	Alg. Con.
601801	8	Grade 8 to Grade 7	780	154	M8.B.1.1.1	Measure.
599610	8	Grade 8 to Grade 7	781	160	M8.A.2.1.1	Numbers & Op.



**Table C–5 (continued). Mathematics Items Used to Link Grade 8 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category
601097	8	Grade 8 to Grade 7	782	159	M8.E.1.1.1	Data & Prob.
601725	8	Grade 8 to Grade 7	783	316	M8.B.1.1.3	Measure.
601744	8	Grade 8 to Grade 7	784	157	M8.B.2.2.3	Measure.
601288	8	Grade 8 to Grade 7	785	157	M8.D.2.1.1	Alg. Con.
601247	8	Grade 8 to Grade 7	786	312	M8.D.2.2.2	Alg. Con.
599698	8	Grade 8 to Grade 7	787	156	M8.A.2.2.2	Numbers & Op.
601763	8	Grade 8 to Grade 7	788	306	M8.D.4.1.2	Alg. Con.
601090	8	Grade 8 to Grade 7	789	154	M8.E.1.1.3	Data & Prob.
601804	8	Grade 8 to Grade 7	790	318	M8.B.1.1.4	Measure.
599640	8	Grade 8 to Grade 7	791	311	M8.A.3.1.1	Numbers & Op.
602158	8	Grade 8 to Grade 7	792	310	M8.B.1.1.2	Measure.
602072	8	Grade 8 to Grade 7	793	315	M8.D.1.1.1	Alg. Con.
601707	8	Grade 8 to Grade 7	794	317	M8.D.1.1.3	Alg. Con.
601332	8	Grade 8 to Grade 7	795	312	M8.D.2.1.2	Alg. Con.
599613	8	Grade 8 to Grade 7	796	317	M8.A.2.2.1	Numbers & Op.
601675	8	Grade 8 to Grade 7	797	317	M8.D.4.1.3	Alg. Con.
601100	8	Grade 8 to Grade 7	798	157	M8.E.3.1.1	Data & Prob.
599583	8	Grade 8 to Grade 7	799	636	M8.A.1.1.1	Numbers & Op.
601340	8	Grade 8 to Grade 7	800	156	M8.D.2.2.1	Alg. Con.
601344	8	Grade 8 to Grade 7	801	321	M8.D.4.1.1	Alg. Con.
600990	8	Grade 8 to Grade 7	802	306	M8.E.1.1.2	Data & Prob.
599645	8	Grade 8 to Grade 7	803	160	M8.A.3.3.1	Numbers & Op.
602058	8	Grade 8 to Grade 7	804	307	M8.C.1.1.1	Geo.

**Table C–6. Mathematics Items Used to Link Algebra I to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Algebra I Diagnostic Category
601121	8	Algebra I to Grade 8	316	1400	M8.A.3.3.1	Numbers & Op.	Op. with Real Num.
601102	8	Algebra I to Grade 8	310	1406	M8.E.3.1.1	Data & Prob.	Data Anal.
601360	8	Algebra I to Grade 8	155	1403	M8.D.4.1.1	Alg. Con.	Functions & Geo.
601764	8	Algebra I to Grade 8	316	1396	M8.D.4.1.3	Alg. Con.	Functions & Geo.
602052	8	Algebra I to Grade 8	318	1396	M8.D.1.1.3	Alg. Con.	Functions & Geo.
599639	8	Algebra I to Grade 8	154	1391	M8.A.3.1.1	Numbers & Op.	Op. with Real Num.
602065	8	Algebra I to Grade 8	156	1376	M8.D.1.1.1	Alg. Con.	Functions & Geo.
601346	8	Algebra I to Grade 8	306	1390	M8.D.2.2.2	Alg. Con.	Linear Eq.
599582	8	Algebra I to Grade 8	625	1387	M8.A.1.1.1	Numbers & Op.	Op. with Real Num.
599697	8	Algebra I to Grade 8	314	1377	M8.A.2.2.1	Numbers & Op.	Op. with Real Num.
600980	8	Algebra I to Grade 8	318	1376	M8.D.2.1.3	Alg. Con.	Linear Eq.
601127	8	Algebra I to Grade 8	158	1376	M8.E.4.1.1	Data & Prob.	Data Anal.
601776	8	Algebra I to Grade 8	311	1370	M8.D.4.1.2	Alg. Con.	Functions & Geo.
601092	8	Algebra I to Grade 8	306	1362	M8.E.1.1.2	Data & Prob.	Data Anal.
601232	8	Algebra I to Grade 8	151	1359	M8.D.2.1.1	Alg. Con.	Linear Eq.
601348	8	Algebra I to Grade 8	311	1402	M8.D.2.2.1	Alg. Con.	Linear Eq.
601777	8	Algebra I to Grade 8	307	1401	M8.D.4.1.3	Alg. Con.	Functions & Geo.
599619	8	Algebra I to Grade 8	314	1388	M8.A.2.2.2	Numbers & Op.	Op. with Real Num.
601222	8	Algebra I to Grade 8	311	1389	M8.C.3.1.1	Geo.	None
601384	8	Algebra I to Grade 8	317	1388	M8.D.4.1.1	Alg. Con.	Functions & Geo.
601091	8	Algebra I to Grade 8	314	1390	M8.E.1.1.3	Data & Prob.	Data Anal.
599585	8	Algebra I to Grade 8	310	1377	M8.A.2.1.1	Numbers & Op.	Op. with Real Num.
599637	8	Algebra I to Grade 8	308	1380	M8.A.3.1.2	Numbers & Op.	Op. with Real Num.
601231	8	Algebra I to Grade 8	313	1374	M8.D.2.1.1	Alg. Con.	Linear Eq.
601663	8	Algebra I to Grade 8	155	1368	M8.D.1.1.2	Alg. Con.	Functions & Geo.
601126	8	Algebra I to Grade 8	308	1370	M8.E.4.1.2	Data & Prob.	Data Anal.
601089	8	Algebra I to Grade 8	151	1357	M8.E.1.1.2	Data & Prob.	Data Anal.
601234	8	Algebra I to Grade 8	303	1356	M8.D.2.1.2	Alg. Con.	Linear Eq.
601775	8	Algebra I to Grade 8	312	1349	M8.D.4.1.2	Alg. Con.	Functions & Geo.
601103	8	Algebra I to Grade 8	319	1344	M8.E.3.2.1	Data & Prob.	Data Anal.
602259	11	Algebra I to Grade 8	312	714	M11.E.2.1.3	Data & Prob.	Data Anal.
604952	11	Algebra I to Grade 8	312	710	M11.E.4.1.2	Data & Prob.	Data Anal.
601837	A1	Algebra I to Grade 8	312	700	A1.2.2.1.1	Alg. Con.	Functions & Geo.
602184	A1	Algebra I to Grade 8	313	1421	A1.2.1.1.1	Alg. Con.	Functions & Geo.
601554	11	Algebra I to Grade 8	313	711	M11.E.2.1.3	Data & Prob.	Data Anal.
602171	A1	Algebra I to Grade 8	309	1382	A1.2.1.2.2	Alg. Con.	Functions & Geo.
601841	A1	Algebra I to Grade 8	313	1383	A1.2.2.1.2	Alg. Con.	Functions & Geo.

**Table C–6 (continued). Mathematics Items Used to Link Algebra I to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Algebra I Diagnostic Category
604806	11	Algebra I to Grade 8	312	710	M11.E.4.1.2	Data & Prob.	Data Anal.
600839	11	Algebra I to Grade 8	313	713	M11.E.1.1.1	Data & Prob.	Data Anal.
601461	11	Algebra I to Grade 8	313	711	M11.E.1.1.1	Data & Prob.	Data Anal.
604804	11	Algebra I to Grade 8	313	705	M11.E.2.1.3	Data & Prob.	Data Anal.
602241	A1	Algebra I to Grade 8	312	1420	A1.2.1.2.1	Alg. Con.	Functions & Geo.
601793	A1	Algebra I to Grade 8	313	1425	A1.2.2.1.4	Alg. Con.	Functions & Geo.
602159	A1	Algebra I to Grade 8	312	1416	A1.2.2.2.1	Alg. Con.	Functions & Geo.
602274	11	Algebra I to Grade 8	312	713	M11.E.4.1.2	Data & Prob.	Data Anal.
601135	A1	Algebra I to Grade 8	315	1418	A1.2.3.3.1	Data & Prob.	Data Anal.
601144	A1	Algebra I to Grade 8	317	1415	A1.1.2.1.3	Alg. Con.	Linear Eq.
600842	11	Algebra I to Grade 8	316	717	M11.A.2.1.3	Numbers & Op.	Op. with Real Num.
601370	A1	Algebra I to Grade 8	314	1364	A1.1.3.1.3	Alg. Con.	Linear Eq.
600646	11	Algebra I to Grade 8	315	710	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601630	11	Algebra I to Grade 8	314	718	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601138	A1	Algebra I to Grade 8	313	1378	A1.2.3.2.1	Data & Prob.	Data Anal.
601139	A1	Algebra I to Grade 8	310	1413	A1.2.3.2.2	Data & Prob.	Data Anal.
600826	11	Algebra I to Grade 8	311	716	M11.A.3.1.1	Numbers & Op.	Op. with Real Num.
601140	A1	Algebra I to Grade 8	310	1408	A1.2.3.2.3	Data & Prob.	Data Anal.
600930	A1	Algebra I to Grade 8	311	707	A1.1.1.4.1	Numbers & Op.	Op. with Real Num.
602260	11	Algebra I to Grade 8	312	717	M11.A.2.1.1	Numbers & Op.	Op. with Real Num.
600931	A1	Algebra I to Grade 8	310	1375	A1.1.1.5.1	Alg. Con.	Op. with Real Num.
602644	11	Algebra I to Grade 8	311	714	M11.A.2.1.1	Numbers & Op.	Op. with Real Num.
604162	11	Algebra I to Grade 8	310	714	M11.A.2.1.2	Numbers & Op.	Op. with Real Num.

**Table C–7. Mathematics Items Used to Link Geometry to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Geometry Diagnostic Category
601740	8	Geometry to Grade 8	306	1052	M8.B.2.1.3	Measure.	Measure.
602118	8	Geometry to Grade 8	319	1049	M8.B.2.2.1	Measure.	Measure.
602056	8	Geometry to Grade 8	306	1052	M8.C.1.1.2	Geo.	Geo. Prop.
602059	8	Geometry to Grade 8	156	1052	M8.C.1.1.2	Geo.	Geo. Prop.
601733	8	Geometry to Grade 8	151	1039	M8.B.2.1.1	Measure.	Measure.
602133	8	Geometry to Grade 8	320	1049	M8.C.1.1.3	Geo.	Geo. Prop.
602117	8	Geometry to Grade 8	151	1046	M8.B.2.2.2	Measure.	Measure.
602128	8	Geometry to Grade 8	312	1047	M8.C.1.1.1	Geo.	Geo. Prop.
601802	8	Geometry to Grade 8	319	1047	M8.B.1.1.3	Measure.	None
602205	8	Geometry to Grade 8	318	1047	M8.C.1.1.1	Geo.	Geo. Prop.
601723	8	Geometry to Grade 8	306	1037	M8.B.1.1.1	Measure.	None
602208	8	Geometry to Grade 8	317	1043	M8.C.1.1.3	Geo.	Geo. Prop.
601326	8	Geometry to Grade 8	317	1038	M8.C.1.2.1	Geo.	Coord. Geo.
601338	8	Geometry to Grade 8	311	1038	M8.C.3.1.1	Geo.	Coord. Geo.
601371	8	Geometry to Grade 8	316	1031	M8.C.3.1.1	Geo.	Coord. Geo.
601736	8	Geometry to Grade 8	316	1048	M8.B.2.1.2	Measure.	Measure.
602136	8	Geometry to Grade 8	316	1034	M8.C.1.2.1	Geo.	Coord. Geo.
601755	8	Geometry to Grade 8	306	1039	M8.C.1.2.1	Geo.	Coord. Geo.
601372	8	Geometry to Grade 8	316	1037	M8.C.3.1.1	Geo.	Coord. Geo.
601782	8	Geometry to Grade 8	156	1028	M8.B.1.1.4	Measure.	None
602204	8	Geometry to Grade 8	308	1039	M8.C.1.1.1	Geo.	Geo. Prop.
602131	8	Geometry to Grade 8	317	1037	M8.C.1.1.2	Geo.	Geo. Prop.
602061	8	Geometry to Grade 8	314	1035	M8.C.1.1.2	Geo.	Geo. Prop.
602115	8	Geometry to Grade 8	317	1029	M8.B.2.2.2	Measure.	Measure.
602087	8	Geometry to Grade 8	312	1034	M8.C.1.1.3	Geo.	Geo. Prop.
602212	8	Geometry to Grade 8	319	1030	M8.C.1.1.3	Geo.	Geo. Prop.
601724	8	Geometry to Grade 8	310	1023	M8.B.1.1.2	Measure.	None
602113	8	Geometry to Grade 8	315	1023	M8.B.2.2.1	Measure.	Measure.
601329	8	Geometry to Grade 8	302	1031	M8.C.3.1.1	Geo.	Coord. Geo.
601743	8	Geometry to Grade 8	305	1029	M8.B.2.2.3	Measure.	Measure.
602661	11	Geometry to Grade 8	316	531	M11.B.2.1.1	Measure.	Measure.
604163	11	Geometry to Grade 8	317	531	M11.B.2.2.2	Measure.	Measure.
604671	GE	Geometry to Grade 8	311	1963	G.1.1.1.1	Geo.	Geo. Prop.
604400	GE	Geometry to Grade 8	316	992	G.1.3.1.1	Geo.	Congruence
604389	GE	Geometry to Grade 8	316	1001	G.2.1.1.1	Geo.	Coord. Geo.
604799	11	Geometry to Grade 8	316	528	M11.B.2.3.1	Measure.	Measure.
604418	GE	Geometry to Grade 8	312	478	G.1.2.1.4	Geo.	Geo. Prop.

**Table C–7 (continued). Mathematics Items Used to Link Geometry to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Mathematics Diagnostic Category	Geometry Diagnostic Category
600651	11	Geometry to Grade 8	315	531	M11.B.2.2.4	Measure.	Measure.
604707	GE	Geometry to Grade 8	314	1053	G.1.2.1.5	Geo.	Geo. Prop.
604180	11	Geometry to Grade 8	316	528	M11.B.2.2.3	Measure.	Measure.
604378	GE	Geometry to Grade 8	316	1048	G.2.2.1.1	Geo.	Measure.
601544	11	Geometry to Grade 8	316	532	M11.B.2.1.1	Measure.	Measure.
600749	11	Geometry to Grade 8	314	531	M11.B.2.2.4	Measure.	Measure.
604392	GE	Geometry to Grade 8	315	1053	G.1.1.1.4	Geo.	Geo. Prop.
604395	GE	Geometry to Grade 8	314	1024	G.1.3.1.2	Geo.	Congruence
604178	11	Geometry to Grade 8	315	531	M11.C.1.3.1	Geo.	Congruence
600785	11	Geometry to Grade 8	315	530	M11.C.1.2.2	Geo.	Geo. Prop.
604522	11	Geometry to Grade 8	313	533	M11.C.1.4.1	Geo.	Coor. Geo.
604763	GE	Geometry to Grade 8	308	503	G.2.2.2.1	Geo.	Measure.
602650	11	Geometry to Grade 8	313	530	M11.C.1.3.1	Geo.	Congruence
604474	GE	Geometry to Grade 8	313	988	G.2.2.1.2	Geo.	Measure.
604600	GE	Geometry to Grade 8	310	1053	G.2.2.2.4	Geo.	Measure.
604361	GE	Geometry to Grade 8	312	525	G.2.3.2.1	Geo.	Measure.
601550	11	Geometry to Grade 8	311	530	M11.C.1.2.3	Geo.	Geo. Prop.
604360	GE	Geometry to Grade 8	309	1042	G.2.3.1.3	Geo.	Measure.
604170	11	Geometry to Grade 8	309	528	M11.C.1.4.1	Geo.	Coor. Geo.
604354	GE	Geometry to Grade 8	306	1007	G.2.2.3.1	Geo.	Measure.
601549	11	Geometry to Grade 8	306	530	M11.C.1.2.3	Geo.	Geo. Prop.
602268	11	Geometry to Grade 8	305	527	M11.C.1.3.1	Geo.	Congruence
604453	GE	Geometry to Grade 8	304	955	G.2.2.2.2	Geo.	Measure.

**Table C–8. Mathematics Items Used to Link Algebra II to Algebra I**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Algebra I Diagnostic Category	Algebra II Diagnostic Category
602167	A1	Algebra II to Algebra I	701	949	A1.1.3.2.1	Linear Eq.	Non-linear
601423	A1	Algebra II to Algebra I	709	951	A1.1.2.1.3	Linear Eq.	Non-linear
602188	A1	Algebra II to Algebra I	708	943	A1.2.2.1.4	Functions & Geo.	Functions
600971	A1	Algebra II to Algebra I	1407	944	A1.1.1.5.1	Op. with Real Num.	Non-linear
601180	A1	Algebra II to Algebra I	1372	948	A1.1.2.1.1	Linear Eq.	Non-linear
601854	A1	Algebra II to Algebra I	670	937	A1.1.2.2.2	Linear Eq.	Non-linear
602253	A1	Algebra II to Algebra I	705	939	A1.2.2.1.2	Functions & Geo.	Functions
601419	A1	Algebra II to Algebra I	693	941	A1.1.3.1.2	Linear Eq.	Non-linear
602251	A1	Algebra II to Algebra I	1371	942	A1.2.1.2.2	Functions & Geo.	Functions
601176	A1	Algebra II to Algebra I	676	941	A1.2.3.2.3	Data Anal.	Data Anal.
600928	A1	Algebra II to Algebra I	1405	935	A1.1.1.2.1	Op. with Real Num.	Non-linear
600926	A1	Algebra II to Algebra I	2816	940	A1.1.1.1.1	Op. with Real Num.	Non-linear
602237	A1	Algebra II to Algebra I	662	931	A1.2.1.1.1	Functions & Geo.	Functions
601394	A1	Algebra II to Algebra I	697	931	A1.2.1.1.3	Functions & Geo.	Functions
600973	A1	Algebra II to Algebra I	682	925	A1.1.1.5.3	Op. with Real Num.	Non-linear
601397	A1	Algebra II to Algebra I	1378	943	A1.1.3.1.1	Linear Eq.	Non-linear
601368	A1	Algebra II to Algebra I	1374	948	A1.1.3.1.3	Linear Eq.	Non-linear
601136	A1	Algebra II to Algebra I	709	942	A1.1.2.1.2	Linear Eq.	Non-linear
601836	A1	Algebra II to Algebra I	713	946	A1.2.2.1.1	Functions & Geo.	Functions
601148	A1	Algebra II to Algebra I	1395	942	A1.2.3.3.1	Data Anal.	Data Anal.
602160	A1	Algebra II to Algebra I	1397	947	A1.2.2.2.1	Functions & Geo.	Functions
601813	A1	Algebra II to Algebra I	1424	941	A1.2.1.2.1	Functions & Geo.	Functions
601805	A1	Algebra II to Algebra I	1348	920	A1.2.2.1.3	Functions & Geo.	Functions
600953	A1	Algebra II to Algebra I	659	940	A1.1.1.1.2	Op. with Real Num.	Non-linear
600932	A1	Algebra II to Algebra I	1411	941	A1.1.1.5.2	Op. with Real Num.	Non-linear
601398	A1	Algebra II to Algebra I	1410	931	A1.1.2.2.1	Linear Eq.	Non-linear
600948	A1	Algebra II to Algebra I	1387	920	A1.2.3.1.1	Data Anal.	Data Anal.
600966	A1	Algebra II to Algebra I	1395	912	A1.1.1.3.1	Op. with Real Num.	Non-linear
602154	A1	Algebra II to Algebra I	1387	918	A1.1.3.2.2	Linear Eq.	Non-linear
601380	A1	Algebra II to Algebra I	1392	915	A1.2.1.1.2	Functions & Geo.	Functions
604700	A2	Algebra II to Algebra I	1406	927	A2.2.1.1.1	Functions & Geo.	Functions
603013	A2	Algebra II to Algebra I	1406	957	A2.1.3.1.4	Linear Eq.	Non-linear
604570	A2	Algebra II to Algebra I	1386	462	A2.2.2.1.3	Functions & Geo.	Functions
603086	A2	Algebra II to Algebra I	1400	914	A2.1.2.1.4	Op. with Real Num.	Non-linear
604625	A2	Algebra II to Algebra I	1380	948	A2.2.1.1.3	Functions & Geo.	Functions
604530	A2	Algebra II to Algebra I	1380	935	A2.1.3.2.2	Linear Eq.	Non-linear
604686	A2	Algebra II to Algebra I	1379	446	A2.2.2.2.1	Functions & Geo.	Functions

**Table C–8 (continued). Mathematics Items Used to Link Algebra II to Algebra I**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Algebra I Diagnostic Category	Algebra II Diagnostic Category
603043	A2	Algebra II to Algebra I	1383	932	A2.1.2.1.2	Op. with Real Num.	Non-linear
603037	A2	Algebra II to Algebra I	1366	950	A2.2.1.1.4	Functions & Geo.	Functions
604572	A2	Algebra II to Algebra I	1377	453	A2.2.2.1.4	Functions & Geo.	Functions
603000	A2	Algebra II to Algebra I	1372	471	A2.1.2.2.2	Op. with Real Num.	Non-linear
604537	A2	Algebra II to Algebra I	1373	908	A2.2.1.1.2	Functions & Geo.	Functions
604634	A2	Algebra II to Algebra I	1369	472	A2.2.3.2.3	Data Anal.	Data Anal.
603106	A2	Algebra II to Algebra I	1360	898	A2.2.3.1.2	Data Anal.	Data Anal.
603057	A2	Algebra II to Algebra I	1351	456	A2.2.3.2.1	Data Anal.	Data Anal.
603055	A2	Algebra II to Algebra I	1397	919	A2.2.3.1.1	Data Anal.	Data Anal.
603018	A2	Algebra II to Algebra I	1408	937	A2.1.2.2.1	Op. with Real Num.	Non-linear
604685	A2	Algebra II to Algebra I	1404	476	A2.2.2.2.1	Functions & Geo.	Functions
603126	A2	Algebra II to Algebra I	1396	474	A2.2.3.2.3	Data Anal.	Data Anal.
604539	A2	Algebra II to Algebra I	1395	941	A2.1.3.2.1	Linear Eq.	Non-linear
604540	A2	Algebra II to Algebra I	1382	889	A2.1.3.2.2	Linear Eq.	Non-linear
604703	A2	Algebra II to Algebra I	1397	479	A2.2.1.1.1	Functions & Geo.	Functions
604629	A2	Algebra II to Algebra I	1387	902	A2.2.2.1.1	Functions & Geo.	Functions
603056	A2	Algebra II to Algebra I	1390	928	A2.2.3.2.1	Data Anal.	Data Anal.
603003	A2	Algebra II to Algebra I	1376	473	A2.1.3.1.2	Linear Eq.	Non-linear
604550	A2	Algebra II to Algebra I	1369	939	A2.2.2.1.4	Functions & Geo.	Functions
603098	A2	Algebra II to Algebra I	1374	944	A2.1.2.1.3	Op. with Real Num.	Non-linear
604544	A2	Algebra II to Algebra I	1370	461	A2.2.1.1.2	Functions & Geo.	Functions
604627	A2	Algebra II to Algebra I	1363	953	A2.2.1.1.3	Functions & Geo.	Functions
603042	A2	Algebra II to Algebra I	1368	936	A2.1.2.1.1	Op. with Real Num.	Non-linear

Tables C–9 through C–16 summarize the number of linking items by diagnostic category. Items coded in a Mathematics diagnostic category and an Algebra I, Geometry, or Algebra II diagnostic category are noted.

**Table C–9. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category**

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Numbers & Operations	8	6	14
Measurement	5	4	9
Geometry	2	4	6
Algebraic Concepts	3	3	6
Data Analysis & Probability	2	3	5
TOTAL	20	20	40

**Table C–10. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category**

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Numbers & Operations	6	7	13
Measurement	3	4	7
Geometry	4	3	7
Algebraic Concepts	3	3	6
Data Analysis & Probability	4	3	7
TOTAL	20	20	40

**Table C–11. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category**

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Numbers & Operations	10	4	14
Measurement	6	4	10
Geometry	5	3	8
Algebraic Concepts	4	4	8
Data Analysis & Probability	5	5	10
TOTAL	30	20	50

**Table C–12. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category**

Diagnostic Category	Grade 6 Items	Grade 7 Items	Total
Numbers & Operations	8	8	16
Measurement	5	4	9
Geometry	6	4	10
Algebraic Concepts	5	8	13
Data Analysis & Probability	6	6	12
TOTAL	30	30	60



**Table C–13. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category**

Diagnostic Category	Grade 7 Items	Grade 8 Items	Total
Numbers & Operations	9	7	16
Measurement	4	5	9
Geometry	6	2	8
Algebraic Concepts	5	11	16
Data Analysis & Probability	6	5	11
TOTAL	30	30	60

**Table C–14a. Number of Items Linking Algebra I to Grade 8 by Diagnostic Category**

Diagnostic Category	Grade 8 Items	Algebra I Items	Total
Numbers & Operations	7	8	15
Measurement	0	0	0
Geometry	1	0	1
Algebraic Concepts	15	10	25
Data Analysis & Probability	7	12	19
No Grade 8 DC	0	0	0
TOTAL	30	30	60

**Table C–14b. Number of Items Linking Algebra I to Grade 8 by Diagnostic Category**

Diagnostic Category	Grade 8 Items	Algebra I Items	Total
Operations with Real Numbers	7	9	16
Linear Equations	6	2	8
Functions	9	7	16
Data Analysis	7	12	19
No Algebra I DC	1	0	1
TOTAL	30	30	60

**Table C–15a. Number of Items Linking Geometry to Grade 8 by Diagnostic Category**

Diagnostic Category	Grade 8 Items	Geometry Items	Total
Numbers & Operations	0	0	0
Measurement	12	0	12
Geometry	18	30	48
Algebraic Concepts	0	0	0
Data Analysis & Probability	0	0	0
No Grade 8 DC	0	0	0
TOTAL	30	30	60

**Table C–15b. Number of Items Linking Geometry to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Geometry Items</b>	<b>Total</b>
Geometric Properties	11	8	19
Congruence	0	4	4
Coordinate	7	2	9
Measurement	8	16	24
No Geometry DC	4	0	4
<b>TOTAL</b>	<b>30</b>	<b>30</b>	<b>60</b>

**Table C–16a. Number of Items Linking Algebra II to Algebra I by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Algebra I Items</b>	<b>Algebra II Items</b>	<b>Total</b>
Operations with Real Numbers	7	6	13
Linear Equations	10	5	15
Functions	10	13	23
Data Analysis	3	6	9
No Algebra I DC	0	0	0
<b>TOTAL</b>	<b>30</b>	<b>30</b>	<b>60</b>

**Table C–16b. Number of Items Linking Algebra II to Algebra I by Diagnostic Category**

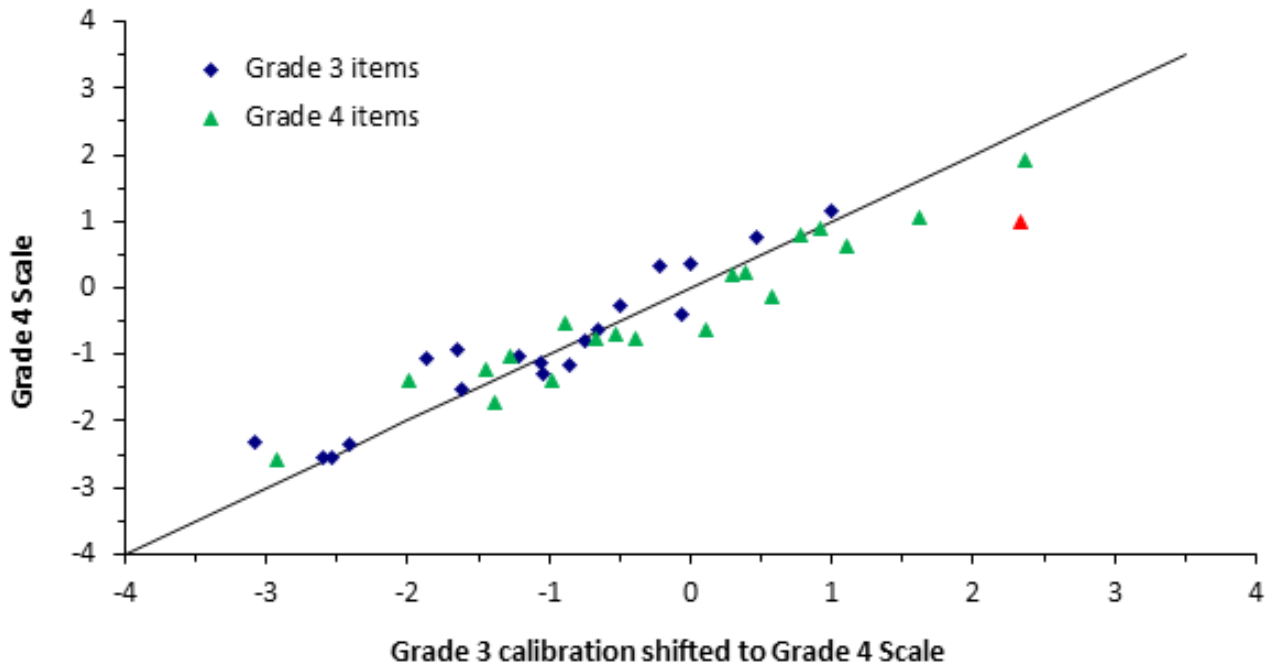
<b>Diagnostic Category</b>	<b>Algebra I Items</b>	<b>Algebra II Items</b>	<b>Total</b>
Op. with Complex Numbers	0	0	0
Non-linear	17	11	28
Functions	10	13	23
Data Analysis	3	6	9
No Algebra II DC	0	0	0
<b>TOTAL</b>	<b>30</b>	<b>30</b>	<b>60</b>

**Table C–17. Mathematics Example of Vertical Linking Workbook**

Item ID	Item Grade	Grade 4 Calibration			Grade 5 Calibration			Discrepancy	Grade 4 on	Grade 5 Scale	Robust Z	Flag
		Difficulty	Fit	Displace	Difficulty	Fit	Displace					
601646	4	-1.028	1.020	-0.006	-1.880	1.000	-0.004	-0.852	-1.650	-0.458		
601987	4	0.195	0.970	0.001	-0.384	0.930	0.000	-0.579	-0.427	0.205		
604493	4	0.784	1.030	0.000	0.204	1.010	0.000	-0.580	0.162	0.203		
601961	4	0.684	1.000	0.002	-0.469	0.910	0.000	-1.153	0.062	-1.189		
604499	4	-0.488	0.900	0.001	-0.492	0.910	0.000	-0.004	-1.110	1.601		
602889	4	-0.160	0.920	-0.002	-1.157	0.840	0.000	-0.997	-0.782	-0.810		
602885	4	0.112	1.200	0.003	0.051	1.220	0.000	-0.061	-0.510	1.463		
602887	4	-0.493	1.070	-0.002	-1.063	1.030	0.000	-0.570	-1.115	0.227		
601639	4	0.397	1.070	0.001	0.149	1.090	0.000	-0.248	-0.225	1.009		
604969	4	1.559	1.060	0.000	1.469	1.080	0.000	-0.090	0.937	1.393		
601994	4	0.257	0.950	0.000	0.100	1.090	0.000	-0.157	-0.365	1.230		
601998	4	-0.551	1.120	-0.001	-1.376	1.140	-0.004	-0.825	-1.173	-0.392		
602000	4	2.034	1.070	-0.006	1.248	1.060	-0.003	-0.786	1.412	-0.297		
601991	4	1.106	0.900	0.001	0.095	0.860	-0.003	-1.011	0.484	-0.844		
604879	4	-0.099	1.020	0.000	-1.101	0.870	-0.003	-1.002	-0.721	-0.822		
601964	4	1.069	1.020	0.001	0.154	1.010	-0.003	-0.915	0.447	-0.611		
602971	4	-0.355	1.000	0.000	-0.858	1.070	-0.003	-0.503	-0.977	0.390		
604486	4	-0.420	0.940	0.000	-0.749	0.970	-0.003	-0.329	-1.042	0.812		
604967	4	-1.495	0.900	0.001	-1.254	0.960	-0.003	0.241	-2.117	2.196	high robust Z	
602973	4	-0.035	0.940	0.003	0.362	1.220	-0.003	0.397	-0.657	2.575	high robust Z	
600853	5	0.883	1.100	0.004	-0.047	1.100	-0.003	-0.930	0.261	-0.647		
604790	5	-0.495	1.010	0.004	-1.082	0.970	0.000	-0.587	-1.117	0.186		
604956	5	1.299	0.870	0.004	0.590	0.820	-0.003	-0.709	0.677	-0.110		
604862	5	1.405	0.920	0.004	0.368	0.850	-0.003	-1.037	0.783	-0.907		
604783	5	0.764	0.970	0.004	-0.814	0.890	0.001	-1.578	0.142	-2.221	high robust Z	
606159	5	0.793	1.090	0.004	-0.157	0.990	-0.003	-0.950	0.171	-0.696		
604848	5	0.301	0.910	0.004	-0.707	1.020	0.001	-1.008	-0.321	-0.837		
604843	5	1.481	1.050	0.004	0.819	0.940	0.001	-0.662	0.859	0.004		
604966	5	-1.974	0.920	0.004	-3.190	0.870	-0.005	-1.216	-2.596	-1.342		
606163	5	0.780	1.130	0.004	0.478	1.200	0.002	-0.302	0.158	0.878		
601532	5	-0.368	0.950	0.000	-1.033	0.920	-0.001	-0.665	-0.990	-0.004		
606160	5	0.382	1.070	0.000	-0.313	0.940	-0.005	-0.695	-0.240	-0.076		
604960	5	0.618	0.910	0.000	0.223	1.050	0.000	-0.395	-0.004	0.652		
600852	5	0.753	1.100	0.000	0.050	1.020	0.002	-0.703	0.131	-0.096		
604834	5	-0.673	0.980	0.000	-1.151	0.980	-0.004	-0.478	-1.295	0.450		
604959	5	0.012	0.880	0.000	-0.871	0.840	-0.001	-0.883	-0.610	-0.533		
604961	5	0.141	1.000	0.000	-0.319	1.010	0.002	-0.460	-0.481	0.494		
606278	5	1.197	1.000	0.000	0.700	0.960	0.001	-0.497	0.575	0.404		
604965	5	-1.454	0.890	0.000	-1.565	0.900	-0.005	-0.111	-2.076	1.342		
604865	5	0.454	0.930	0.000	-0.537	0.910	-0.001	-0.991	-0.168	-0.795		
	<b>Mean</b>	0.234			-0.388			-0.622	-0.388	0.101		
	<b>SD</b>	0.887			0.893			0.413	0.887	1.002		
	<b>SD Ratio</b>	0.993										
	<b>Correlation</b>	0.892										
	<b>Add. Constant</b>	-0.622										
	<b>Median</b>							-0.664				
	<b>Q</b>							0.557				

Figures C-1 through C-8 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

**Figure C-1. CDT Mathematics: Grade 3 to Grade 4 Linking – All Links**



**Figure C-2. CDT Mathematics: Grade 4 to Grade 5 Linking – All Links**

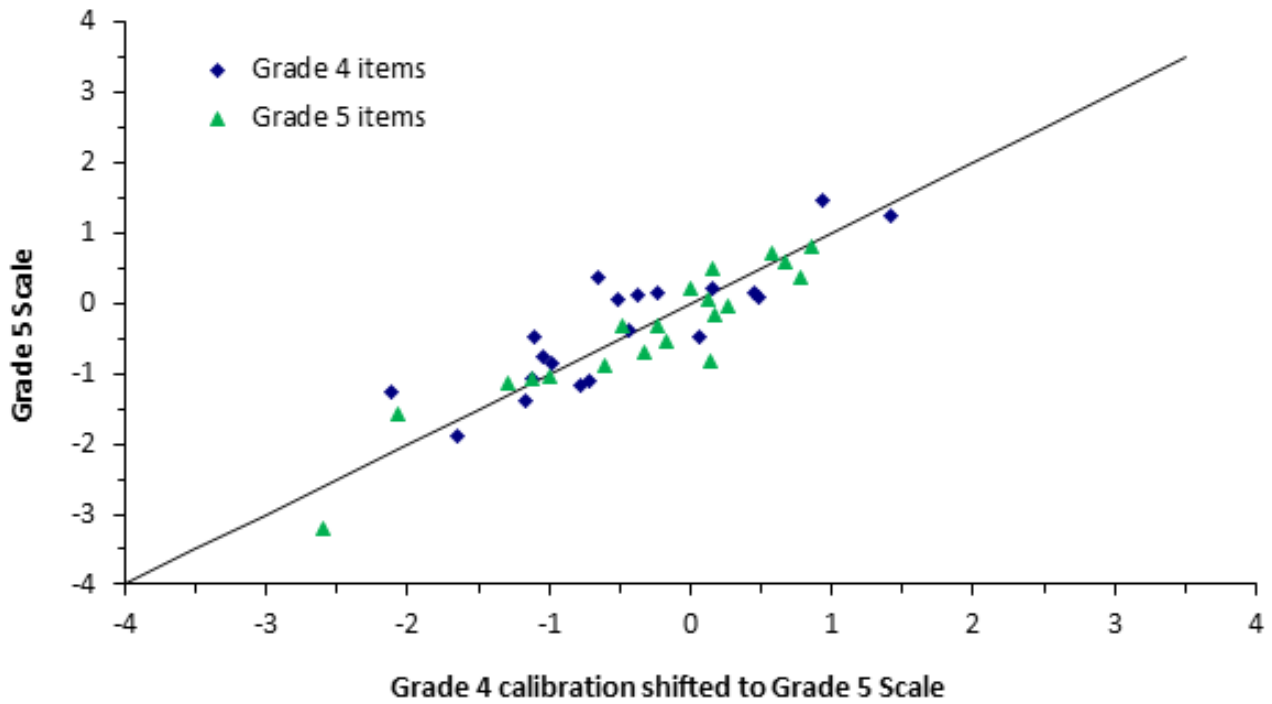


Figure C-3. CDT Mathematics: Grade 5 to Grade 6 Linking – All Links

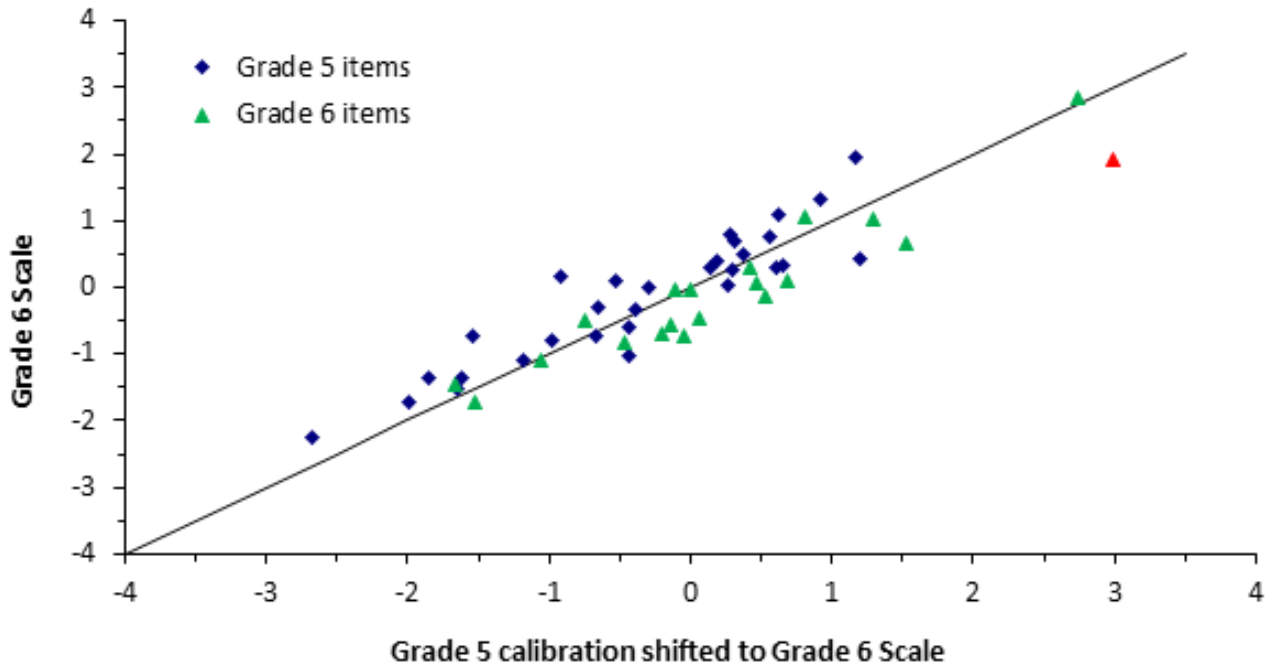


Figure C-4. CDT Mathematics: Grade 6 to Grade 7 Linking – All Links

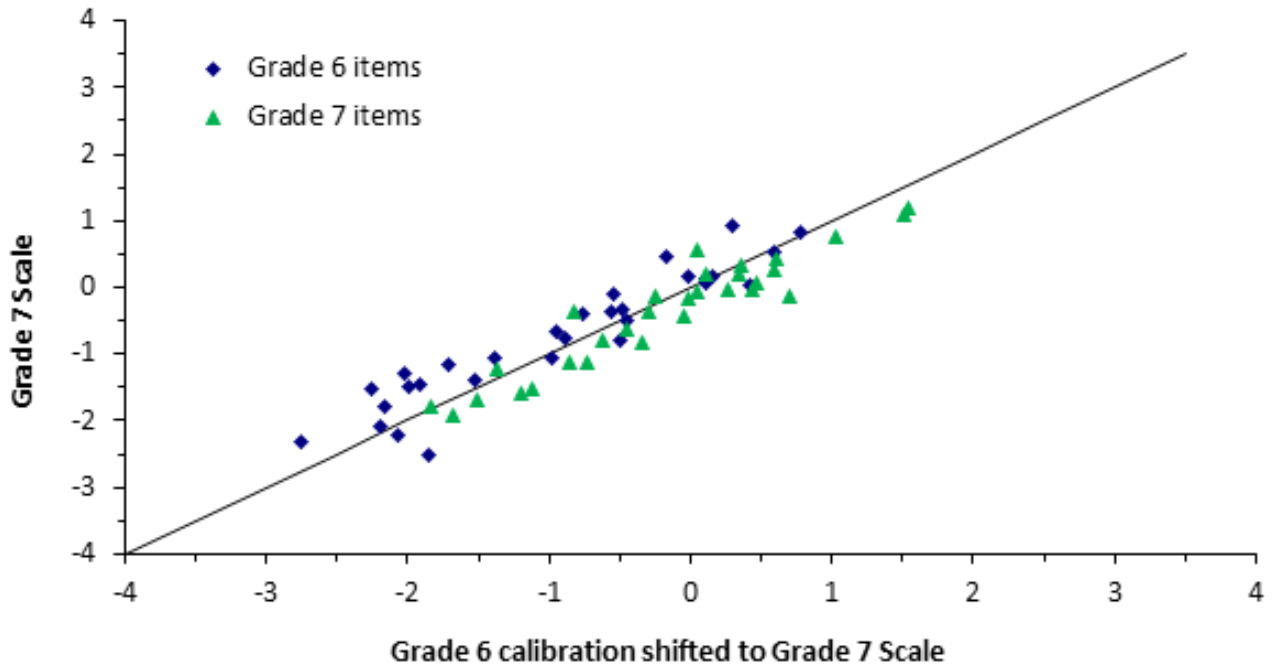


Figure C-5. CDT Mathematics: Grade 8 to Grade 7 Linking – All Links

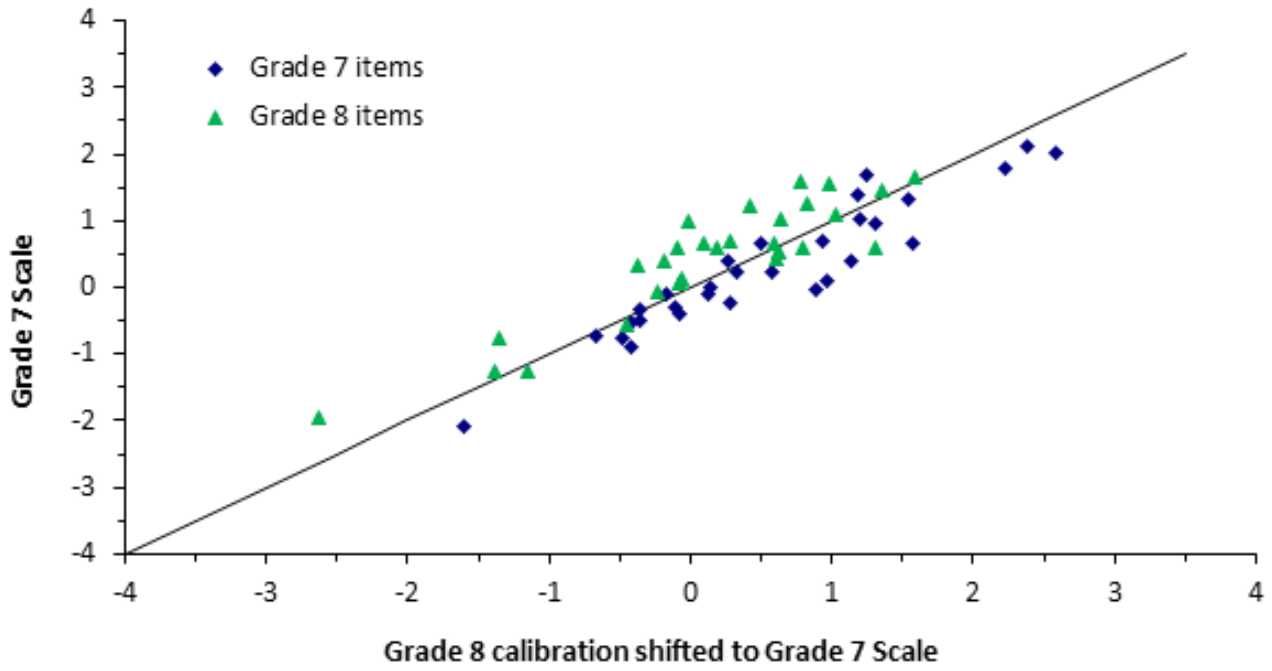


Figure C-6. CDT Mathematics: Algebra I to Grade 8 Linking – All Links

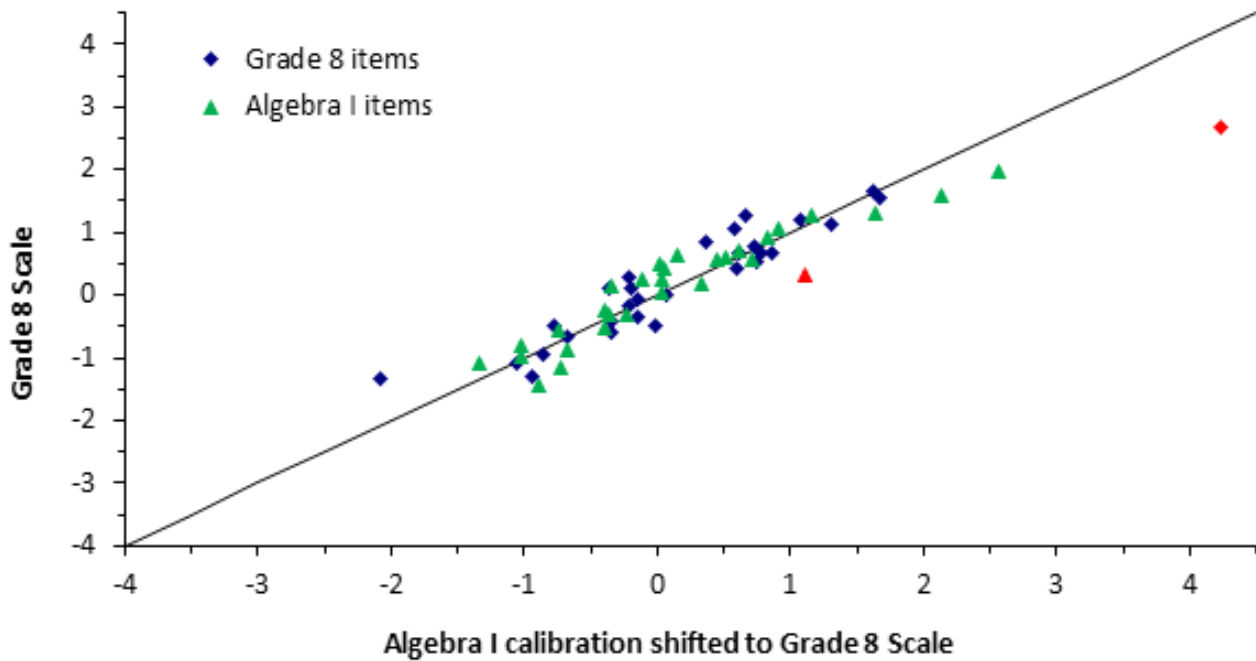


Figure C-7. CDT Mathematics: Geometry to Grade 8 Linking – All Links

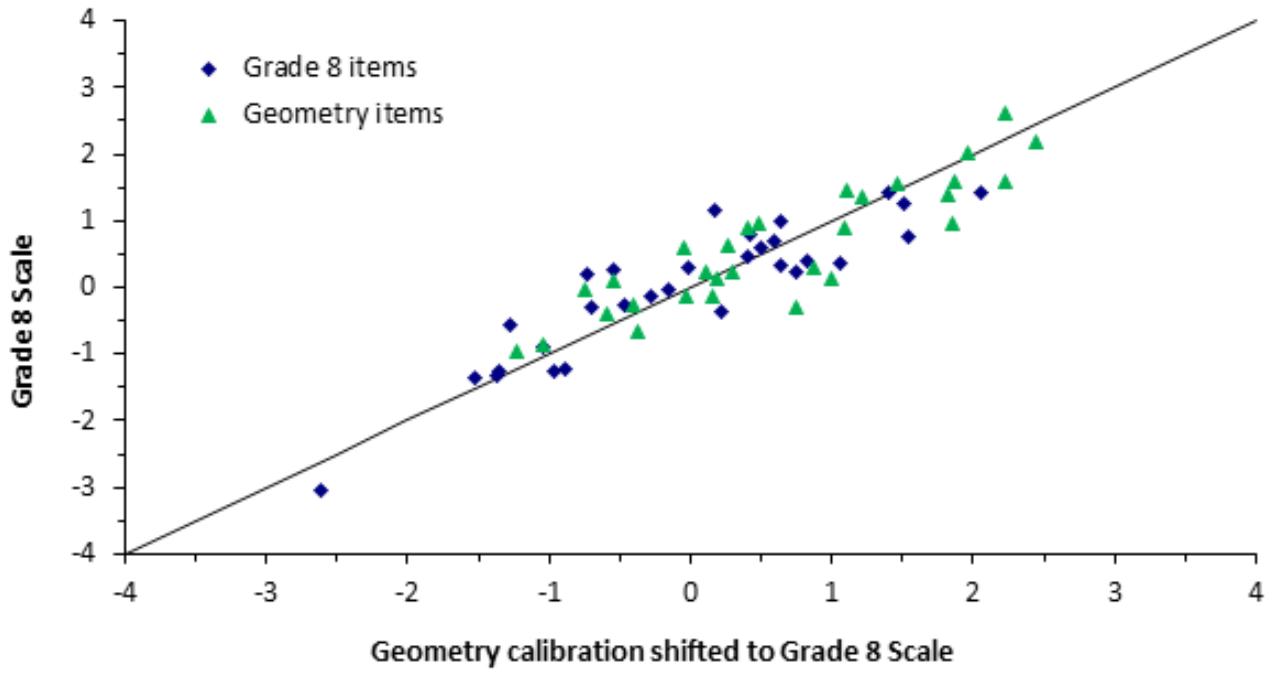
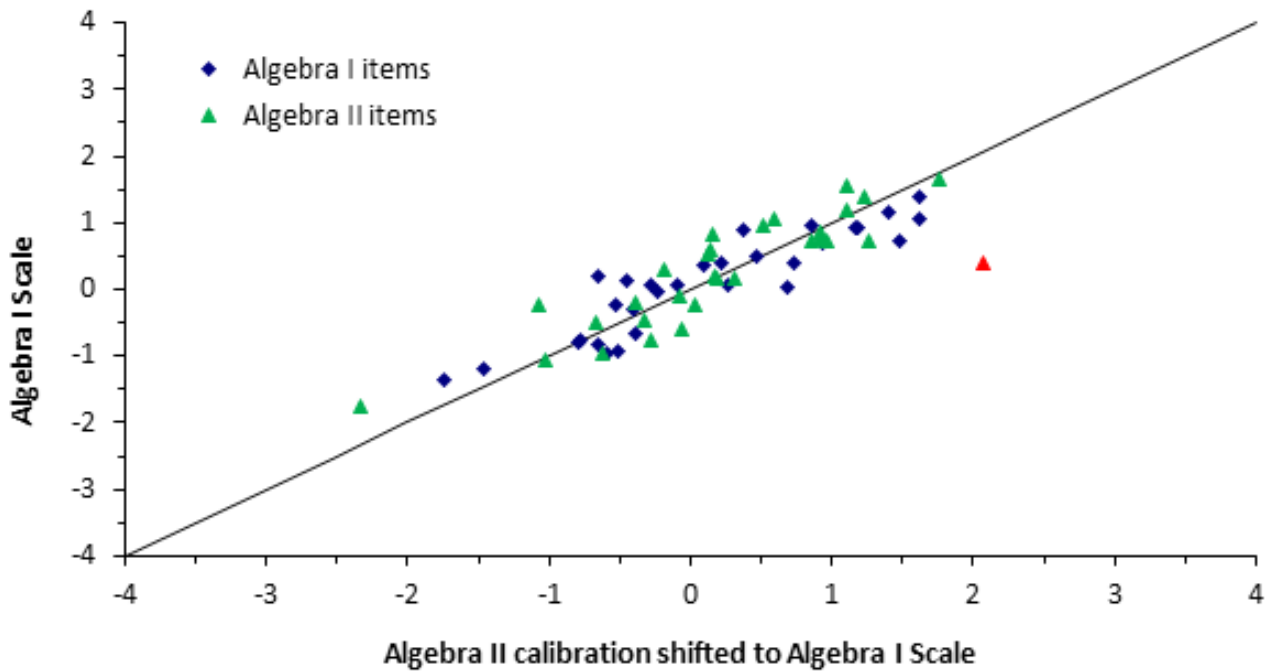


Figure C-8. CDT Mathematics: Algebra II to Algebra I Linking – All Links



## READING/LITERATURE

Tables C–18 through C–23 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 613607 is a grade 3 item used to link grades 3 and 4. It was administered 761 times on the lower grade form (grade 3) and 826 times on the upper grade form (grade 4). In some cases, a linking item was also a common item. This results in n-count that is much higher in one of the two grades. For example, item 613400 is a grade 4 item used to link grades 3 and 4. It was also a common grade 4 item (meaning it appeared on all grade 4 forms). The n-counts reflect this: Grade 3 n-count is 754 while grade 4 n-count is 6,574.

The diagnostic categories are<sup>3</sup>

- Comprehension
- Vocabulary
- Interpretation/Analysis Literary Elements & Devices
- Interpretation/Analysis Persuasive Techniques
- Interpretation/Analysis Organizational Skills

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<sup>3</sup> Reading diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.



**Table C–18. Reading/Literature Items Used to Link Grade 3 to Grade 4**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
613605	3	Grade 3 to Grade 4	5272	823	R3A.1.1.2	Vocabulary
613613	3	Grade 3 to Grade 4	5270	822	R3A.2.2.1	Vocabulary
613614	3	Grade 3 to Grade 4	5275	822	R3A.2.1.1	Vocabulary
613592	3	Grade 3 to Grade 4	5262	822	R3A.2.3.1	Comprehension
613593	3	Grade 3 to Grade 4	5263	822	R3A.2.4.1	Comprehension
613460	3	Grade 3 to Grade 4	5251	823	R3A.1.2.2	Vocabulary
613459	3	Grade 3 to Grade 4	5245	822	R3A.1.1.1	Vocabulary
613461	3	Grade 3 to Grade 4	5242	823	R3A.1.4.1	Comprehension
613463	3	Grade 3 to Grade 4	5246	823	R3B.2.1.1	I/A Literary
613462	3	Grade 3 to Grade 4	5241	823	R3A.1.5.1	Comprehension
613607	3	Grade 3 to Grade 4	761	826	R3A.1.2.1	Vocabulary
613446	3	Grade 3 to Grade 4	752	825	R3A.1.1.1	Vocabulary
613444	3	Grade 3 to Grade 4	752	824	R3B.1.1.1	I/A Literary
613445	3	Grade 3 to Grade 4	751	823	R3A.1.5.1	Comprehension
613440	3	Grade 3 to Grade 4	744	823	R3A.1.2.2	Vocabulary
613439	3	Grade 3 to Grade 4	740	823	R3A.1.1.1	Vocabulary
613438	3	Grade 3 to Grade 4	739	822	R3B.1.1.1	I/A Literary
613443	3	Grade 3 to Grade 4	739	823	R3A.1.6.1	Comprehension
613442	3	Grade 3 to Grade 4	735	822	R3A.1.5.1	Comprehension
613441	3	Grade 3 to Grade 4	733	821	R3A.1.3.1	Comprehension
613220	4	Grade 3 to Grade 4	755	6576	R4B.2.1.3	I/A Literary
613219	4	Grade 3 to Grade 4	754	6573	R4B.2.1.2	I/A Literary
613399	4	Grade 3 to Grade 4	757	6569	R4A.2.2.1	Vocabulary
613400	4	Grade 3 to Grade 4	754	6574	R4A.2.3.1	Comprehension
613402	4	Grade 3 to Grade 4	756	6568	R4B.3.2.1	I/A Persuasive
613403	4	Grade 3 to Grade 4	759	6566	R4B.3.2.1	I/A Persuasive
613401	4	Grade 3 to Grade 4	756	6570	R4A.2.6.1	Comprehension
613288	4	Grade 3 to Grade 4	757	6569	R4A.1.1.2	Vocabulary
613291	4	Grade 3 to Grade 4	756	6567	R4A.1.1.1	Vocabulary
613295	4	Grade 3 to Grade 4	757	6563	R4A.2.2.1	Vocabulary
613289	4	Grade 3 to Grade 4	756	804	R4A.1.2.1	Vocabulary
613292	4	Grade 3 to Grade 4	756	805	R4A.1.2.2	Vocabulary
613215	4	Grade 3 to Grade 4	755	805	R4A.1.2.2	Vocabulary
613213	4	Grade 3 to Grade 4	751	803	R4B.2.1.1	I/A Literary
613214	4	Grade 3 to Grade 4	752	804	R4A.1.4.1	Comprehension
613388	4	Grade 3 to Grade 4	749	827	R4A.2.3.1	Comprehension
613389	4	Grade 3 to Grade 4	750	827	R4A.2.4.1	Comprehension

**Table C–18 (continued). Reading/Literature Items Used to Link Grade 3 to Grade 4**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Reading/Literature Diagnostic Category</b>
613391	4	Grade 3 to Grade 4	748	827	R4B.3.3.2	I/A Organizational
613392	4	Grade 3 to Grade 4	746	826	R4B.3.3.3	I/A Organizational
613390	4	Grade 3 to Grade 4	746	826	R4A.2.5.1	Comprehension

**Table C–19. Reading/Literature Items Used to Link Grade 4 to Grade 5**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
613220	4	Grade 4 to Grade 5	6576	955	R4B.2.1.3	I/A Literary
613219	4	Grade 4 to Grade 5	6573	957	R4B.2.1.2	I/A Literary
613399	4	Grade 4 to Grade 5	6569	958	R4A.2.2.1	Vocabulary
613400	4	Grade 4 to Grade 5	6574	958	R4A.2.3.1	Comprehension
613402	4	Grade 4 to Grade 5	6568	957	R4B.3.2.1	I/A Persuasive
613403	4	Grade 4 to Grade 5	6566	957	R4B.3.2.1	I/A Persuasive
613401	4	Grade 4 to Grade 5	6570	958	R4A.2.6.1	Comprehension
613288	4	Grade 4 to Grade 5	6569	958	R4A.1.1.2	Vocabulary
613291	4	Grade 4 to Grade 5	6567	958	R4A.1.1.1	Vocabulary
613295	4	Grade 4 to Grade 5	6563	958	R4A.2.2.1	Vocabulary
613293	4	Grade 4 to Grade 5	830	931	R4A.2.1.2	Vocabulary
613297	4	Grade 4 to Grade 5	829	930	R4A.2.2.2	Vocabulary
613212	4	Grade 4 to Grade 5	829	930	R4A.1.1.2	Vocabulary
613211	4	Grade 4 to Grade 5	830	926	R4A.1.5.1	Comprehension
613210	4	Grade 4 to Grade 5	829	925	R4A.1.6.1	Comprehension
613369	4	Grade 4 to Grade 5	815	920	R4A.2.2.1	Vocabulary
613370	4	Grade 4 to Grade 5	813	920	R4A.2.4.1	Comprehension
613372	4	Grade 4 to Grade 5	813	919	R4B.3.1.1	I/A Persuasive
613371	4	Grade 4 to Grade 5	813	917	R4A.2.5.1	Comprehension
613373	4	Grade 4 to Grade 5	812	915	R4B.3.3.1	I/A Organizational
611554	5	Grade 4 to Grade 5	812	7546	R5A.2.1.1	Vocabulary
613007	5	Grade 4 to Grade 5	813	7530	R5B.2.1.4	I/A Literary
613005	5	Grade 4 to Grade 5	810	7528	R5B.1.1.1	I/A Literary
613006	5	Grade 4 to Grade 5	812	7526	R5A.1.6.2	Comprehension
611354	5	Grade 4 to Grade 5	811	7530	R5A.2.1.2	Vocabulary
611377	5	Grade 4 to Grade 5	808	7524	R5B.3.3.2	I/A Organizational
611376	5	Grade 4 to Grade 5	812	7526	R5B.3.1.1	I/A Persuasive
611390	5	Grade 4 to Grade 5	810	7517	R5B.3.3.3	I/A Organizational
611374	5	Grade 4 to Grade 5	807	7510	R5A.2.5.1	Comprehension
611375	5	Grade 4 to Grade 5	808	7509	R5A.2.6.2	Comprehension
611550	5	Grade 4 to Grade 5	826	931	R5A.2.1.2	Vocabulary
611245	5	Grade 4 to Grade 5	826	924	R5B.2.1.1	I/A Literary
611246	5	Grade 4 to Grade 5	826	924	R5B.2.2.1	I/A Literary
611244	5	Grade 4 to Grade 5	826	921	R5A.1.4.1	Comprehension
611269	5	Grade 4 to Grade 5	826	935	R5A.2.1.1	Vocabulary
611272	5	Grade 4 to Grade 5	824	935	R5B.3.1.1	I/A Persuasive
611270	5	Grade 4 to Grade 5	823	935	R5A.2.3.1	Comprehension

**Table C–19 (continued). Reading/Literature Items Used to Link Grade 4 to Grade 5**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Reading/Literature Diagnostic Category</b>
611274	5	Grade 4 to Grade 5	824	935	R5B.3.3.2	I/A Organizational
611271	5	Grade 4 to Grade 5	824	934	R5A.2.6.1	Comprehension
611273	5	Grade 4 to Grade 5	824	933	R5B.3.3.1	I/A Organizational

**Table C–20. Reading/Literature Items Used to Link Grade 5 to Grade 6**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
611554	5	Grade 5 to Grade 6	7546	716	R5A.2.1.1	Vocabulary
613007	5	Grade 5 to Grade 6	7530	719	R5B.2.1.4	I/A Literary
613005	5	Grade 5 to Grade 6	7528	721	R5B.1.1.1	I/A Literary
613006	5	Grade 5 to Grade 6	7526	720	R5A.1.6.2	Comprehension
611354	5	Grade 5 to Grade 6	7530	719	R5A.2.1.2	Vocabulary
611377	5	Grade 5 to Grade 6	7524	717	R5B.3.3.2	I/A Organizational
611376	5	Grade 5 to Grade 6	7526	719	R5B.3.1.1	I/A Persuasive
611390	5	Grade 5 to Grade 6	7517	718	R5B.3.3.3	I/A Organizational
611374	5	Grade 5 to Grade 6	7510	717	R5A.2.5.1	Comprehension
611375	5	Grade 5 to Grade 6	7509	717	R5A.2.6.2	Comprehension
611247	5	Grade 5 to Grade 6	928	697	R5A.1.1.1	Vocabulary
611251	5	Grade 5 to Grade 6	928	698	R5B.2.1.4	I/A Literary
611250	5	Grade 5 to Grade 6	926	697	R5B.2.1.3	I/A Literary
611249	5	Grade 5 to Grade 6	926	696	R5A.1.3.2	Comprehension
611248	5	Grade 5 to Grade 6	926	694	R5A.1.3.1	Comprehension
611309	5	Grade 5 to Grade 6	925	688	R5B.3.3.3	I/A Organizational
611278	5	Grade 5 to Grade 6	924	687	R5A.2.3.2	Comprehension
611291	5	Grade 5 to Grade 6	921	685	R5B.3.3.1	I/A Organizational
611545	5	Grade 5 to Grade 6	942	682	R5A.1.1.2	Vocabulary
611553	5	Grade 5 to Grade 6	945	680	R5A.2.1.1	Vocabulary
610132	6	Grade 5 to Grade 6	936	7111	R6A.1.2.1	Vocabulary
610135	6	Grade 5 to Grade 6	937	7105	R6B.2.1.2	I/A Literary
610133	6	Grade 5 to Grade 6	935	7086	R6A.1.4.1	Comprehension
610355	6	Grade 5 to Grade 6	935	7075	R6A.1.3.2	Comprehension
610136	6	Grade 5 to Grade 6	935	7066	R6B.2.2.2	I/A Literary
610134	6	Grade 5 to Grade 6	936	7069	R6A.1.6.1	Comprehension
612249	6	Grade 5 to Grade 6	937	7035	R6B.3.3.4	I/A Organizational
612248	6	Grade 5 to Grade 6	936	7026	R6A.2.6.2	Comprehension
607918	6	Grade 5 to Grade 6	937	7150	R6A.2.1.1	Vocabulary
607921	6	Grade 5 to Grade 6	937	7142	R6A.2.1.2	Vocabulary
607927	6	Grade 5 to Grade 6	941	713	R6A.2.2.1	Vocabulary
607917	6	Grade 5 to Grade 6	941	716	R6A.2.1.1	Vocabulary
610141	6	Grade 5 to Grade 6	938	703	R6A.1.1.1	Vocabulary
610144	6	Grade 5 to Grade 6	937	701	R6B.2.1.1	I/A Literary
610305	6	Grade 5 to Grade 6	933	700	R6A.1.3.1	Comprehension
610145	6	Grade 5 to Grade 6	932	695	R6B.2.2.2	I/A Literary
610142	6	Grade 5 to Grade 6	927	695	R6A.1.5.1	Comprehension

**Table C–20 (continued). Reading/Literature Items Used to Link Grade 5 to Grade 6**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Reading/Literature Diagnostic Category</b>
610143	6	Grade 5 to Grade 6	925	694	R6A.1.6.1	Comprehension
610310	6	Grade 5 to Grade 6	917	726	R6B.3.2.2	I/A Persuasive
610309	6	Grade 5 to Grade 6	917	726	R6A.2.6.1	Comprehension

**Table C–21. Reading/Literature Items Used to Link Grade 6 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
610132	6	Grade 6 to Grade 7	7111	549	R6A.1.2.1	Vocabulary
610135	6	Grade 6 to Grade 7	7105	550	R6B.2.1.2	I/A Literary
610133	6	Grade 6 to Grade 7	7086	551	R6A.1.4.1	Comprehension
610355	6	Grade 6 to Grade 7	7075	551	R6A.1.3.2	Comprehension
610136	6	Grade 6 to Grade 7	7066	551	R6B.2.2.2	I/A Literary
610134	6	Grade 6 to Grade 7	7069	551	R6A.1.6.1	Comprehension
607921	6	Grade 6 to Grade 7	7142	550	R6A.2.1.2	Vocabulary
610327	6	Grade 6 to Grade 7	685	550	R6A.1.2.2	Vocabulary
610328	6	Grade 6 to Grade 7	682	549	R6B.2.1.4	I/A Literary
610329	6	Grade 6 to Grade 7	679	548	R6B.2.2.1	I/A Literary
610065	6	Grade 6 to Grade 7	696	551	R6A.1.1.1	Vocabulary
610071	6	Grade 6 to Grade 7	692	550	R6A.1.3.1	Comprehension
610066	6	Grade 6 to Grade 7	691	550	R6B.2.1.4	I/A Literary
610070	6	Grade 6 to Grade 7	689	551	R6A.1.3.2	Comprehension
610078	6	Grade 6 to Grade 7	687	551	R6B.2.1.3	I/A Literary
609022	6	Grade 6 to Grade 7	1433	551	R6A.1.1.2	Vocabulary
609025	6	Grade 6 to Grade 7	1431	550	R6B.2.1.1	I/A Literary
609026	6	Grade 6 to Grade 7	1431	550	R6B.2.1.4	I/A Literary
609023	6	Grade 6 to Grade 7	1431	549	R6A.1.3.1	Comprehension
609024	6	Grade 6 to Grade 7	1432	548	R6A.1.6.2	Comprehension
609658	7	Grade 6 to Grade 7	722	4978	R7A.1.1.1	Vocabulary
609663	7	Grade 6 to Grade 7	725	4976	R7B.2.2.1	I/A Literary
609661	7	Grade 6 to Grade 7	723	4971	R7A.1.5.1	Comprehension
610324	7	Grade 6 to Grade 7	724	4974	R7A.2.2.1	Vocabulary
610325	7	Grade 6 to Grade 7	723	4968	R7A.2.3.2	Comprehension
610146	7	Grade 6 to Grade 7	722	563	R7A.1.1.1	Vocabulary
610149	7	Grade 6 to Grade 7	723	565	R7B.2.1.1	I/A Literary
610147	7	Grade 6 to Grade 7	722	564	R7A.1.3.1	Comprehension
610338	7	Grade 6 to Grade 7	721	563	R7B.1.1.1	I/A Literary
610148	7	Grade 6 to Grade 7	721	564	R7A.1.6.1	Comprehension
607933	7	Grade 6 to Grade 7	705	545	R7A.1.1.2	Vocabulary
607936	7	Grade 6 to Grade 7	703	545	R7A.1.2.1	Vocabulary
609243	7	Grade 6 to Grade 7	701	544	R7B.2.1.2	I/A Literary
609053	7	Grade 6 to Grade 7	700	544	R7A.1.3.2	Comprehension
609219	7	Grade 6 to Grade 7	700	544	R7A.1.6.2	Comprehension
609037	7	Grade 6 to Grade 7	695	553	R7A.2.2.2	Vocabulary
609038	7	Grade 6 to Grade 7	692	552	R7A.2.4.1	Comprehension

**Table C-21 (continued). Reading/Literature Items Used to Link Grade 6 to Grade 7**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Reading/Literature Diagnostic Category</b>
609039	7	Grade 6 to Grade 7	684	551	R7A.2.6.2	Comprehension
609040	7	Grade 6 to Grade 7	680	553	R7B.3.1.1	I/A Persuasive
609041	7	Grade 6 to Grade 7	678	552	R7B.3.3.1	I/A Organizational



**Table C–22. Reading/Literature Items Used to Link Grade 7 to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
609658	7	Grade 8 to Grade 7	4978	518	R7A.1.1.1	Vocabulary
609663	7	Grade 8 to Grade 7	4976	518	R7B.2.2.1	I/A Literary
609661	7	Grade 8 to Grade 7	4971	517	R7A.1.5.1	Comprehension
610324	7	Grade 8 to Grade 7	4974	516	R7A.2.2.1	Vocabulary
610325	7	Grade 8 to Grade 7	4968	515	R7A.2.3.2	Comprehension
610146	7	Grade 8 to Grade 7	563	491	R7A.1.1.1	Vocabulary
610149	7	Grade 8 to Grade 7	565	491	R7B.2.1.1	I/A Literary
610147	7	Grade 8 to Grade 7	564	490	R7A.1.3.1	Comprehension
610338	7	Grade 8 to Grade 7	563	488	R7B.1.1.1	I/A Literary
610148	7	Grade 8 to Grade 7	564	485	R7A.1.6.1	Comprehension
614855	7	Grade 8 to Grade 7	559	516	R7A.1.1.2	Vocabulary
614859	7	Grade 8 to Grade 7	558	516	R7B.2.2.1	I/A Literary
614858	7	Grade 8 to Grade 7	559	515	R7B.2.1.2	I/A Literary
614856	7	Grade 8 to Grade 7	559	515	R7A.1.3.2	Comprehension
614857	7	Grade 8 to Grade 7	558	514	R7A.1.6.1	Comprehension
609152	7	Grade 8 to Grade 7	550	504	R7B.3.1.1	I/A Persuasive
609072	7	Grade 8 to Grade 7	551	502	R7A.2.5.1	Comprehension
609209	7	Grade 8 to Grade 7	548	500	R7B.1.1.1	I/A Literary
609210	7	Grade 8 to Grade 7	548	496	R7B.2.1.1	I/A Literary
609208	7	Grade 8 to Grade 7	548	495	R7A.1.3.1	Comprehension
609060	8	Grade 8 to Grade 7	550	4645	R8B.3.1.1	I/A Persuasive
609059	8	Grade 8 to Grade 7	550	4647	R8A.2.5.1	Comprehension
608017	8	Grade 8 to Grade 7	550	4637	R8A.1.1.2	Vocabulary
608016	8	Grade 8 to Grade 7	551	4629	R8B.2.1.2	I/A Literary
607999	8	Grade 8 to Grade 7	550	4622	R8A.1.6.2	Comprehension
610087	8	Grade 8 to Grade 7	550	510	R8B.3.3.4	I/A Organizational
610260	8	Grade 8 to Grade 7	550	509	R8B.3.3.2	I/A Organizational
610090	8	Grade 8 to Grade 7	550	511	R8B.3.3.4	I/A Organizational
610089	8	Grade 8 to Grade 7	550	511	R8B.3.3.4	I/A Organizational
610088	8	Grade 8 to Grade 7	550	510	R8B.3.3.4	I/A Organizational
609135	8	Grade 8 to Grade 7	540	531	R8B.3.2.1	I/A Persuasive
609131	8	Grade 8 to Grade 7	540	532	R8B.3.2.1	I/A Persuasive
609120	8	Grade 8 to Grade 7	539	532	R8B.3.3.2	I/A Organizational
609143	8	Grade 8 to Grade 7	539	531	R8A.2.3.2	Comprehension
609140	8	Grade 8 to Grade 7	539	532	R8A.2.6.2	Comprehension
609264	8	Grade 8 to Grade 7	539	513	R8A.1.1.2	Vocabulary
609267	8	Grade 8 to Grade 7	539	513	R8B.2.1.2	I/A Literary

**Table C-22 (continued). Reading/Literature Items Used to Link Grade 7 to Grade 8**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Reading/Literature Diagnostic Category</b>
609265	8	Grade 8 to Grade 7	539	514	R8A.1.3.2	Comprehension
609269	8	Grade 8 to Grade 7	539	514	R8B.2.2.1	I/A Literary
609266	8	Grade 8 to Grade 7	539	515	R8A.1.6.1	Comprehension

**Table C–23. Reading/Literature Items Used to Link Literature to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
608017	8	Literature to Grade 8	4637	255	R8A.1.1.2	Vocabulary
608016	8	Literature to Grade 8	4629	253	R8B.2.1.2	I/A Literary
607999	8	Literature to Grade 8	4622	252	R8A.1.6.2	Comprehension
610087	8	Literature to Grade 8	510	256	R8B.3.3.4	I/A Organizational
610260	8	Literature to Grade 8	509	256	R8B.3.3.2	I/A Organizational
610090	8	Literature to Grade 8	511	255	R8B.3.3.4	I/A Organizational
610089	8	Literature to Grade 8	511	255	R8B.3.3.4	I/A Organizational
610088	8	Literature to Grade 8	510	255	R8B.3.3.4	I/A Organizational
607957	8	Literature to Grade 8	502	254	R8A.1.1.2	Vocabulary
607963	8	Literature to Grade 8	501	254	R8A.1.1.1	Vocabulary
607958	8	Literature to Grade 8	516	258	R8A.1.2.1	Vocabulary
607962	8	Literature to Grade 8	516	258	R8A.1.1.1	Vocabulary
612324	8	Literature to Grade 8	516	257	R8B.3.3.4	I/A Organizational
612280	8	Literature to Grade 8	517	257	R8B.3.3.4	I/A Organizational
612279	8	Literature to Grade 8	517	257	R8A.2.6.1	Comprehension
609244	8	Literature to Grade 8	523	257	R8A.1.1.1	Vocabulary
609254	8	Literature to Grade 8	523	256	R8B.2.1.1	I/A Literary
609279	8	Literature to Grade 8	522	256	R8B.1.1.1	I/A Literary
609245	8	Literature to Grade 8	523	256	R8A.1.3.1	Comprehension
609252	8	Literature to Grade 8	523	256	R8A.1.6.1	Comprehension
608136	Lit	Literature to Grade 8	515	258	L.F.1.3.1	Comprehension
608138	Lit	Literature to Grade 8	515	258	L.F.2.3.4	I/A Literary
608137	Lit	Literature to Grade 8	512	257	L.F.2.2.1	Comprehension
614029	Lit	Literature to Grade 8	515	271	L.F.1.2.4	Vocabulary
614032	Lit	Literature to Grade 8	515	271	L.F.2.3.1	I/A Literary
614030	Lit	Literature to Grade 8	515	271	L.F.2.1.1	Comprehension
614031	Lit	Literature to Grade 8	515	271	L.F.2.2.2	Comprehension
614033	Lit	Literature to Grade 8	515	271	L.F.2.3.2	I/A Literary
614034	Lit	Literature to Grade 8	510	271	L.F.2.5.1	I/A Literary
608118	Lit	Literature to Grade 8	514	265	L.F.1.2.4	Vocabulary
610352	Lit	Literature to Grade 8	516	261	L.F.2.5.2	I/A Literary
610092	Lit	Literature to Grade 8	511	261	L.F.2.2.1	Comprehension
610094	Lit	Literature to Grade 8	509	260	L.F.2.3.6	I/A Literary
610095	Lit	Literature to Grade 8	510	259	L.F.2.4.1	I/A Literary
610093	Lit	Literature to Grade 8	509	260	L.F.2.3.4	I/A Literary
610091	Lit	Literature to Grade 8	507	260	L.F.1.1.1	Comprehension
612547	Lit	Literature to Grade 8	504	258	L.F.1.2.2	Vocabulary

**Table C–23 (continued). Reading/Literature Items Used to Link Literature to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Reading/Literature Diagnostic Category
612498	Lit	Literature to Grade 8	502	258	L.F.2.2.2	Comprehension
612548	Lit	Literature to Grade 8	499	258	L.F.1.3.2	Comprehension
612496	Lit	Literature to Grade 8	497	258	L.F.1.1.1	Comprehension

Tables C–24 through C–29 summarize the number of linking items by diagnostic category.

Vertical linking items are not distributed evenly across the diagnostic categories. This is due to the fact that Reading and Literature items are passage based. The three passage types (literary, persuasive, and organizational) may each have associated comprehension and vocabulary items, as well as interpretation/analysis items.

**Table C–24. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category**

Diagnostic Category	Grade 3 Items	Grade 4 Items	Total
Comprehension	8	6	14
Vocabulary	9	7	16
I/A Literary	3	3	6
I/A Persuasive	0	2	2
I/A Organizational	0	2	2
TOTAL	20	20	40

**Table C–25. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category**

Diagnostic Category	Grade 4 Items	Grade 5 Items	Total
Comprehension	6	6	12
Vocabulary	8	4	12
I/A Literary	2	4	6
I/A Persuasive	3	2	5
I/A Organizational	1	4	5
TOTAL	20	20	40

**Table C–26. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category**

Diagnostic Category	Grade 5 Items	Grade 6 Items	Total
Comprehension	6	8	14
Vocabulary	5	6	11
I/A Literary	4	4	8
I/A Persuasive	1	1	2
I/A Organizational	4	1	5
TOTAL	20	20	40

**Table C–27. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 6 Items</b>	<b>Grade 7 Items</b>	<b>Total</b>
Comprehension	7	8	15
Vocabulary	5	6	11
I/A Literary	8	4	12
I/A Persuasive	0	1	1
I/A Organizational	0	1	1
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–28. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 7 Items</b>	<b>Grade 8 Items</b>	<b>Total</b>
Comprehension	8	6	14
Vocabulary	4	2	6
I/A Literary	7	3	10
I/A Persuasive	1	3	4
I/A Organizational	0	6	6
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–29. Number of Items Linking Literature to Grade 8 by Diagnostic Category**

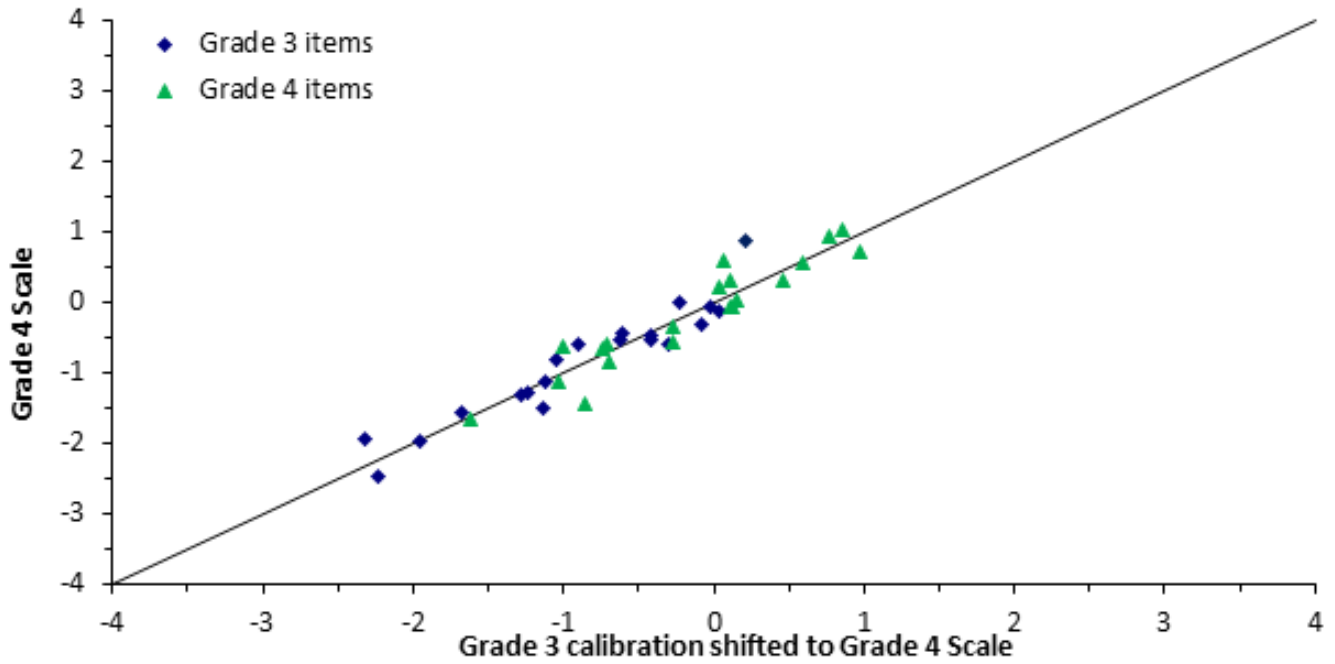
<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Literature Items</b>	<b>Total</b>
Comprehension	4	9	13
Vocabulary	6	3	9
I/A Literary	3	8	11
I/A Persuasive	0	0	0
I/A Organizational	7	0	7
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–30. Reading/Literature Example of Vertical Linking Workbook**

Item ID	Item Grade	Grade 4 Calibration			Grade 5 Calibration			Discrepancy	Grade 4 on	Grade 5 Scale	Robust Z	Flag
		Difficulty	Fit	Displace	Difficulty	Fit	Displace					
613220	4	0.700	1.090	0.000	0.258	1.040	-0.003	-0.442	0.290	-0.271		
613219	4	-0.063	0.980	0.000	-0.495	0.960	-0.003	-0.432	-0.473	-0.235		
613399	4	0.557	1.040	0.000	0.056	0.980	-0.003	-0.501	0.147	-0.486		
613400	4	0.589	1.020	0.000	0.131	1.000	-0.003	-0.458	0.179	-0.329		
613402	4	0.316	1.070	0.000	0.014	0.930	-0.003	-0.302	-0.094	0.238		
613403	4	0.295	0.970	0.000	-0.446	0.890	-0.003	-0.741	-0.115	-1.360		
613401	4	-0.657	0.810	0.000	-1.307	0.810	-0.003	-0.650	-1.067	-1.028		
613288	4	-0.608	0.960	0.000	-1.044	0.950	-0.003	-0.436	-1.018	-0.249		
613291	4	0.927	1.200	0.000	0.628	1.170	-0.003	-0.299	0.517	0.249		
613295	4	-1.117	0.880	0.000	-1.712	0.900	-0.003	-0.595	-1.527	-0.828		
613293	4	0.173	0.930	0.002	-0.113	0.880	0.000	-0.286	-0.237	0.297		
613297	4	0.807	1.070	0.002	0.424	0.990	0.000	-0.383	0.397	-0.056		
613212	4	1.664	1.210	0.003	1.491	1.220	0.000	-0.173	1.254	0.708		
613211	4	0.245	0.930	0.002	0.082	0.890	0.000	-0.163	-0.165	0.744		
613210	4	0.203	1.000	0.002	-0.273	0.910	0.000	-0.476	-0.207	-0.395		
613369	4	-0.556	0.900	0.004	-0.791	0.920	0.000	-0.235	-0.966	0.482		
613370	4	0.433	0.930	0.004	0.151	0.950	0.000	-0.282	0.023	0.311		
613372	4	-0.305	0.860	0.004	-0.698	0.870	0.000	-0.393	-0.715	-0.093		
613371	4	-0.513	0.910	0.004	-0.670	0.960	0.000	-0.157	-0.923	0.766		
613373	4	1.012	1.060	0.004	1.002	1.040	0.000	-0.010	0.602	1.301		
611554	5	1.180	1.170	0.003	1.126	1.050	0.000	-0.054	0.770	1.141		
613007	5	-0.124	0.900	0.003	-0.476	0.960	-0.001	-0.352	-0.534	0.056		
613005	5	2.069	1.250	0.003	2.138	1.220	0.000	0.069	1.659	1.589		
613006	5	2.275	1.240	0.003	2.367	1.120	0.000	0.092	1.865	1.673		
611354	5	0.669	1.020	0.003	0.576	1.020	-0.001	-0.093	0.259	0.999		
611377	5	0.336	1.060	0.003	0.559	1.010	-0.001	0.223	-0.074	2.149	high robust Z	
611376	5	-0.804	0.840	0.003	-0.946	0.850	-0.001	-0.142	-1.214	0.821		
611390	5	1.351	1.110	0.003	1.443	1.040	0.000	0.092	0.941	1.673		
611374	5	0.109	0.930	0.003	-0.065	0.920	-0.001	-0.174	-0.301	0.704		
611375	5	0.581	1.160	0.003	0.605	1.120	-0.001	0.024	0.171	1.425		
611550	5	0.355	1.000	0.001	-0.586	0.900	0.000	-0.941	-0.055	-2.088	high robust Z	
611245	5	1.298	1.070	0.001	0.635	1.030	0.000	-0.663	0.888	-1.076		
611246	5	-0.051	0.860	0.001	-0.532	0.850	0.000	-0.481	-0.461	-0.413		
611244	5	-0.152	0.910	0.001	-0.226	0.940	0.000	-0.074	-0.562	1.068		
611269	5	-0.287	0.900	0.001	-1.341	0.960	-0.006	-1.054	-0.697	-2.499	high robust Z	
611272	5	-0.860	0.840	0.001	-2.081	0.930	-0.006	-1.221	-1.270	-3.107	high robust Z	
611270	5	-0.274	0.900	0.001	-1.286	0.960	-0.006	-1.012	-0.684	-2.346	high robust Z	
611274	5	-0.784	0.760	0.001	-2.720	0.870	-0.006	-1.936	-1.194	-5.709	high robust Z	
611271	5	0.972	0.910	0.001	0.157	0.900	-0.005	-0.815	0.562	-1.629		
611273	5	2.533	1.250	0.001	2.056	1.040	-0.004	-0.477	2.123	-0.399		
	Mean	0.362			-0.048			-0.410	-0.048	-0.155		
	SD	0.868			1.107			0.415	0.868	1.511		
	SD Ratio	0.784										
	Correlation	0.940										
	Add. Constant	-0.410										
	Median							-0.368				
	Q							0.371				

Figures C-9 through C-14 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

**Figure C-9. CDT Reading/Literature: Grade 3 to Grade 4 Linking – All Links**



**Figure C-10. CDT Reading/Literature: Grade 4 to Grade 5 Linking – All Links**

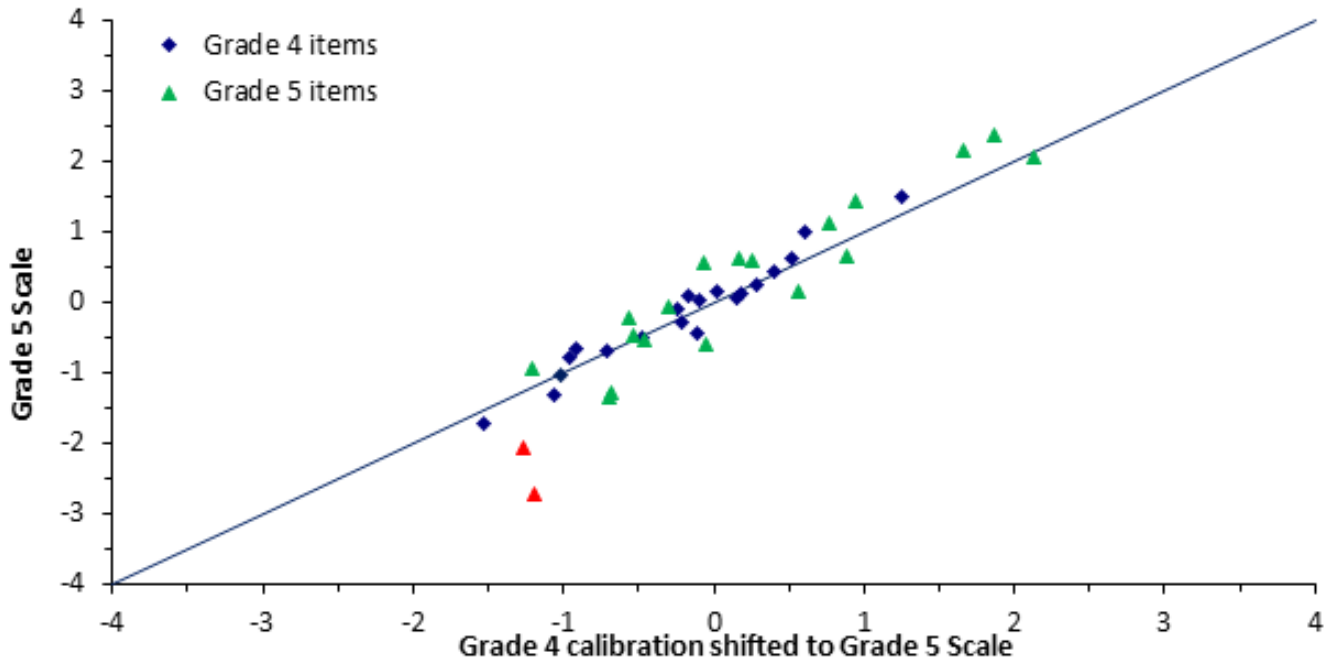


Figure C-11. CDT Reading/Literature: Grade 5 to Grade 6 Linking – All Links

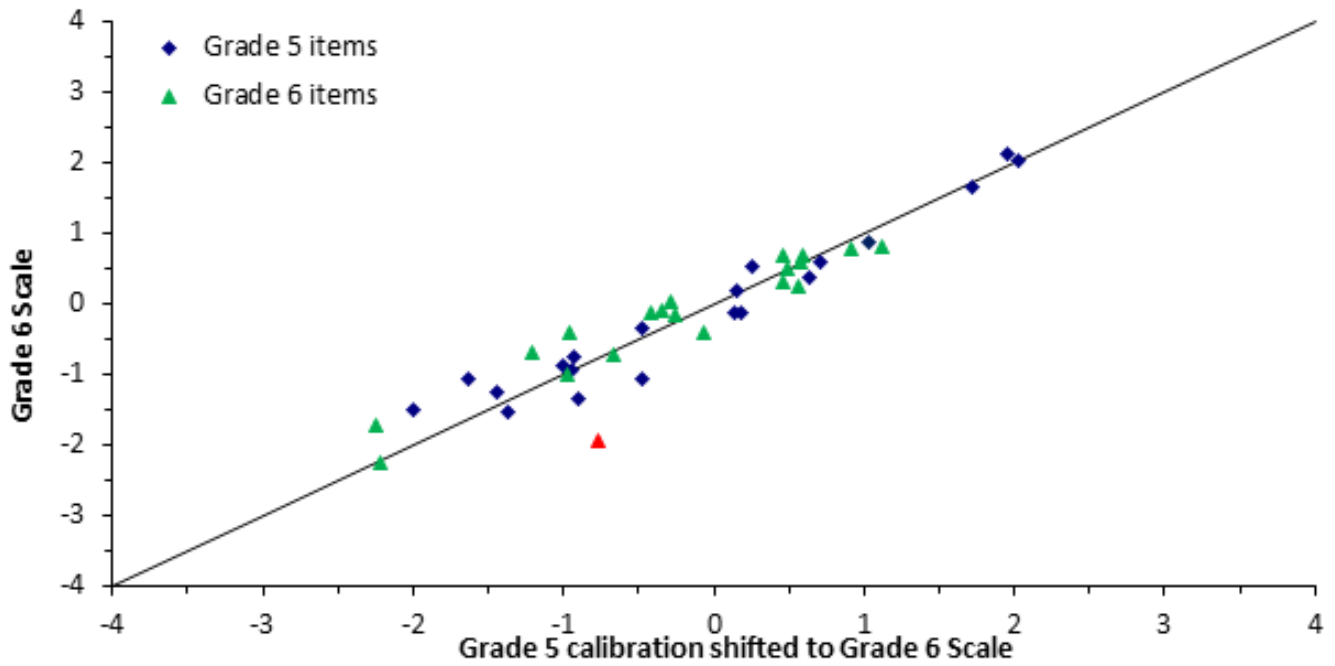


Figure C-12. CDT Reading/Literature: Grade 6 to Grade 7 Linking – All Links

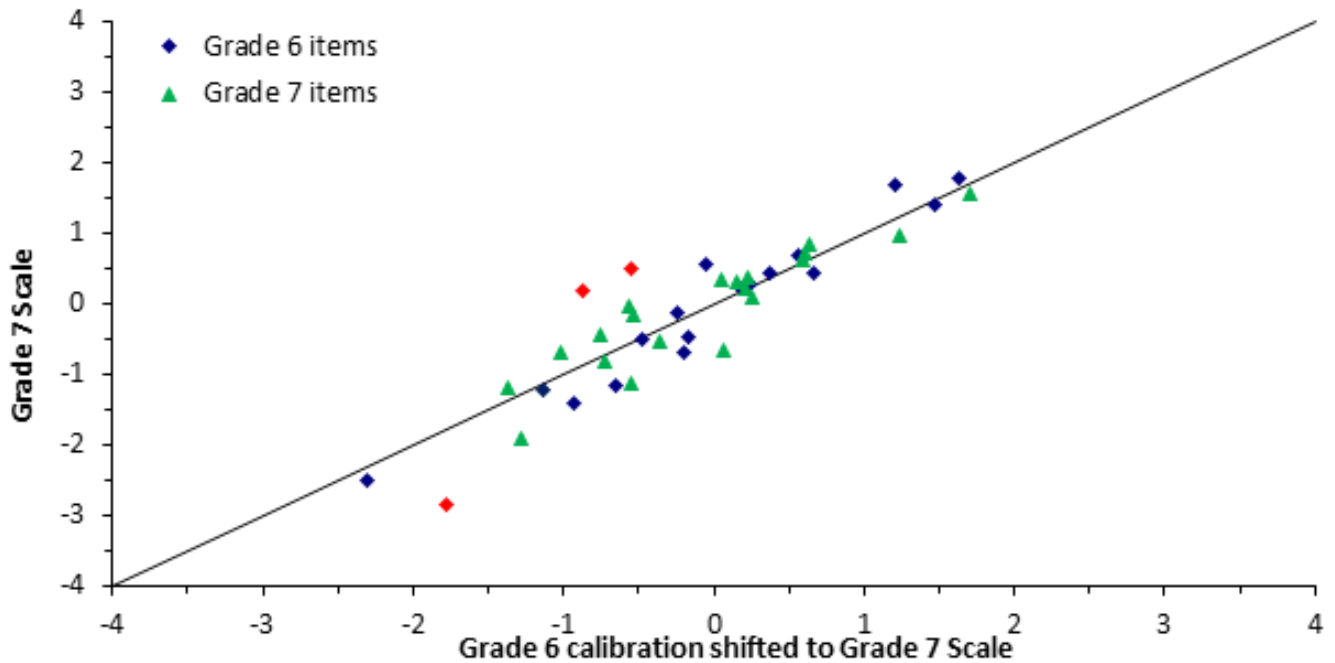




Figure C-13. CDT Reading/Literature: Grade 8 to Grade 7 Linking – All Links

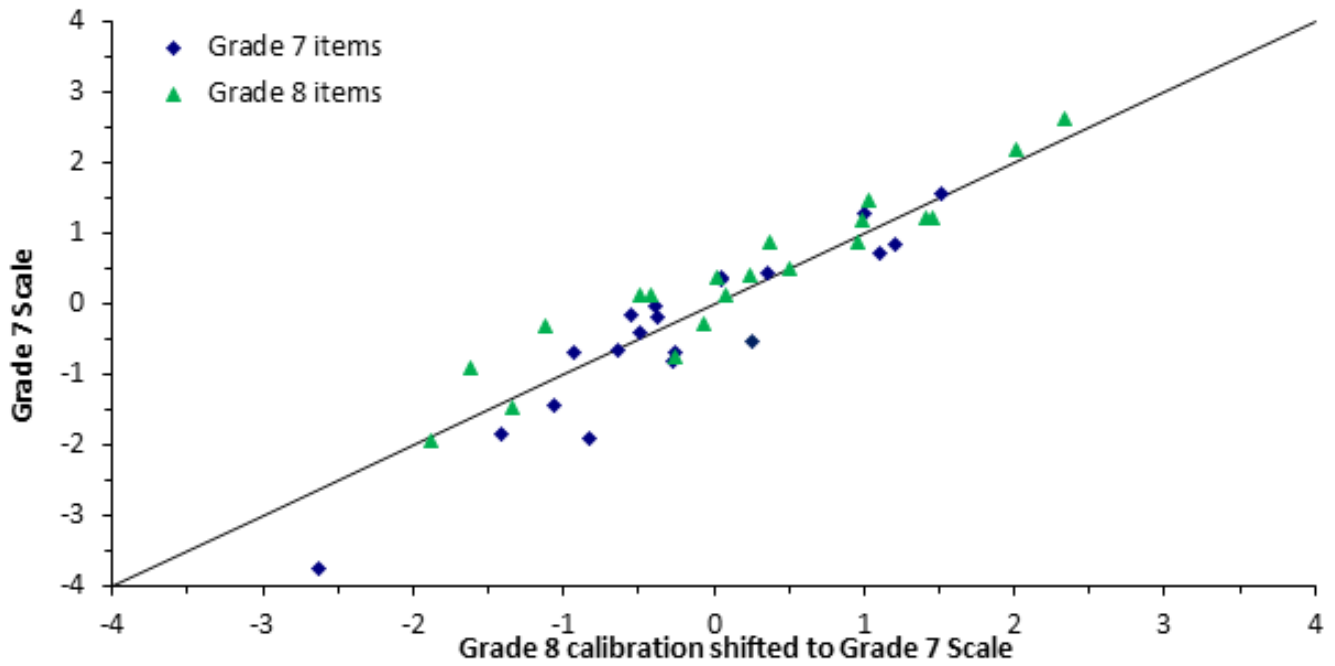
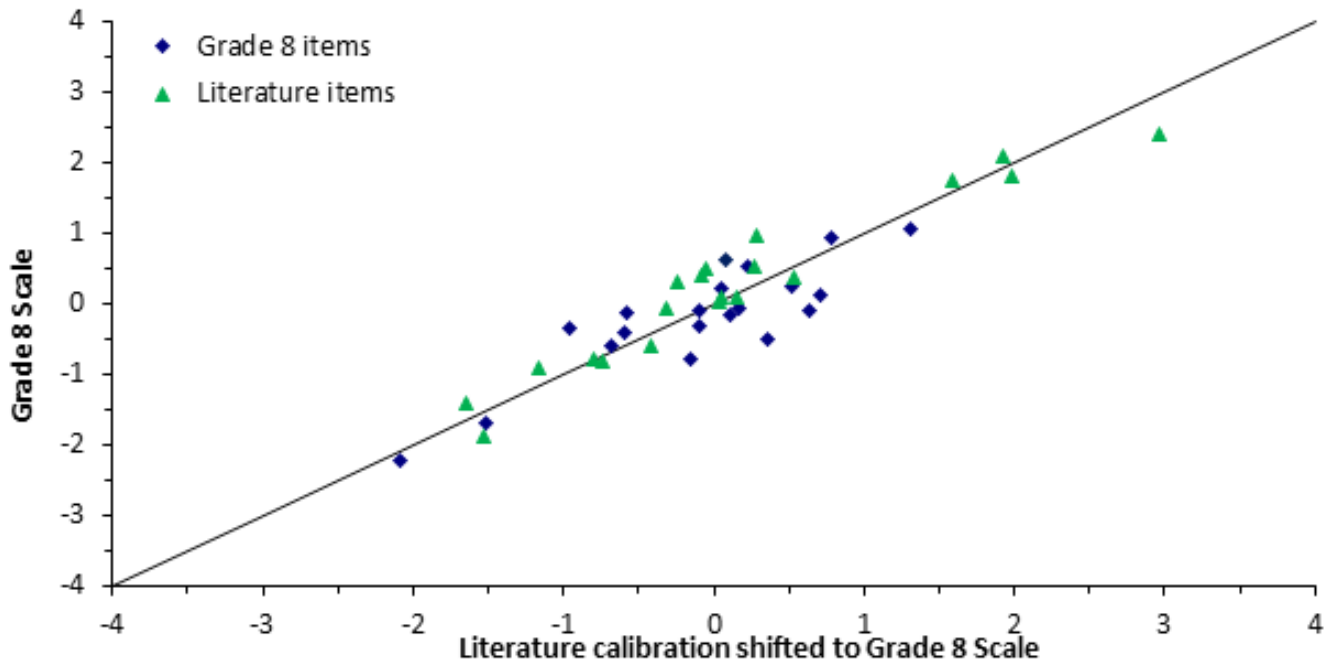


Figure C-14. CDT Reading/Literature: Literature to Grade 8 Linking – All Links



## SCIENCE

Tables C–31 through C–37 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 615315 is a grade 3 item used to link grades 3 and 4. It was administered 789 times on the lower grade form (grade 3) and 530 times on the upper grade form (grade 4). In some cases, a linking item was also a common item. This results in n-count that is much higher in one of the two grades. For example, item 617401 is a Biology item used to link Biology and grade 8. It was also a common Biology item (meaning it appeared on all Biology forms). The n-counts reflect this: Grade 8 n-count is 256 while Biology n-count is 4,874.

Diagnostic categories for Biology and Chemistry are different than diagnostic categories for grades 3 through 8 and 11 Science. Items may fall into both a Science diagnostic category and a Biology or Chemistry diagnostic category. This is shown in Tables C–36 and C–37. For example, item 615777 is in the Science diagnostic category “Biological Sciences” and the Biology diagnostic category “Basic Biological Principles”.

The Science diagnostic categories are:

- The Nature of Science
- Biological Science
- Physical Sciences
- Earth and Space Sciences

The Biology diagnostic categories are:

- Basic Biological Principles/Chemical Basis for Life
- Bioenergetics/Homeostasis and Transport
- Cell Growth and Reproduction/Genetics
- Theory of Evolution/Ecology

The Chemistry diagnostic categories are:

- Properties and Classification of Matter
- Atomic Structure and the Periodic Table
- The Mole and Chemical Bonding
- Chemical Relationships and Reactions

**Table C–31. Science Items Used to Link Grade 3 to Grade 4**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615315	3	Grade 3 to Grade 4	789	530	S3.A.2.1.3	Nature of Science
615379	3	Grade 3 to Grade 4	790	530	S3.D.1.2.1	Earth and Space Sci.
615333	3	Grade 3 to Grade 4	770	530	S3.B.2.1.1	Biological Sci.
615395	3	Grade 3 to Grade 4	797	530	S3.D.1.3.3	Earth and Space Sci.
615363	3	Grade 3 to Grade 4	1559	530	S3.C.1.1.4	Physical Sci.
615368	3	Grade 3 to Grade 4	773	530	S3.C.2.1.2	Physical Sci.
615314	3	Grade 3 to Grade 4	796	530	S3.A.2.1.2	Nature of Science
615331	3	Grade 3 to Grade 4	782	529	S3.B.1.1.4	Biological Sci.
615324	3	Grade 3 to Grade 4	786	529	S3.A.2.1.3	Nature of Science
615347	3	Grade 3 to Grade 4	796	528	S3.B.3.1.2	Biological Sci.
615385	3	Grade 3 to Grade 4	771	525	S3.D.1.2.1	Earth and Space Sci.
615319	3	Grade 3 to Grade 4	790	524	S3.A.3.1.1	Nature of Science
615339	3	Grade 3 to Grade 4	785	524	S3.B.2.2.1	Biological Sci.
617274	3	Grade 3 to Grade 4	796	525	S3.A.1.1.1	Nature of Science
615400	3	Grade 3 to Grade 4	771	524	S3.D.3.1.1	Earth and Space Sci.
615322	3	Grade 3 to Grade 4	1572	523	S3.A.3.2.1	Nature of Science
615325	3	Grade 3 to Grade 4	773	523	S3.B.1.1.1	Biological Sci.
615376	3	Grade 3 to Grade 4	785	521	S3.D.1.1.1	Earth and Space Sci.
615327	3	Grade 3 to Grade 4	787	521	S3.B.1.1.2	Biological Sci.
615334	3	Grade 3 to Grade 4	794	521	S3.B.2.1.2	Biological Sci.
617229	4	Grade 3 to Grade 4	792	538	S4.C.1.1.2	Physical Sci.
617061	4	Grade 3 to Grade 4	793	1086	S4.A.2.1.4	Nature of Science
617244	4	Grade 3 to Grade 4	789	558	S4.D.1.1.1	Earth and Space Sci.
617095	4	Grade 3 to Grade 4	792	1097	S4.B.2.1.2	Biological Sci.
615621	4	Grade 3 to Grade 4	793	1065	S4.A.1.1.1	Nature of Science
617239	4	Grade 3 to Grade 4	793	1073	S4.C.3.1.1	Physical Sci.
617099	4	Grade 3 to Grade 4	793	539	S4.B.2.2.1	Biological Sci.
617249	4	Grade 3 to Grade 4	792	539	S4.D.1.1.3	Earth and Space Sci.
617084	4	Grade 3 to Grade 4	790	536	S4.B.1.1.1	Biological Sci.
615625	4	Grade 3 to Grade 4	791	539	S4.A.1.3.1	Nature of Science
617233	4	Grade 3 to Grade 4	780	535	S4.C.2.1.2	Physical Sci.
615632	4	Grade 3 to Grade 4	782	534	S4.A.1.3.5	Nature of Science
617245	4	Grade 3 to Grade 4	780	536	S4.D.1.1.1	Earth and Space Sci.
617096	4	Grade 3 to Grade 4	780	1092	S4.B.2.1.2	Biological Sci.
615627	4	Grade 3 to Grade 4	781	528	S4.A.1.3.2	Nature of Science
617255	4	Grade 3 to Grade 4	779	538	S4.D.1.2.3	Earth and Space Sci.
617101	4	Grade 3 to Grade 4	778	540	S4.B.3.1.1	Biological Sci.

**Table C–31 (continued). Science Items Used to Link Grade 3 to Grade 4**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>
617253	4	Grade 3 to Grade 4	779	559	S4.D.1.2.2	Earth and Space Sci.
617071	4	Grade 3 to Grade 4	779	531	S4.A.3.1.4	Nature of Science
617091	4	Grade 3 to Grade 4	779	529	S4.B.1.1.5	Biological Sci.

**Table C–32. Science Items Used to Link Grade 4 to Grade 5**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617231	4	Grade 4 to Grade 5	1099	608	S4.C.2.1.1	Physical Sci.
617060	4	Grade 4 to Grade 5	527	606	S4.A.2.1.3	Nature of Science
617092	4	Grade 4 to Grade 5	524	607	S4.B.1.1.5	Biological Sci.
617074	4	Grade 4 to Grade 5	528	608	S4.A.3.2.2	Nature of Science
617246	4	Grade 4 to Grade 5	537	606	S4.D.1.1.2	Earth and Space Sci.
617237	4	Grade 4 to Grade 5	538	607	S4.C.2.1.4	Physical Sci.
617068	4	Grade 4 to Grade 5	536	607	S4.A.3.1.3	Nature of Science
617102	4	Grade 4 to Grade 5	534	604	S4.B.3.1.2	Biological Sci.
617075	4	Grade 4 to Grade 5	557	606	S4.A.3.2.2	Nature of Science
617259	4	Grade 4 to Grade 5	523	604	S4.D.1.3.3	Earth and Space Sci.
617072	4	Grade 4 to Grade 5	539	599	S4.A.3.2.1	Nature of Science
617240	4	Grade 4 to Grade 5	540	600	S4.C.3.1.2	Physical Sci.
617112	4	Grade 4 to Grade 5	533	600	S4.B.3.3.3	Biological Sci.
617080	4	Grade 4 to Grade 5	533	601	S4.A.3.3.1	Nature of Science
617257	4	Grade 4 to Grade 5	538	600	S4.D.1.3.1	Earth and Space Sci.
617271	4	Grade 4 to Grade 5	533	600	S4.D.3.1.3	Earth and Space Sci.
617089	4	Grade 4 to Grade 5	534	600	S4.B.1.1.4	Biological Sci.
617234	4	Grade 4 to Grade 5	527	600	S4.C.2.1.3	Physical Sci.
617070	4	Grade 4 to Grade 5	537	599	S4.A.3.1.4	Nature of Science
617260	4	Grade 4 to Grade 5	531	599	S4.D.1.3.3	Earth and Space Sci.
617311	5	Grade 4 to Grade 5	532	604	S5.B.1.1.2	Biological Sci.
616317	5	Grade 4 to Grade 5	533	609	S5.A.1.1.2	Nature of Science
615950	5	Grade 4 to Grade 5	532	616	S5.B.2.1.1	Biological Sci.
617328	5	Grade 4 to Grade 5	532	610	S5.C.3.2.1	Physical Sci.
617304	5	Grade 4 to Grade 5	533	598	S5.A.2.1.2	Nature of Science
615962	5	Grade 4 to Grade 5	533	606	S5.D.3.1.1	Earth and Space Sci.
615936	5	Grade 4 to Grade 5	533	633	S5.A.1.1.2	Nature of Science
617330	5	Grade 4 to Grade 5	532	636	S5.D.1.1.1	Earth and Space Sci.
615958	5	Grade 4 to Grade 5	532	629	S5.C.1.2.1	Physical Sci.
617307	5	Grade 4 to Grade 5	528	635	S5.A.2.2.1	Nature of Science
617338	5	Grade 4 to Grade 5	540	617	S5.D.1.2.2	Earth and Space Sci.
615939	5	Grade 4 to Grade 5	538	610	S5.A.2.1.1	Nature of Science
617504	5	Grade 4 to Grade 5	541	630	S5.B.3.2.2	Biological Sci.
616969	5	Grade 4 to Grade 5	541	637	S5.C.2.1.1	Physical Sci.
615943	5	Grade 4 to Grade 5	538	627	S5.B.1.1.1	Biological Sci.
617502	5	Grade 4 to Grade 5	539	616	S5.B.2.1.3	Biological Sci.
617499	5	Grade 4 to Grade 5	540	614	S5.A.1.1.3	Nature of Science

**Table C–32 (continued). Science Items Used to Link Grade 4 to Grade 5**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>
615965	5	Grade 4 to Grade 5	540	608	S5.D.1.1.1	Earth and Space Sci.
615942	5	Grade 4 to Grade 5	539	608	S5.A.3.1.1	Nature of Science
617507	5	Grade 4 to Grade 5	539	607	S5.C.2.1.2	Physical Sci.

**Table C–33. Science Items Used to Link Grade 5 to Grade 6**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617334	5	Grade 5 to Grade 6	605	621	S5.C.2.1.4	Physical Sci.
615949	5	Grade 5 to Grade 6	629	622	S5.B.1.1.3	Biological Sci.
615938	5	Grade 5 to Grade 6	608	622	S5.A.2.1.1	Nature of Science
615963	5	Grade 5 to Grade 6	617	623	S5.D.3.1.2	Earth and Space Sci.
615946	5	Grade 5 to Grade 6	617	621	S5.B.1.1.3	Biological Sci.
616968	5	Grade 5 to Grade 6	608	620	S5.C.1.2.2	Physical Sci.
617725	5	Grade 5 to Grade 6	602	620	S5.A.2.2.2	Nature of Science
616319	5	Grade 5 to Grade 6	637	618	S5.C.1.1.2	Physical Sci.
617318	5	Grade 5 to Grade 6	629	618	S5.B.3.1.2	Biological Sci.
616970	5	Grade 5 to Grade 6	637	617	S5.C.2.1.1	Physical Sci.
617339	5	Grade 5 to Grade 6	602	624	S5.D.1.2.1	Earth and Space Sci.
617729	5	Grade 5 to Grade 6	1215	623	S5.B.2.1.4	Biological Sci.
617501	5	Grade 5 to Grade 6	606	625	S5.A.1.1.3	Nature of Science
617342	5	Grade 5 to Grade 6	616	627	S5.D.2.1.2	Earth and Space Sci.
617310	5	Grade 5 to Grade 6	628	626	S5.A.3.2.1	Nature of Science
617326	5	Grade 5 to Grade 6	636	625	S5.C.2.1.4	Physical Sci.
617305	5	Grade 5 to Grade 6	617	625	S5.A.2.1.2	Nature of Science
617323	5	Grade 5 to Grade 6	1219	626	S5.C.1.1.1	Physical Sci.
617312	5	Grade 5 to Grade 6	634	618	S5.B.1.1.2	Biological Sci.
617327	5	Grade 5 to Grade 6	629	609	S5.C.2.1.4	Physical Sci.
615560	6	Grade 5 to Grade 6	614	623	S6.C.1.2.2	Physical Sci.
615518	6	Grade 5 to Grade 6	614	625	S6.A.2.2.1	Nature of Science
617741	6	Grade 5 to Grade 6	614	616	S6.B.2.1.2	Biological Sci.
615520	6	Grade 5 to Grade 6	614	619	S6.A.2.1.1	Nature of Science
615594	6	Grade 5 to Grade 6	614	624	S6.D.2.1.1	Earth and Space Sci.
619132	6	Grade 5 to Grade 6	614	617	S6.C.2.1.3	Physical Sci.
615554	6	Grade 5 to Grade 6	613	625	S6.B.3.2.1	Biological Sci.
615557	6	Grade 5 to Grade 6	613	620	S6.C.1.2.1	Physical Sci.
615514	6	Grade 5 to Grade 6	614	624	S6.A.1.1.3	Nature of Science
615603	6	Grade 5 to Grade 6	612	616	S6.D.3.1.2	Earth and Space Sci.
615574	6	Grade 5 to Grade 6	613	620	S6.C.2.1.3	Physical Sci.
618591	6	Grade 5 to Grade 6	612	625	S6.A.1.2.2	Nature of Science
615532	6	Grade 5 to Grade 6	612	621	S6.B.2.1.2	Biological Sci.
619296	6	Grade 5 to Grade 6	611	625	S6.A.2.1.1	Nature of Science
615601	6	Grade 5 to Grade 6	610	616	S6.D.3.1.1	Earth and Space Sci.
617512	6	Grade 5 to Grade 6	610	625	S6.C.2.1.1	Physical Sci.
615540	6	Grade 5 to Grade 6	610	624	S6.B.3.1.1	Biological Sci.

**Table C–33 (continued). Science Items Used to Link Grade 5 to Grade 6**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>
617508	6	Grade 5 to Grade 6	608	619	S6.B.1.1.1	Biological Sci.
615526	6	Grade 5 to Grade 6	608	620	S6.A.3.2.1	Nature of Science
619365	6	Grade 5 to Grade 6	608	618	S6.D.2.1.1	Earth and Space Sci.



**Table C–34. Science Items Used to Link Grade 6 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
615535	6	Grade 6 to Grade 7	1248	428	S6.A.3.2.1	Nature of Science
615562	6	Grade 6 to Grade 7	620	428	S6.C.1.2.2	Physical Sci.
615530	6	Grade 6 to Grade 7	1234	428	S6.B.2.1.1	Biological Sci.
619141	6	Grade 6 to Grade 7	616	426	S6.D.2.1.3	Earth and Space Sci.
615510	6	Grade 6 to Grade 7	1253	425	S6.A.1.1.2	Nature of Science
618609	6	Grade 6 to Grade 7	625	426	S6.C.3.1.2	Physical Sci.
618590	6	Grade 6 to Grade 7	1243	425	S6.A.1.2.1	Nature of Science
615576	6	Grade 6 to Grade 7	621	424	S6.C.2.1.3	Physical Sci.
615551	6	Grade 6 to Grade 7	621	424	S6.C.1.2.1	Physical Sci.
615512	6	Grade 6 to Grade 7	1233	423	S6.A.1.1.3	Nature of Science
615577	6	Grade 6 to Grade 7	619	428	S6.C.3.1.1	Physical Sci.
618791	6	Grade 6 to Grade 7	1235	428	S6.A.1.2.1	Nature of Science
615531	6	Grade 6 to Grade 7	1225	428	S6.B.2.1.1	Biological Sci.
619624	6	Grade 6 to Grade 7	627	428	S6.D.3.1.2	Earth and Space Sci.
616332	6	Grade 6 to Grade 7	1228	426	S6.A.1.1.3	Nature of Science
619149	6	Grade 6 to Grade 7	618	425	S6.C.3.2.1	Physical Sci.
617533	6	Grade 6 to Grade 7	1249	427	S6.B.2.1.1	Biological Sci.
618794	6	Grade 6 to Grade 7	624	426	S6.C.3.2.1	Physical Sci.
615517	6	Grade 6 to Grade 7	1245	426	S6.A.1.2.2	Nature of Science
615567	6	Grade 6 to Grade 7	616	425	S6.C.2.1.1	Physical Sci.
616616	7	Grade 6 to Grade 7	619	428	S7.D.1.1.2	Earth and Space Sci.
615235	7	Grade 6 to Grade 7	619	430	S7.B.1.1.2	Biological Sci.
617184	7	Grade 6 to Grade 7	616	424	S7.A.1.1.1	Nature of Science
618806	7	Grade 6 to Grade 7	618	427	S7.D.2.1.1	Earth and Space Sci.
615974	7	Grade 6 to Grade 7	618	443	S7.A.1.2.1	Nature of Science
618603	7	Grade 6 to Grade 7	617	439	S7.C.2.1.3	Physical Sci.
615973	7	Grade 6 to Grade 7	617	424	S7.A.1.1.4	Nature of Science
615275	7	Grade 6 to Grade 7	614	870	S7.B.3.3.2	Biological Sci.
615238	7	Grade 6 to Grade 7	609	427	S7.B.1.1.3	Biological Sci.
618802	7	Grade 6 to Grade 7	606	430	S7.C.2.1.1	Physical Sci.
617531	7	Grade 6 to Grade 7	624	424	S7.D.1.1.2	Earth and Space Sci.
616339	7	Grade 6 to Grade 7	626	431	S7.A.2.2.3	Nature of Science
615970	7	Grade 6 to Grade 7	625	429	S7.A.1.1.2	Nature of Science
616626	7	Grade 6 to Grade 7	625	443	S7.D.3.1.1	Earth and Space Sci.
617195	7	Grade 6 to Grade 7	626	444	S7.A.1.3.1	Nature of Science
617526	7	Grade 6 to Grade 7	624	422	S7.C.1.2.2	Physical Sci.
619627	7	Grade 6 to Grade 7	625	428	S7.A.1.1.4	Nature of Science

**Table C–34 (continued). Science Items Used to Link Grade 6 to Grade 7**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>
615252	7	Grade 6 to Grade 7	624	444	S7.B.2.1.3	Biological Sci.
615234	7	Grade 6 to Grade 7	620	427	S7.B.1.1.1	Biological Sci.
616039	7	Grade 6 to Grade 7	618	424	S7.C.2.1.3	Physical Sci.

**Table C–35. Science Items Used to Link Grade 8 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category
617198	7	Grade 8 to Grade 7	431	256	S7.A.1.3.2	Nature of Science
616619	7	Grade 8 to Grade 7	426	256	S7.D.1.2.2	Earth and Space Sci.
615969	7	Grade 8 to Grade 7	427	255	S7.A.1.1.1	Nature of Science
616038	7	Grade 8 to Grade 7	424	256	S7.C.2.1.2	Physical Sci.
616622	7	Grade 8 to Grade 7	427	254	S7.D.2.1.1	Earth and Space Sci.
615971	7	Grade 8 to Grade 7	429	254	S7.A.1.1.3	Nature of Science
615249	7	Grade 8 to Grade 7	425	255	S7.B.2.1.2	Biological Sci.
618803	7	Grade 8 to Grade 7	432	254	S7.D.2.1.1	Earth and Space Sci.
618801	7	Grade 8 to Grade 7	427	252	S7.C.2.1.3	Physical Sci.
615999	7	Grade 8 to Grade 7	423	251	S7.B.1.1.3	Biological Sci.
615308	7	Grade 8 to Grade 7	422	253	S7.C.3.1.3	Physical Sci.
618855	7	Grade 8 to Grade 7	430	254	S7.A.2.1.1	Nature of Science
618853	7	Grade 8 to Grade 7	425	254	S7.A.1.3.1	Nature of Science
616348	7	Grade 8 to Grade 7	438	254	S7.B.2.2.2	Biological Sci.
616621	7	Grade 8 to Grade 7	426	254	S7.D.1.2.3	Earth and Space Sci.
617000	7	Grade 8 to Grade 7	441	254	S7.D.3.1.3	Earth and Space Sci.
616014	7	Grade 8 to Grade 7	419	254	S7.B.3.1.1	Biological Sci.
617196	7	Grade 8 to Grade 7	441	252	S7.A.1.3.1	Nature of Science
616313	7	Grade 8 to Grade 7	430	251	S7.C.3.1.1	Physical Sci.
616007	7	Grade 8 to Grade 7	429	252	S7.B.2.1.2	Biological Sci.
615771	8	Grade 8 to Grade 7	445	262	S8.A.3.3.2	Nature of Science
617489	8	Grade 8 to Grade 7	445	257	S8.C.3.1.1	Physical Sci.
615784	8	Grade 8 to Grade 7	444	262	S8.B.2.1.1	Biological Sci.
620362	8	Grade 8 to Grade 7	444	271	S8.D.1.2.1	Earth and Space Sci.
618535	8	Grade 8 to Grade 7	444	267	S8.A.3.2.2	Nature of Science
617484	8	Grade 8 to Grade 7	444	258	S8.D.1.1.2	Earth and Space Sci.
618896	8	Grade 8 to Grade 7	443	272	S8.D.1.3.2	Earth and Space Sci.
615776	8	Grade 8 to Grade 7	443	255	S8.B.1.1.2	Biological Sci.
618543	8	Grade 8 to Grade 7	442	264	S8.C.2.2.2	Physical Sci.
617735	8	Grade 8 to Grade 7	441	287	S8.A.2.1.2	Nature of Science
617294	8	Grade 8 to Grade 7	432	262	S8.D.2.1.3	Earth and Space Sci.
617289	8	Grade 8 to Grade 7	432	255	S8.B.2.2.1	Biological Sci.
618544	8	Grade 8 to Grade 7	432	260	S8.C.2.2.2	Physical Sci.
620027	8	Grade 8 to Grade 7	432	289	S8.A.3.1.5	Nature of Science
617962	8	Grade 8 to Grade 7	432	259	S8.A.1.3.4	Nature of Science
615810	8	Grade 8 to Grade 7	432	267	S8.C.2.1.1	Physical Sci.
617279	8	Grade 8 to Grade 7	432	258	S8.B.1.1.1	Biological Sci.

**Table C–35 (continued). Science Items Used to Link Grade 8 to Grade 7**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>
617293	8	Grade 8 to Grade 7	430	286	S8.D.2.1.3	Earth and Space Sci.
620020	8	Grade 8 to Grade 7	430	256	S8.A.1.1.2	Nature of Science
620400	8	Grade 8 to Grade 7	430	255	S8.B.3.2.3	Biological Sci.

**Table C–36. Science Items Used to Link Biology to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Biology Diagnostic Category
615777	8	Biology to Grade 8	261	306	S8.B.1.1.3	Biological Sci.	Basic Bio. Princ.
615790	8	Biology to Grade 8	259	306	S8.B.2.1.3	Biological Sci.	Cell Growth
615817	8	Biology to Grade 8	519	306	S8.C.2.1.3	Physical Sci.	No Biology DC
620364	8	Biology to Grade 8	256	305	S8.D.1.3.1	Earth and Space Sci.	Theory of Evolution
617739	8	Biology to Grade 8	288	304	S8.A.2.1.4	Nature of Science	No Biology DC
615789	8	Biology to Grade 8	257	303	S8.B.2.1.2	Biological Sci.	Theory of Evolution
618786	8	Biology to Grade 8	257	305	S8.A.3.2.3	Nature of Science	No Biology DC
617059	8	Biology to Grade 8	266	306	S8.B.1.1.1	Biological Sci.	Basic Bio. Princ.
615791	8	Biology to Grade 8	529	305	S8.B.2.1.3	Biological Sci.	Cell Growth
617284	8	Biology to Grade 8	259	305	S8.B.2.1.3	Biological Sci.	Cell Growth
620015	8	Biology to Grade 8	254	298	S8.A.1.1.1	Nature of Science	No Biology DC
620396	8	Biology to Grade 8	256	298	S8.B.3.2.2	Biological Sci.	Theory of Evolution
617737	8	Biology to Grade 8	252	298	S8.A.2.1.3	Nature of Science	No Biology DC
617292	8	Biology to Grade 8	255	297	S8.B.2.2.2	Biological Sci.	Cell Growth
615822	8	Biology to Grade 8	542	298	S8.C.2.2.3	Physical Sci.	Theory of Evolution
620637	8	Biology to Grade 8	262	298	S8.B.3.1.3	Biological Sci.	Theory of Evolution
618540	8	Biology to Grade 8	259	298	S8.A.3.3.1	Nature of Science	No Biology DC
618548	8	Biology to Grade 8	260	298	S8.D.1.3.4	Earth and Space Sci.	Theory of Evolution
620029	8	Biology to Grade 8	522	298	S8.A.3.2.3	Nature of Science	No Biology DC
620401	8	Biology to Grade 8	259	298	S8.B.3.2.3	Biological Sci.	Theory of Evolution
617377	Bio	Biology to Grade 8	257	305	BIO.A.4.2.1	Biological Sci.	Bioenergetics
617565	Bio	Biology to Grade 8	256	311	BIO.B.4.2.5	Biological Sci.	Theory of Evolution
616111	Bio	Biology to Grade 8	256	303	BIO.A.1.2.1	Biological Sci.	Basic Bio. Princ.
617401	Bio	Biology to Grade 8	256	4874	BIO.B.2.1.1	Biological Sci.	Cell Growth
617430	Bio	Biology to Grade 8	256	309	BIO.B.3.1.1	Biological Sci.	Theory of Evolution
617395	Bio	Biology to Grade 8	256	310	BIO.B.1.2.2	Biological Sci.	Cell Growth
617013	Bio	Biology to Grade 8	257	311	BIO.A.2.2.3	Biological Sci.	Basic Bio. Princ.
617444	Bio	Biology to Grade 8	257	311	BIO.B.3.2.1	Biological Sci.	Theory of Evolution
617458	Bio	Biology to Grade 8	256	295	BIO.B.4.1.2	Biological Sci.	Theory of Evolution
617449	Bio	Biology to Grade 8	256	311	BIO.B.3.3.1	Biological Sci.	Theory of Evolution
617839	Bio	Biology to Grade 8	263	300	BIO.A.4.2.1	Biological Sci.	Bioenergetics
617462	Bio	Biology to Grade 8	263	297	BIO.B.3.3.1	Biological Sci.	Theory of Evolution
616112	Bio	Biology to Grade 8	263	305	BIO.A.1.2.1	Biological Sci.	Basic Bio. Princ.
617457	Bio	Biology to Grade 8	263	4863	BIO.B.4.1.2	Biological Sci.	Theory of Evolution
617394	Bio	Biology to Grade 8	262	296	BIO.B.1.2.2	Biological Sci.	Cell Growth
617454	Bio	Biology to Grade 8	263	310	BIO.B.4.1.1	Biological Sci.	Theory of Evolution
617349	Bio	Biology to Grade 8	263	309	BIO.A.3.1.1	Biological Sci.	Bioenergetics

**Table C–36 (continued). Science Items Used to Link Biology to Grade 8**

<b>Item ID</b>	<b>Item Grade</b>	<b>Link</b>	<b>N Count Lower Grade</b>	<b>N Count Upper Grade</b>	<b>Eligible Content</b>	<b>Science Diagnostic Category</b>	<b>Biology Diagnostic Category</b>
617414	Bio	Biology to Grade 8	263	300	BIO.B.2.2.2	Biological Sci.	Cell Growth
617880	Bio	Biology to Grade 8	263	305	BIO.B.2.2.2	Biological Sci.	Cell Growth
617451	Bio	Biology to Grade 8	263	298	BIO.B.3.3.1	Biological Sci.	Theory of Evolution

**Table C–37. Science Items Used to Link Chemistry to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Chemistry Diagnostic Category
615817	8	Chemistry to Grade 8	519	305	S8.C.2.1.3	Physical Sci.	Properties of Matter
615822	8	Chemistry to Grade 8	542	304	S8.C.2.2.3	Physical Sci.	No Chemistry DC
620029	8	Chemistry to Grade 8	522	307	S8.A.3.2.3	Nature of Science	No Chemistry DC
620025	8	Chemistry to Grade 8	258	308	S8.A.2.1.1	Nature of Science	No Chemistry DC
615819	8	Chemistry to Grade 8	261	308	S8.C.2.2.1	Physical Sci.	No Chemistry DC
620021	8	Chemistry to Grade 8	262	308	S8.A.1.1.3	Nature of Science	No Chemistry DC
615833	8	Chemistry to Grade 8	265	306	S8.D.1.1.2	Earth and Space Sci.	No Chemistry DC
615749	8	Chemistry to Grade 8	259	307	S8.A.2.2.3	Nature of Science	No Chemistry DC
620426	8	Chemistry to Grade 8	253	306	S8.B.3.3.4	Biological Sci.	No Chemistry DC
615723	8	Chemistry to Grade 8	270	305	S8.A.1.3.3	Nature of Science	No Chemistry DC
615809	8	Chemistry to Grade 8	511	307	S8.C.1.1.3	Physical Sci.	Chem. Relation.
615884	8	Chemistry to Grade 8	253	306	S8.A.2.1.1	Nature of Science	No Chemistry DC
615919	8	Chemistry to Grade 8	260	306	S8.C.1.1.1	Physical Sci.	Mole
620030	8	Chemistry to Grade 8	258	307	S8.A.3.2.3	Nature of Science	No Chemistry DC
620427	8	Chemistry to Grade 8	287	304	S8.B.3.3.4	Biological Sci.	No Chemistry DC
615927	8	Chemistry to Grade 8	266	305	S8.A.1.3.1	Nature of Science	No Chemistry DC
615826	8	Chemistry to Grade 8	262	306	S8.C.3.1.2	Physical Sci.	No Chemistry DC
620023	8	Chemistry to Grade 8	262	305	S8.A.1.3.2	Nature of Science	No Chemistry DC
615857	8	Chemistry to Grade 8	267	304	S8.D.2.1.1	Earth and Space Sci.	No Chemistry DC
615804	8	Chemistry to Grade 8	259	306	S8.C.1.1.1	Physical Sci.	Mole
616406	Chem	Chemistry to Grade 8	258	305	CHEM.A.2.1.2	Physical Sci.	Atomic Structure

**Table C–37 (continued). Science Items Used to Link Chemistry to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Science Diagnostic Category	Chemistry Diagnostic Category
618699	Chem	Chemistry to Grade 8	259	302	CHEM.B.2.1.5	Physical Sci.	Chem. Relation.
616511	Chem	Chemistry to Grade 8	259	299	CHEM.B.1.4.1	Physical Sci.	Mole
616362	Chem	Chemistry to Grade 8	258	303	CHEM.A.1.1.2	Physical Sci.	Properties of Matter
618734	Chem	Chemistry to Grade 8	259	307	CHEM.B.2.1.4	Physical Sci.	Chem. Relation.
616367	Chem	Chemistry to Grade 8	259	615	CHEM.A.1.2.2	Physical Sci.	Properties of Matter
616559	Chem	Chemistry to Grade 8	259	305	CHEM.A.1.1.5	Physical Sci.	Properties of Matter
619910	Chem	Chemistry to Grade 8	259	306	CHEM.B.1.4.2	Physical Sci.	Mole
616494	Chem	Chemistry to Grade 8	259	305	CHEM.A.1.2.3	Physical Sci.	Properties of Matter
616518	Chem	Chemistry to Grade 8	259	304	CHEM.B.2.1.5	Physical Sci.	Chem. Relation.
616427	Chem	Chemistry to Grade 8	260	306	CHEM.A.1.1.1	Physical Sci.	Properties of Matter
618726	Chem	Chemistry to Grade 8	260	309	CHEM.B.1.3.1	Physical Sci.	Mole
616365	Chem	Chemistry to Grade 8	260	301	CHEM.A.1.1.5	Physical Sci.	Properties of Matter
616516	Chem	Chemistry to Grade 8	260	306	CHEM.B.2.1.3	Physical Sci.	Chem. Relation.
618733	Chem	Chemistry to Grade 8	260	307	CHEM.B.2.1.3	Physical Sci.	Chem. Relation.
620468	Chem	Chemistry to Grade 8	260	315	CHEM.B.2.1.1	Physical Sci.	Chem. Relation.
616561	Chem	Chemistry to Grade 8	260	307	CHEM.A.1.2.2	Physical Sci.	Properties of Matter
616376	Chem	Chemistry to Grade 8	259	304	CHEM.A.2.3.1	Physical Sci.	Atomic Structure
616533	Chem	Chemistry to Grade 8	259	306	CHEM.A.2.2.2	Physical Sci.	Atomic Structure
618698	Chem	Chemistry to Grade 8	259	302	CHEM.B.2.1.4	Physical Sci.	Chem. Relation.



Tables C–38 through C–44 summarize the number of linking items by diagnostic category. Items coded in a Science diagnostic category and a Biology or Chemistry diagnostic category are noted.

**Table C–38. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 3 Items</b>	<b>Grade 4 Items</b>	<b>Total</b>
Nature of Science	6	6	12
Biological Sciences	7	6	13
Physical Sciences	2	3	5
Earth and Space Sciences	5	5	10
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–39. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 4 Items</b>	<b>Grade 5 Items</b>	<b>Total</b>
Nature of Science	7	7	14
Biological Sciences	4	5	9
Physical Sciences	4	4	8
Earth and Space Sciences	5	4	9
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–40. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 5 Items</b>	<b>Grade 6 Items</b>	<b>Total</b>
Nature of Science	5	6	11
Biological Sciences	5	5	10
Physical Sciences	7	5	12
Earth and Space Sciences	3	4	7
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–41. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 6 Items</b>	<b>Grade 7 Items</b>	<b>Total</b>
Nature of Science	7	7	14
Biological Sciences	3	5	8
Physical Sciences	8	4	12
Earth and Space Sciences	2	4	6
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–42. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 7 Items</b>	<b>Grade 8 Items</b>	<b>Total</b>
Nature of Science	6	6	12
Biological Sciences	5	5	10
Physical Sciences	4	4	8
Earth and Space Sciences	5	5	10
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–43a. Number of Items Linking Biology to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Biology Items</b>	<b>Total</b>
Nature of Science	6	0	6
Biological Sciences	10	20	30
Physical Sciences	2	0	2
Earth and Space Sciences	2	0	2
No Grade 8 DC	0	0	0
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–43b. Number of Items Linking Biology to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Biology Items</b>	<b>Total</b>
Basic Biological Principles	2	3	5
Bioenergetics	0	3	3
Cell Growth	4	5	9
Theory of Evolution	7	9	16
No Biology DC	7	0	7
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–44a. Number of Items Linking Chemistry to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Chemistry Items</b>	<b>Total</b>
Nature of Science	9	0	9
Biological Sciences	2	0	2
Physical Sciences	7	20	27
Earth and Space Sciences	2	0	2
No Grade 8 DC	0	0	0
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

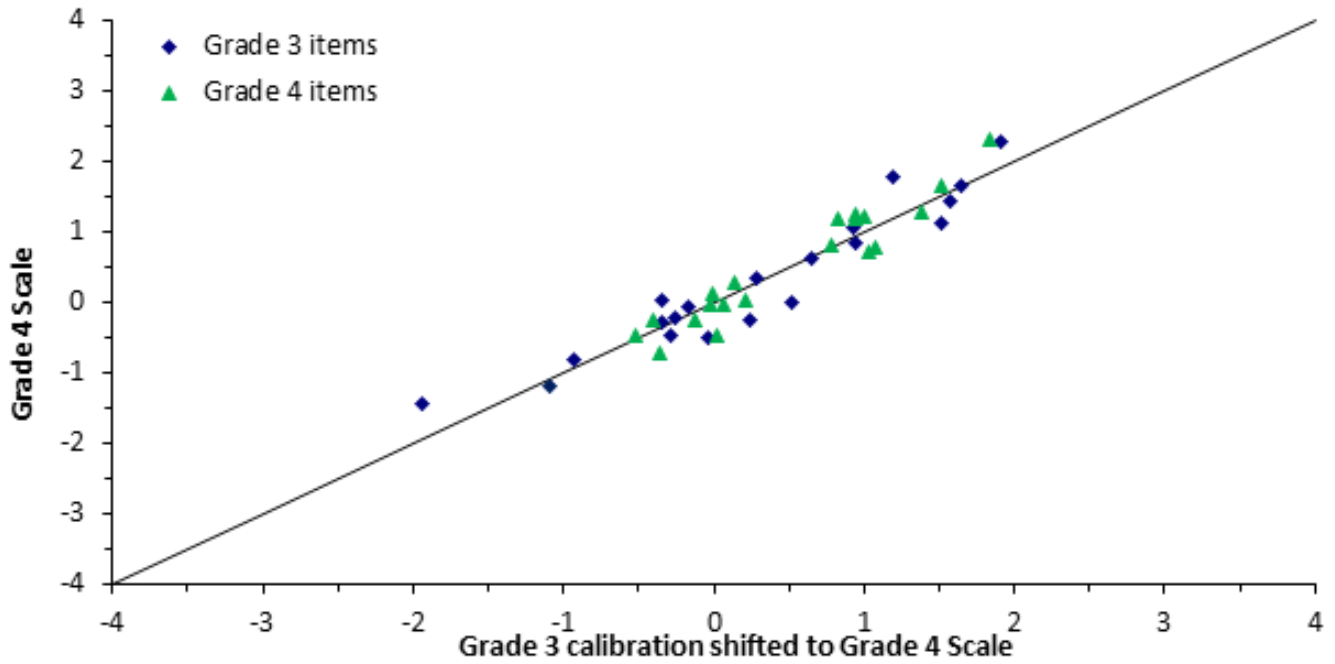
**Table C–44b. Number of Items Linking Chemistry to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Chemistry Items</b>	<b>Total</b>
Properties of Matter	1	7	8
Atomic Structure	0	3	3
The Mole	2	3	5
Chemical Relationships	1	7	8
No Chemistry DC	16	0	16
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>



Figures C–15 through C–21 are the adjacent grade linking plots. Items removed from final linking procedure are colored red.

**Figure C–15. CDT Science: Grade 3 to Grade 4 Linking – All Links**



**Figure C–16. CDT Science: Grade 4 to Grade 5 Linking – All Links**

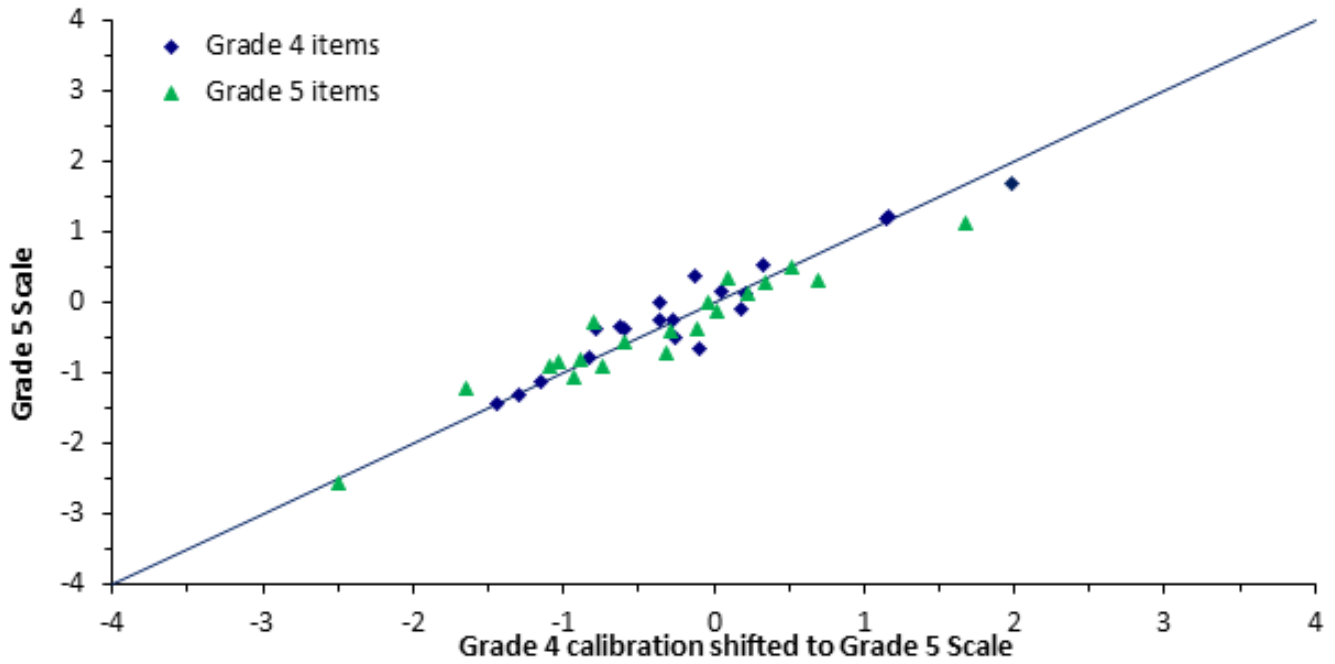


Figure C-17. CDT Science: Grade 5 to Grade 6 Linking – All Links

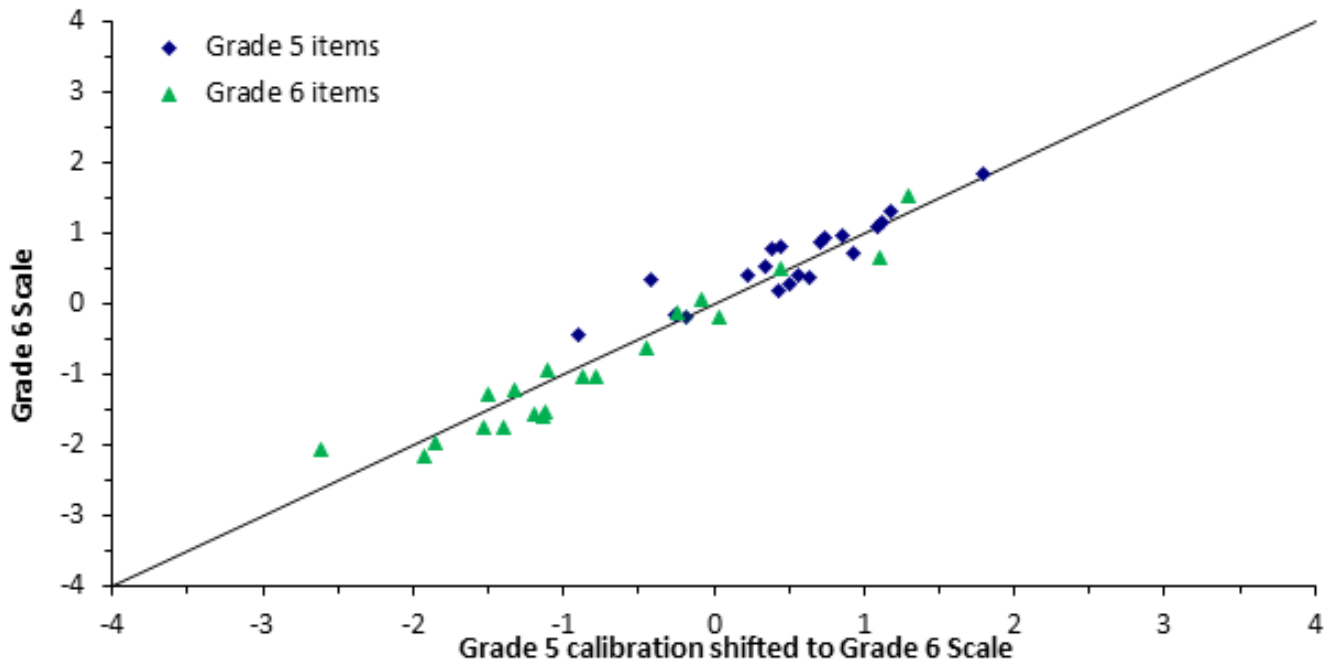


Figure C-18. CDT Science: Grade 6 to Grade 7 Linking – All Links

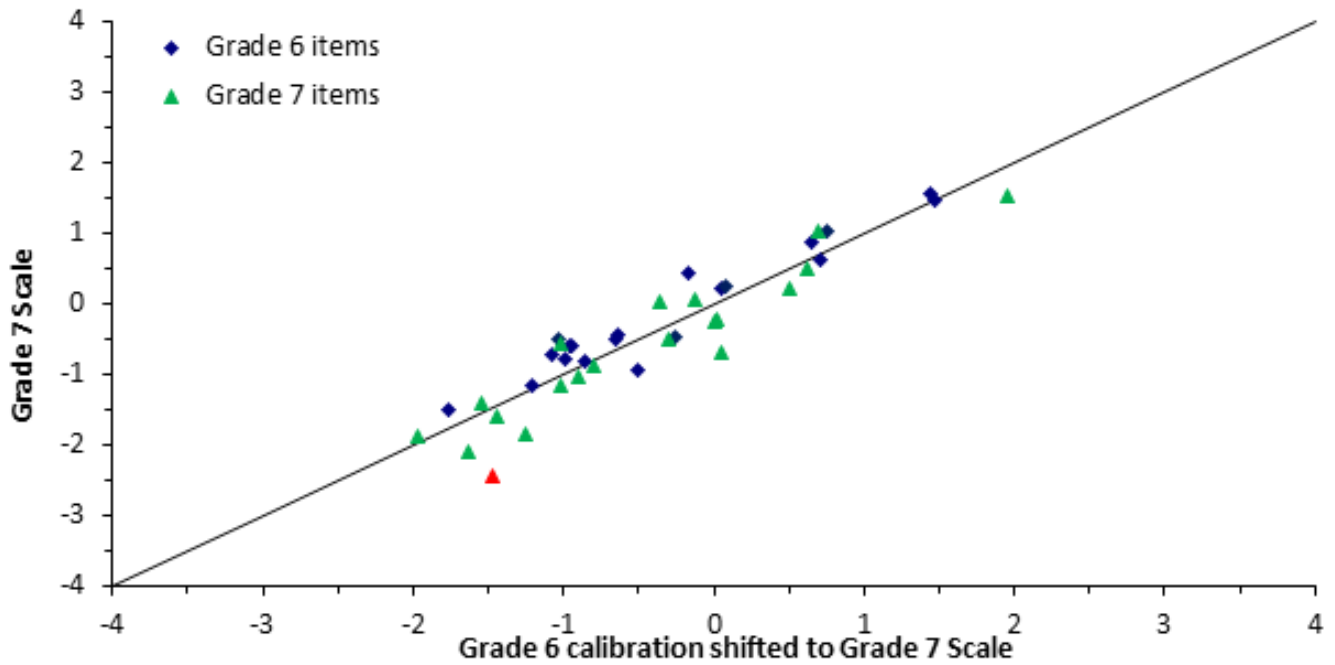


Figure C-19. CDT Science: Grade 8 to Grade 7 Linking – All Links

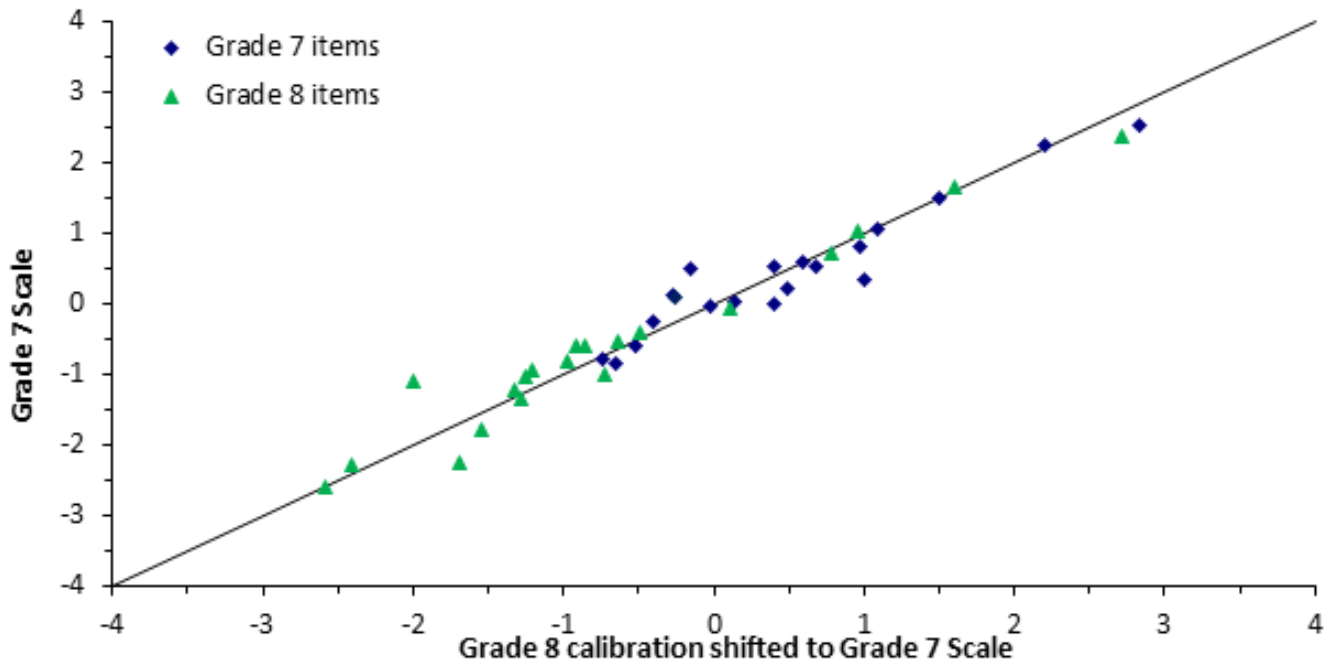


Figure C-20. CDT Science: Biology to Grade 8 Linking – All Links

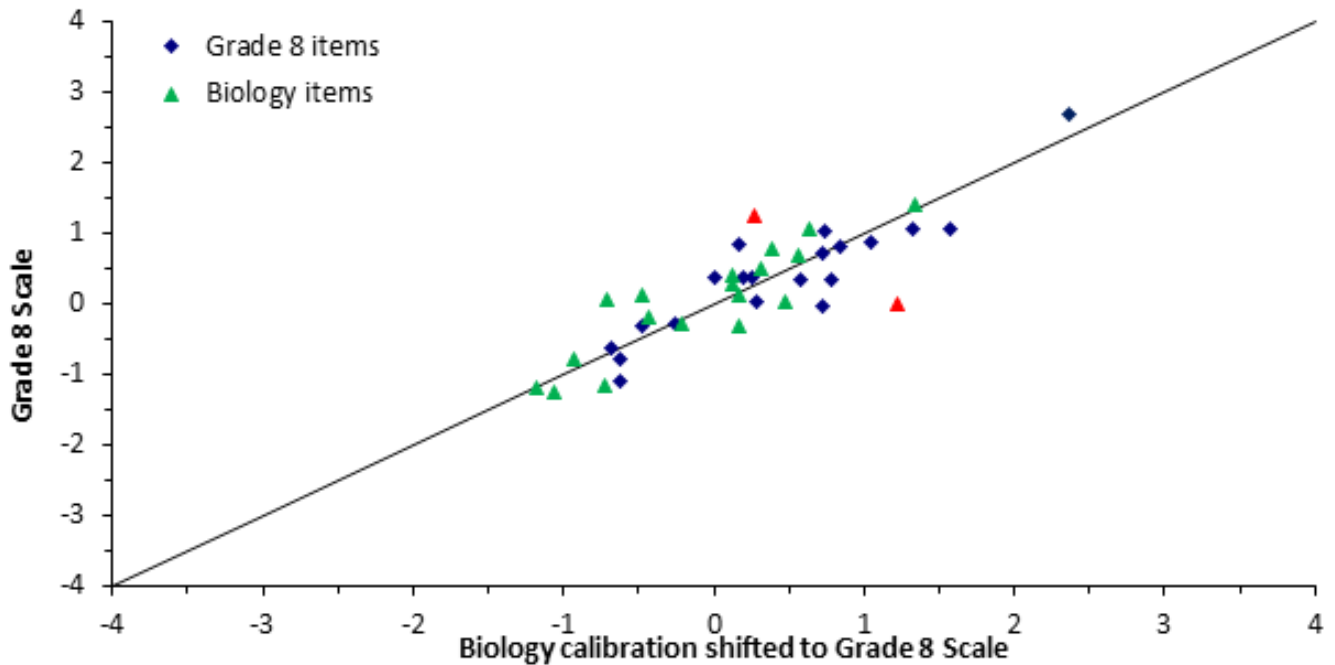
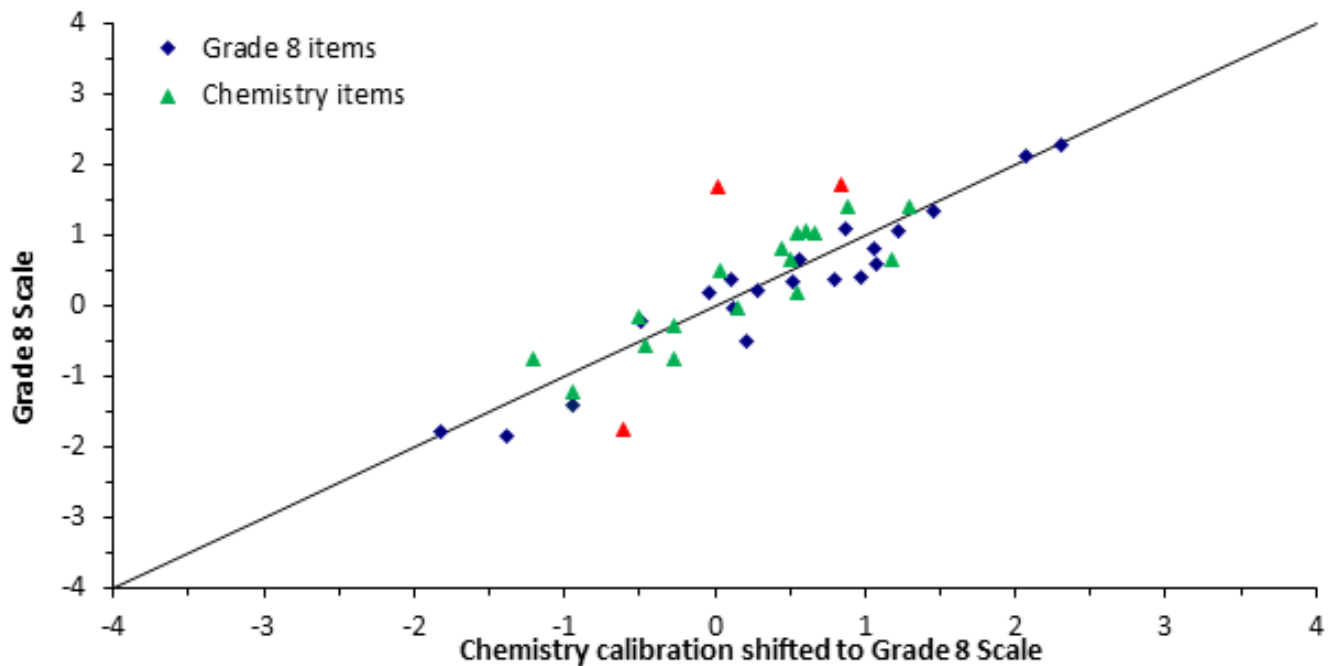


Figure C–21. CDT Science: Chemistry to Grade 8 Linking – All Links



## WRITING/ENGLISH COMPOSITION

Tables C–46 through C–51 show n-counts, eligible content code, and diagnostic category for each of the vertical linking items.

Each item was administered in two grades so there are two n-counts: one for the lower grade and one for the upper grade. For example, item 626547 is a grade 3 item used to link grades 3 and 4. It was administered 274 times on the lower grade form (grade 3) and 234 times on the upper grade form (grade 4).

The diagnostic categories are<sup>4</sup>:

- Quality of Writing: Focus and Content
- Quality of Writing: Organization and Style
- Quality of Writing: Editing
- Conventions: Spelling, Capitalization, and Punctuation
- Conventions: Grammar and Sentence Formation

<sup>4</sup> Writing diagnostic categories changed at the start of the 2013–2014 school year due to re-alignment to the Pennsylvania Core Standards. See Chapter Thirteen for a list of the current diagnostic categories.

**Table C–46. Writing/English Composition Items Used to Link Grade 3 to Grade 4**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
626547	3	Grade 3 to Grade 4	274	234	W.1.5.3.Fb	Spell., Cap., Punct.
621012	3	Grade 3 to Grade 4	276	234	W.1.5.3.Fd	Gram. and Sent.
634030	3	Grade 3 to Grade 4	277	234	W.1.5.3.Fa	Spell., Cap., Punct.
634160	3	Grade 3 to Grade 4	275	234	W.1.5.3.D	Org and Style
623056	3	Grade 3 to Grade 4	275	234	W.1.5.3.C	Org and Style
621006	3	Grade 3 to Grade 4	277	234	W.1.5.3.Fd	Gram. and Sent.
624801	3	Grade 3 to Grade 4	276	234	W.1.5.3.A	Focus and Content
623023	3	Grade 3 to Grade 4	274	234	W.1.5.3.Fd	Gram. and Sent.
622985	3	Grade 3 to Grade 4	274	234	W.1.5.3.B	Focus and Content
624847	3	Grade 3 to Grade 4	277	234	W.1.5.3.Fc	Spell., Cap., Punct.
624849	3	Grade 3 to Grade 4	276	232	W.1.5.3.Fb	Spell., Cap., Punct.
622465	3	Grade 3 to Grade 4	277	232	W.1.5.3.Fd	Gram. and Sent.
634029	3	Grade 3 to Grade 4	275	232	W.1.5.3.Fa	Spell., Cap., Punct.
634162	3	Grade 3 to Grade 4	275	232	W.1.5.3.D	Org and Style
626574	3	Grade 3 to Grade 4	277	232	W.1.5.3.C	Org and Style
636550	3	Grade 3 to Grade 4	276	232	W.1.5.3.Fd	Gram. and Sent.
622979	3	Grade 3 to Grade 4	274	232	W.1.5.3.A	Focus and Content
621008	3	Grade 3 to Grade 4	274	232	W.1.5.3.Fd	Gram. and Sent.
623107	3	Grade 3 to Grade 4	276	232	W.1.5.3.B	Focus and Content
625516	3	Grade 3 to Grade 4	275	232	W.1.5.3.Fc	Spell., Cap., Punct.
623113	4	Grade 3 to Grade 4	274	233	W.1.5.4.C	Org and Style
637175	4	Grade 3 to Grade 4	274	232	W.1.5.4.D	Org and Style
633445	4	Grade 3 to Grade 4	274	235	W.1.5.4.Fa	Spell., Cap., Punct.
635414	4	Grade 3 to Grade 4	274	233	W.1.5.4.A	Focus and Content
639852	4	Grade 3 to Grade 4	274	234	W.1.5.4.Fc	Spell., Cap., Punct.
623033	4	Grade 3 to Grade 4	274	232	W.1.5.4.Fb	Spell., Cap., Punct.
623013	4	Grade 3 to Grade 4	274	233	W.1.5.4.B	Focus and Content
633852	4	Grade 3 to Grade 4	274	233	W.1.5.4.C	Org and Style
624765	4	Grade 3 to Grade 4	274	233	W.1.5.4.Fd	Gram. and Sent.
625527	4	Grade 3 to Grade 4	274	232	W.1.5.4.E	Editing
627004	4	Grade 3 to Grade 4	275	232	W.1.5.4.E	Editing
637177	4	Grade 3 to Grade 4	275	235	W.1.5.4.D	Org and Style
633432	4	Grade 3 to Grade 4	275	233	W.1.5.4.Fa	Spell., Cap., Punct.
633464	4	Grade 3 to Grade 4	275	234	W.1.5.4.A	Focus and Content
639854	4	Grade 3 to Grade 4	275	232	W.1.5.4.Fc	Spell., Cap., Punct.
623136	4	Grade 3 to Grade 4	275	233	W.1.5.4.Fb	Spell., Cap., Punct.
635900	4	Grade 3 to Grade 4	275	233	W.1.5.4.B	Focus and Content
635412	4	Grade 3 to Grade 4	275	233	W.1.5.4.C	Org and Style
630419	4	Grade 3 to Grade 4	275	232	W.1.5.4.Fd	Gram. and Sent.
630295	4	Grade 3 to Grade 4	275	235	W.1.5.4.E	Editing



**Table C–47. Writing/English Composition Items Used to Link Grade 4 to Grade 5**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
623017	4	Grade 4 to Grade 5	235	221	W.1.5.4.E	Editing
625455	4	Grade 4 to Grade 5	233	221	W.1.5.4.A	Focus and Content
622453	4	Grade 4 to Grade 5	234	221	W.1.5.4.E	Editing
623135	4	Grade 4 to Grade 5	232	221	W.1.5.4.Fb	Spell., Cap., Punct.
632573	4	Grade 4 to Grade 5	233	221	W.1.5.4.Fd	Gram. and Sent.
623020	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
633435	4	Grade 4 to Grade 5	233	221	W.1.5.4.Fa	Spell., Cap., Punct.
623108	4	Grade 4 to Grade 5	232	221	W.1.5.4.B	Focus and Content
633468	4	Grade 4 to Grade 5	235	221	W.1.5.4.C	Org and Style
627696	4	Grade 4 to Grade 5	233	221	W.1.5.4.Fc	Spell., Cap., Punct.
623115	4	Grade 4 to Grade 5	233	221	W.1.5.4.E	Editing
622983	4	Grade 4 to Grade 5	234	221	W.1.5.4.A	Focus and Content
622454	4	Grade 4 to Grade 5	232	221	W.1.5.4.E	Editing
621395	4	Grade 4 to Grade 5	233	221	W.1.5.4.Fb	Spell., Cap., Punct.
632587	4	Grade 4 to Grade 5	233	221	W.1.5.4.Fd	Gram. and Sent.
623019	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
634025	4	Grade 4 to Grade 5	232	221	W.1.5.4.Fa	Spell., Cap., Punct.
626922	4	Grade 4 to Grade 5	235	221	W.1.5.4.B	Focus and Content
633469	4	Grade 4 to Grade 5	233	221	W.1.5.4.C	Org and Style
628471	4	Grade 4 to Grade 5	234	221	W.1.5.4.Fc	Spell., Cap., Punct.
637149	5	Grade 4 to Grade 5	233	218	W.1.5.5.Fd	Gram. and Sent.
633440	5	Grade 4 to Grade 5	233	221	W.1.5.5.Fa	Spell., Cap., Punct.
635884	5	Grade 4 to Grade 5	233	221	W.1.5.5.E	Editing
637062	5	Grade 4 to Grade 5	233	218	W.1.5.5.Fd	Gram. and Sent.
623027	5	Grade 4 to Grade 5	233	220	W.1.5.5.Fd	Gram. and Sent.
622469	5	Grade 4 to Grade 5	233	221	W.1.5.5.Fb	Spell., Cap., Punct.
639843	5	Grade 4 to Grade 5	233	222	W.1.5.5.Fc	Spell., Cap., Punct.
635417	5	Grade 4 to Grade 5	233	221	W.1.5.5.C	Org and Style
620819	5	Grade 4 to Grade 5	233	220	W.1.5.5.C	Org and Style
635605	5	Grade 4 to Grade 5	233	221	W.1.5.5.C	Org and Style
637148	5	Grade 4 to Grade 5	232	221	W.1.5.5.C	Org and Style
633439	5	Grade 4 to Grade 5	232	221	W.1.5.5.Fa	Spell., Cap., Punct.
620820	5	Grade 4 to Grade 5	232	218	W.1.5.5.E	Editing
626566	5	Grade 4 to Grade 5	232	220	W.1.5.5.Fd	Gram. and Sent.
623129	5	Grade 4 to Grade 5	232	221	W.1.5.5.Fd	Gram. and Sent.
629858	5	Grade 4 to Grade 5	232	222	W.1.5.5.Fb	Spell., Cap., Punct.
639864	5	Grade 4 to Grade 5	232	221	W.1.5.5.Fc	Spell., Cap., Punct.
627291	5	Grade 4 to Grade 5	232	220	W.1.5.5.C	Org and Style
639349	5	Grade 4 to Grade 5	232	218	W.1.5.5.C	Org and Style
626818	5	Grade 4 to Grade 5	232	221	W.1.5.5.C	Org and Style

**Table C–48. Writing/English Composition Items Used to Link Grade 5 to Grade 6**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
623105	5	Grade 5 to Grade 6	221	303	W.1.5.5.A	Focus and Content
626927	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.d	Gram. and Sent.
632608	5	Grade 5 to Grade 6	220	303	W.1.5.5.E	Editing
625460	5	Grade 5 to Grade 6	221	303	W.1.5.5.C	Org and Style
626923	5	Grade 5 to Grade 6	222	303	W.1.5.5.E	Editing
628065	5	Grade 5 to Grade 6	221	303	W.1.5.5.F.b	Spell., Cap., Punct.
633443	5	Grade 5 to Grade 6	220	303	W.1.5.5.F.a	Spell., Cap., Punct.
621390	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.c	Spell., Cap., Punct.
626820	5	Grade 5 to Grade 6	221	303	W.1.5.5.E	Editing
624842	5	Grade 5 to Grade 6	218	303	W.1.5.5.F.d	Gram. and Sent.
624800	5	Grade 5 to Grade 6	218	304	W.1.5.5.A	Focus and Content
627413	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.d	Gram. and Sent.
630403	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
624804	5	Grade 5 to Grade 6	222	304	W.1.5.5.C	Org and Style
626570	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
624773	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.b	Spell., Cap., Punct.
633442	5	Grade 5 to Grade 6	218	304	W.1.5.5.F.a	Spell., Cap., Punct.
629854	5	Grade 5 to Grade 6	221	304	W.1.5.5.F.c	Spell., Cap., Punct.
623060	5	Grade 5 to Grade 6	221	304	W.1.5.5.E	Editing
627488	5	Grade 5 to Grade 6	220	304	W.1.5.5.F.d	Gram. and Sent.
624292	6	Grade 5 to Grade 6	221	304	W.1.5.6.E	Editing
626934	6	Grade 5 to Grade 6	221	303	W.1.5.6.A	Focus and Content
627013	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.b	Spell., Cap., Punct.
632646	6	Grade 5 to Grade 6	221	305	W.1.5.6.F.d	Gram. and Sent.
624829	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.d	Gram. and Sent.
630378	6	Grade 5 to Grade 6	221	304	W.1.5.6.B	Focus and Content
624297	6	Grade 5 to Grade 6	221	303	W.1.5.6.C	Org and Style
635654	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.c	Spell., Cap., Punct.
639363	6	Grade 5 to Grade 6	221	305	W.1.5.6.C	Org and Style
633448	6	Grade 5 to Grade 6	221	304	W.1.5.6.F.a	Spell., Cap., Punct.
623114	6	Grade 5 to Grade 6	222	303	W.1.5.6.E	Editing
626932	6	Grade 5 to Grade 6	222	304	W.1.5.6.A	Focus and Content
635660	6	Grade 5 to Grade 6	222	305	W.1.5.6.F.b	Spell., Cap., Punct.
626822	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.d	Gram. and Sent.
625478	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.d	Gram. and Sent.
626776	6	Grade 5 to Grade 6	222	303	W.1.5.6.B	Focus and Content
624296	6	Grade 5 to Grade 6	222	304	W.1.5.6.C	Org and Style
628055	6	Grade 5 to Grade 6	222	305	W.1.5.6.F.c	Spell., Cap., Punct.
627289	6	Grade 5 to Grade 6	222	304	W.1.5.6.C	Org and Style
633444	6	Grade 5 to Grade 6	222	304	W.1.5.6.F.a	Spell., Cap., Punct.

**Table C–49. Writing/English Composition Items Used to Link Grade 6 to Grade 7**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
633446	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fa	Spell., Cap., Punct.
635619	6	Grade 6 to Grade 7	305	279	W.1.5.6.D	Org and Style
635662	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fb	Spell., Cap., Punct.
623111	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624754	6	Grade 6 to Grade 7	303	279	W.1.5.6.Fd	Gram. and Sent.
628060	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fc	Spell., Cap., Punct.
627415	6	Grade 6 to Grade 7	305	279	W.1.5.6.Fd	Gram. and Sent.
624287	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624763	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fd	Gram. and Sent.
627960	6	Grade 6 to Grade 7	303	279	W.1.5.6.A	Focus and Content
633447	6	Grade 6 to Grade 7	305	279	W.1.5.6.Fa	Spell., Cap., Punct.
639392	6	Grade 6 to Grade 7	304	279	W.1.5.6.D	Org and Style
635661	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fb	Spell., Cap., Punct.
624289	6	Grade 6 to Grade 7	303	279	W.1.5.6.E	Editing
624756	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fd	Gram. and Sent.
628061	6	Grade 6 to Grade 7	305	279	W.1.5.6.Fc	Spell., Cap., Punct.
628112	6	Grade 6 to Grade 7	304	279	W.1.5.6.Fd	Gram. and Sent.
626567	6	Grade 6 to Grade 7	304	279	W.1.5.6.E	Editing
624840	6	Grade 6 to Grade 7	303	279	W.1.5.6.Fd	Gram. and Sent.
627030	6	Grade 6 to Grade 7	304	279	W.1.5.6.A	Focus and Content
627052	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fd	Gram. and Sent.
639447	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fd	Gram. and Sent.
627058	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fd	Gram. and Sent.
639380	7	Grade 6 to Grade 7	303	279	W.1.5.7.A	Focus and Content
624286	7	Grade 6 to Grade 7	303	280	W.1.5.7.B	Focus and Content
624822	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fb	Spell., Cap., Punct.
636003	7	Grade 6 to Grade 7	303	280	W.1.5.7.C	Org and Style
633454	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fa	Spell., Cap., Punct.
635909	7	Grade 6 to Grade 7	303	279	W.1.5.7.D	Org and Style
634300	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fc	Spell., Cap., Punct.
626992	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fd	Gram. and Sent.
639438	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fd	Gram. and Sent.
628116	7	Grade 6 to Grade 7	303	279	W.1.5.7.Fd	Gram. and Sent.
626764	7	Grade 6 to Grade 7	303	280	W.1.5.7.A	Focus and Content
639394	7	Grade 6 to Grade 7	303	280	W.1.5.7.B	Focus and Content
628476	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fb	Spell., Cap., Punct.
636008	7	Grade 6 to Grade 7	303	280	W.1.5.7.C	Org and Style
633455	7	Grade 6 to Grade 7	303	279	W.1.5.7.Fa	Spell., Cap., Punct.
639420	7	Grade 6 to Grade 7	303	280	W.1.5.7.D	Org and Style
634299	7	Grade 6 to Grade 7	303	280	W.1.5.7.Fc	Spell., Cap., Punct.

**Table C–50. Writing/English Composition Items Used to Link Grade 7 to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
627684	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fd	Gram. and Sent.
625487	7	Grade 8 to Grade 7	279	145	W.1.5.7.Fd	Gram. and Sent.
627464	7	Grade 8 to Grade 7	280	145	W.1.5.7.A	Focus and Content
639375	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633458	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fa	Spell., Cap., Punct.
626996	7	Grade 8 to Grade 7	280	145	W.1.5.7.E	Editing
628098	7	Grade 8 to Grade 7	279	145	W.1.5.7.Fb	Spell., Cap., Punct.
639358	7	Grade 8 to Grade 7	280	145	W.1.5.7.B	Focus and Content
635665	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fc	Spell., Cap., Punct.
627361	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
627056	7	Grade 8 to Grade 7	279	145	W.1.5.7.Fd	Gram. and Sent.
639407	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fd	Gram. and Sent.
626943	7	Grade 8 to Grade 7	280	145	W.1.5.7.A	Focus and Content
639364	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633457	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fa	Spell., Cap., Punct.
626997	7	Grade 8 to Grade 7	279	145	W.1.5.7.Fd	Gram. and Sent.
630429	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fb	Spell., Cap., Punct.
625506	7	Grade 8 to Grade 7	280	145	W.1.5.7.B	Focus and Content
635668	7	Grade 8 to Grade 7	280	145	W.1.5.7.Fc	Spell., Cap., Punct.
627362	7	Grade 8 to Grade 7	280	145	W.1.5.7.C	Org and Style
633498	8	Grade 8 to Grade 7	279	144	W.1.5.8.Fa	Spell., Cap., Punct.
639580	8	Grade 8 to Grade 7	279	145	W.1.5.8.C	Org and Style
624848	8	Grade 8 to Grade 7	279	143	W.1.5.8.Fb	Spell., Cap., Punct.
639612	8	Grade 8 to Grade 7	279	144	W.1.5.8.B	Focus and Content
628115	8	Grade 8 to Grade 7	279	144	W.1.5.8.Fd	Gram. and Sent.
627963	8	Grade 8 to Grade 7	279	144	W.1.5.8.A	Focus and Content
628311	8	Grade 8 to Grade 7	279	145	W.1.5.8.Fd	Gram. and Sent.
628242	8	Grade 8 to Grade 7	279	143	W.1.5.8.B	Focus and Content
639857	8	Grade 8 to Grade 7	279	144	W.1.5.8.Fc	Spell., Cap., Punct.
639441	8	Grade 8 to Grade 7	279	144	W.1.5.8.Fd	Gram. and Sent.
633497	8	Grade 8 to Grade 7	280	145	W.1.5.8.Fa	Spell., Cap., Punct.
639588	8	Grade 8 to Grade 7	280	143	W.1.5.8.C	Org and Style
625522	8	Grade 8 to Grade 7	280	144	W.1.5.8.Fb	Spell., Cap., Punct.
639610	8	Grade 8 to Grade 7	280	144	W.1.5.8.B	Focus and Content
624828	8	Grade 8 to Grade 7	280	144	W.1.5.8.Fd	Gram. and Sent.
625520	8	Grade 8 to Grade 7	280	145	W.1.5.8.A	Focus and Content
625508	8	Grade 8 to Grade 7	280	143	W.1.5.8.Fd	Gram. and Sent.
626775	8	Grade 8 to Grade 7	280	144	W.1.5.8.B	Focus and Content
639856	8	Grade 8 to Grade 7	280	144	W.1.5.8.Fc	Spell., Cap., Punct.
639439	8	Grade 8 to Grade 7	280	144	W.1.5.8.Fd	Gram. and Sent.

**Table C–51. Writing/English Composition Items Used to Link English Composition to Grade 8**

Item ID	Item Grade	Link	N Count Lower Grade	N Count Upper Grade	Eligible Content	Writing/Composition Diagnostic Category
636213	8	English Comp to Grade 8	143	173	W.1.5.8.Fd	Gram. and Sent.
639599	8	English Comp to Grade 8	144	173	W.1.5.8.C	Org and Style
633503	8	English Comp to Grade 8	144	173	W.1.5.8.Fa	Spell., Cap., Punct.
629857	8	English Comp to Grade 8	144	173	W.1.5.8.Fb	Spell., Cap., Punct.
634156	8	English Comp to Grade 8	145	173	W.1.5.8.Fc	Spell., Cap., Punct.
639577	8	English Comp to Grade 8	143	173	W.1.5.8.E	Editing
635385	8	English Comp to Grade 8	144	173	W.1.5.8.Fd	Gram. and Sent.
635351	8	English Comp to Grade 8	144	173	W.1.5.8.Fd	Gram. and Sent.
627964	8	English Comp to Grade 8	144	173	W.1.5.8.A	Focus and Content
626786	8	English Comp to Grade 8	145	173	W.1.5.8.C	Org and Style
636212	8	English Comp to Grade 8	144	171	W.1.5.8.Fd	Gram. and Sent.
639597	8	English Comp to Grade 8	144	171	W.1.5.8.C	Org and Style
633502	8	English Comp to Grade 8	144	171	W.1.5.8.Fa	Spell., Cap., Punct.
629860	8	English Comp to Grade 8	145	171	W.1.5.8.Fb	Spell., Cap., Punct.
634157	8	English Comp to Grade 8	143	171	W.1.5.8.Fc	Spell., Cap., Punct.
639608	8	English Comp to Grade 8	144	171	W.1.5.8.E	Editing
635386	8	English Comp to Grade 8	144	171	W.1.5.8.Fd	Gram. and Sent.
635350	8	English Comp to Grade 8	144	171	W.1.5.8.Fd	Gram. and Sent.
628143	8	English Comp to Grade 8	145	171	W.1.5.8.A	Focus and Content
626785	8	English Comp to Grade 8	143	171	W.1.5.8.C	Org and Style
622816	EC	English Comp to Grade 8	143	173	C.E.1.1.1	Focus and Content
639932	EC	English Comp to Grade 8	143	173	C.E.3.1.5	Gram. and Sent.
639920	EC	English Comp to Grade 8	143	171	C.E.3.1.4	Gram. and Sent.
634313	EC	English Comp to Grade 8	143	173	C.E.3.1.2	Spell., Cap., Punct.
633540	EC	English Comp to Grade 8	143	172	C.E.3.1.1	Spell., Cap., Punct.
622613	EC	English Comp to Grade 8	143	173	C.E.1.1.3	Org and Style
623126	EC	English Comp to Grade 8	143	173	C.E.3.1.4	Gram. and Sent.
639971	EC	English Comp to Grade 8	143	174	C.E.1.1.2	Focus and Content
629853	EC	English Comp to Grade 8	143	174	C.E.3.1.3	Spell., Cap., Punct.
630391	EC	English Comp to Grade 8	143	173	C.E.1.1.3	Org and Style
622815	EC	English Comp to Grade 8	145	174	C.P.1.1.1	Focus and Content
639933	EC	English Comp to Grade 8	145	173	C.E.3.1.5	Gram. and Sent.
639919	EC	English Comp to Grade 8	145	173	C.E.3.1.4	Gram. and Sent.
634349	EC	English Comp to Grade 8	145	174	C.E.3.1.2	Spell., Cap., Punct.
633536	EC	English Comp to Grade 8	145	174	C.E.3.1.1	Spell., Cap., Punct.
622611	EC	English Comp to Grade 8	145	174	C.E.1.1.3	Org and Style
621166	EC	English Comp to Grade 8	145	173	C.E.3.1.4	Gram. and Sent.
630659	EC	English Comp to Grade 8	145	173	C.E.1.1.2	Focus and Content
629822	EC	English Comp to Grade 8	145	173	C.E.3.1.3	Spell., Cap., Punct.
630392	EC	English Comp to Grade 8	145	171	C.E.1.1.3	Org and Style

Tables C–52 through C–57 summarize the number of linking items by diagnostic category.

**Table C–52. Number of Items Linking Grade 3 to Grade 4 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 3 Items</b>	<b>Grade 4 Items</b>	<b>Total</b>
Focus and Content	4	4	8
Org and Style	4	5	9
Editing	0	3	3
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	2	8
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–53. Number of Items Linking Grade 4 to Grade 5 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 4 Items</b>	<b>Grade 5 Items</b>	<b>Total</b>
Focus and Content	4	0	4
Org and Style	4	7	11
Editing	4	2	6
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	2	5	7
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–54. Number of Items Linking Grade 5 to Grade 6 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 5 Items</b>	<b>Grade 6 Items</b>	<b>Total</b>
Focus and Content	2	4	6
Org and Style	2	4	6
Editing	6	2	8
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	4	4	8
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–55. Number of Items Linking Grade 6 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 6 Items</b>	<b>Grade 7 Items</b>	<b>Total</b>
Focus and Content	2	4	6
Org and Style	2	4	6
Editing	4	0	4
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	6	12
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–56. Number of Items Linking Grade 8 to Grade 7 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 7 Items</b>	<b>Grade 8 Items</b>	<b>Total</b>
Focus and Content	4	6	10
Org and Style	4	2	6
Editing	1	0	1
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	5	6	11
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

**Table C–57. Number of Items Linking English Composition to Grade 8 by Diagnostic Category**

<b>Diagnostic Category</b>	<b>Grade 8 Items</b>	<b>Eng Comp Items</b>	<b>Total</b>
Focus and Content	2	4	6
Org and Style	4	4	8
Editing	2	0	2
Spell., Cap., Punct.	6	6	12
Gram. and Sent.	6	6	12
<b>TOTAL</b>	<b>20</b>	<b>20</b>	<b>40</b>

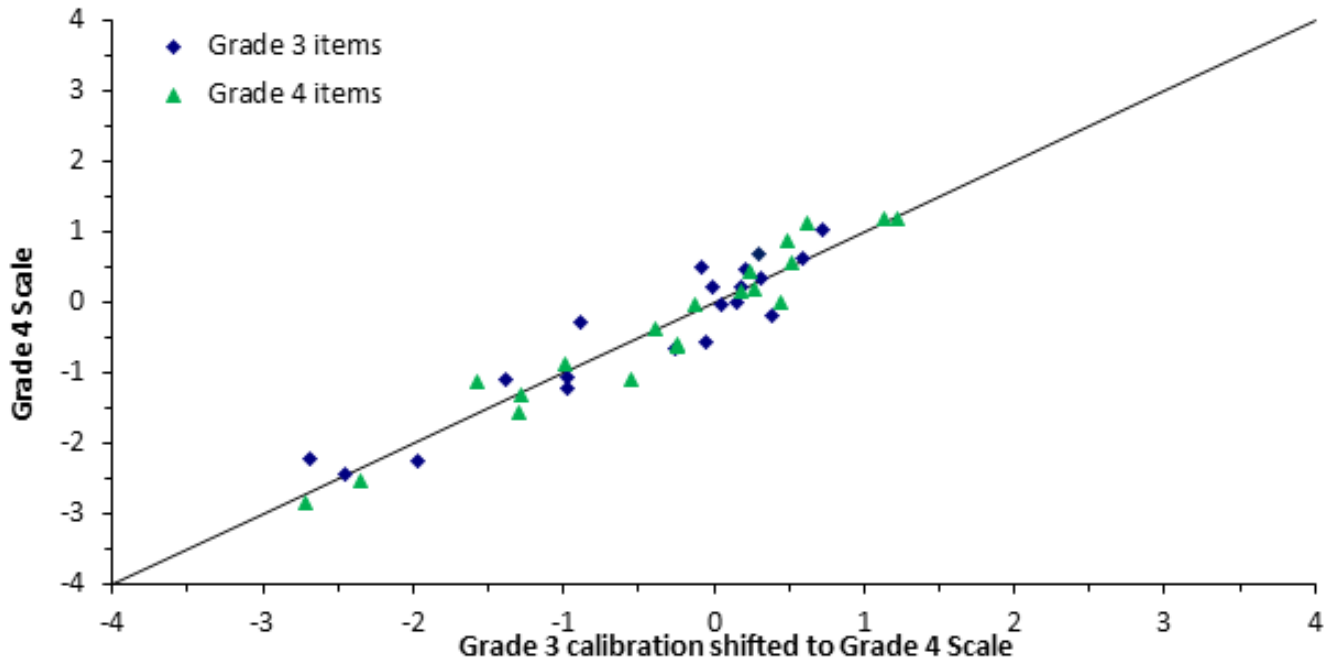
**Table C–58. Writing/English Composition Example of Vertical Linking Workbook**

Item ID	Item Grade	Grade 4 Calibration			Grade 5 Calibration			Discrepancy	Grade 4 on		Flag
		Difficulty	Fit	Displace	Difficulty	Fit	Displace		Grade 5 Scale	Robust Z	
623017	4	-0.784	0.910	-0.006	-0.927	0.910	0.000	-0.143	-1.005	0.233	
625455	4	-0.205	1.030	-0.001	0.132	1.010	0.001	0.337	-0.426	1.437	
622453	4	-0.955	0.910	0.003	-1.526	0.860	0.000	-0.571	-1.176	-0.840	
623135	4	1.520	1.200	0.005	1.516	1.110	0.001	-0.004	1.299	0.582	
632573	4	0.527	1.250	-0.002	0.872	1.190	0.001	0.345	0.306	1.457	
623020	4	-1.254	0.890	-0.001	-1.487	0.900	0.000	-0.233	-1.475	0.008	
633435	4	-0.452	1.020	-0.003	-0.441	0.910	0.000	0.011	-0.673	0.620	
623108	4	-0.152	0.830	0.000	0.025	0.920	0.000	0.177	-0.373	1.036	
633468	4	-0.857	0.900	-0.006	-0.475	0.860	0.000	0.382	-1.078	1.550	
627696	4	1.837	1.210	-0.001	1.968	1.140	0.001	0.131	1.616	0.921	
623115	4	-0.678	0.960	-0.001	-1.072	0.890	-0.003	-0.394	-0.899	-0.396	
622983	4	-0.797	1.020	0.003	-1.360	0.980	-0.003	-0.563	-1.018	-0.820	
622454	4	0.922	1.070	0.005	0.483	1.000	-0.002	-0.439	0.701	-0.509	
621395	4	1.634	1.080	-0.002	0.998	1.090	-0.002	-0.636	1.413	-1.003	
632587	4	0.650	0.830	-0.001	0.149	0.980	-0.002	-0.501	0.429	-0.665	
623019	4	-1.134	0.990	-0.003	-1.611	1.020	-0.003	-0.477	-1.355	-0.605	
634025	4	-0.885	0.960	0.000	-1.496	0.920	-0.003	-0.611	-1.106	-0.941	
626922	4	0.516	1.000	-0.006	0.159	0.970	-0.002	-0.357	0.295	-0.304	
633469	4	-0.151	0.880	-0.001	-0.121	0.900	-0.002	0.030	-0.372	0.667	
628471	4	2.662	1.140	0.003	2.119	1.130	-0.001	-0.543	2.441	-0.770	
637149	5	-2.406	0.960	0.003	-2.126	0.960	0.005	0.280	-2.627	1.294	
633440	5	-0.302	1.040	0.003	-0.227	0.960	0.001	0.075	-0.523	0.780	
635884	5	-1.607	0.840	0.003	-1.708	0.870	-0.001	-0.101	-1.828	0.339	
637062	5	0.739	1.110	0.004	0.794	1.170	0.000	0.055	0.518	0.730	
623027	5	-0.341	0.780	0.003	-0.917	0.800	-0.004	-0.576	-0.562	-0.853	
622469	5	1.057	1.110	0.004	0.730	1.000	0.000	-0.327	0.836	-0.228	
639843	5	-0.548	0.910	0.003	-1.127	0.990	-0.002	-0.579	-0.769	-0.860	
635417	5	0.499	1.050	0.004	0.561	1.050	-0.005	0.062	0.278	0.747	
620819	5	0.739	0.970	0.004	0.337	0.950	-0.005	-0.402	0.518	-0.416	
635605	5	1.417	1.220	0.004	1.437	1.080	0.001	0.020	1.196	0.642	
637148	5	-0.606	0.950	0.002	-1.440	0.920	0.001	-0.834	-0.827	-1.500	
633439	5	0.404	1.100	0.002	0.544	1.050	-0.001	0.140	0.183	0.943	
620820	5	0.287	0.950	0.002	0.089	0.960	0.000	-0.198	0.066	0.095	
626566	5	-0.764	0.860	0.002	-1.003	0.860	-0.004	-0.239	-0.985	-0.008	
623129	5	-1.331	0.800	0.002	-1.323	0.820	0.000	0.008	-1.552	0.612	
629858	5	1.124	1.020	0.003	0.983	1.020	-0.002	-0.141	0.903	0.238	
639864	5	-0.729	0.950	0.002	-1.075	0.900	-0.005	-0.346	-0.950	-0.276	
627291	5	0.515	0.880	0.002	0.008	0.970	-0.005	-0.507	0.294	-0.680	
639349	5	0.658	1.040	0.002	0.285	0.890	0.005	-0.373	0.437	-0.344	
626818	5	1.722	0.970	0.003	0.913	0.990	-0.001	-0.809	1.501	-1.437	
	<b>Mean</b>	0.062			-0.159			-0.221	-0.159	0.037	
	<b>SD</b>	1.088			1.095			0.330	1.088	0.828	
	<b>SD Ratio</b>	0.993									
	<b>Correlation</b>	0.954									
	<b>Add. Constant</b>	-0.221									
	<b>Median</b>							-0.236			
	<b>Q</b>							0.539			



Figures C-22 through C-27 are the adjacent grade linking plots. No items were removed from final linking procedure so there are no red items in these plots.

**Figure C-22. CDT Writing/English Composition: Grade 3 to Grade 4 Linking – All Links**



**Figure C-23. CDT Writing/English Composition: Grade 4 to Grade 5 Linking – All Links**

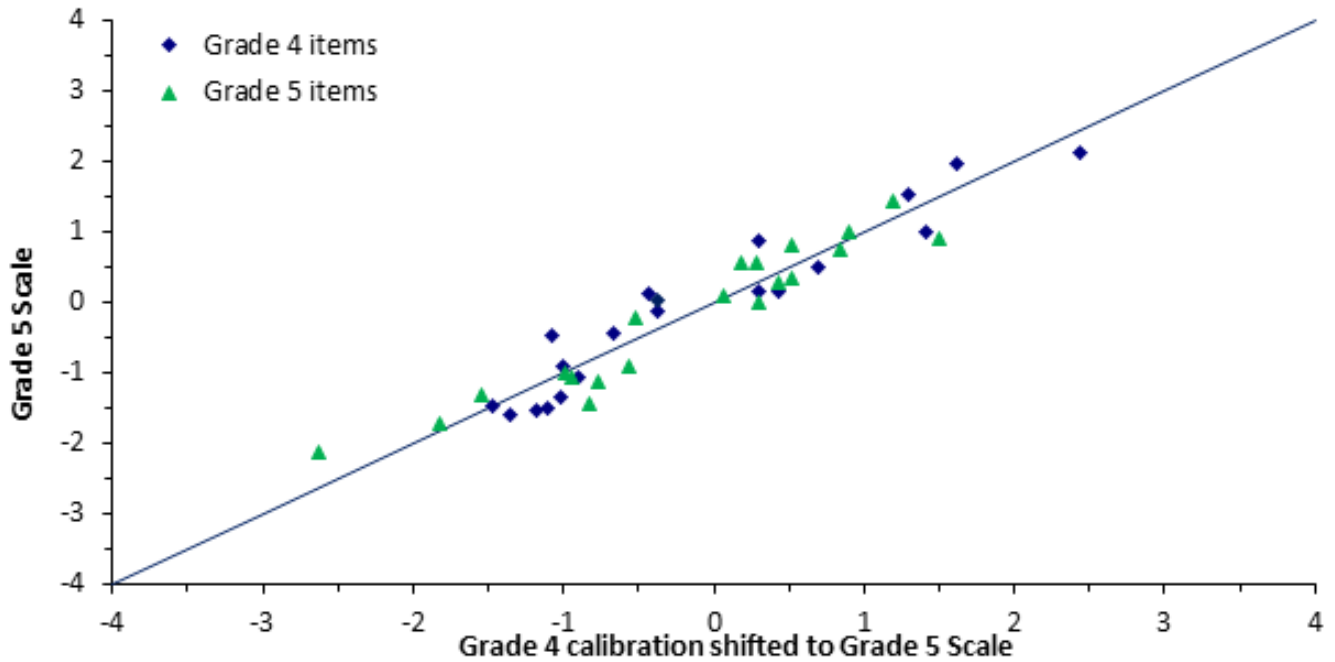


Figure C-24. CDT Writing/English Composition: Grade 5 to Grade 6 Linking – All Links

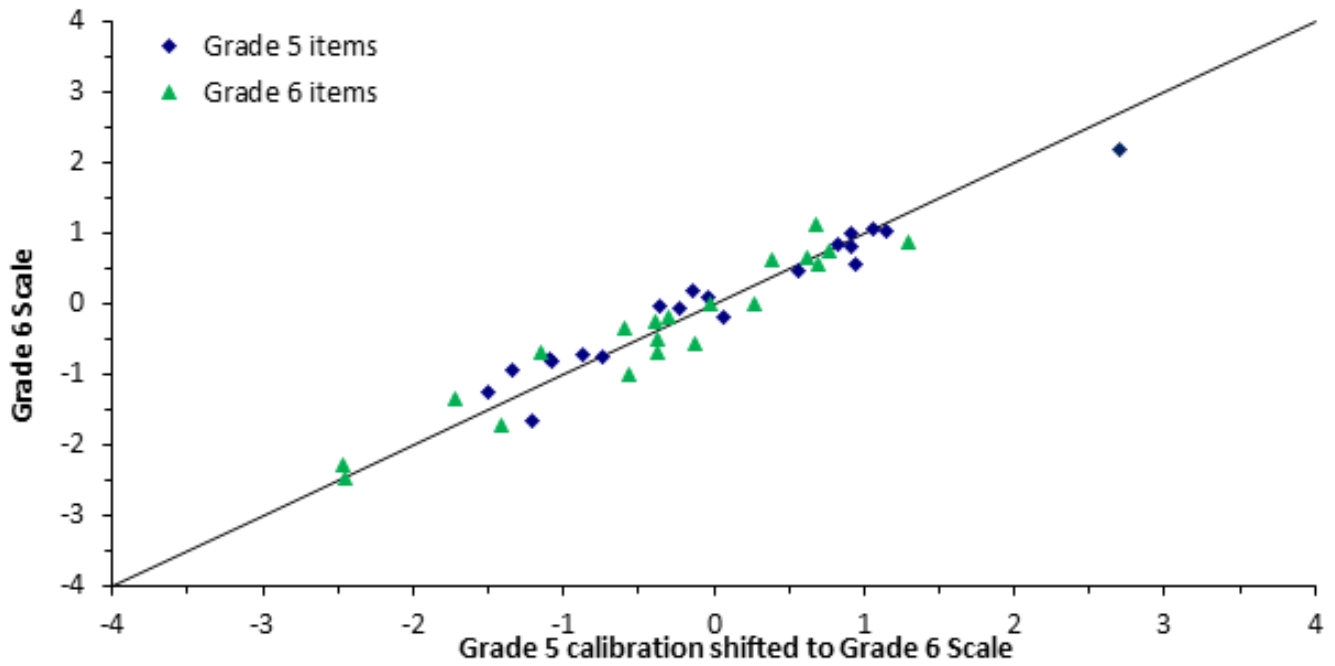


Figure C-25. CDT Writing/English Composition: Grade 6 to Grade 7 Linking – All Links

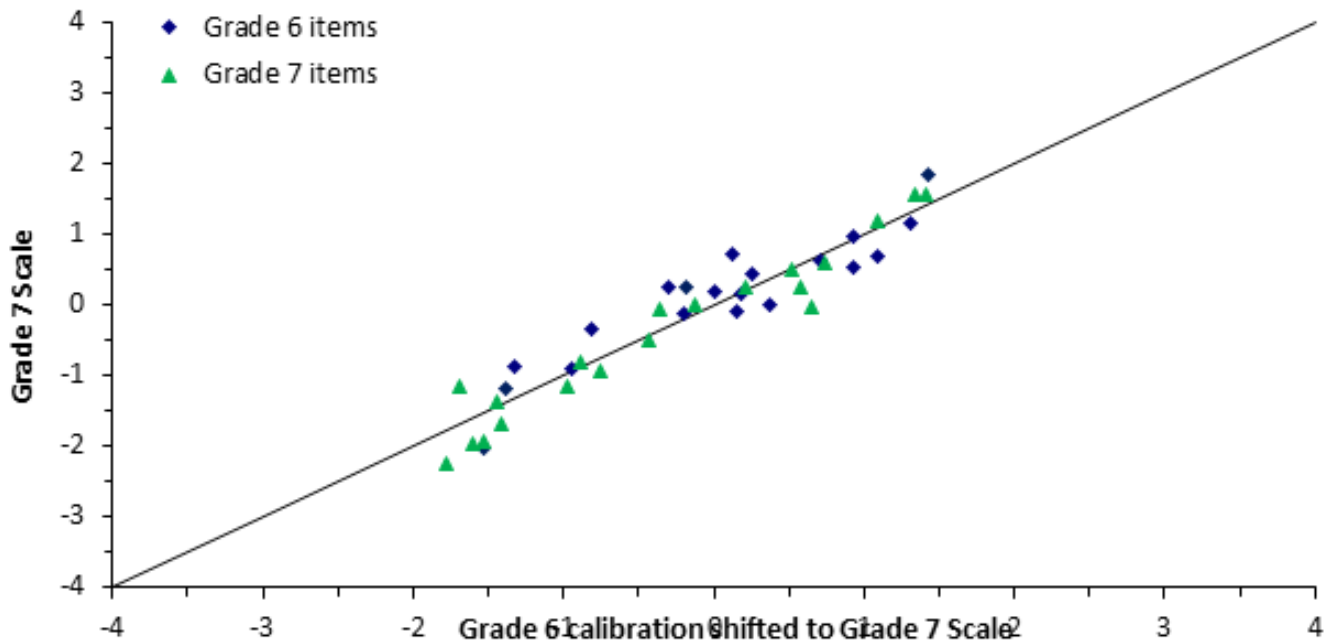


Figure C-26. CDT Writing/English Composition: Grade 8 to Grade 7 Linking – All Links

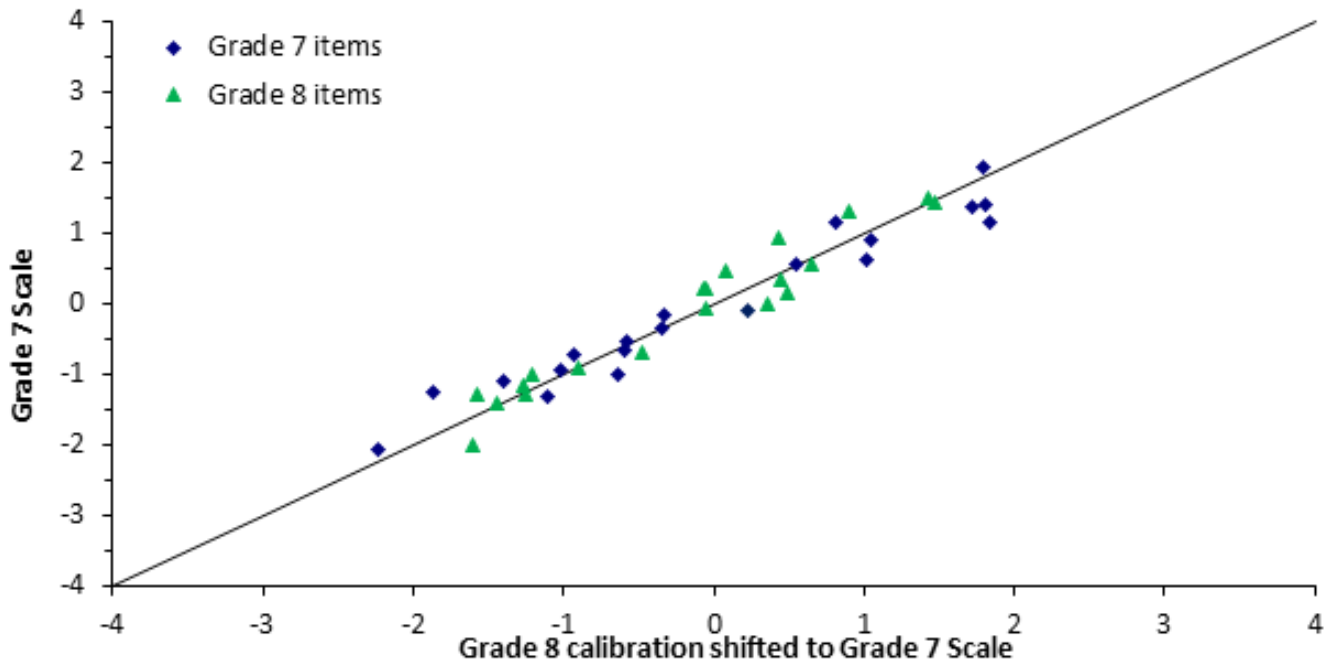
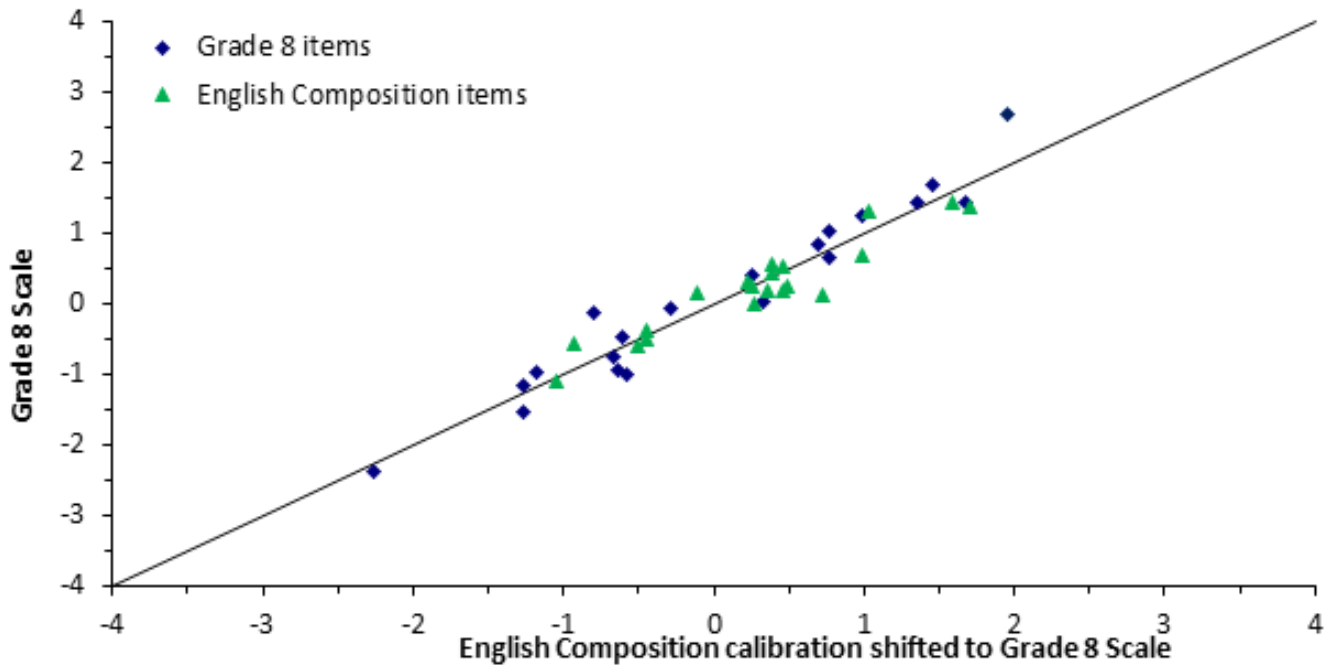


Figure C-27. CDT Writing/English Composition: Literature to Grade 8 Linking – All Links



## APPENDIX D: SIGNIFICANT DIFFERENCES AMONG DIAGNOSTIC CATEGORIES

In Chapter Fifteen (Operational Administration 2023–2024), significant differences among diagnostic categories were tested with a t-test using a Bonferroni correction for multiple comparisons to keep the familywise Type I error rate at 0.32. The tables in this appendix show the significant differences with the familywise Type I error rate at 0.10.

### DIAGNOSTIC CATEGORY SIGNIFICANT DIFFERENCES

**Table D–1a. Diagnostic Category Significant Differences – Math Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	730	130,484	0.6%	99.4%
DC1	DC3	1,282	129,932	1.0%	99.0%
DC1	DC4	836	130,378	0.6%	99.4%
DC2	DC3	1,315	129,899	1.0%	99.0%
DC2	DC4	810	130,404	0.6%	99.4%
DC3	DC4	1,232	129,982	0.9%	99.1%

Note: Z value is 2.39

**Table D–1b. Total Number of Diagnostic Category Significant Differences – Math Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	126,530	96.4%
1	3,496	2.7%
2	868	0.7%
3	307	0.2%
4	13	0.0%
5	0	0.0%
6	0	0.0%

**Table D–2a. Diagnostic Category Significant Differences – Math Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	1,913	182,753	1.0%	99.0%
DC1	DC3	2,282	182,384	1.2%	98.8%
DC1	DC4	2,227	182,439	1.2%	98.8%
DC2	DC3	2,008	182,658	1.1%	98.9%
DC2	DC4	2,125	182,541	1.2%	98.8%
DC3	DC4	2,238	182,428	1.2%	98.8%

Note: Z value is 2.39

**Table D–2b. Total Number of Diagnostic Category Significant Differences – Math Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	175,331	94.9%
1	6,569	3.6%
2	2,121	1.1%
3	598	0.3%
4	47	0.0%
5	0	0.0%
6	0	0.0%

**Table D–3a. Diagnostic Category Significant Differences – Algebra I**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	2,946	102,901	2.8%	97.2%
DC1	DC3	2,606	103,241	2.5%	97.5%
DC1	DC4	3,073	102,774	2.9%	97.1%
DC2	DC3	819	105,028	0.8%	99.2%
DC2	DC4	1,517	104,330	1.4%	98.6%
DC3	DC4	1,544	104,303	1.5%	98.5%

Note: Z value is 2.39

**Table D–3b. Total Number of Diagnostic Category Significant Differences – Algebra I**

Number of Significant Differences	Number of Students	Percent of Students
0	96,694	91.4%
1	6,447	6.1%
2	2,101	2.0%
3	564	0.5%
4	41	0.0%
5	0	0.0%
6	0	0.0%

**Table D–4a. Diagnostic Category Significant Differences – Geometry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	158	8,329	1.9%	98.1%
DC1	DC3	170	8,317	2.0%	98.0%
DC1	DC4	178	8,309	2.1%	97.9%
DC2	DC3	179	8,308	2.1%	97.9%
DC2	DC4	228	8,259	2.7%	97.3%
DC3	DC4	208	8,279	2.5%	97.5%

Note: Z value is 2.39

**Table D-4b. Total Number of Diagnostic Category Significant Differences – Geometry**

Number of Significant Differences	Number of Students	Percent of Students
0	7,747	91.3%
1	457	5.4%
2	196	2.3%
3	76	0.9%
4	11	0.1%
5	0	0.0%
6	0	0.0%

**Table D-5a. Diagnostic Category Significant Differences – Algebra II**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	573	11,205	4.9%	95.1%
DC1	DC3	404	11,374	3.4%	96.6%
DC1	DC4	878	10,900	7.5%	92.5%
DC2	DC3	185	11,593	1.6%	98.4%
DC2	DC4	274	11,504	2.3%	97.7%
DC3	DC4	232	11,546	2.0%	98.0%

Note: Z value is 2.39

**Table D-5b. Total Number of Diagnostic Category Significant Differences – Algebra II**

Number of Significant Differences	Number of Students	Percent of Students
0	10,147	86.2%
1	952	8.1%
2	457	3.9%
3	209	1.8%
4	12	0.1%
5	1	0.0%
6	0	0.0%

**Table D-6a. Diagnostic Category Significant Differences – Reading Grades 3-5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	13	110,936	0.0%	100.0%
DC1	DC3	16	110,933	0.0%	100.0%
DC1	DC4	15	110,934	0.0%	100.0%
DC1	DC5	17	110,932	0.0%	100.0%
DC2	DC3	18	110,931	0.0%	100.0%
DC2	DC4	19	110,930	0.0%	100.0%
DC2	DC5	22	110,927	0.0%	100.0%
DC3	DC4	15	110,934	0.0%	100.0%
DC3	DC5	47	110,902	0.0%	100.0%
DC4	DC5	33	110,916	0.0%	100.0%

Note: Z value is 2.58

**Table D-6b. Total Number of Diagnostic Category Significant Differences – Reading Grades 3-5**

Number of Significant Differences	Number of Students	Percent of Students
0	110,762	99.8%
1	164	0.1%
2	18	0.0%
3	5	0.0%
4	0	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table D–7a. Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	42	284,287	0.0%	100.0%
DC1	DC3	35	284,294	0.0%	100.0%
DC1	DC4	45	284,284	0.0%	100.0%
DC1	DC5	79	284,250	0.0%	100.0%
DC2	DC3	48	284,281	0.0%	100.0%
DC2	DC4	26	284,303	0.0%	100.0%
DC2	DC5	114	284,215	0.0%	100.0%
DC3	DC4	41	284,288	0.0%	100.0%
DC3	DC5	185	284,144	0.1%	99.9%
DC4	DC5	113	284,216	0.0%	100.0%

Note: Z value is 2.58

**Table D–7b. Total Number of Diagnostic Category Significant Differences – Reading/Lit Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	283,670	99.8%
1	597	0.2%
2	55	0.0%
3	7	0.0%
4	0	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table D–8a. Diagnostic Category Significant Differences – Science Grades 3–5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	200	47,134	0.4%	99.6%
DC1	DC3	172	47,162	0.4%	99.6%
DC1	DC4	185	47,149	0.4%	99.6%
DC2	DC3	231	47,103	0.5%	99.5%
DC2	DC4	201	47,133	0.4%	99.6%
DC3	DC4	187	47,147	0.4%	99.6%

Note: Z value is 2.39



**Table D–8b. Total Number of Diagnostic Category Significant Differences – Science Grades 3–5**

Number of Significant Differences	Number of Students	Percent of Students
0	46,456	98.1%
1	648	1.4%
2	164	0.3%
3	64	0.1%
4	2	0.0%
5	0	0.0%
6	0	0.0%

**Table D–9a. Diagnostic Category Significant Differences – Science Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	1,111	136,824	0.8%	99.2%
DC1	DC3	1,204	136,731	0.9%	99.1%
DC1	DC4	1,065	136,870	0.8%	99.2%
DC2	DC3	1,146	136,789	0.8%	99.2%
DC2	DC4	1,048	136,887	0.8%	99.2%
DC3	DC4	900	137,035	0.7%	99.3%

Note: Z value is 2.39

**Table D–9b. Total Number of Diagnostic Category Significant Differences – Science Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	133,226	96.6%
1	3,296	2.4%
2	1,074	0.8%
3	326	0.2%
4	13	0.0%
5	0	0.0%
6	0	0.0%

**Table D–10a. Diagnostic Category Significant Differences – Biology**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	794	110,053	0.7%	99.3%
DC1	DC3	885	109,962	0.8%	99.2%
DC1	DC4	1,104	109,743	1.0%	99.0%
DC2	DC3	494	110,353	0.4%	99.6%
DC2	DC4	1,073	109,774	1.0%	99.0%
DC3	DC4	1,084	109,763	1.0%	99.0%

Note: Z value is 2.39

**Table D-10b. Total Number of Diagnostic Category Significant Differences – Biology**

Number of Significant Differences	Number of Students	Percent of Students
0	106,674	96.2%
1	3,099	2.8%
2	895	0.8%
3	171	0.2%
4	8	0.0%
5	0	0.0%
6	0	0.0%

**Table D-11a. Diagnostic Category Significant Differences – Chemistry**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	245	5,028	4.6%	95.4%
DC1	DC3	157	5,116	3.0%	97.0%
DC1	DC4	137	5,136	2.6%	97.4%
DC2	DC3	10	5,263	0.2%	99.8%
DC2	DC4	15	5,258	0.3%	99.7%
DC3	DC4	11	5,262	0.2%	99.8%

Note: Z value is 2.39

**Table D-11b. Total Number of Diagnostic Category Significant Differences – Chemistry**

Number of Significant Differences	Number of Students	Percent of Students
0	4,835	91.7%
1	318	6.0%
2	103	2.0%
3	17	0.3%
4	0	0.0%
5	0	0.0%
6	0	0.0%

**Table D-12a. Diagnostic Category Significant Differences – Writing Grades 3-5**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	23	18,638	0.1%	99.9%
DC1	DC3	25	18,636	0.1%	99.9%
DC1	DC4	41	18,620	0.2%	99.8%
DC1	DC5	48	18,613	0.3%	99.7%
DC2	DC3	23	18,638	0.1%	99.9%
DC2	DC4	40	18,621	0.2%	99.8%
DC2	DC5	33	18,628	0.2%	99.8%
DC3	DC4	27	18,634	0.1%	99.9%
DC3	DC5	29	18,632	0.2%	99.8%
DC4	DC5	38	18,623	0.2%	99.8%

Note: Z value is 2.58

**Table D-12b. Total Number of Diagnostic Category Significant Differences – Writing Grades 3-5**

Number of Significant Differences	Number of Students	Percent of Students
0	18,419	98.7%
1	187	1.0%
2	30	0.2%
3	20	0.1%
4	5	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

**Table D–13a. Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS**

Group 1	Group 2	Yes	No	% Yes	% No
DC1	DC2	110	42,916	0.3%	99.7%
DC1	DC3	133	42,893	0.3%	99.7%
DC1	DC4	158	42,868	0.4%	99.6%
DC1	DC5	170	42,856	0.4%	99.6%
DC2	DC3	112	42,914	0.3%	99.7%
DC2	DC4	128	42,898	0.3%	99.7%
DC2	DC5	159	42,867	0.4%	99.6%
DC3	DC4	140	42,886	0.3%	99.7%
DC3	DC5	150	42,876	0.3%	99.7%
DC4	DC5	164	42,862	0.4%	99.6%

Note: Z value is 2.58

**Table D–13b. Total Number of Diagnostic Category Significant Differences – Writing/Eng Comp Grades 6–HS**

Number of Significant Differences	Number of Students	Percent of Students
0	41,997	97.6%
1	740	1.7%
2	204	0.5%
3	64	0.1%
4	21	0.0%
5	0	0.0%
6	0	0.0%
7	0	0.0%
8	0	0.0%
9	0	0.0%
10	0	0.0%

## APPENDIX E: DECISION CONSISTENCY

In Chapter Sixteen (Reliability), decision consistency for each CDT test and benchmark cut is reported with two values: exact agreement rate and kappa. However, as noted in the chapter, retest classification probability varies at different points along the scale. For example, the retest probability of green is higher for scores near the red/green cut than for scores very low in the red range. This appendix provides a more detailed examination of the differences in retest probability across the score range. 3 X 3 retest classification probability tables and retest classification percent tables by score range are presented for all CDT tests and benchmark cuts.

### 3 X 3 RETEST CLASSIFICATION PROBABILITY

**Table E–1. Retest Classification Probability – Mathematics Grade 3**

	Red - retest	Green - retest	Blue - retest
Red – test	0.955	0.045	0.000
Green – test	0.150	0.806	0.044
Blue – test	0.000	0.169	0.831

Exact Agreement Rate=0.925

Kappa=0.780

N-count=39,689

**Table E–2. Retest Classification Probability – Mathematics Grade 4**

	Red - retest	Green - retest	Blue - retest
Red – test	0.956	0.044	0.000
Green – test	0.145	0.805	0.050
Blue – test	0.000	0.159	0.841

Exact Agreement Rate=0.927

Kappa=0.784

N-count=42,378

**Table E–3. Retest Classification Probability – Mathematics Grade 5**

	Red - retest	Green - retest	Blue - retest
Red – test	0.950	0.050	0.000
Green – test	0.148	0.809	0.043
Blue – test	0.000	0.198	0.802

Exact Agreement Rate=0.919

Kappa=0.774

N-count=49,147

**Table E-4. Retest Classification Probability – Mathematics Grade 6**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.952	0.048	0.000
Green – test	0.140	0.817	0.044
Blue – test	0.000	0.150	0.850

Exact Agreement Rate=0.921

Kappa=0.792

N-count=61,085

**Table E-5. Retest Classification Probability – Mathematics Grade 7**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.958	0.042	0.000
Green – test	0.151	0.810	0.039
Blue – test	0.000	0.169	0.831

Exact Agreement Rate=0.931

Kappa=0.781

N-count=66,490

**Table E-6. Retest Classification Probability – Mathematics Grade 8**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.962	0.038	0.000
Green – test	0.162	0.802	0.036
Blue – test	0.000	0.142	0.858

Exact Agreement Rate=0.939

Kappa=0.776

N-count=55,899

**Table E-7. Retest Classification Probability – Mathematics High School**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.991	0.009	0.000
Green – test	0.209	0.788	0.003
Blue – test	0.000	0.000	0.000

Exact Agreement Rate=0.988

Kappa=0.661

N-count=1,192

**Table E-8. Retest Classification Probability – Algebra I**

	Red - retest	Green - retest	Blue - retest
Red – test	0.961	0.039	0.000
Green – test	0.163	0.803	0.035
Blue – test	0.000	0.175	0.825

Exact Agreement Rate=0.938

Kappa=0.763

N-count=105,847

**Table E-9. Retest Classification Probability – Geometry**

	Red - retest	Green - retest	Blue - retest
Red – test	0.960	0.040	0.000
Green – test	0.143	0.817	0.040
Blue – test	0.000	0.159	0.841

Exact Agreement Rate=0.936

Kappa=0.786

N-count=8,487

**Table E-10. Retest Classification Probability – Algebra II**

	Red - retest	Green - retest	Blue - retest
Red – test	0.963	0.037	0.000
Green – test	0.142	0.815	0.042
Blue – test	0.000	0.146	0.854

Exact Agreement Rate=0.937

Kappa=0.798

N-count=11,778

**Table E-11. Retest Classification Probability – Reading Grade 3**

	Red - retest	Green - retest	Blue - retest
Red – test	0.951	0.049	0.000
Green – test	0.098	0.855	0.047
Blue – test	0.000	0.193	0.807

Exact Agreement Rate=0.915

Kappa=0.825

N-count=33,621

**Table E-12. Retest Classification Probability – Reading Grade 4**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.950	0.050	0.000
Green – test	0.096	0.854	0.050
Blue – test	0.000	0.214	0.786

Exact Agreement Rate=0.913

Kappa=0.822

N-count=36,314

**Table E-13. Retest Classification Probability – Reading Grade 5**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.947	0.053	0.000
Green – test	0.094	0.858	0.047
Blue – test	0.000	0.247	0.753

Exact Agreement Rate=0.910

Kappa=0.818

N-count=41,014

**Table E-14. Retest Classification Probability – Reading Grade 6**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.940	0.060	0.000
Green – test	0.106	0.858	0.035
Blue – test	0.000	0.263	0.737

Exact Agreement Rate=0.908

Kappa=0.808

N-count=49,798

**Table E-15. Retest Classification Probability – Reading Grade 7**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.946	0.054	0.000
Green – test	0.114	0.855	0.031
Blue – test	0.000	0.258	0.742

Exact Agreement Rate=0.915

Kappa=0.810

N-count=57,221



**Table E–16. Retest Classification Probability – Reading Grade 8**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.948	0.052	0.000
Green – test	0.116	0.855	0.029
Blue – test	0.000	0.262	0.738

Exact Agreement Rate=0.917

Kappa=0.811

N-count=54,925

**Table E–17. Retest Classification Probability – Literature**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.944	0.056	0.000
Green – test	0.108	0.856	0.035
Blue – test	0.000	0.270	0.730

Exact Agreement Rate=0.910

Kappa=0.810

N-count=122,385

**Table E–18. Retest Classification Probability – Science Grade 3**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.933	0.067	0.000
Green – test	0.095	0.827	0.078
Blue – test	0.000	0.184	0.816

Exact Agreement Rate=0.879

Kappa=0.794

N-count=5,228

**Table E–19. Retest Classification Probability – Science Grade 4**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.931	0.069	0.000
Green – test	0.102	0.825	0.073
Blue – test	0.000	0.192	0.808

Exact Agreement Rate=0.879

Kappa=0.788

N-count=29,725

**Table E–20. Retest Classification Probability – Science Grade 5**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.937	0.063	0.000
Green – test	0.106	0.826	0.068
Blue – test	0.000	0.218	0.782

Exact Agreement Rate=0.890

Kappa=0.791

N-count=12,381

**Table E–21. Retest Classification Probability – Science Grade 6**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.938	0.062	0.000
Green – test	0.116	0.834	0.050
Blue – test	0.000	0.222	0.778

Exact Agreement Rate=0.897

Kappa=0.792

N-count=27,416

**Table E–22. Retest Classification Probability – Science Grade 7**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.942	0.058	0.000
Green – test	0.125	0.832	0.043
Blue – test	0.000	0.224	0.776

Exact Agreement Rate=0.904

Kappa=0.792

N-count=43,555

**Table E–23. Retest Classification Probability – Science Grade 8**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.941	0.059	0.000
Green – test	0.136	0.827	0.037
Blue – test	0.000	0.231	0.769

Exact Agreement Rate=0.907

Kappa=0.782

N-count=63,573

**Table E-24. Retest Classification Probability – Science High School**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.970	0.030	0.000
Green – test	0.174	0.798	0.028
Blue – test	0.000	0.232	0.768

Exact Agreement Rate=0.951

Kappa=0.760

N-count=3,391

**Table E-25. Retest Classification Probability – Biology**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.940	0.060	0.000
Green – test	0.139	0.817	0.044
Blue – test	0.000	0.162	0.838

Exact Agreement Rate=0.905

Kappa=0.783

N-count=110,847

**Table E-26. Retest Classification Probability – Chemistry**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.934	0.066	0.000
Green – test	0.173	0.801	0.026
Blue – test	0.000	0.224	0.776

Exact Agreement Rate=0.906

Kappa=0.727

N-count=5,273

**Table E-27. Retest Classification Probability – Writing Grade 3**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.950	0.050	0.000
Green – test	0.114	0.830	0.056
Blue – test	0.000	0.236	0.764

Exact Agreement Rate=0.908

Kappa=0.803

N-count=4,984

**Table E–28. Retest Classification Probability – Writing Grade 4**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.950	0.050	0.000
Green – test	0.117	0.832	0.052
Blue – test	0.000	0.220	0.780

Exact Agreement Rate=0.912

Kappa=0.802

N-count=6,285

**Table E–29. Retest Classification Probability – Writing Grade 5**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.947	0.053	0.000
Green – test	0.125	0.826	0.049
Blue – test	0.000	0.242	0.758

Exact Agreement Rate=0.907

Kappa=0.793

N-count=7,392

**Table E–30. Retest Classification Probability – Writing Grade 6**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.947	0.053	0.000
Green – test	0.122	0.834	0.044
Blue – test	0.000	0.223	0.777

Exact Agreement Rate=0.908

Kappa=0.800

N-count=9,278

**Table E–31. Retest Classification Probability – Writing Grade 7**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.946	0.054	0.000
Green – test	0.118	0.839	0.043
Blue – test	0.000	0.249	0.751

Exact Agreement Rate=0.909

Kappa=0.800

N-count=12,496

**Table E-32. Retest Classification Probability – Writing Grade 8**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.952	0.048	0.000
Green – test	0.128	0.834	0.037
Blue – test	0.000	0.248	0.752

Exact Agreement Rate=0.918

Kappa=0.800

N-count=11,506

**Table E-33. Retest Classification Probability – English Composition**

	<b>Red - retest</b>	<b>Green - retest</b>	<b>Blue - retest</b>
Red – test	0.941	0.059	0.000
Green – test	0.117	0.838	0.044
Blue – test	0.000	0.198	0.802

Exact Agreement Rate=0.900

Kappa=0.802

N-count=9,746

### **RETEST CLASSIFICATION PERCENT FOR VARIOUS SCALE SCORE RANGES**

Tables E-34 through E-66 show the percent chance of scoring in each color range if retested without additional instruction for various scale scores ranges.

**Table E-34. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 3**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	25	>99.9%	0.0%	0.0%	>99.9%
250 to 299	135	>99.9%	0.0%	0.0%	>99.9%
300 to 349	436	>99.9%	0.0%	0.0%	>99.9%
350 to 399	974	>99.9%	0.0%	0.0%	>99.9%
400 to 449	1,391	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,908	>99.9%	0.0%	0.0%	>99.9%
500 to 549	2,662	>99.9%	0.0%	0.0%	>99.9%
550 to 599	3,398	>99.9%	0.0%	0.0%	>99.9%
600 to 649	4,135	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,650	>99.9%	0.0%	0.0%	>99.9%
700 to 749	5,028	99.1%	0.9%	0.0%	99.1%
750 to 799	4,904	87.4%	12.6%	0.0%	87.4%
800 to 849 (Red/Green cut = 822)	4,047	48.0%	52.0%	0.0%	62.4%
850 to 899	2,776	10.5%	89.2%	0.3%	89.2%
900 to 949	1,594	0.7%	93.0%	6.3%	93.0%
950 to 999 (Green/Blue cut = 985)	861	0.0%	62.1%	37.9%	65.5%
1000 to 1049	374	0.0%	18.5%	81.5%	81.5%
1050 to 1099	204	0.0%	1.7%	98.3%	98.3%
1100 to 1149	89	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	61	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	17	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	10	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	5	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	2	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	3	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	39,689				

\* Retest assuming no additional instruction

**Table E-35. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 4**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	8	>99.9%	0.0%	0.0%	>99.9%
300 to 349	74	>99.9%	0.0%	0.0%	>99.9%
350 to 399	272	>99.9%	0.0%	0.0%	>99.9%
400 to 449	727	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,106	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,524	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,025	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,775	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,700	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,619	>99.9%	0.0%	0.0%	>99.9%
750 to 799	5,443	99.9%	0.1%	0.0%	99.9%
800 to 849	5,788	98.1%	1.9%	0.0%	98.1%
850 to 899	5,084	80.5%	19.5%	0.0%	80.5%
900 to 949 (Red/Green cut = 910)	3,637	36.7%	63.3%	0.0%	65.4%
950 to 999	2,383	6.1%	93.1%	0.8%	93.1%
1000 to 1049	1,461	0.3%	88.4%	11.4%	88.4%
1050 to 1099 (Green/Blue cut = 1073)	847	0.0%	50.7%	49.3%	62.7%
1100 to 1149	500	0.0%	11.9%	88.1%	88.1%
1150 to 1199	242	0.0%	0.7%	99.3%	99.3%
1200 to 1249	94	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	46	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	12	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	5	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	4	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	1	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	1	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	42,378				

\* Retest assuming no additional instruction

**Table E-36. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 5**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	1	>99.9%	0.0%	0.0%	>99.9%
250 to 299	4	>99.9%	0.0%	0.0%	>99.9%
300 to 349	5	>99.9%	0.0%	0.0%	>99.9%
350 to 399	66	>99.9%	0.0%	0.0%	>99.9%
400 to 449	325	>99.9%	0.0%	0.0%	>99.9%
450 to 499	713	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,141	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,610	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,146	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,009	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,000	>99.9%	0.0%	0.0%	>99.9%
750 to 799	5,194	>99.9%	0.0%	0.0%	>99.9%
800 to 849	6,150	99.9%	0.1%	0.0%	99.9%
850 to 899	6,655	97.9%	2.1%	0.0%	97.9%
900 to 949	6,392	78.9%	21.1%	0.0%	78.9%
950 to 999 (Red/Green cut = 958)	4,978	34.8%	65.1%	0.0%	66.4%
1000 to 1049	3,342	5.5%	93.7%	0.8%	93.7%
1050 to 1099	1,865	0.2%	88.5%	11.3%	88.5%
1100 to 1149 (Green/Blue cut = 1121)	919	0.0%	49.5%	50.5%	61.8%
1150 to 1199	370	0.0%	11.7%	88.3%	88.3%
1200 to 1249	140	0.0%	0.8%	99.2%	99.2%
1250 to 1299	56	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	39	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	12	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	6	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	6	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	2	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	1	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	49,147				

\* Retest assuming no additional instruction



**Table E-37. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 6**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	12	>99.9%	0.0%	0.0%	>99.9%
450 to 499	86	>99.9%	0.0%	0.0%	>99.9%
500 to 549	445	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,083	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,810	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,423	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,284	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,412	>99.9%	0.0%	0.0%	>99.9%
800 to 849	5,938	>99.9%	0.0%	0.0%	>99.9%
850 to 899	7,589	>99.9%	0.0%	0.0%	>99.9%
900 to 949	8,297	99.3%	0.7%	0.0%	99.3%
950 to 999	8,055	88.5%	11.5%	0.0%	88.5%
1000 to 1049 (Red/Green cut = 1023)	6,674	48.9%	51.1%	0.0%	62.9%
1050 to 1099	4,812	10.1%	89.7%	0.2%	89.7%
1100 to 1149	2,898	0.6%	93.9%	5.5%	93.9%
1150 to 1199 (Green/Blue cut = 1186)	1,573	0.0%	63.8%	36.2%	67.0%
1200 to 1249	824	0.0%	18.1%	81.9%	81.9%
1250 to 1299	484	0.0%	1.4%	98.6%	98.6%
1300 to 1349	204	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	117	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	34	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	20	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	5	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	2	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	3	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	1	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	61,085				

\* Retest assuming no additional instruction

**Table E–38. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 7**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	12	>99.9%	0.0%	0.0%	>99.9%
450 to 499	74	>99.9%	0.0%	0.0%	>99.9%
500 to 549	283	>99.9%	0.0%	0.0%	>99.9%
550 to 599	791	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,500	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,222	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,854	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,934	>99.9%	0.0%	0.0%	>99.9%
800 to 849	5,324	>99.9%	0.0%	0.0%	>99.9%
850 to 899	6,872	>99.9%	0.0%	0.0%	>99.9%
900 to 949	8,303	>99.9%	0.0%	0.0%	>99.9%
950 to 999	8,834	99.6%	0.4%	0.0%	99.6%
1000 to 1049	8,443	92.4%	7.6%	0.0%	92.4%
1050 to 1099 (Red/Green cut = 1082)	7,068	57.9%	42.1%	0.0%	64.2%
1100 to 1149	4,671	14.8%	85.1%	0.1%	85.1%
1150 to 1199	2,604	1.1%	95.8%	3.1%	95.8%
1200 to 1249 (Green/Blue cut = 1245)	1,383	0.0%	71.9%	28.1%	72.2%
1250 to 1299	719	0.0%	25.0%	75.0%	75.0%
1300 to 1349	353	0.0%	2.6%	97.4%	97.4%
1350 to 1399	150	0.0%	0.1%	99.9%	99.9%
1400 to 1449	47	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	30	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	9	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	6	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	2	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	1	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	66,490				

\* Retest assuming no additional instruction

**Table E-39. Retest Classification Percent for Various Scale Score Ranges – Mathematics Grade 8**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	4	>99.9%	0.0%	0.0%	>99.9%
450 to 499	30	>99.9%	0.0%	0.0%	>99.9%
500 to 549	153	>99.9%	0.0%	0.0%	>99.9%
550 to 599	549	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,171	>99.9%	0.0%	0.0%	>99.9%
650 to 699	1,838	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,544	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,189	>99.9%	0.0%	0.0%	>99.9%
800 to 849	3,886	>99.9%	0.0%	0.0%	>99.9%
850 to 899	4,865	>99.9%	0.0%	0.0%	>99.9%
900 to 949	5,954	>99.9%	0.0%	0.0%	>99.9%
950 to 999	6,886	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	7,438	99.2%	0.8%	0.0%	99.2%
1050 to 1099	6,658	87.6%	12.4%	0.0%	87.6%
1100 to 1149 (Red/Green cut = 1121)	4,818	47.4%	52.6%	0.0%	62.8%
1150 to 1199	2,694	9.8%	90.0%	0.2%	90.0%
1200 to 1249	1,430	0.5%	93.6%	5.9%	93.6%
1250 to 1299 (Green/Blue cut = 1284)	772	0.0%	62.6%	37.4%	66.4%
1300 to 1349	481	0.0%	16.9%	83.1%	83.1%
1350 to 1399	277	0.0%	1.3%	98.7%	98.7%
1400 to 1449	145	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	69	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	29	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	8	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	4	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	6	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	55,899				

\* Retest assuming no additional instruction

**Table E–40. Retest Classification Percent for Various Scale Score Ranges – Mathematics High School**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	3	>99.9%	0.0%	0.0%	>99.9%
500 to 549	12	>99.9%	0.0%	0.0%	>99.9%
550 to 599	36	>99.9%	0.0%	0.0%	>99.9%
600 to 649	75	>99.9%	0.0%	0.0%	>99.9%
650 to 699	113	>99.9%	0.0%	0.0%	>99.9%
700 to 749	138	>99.9%	0.0%	0.0%	>99.9%
750 to 799	140	>99.9%	0.0%	0.0%	>99.9%
800 to 849	150	>99.9%	0.0%	0.0%	>99.9%
850 to 899	113	>99.9%	0.0%	0.0%	>99.9%
900 to 949	106	>99.9%	0.0%	0.0%	>99.9%
950 to 999	121	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	95	99.8%	0.2%	0.0%	99.8%
1050 to 1099	51	93.9%	6.1%	0.0%	93.9%
1100 to 1149 (Red/Green cut = 1134)	28	60.3%	39.7%	0.0%	65.2%
1150 to 1199	7	12.3%	87.6%	0.1%	87.6%
1200 to 1249	4	2.1%	96.6%	1.4%	96.6%
1250 to 1299 (Green/Blue cut = 1297)	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	1,192				

\* Retest assuming no additional instruction

**Table E-41. Retest Classification Percent for Various Scale Score Ranges – Algebra I**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	2	>99.9%	0.0%	0.0%	>99.9%
450 to 499	15	>99.9%	0.0%	0.0%	>99.9%
500 to 549	174	>99.9%	0.0%	0.0%	>99.9%
550 to 599	856	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,241	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,639	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,888	>99.9%	0.0%	0.0%	>99.9%
750 to 799	5,830	>99.9%	0.0%	0.0%	>99.9%
800 to 849	6,917	>99.9%	0.0%	0.0%	>99.9%
850 to 899	8,197	>99.9%	0.0%	0.0%	>99.9%
900 to 949	9,921	>99.9%	0.0%	0.0%	>99.9%
950 to 999	12,075	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	13,873	99.7%	0.3%	0.0%	99.7%
1050 to 1099	13,994	93.1%	6.9%	0.0%	93.1%
1100 to 1149 (Red/Green cut = 1134)	10,715	60.2%	39.8%	0.0%	65.0%
1150 to 1199	6,305	16.3%	83.6%	0.1%	83.6%
1200 to 1249	3,187	1.2%	96.0%	2.8%	96.0%
1250 to 1299 (Green/Blue cut = 1297)	1,646	0.0%	73.7%	26.3%	73.7%
1300 to 1349	775	0.0%	26.4%	73.6%	73.6%
1350 to 1399	354	0.0%	3.0%	97.0%	97.0%
1400 to 1449	144	0.0%	0.1%	99.9%	99.9%
1450 to 1499	54	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	27	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	12	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	4	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	1	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	1	0.0%	0.0%	>99.9%	>99.9%
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	105,847				

\* Retest assuming no additional instruction

**Table E-42. Retest Classification Percent for Various Scale Score Ranges – Geometry**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	2	>99.9%	0.0%	0.0%	>99.9%
450 to 499	10	>99.9%	0.0%	0.0%	>99.9%
500 to 549	26	>99.9%	0.0%	0.0%	>99.9%
550 to 599	87	>99.9%	0.0%	0.0%	>99.9%
600 to 649	114	>99.9%	0.0%	0.0%	>99.9%
650 to 699	183	>99.9%	0.0%	0.0%	>99.9%
700 to 749	244	>99.9%	0.0%	0.0%	>99.9%
750 to 799	320	>99.9%	0.0%	0.0%	>99.9%
800 to 849	396	>99.9%	0.0%	0.0%	>99.9%
850 to 899	569	>99.9%	0.0%	0.0%	>99.9%
900 to 949	682	>99.9%	0.0%	0.0%	>99.9%
950 to 999	862	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	1,100	>99.9%	0.0%	0.0%	>99.9%
1050 to 1099	1,157	98.8%	1.2%	0.0%	98.8%
1100 to 1149	1,012	84.4%	15.6%	0.0%	84.4%
1150 to 1199 (Red/Green cut = 1165)	713	41.9%	58.1%	0.0%	63.7%
1200 to 1249	487	6.8%	92.8%	0.4%	92.8%
1250 to 1299	263	0.3%	91.7%	8.0%	91.7%
1300 to 1349 (Green/Blue cut = 1328)	130	0.0%	56.3%	43.7%	64.1%
1350 to 1399	70	0.0%	13.4%	86.6%	86.6%
1400 to 1449	30	0.0%	1.3%	98.7%	98.7%
1450 to 1499	18	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	8	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	1	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	2	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	1	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	8,487				

\* Retest assuming no additional instruction

**Table E-43. Retest Classification Percent for Various Scale Score Ranges – Algebra II**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	0	N/A	N/A	N/A	N/A
500 to 549	0	N/A	N/A	N/A	N/A
550 to 599	8	>99.9%	0.0%	0.0%	>99.9%
600 to 649	27	>99.9%	0.0%	0.0%	>99.9%
650 to 699	118	>99.9%	0.0%	0.0%	>99.9%
700 to 749	276	>99.9%	0.0%	0.0%	>99.9%
750 to 799	371	>99.9%	0.0%	0.0%	>99.9%
800 to 849	470	>99.9%	0.0%	0.0%	>99.9%
850 to 899	555	>99.9%	0.0%	0.0%	>99.9%
900 to 949	727	>99.9%	0.0%	0.0%	>99.9%
950 to 999	885	>99.9%	0.0%	0.0%	>99.9%
1000 to 1049	1,169	>99.9%	0.0%	0.0%	>99.9%
1050 to 1099	1,455	>99.9%	0.0%	0.0%	>99.9%
1100 to 1149	1,611	99.5%	0.5%	0.0%	99.5%
1150 to 1199	1,353	90.6%	9.4%	0.0%	90.6%
1200 to 1249 (Red/Green cut = 1228)	1,051	53.6%	46.4%	0.0%	63.4%
1250 to 1299	733	12.9%	87.0%	0.1%	87.0%
1300 to 1349	450	0.8%	95.2%	4.0%	95.2%
1350 to 1399 (Green/Blue cut = 1391)	231	0.0%	69.9%	30.1%	70.6%
1400 to 1449	149	0.0%	22.7%	77.3%	77.3%
1450 to 1499	64	0.0%	2.5%	97.5%	97.5%
1500 to 1549	29	0.0%	0.1%	99.9%	99.9%
1550 to 1599	24	0.0%	0.0%	>99.9%	>99.9%
1600 to 1649	9	0.0%	0.0%	>99.9%	>99.9%
1650 to 1699	5	0.0%	0.0%	>99.9%	>99.9%
1700 to 1749	4	0.0%	0.0%	>99.9%	>99.9%
1750 to 1799	2	0.0%	0.0%	>99.9%	>99.9%
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	2	0.0%	0.0%	>99.9%	>99.9%
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	11,778				

\* Retest assuming no additional instruction

**Table E-44. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 3**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	2	>99.9%	0.0%	0.0%	>99.9%
300 to 349	6	>99.9%	0.0%	0.0%	>99.9%
350 to 399	42	>99.9%	0.0%	0.0%	>99.9%
400 to 449	376	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,586	>99.9%	0.0%	0.0%	>99.9%
500 to 549	4,185	>99.9%	0.0%	0.0%	>99.9%
550 to 599	5,282	>99.9%	0.0%	0.0%	>99.9%
600 to 649	4,219	99.6%	0.4%	0.0%	99.6%
650 to 699	3,517	93.6%	6.4%	0.0%	93.6%
700 to 749 (Red/Green cut = 741)	3,176	64.1%	35.9%	0.0%	65.8%
750 to 799	3,070	21.5%	78.5%	0.0%	78.5%
800 to 849	2,633	2.7%	97.2%	0.1%	97.2%
850 to 899	2,185	0.1%	96.8%	3.1%	96.8%
900 to 949	1,525	0.0%	77.0%	23.0%	77.0%
950 to 999 (Green/Blue cut = 956)	974	0.0%	35.6%	64.4%	65.2%
1000 to 1049	512	0.0%	8.2%	91.8%	91.8%
1050 to 1099	232	0.0%	1.0%	99.0%	99.0%
1100 to 1149	71	0.0%	0.1%	99.9%	99.9%
1150 to 1199	19	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	7	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	2	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	33,621				

\* Retest assuming no additional instruction



**Table E-45. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 4**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	2	>99.9%	0.0%	0.0%	>99.9%
350 to 399	21	>99.9%	0.0%	0.0%	>99.9%
400 to 449	135	>99.9%	0.0%	0.0%	>99.9%
450 to 499	766	>99.9%	0.0%	0.0%	>99.9%
500 to 549	2,337	>99.9%	0.0%	0.0%	>99.9%
550 to 599	4,010	>99.9%	0.0%	0.0%	>99.9%
600 to 649	4,080	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,417	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,325	99.0%	1.0%	0.0%	99.0%
750 to 799	3,581	87.7%	12.3%	0.0%	87.7%
800 to 849 (Red/Green cut = 826)	3,442	50.5%	49.5%	0.0%	61.7%
850 to 899	3,227	13.3%	86.7%	0.0%	86.7%
900 to 949	2,895	1.3%	98.3%	0.4%	98.3%
950 to 999	2,266	0.0%	93.3%	6.6%	93.3%
1000 to 1049 (Green/Blue cut = 1041)	1,489	0.0%	65.7%	34.3%	66.7%
1050 to 1099	801	0.0%	26.6%	73.4%	73.4%
1100 to 1149	340	0.0%	5.3%	94.7%	94.7%
1150 to 1199	138	0.0%	0.7%	99.3%	99.3%
1200 to 1249	31	0.0%	0.1%	99.9%	99.9%
1250 to 1299	9	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	36,314				

\* Retest assuming no additional instruction

**Table E-46. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 5**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	27	>99.9%	0.0%	0.0%	>99.9%
450 to 499	168	>99.9%	0.0%	0.0%	>99.9%
500 to 549	750	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,193	>99.9%	0.0%	0.0%	>99.9%
600 to 649	3,631	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,014	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,624	>99.9%	0.0%	0.0%	>99.9%
750 to 799	3,697	99.6%	0.4%	0.0%	99.6%
800 to 849	3,975	93.5%	6.5%	0.0%	93.5%
850 to 899 (Red/Green cut = 890)	4,182	63.2%	36.8%	0.0%	65.4%
900 to 949	4,165	20.7%	79.3%	0.0%	79.3%
950 to 999	3,918	2.6%	97.2%	0.1%	97.2%
1000 to 1049	3,102	0.1%	96.5%	3.4%	96.5%
1050 to 1099	2,065	0.0%	76.1%	23.9%	76.1%
1100 to 1149 (Green/Blue cut = 1105)	1,012	0.0%	37.0%	63.0%	63.8%
1150 to 1199	352	0.0%	9.6%	90.4%	90.4%
1200 to 1249	100	0.0%	1.6%	98.4%	98.4%
1250 to 1299	31	0.0%	0.2%	99.8%	99.8%
1300 to 1349	6	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	41,014				

\* Retest assuming no additional instruction

**Table E-47. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 6**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	32	>99.9%	0.0%	0.0%	>99.9%
500 to 549	164	>99.9%	0.0%	0.0%	>99.9%
550 to 599	759	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,193	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,856	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,536	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,512	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,864	99.7%	0.3%	0.0%	99.7%
850 to 899	5,521	94.7%	5.3%	0.0%	94.7%
900 to 949 (Red/Green cut = 945)	5,895	67.7%	32.3%	0.0%	68.3%
950 to 999	5,813	23.8%	76.2%	0.0%	76.2%
1000 to 1049	4,970	3.2%	96.7%	0.1%	96.7%
1050 to 1099	3,504	0.2%	97.4%	2.4%	97.4%
1100 to 1149	1,978	0.0%	79.8%	20.2%	79.8%
1150 to 1199 (Green/Blue cut = 1160)	844	0.0%	41.9%	58.1%	61.2%
1200 to 1249	286	0.0%	12.5%	87.5%	87.5%
1250 to 1299	50	0.0%	2.7%	97.3%	97.3%
1300 to 1349	16	0.0%	0.6%	99.4%	99.4%
1350 to 1399	4	0.0%	0.1%	99.9%	99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	49,798				

\* Retest assuming no additional instruction

**Table E–48. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 7**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	6	>99.9%	0.0%	0.0%	>99.9%
450 to 499	22	>99.9%	0.0%	0.0%	>99.9%
500 to 549	154	>99.9%	0.0%	0.0%	>99.9%
550 to 599	772	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,505	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,556	>99.9%	0.0%	0.0%	>99.9%
700 to 749	5,060	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,939	>99.9%	0.0%	0.0%	>99.9%
800 to 849	5,108	>99.9%	0.0%	0.0%	>99.9%
850 to 899	5,680	99.2%	0.8%	0.0%	99.2%
900 to 949	6,253	89.4%	10.6%	0.0%	89.4%
950 to 999 (Red/Green cut = 979)	6,520	53.2%	46.8%	0.0%	62.2%
1000 to 1049	5,976	14.4%	85.6%	0.0%	85.6%
1050 to 1099	4,572	1.4%	98.3%	0.3%	98.3%
1100 to 1149	2,847	0.1%	94.5%	5.5%	94.5%
1150 to 1199 (Green/Blue cut = 1194)	1,374	0.0%	69.1%	30.9%	69.5%
1200 to 1249	615	0.0%	30.0%	70.0%	70.0%
1250 to 1299	194	0.0%	7.9%	92.1%	92.1%
1300 to 1349	52	0.0%	1.7%	98.3%	98.3%
1350 to 1399	11	0.0%	0.4%	99.6%	99.6%
1400 to 1449	3	0.0%	0.1%	99.9%	99.9%
1450 to 1499	1	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	57,221				

\* Retest assuming no additional instruction

**Table E-49. Retest Classification Percent for Various Scale Score Ranges – Reading Grade 8**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	1	>99.9%	0.0%	0.0%	>99.9%
450 to 499	7	>99.9%	0.0%	0.0%	>99.9%
500 to 549	74	>99.9%	0.0%	0.0%	>99.9%
550 to 599	405	>99.9%	0.0%	0.0%	>99.9%
600 to 649	1,492	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,444	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,748	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,926	>99.9%	0.0%	0.0%	>99.9%
800 to 849	4,857	>99.9%	0.0%	0.0%	>99.9%
850 to 899	4,980	99.9%	0.1%	0.0%	99.9%
900 to 949	5,446	97.7%	2.3%	0.0%	97.7%
950 to 999	6,026	79.6%	20.4%	0.0%	79.6%
1000 to 1049 (Red/Green cut = 1011)	6,152	36.9%	63.1%	0.0%	65.3%
1050 to 1099	5,368	7.0%	93.0%	0.0%	93.0%
1100 to 1149	3,747	0.5%	98.5%	1.0%	98.5%
1150 to 1199	2,064	0.0%	88.3%	11.7%	88.3%
1200 to 1249 (Green/Blue cut = 1226)	803	0.0%	55.5%	44.5%	61.1%
1250 to 1299	280	0.0%	20.1%	79.9%	79.9%
1300 to 1349	74	0.0%	4.7%	95.3%	95.3%
1350 to 1399	25	0.0%	1.1%	98.9%	98.9%
1400 to 1449	6	0.0%	0.2%	99.8%	99.8%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	54,925				

\* Retest assuming no additional instruction

**Table E–50. Retest Classification Percent for Various Scale Score Ranges – Literature**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	5	>99.9%	0.0%	0.0%	>99.9%
450 to 499	13	>99.9%	0.0%	0.0%	>99.9%
500 to 549	104	>99.9%	0.0%	0.0%	>99.9%
550 to 599	648	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,622	>99.9%	0.0%	0.0%	>99.9%
650 to 699	6,224	>99.9%	0.0%	0.0%	>99.9%
700 to 749	9,049	>99.9%	0.0%	0.0%	>99.9%
750 to 799	9,399	>99.9%	0.0%	0.0%	>99.9%
800 to 849	8,804	>99.9%	0.0%	0.0%	>99.9%
850 to 899	9,319	>99.9%	0.0%	0.0%	>99.9%
900 to 949	10,409	99.4%	0.6%	0.0%	99.4%
950 to 999	12,532	90.7%	9.3%	0.0%	90.7%
1000 to 1049 (Red/Green cut = 1033)	13,919	56.8%	43.2%	0.0%	62.8%
1050 to 1099	14,244	16.4%	83.5%	0.0%	83.5%
1100 to 1149	11,446	1.9%	97.9%	0.2%	97.9%
1150 to 1199	7,484	0.1%	94.9%	5.0%	94.9%
1200 to 1249 (Green/Blue cut = 1248)	4,018	0.0%	71.8%	28.2%	71.8%
1250 to 1299	1,508	0.0%	33.4%	66.6%	66.6%
1300 to 1349	491	0.0%	10.0%	90.0%	90.0%
1350 to 1399	118	0.0%	2.6%	97.4%	97.4%
1400 to 1449	26	0.0%	0.7%	99.3%	99.3%
1450 to 1499	2	0.0%	0.2%	99.8%	99.8%
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	1	0.0%	0.1%	99.9%	99.9%
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	122,385				

\* Retest assuming no additional instruction

**Table E–51. Retest Classification Percent for Various Scale Score Ranges – Science Grade 3**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	23	>99.9%	0.0%	0.0%	>99.9%
250 to 299	86	>99.9%	0.0%	0.0%	>99.9%
300 to 349	174	>99.9%	0.0%	0.0%	>99.9%
350 to 399	239	>99.9%	0.0%	0.0%	>99.9%
400 to 449	219	>99.9%	0.0%	0.0%	>99.9%
450 to 499	255	>99.9%	0.0%	0.0%	>99.9%
500 to 549	320	>99.9%	0.0%	0.0%	>99.9%
550 to 599	398	99.7%	0.3%	0.0%	99.7%
600 to 649	465	94.3%	5.7%	0.0%	94.3%
650 to 699 (Red/Green cut = 694)	574	65.6%	34.4%	0.0%	66.7%
700 to 749	582	22.6%	77.3%	0.0%	77.3%
750 to 799	637	3.1%	95.4%	1.5%	95.4%
800 to 849	559	0.1%	84.1%	15.8%	84.1%
850 to 899 (Green/Blue cut = 867)	358	0.0%	45.2%	54.8%	62.0%
900 to 949	225	0.0%	10.6%	89.4%	89.4%
950 to 999	78	0.0%	0.8%	99.2%	99.2%
1000 to 1049	29	0.0%	0.0%	>99.9%	>99.9%
1050 to 1099	6	0.0%	0.0%	>99.9%	>99.9%
1100 to 1149	1	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	0	N/A	N/A	N/A	N/A
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	5,228				

\* Retest assuming no additional instruction

**Table E-52. Retest Classification Percent for Various Scale Score Ranges – Science Grade 4**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	13	>99.9%	0.0%	0.0%	>99.9%
250 to 299	94	>99.9%	0.0%	0.0%	>99.9%
300 to 349	385	>99.9%	0.0%	0.0%	>99.9%
350 to 399	1,021	>99.9%	0.0%	0.0%	>99.9%
400 to 449	1,378	>99.9%	0.0%	0.0%	>99.9%
450 to 499	1,450	>99.9%	0.0%	0.0%	>99.9%
500 to 549	1,548	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,738	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,015	99.8%	0.2%	0.0%	99.8%
650 to 699	2,507	96.0%	4.0%	0.0%	96.0%
700 to 749	3,260	71.6%	28.4%	0.0%	71.6%
750 to 799 (Red/Green cut = 751)	3,731	28.2%	71.7%	0.0%	71.7%
800 to 849	3,668	4.2%	94.7%	1.0%	94.7%
850 to 899	3,040	0.2%	87.8%	12.0%	87.8%
900 to 949 (Green/Blue cut = 924)	2,127	0.0%	51.8%	48.2%	61.9%
950 to 999	1,071	0.0%	13.2%	86.8%	86.8%
1000 to 1049	459	0.0%	1.2%	98.8%	98.8%
1050 to 1099	167	0.0%	0.0%	>99.9%	>99.9%
1100 to 1149	41	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	8	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	4	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	29,725				

\* Retest assuming no additional instruction



**Table E–53. Retest Classification Percent for Various Scale Score Ranges – Science Grade 5**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	1	>99.9%	0.0%	0.0%	>99.9%
300 to 349	42	>99.9%	0.0%	0.0%	>99.9%
350 to 399	150	>99.9%	0.0%	0.0%	>99.9%
400 to 449	412	>99.9%	0.0%	0.0%	>99.9%
450 to 499	583	>99.9%	0.0%	0.0%	>99.9%
500 to 549	691	>99.9%	0.0%	0.0%	>99.9%
550 to 599	793	>99.9%	0.0%	0.0%	>99.9%
600 to 649	913	>99.9%	0.0%	0.0%	>99.9%
650 to 699	1,013	99.9%	0.1%	0.0%	99.9%
700 to 749	1,259	96.5%	3.5%	0.0%	96.5%
750 to 799	1,390	74.4%	25.6%	0.0%	74.4%
800 to 849 (Red/Green cut = 804)	1,425	31.0%	69.0%	0.0%	69.2%
850 to 899	1,371	4.8%	94.4%	0.8%	94.4%
900 to 949	1,108	0.2%	89.3%	10.5%	89.3%
950 to 999 (Green/Blue cut = 977)	735	0.0%	54.5%	45.5%	62.4%
1000 to 1049	347	0.0%	15.2%	84.8%	84.8%
1050 to 1099	112	0.0%	1.4%	98.6%	98.6%
1100 to 1149	30	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	6	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	12,381				

\* Retest assuming no additional instruction

**Table E–54. Retest Classification Percent for Various Scale Score Ranges – Science Grade 6**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	1	>99.9%	0.0%	0.0%	>99.9%
350 to 399	1	>99.9%	0.0%	0.0%	>99.9%
400 to 449	20	>99.9%	0.0%	0.0%	>99.9%
450 to 499	184	>99.9%	0.0%	0.0%	>99.9%
500 to 549	772	>99.9%	0.0%	0.0%	>99.9%
550 to 599	1,714	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,335	>99.9%	0.0%	0.0%	>99.9%
650 to 699	2,494	>99.9%	0.0%	0.0%	>99.9%
700 to 749	2,653	99.9%	0.1%	0.0%	99.9%
750 to 799	2,872	97.9%	2.1%	0.0%	97.9%
800 to 849	3,251	80.0%	20.0%	0.0%	80.0%
850 to 899 (Red/Green cut = 861)	3,549	36.4%	63.6%	0.0%	65.7%
900 to 949	3,312	6.4%	93.2%	0.4%	93.2%
950 to 999	2,385	0.3%	92.7%	7.0%	92.7%
1000 to 1049 (Green/Blue cut = 1034)	1,198	0.0%	62.1%	37.9%	65.4%
1050 to 1099	471	0.0%	18.6%	81.4%	81.4%
1100 to 1149	143	0.0%	1.7%	98.3%	98.3%
1150 to 1199	44	0.0%	0.0%	>99.9%	>99.9%
1200 to 1249	14	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	1	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	1	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	1	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	27,416				

\* Retest assuming no additional instruction

**Table E–55. Retest Classification Percent for Various Scale Score Ranges – Science Grade 7**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	17	>99.9%	0.0%	0.0%	>99.9%
450 to 499	113	>99.9%	0.0%	0.0%	>99.9%
500 to 549	805	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,437	>99.9%	0.0%	0.0%	>99.9%
600 to 649	3,329	>99.9%	0.0%	0.0%	>99.9%
650 to 699	3,599	>99.9%	0.0%	0.0%	>99.9%
700 to 749	3,831	>99.9%	0.0%	0.0%	>99.9%
750 to 799	4,117	99.9%	0.1%	0.0%	99.9%
800 to 849	4,644	97.5%	2.5%	0.0%	97.5%
850 to 899	5,287	77.7%	22.3%	0.0%	77.7%
900 to 949 (Red/Green cut = 908)	5,474	33.9%	66.1%	0.0%	67.2%
950 to 999	4,901	5.6%	93.9%	0.5%	93.9%
1000 to 1049	2,991	0.3%	91.9%	7.8%	91.9%
1050 to 1099 (Green/Blue cut = 1081)	1,332	0.0%	60.3%	39.7%	64.5%
1100 to 1149	468	0.0%	17.4%	82.6%	82.6%
1150 to 1199	144	0.0%	1.6%	98.4%	98.4%
1200 to 1249	42	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	17	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	7	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	43,555				

\* Retest assuming no additional instruction

**Table E–56. Retest Classification Percent for Various Scale Score Ranges – Science Grade 8**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	9	>99.9%	0.0%	0.0%	>99.9%
450 to 499	111	>99.9%	0.0%	0.0%	>99.9%
500 to 549	839	>99.9%	0.0%	0.0%	>99.9%
550 to 599	2,836	>99.9%	0.0%	0.0%	>99.9%
600 to 649	4,548	>99.9%	0.0%	0.0%	>99.9%
650 to 699	4,696	>99.9%	0.0%	0.0%	>99.9%
700 to 749	4,804	>99.9%	0.0%	0.0%	>99.9%
750 to 799	5,361	>99.9%	0.0%	0.0%	>99.9%
800 to 849	6,246	99.8%	0.2%	0.0%	99.8%
850 to 899	7,279	95.8%	4.2%	0.0%	95.8%
900 to 949 (Red/Green cut = 949)	8,252	70.9%	29.1%	0.0%	70.9%
950 to 999	7,855	26.6%	73.4%	0.0%	73.4%
1000 to 1049	5,873	3.7%	95.4%	0.9%	95.4%
1050 to 1099	3,111	0.1%	88.5%	11.3%	88.5%
1100 to 1149 (Green/Blue cut = 1122)	1,183	0.0%	51.1%	48.9%	61.9%
1150 to 1199	399	0.0%	12.5%	87.5%	87.5%
1200 to 1249	130	0.0%	0.8%	99.2%	99.2%
1250 to 1299	30	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	7	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	3	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	1	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	63,573				

\* Retest assuming no additional instruction

**Table E-57. Retest Classification Percent for Various Scale Score Ranges – Science High School**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	4	>99.9%	0.0%	0.0%	>99.9%
450 to 499	20	>99.9%	0.0%	0.0%	>99.9%
500 to 549	114	>99.9%	0.0%	0.0%	>99.9%
550 to 599	281	>99.9%	0.0%	0.0%	>99.9%
600 to 649	387	>99.9%	0.0%	0.0%	>99.9%
650 to 699	356	>99.9%	0.0%	0.0%	>99.9%
700 to 749	290	>99.9%	0.0%	0.0%	>99.9%
750 to 799	277	>99.9%	0.0%	0.0%	>99.9%
800 to 849	342	>99.9%	0.0%	0.0%	>99.9%
850 to 899	268	99.9%	0.1%	0.0%	99.9%
900 to 949	323	98.0%	2.0%	0.0%	98.0%
950 to 999	289	81.4%	18.6%	0.0%	81.4%
1000 to 1049 (Red/Green cut = 1012)	223	39.0%	61.0%	0.0%	64.0%
1050 to 1099	120	7.6%	92.1%	0.3%	92.1%
1100 to 1149	49	0.5%	94.0%	5.6%	94.0%
1150 to 1199 (Green/Blue cut = 1185)	29	0.0%	58.3%	41.6%	62.3%
1200 to 1249	13	0.0%	17.2%	82.8%	82.8%
1250 to 1299	4	0.0%	1.4%	98.6%	98.6%
1300 to 1349	2	0.0%	0.1%	99.9%	99.9%
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	3,391				

\* Retest assuming no additional instruction

**Table E–58. Retest Classification Percent for Various Scale Score Ranges – Biology**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	3	>99.9%	0.0%	0.0%	>99.9%
450 to 499	18	>99.9%	0.0%	0.0%	>99.9%
500 to 549	138	>99.9%	0.0%	0.0%	>99.9%
550 to 599	788	>99.9%	0.0%	0.0%	>99.9%
600 to 649	2,849	>99.9%	0.0%	0.0%	>99.9%
650 to 699	5,849	>99.9%	0.0%	0.0%	>99.9%
700 to 749	7,876	>99.9%	0.0%	0.0%	>99.9%
750 to 799	8,535	>99.9%	0.0%	0.0%	>99.9%
800 to 849	9,267	>99.9%	0.0%	0.0%	>99.9%
850 to 899	11,235	99.9%	0.1%	0.0%	99.9%
900 to 949	13,365	98.0%	2.0%	0.0%	98.0%
950 to 999	15,067	80.7%	19.3%	0.0%	80.7%
1000 to 1049 (Red/Green cut = 1012)	13,346	38.3%	61.7%	0.0%	64.7%
1050 to 1099	9,451	7.0%	92.6%	0.4%	92.6%
1100 to 1149	5,857	0.4%	93.0%	6.6%	93.0%
1150 to 1199 (Green/Blue cut = 1185)	3,411	0.0%	61.9%	38.0%	65.4%
1200 to 1249	1,924	0.0%	18.7%	81.3%	81.3%
1250 to 1299	1,008	0.0%	1.8%	98.2%	98.2%
1300 to 1349	522	0.0%	0.1%	99.9%	99.9%
1350 to 1399	218	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	89	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	24	0.0%	0.0%	>99.9%	>99.9%
1500 to 1549	7	0.0%	0.0%	>99.9%	>99.9%
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	110,847				

\* Retest assuming no additional instruction

**Table E-59. Retest Classification Percent for Various Scale Score Ranges – Chemistry**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 400	0	N/A	N/A	N/A	N/A
400 to 449	0	N/A	N/A	N/A	N/A
450 to 499	0	N/A	N/A	N/A	N/A
500 to 549	0	N/A	N/A	N/A	N/A
550 to 599	8	>99.9%	0.0%	0.0%	>99.9%
600 to 649	13	>99.9%	0.0%	0.0%	>99.9%
650 to 699	62	>99.9%	0.0%	0.0%	>99.9%
700 to 749	125	>99.9%	0.0%	0.0%	>99.9%
750 to 799	278	>99.9%	0.0%	0.0%	>99.9%
800 to 849	485	>99.9%	0.0%	0.0%	>99.9%
850 to 899	577	>99.9%	0.0%	0.0%	>99.9%
900 to 949	856	99.8%	0.2%	0.0%	99.8%
950 to 999	975	95.1%	4.9%	0.0%	95.1%
1000 to 1049 (Red/Green cut = 1045)	849	69.5%	30.5%	0.0%	69.9%
1050 to 1099	583	25.2%	74.8%	0.0%	74.8%
1100 to 1149	280	3.1%	95.9%	0.9%	95.9%
1150 to 1199	114	0.1%	87.4%	12.5%	87.4%
1200 to 1249 (Green/Blue cut = 1218)	48	0.0%	51.1%	48.9%	62.4%
1250 to 1299	11	0.0%	12.4%	87.6%	87.6%
1300 to 1349	4	0.0%	1.0%	99.0%	99.0%
1350 to 1399	2	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	3	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	5,273				

\* Retest assuming no additional instruction

**Table E–60. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 3**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	4	>99.9%	0.0%	0.0%	>99.9%
250 to 299	13	>99.9%	0.0%	0.0%	>99.9%
300 to 349	74	>99.9%	0.0%	0.0%	>99.9%
350 to 399	199	>99.9%	0.0%	0.0%	>99.9%
400 to 449	378	>99.9%	0.0%	0.0%	>99.9%
450 to 499	360	>99.9%	0.0%	0.0%	>99.9%
500 to 549	335	>99.9%	0.0%	0.0%	>99.9%
550 to 599	341	>99.9%	0.0%	0.0%	>99.9%
600 to 649	380	>99.9%	0.0%	0.0%	>99.9%
650 to 699	416	99.4%	0.6%	0.0%	99.4%
700 to 749	516	90.2%	9.8%	0.0%	90.2%
750 to 799 (Red/Green cut = 780)	534	53.6%	46.4%	0.0%	62.7%
800 to 849	525	14.5%	85.4%	0.1%	85.4%
850 to 899	441	1.3%	95.9%	2.8%	95.9%
900 to 949	281	0.0%	76.5%	23.5%	76.5%
950 to 999 (Green/Blue cut = 953)	125	0.0%	35.0%	65.0%	65.2%
1000 to 1049	43	0.0%	5.2%	94.8%	94.8%
1050 to 1099	13	0.0%	0.2%	99.8%	99.8%
1100 to 1149	6	0.0%	0.0%	>99.9%	>99.9%
1150 to 1199	0	N/A	N/A	N/A	N/A
1200 to 1249	0	N/A	N/A	N/A	N/A
1250 to 1299	0	N/A	N/A	N/A	N/A
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	4,984				

\* Retest assuming no additional instruction



**Table E–61. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 4**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	3	>99.9%	0.0%	0.0%	>99.9%
300 to 349	32	>99.9%	0.0%	0.0%	>99.9%
350 to 399	125	>99.9%	0.0%	0.0%	>99.9%
400 to 449	274	>99.9%	0.0%	0.0%	>99.9%
450 to 499	378	>99.9%	0.0%	0.0%	>99.9%
500 to 549	382	>99.9%	0.0%	0.0%	>99.9%
550 to 599	366	>99.9%	0.0%	0.0%	>99.9%
600 to 649	400	>99.9%	0.0%	0.0%	>99.9%
650 to 699	481	>99.9%	0.0%	0.0%	>99.9%
700 to 749	554	99.9%	0.1%	0.0%	99.9%
750 to 799	645	96.6%	3.4%	0.0%	96.6%
800 to 849	682	73.3%	26.7%	0.0%	73.3%
850 to 899 (Red/Green cut = 852)	676	29.0%	71.0%	0.0%	71.0%
900 to 949	602	4.1%	95.1%	0.8%	95.1%
950 to 999	401	0.2%	89.2%	10.6%	89.2%
1000 to 1049 (Green/Blue cut = 1025)	195	0.0%	56.4%	43.6%	63.7%
1050 to 1099	62	0.0%	12.9%	87.1%	87.1%
1100 to 1149	22	0.0%	1.3%	98.7%	98.7%
1150 to 1199	3	0.0%	0.1%	99.9%	99.9%
1200 to 1249	1	0.0%	0.0%	>99.9%	>99.9%
1250 to 1299	1	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	6,285				

\* Retest assuming no additional instruction

**Table E–62. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 5**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	1	>99.9%	0.0%	0.0%	>99.9%
300 to 349	7	>99.9%	0.0%	0.0%	>99.9%
350 to 399	60	>99.9%	0.0%	0.0%	>99.9%
400 to 449	219	>99.9%	0.0%	0.0%	>99.9%
450 to 499	319	>99.9%	0.0%	0.0%	>99.9%
500 to 549	336	>99.9%	0.0%	0.0%	>99.9%
550 to 599	344	>99.9%	0.0%	0.0%	>99.9%
600 to 649	369	>99.9%	0.0%	0.0%	>99.9%
650 to 699	505	>99.9%	0.0%	0.0%	>99.9%
700 to 749	602	>99.9%	0.0%	0.0%	>99.9%
750 to 799	659	99.9%	0.1%	0.0%	99.9%
800 to 849	789	96.2%	3.8%	0.0%	96.2%
850 to 899	833	71.5%	28.5%	0.0%	71.5%
900 to 949 (Red/Green cut = 900)	883	27.2%	72.8%	0.0%	72.8%
950 to 999	672	3.9%	95.2%	0.8%	95.2%
1000 to 1049	461	0.2%	88.7%	11.2%	88.7%
1050 to 1099 (Green/Blue cut = 1073)	231	0.0%	50.9%	49.1%	61.7%
1100 to 1149	72	0.0%	13.1%	86.9%	86.9%
1150 to 1199	25	0.0%	0.9%	99.1%	99.1%
1200 to 1249	3	0.0%	0.1%	99.9%	99.9%
1250 to 1299	2	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	7,392				

\* Retest assuming no additional instruction

**Table E–63. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 6**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	2	>99.9%	0.0%	0.0%	>99.9%
350 to 399	4	>99.9%	0.0%	0.0%	>99.9%
400 to 449	20	>99.9%	0.0%	0.0%	>99.9%
450 to 499	104	>99.9%	0.0%	0.0%	>99.9%
500 to 549	319	>99.9%	0.0%	0.0%	>99.9%
550 to 599	502	>99.9%	0.0%	0.0%	>99.9%
600 to 649	566	>99.9%	0.0%	0.0%	>99.9%
650 to 699	607	>99.9%	0.0%	0.0%	>99.9%
700 to 749	649	>99.9%	0.0%	0.0%	>99.9%
750 to 799	741	>99.9%	0.0%	0.0%	>99.9%
800 to 849	901	99.7%	0.3%	0.0%	99.7%
850 to 899	1,035	93.6%	6.4%	0.0%	93.6%
900 to 949 (Red/Green cut = 938)	1,098	61.7%	38.3%	0.0%	65.1%
950 to 999	1,109	18.2%	81.8%	0.0%	81.8%
1000 to 1049	829	1.7%	96.9%	1.5%	96.9%
1050 to 1099	442	0.0%	83.4%	16.6%	83.4%
1100 to 1149 (Green/Blue cut = 1111)	249	0.0%	40.1%	59.9%	64.2%
1150 to 1199	75	0.0%	7.3%	92.7%	92.7%
1200 to 1249	24	0.0%	0.5%	99.5%	99.5%
1250 to 1299	2	0.0%	0.0%	>99.9%	>99.9%
1300 to 1349	0	N/A	N/A	N/A	N/A
1350 to 1399	0	N/A	N/A	N/A	N/A
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	9,278				

\* Retest assuming no additional instruction

**Table E–64. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 7**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	2	>99.9%	0.0%	0.0%	>99.9%
400 to 449	11	>99.9%	0.0%	0.0%	>99.9%
450 to 499	110	>99.9%	0.0%	0.0%	>99.9%
500 to 549	352	>99.9%	0.0%	0.0%	>99.9%
550 to 599	685	>99.9%	0.0%	0.0%	>99.9%
600 to 649	703	>99.9%	0.0%	0.0%	>99.9%
650 to 699	679	>99.9%	0.0%	0.0%	>99.9%
700 to 749	720	>99.9%	0.0%	0.0%	>99.9%
750 to 799	838	>99.9%	0.0%	0.0%	>99.9%
800 to 849	1,068	>99.9%	0.0%	0.0%	>99.9%
850 to 899	1,225	99.2%	0.8%	0.0%	99.2%
900 to 949	1,357	87.8%	12.2%	0.0%	87.8%
950 to 999 (Red/Green cut = 974)	1,503	48.7%	51.3%	0.0%	62.3%
1000 to 1049	1,427	10.5%	89.3%	0.1%	89.3%
1050 to 1099	1,024	0.7%	96.1%	3.3%	96.1%
1100 to 1149 (Green/Blue cut = 1147)	528	0.0%	73.8%	26.2%	73.9%
1150 to 1199	207	0.0%	28.2%	71.8%	71.8%
1200 to 1249	40	0.0%	3.9%	96.1%	96.1%
1250 to 1299	14	0.0%	0.2%	99.8%	99.8%
1300 to 1349	2	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	1	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	0	N/A	N/A	N/A	N/A
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	12,496				

\* Retest assuming no additional instruction

**Table E–65. Retest Classification Percent for Various Scale Score Ranges – Writing Grade 8**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	0	N/A	N/A	N/A	N/A
250 to 299	0	N/A	N/A	N/A	N/A
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	9	>99.9%	0.0%	0.0%	>99.9%
450 to 499	59	>99.9%	0.0%	0.0%	>99.9%
500 to 549	279	>99.9%	0.0%	0.0%	>99.9%
550 to 599	657	>99.9%	0.0%	0.0%	>99.9%
600 to 649	786	>99.9%	0.0%	0.0%	>99.9%
650 to 699	761	>99.9%	0.0%	0.0%	>99.9%
700 to 749	792	>99.9%	0.0%	0.0%	>99.9%
750 to 799	846	>99.9%	0.0%	0.0%	>99.9%
800 to 849	940	>99.9%	0.0%	0.0%	>99.9%
850 to 899	1,042	99.6%	0.4%	0.0%	99.6%
900 to 949	1,212	92.6%	7.4%	0.0%	92.6%
950 to 999 (Red/Green cut = 985)	1,328	58.7%	41.3%	0.0%	63.9%
1000 to 1049	1,212	16.8%	83.2%	0.0%	83.2%
1050 to 1099	887	1.4%	96.9%	1.7%	96.9%
1100 to 1149	470	0.0%	82.6%	17.3%	82.6%
1150 to 1199 (Green/Blue cut = 1158)	164	0.0%	38.8%	61.2%	63.6%
1200 to 1249	41	0.0%	7.7%	92.3%	92.3%
1250 to 1299	13	0.0%	0.3%	99.7%	99.7%
1300 to 1349	5	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	2	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	1	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	11,506				

\* Retest assuming no additional instruction

**Table E–66. Retest Classification Percent for Various Scale Score Ranges – English Composition**

Scale Score Range	Number of Students	Red (% Chance in Category if Retested*)	Green (% Chance in Category if Retested*)	Blue (% Chance in Category if Retested*)	% Chance in Same Category if Retested*
< 200	0	N/A	N/A	N/A	N/A
200 to 249	1	>99.9%	0.0%	0.0%	>99.9%
250 to 299	1	>99.9%	0.0%	0.0%	>99.9%
300 to 349	0	N/A	N/A	N/A	N/A
350 to 399	0	N/A	N/A	N/A	N/A
400 to 449	4	>99.9%	0.0%	0.0%	>99.9%
450 to 499	56	>99.9%	0.0%	0.0%	>99.9%
500 to 549	232	>99.9%	0.0%	0.0%	>99.9%
550 to 599	446	>99.9%	0.0%	0.0%	>99.9%
600 to 649	534	>99.9%	0.0%	0.0%	>99.9%
650 to 699	484	>99.9%	0.0%	0.0%	>99.9%
700 to 749	466	>99.9%	0.0%	0.0%	>99.9%
750 to 799	542	>99.9%	0.0%	0.0%	>99.9%
800 to 849	613	>99.9%	0.0%	0.0%	>99.9%
850 to 899	729	99.8%	0.2%	0.0%	99.8%
900 to 949	906	95.0%	5.0%	0.0%	95.0%
950 to 999 (Red/Green cut = 994)	1,155	66.2%	33.8%	0.0%	67.2%
1000 to 1049	1,317	22.1%	77.9%	0.0%	77.9%
1050 to 1099	1,066	2.4%	96.6%	1.0%	96.6%
1100 to 1149	659	0.1%	86.9%	13.1%	86.9%
1150 to 1199 (Green/Blue cut = 1167)	317	0.0%	45.1%	54.9%	62.6%
1200 to 1249	145	0.0%	8.9%	91.1%	91.1%
1250 to 1299	51	0.0%	0.6%	99.4%	99.4%
1300 to 1349	14	0.0%	0.0%	>99.9%	>99.9%
1350 to 1399	7	0.0%	0.0%	>99.9%	>99.9%
1400 to 1449	1	0.0%	0.0%	>99.9%	>99.9%
1450 to 1499	0	N/A	N/A	N/A	N/A
1500 to 1549	0	N/A	N/A	N/A	N/A
1550 to 1599	0	N/A	N/A	N/A	N/A
1600 to 1649	0	N/A	N/A	N/A	N/A
1650 to 1699	0	N/A	N/A	N/A	N/A
1700 to 1749	0	N/A	N/A	N/A	N/A
1750 to 1799	0	N/A	N/A	N/A	N/A
1800 to 1849	0	N/A	N/A	N/A	N/A
1850 to 1899	0	N/A	N/A	N/A	N/A
1900 to 1949	0	N/A	N/A	N/A	N/A
1950 to 1999	0	N/A	N/A	N/A	N/A
>= 2000	0	N/A	N/A	N/A	N/A
TOTAL	9,746				

\* Retest assuming no additional instruction

## APPENDIX F: CDT LEARNING PROGRESSIONS

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The CDT learning progressions were developed by the Pennsylvania Department of Education (PDE) and its curriculum consultants, including staff from Data Recognition Corporation (DRC), to show the developmental sequences or building blocks of content/skills students need to master as they progress toward career and college readiness. The progressions were developed for each content area (i.e., English language arts, mathematics, and science.) They served and continue to serve as roadmaps or the pathways (K-12) that students travel as they progress toward mastery of the skills needed for career and college readiness. As such, each learning progression was developed to provide teachers with the opportunity to determine whether students have navigated successfully through the building blocks and are able to move forward along the road to career and college readiness for a given content area. Each progression also provides teachers with the opportunity to identify students who may need additional instruction in a given content area, as well as to identify students who have navigated successfully beyond the building blocks or mileposts for each grade and/or course and are in need of accelerated curriculum. The learning progressions are directly aligned and based upon the Pennsylvania Academic Standards, the Assessment Anchors, and the Eligible Contents and as such provide evidence of the linkage between the CDT and the Pennsylvania PSSA and Keystone assessments addressing career and college readiness success with interpretations.

The learning progressions were first developed in 2009. Upon the initial development of the learning progression, the progressions were reviewed by Pennsylvania educators to confirm alignment to the Pennsylvania Standards and to confirm that the progressions, do, in fact, serve to show the development sequences of content/skills students need to master as they progress toward career and college readiness. At this meeting with educators, PDE and DRC provided information about the development of the learning progressions, the purpose of the progressions, and the actual progressions for each content area. The committees of Pennsylvania educators reviewed the progressions, which serve to show the vertical articulation of the Pennsylvania Academic Standards, Assessment Anchors and Eligible Content across grades within a given subject area (e.g., reading, mathematics). Pennsylvania educators were asked to confirm that the progressions were an accurate representation of how the content/skills included in the Pennsylvania Academic Standards progressed across grades and provided a broad description of the essential content and general sequencing for student learning and skill development as each student progresses toward college and career readiness.

Beginning 2010, the learning progressions have continued to be used during item reviews for the CDT, as well as for the PSSA and the Keystone assessments. For example, during each subsequent review of items for potential use on these assessments, including the CDT, Pennsylvania educators, in addition to reviewing items for alignment to the standards, cognitive complexity, technical quality, etc. also review items for alignment to the learning progressions. The learning progressions are included in this evidence to demonstrate the content/skills linkage between the CDT to address career and college readiness success.

## **APPENDIX G: DEVELOPMENT OF THE PENNSYLVANIA ACADEMIC STANDARDS, ASSESSMENT ANCHOR CONTENT STANDARDS, AND ELIGIBLE CONTENT**

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The Assessment Anchor Content Standards and Eligible Content statements are based on the Pennsylvania Academic Standards in English language arts and mathematics and the Pennsylvania Academic Standards in science. Although the Academic Standards indicated in broad terms what students should know and be able to do, educator concerns regarding the number and breadth of the Academic Standards led to an initiative by the Pennsylvania Department of Education (PDE) to develop Assessment Anchor Content Standards to indicate which parts of the Academic Standards (Instructional Content Standards) would be assessed on the summative assessments. Based on recommendations from Pennsylvania educators, the Assessment Anchor Content Standards were designed to improve the articulation of curricular, instructional, and assessment practices. The anchors clarify what is expected across each grade and content area and focus the content of the standards into what is assessable on a large-scale test. The Assessment Anchor Content Standards also serve to communicate Eligible Content or assessment limits. The Eligible Content statements also provide for the range of knowledge and skills from which the summative assessments and the CDT is designed.

The Assessment Anchor Content Standards' structure includes the content, grade level, Reporting Category, Assessment Anchor, descriptor (Sub-Assessment Anchor), and Eligible Content. Each of the Assessment Anchor Content Standards has one or more descriptors (Sub-Assessment Anchors) and Eligible Content to reflect grade-level appropriateness. The Assessment Anchor Content Standards form the basis of the test design. In turn, this hierarchy is the basis for organizing the total content scores (based on the core [common] sections). The Assessment Anchor Content Standards, therefore, are the general descriptions of what students should know and be able to do. The Eligible Content statements are the more specific statements of the knowledge and/or skills that students are expected to demonstrate in a given grade and content area. The Eligible Content statements are considered the granular level to which items are written. As such, they serve to define at a more granular level what students should know and be able to do. They also serve as the checkpoints that monitor progress toward meeting the board Pennsylvania Academic Standards. In other states' structures of content standards, the Assessment Anchor Content Standards are often labeled Benchmarks, and the Eligible Content statements are often labeled grade-level expectations.

The complete set of Assessment Anchor Content Standards and Eligible Content statements aligned to the board Pennsylvania Academic Standards can be found at the PDE's website: [www.education.pa.gov](http://www.education.pa.gov).

### **DEVELOPMENT OF THE ASSESSMENT ANCHOR CONTENT STANDARDS AND THE ELIGIBLE CONTENT STATEMENTS**

With Pennsylvania's decision to adopt the Pennsylvania Academic Standards in July 2010, committees of Pennsylvania educators then met in October 3–6, 2011 to write and review the Assessment Anchor Content Standards and Eligible Content statements aligned to the new Pennsylvania Academic Standards. Members of the committees included representatives from the PDE curriculum and instruction, the PDE assessment, Pennsylvania educators, and a team of expert consultants appointed by the PDE. The consultants were Pennsylvania known and nationally known experts representing specific areas of expertise. These appointed consultants were members of the Pennsylvania Quality Review Team, and their function was to oversee the process, ensuring quality throughout.

Prior to the beginning of the development of the Assessment Anchor Content Standards and the Eligible Content statements, the PDE-selected Quality Review Team consultants and the PDE assessment and curriculum staff analyzed pertinent national career- and college-ready standards and curriculum framework documents including frameworks from the National Assessment of Educational Progress (NAEP). Once the analysis was completed, members of the PDE-selected Quality Review Team met with the testing vendor, Data Recognition Corporation (DRC) to provide recommendations as to what materials and documents would be needed to facilitate the committees of Pennsylvania educators in the development and review of the Assessment Anchor Content Standards and the Eligible Content statements. In addition, the purpose of this meeting with the Quality Review Team was to come to agreement on the Assessment Anchor Content Standards and Eligible Content development process, including the role of the Pennsylvania educators, the PDE assessment staff, the PDE curriculum staff, the Quality Review Team members, and the testing vendor, DRC.



To provide initial focus at the October 2011 meetings, each content and grade committee of Pennsylvania educators was presented with materials specific to the content and grade to which the anchors and Eligible Content statements were to be developed, including a basic blueprint structure of the summative assessment and the CDT. The Pennsylvania Academic Standards, the 2005 version of the Pennsylvania Assessment Anchor Content Standards and Eligible Content aligned to the previous Pennsylvania Academic Standards, other career- and college-ready state standards, and draft Eligible Content statements aligned to the newly revised Pennsylvania Academic Standards were also provided. Committees then completed an iterative process of developing, reviewing, and revising the Assessment Anchor Content Standards and Eligible Content statements followed by discussions across grade-level committees to ensure vertical articulation across the grades. The results from the committee work were recorded and eventually evaluated by national, state, and local subject experts as noted in the sections below.

To begin the process, a general training session was held for all meeting participants. The training included welcome remarks, setting of the context for the task by the PDE staff and the PDE Quality Review Team member staff, and a presentation of the procedural training and meeting logistics by the testing vendor, DRC. Each meeting began with an introduction to Pennsylvania's Standards Aligned System and an overview of the assessment program. The PDE staff and the PDE Quality Review Team members articulated Pennsylvania's vision for the content standards, including the role that the Assessment Anchor Content Standards and Eligible Content statements would play in defining what students should know and be able to do. The opening presentation also included providing educators with the definition, structure, and purpose of the content standards, including definitions of Assessment Anchor Content Standards and Eligible Content statements. Training was also provided concerning writing, reviewing, and revising the Assessment Anchor Content Standards and Eligible Content statements. The focus of the training was to follow the design parameters to include clear, focused, rigorous, manageable, and subject-area statements.

The following materials were provided at the meeting:

- **Pennsylvania Curriculum Framework:** The Curriculum Framework specifies what is to be taught for each subject in the curriculum. In Pennsylvania, Curriculum Frameworks include Big Ideas, Concepts, Competencies, and Essential Questions aligned to standards. They are defined as follows:
  - Big Ideas:** The big ideas are the declarative statements that describe concepts that transcend grade levels. Big Ideas are essential to provide focus on specific content for all students.
  - Concepts:** The concepts are what students should know (key knowledge) as a result of this instruction specific to grade level.
  - Competencies:** The competences are what students should be able to do (key skills) as a result of this instruction, specific to grade level.
  - Essential Questions:** The essential questions are connected to the Standards Aligned System (SAS) framework and are specifically linked to the big ideas. They frame student inquiry, promote critical thinking, and assist in learning transfer.
- Pennsylvania Academic Standards
- Other documents as relevant, including hard copy working documents with adequate white space

After the training, committee members were instructed to begin the development process. Committee members were provided with hard copy working documents. Using their background knowledge and the materials they were provided during the meeting (e.g., documents from the Standards Aligned System, curriculum framework, Pennsylvania's Academic Standards), Pennsylvania educators created their own short list of the critical concepts that Pennsylvania students must know and be able to do for each grade and content area. Beginning with one concept at a time, concepts or Eligible Content statements were recorded on the master list; Assessment Anchor Content Standards were then developed and reviewed. As the Assessment Anchor Content Standards and Eligible Content statements were developed, they were displayed using a laptop and projector. A scribe from the testing vendor, DRC, served to record the committee members' work as well as other comments. The scribe also recorded changes or additions to the anchors and/or statements as directed from the consensus of the group.

Next, the entire group reviewed and discussed the recommendations for the anchors and the Eligible Content statements. Consensus was reached. The committee of Pennsylvania educators proceeded in this manner until all Assessment Anchor Content Standards and Eligible Content statements for each grade and content area were developed, reviewed, and discussed. DRC’s facilitator took notes verbatim regarding the intent and direction of the committee. The notes were prepared for use in subsequent meetings.

## **FOLLOW-UP MEETINGS WITH THE QUALITY REVIEW TEAM AND PDE**

A series of follow-up meetings took place with the PDE-appointed team of consultants, PDE assessment staff, and PDE-appointed Quality Review Team members. Prior to the follow-up meetings, a draft of the Assessment Anchor Content Standards and Eligible Content statements for each grade and content area were prepared for review, including all notes from the meeting with Pennsylvania educators. During the follow-up meetings, the Assessment Anchor Content Standards and Eligible Content statements were reviewed, and revisions were suggested. After the follow-up meetings, the Assessment Anchor Content Standards and Eligible Content statements were revised by the PDE and the PDE Quality Review Team per agreed-upon feedback. This revised draft was then posted on the Pennsylvania System of Aligned Standards (SAS) website for public review and opinion. All additional feedback from the public review was reviewed again by the PDE and the PDE-appointed Quality Review Team and agreed upon revisions to the Assessment Anchor Content Standards and Eligible Content statements were made. The Assessment Anchor Content Standards and Eligible Content statements were then finalized and prepared for the Pennsylvania Board of Education for approval as the official Pennsylvania Academic Content Standards.

## **PENNSYLVANIA BOARD OF EDUCATION APPROVAL**

The Assessment Anchor Content Standards and Eligible Content statements were presented to the State Board of Education in September 2013. They were subsequently approved by the State Board at the September 2013 State Board meeting as Pennsylvania Content Standards.

## **APPENDIX H: CDT PASSAGE DEVELOPMENT PROCESS**

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The task of writing passages or securing passages and or other stimuli for the CDT is conducted by Data Recognition Corporation (DRC) professionals with classroom experience in reading/language arts as well as experience writing the various types of passages and/or stimuli required by the CDT and the Pennsylvania Academic Standards, Assessment Anchors, and Eligible Content. Guidelines provided to writers for passage/stimulus writing for the CDT include appropriate length, text structure, density, and vocabulary for the grade level as reviewed and approved by the Pennsylvania Department of Education (PDE) and as aligned to the Pennsylvania Academic Standards, Assessment Anchors, and Eligible Content. Passage/stimulus writers are given a specified number of passages/stimuli to write for each genre/standard per grade. Passage/stimulus training includes training writers to develop passages/stimuli to meet the following requirements:

- Grade appropriateness
- Appropriate readability for the assigned grade
- Interest value for students
- Freedom from bias, fairness, and sensitivity issues
- Representation of different cultures
- Ability to generate a variety of item types
- Avoidance of dated subject matter, unless a relevant historical context is provided
- No need for extensive background knowledge in a certain discipline or subject area

While DRC does train passage writers to be knowledgeable of each passage’s readability, for the CDT we also statistically analyze readability of each passage, using Lexile, Flesch-Kincaid, Powers, and Spache measurements. The process that DRC’s item and test development team uses to determine text complexity involves (1) the quantitative evaluation of the text, and (2) the qualitative evaluation of the text. This analysis is documented on a passage placemat. (See example passage placemat at the end of this section.) A third component, matching reader to text and task, is also taken into consideration during passage evaluation and internal reviews.

### **QUANTITATIVE EVALUATION**

Evaluating the complexity of a passage is a judgment process conducted by DRC passage writers and internal reviewers who are familiar with the classroom context and what is developmentally and linguistically appropriate for students at a given grade level. DRC uses common readability formulas along with the qualitative information when selecting passages during development.

### **QUALITATIVE EVALUATION**

For programs such as the CDT, DRC also implements qualitative measures to help determine placement and appropriateness of passages. These measures include rubric-based qualitative evaluations and external reviewers to provide expert opinions on grade-level appropriateness, as part of considerations for matching the reader to text and task. Rubrics provide the qualitative measures for literary and informational passages. As indicated on the placemats, the quantitative rubrics suggest the appropriate grade band of the passage, while the qualitative rubrics help to further clarify the specific grade level of the passage. These rubrics provide a powerful and comprehensive way of evaluating a range of stimulus materials that cover the literary and informational scope outlined in the client state’s standards.

### **TEXT COMPLEXITY: QUALITATIVE-MEASURES RUBRIC—LITERARY TEXTS**

The English Language Arts State Collaborative on Assessment and Student Standards (SCASS) developed the following qualitative-measures rubric for determining the text complexity of literary passages. The rubric examines criteria judged as central to students’ successful comprehension of text meaning, text structure, language features, and knowledge demands. Each of these categories is ranked based on descriptors associated with the following levels: slightly complex, moderately complex, very complex, and exceedingly complex.

**Qualitative-Measures Rubric—Literary Passages**

Features	Exceedingly Complex	Very Complex	Moderately Complex	Slightly Complex
<b>Meaning</b>	Several levels and competing elements of meaning that are difficult to identify, separate, and interpret; theme is implicit or subtle, often ambiguous and revealed over the entirety of the text	Several levels of meaning that may be difficult to identify or separate; theme is implicit or subtle and may be revealed over the entirety of the text	More than one level of meaning with levels clearly distinguished from each other; theme is clear but may be conveyed with some subtlety	One level of meaning; theme is obvious and revealed early in the text
<b>Organization</b>	Organization is intricate with regard to elements such as narrative viewpoint, time shifts, multiple characters, storylines, and detail	Organization may include subplots, time shifts, and more complex characters	Organization may have two or more storylines and is occasionally difficult to predict	Organization of text is clear, chronological, or easy to predict
<b>Use of images</b>	If used, minimal illustrations that support the text	If used, a few illustrations that support the text	If used, a range of illustrations that support selected parts of the text	If used, extensive illustrations that directly support and assist in interpreting the written text
<b>Language Features</b>	<b>Conventionality</b> Dense and complex; contains abstract, ironic, and/or figurative language	<b>Conventionality</b> Complex; contains some abstract, ironic, and/or figurative language	<b>Conventionality</b> Largely explicit and easy to understand, with some occasions for more complex meaning	<b>Conventionality</b> Explicit, literal, straightforward, easy to understand
	<b>Vocabulary</b> Generally unfamiliar, archaic, subject-specific, or overly academic language; may be ambiguous or purposefully misleading	<b>Vocabulary</b> Somewhat complex language that is sometimes unfamiliar, archaic, subject-specific, or overly academic	<b>Vocabulary</b> Mostly contemporary, familiar, conversational; rarely unfamiliar or overly academic	<b>Vocabulary</b> Contemporary, familiar, conversational language
	<b>Sentence Structure</b> Mainly complex sentences, often containing multiple concepts	<b>Sentence Structure</b> Many complex sentences with several subordinate phrases or clauses and transition words	<b>Sentence Structure</b> Simple and compound sentences, with some more complex constructions	<b>Sentence Structure</b> Mainly simple sentences
<b>Knowledge Demands</b>	<b>Life Experiences</b> Explores complex, sophisticated themes; experiences are distinctly different from those of the common reader	<b>Life Experiences</b> Explores themes of varying levels of complexity; experiences portrayed are uncommon to most readers	<b>Life Experiences</b> Explores a single theme; experiences portrayed are common to many readers	<b>Life Experiences</b> Explores a single theme; experiences portrayed are everyday and common to most readers
	<b>Intertextuality and Cultural Knowledge</b> Many references or allusions to other texts or cultural elements	<b>Intertextuality and Cultural Knowledge</b> Some references or allusions to other texts or cultural elements	<b>Intertextuality and Cultural Knowledge</b> A few references or allusions to other texts or cultural elements	<b>Intertextuality and Cultural Knowledge</b> No references or allusions to other texts or cultural elements

**Qualitative-Measures Rubric—Informational Texts**

Features	Exceedingly Complex	Very Complex	Moderately Complex	Slightly Complex
<b>Purpose</b>	<b>Purpose</b> Subtle, implied, difficult to determine; intricate, theoretical elements	<b>Purpose</b> Implied but fairly easy to infer; more theoretical than concrete	<b>Purpose</b> Implied but easy to identify based upon context or source	<b>Purpose</b> Explicitly stated; clear, concrete with a narrow focus
<b>Text Structure</b>	<b>Organization of Main Ideas</b> Connections between an extensive range of ideas, processes, or events are deep and often implicit or subtle; organization of the text is intricate or specialized for a particular discipline	<b>Organization of Main Ideas</b> Connections between an expanded range of ideas, processes, or events are deeper and often implicit or subtle; organization may contain multiple pathways and may exhibit traits common to a specific discipline	<b>Organization of Main Ideas</b> Connections between some ideas or events are implicit or subtle; organization is evident and generally sequential	<b>Organization of Main Ideas</b> Connections between ideas, processes, or events are explicit and clear; organization of text is clear or chronological or easy to predict
	<b>Text Features</b> If used, are essential in understanding content	<b>Text Features</b> If used, greatly enhance the reader’s understanding of content	<b>Text Features</b> If used, enhance the reader’s understanding of content	<b>Text Features</b> If used, help the reader navigate and understand content but are not essential
	<b>Use of Images</b> If used, essential, intricate, essential integrated images, tables, charts, etc., necessary to make meaning of text; also may provide information not otherwise conveyed in the text	<b>Use of Images</b> If used, essential integrated images, tables, charts, etc., may occasionally be essential to understanding the text	<b>Use of Images</b> If used, images such as indexes and glossaries are mostly supplementary to understanding of the text; graphs, pictures, tables, and charts directly support the text	<b>Use of Images</b> If used, images are simple and unnecessary to understanding the text but directly support and assist in interpreting the written text
<b>Language Features</b>	<b>Conventionality</b> Dense and complex; contains abstract, ironic, and/or figurative language	<b>Conventionality</b> Complex; contains some abstract, ironic, and/or figurative language	<b>Conventionality</b> Largely explicit and easy to understand, with some occasions for more complex meaning	<b>Conventionality</b> Explicit, literal, straightforward, easy to understand
	<b>Vocabulary</b> Generally unfamiliar, archaic, subject-specific, or overly academic language; may be ambiguous or purposefully misleading	<b>Vocabulary</b> Somewhat complex language that is sometimes unfamiliar, archaic, subject-specific, or overly academic	<b>Vocabulary</b> Mostly contemporary, familiar, conversational; rarely unfamiliar or overly academic	<b>Vocabulary</b> Contemporary, familiar, conversational language
	<b>Sentence Structure</b> Mainly complex sentences, often containing multiple concepts	<b>Sentence Structure</b> Many complex sentences with several subordinate phrases or clauses and transition words	<b>Sentence Structure</b> Simple and compound sentences, with some more complex constructions	<b>Sentence Structure</b> Mainly simple sentences
<b>Knowledge Demands</b>	<b>Subject Matter Knowledge</b> Extensive, perhaps specialized or even theoretical discipline-specific content knowledge; range of challenging abstract and theoretical concepts	<b>Subject Matter Knowledge</b> Moderate levels of discipline-specific content knowledge; some theoretical knowledge may enhance understanding; range of recognizable ideas and challenging abstract concepts	<b>Subject Matter Knowledge</b> Everyday practical knowledge and some discipline-specific content knowledge; both simple and more complicated, abstract ideas	<b>Subject Matter Knowledge</b> Everyday, practical knowledge; simple, concrete ideas
	<b>Intertextuality</b> Many references or allusions to other texts or outside ideas, theories, etc.	<b>Intertextuality</b> Some references or allusions to other texts or outside ideas, theories, etc.	<b>Intertextuality</b> A few references or allusions to other texts or outside ideas, theories, etc.	<b>Intertextuality</b> No references or allusions to other texts, or outside ideas, theories, etc.

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## Passage Placemat

Below is an example of a passage placemat for item writer use.

Worksheet: Text Complexity Analysis		
Title	Author	Text Description



Recommended Placement for Assessment: Grade X

Qualitative Measures	Quantitative Measures												
<b>PURPOSE</b> : <b>TEXT STRUCTURE</b> <b>Organization of Main Ideas:</b> : <b>Text Features:</b> N/A <b>Use of Images:</b> N/A <b>LANGUAGE FEATURES</b> <b>Conventionality:</b> : <b>Vocabulary:</b> : <b>Sentence Structure:</b> : <b>KNOWLEDGE DEMANDS</b> <b>Subject Matter Knowledge:</b> : <b>Intertextuality:</b> :	<b>Common Core State Standards Appendix A Complexity Band Level</b> (if applicable): <b>Lexile or Other Quantitative Measure of the Text:</b> Lexile: Flesch-Kincaid: <hr/> <b>Considerations for Passage Selection</b> Passage selection should be based on the ELA Content Specifications targets and the cognitive demands of the assessment tasks. <b>Potential Challenges This Text May Pose (check all that apply):</b> <table border="1"> <tr> <td><input type="checkbox"/></td> <td>Accessibility</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Sentence and text structures</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Archaic language, slang, idioms, or other language challenges</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Background knowledge</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Bias and sensitivity issues</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Word count</td> </tr> </table>	<input type="checkbox"/>	Accessibility	<input type="checkbox"/>	Sentence and text structures	<input type="checkbox"/>	Archaic language, slang, idioms, or other language challenges	<input type="checkbox"/>	Background knowledge	<input type="checkbox"/>	Bias and sensitivity issues	<input type="checkbox"/>	Word count
<input type="checkbox"/>	Accessibility												
<input type="checkbox"/>	Sentence and text structures												
<input type="checkbox"/>	Archaic language, slang, idioms, or other language challenges												
<input type="checkbox"/>	Background knowledge												
<input type="checkbox"/>	Bias and sensitivity issues												
<input type="checkbox"/>	Word count												

Adapted from Smarter Balanced and the 2012 ELASCASS work

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