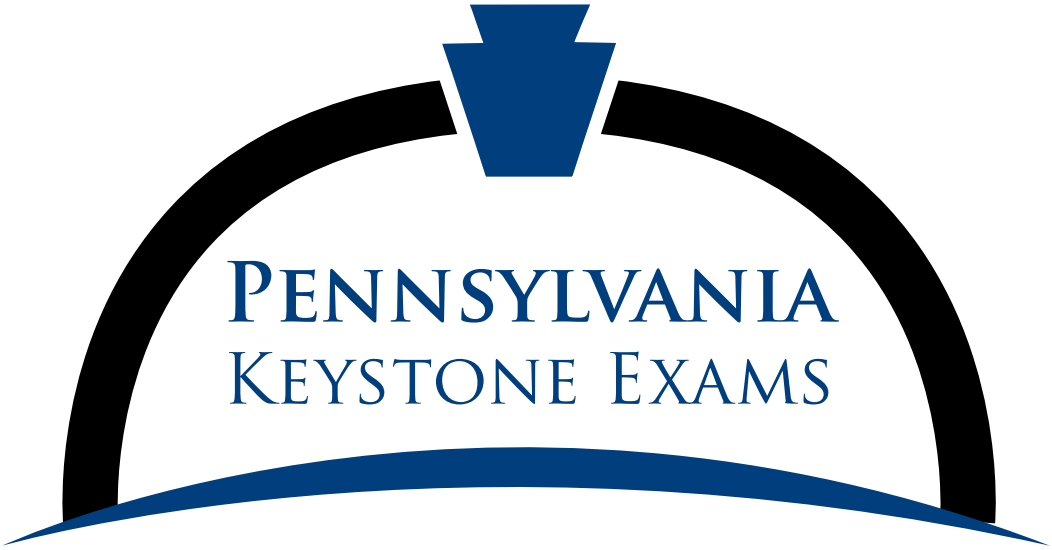
TECHNICAL REPORT



2022 Keystone Technical Report: Algebra I, Biology, and Literature

Provided by Data Recognition Corporation

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PREFACE: AN OVERVIEW OF THE ASSESSMENTS

THE KEYSTONE EXAMS FROM 2008 TO PRESENT

COMPREHENSIVE GRADUATION COMPETENCY ASSESSMENT PROGRAM

In 2008, the Commonwealth of Pennsylvania initiated a comprehensive graduation competency assessment program. The goals of this program include the following:

- To provide a system that is aligned, focused, standards-based, accurate, universally applicable, and publicly accessible
- To develop, produce, distribute, administer (both online and in paper-and-pencil), collect, score, analyze, track, and report results of graduation competency assessments for ten high school–level content areas: Algebra I, Algebra II, Biology, Chemistry, Civics and Government, English Composition, Geometry, Literature, U.S. History, and World History, with each area or course comprised of modules containing unique content
- To provide graduation competency testing opportunities for students three times each school year—spring, summer, and fall—with students permitted to retake modules until proficiency is achieved on each module
- To report graduation competency results under accelerated timelines
- To ensure validity and reliability of the assessment systems through technically sound test development and psychometric practices, detailed statistical analyses and research studies, and well-documented processes and quality procedures

The Keystone Exams, as the graduation competency assessments are named, are just one component of Pennsylvania's system of high school graduation requirements. Keystone Exams are designed to help school districts guide students toward meeting state standards—standards aligned with expectations for success in college and the workplace. In order to receive a diploma, students are also required to meet local district credit and attendance requirements and to complete a culminating project, along with any additional district requirements.

For graduating classes, students are to demonstrate successful completion of secondary-level course work in Algebra I, Biology, and Literature, in which the Keystone Exam served as the final course exam. Students' Keystone Exam scores count for at least one-third of the final course grades.

Based upon Chapter 4 regulations, each Keystone Exam is designed in modules that reflect distinct, related academic content common to the traditional progression of course work. Students who do not score Proficient or above on a Keystone Exam module may choose to complete a project-based assessment for that module based upon other specific requirements.

ASSESSMENT ACTIVITIES OCCURRING FROM 2010 TO PRESENT

The first assessment activities took place in the 2010–2011 school year. Prior to November 2010, there were no Keystone Exams assessment events. The table below outlines the field tests and operational exams administered during the 2010–11 school year.

Following the development of Assessment Anchors and Eligible Content, exams were developed for the initial field test in 2010 and were subsequently administered as operational exams in 2011. Additional exams, which were based on the Assessment Anchors and Eligible Content developed in 2009 and 2010, were developed for the initial field test in 2011. Detailed information about the operational exam activities that occurred during the 2010–2011 school year is in the *Keystone Exams Spring 2011 Algebra I, Biology, and Literature Technical Report.*

Field Test and Operational Exams during the 2015–16 School Year

Exam	Assessment Activity	Date
Algebra I	Initial Stand-Alone Field Test	Fall 2010 (November)
Algebra I	Inaugural Operational Exam Administration	Spring 2011 (May)
Algebra II	Initial Stand-Alone Field Test	Spring 2011 (May)
Biology	Initial Stand-Alone Field Test	Fall 2010 (November)
Biology	Inaugural Operational Exam Administration	Spring 2011 (May)
English Composition	Initial Stand-Alone Field Test	Spring 2011 (May)
Geometry	Initial Stand-Alone Field Test	Spring 2011 (May)
Literature	Initial Stand-Alone Field Test	Fall 2010 (November)
Literature	Inaugural Operational Exam Administration	Spring 2011 (May)

Following a one-year program hiatus in 2012, the field-test items embedded in the Spring 2011 operational forms were used to construct the forms for the next four administrations (spring, summer, winter, and possible breach). The table below outlines exams administered during the 2012–13 school year. Detailed information about the operational exam activities that occurred during the 2012–2013 school year is in the *Keystone Exams Spring 2013 Algebra I, Biology, and Literature Technical Report.*

Operational Exams during the 2012–13 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2012/2013 (December–January)
Algebra I	Operational Exam Administration	Spring 2013 (May)
Algebra I	Operational Retest Exam Administration	Summer 2013 (August)
Biology	Operational Retest Exam Administration	Winter 2012/2013 (December–January)
Biology	Operational Exam Administration	Spring 2013 (May)
Biology	Operational Retest Exam Administration	Summer 2013 (August)
Literature	Operational Retest Exam Administration	Winter 2012/2013 (December–January)
Literature	Operational Exam Administration	Spring 2013 (May)
Literature	Operational Retest Exam Administration	Summer 2013 (August)

Some of the field-test items embedded in the Spring 2013 operational forms were used to construct the forms for the next four administrations (spring, summer, winter, and possible breach). The core items on the 2013–2014 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2013–14 school year. Detailed information about the operational exam activities that occurred during the 2013–2014 school year is in the *Keystone Exams Spring 2014 Algebra I, Biology, and Literature Technical Report.*

Operational Exams during the 2013–14 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2013/2014 (December–January)
Algebra I	Operational Exam Administration	Spring 2014 (May)
Algebra I	Operational Retest Exam Administration	Summer 2014 (August)
Biology	Operational Retest Exam Administration	Winter 2013/2014 (December–January)
Biology	Operational Exam Administration	Spring 2014 (May)
Biology	Operational Retest Exam Administration	Summer 2014 (August)
Literature	Operational Retest Exam Administration	Winter 2013/2014 (December–January)
Literature	Operational Exam Administration	Spring 2014 (May)
Literature	Operational Retest Exam Administration	Summer 2014 (August)

Some of the field-test items embedded in the Spring 2014 operational forms were used to construct the forms for the next year's administrations (spring, summer, winter). The core items on the 2014–2015 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2014–15 school year.

Operational Exams during the 2014–15 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2014/2015 (December–January)
Algebra I	Operational Exam Administration	Spring 2015 (May)
Algebra I	Operational Retest Exam Administration	Summer 2015 (August)
Biology	Operational Retest Exam Administration	Winter 2014/2015 (December–January)
Biology	Operational Exam Administration	Spring 2015 (May)
Biology	Operational Retest Exam Administration	Summer 2015 (August)
Literature	Operational Retest Exam Administration	Winter 2014/2015 (December–January)
Literature	Operational Exam Administration	Spring 2015 (May)
Literature	Operational Retest Exam Administration	Summer 2015 (August)

Some of the field-test items embedded in the Spring 2015 operational forms were used to construct the forms for the next year's administrations (spring, summer, winter). The core items on the 2015–2016 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2015-16 school year.

Operational Exams during the 2015–16 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2015/2016 (December–January)
Algebra I	Operational Exam Administration	Spring 2016 (May)
Algebra I	Operational Retest Exam Administration	Summer 2016 (August)
Biology	Operational Retest Exam Administration	Winter 2015/2016 (December–January)
Biology	Operational Exam Administration	Spring 2016 (May)
Biology	Operational Retest Exam Administration	Summer 2016 (August)
Literature	Operational Retest Exam Administration	Winter 2015/2016 (December–January)
Literature	Operational Exam Administration	Spring 2016 (May)
Literature	Operational Retest Exam Administration	Summer 2016 (August)

Some of the field-test items embedded in the Spring 2016 operational forms were used to construct the forms for the next year's administrations (spring, summer, winter). The core items on the 2016–2017 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2016-17 school year.

Operational Exams during the 2016–17 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2016/2017 (December–January)
Algebra I	Operational Exam Administration	Spring 2017 (May)
Algebra I	Operational Retest Exam Administration	Summer 2017 (July–August)
Biology	Operational Retest Exam Administration	Winter 2016/2017 (December–January)
Biology	Operational Exam Administration	Spring 2017 (May)
Biology	Operational Retest Exam Administration	Summer 2017 (July–August)
Literature	Operational Retest Exam Administration	Winter 2016/2017 (December–January)
Literature	Operational Exam Administration	Spring 2017 (May)
Literature	Operational Retest Exam Administration	Summer 2017 (July–August)

Some of the field-test items embedded in the spring 2017 operational forms were used to construct the forms for the next year's administrations (spring, summer, winter). The core items on the 2017–2018 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2017–2018 school year.

Operational Exams during the 2017–18 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2017/2018 (December–January)
Algebra I	Operational Exam Administration	Spring 2018 (May)
Algebra I	Operational Retest Exam Administration	Summer 2018 (July–August)
Biology	Operational Retest Exam Administration	Winter 2017/2018 (December–January)
Biology	Operational Exam Administration	Spring 2018 (May)
Biology	Operational Retest Exam Administration	Summer 2018 (July-August)
Literature	Operational Retest Exam Administration	Winter 2017/2018 (December–January)
Literature	Operational Exam Administration	Spring 2018 (May)
Literature	Operational Retest Exam Administration	Summer 2018 (July–August)

Some of the field-test items embedded in the spring 2018 operational forms were used to construct the forms for the next year's administrations (spring, summer, winter). The core items on the 2018–2019 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2018–2019 school year.

Operational Exams during the 2018–19 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2018/2019 (December–January)
Algebra I	Operational Exam Administration	Spring 2019 (May)
Algebra I	Operational Retest Exam Administration	Summer 2019 (July–August)
Biology	Operational Retest Exam Administration	Winter 2018/2019 (December–January)
Biology	Operational Exam Administration	Spring 2019 (May)
Biology	Operational Retest Exam Administration	Summer 2019 (July–August)
Literature	Operational Retest Exam Administration	Winter 2018/2019 (December–January)
Literature	Operational Exam Administration	Spring 2019 (May)
Literature	Operational Retest Exam Administration	Summer 2019 (July–August)

Some of the field-test items embedded in the spring 2019 operational forms were used to construct the forms for the next year's administrations (summer, winter). The core items on the 2019–2020 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2019–2020 school year.

The spring administration of the Keystone exams was cancelled due to Coronavirus (COVID-19) mitigation efforts. On March 27, 2020, the U.S. Department of Education (USDE) approved Pennsylvania's request to waive federal assessment requirements for the 2019–20 school year, along with accountability and certain reporting requirements based on data derived from the 2019–20 school year.

The waiver's coverage of assessment requirements applies to the cohort of 2019–2020 test takers who were scheduled to take one or more Keystone Exams in the spring of 2020 (Spring 2019–2020 Cohort). Accordingly, the Federal government is not requiring any student enrolled in a Keystone Exam trigger course (Algebra I, Biology, English Literature) during the spring of the 2019–2020 school year, regardless of their current grade level or expected graduation date, to take the associated Keystone Exam(s) once schools reopen and federal assessment requirements resume. Because Keystone Exams scores are "banked" for accountability purposes and applied in grade 11, this waiver will affect students enrolled in grades other than grades 11 and 12, including as low as grade 6.

Students who took the Keystone Exams during the 2019–2020 school year prior to the pandemic (i.e., summer 2019 or winter 2020) may use those results to satisfy their individual Act 158 requirements and for any local purposes. However, because 2019–2020 school year cohort results will not be comparable with prior or future years results, these results will not be factored into future accountability determinations such as cyclical Comprehensive Support and Improvement (CSI) and Additional Targeted Support and Improvement determinations (A-TSI) (scores of students who took the Keystone Exams in the summer of 2019 or the winter of 2019–2020 as a re-tester will be attributed for the purposes of federal accountability and reporting.)

For this reason, these partial results were not reported through Future Ready in fall 2020.

Operational Exams during the 2019–20 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2019/2020 (December–January)
Algebra I	Operational Exam Administration	Cancelled due to Coronavirus (COVID-19) mitigation efforts.
Algebra I	Operational Retest Exam Administration	Autumn 2020 (September–October) *previously a summer administration
Biology	Operational Retest Exam Administration	Winter 2019/2020 (December–January)
Biology	Operational Exam Administration	Cancelled due to Coronavirus (COVID-19) mitigation efforts.
Biology	Operational Retest Exam Administration	Autumn 2020 (September–October) *previously a summer administration
Literature	Operational Retest Exam Administration	Winter 2019/2020 (December–January)
Literature	Operational Exam Administration	Cancelled due to Coronavirus (COVID-19) mitigation efforts.
Literature	Operational Retest Exam Administration	Autumn 2020 (September–October) *previously a summer administration

The core items on the 2019–2020 forms also consisted of items that appeared on the core forms of the administrations two years prior. More information on these core-to-core overlap items can be found in Chapter Three. The table below outlines exams administered during the 2020–2021 school year.

Operational Exams during the 2020–21 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2020/2021 (December–January)
Algebra I	Operational Exam Administration	Spring 2021 (May–September)
Biology	Operational Retest Exam Administration	Winter 2020/2021 (December–January)
Biology	Operational Exam Administration	Spring 2021 (May–September)
Literature	Operational Retest Exam Administration	Winter 2020/2021 (December–January)
Literature	Operational Exam Administration	Spring 2021 (May–September)

The core items on the 2020–2021 forms also consisted of items that appeared on the core forms of prior administrations. More information on these core-to-core overlap items can be found in Chapter Three.

Operational Exams during the 2021–22 School Year

Exam	Assessment Activity	Date
Algebra I	Operational Retest Exam Administration	Winter 2021/2022 (December–January)
Algebra I	Operational Exam Administration	Spring 2022 (May–September)
Algebra I	Operational Retest Exam Administration	Summer 2022 (July–August)
Biology	Operational Retest Exam Administration	Winter 2021/2022 (December–January)
Biology	Operational Exam Administration	Spring 2022 (May–September)
Biology	Operational Retest Exam Administration	Summer 2022 (July–August)
Literature	Operational Retest Exam Administration	Winter 2021/2022 (December–January)
Literature	Operational Exam Administration	Spring 2022 (May–September)
Literature	Operational Retest Exam Administration	Summer 2022 (July–August)

The core items on the 2021–2022 forms also consisted of items that appeared on the core forms of prior administrations. More information on these core-to-core overlap items can be found in Chapter Three.

CHAPTER ONE: BACKGROUND OF THE KEYSTONE EXAMS

This brief overview of the Pennsylvania Keystone Exams summarizes the history of the program's development process, intent and purpose, and recent changes.

ASSESSMENT HISTORY IN PENNSYLVANIA

Pennsylvania's involvement in statewide assessment actually began in the 1969–1970 school year with a purely school-based assessment known as *Educational Quality Assessment* (EQA), which continued through the 1987–1988 school year. A state-mandated student competency testing program called *Testing for Essential Learning and Literacy Skills* (TELLS) also operated from the school years of 1984–1985 through 1990–1991. Also in 1990, the state initiated an on-demand writing assessment.

The Pennsylvania System of School Assessment (PSSA) program was instituted in 1992 as a school evaluation model with reporting at the school level only. The PSSA initially measured performance in the content areas of mathematics and reading at grades 5, 8, and 11, and in writing at grades 6 and 9. Starting in 1994, as part of Chapter 5 regulations, the PSSA added student-level reports. In 1999, as part of Chapter 4 regulations, the State Board of Education adopted the Pennsylvania Academic Standards for mathematics and for reading, writing, speaking, and listening. Proficiency levels for Advanced, Proficient, Basic, and Below Basic were defined in 2000. In 2001 and 2004, the reading and mathematics assessments underwent various content enhancements to improve alignment to the 1999 Academic Standards. Grade 11 was added to the writing assessment in 2001. Then, in 2004-2005, the PSSA Assessment Anchors and Eligible Content were developed to clarify content structure and improve articulation between assessment and instruction. In addition, in 2005, the grade 6 and 9 writing assessments were moved to grades 5 and 8. By 2006, the operational mathematics and reading assessments incorporated grades 3 through 8 and 11. In 2007, the PSSA and the PSSA Assessment Anchors and Eligible Content underwent additional content enhancements. In 2008, science was added to the PSSA as an operational assessment. Starting with the 2013 field test, PSSA began a multiyear transition to a new set of standards called the Pennsylvania Core Standards. Detailed information about the operational exam activities that occurred during the 2013–2014 school year is in the *2014 PSSA Technical Report.*

THE KEYSTONE EXAMS

In 2008, the Commonwealth of Pennsylvania initiated a comprehensive graduation competency assessment program. As a key piece of this program, the Keystone Exams are designed to assess proficiency in various subject areas, including Algebra I, Algebra II, Biology, Chemistry, Civics and Government, English Composition, Geometry, Literature, U.S. History, and World History. The Keystone Exams are just one component of Pennsylvania's high school graduation requirements. Students must also earn state-specified credits, fulfill the state's service learning and attendance requirements, and complete any additional local school system requirements to receive a Pennsylvania high school diploma.

The stated goals of the Keystone program are to

- provide for a system that is aligned, focused, standards-based, accurate, universally applicable, and publicly accessible.
- develop, produce, distribute, administer (both online and in paper-and-pencil), collect, score, analyze, track, and report results of graduation competency assessments for ten high school–level content areas: Algebra I, Algebra II, Biology, Chemistry, Civics and Government, English Composition, Geometry, Literature, U.S. History, and World History, with each area or course composed of modules containing unique content.
- provide graduation competency testing opportunities for students three times each school year—spring, summer, and fall—with students permitted to retake modules until proficiency is achieved in each module.
- report graduation competency results under accelerated timelines.
- ensure validity and reliability of the assessment systems through technically sound test development and psychometric practices, detailed statistical analyses and research studies, and well-documented processes and quality procedures.

GRADUATION REQUIREMENTS AND THE KEYSTONE EXAMS

Based upon Chapter 4 regulations, each Keystone Exam is designed in modules that reflect distinct, related academic content common to the traditional progression of coursework. Students who do not score Proficient or above on a Keystone Exam module may choose to complete a project-based assessment for that module based on the requirements detailed below.

If a student is unable to meet the requirements in § 4.24(b)(1)(iv)(A) (relating to high school graduation requirements) after two attempts on a Keystone Exam, the student may supplement a Keystone Exam score with satisfactory completion of a project-based assessment. Points earned through satisfactory performance on one or more project modules related to the Keystone Exam module or modules that the student did not pass shall be added to the student's highest Keystone Exam score.

A student may qualify to participate in one or more project-based assessments if the student has met all of the following conditions:

1. The student has taken the course.
2. The student was unsuccessful in achieving a score of Proficient on the Keystone Exam after at least two attempts.
3. The student has met the district's attendance requirements for the course.
4. The student has participated in a satisfactory manner in supplemental instructional services under § 4.24(i).

KEYSTONE ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

In 2009, the state initiated development of test designs and test blueprints for the Keystone Exams based on Pennsylvania Keystone Course Standards. Committees of Pennsylvania educators met in 2009, 2010, and 2011 to write, review, and approve Assessment Anchors and Eligible Content statements and sample exam items. To provide initial focus, each test blueprint committee was presented with materials specific to the exam in question, including a basic blueprint structure, the Pennsylvania State Standards, and draft Eligible Content statements based on the standards. The results from the initial committee work were evaluated by national, state, and local subject experts, and following revisions, they were ultimately validated by another committee of Pennsylvania educators. Following committee approval, the Keystone Assessment Anchors and Eligible Content statements for literacy, mathematics, and science were approved by the State Board of Education in September 2010.

- Mathematics
    - The first committee meetings took place in April 2009, where initial drafts of the test blueprints were developed for Algebra I, Algebra II, and Geometry.
    - A follow-up committee meeting for the three mathematics exams was held in August 2009.
- Literacy
    - The first committee meetings took place in April 2009, where initial drafts of the test blueprints were developed for English Composition and Literature.
    - A follow-up committee meeting for the two literacy exams was held in November 2009.
- Science
    - The first committee meetings took place in October 2009, where the initial draft of the test blueprint was developed for Biology.
    - A follow-up committee meeting for Biology was held in January 2010.
    - In addition, in January 2010, the initial draft of the test blueprint was developed for Chemistry.
    - Chemistry was part of a follow-up committee meeting held in late January 2010.

- Social Studies
    - The first committee meetings took place in November 2010, where initial drafts of the test blueprints were developed for Civics and Government, U.S. History, and World History.
    - A follow-up committee meeting for the Civics and Government exam was held in October 2011.
    - A follow-up committee meeting for U.S. History and World History remains unscheduled pending further decisions about the future of these Keystone exams.

WAVE IMPLEMENTATION OF THE EXAMS

The implementation plan for the Keystone Exams envisioned the ten Keystone Exams becoming operational through a series of waves. The initial wave included Algebra I, Biology, and Literature. These first three exams were field-tested in fall 2010 and reached operational status with the spring 2011 administration. The second wave included Algebra II, English Composition, and Geometry; these were field-tested in spring 2011. English Composition is scheduled to reach operational status at a future date. Civics and Government is projected to reach operational status following English Composition. The implementation of the five remaining courses, Algebra II, Geometry, Chemistry, U.S. History, and World History, is currently unscheduled. The Pennsylvania Department of Education continues to evaluate the implementation schedule. Table 1–1 reflects the implementation plans as of September 2021.

Table 1–1. Keystone Exams Wave Implementation Plan

Wave	Exam(s)	Initial Field Test	First Operational
1	Algebra I, Biology, Literature	Fall 2010	Spring 2011
2	English Composition	Spring 2011	TBD
2	Algebra II, Geometry	Spring 2011	Not Scheduled
3	Civics and Government	TBD	Not Scheduled
4	Chemistry, U.S. History, World History	TBD	Not Scheduled

MODE OF DELIVERY FOR THE EXAMS

One key feature of the Keystone Exams is the dual mode of delivery of the testing materials that is available to districts. In addition to the traditional paper-and-pencil format, the Keystone Exams are also available in a computer-based online format using test-delivery software.

While exam materials are still available in the traditional format (two pieces of exam materials—a test book and a separate answer book [or, in the case of English Composition, a single test/answer book]), districts are given the option to administer the exams using computer-based online testing software instead of the paper-and-pencil format.

For more information about how the online exams were developed in concert with the traditional paper-and-pencil format, see Chapter Three.

MULTIPLE TESTING OPPORTUNITIES

Another key feature of the Keystone Exams is the multiple testing opportunities provided to students. Main administrations in both spring and winter provide options for students completing course work at various times of the year and accommodate both traditional and block scheduling. In addition, a summer retest opportunity is also available. More information about the spring, winter, and summer administrations can be found in Chapter Seven.

PERFORMANCE LEVELS FOR THE KEYSTONE EXAMS

The State Board approved a set of criteria defining Advanced, Proficient, Basic, and Below Basic levels of performance for the Keystone Exams. More information about these Performance Level Descriptors (PLDs) is found in Chapter Thirteen.

OPERATIONAL TEST DESIGN INFORMATION

The test definition of each of the operational Keystone Exams, including information about exam-specific test designs, test blueprints, test layouts, item types, and other exam elements, is detailed in Chapter Three.

CHAPTER TWO: TEST DEVELOPMENT OVERVIEW OF THE KEYSTONE EXAMS

KEYSTONE BLUEPRINT/ASSESSMENT ANCHORS AND ELIGIBLE CONTENT

The Keystone Test Blueprints—known as the Keystone Exams Assessment Anchors and Eligible Content—are based on Pennsylvania Keystone Course Standards and the Pennsylvania Core 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 ready for college and career.

Although the Keystone Course Standards indicate what students should know and be able to do, Assessment Anchors are designed to indicate the parts of the Keystone Course Standards (Instructional Standards) that 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—the range of knowledge and skills from which the Keystone Exams are designed.

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

- **Clear:** The Assessment Anchors are easy to read and user friendly; they clearly detail which standards are assessed on the Keystone Exams.
- **Focused:** The Assessment Anchors identify a core set of standards that can be reasonably assessed on a large-scale assessment; this keeps 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 by increasing levels of detail: first, Module (Reporting Category); second, Assessment Anchor; third, Anchor Descriptor; and fourth, Eligible Content statement. The common format of this outline is followed across the Keystone Exams.

A description of each level in the labeling system for the Keystone Exams is as follows:

- **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 details 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 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 in the Keystone Exams. This level is considered the assessment limit. It 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 clarify 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 (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 (based on the core [common] portions).

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 aligned to the Pennsylvania Academic Standards can be referenced at PDE's website: www.education.pa.gov.

HIGH-LEVEL TEST DESIGN CONSIDERATIONS

The Keystone Exams employ two types of test items (questions): multiple-choice and constructed-response. These item types assess different levels of knowledge and provide different information about achievement. Psychometrically, multiple-choice items are very useful and efficient tools for collecting information about a student's academic achievement. Constructed-response performance tasks generally generate fewer scorable points than multiple-choice items generate in the same amount of testing time; however, they provide tasks that are more realistic and sample eligible content that best lends itself to this item type. Furthermore, well-constructed scoring guides have made it possible to include constructed-response tasks in large-scale assessments, and trained scorers apply the scoring guides to efficiently score large numbers of student responses in a highly reliable way. The design of the Keystone Exams attempts to achieve a reasonable balance between the two item types.

Table 2–2. Keystone Exams High-Level Design Considerations

Exam	MC as Percentage of Core Points	CR as Percentage of Core Points	Number of Points per MC	Number of Points per CR	Number of Modules	Number of Assessment Anchors	Number of Eligible Content
Algebra I	60	40	1	4	2	6	33
Biology	73	27	1	3	2	8	38
Literature	65	35	1	3	2	4	56

DEPTH OF KNOWLEDGE

The goal of each Keystone Exam is for each item to be of sufficient rigor, or Webb's Depth of Knowledge (DOK) Level 3. Webb's DOK was created by Norman Webb of the Wisconsin Center for Education Research. Webb's definition of depth of knowledge is the degree or complexity of knowledge that the content curriculum standards and expectations require. Therefore, when reviewing items for depth of knowledge, the item is reviewed to determine whether it is as demanding cognitively as what the actual content curriculum standard expects. In the case of the Pennsylvania Keystone items, the item meets the criterion if the DOK of the item is in alignment with the DOK of the Assessment Anchor as defined by the Eligible Content. Webb's DOK includes four levels, from the lowest (basic recall) level to the highest (extended thinking) level.

In some specific cases, DOK level 2 was allowed when the cognitive intent of an Eligible Content was level 2. For more information on DOK, see Chapter Three and Appendix A.

ONLINE TESTING DESIGN CONSIDERATIONS

The Keystone Exams were designed from the beginning to provide a dual mode of test delivery, using traditional paper-and-pencil forms and using computer-based online forms. The computer-based online testing environment (called INSIGHT) is designed to provide a testing experience that mirrors the elements of traditional paper-and-pencil-based test delivery. This includes not only standard ancillary testing materials available in or with the printed forms, like formula sheets, periodic tables, scoring guidelines, and response spaces, but also analogs of the mechanical elements of response generation not necessarily associated with a computer-screen interface. These elements include line guides, rulers, screen highlighters, magnifiers, equation-building software, online calculators and graphing tools, and keyboard shortcuts.

Consideration of other components of online testing—like item layout, passage layout, font, screen resolution, navigation tools, and other interface mechanisms—all played a role in the overall design constraints, with some considerations having a more meaningful impact on specific exams. For more information on how the online test design impacted the overall test design considerations, see the sections below under each exam.

Online testing also provides an opportunity to utilize software to generate scores for student responses. In cases where responses to questions invoke numerical strings or equations, online responses can be scored through the use of lookup tables. Lookup tables are automated scoring rubrics that contain common correct and incorrect responses. When a response does not match a record in the lookup table, a human scorer is used to adjudicate the score. Operational autoscoring was only used for the Algebra I Exam; see below for more information on its use in Algebra I. For more information on scoring, see Chapter Eight.

ALGEBRA I

The Keystone Algebra I Exam has two reporting categories: Module 1, Operations and Linear Equations & Inequalities, and Module 2, Linear Functions and Data Organizations. Both modules include three Assessment Anchors. Module 1 has 18 Eligible Content, and Module 2 has 15 Eligible Content. Each module corresponds to specific content aligned to statements and specifications included in the course-specific Assessment Anchor documents. The Algebra I content included in the Keystone Algebra I multiple-choice items aligns with the Assessment Anchors and Eligible Content statements. The process skills, directives, and action statements also specifically align with the Assessment Anchors and Eligible Content statements. The content included in Algebra I constructed-response items aligns with content included in the Eligible Content statements. The process skills, directives, and action statements included in the performance demands of the Algebra I constructed-response items align with specifications included in the Assessment Anchor statements, the Anchor Descriptor statements, and/or the Eligible Content statements. In other words, the verbs or action statements used in the constructed-response items or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

ALGEBRA I ONLINE CONSIDERATIONS

Students taking the computer-based online delivery of the Algebra I exam are provided with online versions of several common tools typically available to a student taking a traditional paper-and-pencil exam. Each student has access to the following online tools: a standard four-function calculator, a scientific calculator, a graphing tool (similar, but not identical to, a graphing calculator), a ruler (available in metric and English units), a highlighter, a line guide, a magnifier, a sticky note generator, and a cross-off tool. In addition, an equation builder—which allows students to generate complex equations not normally possible with a standard keyboard—is also made available with all constructed-response items. Also, if the constructed-response item requests that the student draw, label, or otherwise change a graph, special graph-drawing tools are provided for on-screen graph generation. The Algebra I general scoring guideline and formula sheets are also available to students.

Layout of both the multiple-choice and constructed-response items is optimized for minimal screen manipulation (minimal scrolling required to see graphics or text that extend beyond the visible working space on the computer screen), and exam items are scrutinized carefully in both print and online versions for continuity and accuracy.

ALGEBRA I MULTIPLE-CHOICE ITEMS

Sixty percent of the possible points on the Algebra I Exam are derived from multiple-choice items. This item type is especially efficient for measuring a broad range of content. Each multiple-choice item has four response options, only one of which is correct. The student is awarded one point for choosing the correct response. Distractors typically represent incorrect concepts, incorrect logic, incorrect application of an algorithm, or computational errors.

Algebra I multiple-choice items are intended to take about one and a half minutes of response time per item. They are used to assess a variety of skill levels, including problem solving. Algebra I items involving application emphasize the requirement to carry out some mathematical process to find an answer rather than simply recalling information from memory.

ALGEBRA I CONSTRUCTED-RESPONSE ITEMS

Constructed-response items (tasks) require that students read a problem description and develop an appropriate solution. Algebra I constructed-response items are designed to take about ten minutes of response time per item. Most of the constructed-response items have several components in the overall task that may enable students to enter or begin the problem at different places. In some items, each successive component is designed to assess progressively more difficult skills or higher knowledge levels. Certain components may ask students to explain their reasoning for applying particular operations or for arriving at certain conclusions. The types of tasks utilized do not necessarily require computations. Students may also be asked to perform such tasks as constructing a graph, shading some portion of a figure, or listing object combinations that meet specified criteria.

Constructed-response tasks are especially useful for measuring students' problem-solving skills in Algebra. They offer the opportunity to present real-life situations that necessitate that the students solve problems using mathematics abilities learned in the classroom. Students must read the task carefully, identify the necessary information, devise a method of solution, perform the calculations, enter the solution directly in the answer document, and, when required, offer an explanation. This provides insight into the students' mathematical knowledge, abilities, and reasoning processes.

The constructed-response Algebra items are scored on a 0–4 point scale using an item-specific scoring guideline. The item-specific scoring guideline outlines the requirements for each score point. Item-specific scoring guidelines are based on the Algebra I General Description of Scoring Guidelines. The general guidelines describe a hierarchy of responses, which represent the five score levels, see Appendix B.

The Algebra I Keystone Exam includes two types of constructed-response items: Scaffolded Constructed-Response Items (SCR) and Extended Constructed-Response Items (ECR). Both types are scored on the same 0–4 point scale using the same Algebra I General Description of Scoring Guidelines as the base. SCR items are constructed to generally elicit four distinct responses (a response may contain more than one answer blank), and each response has the potential to earn a discrete number of score points (generally just one [1] score point per response). In turn, the four distinct responses are generally organized into four sections, with each labeled as a "Part" within an SCR. The next table shows a generic (nonauthentic) illustration of the application of this concept.

Table 2–3. Generic Example [Nonauthentic] Showing Concept of Four Distinct Responses

Stem	Part A	Part B	Part C	Part D
Presents a numerical distribution	In the answer spaces, write the list of numbers from least to greatest.	Write the mean in an answer blank.	Write the median in an answer blank.	Write the mode in an answer blank.
4 points	1 distinct point even though students enter more than one number	1 distinct point with one distinct entry	1 distinct point with one distinct entry	1 distinct point with one distinct entry

- SCR items do not require narrative, explanation, or "show all your work" responses.
- Most SCR item responses lend themselves to automatic scoring; however, **not all items can be automatically scored exclusively with the use of lookup tables.** The full application of Assessment Anchors and Eligible Content sometimes requires item construction that is incompatible with lookup tables.

In familiar and probably the most descriptive terms, Algebra I ECR items—in form, format, and scoring provisions—adhere to the philosophy of PSSA OE item format. Like SCR items, development is based on the item qualities that best measure the skills and concepts with which the item aligns.

- ECR items intentionally elicit narrative, explanation of reasoning, "explain why . . .", and/or "show your work" responses.
- In contrast to SCR items, in which DOK level 3 cognitive engagement is inferred from student responses, ECR items (through explanations and recorded work) often provide direct evidence of DOK level 3 engagement. This aspect of ECR items is intentionally included during development. Following initial development, the ECR item will be approved by PDE as accepted by the review committee, or PDE and DRC will collaborate in amending the item.

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. Both modules have four Assessment Anchors. Module A has 16 Eligible Content, and Module B has 22 Eligible Content. Each module corresponds to specific content aligned to statements and specifications included in the course-specific assessment anchor documents. The Biology content included in the Keystone Biology multiple-choice items aligns with the Assessment Anchors and Eligible Content statements. The process skills, directives, and action statements also specifically align with the Assessment Anchors and Eligible Content statements. The content included in Biology constructed-response items aligns with content included in the Eligible Content statements. The process skills, directives, and action statements included in the performance demands of the Biology constructed-response items align with specifications included in the Assessment Anchor statements, the Anchor Descriptor statements, and/or the Eligible Content statements. In other words, the verbs or action statements used in the constructed-response items or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

BIOLOGY ONLINE CONSIDERATIONS

Students taking the computer-based online delivery of the Biology Exam are provided with online versions of several common tools typically available to a student taking a traditional paper-and-pencil exam. Each student has access to the following online tools: a highlighter, a line guide, a magnifier, a sticky note generator, and a cross-off tool. The Biology general scoring guideline and a periodic table are also provided to students.

Layout of both the multiple-choice and constructed-response items is optimized for minimal screen manipulation (minimal scrolling to see graphics or text that extend beyond the visible working space on the computer screen), and exam items are scrutinized carefully in both print and online versions for continuity and accuracy.

BIOLOGY MULTIPLE-CHOICE ITEMS

Seventy-three percent of the possible points on the Biology Exam are derived from multiple-choice items. Multiple-choice items are especially efficient for measuring a broad range of content. Each multiple-choice item has four response options, only one of which is correct. The student is awarded one point for choosing the correct response. Distractors typically represent incorrect concepts, incorrect logic, or incorrect application of a biological principle.

Biology multiple-choice items are intended to take about one and a quarter minutes of response time per item. They are used to assess a variety of skill levels, including the application of Biology content. Biology items involving application emphasize the requirement to utilize science content to find an answer rather than simply recalling information from memory.

BIOLOGY CONSTRUCTED-RESPONSE ITEMS

Constructed-response items (tasks) require students to read a description of a Biology problem and to develop an appropriate solution. Biology constructed-response items are designed to take about eight minutes of response time per item. Constructed-response tasks are especially useful for measuring students' skills in biology. These tasks may present real-life situations that require students to solve problems using science abilities learned in the classroom. Students must read a task carefully, identify the necessary information, devise a method of solution, enter the solution directly into the answer document, and when required, offer an explanation. This provides insight into students' science knowledge, abilities, and reasoning processes.

The constructed-response science items are scored on a 0–3 point scale with an item-specific scoring guideline, and each task is carefully constructed with a scoring guideline reflecting the task requirements. The general guidelines describe a hierarchy of responses, which represents the four score levels. Each item-specific scoring guideline outlines the requirements at each score point, and each item-specific scoring guideline is based on the Biology General Description of Scoring Guidelines, see Appendix B.

LITERATURE

The Keystone Literature Exam has two reporting categories: Module 1, Fiction; and Module 2, Nonfiction. Both modules have two Assessment Anchors. Module 1 has 25 Eligible Content, and Module 2 has 33 Eligible Content. The Literature Exam employs two types of test items, multiple-choice and constructed-response, and the content included aligns with content included in the Eligible Content statements. The items are designed to measure students' comprehension of the content contained in the literature passages. Each module corresponds to specific content aligned to statements and specifications included in the course-specific Assessment Anchor documents. The Literature content included in the Keystone Literature multiple-choice items aligns with the Assessment Anchors and Eligible Content statements. The process skills, directives, and action statements also specifically align with the Assessment Anchors and Eligible Content statements. The content included in Literature constructed-response items aligns with content included in the Eligible Content statements. The process skills, directives, and action statements included in the performance demands of the Literature constructed-response items align with specifications included in the Assessment Anchor statements, the Anchor Descriptor statements, and/or the Eligible Content statements. In other words, the verbs or action statements used in the constructed-response items or stems can come from the Eligible Content, Anchor Descriptor, or Assessment Anchor statements.

LITERATURE ONLINE CONSIDERATIONS

Students taking the computer-based online delivery of the Literature Exam are provided with online versions of several common tools typically available to a student taking a traditional paper-and-pencil exam. Each student has access to the following online tools: a highlighter, a line guide, a magnifier, a sticky note generator, and a cross-off tool. The Literature general scoring guideline is also provided to students.

Layout of passages, multiple-choice items, and constructed-response items is optimized for minimal screen manipulation (minimal scrolling to see text and graphics that extend beyond the visible working space on the computer screen), and exam items are scrutinized carefully in both print and online versions for continuity and accuracy. In addition, the amount of space devoted to the passage compared to the amount of space devoted to the exam questions was also optimized.

LITERATURE MULTIPLE-CHOICE ITEMS

Sixty-five percent of the possible points on the Literature Exam are derived from multiple-choice items. Literature multiple-choice items are intended to take about one minute of response time per item. They are designed to measure how well students comprehend the overall meaning of a passage or make basic inferences about it. At times, asking students to choose a preferred answer is the best way to determine whether they have gleaned certain information from a story. Such information may include central idea, setting, or main events and their sequence.

Each Literature multiple-choice item has four response options, only one of which is correct. The student is awarded one point for choosing the correct response. Distractors typically represent some kind of misinterpretation, predisposition, unsound reasoning, or casual reading.

LITERATURE CONSTRUCTED-RESPONSE ITEMS

Constructed-response items (tasks) are designed to address comprehension of text in ways that multiple-choice items cannot. Literature constructed-response items are designed to take about five minutes of response time per item. A short written response allows students to prepare an answer and summarize using supporting details or examples derived from the text.

The Literature constructed-response items are scored on a 0–3 point scale using an item-specific scoring guideline. Each task is text-dependent and is carefully constructed with the scoring guideline reflecting the task requirements. All item-specific scoring guidelines are based on the Literature General Description of Scoring Guidelines. The general guidelines describe a hierarchy of responses, which represent the four score levels, see Appendix B.

LITERATURE PASSAGES

One of the key requirements of the Keystone Literature Exam is that students should be able to read and comprehend both literature and informational texts of sufficient text complexity and quality as required by the Assessment Anchors and Eligible Content. For example, the Literature Keystone Assessment Anchors and Eligible Content require students to engage with appropriately complex literary fiction, literary nonfiction, and informational works. Passage genres include, but are not limited to, the following: stories; excerpts from novels, biographies, and autobiographies; letters; dramas; poems; myths from diverse cultures and different time periods; texts in history/social studies, science, and other disciplines; seminal U.S. documents; the classics of American, British, and world literature; and current articles and editorials.

TEXT COMPLEXITY

Text complexity involves three components: matching reader to text and task, qualitative evaluation of the text, and quantitative evaluation of the text.

MATCHING READER TO TEXT AND TASK

A number of factors are taken into consideration when deciding whether a passage will be placed in the pool for possible use on the Keystone Literature Exam. The factors include, but are not limited to, the following:

- Are the conceptual load, vocabulary, syntactic patterns, sentence length, and clarity appropriate for the grade level?
- Does the passage stand the test of time as an example of literary fiction, literary nonfiction, and/or informational text, and is it judged by the committee of Pennsylvania educators as having sufficient quality?
- Is the passage “rich” enough to generate a variety of items?
- Do the passages represent a range of reading levels appropriate to the grade level?
- Do the passages lend themselves well to measuring the Keystone Assessment Anchors and Eligible Content, including text structures and elements?
- Are the passages free of issues of bias, fairness, and/or sensitivity?
- Does the pool of passages represent diversity in the areas of gender, culture, ethnicity, urban/rural status, socioeconomic status, physical differences, and age?

QUALITATIVE EVALUATION OF THE TEXT

Evaluating the text complexity of a passage is essentially a judgmental process by individuals familiar with the classroom context and what is linguistically appropriate at a given grade level. All Keystone passages to be included in the pool of passages for possible use on the Keystone Literature Exam are reviewed and approved by PDE and the Pennsylvania Reading Content Committee (a committee of Pennsylvania educators). The passages are reviewed by Pennsylvania educators to judge whether each passage meets the criteria outlined above. All potential passages are also reviewed by the Pennsylvania Bias, Fairness, and Sensitivity Committee.

QUANTITATIVE EVALUATION OF THE TEXT

Each readability program uses different methods to determine the readability for a particular passage (e.g., syllables, sentence length, number of words, vocabulary lists). Each readability formula is designed for a particular grade range of materials. When using the various readability formulas, a wide range of readability levels may be identified for a particular passage. Some readability formulas are better suited to a particular grade level. If a particular formula being used is outside of the intended range, then the results may be unreliable.

Readability of the Keystone Literature Exam passages has been determined using several of the most widely accepted readability formulas. These formulas are not used in a rigid way, but rather more informally to provide for several "snapshots" of a passage. The readability formulas used for the passages that appear on the Keystone Literature Exam are the Dale-Chall Formula, the Flesch Grade Level Formula, and the Fry Graph.

CHAPTER THREE: ITEM AND TEST DEVELOPMENT PROCESSES

GENERAL KEYSTONE TEST DEVELOPMENT PROCESSES

The 2022 Keystone Exams continued to use the core-to-core biennial overlap. Approximately 30% to 50% of the operational points in each module overlap with items used operationally 2 years prior. The 2022 Keystone Exam cores were made up of items that had appeared on the Spring 2019, Summer 2019, and/or Winter 2019/2020 cores. The remainder of the operational 2022 exams were made up of items that were field-tested on the Spring 2019 Keystone Exams embedded field-test administration. Table 3–1 is a graphic representation of the basic process flow and overlap of the development cycles.

Table 3–1. General Development and Usage Cycle of the Algebra I, Biology, and Literature Keystone Exams

Admin Year	Events Occurring in Year 1	Events Occurring in Year 2	Events Occurring in Year 3	Events Occurring in Year 4	Events Occurring in Year 5
Year 1	Winter Admin; New Item Dev. for Spring Year 2	Spring Admin (Oper. & Embedded FT); Data Review of previous year's Spring FT; Summer Admin	Biennial Core-to-Core Overlap (a portion of the year 1 core included as a portion of the year 3 core)		
Year 2		Winter Admin; New Item Dev. for Spring Year 3	Spring Admin (Oper. & Embedded FT); Data Review of previous year's Spring FT; Summer Admin	Biennial Core-to-Core Overlap (a portion of the year 2 core included as a portion of the year 4 core)	
Year 3			Winter Admin; New Item Dev. for Spring Year 4	Spring Admin (Oper. & Embedded FT); Data Review of previous year's Spring FT; Summer Admin	Biennial Core-to-Core Overlap (a portion of the year 4 core included as a portion of the year 5 core)

GENERAL TEST DEFINITION

The plan for the Keystone Exam was developed through the collaborative efforts of the Pennsylvania Department of Education (PDE) and Data Recognition Corporation (DRC). The exams are presented online or in two printed testing materials, a test book and a separate answer book. The test book contains multiple-choice (MC) items. The answer book contains scannable pages for multiple-choice responses, constructed-response (CR) items with response spaces, and demographic data collection areas. All MC items are worth 1 point. Algebra I CR items receive a maximum of 4 points (on a scale of 0–4), and all Biology and Literature CR items receive a maximum of 3 points (on a scale of 0–3).

CORE-TO-CORE OVERLAP ITEMS

The operational items consist of a set of core items taken by all students. Starting in 2014 these core items included core-to-core overlapping items, which are items that also appeared on the core form of the administration two years before. The overlap connects the spring and summer administrations of year *x* and the winter administration of year *x*+1, with the year *x*+2 spring and summer and year *x*+3 winter administrations. The first biennial core-to-core overlap from the spring 2011 and winter 2011–2012 core was scheduled to begin with the spring 2013 administration. However, when the program was placed on hiatus during the 2011–2012 school year, the overlap was moved to the spring 2014 administration.

ALGEBRA I TEST DEFINITIONS

The Spring 2022 Algebra I Keystone Exam was composed of 24 forms. All of the forms contained operational core items identical for all students and sets of generally unique items. The following two tables display the design for Algebra I for forms 1 through 24. The column entries for these tables denote the following:

- Number of unique core MC items
- Number of unique core CR items
- Number of embedded MC field-test items
- Number of embedded CR field-test items
- Total number of MC and CR items in the form

Table 3–2. Algebra I Test Plan (Spring 2022) per Operational Form

Module	Core per Form MC Items	Core per Form CR Items	Field Test per Form MC Items	Field Test per Form CR Items	Total per Form Core & FT MC Items	Total per Form Core & FT CR Items
1	18	3	5	1	23	4
2	18	3	5	1	23	4
Total	36	6	10	2	46	8

Table 3–3. Algebra I Test Plan (Spring 2022) per 24 Operational Forms

Module	Core per 24 Forms MC Items	Core per 24 Forms CR Items	Field Test per 24 Forms MC Items	Field Test per 24 Forms CR Items	Total per 24 Forms Core & FT MC Items	Total per 24 Forms Core & FT CR Items
1	18	3	120	24	138	27
2	18	3	120	24	138	27
Total	36	6	120	48	276	54

The operational (core) portions of the Spring 2022, Summer 2022, and the Winter 2022/2023 administrations came from the same sources. Therefore 30% to 50% of the 2022/2023 Winter, Spring and Summer cores overlap with the Spring 2019, Summer 2019, and Winter 19/20 cores. The remaining core items that appeared on the 2022/2023 forms were field-tested on prior administrations. Although each spring administration includes embedded field-test items, the summer, winter, and breach forms do not include any embedded field-test items due to the lower *n*-counts for these administrations. However, summer, winter, and breach forms still include the same number of items that appear in the spring administration. Instead of field-test items, the slots in these exams are filled by placeholder (PH) items. Table 3–4 displays the design for the Algebra I Summer, Winter, and Breach operational forms.

Table 3–4. Algebra I Test Plan (2022 Summer, Winter, and Breach) per Operational Form

Module	Core per Form MC Items	Core per Form CR Items	Placeholders per Form MC Items	Placeholders per Form CR Items	Total per Form Core & PH MC Items	Total per Form Core & PH CR Items	Number of Forms Master Core	Number of Forms Scrambles
1	18	3	5	1	23	4	1	3
2	18	3	5	1	23	4	1	3
Total	36	6	10	2	46	8	1	3

Since an individual student's score is based solely on the operational (or core) items, the total number of operational points is 60 for Algebra I. The total score is obtained by combining the points from the core MC (1 point each) and core CR (up to 4 points each) portions of the exam as follows:

Table 3–5. Algebra I Core Points

Category	Module 1 MC Items	Module 1 CR Items	Module 2 MC Items	Module 2 CR Items	Total MC Items	Total CR Items
Total Points	30 (50%)		30 (50%)		60 (100%)	
Core Items	18	3	18	3	36	6
Core Points	18	12	18	12	36	24

The Algebra I Exam results will be reported in two categories based on the two modules of the Algebra I Exam. The code letters for these Assessment Anchor categories are

1. Operations and Linear Equations & Inequalities
2. Linear Functions and Data Organization

The distribution of Algebra I items into these two categories is shown in the following table.

Table 3–6. Algebra I Module and Anchor Distribution

Algebra I Module	Raw Points	Module Weight	Number of Anchors	Number of Eligible Content
1	30	50%	3	18
2	30	50%	3	15

The reporting categories are further subdivided for specificity and Eligible Content (limits). Each subdivision is coded by adding an additional character to the framework of the labeling system. These subdivisions are called Assessment Anchors and Eligible Content. More information about Assessment Anchors and Eligible Content is in Chapter Two.

For more information concerning the process used to convert the Algebra I operational test plan into forms (i.e., form construction), see Chapter Six.

For more information concerning the test sessions, timing, and layout for the Algebra I operational exam, see Chapter Seven.

BIOLOGY TEST DEFINITIONS

The Spring 2022 Biology Keystone Exam was composed of 20 forms. All of the forms contained operational core items identical for all students and sets of generally unique items. The following two tables display the design for Biology for forms 1 through 20. The column entries for these tables denote the following:

- Number of unique core MC items
- Number of unique core CR items
- Number of embedded MC field-test items
- Number of embedded CR field-test items
- Total number of MC and CR items in the form

Table 3–7. Biology Test Plan (Spring 2022) per Operational Form

Module	Core per Form MC Items	Core per Form CR Items	Field Test per Form MC Items	Field Test per Form CR Items	Total per Form Core & FT MC Items	Total per Form Core & FT CR Items
1	24	3	8	1	32	4
2	24	3	8	1	32	4
Total	48	6	16	2	64	8

Table 3–8. Biology Test Plan (Spring 2022) per 20 Operational Forms

Module	Core per 20 Forms MC Items	Core per 20 Forms CR Items	Field Test per 20 Forms MC Items	Field Test per 20 Forms CR Items	Total per 20 Forms Core & FT MC Items	Total per 20 Forms Core & FT CR Items
1	24	3	160	20	184	23
2	24	3	160	20	184	23
Total	48	6	320	40	368	46

The operational (core) portions of the Spring 2022, Summer 2022, and the Winter 2022/2023 administrations came from the same sources. Therefore 30% to 50% of the 2022/2023 Winter, Spring and Summer cores overlap with the Spring 2019, Summer 2019, and Winter 19/20 cores. The remaining core items that appeared on the 2022/2023 forms were field-tested on prior administrations. Although each spring administration includes embedded field-test items, the summer, winter, and breach forms do not include any embedded field-test items due to the lower *n*-counts for these administrations. However, summer, winter, and breach forms still include the same number of items that appear in the spring administration. Instead of field-test items, the slots in these exams are filled by placeholder (PH) items. Table 3–9 displays the design for the Biology Summer, Winter, and Breach operational forms.

Table 3–9. Biology Test Plan (2022 Summer, Winter, and Breach) per Operational Form

Module	Core per Form MC Items	Core per Form CR Items	Placeholders per Form MC Items	Placeholders per Form CR Items	Total per Form Core & PH MC Items	Total per Form Core & PH CR Items	Number of Forms Master Core	Number of Forms Scrambles
1	24	3	8	1	32	4	1	3
2	24	3	8	1	32	4	1	3
Total	48	6	16	2	64	8	1	3

Since an individual student's score is based solely on the operational (or core) items, the total number of operational points is 66 for Biology. The total score is obtained by combining the points from the core MC (1 point each) and core CR (up to 3 points each) portions of the exam as follows:

Table 3–10. Biology Core Points

Category	Module 1 MC Items	Module 1 CR Items	Module 2 MC Items	Module 2 CR Items	Total MC Items	Total CR Items
Total Points	33 (50%)		33 (50%)		66 (100%)	
Core Items	24	3	24	3	48	6
Core Points	24	9	24	9	48	18

The Biology Exam results will be reported in two categories based on the two modules of the Biology Exam.

1. Cells and Cell Processes
2. Continuity and Unity of Life

The distribution of Biology items into these two categories is shown in the following table.

Table 3–11. Biology Module and Anchor Distribution

Biology Module	Raw Points	Module Weight	Number of Anchors	Number of Eligible Content
1	33	50%	4	16
2	33	50%	4	22

The reporting categories are further subdivided for specificity and Eligible Content (limits). Each subdivision is coded by adding an additional character to the framework of the labeling system. These subdivisions are called Assessment Anchors and Eligible Content. More information about Assessment Anchors and Eligible Content is in Chapter Two.

For more information concerning the process used to convert the Biology operational test plan into forms (i.e., form construction), see Chapter Six.

For more information concerning the test sessions, timing, and layout for the Biology operational exam, see Chapter Seven.

LITERATURE TEST DEFINITIONS

The Spring 2022 Literature Keystone Exam was composed of 24 forms. All of the forms contained operational core items identical for all students and sets of generally unique items. The following two tables display the design for Literature for forms 1 through 24. The column entries for these tables denote the following:

- Number of unique core passages
- Number of unique core MC items
- Number of unique core CR items
- Number of embedded field-test passages
- Number of embedded MC field-test items
- Number of embedded CR field-test items
- Total number of passages, MC items, and CR items in the form

Table 3–12. Literature Test Plan (Spring 2022) per Operational Form

Module	Core per Form Passages	Core per Form MC Items	Core per Form CR Items	Field Test per Form Passages	Field Test per Form MC Items	Field Test per Form CR Items	Total per Form Passages	Total per Form Core & FT MC Items	Total per Form Core & FT CR Items
1	2	17	*3	1	6	1	3	23	4
2	2	17	*3	1	6	1	3	23	4
Total	4	34	6	2	12	2	6	46	8

*For each module, one core passage has two CRs and one core passage has one CR.

Table 3–13. Literature Test Plan (Spring 2022) per 24 Operational Forms

Module	Core per 24 Forms Passages	Core per 24 Forms MC Items	Core per 24 Forms CR Items	Field Test per 24 Forms Passages	Field Test per 24 Forms MC Items	Field Test per 24 Forms CR Items	Total per 24 Forms Passages	Total per 24 Forms Core & FT MC Items	Total per 24 Forms Core & FT CR Items
1	2	17	*3	12	144	24	26	161	27
2	2	17	*3	12	144	24	26	161	27
Total	4	34	6	24	288	48	52	322	54

*For each module, one core passage has two CRs and one core passage has one CR.

The operational (core) portions of the Spring 2022, Summer 2022, and the Winter 2022/2023 administrations came from the same sources. Therefore 30% to 50% of the 2022/2023 Winter, Spring and Summer cores overlap with the Spring 2019, Summer 2019, and Winter 19/20 cores. The remaining core items that appeared on the 2022/2023 forms were field-tested on prior administrations. Although each spring administration includes embedded field-test items, the summer, winter, and breach forms do not include any embedded field-test items due to the lower *n*-counts for these administrations. However, summer, winter, and breach forms still include the same number of items that appear in the spring administration. Instead of field-test items, the slots in these exams are filled by placeholder (PH) items. Table 3–14 displays the design for the Literature Summer, Winter, and Breach operational forms.

Table 3–14. Literature Test Plan (2022 Summer, Winter, and Breach) per Operational Form

Module	Core per Form MC Items	Core per Form CR Items	Placeholders per Form MC Items	Placeholders per Form CR Items	Total per Form Core & PH MC Items	Total per Form Core & PH CR Items	Number of Forms Master Core	Number of Forms Scrambles
1	2	17	*3	1	6	1	1	3
2	2	17	*3	1	6	1	1	3
Total	4	34	6	2	12	2	1	3

*For each module, one core passage has two CRs and one core passage has one CR.

Since an individual student's score is based solely on the operational (or core) items, the total number of operational points is 52 for Literature. The total score is obtained by combining the points from the core MC (1 point each) and core CR (up to 3 points each) portions of the exam as follows:

Table 3–15. Literature Core Points

Category	Module 1 Passages	Module 1 MC Items	Module 1 CR Items	Module 2 Passages	Module 2 MC Items	Module 2 CR Items	Total Passages	Total MC Items	Total CR Items
Total Points	26 (50%)			26 (50%)			52 (50%)		
Core Items	2	17	3	2	17	3	4	34	6
Core Points	NA	17	9	NA	17	9	NA	34	18

The Literature Exam results will be reported in two broad categories based on the two modules of the Literature Exam.

1. Fiction Literature
2. Nonfiction Literature

The distribution of Literature items into these two categories is shown in the following table.

Table 3–16. Literature Module and Anchor Distribution

Literature Module	Raw Points	Module Weight	Number of Anchors	Number of Eligible Content
1	26	50%	2	25
2	26	50%	2	31

The reporting categories are further subdivided for specificity and Eligible Content (limits). Each subdivision is coded by adding an additional character to the framework of the labeling system. These subdivisions are called Assessment Anchors and Eligible Content. More information about Assessment Anchors and Eligible Content is in Chapter Two.

For more information concerning the process used to convert the Literature operational test plan into forms (i.e., form construction), see Chapter Six.

For more information concerning the test sessions, timing, and layout for the Literature operational exam, see Chapter Seven.

ITEM DEVELOPMENT CONSIDERATIONS

Alignment to the Keystone Assessment Anchors and Eligible Content, 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* (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 2014) and *Universal Design* (Thompson, Johnstone, & Thurlow, 2002) guided the development process. In addition, *Fairness in Testing: Training Manual for Issues of Bias, Fairness, and Sensitivity* (DRC, 2010) was 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 uses 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 related to issues of bias, fairness, and sensitivity (as well as based on 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 include 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, region/geography, ethnic/cultural, socioeconomics/class, religion, experience, 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.

See the sections below in this chapter for more information about the Bias, Fairness, and Sensitivity Review meetings conducted for the Keystone Exams.

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 Keystone Exams. 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.
- Items allow changes to other formats, such as Braille, without changing meaning or difficulty.
- 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 provided in Chapter Four.

DEPTH-OF-KNOWLEDGE OVERVIEW

An important element in statewide graduation exams 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 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" (Webb, 1999, pp. 7–8). The four levels of cognitive complexity (i.e., DOK) are as follows:

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

DOK levels were incorporated into the item writing and review process, and items were coded with respect to the level they represented. The DOK level for MC and CR items are at Level 3, Level 2, or Level 1 depending on the cognitive intent of an Eligible Content. DOK Level 4 items are not included on the Keystone Exams. For more information on DOK (and a comparison of DOK to Bloom's Taxonomy), see Appendix A.

PASSAGE READABILITY OVERVIEW

Evaluating the readability of a passage is essentially a judgment by individuals familiar with the classroom context and what is linguistically appropriate (PDE recommends that the Literature Keystone Exam be administered at grade 10). 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. For more information on Literature passages, see Chapter Two and the literature passage-selection process described below.

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 Algebra I 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 course level for non-Literature exams. There was a conscious effort made to ensure that each question was evaluating a student's ability to build toward mastery of the course standards rather than evaluating 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 several different committees composed 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, determine the validity of the vocabulary used, and work to minimize the level of reading required.

Vocabulary was also addressed at the Bias, Fairness, and Sensitivity Review, although the focus was on how certain words or phrases may represent possible sources of bias or issues of fairness or sensitivity. See the sections that follow in this chapter for more information about the Bias, Fairness, and Sensitivity Review meetings conducted for the Keystone Exams.

ITEM AND TEST DEVELOPMENT CYCLE

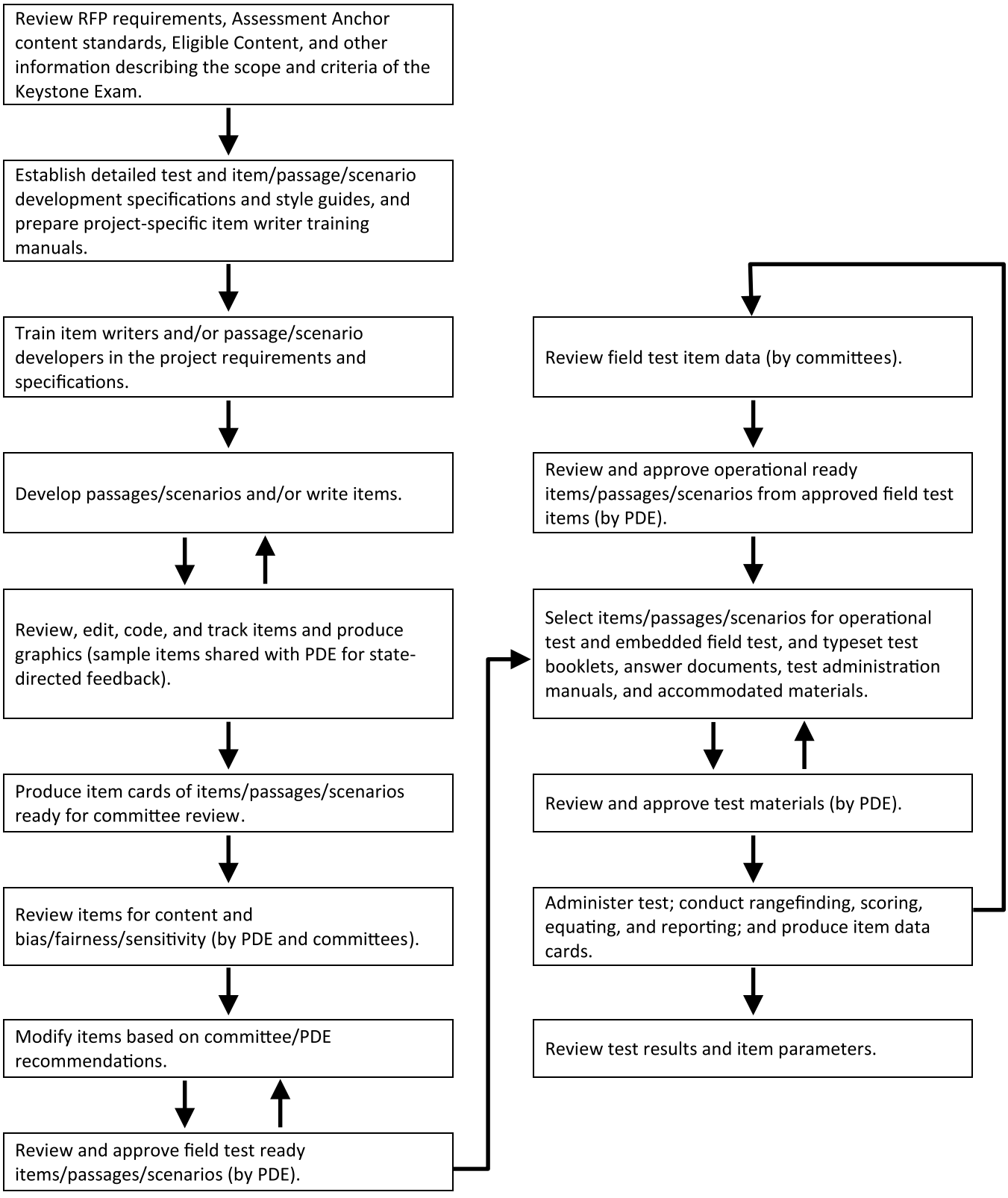
The item development process for items followed a logical cycle and time line, which are outlined in the table and figure on the next pages. On the front end of the schedule, tasks were generally completed with the goal of presenting field-test candidate items to committees of Pennsylvania educators. On the back end of the schedule, all tasks led to the field-test data review and operational test construction. This process represents a typical life cycle for an embedded Keystone field-test event, not a stand-alone field-test event or an accelerated development cycle.

The process flowchart, also shown below, illustrates the interrelationship among the steps in the primary cycle that occurs in a normal process of development (i.e., when the items for field testing are primarily from new development, as opposed to being selected from an existing item bank). In addition, a detailed process table describing the item and test development processes also appears in Appendix C.

Table 3–17. General Item and Test Development Life Cycle for Spring Keystone Administrations

Cycle	Steps in Development Life Cycle	Time Line	Approximate Window	
Primary	Development Planning	Summer/Fall	Month 1–4	Jul–Oct
Primary	Literature Passage Selection	Summer/Fall	Month 1–6	Jul–Dec
Primary	Item Writer Training	Fall	Month 5	Nov
Primary	Initial Item Authoring	Fall/Winter	Month 5–9	Nov–Mar
Primary	Internal Reviews and PDE Reviews	Fall to Spring	Month 6–12	Dec–Jun
Primary	Bias, Fairness, and Sensitivity Review	Summer	Month 13	Jul
Primary	New Item Content Committee Review (PA Educators)	Summer	Month 13	Jul
Primary	Post-Review Resolution and Cleanup	Summer	Month 13–14	Jul–Aug
Primary	Build Field-Test Forms	Summer/Fall	Month 15–16	Sep–Oct
Primary	Internal Form Reviews and PDE Reviews	Summer/Fall	Month 15–18	Sep–Dec
Primary	Final Form and Printer Proof Approvals	Fall/Winter	Month 18–19	Dec–Jan
Primary	Ancillary and Accommodated Form Development	Fall/Winter	Month 18–20	Dec–Feb
Primary	Form Printing, Spiraling, Packaging, and Shipping	Winter/Spring	Month 19–22	Jan–Apr
Primary	Field-Test Administration	Spring	Month 23	May
Primary	Material/Data Processing, Rangefinding, and Scoring	Spring/Summer	Month 23–26	May–Aug
Primary	Field-Test Item Data Review (PA Educators)	Summer	Month 27	Sept
Primary	Select Operational Items	Summer/Fall	Month 27–28	Sep–Oct
Primary	Build Operational Forms	Fall	Month 28–29	Oct–Nov
Primary	Internal Form Reviews and PDE Reviews	Fall	Month 29–30	Nov–Dec
Primary	Final Form and Printer Proof Approvals	Fall/Winter	Month 30–31	Dec–Jan
Primary	Ancillary and Accommodated Form Development	Fall/Winter	Month 31–33	Jan–Mar
Primary	Form Printing, Spiraling, Packaging, and Shipping	Winter/Spring	Month 31–33	Jan–Mar
Primary	Operational Test Administration	Spring	Month 35	May
Primary	Material/Data Processing and Scoring	Spring/Summer	Month 35–36	May–Jun
Primary	Score Reporting	Summer	Month 35–39	May–Sep
Secondary	Select Biennial Core-to-Core Overlap Items (Operational Items)	Summer/Fall	Month 51–52	Sep–Oct
Secondary	Build Operational Forms	Fall/Winter	Month 52–53	Oct–Nov
Secondary	Internal Form Reviews and PDE Reviews	Winter	Month 53–54	Nov–Dec
Secondary	Final Form and Printer Proof Approvals	Winter	Month 54–55	Dec–Jan
Secondary	Ancillary and Accommodated Form Development	Winter/Spring	Month 55–57	Jan–Mar
Secondary	Form Printing, Spiraling, Packaging, and Shipping	Winter/Spring	Month 56–58	Feb–Apr
Secondary	Second Operational Test Administration	Spring	Month 59	May
Secondary	Material/Data Processing and Scoring	Spring/Summer	Month 59–60	May–Jun
Secondary	Score Reporting	Summer	Month 59–63	May–Sep
Tertiary	Release Core-to-Core Overlap Items in Samplers	Fall	Month 63	Sep

Figure 3–1. DRC Item and Test Development Primary Cycle



GENERAL ITEM AND TEST DEVELOPMENT PROCESS

This section describes the processes which lead up to an operational exam. These processes were used to develop the entire pool of items that appeared in the field-test and operational administrations.

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 for the next administration, including the test blueprint, the field-test plan (including development counts), procedures, timelines, etc. With a complete development cycle lasting about three years (from item authoring through field test, data review, and operational usage), the initial planning begins well in advance of the anticipated administration.

ITEM WRITER TRAINING

Item writers were selected and trained for the subject areas of Algebra I, Biology, and Literature. Qualified writers—either hired independently by the testing vendor, DRC, or through subcontractors like Victory—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 MC and CR items. Prior to developing items for the Keystone Exams, the cadre of item writers was trained with regard to the following areas:

- Keystone Assessment Anchors and Eligible Content
- Webb's levels of cognitive complexity, DOK
- Subject-specific general scoring guidelines
- Specific and general guidelines for item writing
- Bias, fairness, and sensitivity guidelines
- Principles of universal design
- Item quality technical style guidelines
- Reference information
- Sample items

LITERATURE PASSAGE SELECTION

The task of searching for passages was conducted by DRC professionals with classroom experience in reading/language arts. These professionals also underwent specialized training (provided by DRC) in the characteristics of acceptable passages. Guidelines for passage selection 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 finders were given the task of searching for a specified number of passages for each genre. Generally, they looked for at least twice as many passages as were needed. Passages acquired were either authentic (permissioned), in that they were culled from published materials, or commissioned by experienced authors. See Chapter Two for more information on the types of passages used on the Literature Keystone Exam.

For permissioned passages, approval to reprint was secured from the publishers. 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 from a variety of sources.
- Passages are able to stand the test of time.

- Passages are sufficiently rich to generate a variety of MC and CR items.
- Passages are complete with all necessary permissions documentation.
- 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, the passages deemed potentially acceptable were reviewed by the Reading Content Committee and the Bias, Fairness, and Sensitivity Committee for final approval.

ITEM AUTHORING AND TRACKING

Initially, items are generated with software-prepared Keystone Exams Item Cards, which allow for preliminary sorting and reviewing. Although very similar, the Keystone Exams Item Card for Multiple-Choice Items differs from the Keystone Exams Item Card for Constructed-Response Items in that the former has a location at the bottom of the card for comments regarding the distractors. Blank examples of these two cards are shown in Appendix D. In both instances, 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, DOK (cognitive complexity), estimated difficulty, answer key (for MC items), 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 in a test form (for both print and online delivery). 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). A sample IDEAS Item Card is presented in Appendix D.

INTERNAL REVIEWS AND PDE 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, his/her knowledge of the content area curriculum, and the 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 difficulty and for cognitive complexity focused on DOK Level 3.

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/or Assessment Anchor. They also assessed each item to make certain that it was appropriate for the intended grade and that it provided and cued only one correct answer (MC items only). In addition, the difficulty level, DOK, graphics, language demand, and distractors were also evaluated. Other elements considered in this process included, but were not limited to, universal design, bias, source of challenge, grammar/punctuation, and Keystone style.

Following this internal process, items were reviewed by content specialists at PDE, who then consulted with DRC about any general issues or concerns (e.g., style, format, interpretation of Assessment Anchors and Eligible Content) and about edits to specific items. Following PDE's review, the items were prepared for the content review meetings conducted with Pennsylvania educators.

ITEM CONTENT REVIEWS

Prior to the 2022 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 with regard to quality and content classification, including grade-level (course) appropriateness, estimated difficulty, DOK, and source of challenge. They also suggested revisions and made recommendations for reclassification of items. In some cases when an item was deleted, the committee suggested a replacement item and/or reviewed a suggested replacement item provided by the facilitators. The committee also reviewed the items for adherence to the principles of universal design, including language demand and issues of bias, fairness, and sensitivity.

With source of challenge, items were identified where the cognitive demand was focused on an unintended content, concept, or skill (Webb, 2002). Source of challenge may be a contributing factor if the reason that an answer could be given results from a cultural bias, an inappropriate reading level, a flawed graphic in an item, or if an item requires specialized, noncontent-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.

DRC content assessment specialists facilitated the reviews and were assisted by representatives of PDE. Committee members, grouped by exam, worked through and reviewed the items for quality and content, as well as for the following categories:

- Assessment Anchor alignment
- Content limits
- Grade-level (course-level) appropriateness
- Difficulty level
- DOK
- Appropriate source of challenge
- Correct answer
- Quality of distractors
- Graphics in regards to appropriateness
- Appropriate language demand
- Freedom from bias

The members then came to consensus and assigned a status to each item: Approved, Accepted with Revision, or Rejected. All comments were recorded, and a master rating sheet was completed. Committee facilitators recorded the committee consensus on the Item Review Rating Sheet. A sample form and rating criteria may be found in Appendix E.

Security was addressed by adhering to a strict set of procedures. Items in binders were distributed for committee review by number and signed for by each member on a daily basis. 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. 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, multiethnic 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, 2017). Members of the committee also had expertise with special needs students and English Learners (EL). PDE staff members were also trained and participated in the review. 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 consensus as to which decisions 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 PDE. This review followed the same security procedures as outlined above.

CHAPTER FOUR: UNIVERSAL DESIGN PROCEDURES APPLIED TO THE KEYSTONE EXAMS TEST DEVELOPMENT PROCESS

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 (in both print and online delivery methods) were designed and developed using the elements of universally designed assessments established by the National Center on 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 English Learners and students with disabilities. The benefits of universally designed assessments not only apply to these groups of students, but to all individuals with wide-ranging characteristics.

DRC's test development team was trained in the elements of Universal Design as they relate 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 Learners. Likewise, some members of the Bias, Fairness, and Sensitivity Committee were conversant with these issues. What follows are the Universal Design guidelines that were followed during all stages of the item development process for the Keystone Exams.

ELEMENTS OF UNIVERSALLY DESIGNED ASSESSMENTS

After a review of research relevant to the assessment development process and the Principles of Universal Design (Connell et al., 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 Keystone Exams.

- **Inclusive Assessment Population**

  The target population includes students attending Commonwealth schools who participate in one or more of the graduation competency exams.

- **Precisely Defined Constructs**

  An important function of well-designed assessments is that the assessments actually measure what they are intended to measure. The Keystone Exams Assessment Anchor Content Standards (Assessment Anchors) provided clear descriptions of the constructs to be measured on each of the exams. Universally designed assessments must remove all non-construct-oriented cognitive, sensory, emotional, and physical barriers.

- **Accessible, Nonbiased Items**

  DRC conducted both internal and external reviews of items and test specifications to ensure that they did not create barriers due to lack of sensitivity to disability, culture, or other subgroups. Items and test specifications were developed by a team who understood 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 (see also the section on Assessment Accommodations later in this chapter).

- **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, and text organization. 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 new Keystone Exam 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 directing 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 assessing. A style guide was developed and utilized that 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 followed. For more information on the checklist, see the Universal Design Overview section in Chapter Three of this report.

1. **Items measure what they are intended to measure.** Item writing training included making certain that writers and reviewers had a clear understanding of Pennsylvania's Academic Standards and the Keystone Assessment Anchors. During all phases of test development, items were presented with content-standard information to ensure that each item reflected the intended Assessment Anchor. Careful consideration of the content standards was important in determining which skills involved in responding to an item were extraneous and which were relevant. With certain types of items, an additional skill was 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 were presented to students must allow for maximum readability for all students. Appropriate fonts and point sizes were employed with minimal use of italics, which are far less legible and are read considerably more slowly than standard typeface. Captions, keys, and legends were at least a 12-point size, while footnotes and sentence numbers used a 10-point font.[1] Legibility was enhanced by sufficient spacing between letters, words, and lines. Blank space was used around paragraphs and between columns and staggered right margins.
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 when possible. Sufficient contrast between the 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.
    - Questions to be answered were clearly identifiable.
6. **Items allow changes to format without changing meaning or difficulty.** A Braille version was available for each operational exam. Attention was given to using items that allow for Braille. Specific accommodations were permitted, such as signing to a student, the use of oral presentation under specified conditions, and the use of various assistive technologies. A Spanish version of the Algebra I and Biology exams was available for use by English Learners who would benefit from this accommodation and who were in U.S. schools for less than three years.
7. **The test has an overall appearance that is clean and organized.** Information was organized in a left-right, top-bottom format. 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.

ITEM DEVELOPMENT

DRC worked closely with the Pennsylvania Department of Education to ensure that the Keystone Exams complied with nationally recognized principles of Universal Design. The implementation of accommodations on large-scale statewide assessments for students with disabilities was supported in the development of the Keystone Exams. In addition to the principles of Universal Design as described in the Pennsylvania Technical Report, DRC applied 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).

[1] While font size follows specific requirements during online setup of an exam, the screen resolution used at the local level can impact whether the effective font size is visible to the student.

To this end, DRC embraces the following precepts:

- Test directions are worded to allow for alternate responses to constructed-response items.
- During item and bias reviews, committee members are made aware of the Principles of Universal Design and of issues that may adversely affect students with disabilities. The goal is to make certain that the Keystone Exams are bias free for all students. With the goal of ensuring that the Keystone Exams are accessible to the widest range of diverse student populations, PDE instructs DRC to limit item types that are difficult to format in Braille and that may become distorted when published in large print. DRC is instructed to limit the following on the Keystone Exams.
    - Algebra I: Complicated tessellations; charts or graphs that extend beyond one page
    - Literature: Graphics and illustrations that are not germane to the content presented
    - All exams: Unnecessary boxes and framing of text, unless enclosing the text provides necessary context for the student; use of italics (limited to only when it is absolutely necessary, such as with variables)

ITEM FORMAT

For all Keystone Exams (both online and print), DRC formats the items to maximize accessibility for all students by using text that is in an easily readable size and font style. DRC limits shading, graphics, charts, and the number of items per page so that there is sufficient white space on each page. Whenever possible, 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 when possible to convey pertinent information. Tests are published on dull-finish paper to avoid the glare encountered on glossy paper. DRC pays close attention to the binding of the exam books to ensure that they lie flat for two-page viewing and ease of reading and handling.

DRC ensures consistency across Keystone Exams 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 when 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.
- Pictures that require physical measurement are true to size.

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 make certain 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. Accommodations manuals for Pennsylvania assessments titled *Accommodations Guidelines* and *Accommodations Guidelines for English Learners* were developed for use with the Keystone Exams. The PDE guideline manuals can be accessed by going to www.education.pa.gov.

In addition, Spanish-language versions, translated from the original English versions were made available for both the Algebra I Exam and the Biology Exam. The Spanish-translation editions of the exams are discussed in Chapter Six.

CHAPTER FIVE: EMBEDDED FIELD TEST

FIELD TEST OVERVIEW

Every Keystone spring administration, field-test items are embedded on operational forms. The main purposes of field testing items prior to future operational use are (a) to calculate item statistics, (b) to determine if items meet the criteria with respect to statistical properties for future operational use, and (c) to obtain item parameters for pre-equating purposes. In comparison to stand-alone field tests, embedded field tests (EFT) allow for more accurate item statistics and item parameters by alleviating concerns of whether students may perceive differences between field-test and operational items. The EFT approach allows item parameters to be used for future pre-equating purposes and is based on the assumption that students should be equally motivated to take the operational and field-test items because they are not aware of which items are field-test items. To minimize item context and item position effects (i.e., lack of motivation and fatigue), field-test items were interspersed within the operational sections. With this design, students have a smaller chance of knowing the field-test item positions.

Keystone test forms contained common operational items that were identical on all forms along with embedded field-test items. In most instances, the field-test items were unique to a given form; however, there were instances in which an embedded field-test item appeared on more than one form. More information on the field-test designs for all subjects can be found in the content-specific portions of Chapter Three. In general, the field-test items for each year represent a portion of the previous year's operational forms (Spring, Summer, and Winter). For example, items from the field-test in Spring 2018 were selected for the Spring 2019, Summer 2019, and Winter 2019–2020 operational forms. This chapter presents information about the 2022 EFT, including classical item analyses, Differential Item Functioning (DIF) analyses, identification of items for data review, and outcomes from data review.

The number of field-test positions on spring forms varies by subject. Table 5–1 displays the number of field-test positions by subject and module. It is important to note that the number of item positions and the number of field-test items on a spring administration may differ slightly.

Table 5–1. Number of FT Item Positions by Item Type (MC, CR), Content Area and Module

Content Area	Module	MC Item Positions per Form	CR Item Positions per Form	Passages per Form	MC Item Positions (Total)*	CR Item Positions (Total)*	Passages (Total)*
Algebra I	1	5	1	0	120	24	0
Algebra I	2	5	1	0	120	24	0
Algebra I	Total	10	2	0	240	48	0
Biology	1	8	1	0	160	20	0
Biology	2	8	1	0	160	20	0
Biology	Total	16	2	0	320	40	0
Literature	1	6	1	1	144	24	12
Literature	2	6	1	1	144	24	12
Literature	Total	12	2	2	288	48	24

*Total FT Item Positions across 20 Biology forms, and 24 Literature and Algebra I forms.
Note. Each FT passage is repeated across 2 forms with different sets of FT items to yield the highest volume of eligible items for subsequent forms selection.

CLASSICAL ITEM ANALYSIS

Classical item analyses of field-test items are conducted in order to assess the items' quality and to identify items for data review. Specifically, item difficulty (also referred to as *p*-values, which represent the proportion of students correctly answering the item) and item-total correlations (the relationship between whether a student answers an item correctly and that student's total test score) are estimated for the item, for each option for MC items, and for each score point for multi-point items.

ITEM DIFFICULTY

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

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

In the mean score formula above, the individual item scores (*xi*) are summed and then divided by the total number of students (*n*). For MC items, student scores are represented by 0's and 1's (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[1] 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 students answered the item correctly. Additionally, this value might suggest that the item is relatively easy or that the students who attempted the item are relatively high achievers. In other words, item difficulty and student ability are somewhat confounded.

For CR items, mean scores can range from the minimum possible score (usually zero) to the maximum possible score (e.g., four points in the case of Algebra I CR items, three points in the case of Biology and Literature CR items). Sometimes a *pseudo p*-value is provided for a CR item 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 Keystone Exams because of the various student achievement levels (Below Basic, Basic, Proficient, and Advanced). Items that are either very hard or very easy provide little information about student differences in achievement. However, an item answered correctly by a high percentage of students would suggest that the knowledge or skill the item measures has been mastered by most students. Conversely, an item answered correctly by a low percentage of students would suggest that few students have mastered the knowledge or skill the item measures. So on criteria-referenced tests like the Keystone Exams, a test development goal is to include a wide range of item difficulties.

ITEM DISCRIMINATION

At the most general level, item discrimination[2] 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 Keystone Exams overall) would be more likely to answer any given item correctly, while students with low ability (i.e., those who perform poorly on the Keystone Exams overall) would be more likely to answer the same item incorrectly. For the Keystone Exams, Pearson's product-moment correlation coefficient between item scores and test scores is used to indicate discrimination. As commonly practiced, Data Recognition Corporation (DRC) removes the item score from the total score so that the resulting correlations will not be spuriously high. The correlation coefficient can range from negative 1.0 to positive 1.0. If higher-scoring students tend to answer the item correctly while lower-scoring students do not answer the item correctly, the correlation between the item score and the total test score

[1] For MC items with four response options, pure random guessing would lead to an expected *p*-value of 0.25.

[2] As noted earlier, the discrimination index for dichotomous MC items is typically referred to as the *point-biserial correlation coefficient*. For CR items, the term *item-test correlation* is sometimes used.

will be both positive and noticeably large in its magnitude (i.e., well above zero), indicating that the item is good at discriminating between higher-scoring and lower-scoring 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 would be less likely to choose a distractor, while students with low ability 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.[3] In other words, 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., items with extreme *p*-values) can have reduced power to discriminate and thus can have lower correlations.

CLASSICAL ITEM ANALYSIS RESULTS

Table 5–2 provides the summary statistics for the difficulty and discrimination for the 2022 field-test items with respect to each content area and item type (see Chapter Eleven for summary statistics for operational items). There is a range of *p*-values across all content areas, where mean *p*-values were between 0.47 to 0.65 for MC items and 0.25 to 0.53 for CR items. The mean item-total correlations were between 0.34 to 0.37 for MC items and 0.64 to 0.72 for CR items.

Table 5–2. Summary Statistics of Difficulty and Discrimination by Content Area and Item Type

Content Area	Item Type	N	Mean *p*-value	Min p-val.	Median *p*-value	Max *p*-value	Mean I-T Corr.	Min I-T Corr.	Median I-T Corr.	Max I-T Corr.
Algebra I	CR	48	0.25	0.06	0.25	0.52	0.67	0.51	0.69	0.80
Algebra I	MC	240	0.47	0.08	0.48	0.83	0.37	-0.14	0.40	0.58
Biology	CR	40	0.37	0.14	0.36	0.63	0.64	0.49	0.64	0.74
Biology	MC	320	0.48	0.10	0.47	0.83	0.34	-0.07	0.37	0.56
Literature	CR	48	0.53	0.47	0.53	0.61	0.72	0.67	0.72	0.76
Literature	MC	287	0.65	0.19	0.67	0.93	0.36	-0.12	0.39	0.59

Note. I-T Corr. is the item-test score correlation.

DIFFERENTIAL ITEM FUNCTIONING

Differential item functioning (DIF) occurs when examinees who have the same ability level but belong to different groups do not have the same probability of answering an item correctly. When the probability differs, it is important for content experts to review items for any potential *item bias*. It is important to note that, as a statistical concept, DIF is different from item bias. DIF detects a difference in performance after controlling for student ability, whereas bias is a content issue that can arise in situations where something other than the intended construct of measurement affects the probability of a correct response for a particular group. For example, bias is present when an item presents negative group stereotypes that draw the attention of the examinee, uses non-construct relevant language that is more familiar to one subpopulation than to another, or is presented in a non-construct relevant format that disadvantages certain learning styles. While the source of item bias can be plain to trained judges, DIF may have no clear cause. In such cases, something other than bias, including construct relevant content, may be explaining the differential performance on the item. Flagging items with DIF provides the opportunity for reviewers to assess and correct potential bias, but DIF does not necessarily mean that bias is present.

DIF DETECTION PROCEDURES

For MC items, the Mantel-Haenszel (MH) procedure (Mantel & Haenszel, 1959) for detecting DIF is a commonly used technique. 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 for the analysis.

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

The MH 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 likely 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, black and Hispanic for ethnicity-based DIF, and the computer-based-test (CBT) group for the test administration mode-based DIF; reference groups were male, white, and the paper-and-pencil test (PPT) group for the gender, ethnicity, and mode-based DIFs, respectively. The MH statistic for each item is computed from a contingency table. The table has two groups (focal and reference) and two outcomes (right or wrong). The ability groups are defined by the total score distribution for the total examinee populations.

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 CR items, a comparable statistic is computed based on the standardized mean difference (SMD) (Dorans, Schmitt, & Bleistein, 1992), 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, all items are assigned a severity code (A, B, or C) based on the magnitude of the MH statistic and a direction (minus or plus) based on the direction of the MH 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. A plus sign indicates that the item favors the focal group, and a minus sign indicates that the item favors the reference group.

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 reviews 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 automatically accepted because the statistical method did not flag them.

Statistical detection of DIF is not an exact science. There have been a variety of methods proposed for detecting DIF, but no single statistic can be considered either necessary or sufficient. Different methods are more or less successful and detect DIF at different rates. No analysis can guarantee that a test is free of bias, but thoughtful item development and field-test analysis can prevent potentially biased items from unfairly impacting student scores.

A fundamental shortcoming of all statistical methods used in DIF evaluation is that they are all intrinsic to the test being evaluated. If a test is unbiased overall but contains one or two DIF items, any method can identify DIF. However, because all current methods use total test performance as the measure on which to control for group abilities, a test with all DIF items will not be able to separate DIF effects from true differences in achievement on the test.

CRITERIA FOR IDENTIFYING ITEMS

As previously discussed, all field-test items were analyzed statistically using conventional item analysis methods. For MC items, classical item statistics included the corrected point-biserial correlation (Pt. Bis.) for the correct and incorrect responses (distractors), the percentage correct (*p*-value), and the percentage incorrect. For constructed-response (CR) items, the statistical indices included the item-test correlation, the point-biserial correlation for each score point, the percentage of responses in each score point, and the percentage of non-scorable responses.

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 in question will be reviewed by DRC test development staff and committees of Pennsylvania educators to determine the nature of the problem and the characteristics of the students affected. The primary ways of detecting such conditions are through the point-biserial correlation coefficient for dichotomously scored MC items and the item-total correlation for polytomously scored CR 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 CR item score) and negative when the reverse is true.

The following set of criteria was used to identify items for additional review.

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

1. Percentage Correct (*p*-value) less than 0.3 or greater than 0.9
2. Item-total correlation for the correct response less than 0.25
3. Point-biserial correlation for any incorrect response greater than 0.0
4. Percentage responding to any incorrect responses greater than the percentage correct
5. Gender, ethnic, or mode DIF code of C+ or C-

For a CR item to be flagged, the item needed to meet any of the following criteria:

1. Percentage Correct (*p*-value) less than 0.3 or greater than 0.9
2. Item-total correlation for the correct response less than 0.25
3. Score proportion less than 0.05
4. Gender, ethnic, or mode DIF code of C+ or C-

The intent of the above criteria is to flag items for review. For this purpose, the preference is to over-identify rather than under-identify items to ensure they are appropriate for future use. Any of the criteria would cause the item to be reviewed by content experts, but there are many reasons the experts may want to keep an item in spite of the statistics.

RESULTS AND OBSERVATIONS

Each form has a set of operational items along with embedded FT items. Test forms are spiraled to ensure that a representative sample of students answer each set of FT items (see Chapter Nine for additional information about spiraling). For MC items, all data is used for classical item analyses and DIF analyses. In contrast, a random sample of responses are selected to be scored for FT analyses for CR items.

This section focuses on reporting the number (*N*) and percentage (%) of items flagged by different criteria (see Tables 5–3 to 5–5). For the DIF analysis, the number and percentage of items were provided not only for the C- and C+ bias codes, which were used as the criteria to flag items, but also for the bias codes A-, A+, B-, and B+.

Table 5–3. Summary of Items Flagged by the Classical Item Statistics

Item Type	Flagging Criterion	Alg. I Total N	Alg. I N	Alg. I %	Bio. Total N	Bio. N	Bio. %	Lit. Total N	Lit. N	Lit. %
MC	1 (Low *P*-value)	240	29	12.1	320	33	10.3	287	7	2.4
MC	2 (Low Point-Biserial Correlation)	240	37	15.4	320	76	23.8	287	49	17.1
MC	3 (Non-negative distractor correlation)	240	39	16.3	320	64	20.0	287	43	15.0
MC	4 (High distractor proportion)	240	39	16.3	320	48	15.0	287	18	6.3
CR	1 (Low *P*-value)	48	31	64.6	40	4	10.0	48	0	0.0
CR	2 (Low Point-Biserial Correlation)	48	0	0.0	40	0	0.0	48	0	0.0
CR	3 (Low score-point proportion)	48	0	0.0	40	0	0.0	48	0	0.0

Note. Refer to Criteria for Identifying Items.

Table 5–4. DIF Summary — MC Items

Reference Group	Focal Group	Bias Code	Alg. I (Total N=240) N	Alg. I (Total N=240) %	Biology (Total N=320) N	Biology (Total N=320) %	Literature (Total N=287) N	Literature (Total N=287) %
Male	Female	A-	125	52.1	158	49.4	140	48.8
Male	Female	A+	111	46.3	160	50.0	126	43.9
Male	Female	B-	4	1.7	2	0.6	11	3.8
Male	Female	B+	0	0.0	0	0.0	5	1.7
Male	Female	C-	0	0.0	0	0.0	5	1.7
Male	Female	C+	0	0.0	0	0.0	0	0.0
White	Black	A-	149	62.1	184	57.5	164	57.1
White	Black	A+	89	37.1	135	42.2	108	37.6
White	Black	B-	1	0.4	1	0.3	10	3.5
White	Black	B+	1	0.4	0	0.0	2	0.7
White	Black	C-	0	0.0	0	0.0	2	0.7
White	Black	C+	0	0.0	0	0.0	1	0.3
White	Hispanic	A-	129	53.8	173	54.1	170	59.2
White	Hispanic	A+	111	46.3	147	45.9	107	37.3
White	Hispanic	B-	0	0.0	0	0.0	8	2.8
White	Hispanic	B+	0	0.0	0	0.0	1	0.3
White	Hispanic	C-	0	0.0	0	0.0	1	0.3
White	Hispanic	C+	0	0.0	0	0.0	0	0.0
PPT	CBT	A-	70	29.2	166	51.9	145	50.5
PPT	CBT	A+	169	70.4	152	47.5	138	48.1
PPT	CBT	B-	1	0.4	2	0.6	1	0.3
PPT	CBT	B+	0	0.0	0	0.0	3	1.0
PPT	CBT	C-	0	0.0	0	0.0	0	0.0
PPT	CBT	C+	0	0.0	0	0.0	0	0.0

Table 5–5. DIF Summary — CR Items

Reference Group	Focal Group	Bias Code	Alg. I (Total N=48) N	Alg. I (Total N=48) %	Biology (Total N=40) N	Biology (Total N=40) %	Literature (Total N=48) N	Literature (Total N=48) %
Male	Female	A-	20	41.7	13	32.5	0	0.0
Male	Female	A+	26	54.2	25	62.5	19	39.6
Male	Female	B-	1	2.1	0	0.0	0	0.0
Male	Female	B+	0	0.0	2	5.0	26	54.2
Male	Female	C-	1	2.1	0	0.0	0	0.0
Male	Female	C+	0	0.0	0	0.0	3	6.3
White	Black	A-	34	70.8	31	77.5	0	0.0
White	Black	A+	14	29.2	5	12.5	0	0.0
White	Black	B-	0	0.0	3	7.5	0	0.0
White	Black	B+	0	0.0	0	0.0	0	0.0
White	Black	C-	0	0.0	1	2.5	0	0.0
White	Black	C+	0	0.0	0	0.0	0	0.0
White	Hispanic	A-	36	75.0	25	62.5	0	0.0
White	Hispanic	A+	11	22.9	13	32.5	0	0.0
White	Hispanic	B-	1	2.1	1	2.5	0	0.0
White	Hispanic	B+	0	0.0	0	0.0	0	0.0
White	Hispanic	C-	0	0.0	1	2.5	0	0.0
White	Hispanic	C+	0	0.0	0	0.0	0	0.0
PPT	CBT	A-	35	72.9	29	72.5	35	72.9
PPT	CBT	A+	13	27.1	10	25.0	3	6.3
PPT	CBT	B-	0	0.0	0	0.0	9	18.8
PPT	CBT	B+	0	0.0	0	0.0	0	0.0
PPT	CBT	C-	0	0.0	0	0.0	1	2.1
PPT	CBT	C+	0	0.0	1	2.5	0	0.0

REVIEW OF ITEMS WITH DATA

In the preceding section, it was stated that test development content-area specialists used certain statistics from classical item analyses and DIF analyses of the 2022 field test to identify items for review by Pennsylvania educators. Items not identified for this review had good statistical characteristics and, consequently, were entered into the eligible pool for future item selection. DRC content-area test development specialists and DRC psychometric specialists identified the remaining items for further review by a committee of Pennsylvania educators. The intent was to capture all items that needed a closer review; thus, the criteria employed tended to over-identify rather than under-identify items.

The review of the relevant items was conducted by more than 30 Pennsylvania educators (teachers and PDE staff) broken out into exam-based committees. The review took place on September 7 and 8, 2022. In these sessions, committee members were first trained by a representative from DRC's psychometrics staff with regard to the statistical indices used in item evaluation. This training was followed by a discussion with examples concerning reasons 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 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 flagged EFT items and made recommendations on each item. The results of the committee reviews are shown in the table below.

Table 5–6. Data Review Committee Results

Exam	Module	Total No. of FT Items	No. Reviewed Items	% of Reviewed Items	No. of Items Rejected by Committee	% of Items Rejected by Committee	No. of Items Classified as Rejected*	% of Items Classified as Rejected*
Algebra I	1	144	53	36.8%	0	0.0%	1	0.7%
Algebra I	2	144	59	41.0%	0	0.0%	0	0.0%
Biology	1	180	57	31.7%	14	7.8%	17	9.4%
Biology	2	180	46	25.6%	6	3.3%	10	5.6%
Literature	1	168	42	25.0%	4	2.4%	4	2.4%
Literature	2	168	35	20.8%	3	1.8%	3	1.8%
	Total	984	292	29.7%	27	2.7%	35	3.6%

* Items Classified as "Rejected" from Spring 2022 EFT (all sources: Data Review Committee, PDE, and DRC)

CHAPTER SIX: OPERATIONAL FORMS CONSTRUCTION FOR 2022 ADMINISTRATIONS

FINAL SELECTION OF ITEMS AND KEYSTONE FORMS CONSTRUCTION

Approximately 50% of the items that made up the Spring 2022, Summer 2022, and Winter 2022/2023 operational forms emerged from the Spring 2019 embedded field test. The remaining operational (core) items were part of the biennial core-to-core overlap. For more information about the core-to-core overlapping items, please see Chapter Three. Prior to being placed on the operational tests, these items had undergone multiple reviews, including the following:

- Reviews by Data Recognition Corporation (DRC) content-area test development specialists and curriculum specialists to ensure that all items were properly aligned with content standards
- Formal bias, fairness, and sensitivity review by the Bias, Fairness, and Sensitivity Committee, which consisted of a multiethnic group of men and women having expertise with special-needs students and English Learners (EL)
- Formal review by the content committees consisting of Pennsylvania educators, including teachers as well as district personnel
- Pennsylvania Department of Education (PDE) review
- Item data review by members of the PDE subject-area teacher committees

The item and bias reviews are detailed in Chapter Three. The results of the data review are summarized in Chapter Five.

The end product of the above process was an item status designation for each field-test item. All items having an item status code of Accepted/Operational Ready were candidates to be selected for the 2022 Keystone Exams. To have an item status code of Accepted/Operational Ready meant that the item met the following criteria:

- Appropriately aligned with its designated Keystone Assessment Anchor Content Standard (Assessment Anchor) and subclassifications
- Acceptable in terms of bias/fairness/sensitivity issues, including differential item functioning (for gender and ethnicity)
- Acceptable in terms of psychometric standards, including a special review of flagged items

Next, all relevant information regarding the acceptable items, including associated graphics, was entered into the item banking system known as IDEAS (Item Development and Education Assessment System). From IDEAS and other database sources, Microsoft Excel files were created for each exam. These files contained all relevant content codes and statistical characteristics. IDEAS also created an item card displaying each acceptable item, any associated graphic, and all relevant exam codes and item statistics for use by the subject-area test development specialists and psychometric services staff.

DRC test development specialists reviewed the test design blueprint, including the number of items per strand for each content-area test. Psychometricians provided content-area test development specialists with an overview of the psychometric guidelines for forms construction.

Senior DRC content-area test development specialists reviewed all items in the operational pool to make an initial selection (pull) for common (core) positions according to test blueprint requirements and psychometric guidelines. Changes to items were not encouraged since alterations could affect how an item would perform in subsequent testing.

For these common items, this meant that the combination of multiple-choice (MC) and constructed-response (CR) items would yield the appropriate range of points while tapping an appropriate variety of the Assessment Anchors and related Eligible Content within each Reporting Category (module). Items selected in the first round were examined with regard to how well they fit together as a set. Of particular concern were the following:

- One item providing cues as to the correct answer to another item
- Context redundancy (e.g., mathematics items with a sports context)
- Presence of clang (distractors not unique from one another)
- Diversity of names and artwork for gender and ethnicity

A core-building software tool known as PerForm was used in concert with performance data and metadata from IDEAS to aid in the organization and communication of the pulled data. PerForm automatically tabulates the statistical characteristics of the proposed core, updating instantly whenever item swaps were performed. Using PerForm, the first round of items was then evaluated for statistical features such as an acceptable point-biserial correlation and whether correct answers were distributed equally—that is, whether approximately 25 percent of correct answers appeared in each of the four possible positions (A, B, C, or D). Selected items that were deemed psychometrically less advantageous in contrast to the overall psychometric characteristics of the core resulted in a search by the senior reviewer for suitable replacements. At this point, the second round of items was analyzed. If necessary, this iterative process between content-based selections and statistical properties continued in an effort to reach the best possible balance.

Once the recommendations were finalized for the core items, they were submitted to PDE for review. Department staff provided feedback, which could be in the form of approval or recommendations for replacement of certain items. Any item replacement was accomplished by the collective effort of the test development specialists, psychometricians, and PDE staff until final PDE approval was given. See Appendix F for the Keystone Exams Tally Sheets.

Following final approval by PDE, test development specialists developed print and online forms based on the approved core and approved embedded field-test items. Both modes of delivery were built using IDEAS. Highly skilled test development specialists and editors used specialized checklists to verify accuracy of layout and formatting in both modes of delivery. Following final approval to print, the documents were prepared for the printing presses.

SPECIAL FORMS USED WITH THE OPERATIONAL 2022 KEYSTONE EXAMS

SPANISH TRANSLATION

Starting with the operational exams in spring 2011, school personnel had the option of allowing Spanish-speaking students who had been enrolled in schools in the United States for less than three years to respond to a Spanish version of the Keystone Exams for Algebra I and Biology. The original translation of the items and the *Directions for Administration Manual* was initiated by Language Services Associates and completed/verified by Exact Communications. These companies use translators with varying cultural and regional backgrounds to create the Spanish versions. The translations were then reviewed and verified by DRC's internal Spanish group. As part of the internal review, a Spanish style guide is maintained to document Spanish word choice from administration-to-administration and across exams within an administration.

Following PDE's approval of the translation, the translated text was typeset into print delivery forms. The test book is constructed with a side-by-side format with the English text and Spanish-translated text on facing pages. The Spanish-translated text is on the left-hand side followed by the original English text on the right-hand (facing) side. Each CR item covered either two or four pages in the answer book, depending on the length of the original English-language item. In the case of four-page open-ended items, the first set of facing pages of an item was presented in Spanish. The second set of facing pages of an item was presented in the original English.

Those students using this accommodated version are permitted to write their answers on either the English language pages or on the translated Spanish language pages. Their answers can be written in English, Spanish, or a combination of both Spanish and English because all pages are evaluated and scored, and the highest possible scores from those combinations are recorded for the students.

On a yearly basis, the PDE examines accommodations policies and current research to ensure that valid, acceptable accommodations are available for students. Accommodations manuals for Pennsylvania assessments titled *Accommodations Guidelines* and *Accommodations Guidelines for English Learners (ELs)* were developed for use with the Keystone Exams. The PDE guideline manuals can be accessed by going to www.education.pa.gov. For more information about the general on-screen testing aids available to students taking the online mode of delivery, see Chapter Two.

AUDIO

For students requiring an auditory presentation accommodation, a text-to-speech synthesizer is available to students taking the Algebra I and/or Biology Exams using the online mode of test delivery. For each operational exam, one form was selected for the creation of the audio version. Special scripts are crafted, writing out each item, distractor, graphic, and directions to utilize the rich, synthesized voice features while accounting for specific nuances of the intended sounds. The resulting audio information is provided to students receiving the accommodation. Since additional software is required to generate the vocalization from the scripted text and since headphones are required to minimize disruptions within a computer lab setting, local school personnel generally must preplan to use the audio version in order to ensure that the student has a properly equipped computer and a proper setting.

BRAILLE, LARGE PRINT, AND VIDEO SIGN LANGUAGE

Students were able to respond to test materials that were available in Braille, large print, or Video Sign Language. At each grade level assessed, one form was selected for the creation of these accommodations.

The large print edition is a replication of the standard print form; 8.5×11 standard form is enlarged to an 11×17 page format to achieve a font size of approximately 18-point. A side-by-side verification is completed between the standard print and large print forms to ensure that the integrity of all formatting and graphics is maintained on the large print forms.

For Braille production, the final selected form is delivered to American Printing House for the Blind (APH) via APH's secure website. APH ensures that all tests are translated correctly and accurately by using a translator and a validator. After all Braille booklets are printed, APH conducts a quality assurance step to ensure all items are bound in order and directions are included. All Braille booklets are shipped from APH to DRC via UPS.

DRC applies a security barcode to each large print and Braille booklet for purposes of shipping, distributing, and collecting the materials. This security barcode is used with DRC's Operations Materials Management System (Ops MMS).

School personnel were directed to transcribe all student answers (SR and CR) into scannable answer documents exactly as the student responded. No alterations or corrections of student work were permitted, and the transcribed answer document had to have the same form designation as the Braille and large print version.

DRC utilizes Victory Productions for the production of Sign Language Videos. The items are passed to Victory Productions via a secure ftp site. Two to three different interpreters are used to interpret and validate the translations during video recording. After the interpretations are recorded and returned to DRC via a secure ftp site, DRC loads these videos in the online test engine. When school personnel assign the specific sign language accommodation, the student will be able to play each video next to the item.

CHAPTER SEVEN: TEST ADMINISTRATION PROCEDURES

SECTIONS, SESSIONS, TIMING, AND LAYOUT OF THE KEYSTONE EXAMS

The design for most Keystone Exams utilizes separate test books and answer books. An answer book is used to respond to the multiple-choice (MC), evidence-based selected-response (EBSR), and constructed-response (CR) items and to collect demographic information. The MC items and all stimulus text are placed within the test book. One exam uses a single consumable book. When a single scannable answer book is utilized, the contents of the answer book and the test book are combined into one integrated book. The table below identifies the exam material format for each 2022 Keystone Exam.

Table 7–1. Book Type by Exam

Exam	Test Book	Answer Book	Single Consumable Book
Algebra I	✓	✓	
Biology	✓	✓	
Literature	✓	✓	

Generally, a separate test book and answer book are used to separate the MC items and the CR items. For passage-based exams, like Literature, the separate exam materials allow the students to reference stimulus materials at the same time that a response to a CR item is composed. In addition, since all student responses must be scanned for scoring and storage purposes, a separate answer book limits the volume of data that must be stored.

SECTIONS AND SESSIONS

Each operational Keystone Exam is organized around two equally sized test modules; the focus of each is on two or more specific, thematically linked Assessment Anchors and Eligible Content. The content in each module remains separate, and items measuring the Eligible Content in a module appear only in that module. The module design is identical in the print (paper-and-pencil) and online modes of delivery.

Each exam section is administered in an exam session. Local districts must schedule the two modules as two separate exam sessions (morning and afternoon or two separate days), and an individual module must be completed in one exam session.

Each test session is to be completed within a prescribed testing window. The testing windows below reflect both online and paper-based administrations in the 2021–2022 school year. The testing windows also include all make-up testing. Schools were able to choose one of the two testing windows ("waves") for the winter administration. Two windows were provided to accommodate different semester end dates for schools with block scheduling.

Table 7–2. Winter 2021/2022 Operational Keystone Exam Testing Windows

Exams	Wave 1 Dates	Wave 2 Dates
Algebra I, Biology, Literature	December 1–15, 2021	January 3–14, 2022

Table 7–3. Spring 2022 Operational Keystone Exam Testing Window

Exams	Dates
Algebra I, Biology, Literature	May 16–27, 2022

Table 7–4. Summer 2022 Operational Keystone Exam Testing Window

Exams	Dates
Algebra I, Biology, Literature	July 25–29, 2022

TIMING

In general, the estimated testing times allow 1–2 minutes per MC item on the Keystone Exams, depending on the exam. The CR items are estimated to take approximately 5–10 minutes per item, also depending on the exam. Each stimulus passage on the Literature exam is estimated to take about 10 minutes to read. There was no difference in the timing for online and print forms of delivery.

Test administrators were instructed that each section (module) in a form should be scheduled as a separate exam session. Exam modules were not to have been scheduled back-to-back in the morning (or in the afternoon). Instead, the exam modules were to be divided across two days or divided across the morning and afternoon of the same day.

Since not all students are expected to finish the exam sections at the same time, test administrators are advised to use the flexibility of the time limits to the students' advantage. For example, test administrators manage the testing time so that students do not feel rushed while they are taking any assessment section, and no student is penalized because he or she works slowly. It is also stressed to test administrators that a student should not be given an opportunity to waste time. Students are told to close their exam materials when they have finished the section of the exam in which they have been working. Students who finish early are allowed to sit quietly or read for pleasure until all students have finished. Students with special requirements and/or abilities (i.e., physical, visual, auditory, or learning disabilities as defined by their IEP or service contracts) and students who just work slowly may require extended time. Special assessment situations are arranged for these students. When all students in a testing session indicate that they have finished an exam section, test administrators end the section.

Scheduled extended time is provided by a test administrator, and students are allowed to request extended time if they indicate that they have not completed the task. Such requests are granted if the test administrator finds the request to be educationally valid. Test administrators are advised that not permitting ample time for students to complete the assessment might impact the students' and school's performances.

As a general guideline, however, when all students indicate that they have finished a section, that section is closed. Students requiring time beyond the majority of the student population are allowed to continue immediately following the regularly scheduled session in another setting. When such accommodations are made, school personnel ensure that students are monitored at all times to prevent sharing of information. Students are not permitted to continue a section of the assessment after a significant lapse of time from the original session.

Table 7–5. Keystone Testing Load and Duration by Exam

Exam	Total No. of MC Items per Form per Administration	Total No. of CR Items per Form per Administration	Total Estimated Testing Time per Form (in minutes)	Total Estimated Administration Time per Form (in minutes)
Algebra I	46	8	150	170–180
Biology	64	8	144	164–174
Literature	46	8	146	166–176

Table 7–6. Keystone Testing Load and Duration by Type per Unit (in minutes)

Exam	Administration Tasks	Stimulus Passages	MC Points per Minute [PPM]*	CR [PPM]*	Estimated Overall PPM**
Algebra I	24	–	1.5 [0.670]	10 [0.400]	0.400
Biology	24	–	1.25 [0.800]	8 [0.375]	0.458
Literature	24	–	1 [1.000]	5 [0.600]	0.356

*Based on rates per item type
**Based on total testing time

Prior to beginning the exam, students were asked to verify that they understood the *Code of Conduct for Test Takers* by marking the circle in the exam. Additionally, an Attention statement was added to the beginning of the exams to notify students of the penalties incurred if exam materials are copied.

LAYOUT

The layout of the operational Keystone Exams follows a general sequence regardless of the exam. Each exam is divided into thematically linked sets of content called modules. Within each module, there are core (common) items and field-test items. Both core and field-test items are represented though MC and CR items.

Stimulus material (like passages), text for MC items, answer options, and any stimulus materials associated with MC items or answer options appear in the test book. Answer bubbles, text for CR items, and associated response spaces appear in the answer book.

Within a non-passage-based module (like Algebra I and Biology), the sequencing of items follows this pattern:

1st: Approximately half of the MC items

2nd: Half of the CR items

3rd: Remaining half of the MC items

4th: Remaining CR items

Within a passage-based module (like Literature), the sequencing of items follows this pattern:

1st: Stimulus Passage X

2nd: MC items associated with Passage X

3rd: CR items associated with Passage X

4th: Stimulus Passage Y

5th: MC items associated with Passage Y

6th: CR items associated with Passage Y

7th: Stimulus Passage Z

8th: MC items associated with Passage Z

9th: CR items associated with Passage Z

Regardless of sequencing pattern, the field-test items appear in the relative middle of each module, and item sequencing is self-contained within a module.

For more information about the test layout of the operational Keystone Exams, see Appendix G.

SHIPPING, PACKAGING, AND DELIVERY OF MATERIALS

Participating sites receive the *Handbook for Assessment Coordinators,* the *Directions for Administration Manual*s, the administrative materials (e.g., Return Shipping labels, District/School labels, Do Not Score labels, Student Precode labels) and secure materials (e.g., consumable test/answer books) for each tested subject in Algebra I, Biology, and Literature Keystone Exams. All materials arrive at least two weeks prior to the start of the testing window.

DRC ensured that all exam materials were assembled correctly prior to shipping. DRC operations staff used the automated Operations Materials Management System (Ops MMS) to assign secure materials to a school at the time of ship out. This system used barcode technology to provide an automated quality check between items requested for a site and items shipped to a site. A shipment box manifest was produced for and placed in each box shipped. DRC operations staff double-checked all box contents with the box manifest prior to sealing the box for shipping to ensure accurate delivery of materials. DRC operations staff performed lot acceptance sampling on both shipments. Districts and schools were selected at random and examined for correct and complete packaging and labeling. This sampling represented a minimum of 10 percent of all shipping sites.

DRC's materials management system, along with the systems of shippers, allowed DRC to track materials from DRC's warehouse facility to receipt at the district, school, or testing site. All DRC shipping facilities, materials processing facilities, and storage facilities are secure. Access is restricted by security code. Non-DRC personnel are escorted by a DRC employee at all times. Only DRC inventory control personnel have access to stored secure materials. DRC employees are trained in and made aware of the high level of security that is required.

DRC used United Parcel Service (UPS) to deliver the secure materials to the testing sites.

ONLINE TESTING

Online administration is managed through the DRC INSIGHT Portal that provides tiered, secure access to all required administrative functions. Within the DRC INSIGHT Portal, users manage student information and create test sessions.

Student information from the Pennsylvania Information Management System (PIMS) is imported into the DRC INSIGHT Portal Test Setup application via file transfer. If a record was not transferred via the PIMS file, LEAs also have the opportunity to upload a student(s) directly into the DRC INSIGHT Portal so the student can be included in a test session.

Once the student data is loaded into Test Setup, users organize students into test sessions. Test sessions can be created by class, grade, or school. Through Test Setup, users can also update student accommodation information, print test tickets, and monitor student testing status.

The student login ticket contains unique login credentials used by the student to access the testing software. For a selected test session, users can download and print a PDF document containing instructions, a roster of student tickets being printed, and the actual test tickets. Student test tickets are considered secure materials and LEAs are required to keep printed tickets in a predetermined, locked, secure storage area.

The web-based test engine, DRC INSIGHT Online Learning System, is downloaded onto computers that students will access during the assessment. Test items and forms can only be accessed using a valid test ticket. During testing, responses are sent to a DRC server each time the student navigates away from an item or clicks the *Next* button to submit an answer. The system is configured to allow students to review answers before submitting their test.

TEST SECURITY MEASURES

Test security is essential to obtaining reliable and valid scores for accountability purposes. Test Security Certifications were required to be signed by each building Principal, School Assessment Coordinator, District Assessment Coordinator, Test Administrator, and Proctor after the assessment is administered. All signed Certifications were returned to the Chief School Administrator who must retain the Certifications for three years. The purpose of the Certifications was to serve as a tool to document that the individuals responsible for administering the assessments both understood and acknowledged the importance of test security and accountability. Additional details can be found in the *Handbook for Assessment Coordinators*. A screen shot of the Test Administrator Certificate is provided in Figure 7–1.

Figure 7–1. Test Administrator and Proctor Test Security Certification

Keystone Exam Test Security Certification Form

(Test Administrator and Proctor)

District: _____

School: _____

AUN: _____

Maintaining the security and integrity of all assessment materials, preventing any dishonest or fraudulent behavior in the administration and handling of the assessment, and promoting a fair and equitable testing environment are essential in order to obtain reliable and valid student scores. In that regard, I certify the following:

Prior to the administration of the assessment, I completed the Pennsylvania State Test Administration Training, and I understand that the assessment materials are secure, confidential, and proprietary documents owned by the Pennsylvania Department of Education.

I have not reviewed, discussed, disseminated, described, or otherwise revealed the contents of the assessment to anyone. I have not removed any assessment materials from the school building unless I was specifically authorized to administer the assessment to a student on homebound instruction. I have not kept, copied, reproduced, released, or used any assessment, assessment question, specific assessment content, or examinee response to any item or any section of the secure assessment in any manner that is inconsistent with the instructions provided by or through the Pennsylvania Department of Education. I have not provided any examinee with an answer to an assessment question or in any way influenced an examinee's response to any assessment question. I have not in any manner altered or caused the alteration of any examinee response, assessment booklet, or papers used by examinees.

I understand that any breach in assessment security could result in the invalidation of assessment results, professional discipline, and/or criminal prosecution.

I understand that false statements herein are made subject to the penalties of 18 Pa.C.S. § 4904.

_____	_____	_____
Administrator/Proctor Name	Administrator/Proctor Signature	Date of Signature

SAMPLE MANUALS

Copies of the *Handbook for Assessment Coordinators* and the *Directions for Administration Manual*s can be found on the PDE website at www.education.pa.gov.

TESTING WINDOW ASSESSMENT ACCOMMODATIONS

PDE develops an *Accommodations Guidelines* handbook for use with the Keystone Exams. This manual can be found on the PDE website at www.education.pa.gov. Additional information regarding assessment accommodations can be found in Chapter Four and Six of this report.

CHAPTER EIGHT: PROCESSING AND SCORING

RECEIPT OF MATERIALS

Receipt of Pennsylvania Keystone Exams' test materials began five days after the start of the test window. DRC's Operations Materials Management System (Ops MMS) was utilized to receive assessment materials securely, accurately, and efficiently. This system features innovative automation and advanced barcode scanners. Captured data was organized into reports, which provided timely information with respect to suspected missing material.

The first step in Ops MMS was Box Receipt. When a shipment arrived at DRC, the boxes were removed from the carrier's truck and passed under a barcode reader, which read the barcode printed on the return label and identified the district and school. The number of boxes was immediately compared to what was picked up at the district. The data collected in this process was stored in the Ops MMS database. After the barcode data was captured, the boxes were placed on a pallet and assigned a corresponding pallet number.

Once the Box Receipt process was completed, the Materials Separation phase began. Warehouse personnel opened the boxes and sorted materials by grade, subject, and status (used and/or unused booklets) into scanning boxes. Every booklets' security barcode and precode barcode were hand scanned to link each document to the original box. As the booklets were sorted, Ops MMS guided the floor operator to the box in which to place the document. Ops MMS kept count and record of the materials placed in each box. This count remained correlated to the box as an essential quality-control step throughout the secure booklet processing and provided a target number for all steps of the check-in process. Once a box was closed, an MMS Processing Label was placed on that box.

Once labeled, the sorted and counted boxes proceeded to Quality Assurance, where a secure booklet check-in operator used a hand scanner to scan the MMS Processing Label. This procedure identified the material type and quantity parameters for what Ops MMS should expect within a box. The box contents were then loaded into the stream feeder.

The documents were fed past oscillating scanners that captured both the security code and precode from the booklets. A human operator monitored an Ops MMS screen that displayed scan errors, an ordered accounting of what was successfully scanned, and the document count for each box. The system ensured that all material within the box matched the information obtained from the original hand-scanning process.

When all materials were scanned and the correct document count was confirmed, the box was sealed and placed on a pallet. If the correct document count was not confirmed, or if the operator encountered difficulties with material scanning, the box and its contents were delivered to an exception-handling station for resolution.

This check-in process occurred immediately upon receipt of materials; therefore, DRC provided feedback to districts and schools regarding any missing materials based on actual receipt versus expected receipt. Sites that had 100 percent of their materials missing after the date they were due to DRC were contacted, and any issues were resolved.

Throughout the process of secure booklet check-in, DRC project management ran a daily Missing Materials Report. Every site that was missing any number of booklets was contacted by DRC. Results of these correspondences were recorded for inclusion in the final Missing Materials Report if the missing booklets were not returned by the testing site. DRC produced the Missing Materials Report for PDE upon completion of secure booklet check-in. The report listed all schools in each participating district, along with security barcodes for any booklets not returned to DRC.

After scannable materials (used answer booklets) were processed through booklet check-in, the materials became available to the DRC Document Processing log-in staff for document log-in. The booklets were logged in using the following process:

- A DRC scannable barcode batch header was scanned, and a batch number was assigned to each box of booklets.
- The DRC box label barcode was scanned into the system to link the box and booklets to the newly created batch and to create a Batch Control Sheet.
- The DRC box label barcode number and the number of booklets in the box were printed on the Batch Control Sheet for document-tracking purposes. All booklets linked to the box barcode were assigned to the batch number and tracked through all processing steps. As booklets were processed, DRC staff dated and initialed the Batch Control Sheet to indicate that proper processing and controls were observed.

Before the booklets were scanned, all batches went through a quality inspection to ensure batch integrity and correct document placement.

After a quality check-in at the DRC Document Processing log-in area, the spines were cut off the scannable documents, and the pages were sent to DRC's Imaging and Scoring System.

SCANNING OF MATERIALS

Customized scanning programs for all scannable documents were prepared to read the books and to format the scanned information electronically. Before materials arrived, all image-scanning programs went through a quality review process that included scanning of mock data from production books to ensure proper data collection.

DRC's image scanners were calibrated using a standard deck of scannable pages with 16 known levels of gray. On a predefined page location, the average pixel darkness was compared to the standard calibration to determine the level of gray. Marks with an average darkness level of 4 or above on a scale of 16 (0 through F) were determined to be valid responses, per industry standards. If multiple marks were read for a single item and the difference between the grayscale reads was greater than four levels, the lighter mark was discarded. If the multiple marks had fewer than four levels of grayscale difference, the response was flagged and forwarded to an editor for resolution.

DRC's image scanners read selected-response, demographic, and identification information. The image scanners also used barcode readers to read preprinted barcodes from a label on the book.

The scannable documents were automatically fed into the image scanners where predefined processing criteria determined which fields were to be captured electronically. Open-ended (OE) response images were separated out for image-based scoring.

During scanning, a unique serial number was printed on each sheet of paper. This serial number was used to ensure document integrity and to maintain sequencing within a batch of books.

A monitor randomly displayed images, and the human operator adjusted or cleaned the scanner when the scanned image did not meet DRC's strict quality standards for image clarity.

All images passed through a process and a software clean-up program that despeckled, deskewed, and desmeared the images. A random sample of images was reviewed for image quality approval. If any document failed to meet image quality standards, the document was returned for rescanning.

Page-scan verification was performed to ensure that all predefined portions of the booklets were represented in their entirety in the image files. If a page was missing, the entire book was flagged for resolution.

After each batch was scanned, books were processed through a computer-based editing program to detect potential errors as a result of smudges, multiple marks, and omissions in predetermined fields. Marks that did not meet the predefined editing standards were routed to editors for resolution.

Experienced DRC Document Processing editing staff reviewed all potential errors detected during scanning and made necessary corrections to the data file. The imaging system displayed each suspected error. The editing staff then inspected the image and made any necessary corrections using the unique serial number printed on the document during scanning.

Upon completion of editing, quality control reports were run to ensure that all detected potential errors were reviewed again and a final disposition was determined.

Before batches of books were extracted for scoring, a final edit was performed to ensure that all requirements for final processing were met. If a batch contained errors, it was flagged for further review before being extracted for scoring and reporting.

During this processing step, the actual number of documents scanned was compared to the number of books assigned to the box during book receipt. Count discrepancies between book receipt and books scanned were resolved at this time.

Once all requirements for final processing were met, the batch was released for scoring and student level processing.

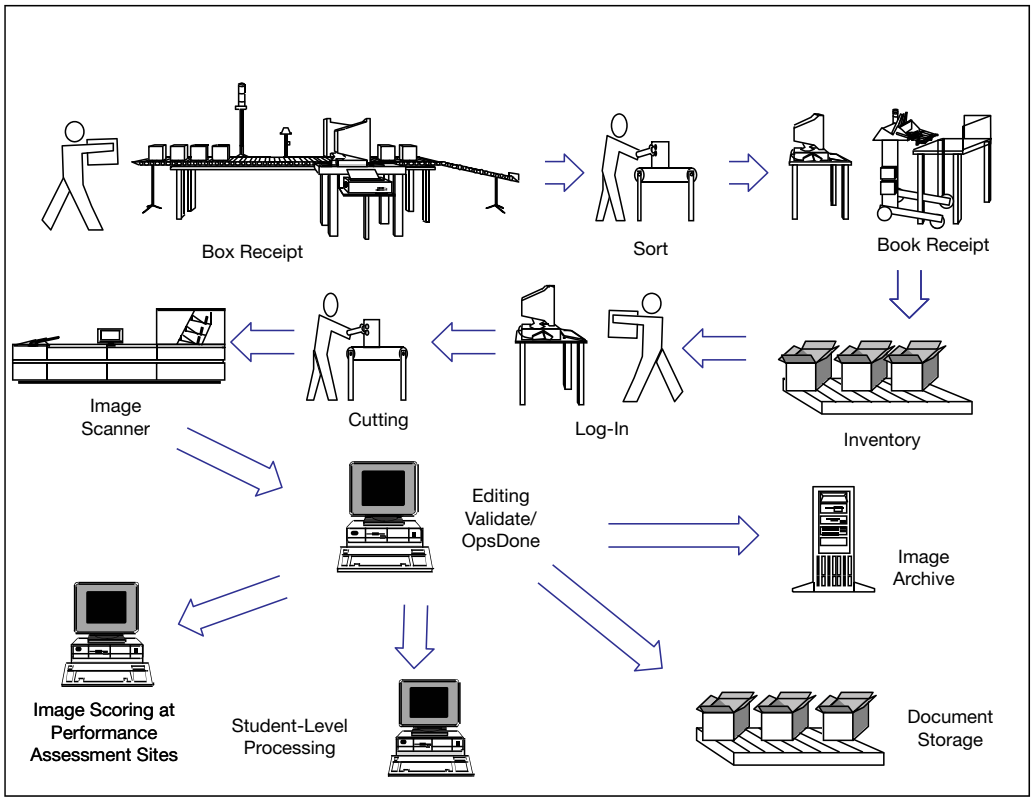
Table 8–1 shows the number of answer books received through book check-in, the number of books that contained student responses that were scanned and scored, the number of test books received, and the total number of books received for the Algebra I, Biology, and Literature Keystone Exams.

Table 8–1. Counts of 2022 Keystone Exams Materials Received: Algebra I, Biology, and Literature

Exam	Answer Books Received	Used Answer Books Received	Test Books Received	Total Books Received	Total Books Shipped
Algebra I (Winter)	80,272	31,349	80,272	160,544	160,770
Biology (Winter)	65,778	25,645	65,789	131,567	131,802
Literature (Winter)	61,667	24,600	61,667	123,334	123,560
Algebra I (Spring)	189,571	127,858	189,536	379,107	379,348
Biology (Spring)	155,338	107,303	155,341	310,679	310,800
Literature (Spring)	148,192	102,656	148,202	296,394	296,538
Algebra I (Summer)	2,781	147	2,781	5,562	5,562
Biology (Summer)	2,369	131	2,369	4,738	4,738
Literature (Summer)	2,258	129	2,258	4,516	4,516

Figure 8–1 illustrates the production workflow for DRC's Ops MMS and Image Scanning and Scoring System from receipt of materials through all processing of materials and the presentation of scanned images for scoring.

Figure 8–1. Workflow System



MATERIALS STORAGE

Upon completion of processing, student response documents were boxed for security purposes and final storage as follows:

- Project-specific box labels were created containing unique customer and project information, material type, batch number, pallet/box number, and the number of boxes for a given batch.
- Boxes were stacked on pallets that were labeled with the project information and a list of the pallet's contents before delivery to the Materials Distribution Center for final secure storage.

Materials will be destroyed one year after the contract year ends with PDE written approval.

ONLINE TESTING

The DRC INSIGHT test engine runs on a custom web browser that is designed to ensure a fully secure environment during testing. The secure browser "locks down" the student's testing device, preventing the student from accessing the desktop, the Internet, and other external programs. For non-secure testing such as practice and training sessions, students can use the Online Tools Training (OTT) environment, which runs on a standard web browser.

The custom browser software is downloaded from the DRC INSIGHTS Portal and installed onto student testing devices. The secure browser can be installed on computers individually, or it can be downloaded to a central location, copied, and distributed to multiple computers simultaneously using common network distribution tools. Everything needed for testing is found within the secure browser, eliminating the need for districts to coordinate updates to third-party software.

Prior to operational use, DRC's quality assurance staff will perform full system-level tests in an independent test environment that simulates the production configuration. Tests are run on all supported computer platforms and browsers and include comprehensive review of system functionality, usability, reliability, security, and overall performance. Test content is also validated during this process.

Multiple methods are used to ensure secure data transfer, including encryption technologies and Secure Sockets Layer (SSL) protocol through Hypertext Transfer Protocol Secure (HTTPS). Test content is encrypted at the host server, and remains encrypted throughout all network transmissions; content is decrypted only once the student login is validated. Decrypted test content on the student workstation is stored only in memory during each test session. Once the session is ended (the test is completed or the student logs out), computer memory is purged to ensure security of test content is maintained.

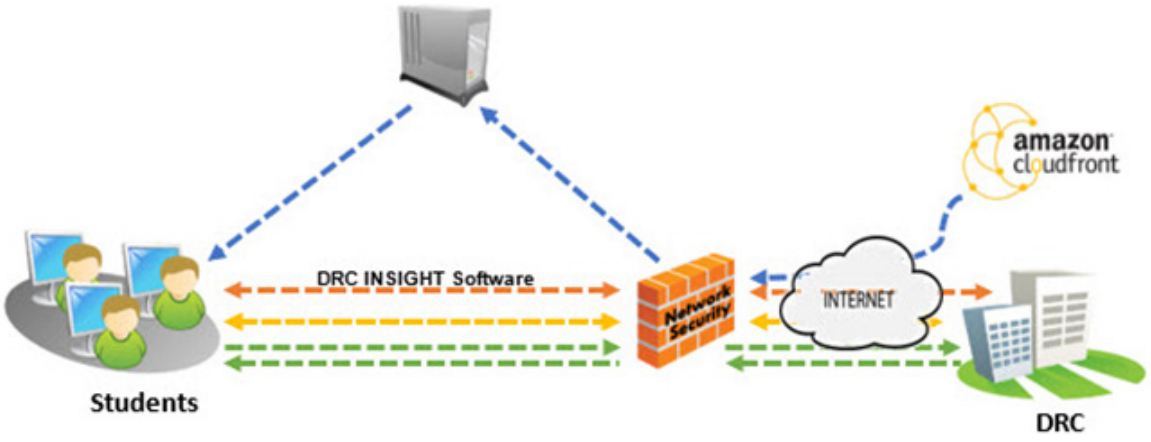
Responses are saved automatically every 45 seconds during testing, or when the student navigates away from an item or answers a selected-response item (whichever comes first). If a particular question takes the student longer than 45 seconds to answer, then the partial, incomplete responses are submitted at 45-second intervals until the student completes the item. This auto-save helps safeguard against students losing their work on longer items, such as constructed-response items. When the student returns to the test after a break or interruption, the student is returned to the point that they left off without having to navigate through all previously answered questions.

Table 8–2. Counts of 2022 Keystone Exams Online Assessments

Grade/Subject	Total Online Assessments Completed
Algebra I (Winter)	11,935
Biology (Winter)	11,548
Literature (Winter)	11,283
Algebra I (Spring)	47,065
Biology (Spring)	45,642
Literature (Spring)	41,349
Algebra I (Summer)	231
Biology (Summer)	122
Literature (Summer)	89

Figure 8–2 illustrates the secure transfer of online test responses between the student and DRC.

Figure 8–2. Architecture of the Student Testing Experience



SCORING MULTIPLE-CHOICE ITEMS

For both online and paper-and-pencil modes, the scoring process included the scoring of multiple-choice (MC) items against the answer key and the aggregation of raw scores from the OE responses. A student's raw score is the actual number of points achieved for tested elements of an assessment. From the raw scores, the scale scores were calculated.

The student file was scored against the final and approved MC answer key. Items were scored as right, wrong, omitted, or double-gridded (more than one answer was bubbled for an item). Sections of the exam were evaluated as a whole, and an attempt status was determined for each student for each subject. The score program defined all data elements for reporting at the student level.

RANGEFINDING

After student answer documents were received and processed, DRC's Performance Assessment Services (PAS) staff assembled groups of responses that exemplified the different score points for each subject. The score point ranges were represented by the following scoring guidelines:

- 0–3 item-specific scoring guidelines for Literature
- 0–4 item-specific scoring guidelines for Algebra I (some items were divided into separate parts that were scored on a 0–1, 0–2, or 0–3 point scale, but the sum of the parts always resulted in an overall score of 0–4 for each item)
- 0–3 item-specific scoring guidelines for Biology

Responses were pulled from the embedded field-test portion of the Keystone Exams for each subject. Once examples of all score points were selected for each item, sets were assembled for rangefinding and copies were made for each rangefinding participant. Rangefinding committees consisted of Pennsylvania educators, PDE staff members, DRC Test Development staff, and DRC Performance Assessment Services staff. The rangefinding meetings were scheduled to be held from July 11th-15th for Literature and Algebra 1, and from July 11th – July 14th for Biology, at the Best Western Premiere- The Central Hotel and Conference Center in Harrisburg, PA. On the morning of July 12th, the in-person meeting was closed due to Covid. During the remainder of July 12th, and on July 13th, DRC worked closely with PDE to develop a plan to continue rangefinding in a remote environment. Rangefinding resumed remotely on July 14th for all three subjects and concluded on July 15th.

Each rangefinding meeting began in a joint session with a review of the history of the assessment as well as a discussion of the purpose of the rangefinding meeting and the role rangefinding plays within the item development process. The session then broke into subject/grade-specific committees. Sets of student responses were presented to the committees, one item at a time. Each committee initially reviewed and scored student responses as a group to ensure consistency in the interpretation of the scoring guidelines. Committee members then went on to score responses independently. For each student response, committee members' scores were discussed until a consensus was reached. Only those responses for which there was strong agreement among committee members were chosen for inclusion in training materials for DRC raters.

Once rangefinding shifted to remote, the exact same process for applying scores was used as was used in-person. The only difference was that committee members, DRC personnel, and PDE representatives were now using secure video conferencing to discuss and score the responses. Additionally, instead of viewing papers copies of student responses, committee members accessed the materials securely online.

Discussions of student responses included the mandatory use of scoring guideline language. This ensured that committee members remained focused on the specific requirements of each score level. DRC PAS staff took notes addressing how and why the committees arrived at score point decisions, and this information was used by the scoring directors in rater training.

DRC and PDE discussed scoring guideline edits suggested by the rangefinding committees. Changes approved by PDE were incorporated into the scoring guidelines by DRC Test Development staff. The edited scoring guidelines were used in the preparation of materials and the training of raters.

While the majority of rangefinding responses were scored by the committees, due to the shortened length of this year's rangefinding, each content area had a few remaining items that were not reviewed by rangefinding committees. For these items, scoring directors assembled training materials based on the scoring guidelines established by the rangefinding committees and PDE, and these training materials were submitted to PDE. PDE then reviewed and approved these training materials before they were used to train raters.

RATER RECRUITMENT/QUALIFICATIONS

DRC retains a number of raters from year to year; the overall return rate in 2022 was 42%. This pool of experienced raters was drawn from to staff the scoring of the 2022 Keystone Exams. To complete the rater staffing for this project, recruiting events were held and applications for rater positions were screened by DRC's recruiting staff. Candidates were personally interviewed by DRC staff. In addition, each candidate was required to provide an on-demand writing sample, an on-demand math sample, references, and proof of a four-year college degree. In this screening process, preference was given to candidates with previous experience scoring large-scale assessments and degrees emphasizing expertise in the subjects being scored. Staffing partners were used to augment hiring using the same practices as those employed by DRC. The rater pool consisted of educators and other professionals with content-specific backgrounds. These individuals were valued for their content-specific knowledge, but they were required to set aside their own biases about student performance and accept the scoring standards of the Keystone Exams.

LEADERSHIP RECRUITMENT/QUALIFICATIONS

Scoring directors and team leaders were selected from a pool of employees who displayed expertise as raters and leaders on previous DRC projects. These individuals had strong backgrounds in mathematics, English language arts, or science, and demonstrated organizational, leadership, communication, and management skills. All scoring directors had previous leadership experience working on large scale assessments. All scoring directors, team leaders, and raters were required to sign confidentiality agreements before handling secure materials.

Each group of raters was assigned a scoring director. All handscoring activities were led by a scoring director for the duration of the project. Scoring directors assisted in rangefinding, worked with supervisors to create training materials, conducted team leader training, and were responsible for training the raters. The scoring director made sure that handscoring reports were available and interpreted those reports for the raters. The scoring director also supervised the team leaders. Scoring directors were monitored by the project managers throughout the project.

Team leaders assisted the scoring director with rater training by answering individual questions that raters may not have felt comfortable asking in a large group. Once raters were qualified, team leaders were responsible for monitoring and maintaining the accuracy and workload of each team member. Ongoing monitoring identified those individuals having difficulty maintaining accuracy. These raters received one-on-one retraining from the team leader or scoring director. Any rater who could not be successfully retrained had his/her scores purged and was released from the project.

TRAINING

As part of preparation for the 2022 Keystone Exams, DRC's PAS staff assembled the PDE-approved scoring guidelines and scored student responses approved by rangefinding committees into sets used for training raters. These item-specific scoring guidelines served as the raters' constant reference. Responses that were relevant in terms of the scoring concepts they illustrated were annotated and included in an anchor set. The full range of each score point was clearly represented and annotated in the anchor set, which was used for reference by raters throughout the project.

Training sets and qualifying sets contained student responses consensus-scored by rangefinding committee members. Raters were instructed on how to apply the scoring guidelines and were required to demonstrate a clear comprehension of each anchor set by performing well on the associated training materials. Responses were selected for training to show raters the range of each score point (e.g., high, mid, and low 2s). Examples of 0s were also included for all items. This process helped raters recognize the various ways that a student could respond in order to earn each score point outlined and defined in the item-specific scoring guidelines.

The scoring director conducted a team leader training session before training the raters. This session followed the same procedures as rater training but was more rigorous and in-depth due to the extra responsibilities required of team leaders. During team leader training, all pertinent training materials were reviewed and discussed. Team leaders were given access to fully annotated training materials with committee justifications from the rangefinding meetings. To facilitate scoring consistency, it was imperative that all team leaders imparted the same rationale for each response. Once the team leaders were qualified, leadership responsibilities were reviewed and team assignments were given. A ratio of one team leader per 7–10 raters ensured sufficient monitoring rates for team members.

Rater training began with the scoring director providing an intensive review of the scoring guidelines and anchor responses. Next, raters practiced by independently scoring the responses in the training sets. After each training set, the scoring director led a thorough discussion of the responses.

Once the scoring guidelines, anchor sets, and training sets were thoroughly discussed, each rater was required to demonstrate understanding of the scoring criteria by qualifying (i.e., scoring with acceptable agreement to the true scores) on at least one of the qualifying sets. Raters who failed to achieve at least 70 percent exact agreement on the first qualifying set were given additional training, either individually or in a small group setting. Raters who did not perform at the required level of agreement by the end of the qualifying process were not allowed to score any student responses. These individuals were removed from the pool of potential raters in DRC's imaging system and released from the project.

DRC's remote scoring is designed to very closely emulate the work that is done in our physical scoring locations. The platform, content, and expectations for quality remain the same, and interactive technology and content training and discussions are conducted live (virtually). The differences come with the method through which training is delivered (online), and in the modes of communication that are used (web screen sharing, webcast, video chat, and chat). Our scoring leaders are equipped with a variety of tools to ensure every scorer is successful in understanding and applying scoring criteria to student responses.

The 2022 assessment included the opportunity for students to respond in Spanish to Algebra I and Biology items. Rater training for the Spanish language response scoring was conducted by Tri-Lin Integrated Services in San Antonio, Texas, and was overseen by a DRC project manager, who is a Spanish language speaker with a strong handscoring background. All Spanish raters were bilingual and hired specifically to score the Spanish portion of the assessment and were required to meet the same standards set for raters of the English language version of the assessment.

Table 8–3. Qualification Rates for 2022 Keystone Open-Ended Response Items – Winter

Subject	% Qualifying	% That Did Not Qualify
Algebra I	100	0
Biology	100	0
Literature	99	1

Table 8–4. Qualification Rates for 2022 Keystone Open-Ended Response Items – Spring

Subject	% Qualifying	% That Did Not Qualify
Algebra I	99	1
Biology	99	1
Literature	99	1

Table 8–5. Qualification Rates for 2022 Keystone Open-Ended Response Items – Summer

Subject	% Qualifying	% That Did Not Qualify
Algebra I	100	0
Biology	100	0
Literature	100	0

HANDSCORING PROCESS

Student responses were scored independently. All responses were scored once, and ten percent of the responses were scored a second time. The data collected from the ten-percent double-read portion was used to calculate the exact and adjacent agreement rates in the Scoring Summary Reports. The responses that were used for the ten percent read behind were randomly chosen by the imaging system at the item level. Additional read behinds by the team leaders and scoring directors were done to further ensure reliability.

Raters scored the imaged student responses remotely on either a laptop or desktop computer.

Raters worked in a secure location in their homes. Image distribution was controlled, ensuring that student images were sent only to designated groups of raters qualified to score those items. Imaged student responses were electronically separated for routing to individual raters by item. Raters were only provided with student responses for items that they were qualified to score. Scores were keyed into DRC's imaging system.

To handle possible alerts (i.e., student responses indicating potential issues related to students' safety and well-being that sometimes require attention at the state or local level), DRC's imaging system allows raters to forward responses needing attention to the scoring director. These alerts are reviewed by project management, who then notifies the students' schools and PDE of the occurrences. PDE does not receive any identifying information about the students. At no point in the alerts process do raters, or other DRC handscoring staff, acquire any knowledge concerning a student's personal identity.

HANDSCORING VALIDITY PROCESS

One of the training tools PAS utilized to ensure rater accuracy was the validity process. The goal of the validity process is to ensure that scoring standards are maintained. Specifically, the objective is to make sure that raters score student responses in a manner consistent with statewide standards both within a single administration of the Keystones and across consecutive administrations. In scoring the 2022 Keystone Exams, scoring consistency was maintained, in part, through the validity process.

The validity process began with the selection of scored responses. Forty validity responses were selected for each core open-ended (OE) item. These 40 responses were drawn from a pool of exemplars (responses that are representative of a particular score point and have been verified by the scoring director). The scores on validity responses are considered true scores.

The validity responses were then implemented to test rater accuracy. The responses were selected within the imaging system and dispersed intermittently to the raters. By the end of the project, raters had scored all 40 validity responses for any items they were qualified to score. Raters were unaware of when they were being dealt pre-scored validity responses and assumed that they were scoring live student responses. This helped bolster the internal validity of the process. All raters who received validity responses had already successfully completed the training/qualifying process.

The scores that the raters assigned to the validity responses were compared to the true scores in order to determine the validity of the raters' scores. For each item, the percentage of exact agreement as well as the percentage of high and low scores was computed. This data was accessed through the Validity Item Detail Report. The same sort of data was also computed for each specific rater. This data was accessed through the Validity Reader Detail Report. Both of these may be run as daily or cumulative reports.

The Validity Reader Detail Report was used to identify particular raters for retraining. If a rater on a certain day generated a lower rate of agreement on a group of validity responses, it was immediately apparent in the Validity Reader Detail Report. A lower rate of agreement was defined as anything below 70 percent exact agreement with the true scores. Any time a rater's validity agreement rate fell below 70 percent, the scoring director was cued to examine that rater's scoring. First, the scoring director attempted to ascertain what kind of validity responses the rater was scoring incorrectly. This was done to determine whether there was any sort of a trend (e.g., trending low on the 1–2 line). Once the source of the low agreement rate was determined, the rater was retrained. If it was determined that the rater had been scoring live responses inaccurately, then his/her scores were purged for that day, and the responses were re-circulated and scored by other raters.

The cumulative Validity Item Detail Report was utilized to identify potential group-wide trends in need of correction. For instance, if a particular validity response with a true score of 3 was given a score of 2 by a significant number of raters within the group, that trend would be revealed in the Validity Item Detail Report. To correct a trend of this sort, the scoring director would look for student responses similar to the validity response being scored incorrectly. Once located, these responses would be used in group-wide re-training, usually in the form of an annotated handout or a short set of responses without printed scores given to raters as a recalibration test.

Validity was employed on all core Algebra I, Biology, and Literature OE items. Each 40-response validity set was formulated to mirror the score point distribution that the item generated during its previous administration. Each validity set included at least five examples of each score point. Examples of different types of responses were included to ensure that raters were tested on the full spectrum of response types.

The exact rater agreement rate generated during the validity process was often higher than the inter-rater agreement rate for the same item. The reason for this discrepancy has to do with how validity sets are formulated. The 40 validity responses for each item are intended to cover the full breadth of each score point. For example, each validity set contains examples of high, mid, and low 2s. This scope ensures that the validity process is truly valid in terms of addressing the complete spectrum of response types. However, certain types of responses are generally not included in validity sets. These include line responses (i.e., examples of score points that are so close to the adjacent score point that raters are instructed to consult with a supervisor before assigning a score) and responses that, because of poor word choice/writing, are difficult to understand. The reason for these exclusions is that confusing/line/illegible responses often do not impart a teachable lesson. Since these types of responses are usually unique, any potential lesson the response might teach would apply only to that particular response. Conversely, the responses in validity sets are chosen because they represent common response types and teach lessons that can be applied to other similar responses. Due to this distinction, validity sets often generate a slightly higher agreement rate than is typically generated during operational scoring.

QUALITY CONTROL

Rater accuracy was monitored throughout the scoring session by means of daily and on-demand reports. These reports ensured that an acceptable level of scoring accuracy was maintained throughout the project. Inter-rater reliability was tracked and monitored with multiple quality control reports that were reviewed by quality assurance analysts. These reports and other quality control documents were generated at the scoring centers, where they were reviewed by the scoring directors, team leaders, and project managers. The following reports and documents were used during the scoring of the open-ended items:

The Scoring Summary Report (includes two related reports).

- The Reader Monitor Report monitored how often raters were in exact agreement with one another and ensured that an acceptable agreement rate was maintained throughout the project. This report provided daily and cumulative exact and adjacent inter-rater agreement on the ten percent that was double read.

- The Score Point Distribution Report monitored the percentage of responses given each of the score points. For example, the Algebra I daily and cumulative reports showed what percentage of 0s, 1s, 2s, 3s, and 4s a rater—or group of raters—had given to all the responses scored at the time the report was produced. It also indicated the number of responses read by each rater so that production rates could be monitored.
- The Item Status Report monitored the progress of handscoring. This report tracked each response and indicated the status (e.g., not read, complete, awaiting supervisor review, etc.). This report ensured that all responses were scored by the end of the project.

The Reader Score Report identified all responses scored by an individual rater. This report was useful if any responses needed rescoring due to possible rater drift.

The Validity Reports (addressed in detail on previous page) tracked how raters performed by comparing pre-scored responses to raters' scores for the same responses. If a rater's scoring fell below the 70 percent determined agreement rate, remediation occurred. Raters who did not retrain to the required level of agreement were released from the project.

The Read-Behind Log was used by the team leader/scoring director to monitor individual rater reliability. Team leaders read randomly-selected, scored responses from each team member on a daily basis. If the team leader disagreed with a rater's score, remediation occurred. This was a particularly effective form of feedback because it was performed in real time with live student responses scored by each rater.

Recalibration Sets were used throughout the scoring sessions to ensure accuracy by comparing each rater's scores with the true scores on a pre-selected set of responses. Recalibration sets helped to refocus raters on Pennsylvania scoring standards. These checks made sure there was no change in the scoring pattern as the project progressed. Raters failing to achieve 70 percent agreement with the recalibration true scores were given additional training to achieve the highest degree of accuracy possible. Raters who were unable to recalibrate were released from the project. The process used for creating and administering recalibration sets was similar to the process employed for creating and administering training sets.

Table 8–6. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items Winter 2022

Exam	Module	Item ID	Item Part	Score Point Range	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Validity Agreement	% 0s	% 1s	% 2s	% 3s	% 4s	% B/ NS
Alg. 1	1	701631		0-4	95	5	97	43	29	9	3	2	15
Alg. 1	1	713901	A	0-1	100	0	100	76	6	NA	NA	NA	18
Alg. 1	1	713901	B	0-1	100	0	100	77	5	NA	NA	NA	18
Alg. 1	1	713901	C	0-1	100	0	100	66	16	NA	NA	NA	18
Alg. 1	1	713901	D	0-1	100	0	100	69	13	NA	NA	NA	18
Alg. 1	1	739457		0-4	94	6	96	23	38	14	6	1	18
Alg. 1	2	714657		0-4	94	6	97	15	30	29	9	1	16
Alg. 1	2	672734		0-4	95	5	97	42	24	10	4	1	19
Alg. 1	2	734691	A	0-1	100	0	100	29	53	NA	NA	NA	17
Alg. 1	2	734691	B	0-1	99	1	100	58	24	NA	NA	NA	17
Alg. 1	2	734691	C	0-1	100	0	100	73	10	NA	NA	NA	17
Alg. 1	2	734691	D	0-1	100	0	99	76	7	NA	NA	NA	17
Bio.	1	813190		0-3	90	10	94	27	26	16	13	NA	17
Bio.	1	742581		0-3	94	6	96	24	39	15	2	NA	20
Bio.	1	813191		0-3	88	11	93	33	25	16	8	NA	18
Bio.	2	887612		0-3	85	15	94	6	24	31	20	NA	18
Bio.	2	877365		0-3	91	9	97	24	28	21	7	NA	20
Bio.	2	982779		0-3	90	10	94	11	32	26	13	NA	18
Lit.	1	928826		0-3	88	12	89	12	34	33	5	NA	16
Lit.	1	928784		0-3	85	15	81	10	31	35	8	NA	17
Lit.	1	928785		0-3	86	14	88	16	40	21	4	NA	19
Lit.	2	984976		0-3	87	13	89	12	28	34	8	NA	18
Lit.	2	904155		0-3	86	14	86	11	29	34	8	NA	18
Lit.	2	904157		0-3	88	12	91	9	37	28	5	NA	20

Notes. B = blank; N = non-scorable. NA= non-applicable. Algebra I responses received a possible total of 0–4 points. For some Algebra I items, raters applied a single score of 0, 1, 2, 3, or 4; however, many Algebra I items were divided into separate parts that were scored on 0–1, 0–2, or 0–3-point scales, the sum of which always resulted in an overall score of 0–4 points. For example, an Algebra I item might have a part A, a part B, a part C, and a part D, each of which was scored on a 0–1-point scale, resulting in a summed 0–4-point total score scale. Additionally, some Algebra I items with multiple parts could receive up to one point for "minimal understanding" (MU) even if the student did not receive a point, or points, for any of the item's individual parts.

Table 8–7. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items Spring 2022

Exam	Module	Item ID	Item Part	Score Point Range	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Validity Agreement	% 0s	% 1s	% 2s	% 3s	% 4s	% B/ NS
Alg. 1	1	98201	A	0-1	100	0	100	41	50	NA	NA	NA	10
Alg. 1	1	98201	B	0-1	100	0	100	40	51	NA	NA	NA	10
Alg. 1	1	98201	C	0-1	98	2	96	68	23	NA	NA	NA	10
Alg. 1	1	98201	D	0-1	99	1	99	88	2	NA	NA	NA	10
Alg. 1	1	714220		0-4	91	9	85	46	23	13	5	1	13
Alg. 1	1	673351	A	0-1	99	1	99	35	53	NA	NA	NA	11
Alg. 1	1	673351	B	0-1	99	1	99	67	21	NA	NA	NA	11
Alg. 1	1	673351	C	0-1	99	1	100	56	32	NA	NA	NA	11
Alg. 1	1	673351	D	0-1	99	1	99	62	26	NA	NA	NA	11
Alg. 1	2	980212		0-4	82	17	84	27	33	15	10	3	13
Alg. 1	2	969456		0-4	91	9	94	37	29	14	7	1	13
Alg. 1	2	730209	A	0-1	99	1	99	60	27	NA	NA	NA	13
Alg. 1	2	730209	B	0-1	99	1	99	41	46	NA	NA	NA	13
Alg. 1	2	730209	C	0-1	100	0	98	81	6	NA	NA	NA	13
Alg. 1	2	730209	D	0-1	99	1	99	70	17	NA	NA	NA	13
Bio.	1	812928		0-3	83	17	81	24	25	27	13	NA	13
Bio.	1	978214		0-3	91	9	92	26	30	22	5	NA	16
Bio.	1	869091		0-3	87	13	90	34	26	17	8	NA	14
Bio.	2	877375		0-3	88	12	92	27	20	20	18	NA	14
Bio.	2	678296		0-3	88	12	91	10	17	31	28	NA	14
Bio.	2	983814		0-3	90	10	88	40	22	13	9	NA	16
Lit.	1	800287		0-3	76	24	77	7	36	36	9	NA	11
Lit.	1	994122		0-3	81	19	88	9	41	30	6	NA	14
Lit.	1	994152		0-3	84	16	85	8	37	32	7	NA	15
Lit.	2	826290		0-3	81	19	89	7	26	39	14	NA	13
Lit.	2	984201		0-3	81	19	85	6	30	41	9	NA	13
Lit.	2	984191		0-3	79	21	81	11	34	30	9	NA	15

Notes. B = blank; NS = non-scorable. NA= non-applicable. Algebra I responses received a possible total of 0–4 points. For some Algebra I items, raters applied a single score of 0, 1, 2, 3, or 4; however, many Algebra I items were divided into separate parts that were scored on 0–1, 0–2, or 0–3-point scales, the sum of which always resulted in an overall score of 0–4 points. For example, an Algebra I item might have a part A, a part B, a part C, and a part D, each of which was scored on a 0–1-point scale, resulting in a summed 0–4-point total score scale. Additionally, some Algebra I items with multiple parts could receive up to one point for "minimal understanding" (MU) even if the student did not receive a point, or points, for any of the item's individual parts.

Table 8–8. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items Summer 2022

Exam	Module	Item ID	Item Part	Score Point Range	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Validity Agreement	% 0s	% 1s	% 2s	% 3s	% 4s	% B/ NS
Alg. 1	1	818614	A	0-1	100	0	100	56	33	NA	NA	NA	11
Alg. 1	1	818614	B	0-1	98	2	95	67	22	NA	NA	NA	11
Alg. 1	1	818614	C	0-1	98	2	99	78	11	NA	NA	NA	11
Alg. 1	1	818614	D	0-1	96	4	98	76	13	NA	NA	NA	11
Alg. 1	1	897708		0-4	93	7	83	25	47	9	4	1	15
Alg. 1	1	892937	A	0-1	98	2	100	62	23	NA	NA	NA	15
Alg. 1	1	892937	B	0-1	100	0	100	50	35	NA	NA	NA	15
Alg. 1	1	892937	C	0-1	100	0	96	73	12	NA	NA	NA	15
Alg. 1	1	892937	D	0-1	100	0	100	77	9	NA	NA	NA	15
Alg. 1	2	739460		0-4	94	6	99	32	37	13	6	1	11
Alg. 1	2	905406	A	0-1	100	0	100	31	57	NA	NA	NA	12
Alg. 1	2	905406	B	0-1	100	0	100	72	16	NA	NA	NA	12
Alg. 1	2	905406	C	0-1	100	0	100	77	11	NA	NA	NA	12
Alg. 1	2	905406	D	0-1	100	0	100	84	4	NA	NA	NA	12
Alg. 1	2	714437		0-4	93	7	88	31	26	20	6	3	14
Bio.	1	880296		0-3	93	7	83	35	29	19	7	NA	11
Bio.	1	808340		0-3	98	2	75	53	17	12	6	NA	13
Bio.	1	810317		0-3	96	4	93	32	23	17	13	NA	15
Bio.	2	747647		0-3	98	2	89	14	38	29	7	NA	12
Bio.	2	809284		0-3	86	14	81	26	34	17	8	NA	15
Bio.	2	810558		0-3	98	2	97	29	28	14	15	NA	15
Lit.	1	994606		0-3	90	10	96	8	26	20	7	NA	38
Lit.	1	994349		0-3	88	13	97	12	27	19	3	NA	39
Lit.	1	994348		0-3	93	7	92	18	31	10	0	NA	41
Lit.	2	904400		0-3	95	5	97	9	32	20	2	NA	39
Lit.	2	928181		0-3	89	11	89	13	37	9	1	NA	41
Lit.	2	928178		0-3	100	0	93	22	25	11	0	NA	40

Notes. B = blank; NS = non-scorable. NA= non-applicable. Algebra I responses received a possible total of 0–4 points. For some Algebra I items, raters applied a single score of 0, 1, 2, 3, or 4; however, many Algebra I items were divided into separate parts that were scored on 0–1, 0–2, or 0–3-point scales, the sum of which always resulted in an overall score of 0–4 points. For example, an Algebra I item might have a part A, a part B, a part C, and a part D, each of which was scored on a 0–1-point scale, resulting in a summed 0–4-point total score scale. Additionally, some Algebra I items with multiple parts could receive up to one point for "minimal understanding" (MU) even if the student did not receive a point, or points, for any of the item's individual parts.

CHAPTER NINE: DESCRIPTION OF DATA SOURCES

This section describes the filtering process and data sources used for the various analysis procedures discussed in the remaining sections of this report. Psychometric analyses were conducted at several points for the winter, spring, and summer. Pennsylvania Keystone Exams in Algebra I, Biology, and Literature: 1) key verification analyses for quality-control purposes; 2) pre-equating verification; 3) item analysis and calibration of field-test items embedded in the spring forms; and 4) analyses for this technical report.

STUDENT FILTERING CRITERIA

Students' records included used for psychometric analyses needed to meet at least the following criteria:

- Module 1 Attempted Status = 1 (1 represent if the student attempted a minimum of five items in Module 1)
- Module 2 Attempted Status = 1 (1 represents if the student attempted a minimum of five items in Module 2)
- Module 1 Invalidated = N (N represents if the student's score was not invalidated)
- Module 2 Invalidated = N (N represents if the student's score was not invalidated)
- Student Duplication Status = N (N represents if no record duplication)
- Module 1 Form Number = Module 2 Form Number
- Module 1 Form Name ≠ 01V (exclude students administered the VSL form)
- Module 2 Form Name ≠ 01V (exclude students administered the VSL form)

For each specific analysis conducted at different times, additional criteria might be needed to filter students. For example, the following criteria were used in addition to the ones listed above for the pre-equating verification, since the analyses were conducted during the scoring window:

- Module 1 Complete Status = 01
- Module 2 Complete Status = 01

The complete status of 01 represents the response string which includes scores on both the multiple-choice (MC) and constructed-response (CR) operational items. When the analyses were conducted by using the final data files, these criteria were no longer necessary since all operational CR items had been scored.

Item analysis and calibration of embedded field-test items were conducted using the first-time testers only (i.e., retester = N). The classical item statistics for the field-test items analyzed by using the first-time testers were more comparable to the results of the spring 2011 Keystone Exams, which were given to the first-time test takers.

Because a large number of students took the Keystone Exams, only a representative sample of students' responses on field-test CR items was scored within each content area. For the item analysis of field-test CR items, the following additional criteria were used to select only those who were sampled for hand-scoring:

- Module 1 Complete Status = 02
- Module 2 Complete Status = 02

KEY VERIFICATION DATA

The key verification data are mentioned only for completeness, as no formal results are provided in this technical document. Key verification is often conducted early in the scoring process to ensure the keys for the MC items are applied correctly. The data files used for the key verification analysis are usually (but not always) based on the student data from early-return schools. The sample representativeness is not required for this internal quality check. Available student data typically suffices as long as there is reasonable variability in the total-test scores of students. The details about the sample sizes for the winter, spring, and summer administrations can be found in Table 9–1.

PRE-EQUATING VERIFICATION

The pre-equating verification data included all students who met the inclusion criteria and were scored by February 28, June 28, and August 22 for the winter, spring, and summer administrations, respectively. Pre-equating verification data included students who had testing accommodations, except those who utilized alternate video sign language forms.

FINAL DATA

The final data files were used to conduct item analyses for the operational items and analyses conducted for Chapters Sixteen through Nineteen in this technical report. The final data contained students' responses to both the MC and CR items. All students' responses included in the analyses met the filtering criteria. The final sample sizes (or *n*-counts) can be found in the column labeled "Final" in Table 9–1.

Table 9–1. Data Source *N*-Counts

Administration	Content Area	Key Verification	Pre-Equating Verification	Final
Winter	Algebra I	10867	36945	36950
Winter	Biology	8025	31017	31027
Winter	Literature	9412	30413	30416
Spring	Algebra I	65727	158888	158934
Spring	Biology	56128	137374	137405
Spring	Literature	58892	128693	128707
Summer	Algebra I	352	352	353
Summer	Biology	256	257	257
Summer	Literature	160	161	161

SPIRALING OF FORMS

During the administration of Keystone Exams, test forms were spiraled at the student level. The goal of spiraling is to achieve equivalent samples of students across forms so the classical statistics (e.g., *p*-value and point-biserial correlation) for all the field-test items can be compared. Given that the field-test items were embedded in the spring administration only, the equivalence of samples was checked for the spring administration instead of all administrations. When spiraling achieves randomly equivalent samples, the forms will have equal means (within sampling error) over the operational items.

Appendix H provides summary statistics for all the spring forms for each content area exam. The tables provide the form number (Form), number of students (*N*), test length in items (L), total points (Pts.), minimum (Min) score, maximum (Max) score, mean (Mean) score, median (Med) score, and standard deviation (SD). The extent to which the mean raw scores across forms are similar indicates the extent to which the student populations taking each form are of approximately equal ability. This equivalence of ability distributions across forms is the desired outcome of spiraling and allows for optimum analysis of the embedded field-test items.

Figure 9–1 presents the mean raw scores for all forms by content area and is based on the final data; in addition, accommodated forms (i.e., Spanish, Braille, large print, VSL) were removed to best represent comparisons among similar groups of test-takers. The spring form mean raw scores are plotted (circle-shaped marker) with standard error of mean lines. For each form, the standard error of mean was computed by taking the standard deviation of all student scores (assumed as the population standard deviation divided by the square root of the form *n*-count). The mean score across all forms is indicated by the red horizontal broken line. If the three-standard error band captures the horizontal line, then that suggests only random differences exist between the form mean and the population mean. This is true for all forms in all content areas.

Figure 9–1. Spring Form Mean Scores with +/- Standard Error (SE) Bands

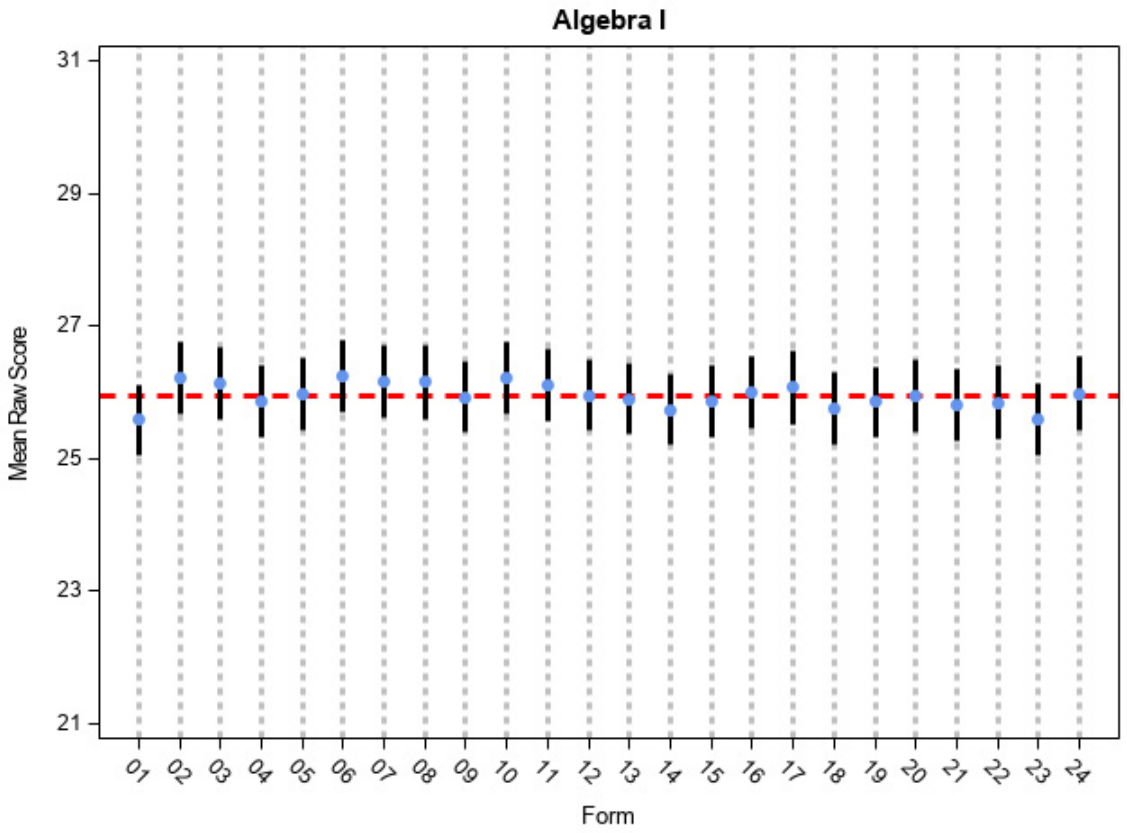
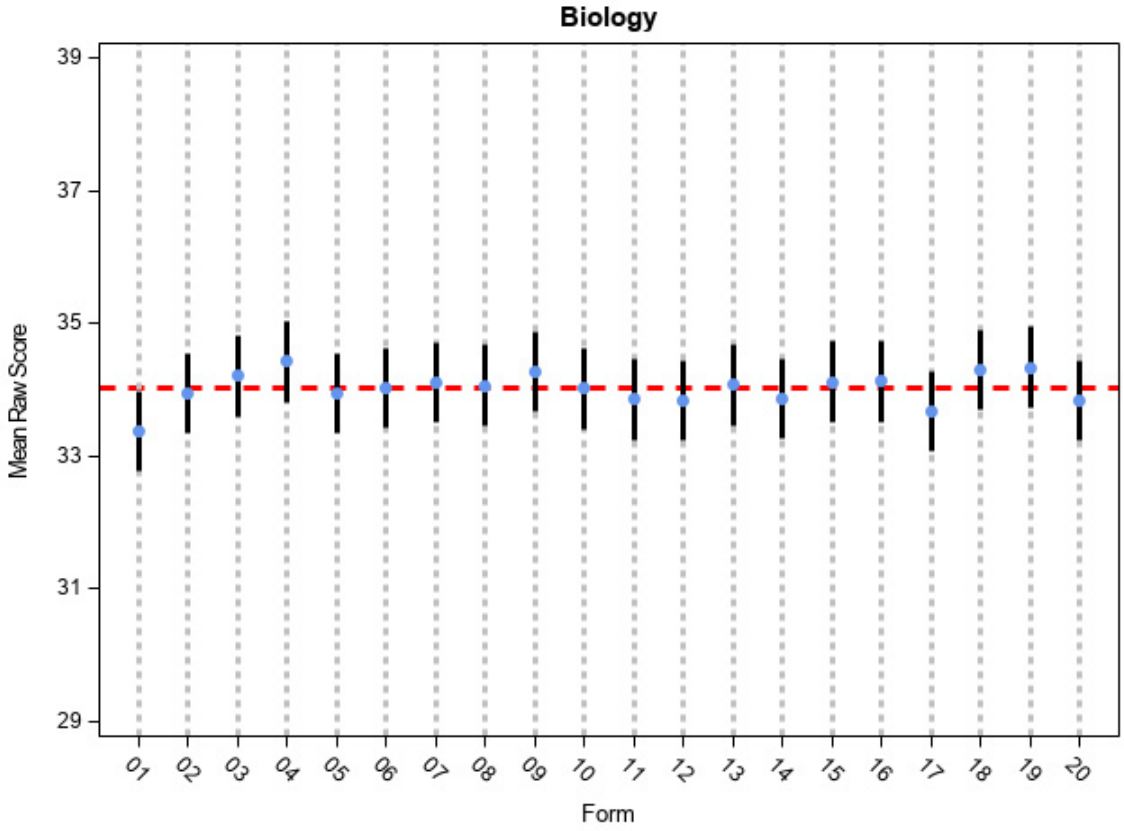
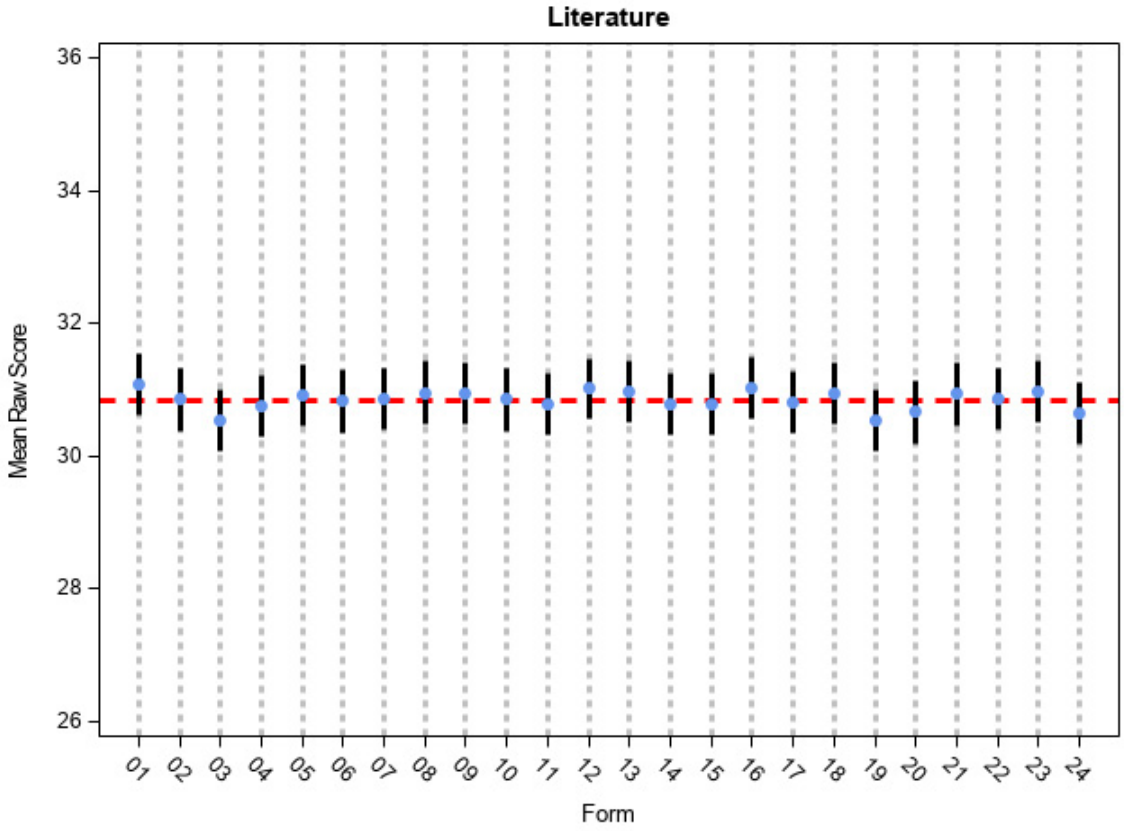


Figure 9–1 (continued). Spring Form Mean Scores with +/- Standard Error (SE) Bands





CHAPTER TEN: SUMMARY DEMOGRAPHIC AND ACCOMMODATION DATA FOR SPRING 2022 KEYSTONE EXAMS

ASSESSED STUDENTS

Students assessed on the Keystone Exams include students from public schools who are required to participate by virtue of being in the graduating class of 2023, students in a school district planning to use the Keystone Exams to meet graduation requirements, and students enrolled in an Algebra I, Biology, or Literature course during the 2021–2022 school year. The operational Keystone Exams were administered in both paper-and-pencil test (PPT) and computer-based test (CBT) formats.

Statistical tables and associated commentary embedded in this chapter are based on data from the Spring test administration of the Keystone Exams. There were two other administrations during the school year, each of which involved fewer students than the spring. One occurred during winter and the other in the summer. Tables summarizing results from these two administrations can be found in Appendix I.

Results for this chapter are presented in sets of tables for the three Keystone Exams administered in Spring (Algebra I, Biology, and Literature). Accompanying each numbered table is a letter (A, B, or L) to designate the content area. Tables 10–1A through 10–1L provides a summary of tests processed and scored, which are displayed separately by student grade level. The first two rows present the number processed for each administration mode (PPT and CBT). The total number of tests processed is presented on the third row. The fourth and fifth rows show the number and percentage of students with a Keystone Exam score, while the sixth and seventh row presents the number and percentage not receiving a score. Please note that the percent of students assessed (received a total score) is typically in the high 90s across grade levels.

Table 10–1A. Students Assessed on the Spring 2022 Keystone Exam: Algebra I

Description	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	40	209	3,916	19,955	50,925	31,888	14,818	267	122,018
Total number of CBT processed (Number)	1	87	2,462	9,421	18,650	11,024	5,322	98	47,065
Total number of tests processed (Number)	41	296	6,378	29,376	69,575	42,912	20,140	365	169,083
Total number of tests processed with a score (Number)	29	296	6,339	29,005	64,835	38,639	17,216	253	156,612
Total number of tests processed with a score (Percent)	70.7	100	99.4	98.7	93.2	90	85.5	69.3	92.6
Total number of tests processed without a score (Number)	12	0	39	371	4,740	4,273	2,924	112	12,471
Total number of tests processed without a score (Percent)	29.3	0	.6	1.3	6.8	10	14.5	30.7	7.4

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table 10–1B. Students Assessed on the Spring 2022 Keystone Exam: Biology

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	22	272	35,721	47,413	17,983	329	101,740
Total number of CBT processed (Number)	1	7	16,089	22,943	6,515	87	45,642
Total number of tests processed (Number)	23	279	51,810	70,356	24,498	416	147,382
Total number of tests processed with a score (Number)	10	267	49,330	64,913	20,779	303	135,602
Total number of tests processed with a score (Percent)	43.5	95.7	95.2	92.3	84.8	72.8	92
Total number of tests processed without a score (Number)	13	12	2,480	5,443	3,719	113	11,780
Total number of tests processed without a score (Percent)	56.5	4.3	4.8	7.7	15.2	27.2	8

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table 10–1L. Students Assessed on the Spring 2022 Keystone Exam: Literature

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	21	6	6,452	70,481	19,111	200	96,271
Total number of CBT processed (Number)	1	0	1,836	31,181	8,263	68	41,349
Total number of tests processed (Number)	22	6	8,288	101,662	27,374	268	137,620
Total number of tests processed with a score (Number)	13	5	7,288	95,959	23,401	183	126,849
Total number of tests processed with a score (Percent)	59.1	83.3	87.9	94.4	85.5	68.3	92.2
Total number of tests processed without a score (Number)	9	1	1,000	5,703	3,973	85	10,771
Total number of tests processed without a score (Percent)	40.9	16.7	12.1	5.6	14.5	31.7	7.8

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

REASONS FOR STUDENT NON-ASSESSMENT

Typically, a small percent of students were not assessed. Although there are a variety of reasons for this, the major ones pertain to:

- Extended absence from school that continued beyond the assessment window.
- Failure to meet the attempt criteria on one or more test modules and no exclusion code marked by school personnel. The attempt criteria required a minimum of five items to be completed in each module.
- Medical emergency.
- Parental request in which the student's parent/guardian reviewed the assessment, found it in conflict with his/her religious belief, and requested in writing that the student be excluded from participation.

- Parental request in which the student's parent/guardian chose to have his/her child excluded from participation based on reasons other than conflict with religious belief, even though there is no provision for this exclusion in Pennsylvania regulation.
- Other reasons.

The number of students without a total test score for each of these reasons is provided in Tables 10–2A through 10–2L. Associated with this number is the percent of the total of non-assessed students in each column (grade level) attributed to a particular reason.

Table 10–2A. Counts/Percentages of Students without Scores on the Spring 2022 Keystone Exam: Algebra I

Reason for Non-Assessment	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	3	0	9	92	1,535	1,391	970	50	4,050
Extended absence from school (Percent)	25	0	23.1	24.8	32.4	32.6	33.2	44.6	32.5
Non-attempt (Number)	3	0	3	45	1,978	1,497	787	13	4,326
Non-attempt (Percent)	25	0	7.7	12.1	41.7	35	26.9	11.6	34.7
Medical emergency (Number)	1	0	6	47	97	81	47	2	281
Medical emergency (Percent)	8.3	0	15.4	12.7	2	1.9	1.6	1.8	2.3
Parental request - Chapter 4 (Number)	0	0	5	53	158	197	112	2	527
Parental request - Chapter 4 (Percent)	0	0	12.8	14.3	3.3	4.6	3.8	1.8	4.2
Parental request - Other reasons (Number)	2	0	7	84	338	339	281	10	1,061
Parental request - Other reasons (Percent)	16.7	0	17.9	22.6	7.1	7.9	9.6	8.9	8.5
Other reasons (Number)	3	0	9	50	634	768	727	35	2,226
Other reasons (Percent)	25	0	23.1	13.5	13.4	18	24.9	31.3	17.8
Total not assessed (Number)	12	0	39	371	4,740	4,273	2,924	112	12,471

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table 10–2B. Counts/Percentages of Students without Scores on the Spring 2022 Keystone Exam: Biology

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	0	3	775	1,740	1,291	43	3,852
Extended absence from school (Percent)	0	25	31.3	32	34.7	38.1	32.7
Non-attempt (Number)	1	2	736	1,707	873	11	3,330
Non-attempt (Percent)	7.7	16.7	29.7	31.4	23.5	9.7	28.3
Medical emergency (Number)	1	0	77	147	54	1	280
Medical emergency (Percent)	7.7	0	3.1	2.7	1.5	.9	2.4
Parental request - Chapter 4 (Number)	0	2	112	298	162	3	577
Parental request - Chapter 4 (Percent)	0	16.7	4.5	5.5	4.4	2.7	4.9
Parental request - Other reasons (Number)	2	3	217	536	362	6	1,126
Parental request - Other reasons (Percent)	15.4	25	8.8	9.8	9.7	5.3	9.6
Other reasons (Number)	9	2	563	1,015	977	49	2,615
Other reasons (Percent)	69.2	16.7	22.7	18.6	26.3	43.4	22.2
Total not assessed (Number)	13	12	2,480	5,443	3,719	113	11,780

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table 10–2L. Counts/Percentages of Students without Scores on the Spring 2022 Keystone Exam: Literature

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	3	1	373	1,842	1,260	22	3,501
Extended absence from school (Percent)	33.3	100	37.3	32.3	31.7	25.9	32.5
Non-attempt (Number)	0	0	238	1,821	1,034	12	3,105
Non-attempt (Percent)	0	0	23.8	31.9	26	14.1	28.8
EL in first year in U.S. schools (Number)	0	0	8	34	33	0	75
EL in first year in U.S. schools (Percent)	0	0	.8	.6	.8	0	.7
Medical emergency (Number)	0	0	22	181	64	1	268
Medical emergency (Percent)	0	0	2.2	3.2	1.6	1.2	2.5
Parental request - Chapter 4 (Number)	0	0	29	357	191	3	580
Parental request - Chapter 4 (Percent)	0	0	2.9	6.3	4.8	3.5	5.4
Parental request - Other reasons (Number)	1	0	108	604	357	10	1,080
Parental request - Other reasons (Percent)	11.1	0	10.8	10.6	9	11.8	10
Other reasons (Number)	5	0	222	864	1,034	37	2,162
Other reasons (Percent)	55.6	0	22.2	15.1	26	43.5	20.1
Total not assessed (Number)	9	1	1,000	5,703	3,973	85	10,771

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

DEMOGRAPHIC CHARACTERISTICS OF STUDENTS RECEIVING TEST SCORES

COMPOSITION OF SAMPLE USED IN SUBSEQUENT TABLES

The following state summary statistic data analyses were completed using the final individual student data file containing records from the Spring administration, which are typically provided to the Pennsylvania Department of Education in July. State summary statistics were based on students who received a total test score on the Spring administration with the exception of students who attended non-public schools or those who were home schooled. Also excluded were students who were non-Keystone proficient.

Demographic data for students taking the Keystone Exams is presented separately for each subject (Tables 10–3A, 10–3B, 10–3L). Results for accommodations received were collected separately by subject and are presented in separate tables as well. For example, tables involving accommodations for Biology are found in Tables 10–4B, 10–5B, 10–6B, and 10–7B.

COLLECTION OF STUDENT DEMOGRAPHIC INFORMATION

Data for analyses involving demographic characteristics were obtained primarily from information supplied by school district personnel through the Pennsylvania Information Management System (PIMS) and subsequently transmitted to DRC. Some data such as accommodation information are recorded by school personnel directly on the student answer document (PPT) or in the DRC INSIGHT Portal Test Setup (CBT) at the time a Keystone Exam is administered.

DEMOGRAPHIC CHARACTERISTICS

Frequency data for each demographic category is presented in Tables 10–3A through 10–3L. Data is presented by grade level with PPT and CBT formats combined into a single composite. Shown at the bottom of the appropriate table is the number of assessed students contributing to summary statistics on which the column percentages are based.

Table 10–3A. Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	1	84	2,834	14,966	32,268	18,474	8,050	96	76,773
Female (Percent)	3.4	28.4	44.7	51.6	49.8	47.8	46.8	37.9	49
Male (Number)	8	212	3,504	14,033	32,554	20,157	9,162	156	79,786
Male (Percent)	27.6	71.6	55.3	48.4	50.2	52.2	53.2	61.7	50.9
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	6	38	127	84	39	1	295
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.1	.1	.2	.2	.2	.4	.2
Asian (not Hispanic) (Number)	2	120	894	1,972	2,349	1,054	526	8	6,925
Asian (not Hispanic) (Percent)	6.9	40.5	14.1	6.8	3.6	2.7	3.1	3.2	4.4
Black or African American (not Hispanic) (Number)	0	2	143	1,446	10,731	7,597	4,008	59	23,986
Black or African American (not Hispanic) (Percent)	0	.7	2.3	5	16.6	19.7	23.3	23.3	15.3
Hispanic (any race) (Number)	1	4	257	1,847	10,328	7,012	3,566	61	23,076
Hispanic (any race) (Percent)	3.4	1.4	4.1	6.4	15.9	18.1	20.7	24.1	14.7
Multi-Racial (not Hispanic) (Number)	0	13	248	999	2,849	1,644	737	14	6,504
Multi-Racial (not Hispanic) (Percent)	0	4.4	3.9	3.4	4.4	4.3	4.3	5.5	4.2
White (not Hispanic) (Number)	7	157	4,787	22,673	38,374	21,210	8,323	109	95,640
White (not Hispanic) (Percent)	24.1	53	75.5	78.2	59.2	54.9	48.3	43.1	61.1
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	3	22	67	31	13	0	136
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	.1	.1	.1	.1	0	.1
IEP (not gifted) (Number)	3	19	148	1,143	9,729	9,180	5,241	100	25,563
IEP (not gifted) (Percent)	10.3	6.4	2.3	3.9	15	23.8	30.4	39.5	16.3
Student exited IEP in last 2 years (Number)	0	0	103	373	805	384	179	1	1,845
Student exited IEP in last 2 years (Percent)	0	0	1.6	1.3	1.2	1	1	.4	1.2
Title I (Number)	1	41	744	6,173	20,243	13,874	6,544	149	47,769
Title I (Percent)	3.4	13.9	11.7	21.3	31.2	35.9	38	58.9	30.5
Title III served (Number)	0	1	9	201	3,071	2,479	1,566	44	7,371
Title III served (Percent)	0	.3	.1	.7	4.7	6.4	9.1	17.4	4.7
Title III not served (Number)	1	30	693	3,487	8,338	5,402	2,528	63	20,542
Title III not served (Percent)	3.4	10.1	10.9	12	12.9	14	14.7	24.9	13.1
Migrant student (Number)	0	0	0	6	87	58	31	2	184
Migrant student (Percent)	0	0	0	0	.1	.2	.2	.8	.1
EL enrolled first year (Number)	0	1	1	21	388	282	233	7	933
EL enrolled first year (Percent)	0	.3	0	.1	.6	.7	1.4	2.8	.6
EL enrolled not first year (Number)	0	0	8	234	2,806	2,348	1,386	39	6,821
EL enrolled not first year (Percent)	0	0	.1	.8	4.3	6.1	8.1	15.4	4.4

Table 10–3A (continued). Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	5	36	143	72	33	1	290
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	.1	.1	.2	.2	.2	.4	.2
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	1	18	45	135	105	38	0	342
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	.3	.3	.2	.2	.3	.2	0	.2
Former EL no longer monitored (Number)	1	3	89	418	1,198	673	318	3	2,703
Former EL no longer monitored (Percent)	3.4	1	1.4	1.4	1.8	1.7	1.8	1.2	1.7
LIFE first year (Number)	0	0	0	0	6	3	2	0	11
LIFE first year (Percent)	0	0	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	0	28	48	45	0	121
LIFE not first year (Percent)	0	0	0	0	0	.1	.3	0	.1
Former EL exited and in 3rd year of monitoring (Number)	0	0	23	161	188	123	54	0	549
Former EL exited and in 3rd year of monitoring (Percent)	0	0	.4	.6	.3	.3	.3	0	.4
Former EL exited and in 4th year of monitoring (Number)	1	2	32	154	319	102	57	0	667
Former EL exited and in 4th year of monitoring (Percent)	3.4	.7	.5	.5	.5	.3	.3	0	.4
Foreign exchange student (Number)	0	0	0	0	0	2	0	0	2
Foreign exchange student (Percent)	0	0	0	0	0	0	0	0	0
Economically disadvantaged (Number)	1	11	743	6,731	30,618	20,860	9,792	166	68,922
Economically disadvantaged (Percent)	3.4	3.7	11.7	23.2	47.2	54	56.9	65.6	44
Historically Underperforming Subgroup (Number)	3	28	868	7,625	36,021	25,472	12,448	212	82,677
Historically Underperforming Subgroup (Percent)	10.3	9.5	13.7	26.3	55.6	65.9	72.3	83.8	52.8
Enrollment in school of residence after Oct 1 (Number)	1	1	51	333	2,575	2,013	1,271	28	6,273
Enrollment in school of residence after Oct 1 (Percent)	3.4	.3	.8	1.1	4	5.2	7.4	11.1	4
Enrollment in district of residence after Oct 1 (Number)	1	1	41	302	2,206	1,695	1,116	24	5,386
Enrollment in district of residence after Oct 1 (Percent)	3.4	.3	.6	1	3.4	4.4	6.5	9.5	3.4
Enrollment as PA resident after Oct 1 (Number)	0	1	26	163	1,276	827	613	13	2,919
Enrollment as PA resident after Oct 1 (Percent)	0	.3	.4	.6	2	2.1	3.6	5.1	1.9
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	1	101	1,390	3,287	35,308	8,724	3,748	82	52,641

Table 10–3A (continued). Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	3.4	34.1	21.9	11.3	54.5	22.6	21.8	32.4	33.6
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	17	217	1,179	8,431	3,775	1,936	65	15,620
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	5.7	3.4	4.1	13	9.8	11.2	25.7	10
Military family (Number)	0	0	24	192	331	204	77	4	832
Military family (Percent)	0	0	.4	.7	.5	.5	.4	1.6	.5
Homeless (Number)	0	0	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0	0	0
Foster (Number)	0	0	2	25	288	208	154	11	688
Foster (Percent)	0	0	0	.1	.4	.5	.9	4.3	.4
Home schooled (Number)	0	0	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	0	1	46	30	20	24	121
Court/agency placed (Percent)	0	0	0	0	.1	.1	.1	9.5	.1
Number of assessed students (Number)	29	296	6,339	29,005	64,835	38,639	17,216	253	156,612

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table 10–3B. Demographic Characteristics of Students Taking the Spring 2022 Keystone Exam: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	1	140	25,169	31,281	9,995	148	66,734
Female (Percent)	10	52.4	51	48.2	48.1	48.8	49.2
Male (Number)	1	127	24,153	33,627	10,782	153	68,843
Male (Percent)	10	47.6	49	51.8	51.9	50.5	50.8
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	65	106	53	0	224
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.1	.2	.3	0	.2
Asian (not Hispanic) (Number)	0	34	2,964	2,222	620	9	5,849
Asian (not Hispanic) (Percent)	0	12.7	6	3.4	3	3	4.3
Black or African American (not Hispanic) (Number)	1	12	5,031	9,626	4,776	112	19,558
Black or African American (not Hispanic) (Percent)	10	4.5	10.2	14.8	23	37	14.4
Hispanic (any race) (Number)	1	11	4,849	9,590	4,168	73	18,692
Hispanic (any race) (Percent)	10	4.1	9.8	14.8	20.1	24.1	13.8
Multi-Racial (not Hispanic) (Number)	0	8	2,059	2,624	860	16	5,567
Multi-Racial (not Hispanic) (Percent)	0	3	4.2	4	4.1	5.3	4.1
White (not Hispanic) (Number)	0	201	34,296	40,677	10,282	91	85,547
White (not Hispanic) (Percent)	0	75.3	69.5	62.7	49.5	30	63.1
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	1	57	64	18	0	140
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	.4	.1	.1	.1	0	.1
IEP (not gifted) (Number)	1	6	5,773	12,649	5,050	98	23,577
IEP (not gifted) (Percent)	10	2.2	11.7	19.5	24.3	32.3	17.4
Student exited IEP in last 2 years (Number)	0	0	623	663	229	2	1,517
Student exited IEP in last 2 years (Percent)	0	0	1.3	1	1.1	.7	1.1
Title I (Number)	2	83	10,993	17,419	8,394	153	37,044
Title I (Percent)	20	31.1	22.3	26.8	40.4	50.5	27.3
Title III served (Number)	0	5	969	2,986	1,710	57	5,727
Title III served (Percent)	0	1.9	2	4.6	8.2	18.8	4.2
Title III not served (Number)	2	54	6,475	9,318	2,802	54	18,705
Title III not served (Percent)	20	20.2	13.1	14.4	13.5	17.8	13.8
Migrant student (Number)	0	0	31	69	36	0	136
Migrant student (Percent)	0	0	.1	.1	.2	0	.1
EL enrolled first year (Number)	0	0	102	292	247	7	648
EL enrolled first year (Percent)	0	0	.2	.4	1.2	2.3	.5
EL enrolled not first year (Number)	0	5	925	2,878	1,534	53	5,395
EL enrolled not first year (Percent)	0	1.9	1.9	4.4	7.4	17.5	4

Table 10–3B (continued). Demographic Characteristics of Students Taking the Spring 2022 Keystone Exam: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	75	119	37	0	231
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	.2	.2	.2	0	.2
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	92	175	38	1	306
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	.2	.3	.2	.3	.2
Former EL no longer monitored (Number)	0	5	932	1,234	336	4	2,511
Former EL no longer monitored (Percent)	0	1.9	1.9	1.9	1.6	1.3	1.9
LIFE first year (Number)	0	0	0	3	5	0	8
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	20	54	40	0	114
LIFE not first year (Percent)	0	0	0	.1	.2	0	.1
Former EL exited and in 3rd year of monitoring (Number)	0	3	109	182	72	0	366
Former EL exited and in 3rd year of monitoring (Percent)	0	1.1	.2	.3	.3	0	.3
Former EL exited and in 4th year of monitoring (Number)	0	3	183	149	54	0	389
Former EL exited and in 4th year of monitoring (Percent)	0	1.1	.4	.2	.3	0	.3
Foreign exchange student (Number)	0	0	0	4	1	1	6
Foreign exchange student (Percent)	0	0	0	0	0	.3	0
Economically disadvantaged (Number)	2	39	17,008	29,447	11,443	214	58,153
Economically disadvantaged (Percent)	20	14.6	34.5	45.4	55.1	70.6	42.9
Historically Underperforming Subgroup (Number)	2	45	20,192	35,987	14,084	266	70,576
Historically Underperforming Subgroup (Percent)	20	16.9	40.9	55.4	67.8	87.8	52
Enrollment in school of residence after Oct 1 (Number)	0	1	1,254	2,528	1,469	31	5,283
Enrollment in school of residence after Oct 1 (Percent)	0	.4	2.5	3.9	7.1	10.2	3.9
Enrollment in district of residence after Oct 1 (Number)	0	1	1,084	2,108	1,300	28	4,521
Enrollment in district of residence after Oct 1 (Percent)	0	.4	2.2	3.2	6.3	9.2	3.3
Enrollment as PA resident after Oct 1 (Number)	0	0	536	992	707	13	2,248
Enrollment as PA resident after Oct 1 (Percent)	0	0	1.1	1.5	3.4	4.3	1.7
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	1	54	21,981	12,275	4,541	99	38,951

Table 10–3B (continued). Demographic Characteristics of Students Taking the Spring 2022 Keystone Exam: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	10	20.2	44.6	18.9	21.9	32.7	28.7
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	1	11	4,934	5,000	2,362	67	12,375
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	10	4.1	10	7.7	11.4	22.1	9.1
Military family (Number)	0	1	276	298	94	3	672
Military family (Percent)	0	.4	.6	.5	.5	1	.5
Homeless (Number)	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	139	301	148	9	597
Foster (Percent)	0	0	.3	.5	.7	3	.4
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	35	29	21	19	104
Court/agency placed (Percent)	0	0	.1	0	.1	6.3	.1
Number of assessed students (Number)	10	267	49,330	64,913	20,779	303	135,602

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade.

Table 10–3L. Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	3	4	3,512	47,241	10,461	73	61,294
Female (Percent)	23.1	80	48.2	49.2	44.7	39.9	48.3
Male (Number)	1	1	3,775	48,705	12,937	109	65,528
Male (Percent)	7.7	20	51.8	50.8	55.3	59.6	51.7
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	11	154	42	0	207
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.2	.2	.2	0	.2
Asian (not Hispanic) (Number)	0	0	257	4,594	713	5	5,569
Asian (not Hispanic) (Percent)	0	0	3.5	4.8	3	2.7	4.4
Black or African American (not Hispanic) (Number)	2	0	960	12,252	5,236	53	18,503
Black or African American (not Hispanic) (Percent)	15.4	0	13.2	12.8	22.4	29	14.6
Hispanic (any race) (Number)	1	0	1,050	10,821	4,338	32	16,242
Hispanic (any race) (Percent)	7.7	0	14.4	11.3	18.5	17.5	12.8
Multi-Racial (not Hispanic) (Number)	0	0	302	3,738	1,006	7	5,053
Multi-Racial (not Hispanic) (Percent)	0	0	4.1	3.9	4.3	3.8	4
White (not Hispanic) (Number)	1	5	4,701	64,291	12,047	85	81,130
White (not Hispanic) (Percent)	7.7	100	64.5	67	51.5	46.4	64
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	6	98	16	0	120
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	.1	.1	.1	0	.1
IEP (not gifted) (Number)	2	0	1,219	15,205	6,306	78	22,810
IEP (not gifted) (Percent)	15.4	0	16.7	15.8	26.9	42.6	18
Student exited IEP in last 2 years (Number)	0	0	41	1,103	242	2	1,388
Student exited IEP in last 2 years (Percent)	0	0	.6	1.1	1	1.1	1.1
Title I (Number)	1	1	2,199	22,381	8,702	114	33,398
Title I (Percent)	7.7	20	30.2	23.3	37.2	62.3	26.3
Title III served (Number)	0	0	226	2,717	1,688	19	4,650
Title III served (Percent)	0	0	3.1	2.8	7.2	10.4	3.7
Title III not served (Number)	1	0	1,033	13,506	3,529	47	18,116
Title III not served (Percent)	7.7	0	14.2	14.1	15.1	25.7	14.3
Migrant student (Number)	0	0	15	67	33	0	115
Migrant student (Percent)	0	0	.2	.1	.1	0	.1
EL enrolled first year (Number)	0	0	14	176	145	0	335
EL enrolled first year (Percent)	0	0	.2	.2	.6	0	.3
EL enrolled not first year (Number)	0	0	234	2,732	1,643	20	4,629
EL enrolled not first year (Percent)	0	0	3.2	2.8	7	10.9	3.6

Table 10–3L (continued). Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	4	142	48	1	195
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	.1	.1	.2	.5	.2
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	10	218	45	0	273
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	.1	.2	.2	0	.2
Former EL no longer monitored (Number)	0	0	118	1,946	387	2	2,453
Former EL no longer monitored (Percent)	0	0	1.6	2	1.7	1.1	1.9
LIFE first year (Number)	0	0	0	2	1	0	3
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	1	53	44	0	98
LIFE not first year (Percent)	0	0	0	.1	.2	0	.1
Former EL exited and in 3rd year of monitoring (Number)	0	0	7	240	84	0	331
Former EL exited and in 3rd year of monitoring (Percent)	0	0	.1	.3	.4	0	.3
Former EL exited and in 4th year of monitoring (Number)	0	0	21	202	71	0	294
Former EL exited and in 4th year of monitoring (Percent)	0	0	.3	.2	.3	0	.2
Foreign exchange student (Number)	0	0	0	7	0	0	7
Foreign exchange student (Percent)	0	0	0	0	0	0	0
Economically disadvantaged (Number)	2	0	3,381	37,189	12,738	122	53,432
Economically disadvantaged (Percent)	15.4	0	46.4	38.8	54.4	66.7	42.1
Historically Underperforming Subgroup (Number)	3	0	3,882	45,063	15,878	151	64,977
Historically Underperforming Subgroup (Percent)	23.1	0	53.3	47	67.9	82.5	51.2
Enrollment in school of residence after Oct 1 (Number)	0	0	318	2,974	1,503	20	4,815
Enrollment in school of residence after Oct 1 (Percent)	0	0	4.4	3.1	6.4	10.9	3.8
Enrollment in district of residence after Oct 1 (Number)	0	0	254	2,494	1,306	19	4,073
Enrollment in district of residence after Oct 1 (Percent)	0	0	3.5	2.6	5.6	10.4	3.2
Enrollment as PA resident after Oct 1 (Number)	0	0	97	1,135	620	9	1,861
Enrollment as PA resident after Oct 1 (Percent)	0	0	1.3	1.2	2.6	4.9	1.5
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	1	0	3,018	17,033	4,840	60	24,952

Table 10–3L (continued). Demographic Characteristics of Students taking the Spring 2022 Keystone Exam: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	7.7	0	41.4	17.8	20.7	32.8	19.7
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	1	0	838	6,203	2,528	45	9,615
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	7.7	0	11.5	6.5	10.8	24.6	7.6
Military family (Number)	0	0	39	449	112	2	602
Military family (Percent)	0	0	.5	.5	.5	1.1	.5
Homeless (Number)	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	37	341	182	10	570
Foster (Percent)	0	0	.5	.4	.8	5.5	.4
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	44	35	20	24	123
Court/agency placed (Percent)	0	0	.6	0	.1	13.1	.1
Number of assessed students (Number)	13	5	7,288	95,959	23,401	183	126,849

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

PARTICIPATION BY ADMINISTRATION MODE

Although there are two administration modes, paper/pencil test (PPT) and computer-based test (CBT), most students are administered PPT.

TEST ACCOMMODATIONS PROVIDED

School personnel supplied information regarding accommodations that a student may have received while taking the Keystone Exams. Accommodations are classified in terms of presentation, response, setting, and timing to enable students to better manage disabilities that hinder their ability to learn and respond to assessments. An accommodations manual entitled, *Accommodations Guidelines* was updated for use with the PSSA and Keystone Exams. This manual may be found on the PDE website at www.education.pa.gov. A glossary of accommodation terms as applied to the Keystone Exams is provided in Table 10–10 at the end of this chapter.

The frequency with which accommodations were utilized for PPT and CBT formats is summarized separately for each subject exam in Tables 10–4A through 10–7L. Tabled values are based on all students whose scores contributed to state summary statistics in a given Keystone Exam. Because of the very small incidence of usage of many accommodations, combined with the fact that a number of accommodations are primarily accessed by only one of the two administration modes, meaningful comparisons between modes are rather limited. In the following tables, a value of "NA" denotes those instances in which a particular accommodation does not apply to one of the testing modes.

PRESENTATION ACCOMMODATIONS RECEIVED

Presentation accommodations are those that provide alternate ways for students to access and process printed instructional material and assessments. These include auditory, tactile, visual, and combined auditory/visual modes of presentation. The number of presentation accommodations provided in the Keystone Exams varied by content area and test administration mode.

As depicted in Tables 10–4A through 10–4L, the actual frequencies were quite low, generally representing less than one-tenth of one percent of assessed students in each subject. The most notable exceptions, applicable to Algebra I and Biology only, were "All items/questions read aloud" and "Some items/questions read aloud." Among accommodations specific to CBT, the use of audio was the most frequent.

Table 10–4A. Incidence of Presentation Accommodations Received on the Spring 2022 Keystone Exam: Algebra I

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	6	N/A	6
Braille format (Percent)	0	N/A	0
Large print format (Number)	63	N/A	63
Large print format (Percent)	.1	N/A	0
Computer Assistive Technology (Number)	8	N/A	8
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	603	777	1,380
Some test items/questions read aloud (Percent)	.5	1.7	.9
All test items/questions read aloud (Number)	369	564	933
All test items/questions read aloud (Percent)	.3	1.3	.6
Test items/questions signed (Number)	3	5	8
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	53	15	68
Test items/questions interpreted for EL student (Percent)	0	0	0
Amplification device (Number)	14	13	27
Amplification device (Percent)	0	0	0
Magnification device (Number)	7	7	14
Magnification device (Percent)	0	0	0
Color overlay (Number)	2	N/A	2
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	64	47	111
Other (per Accommodations Guidelines) (Percent)	.1	.1	.1
Spanish version (Number)	1,317	N/A	1,317
Spanish version (Percent)	1.2	N/A	.8
Audio (Number)	N/A	2,408	2,408
Audio (Percent)	N/A	5.4	1.5
Color Chooser (Number)	N/A	54	54
Color Chooser (Percent)	N/A	.1	0
Contrasting Text Chooser (Number)	N/A	58	58
Contrasting Text Chooser (Percent)	N/A	.1	0
Reverse Contrast (Number)	N/A	0	0
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	1	1
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	2	2
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	111,977	44,635	156,612

Table 10–4B. Incidence of Presentation Accommodations Received on the Spring 2022 Keystone Exam: Biology

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	6	N/A	6
Braille format (Percent)	0	N/A	0
Large print format (Number)	45	N/A	45
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	15	N/A	15
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	431	939	1,370
Some test items/questions read aloud (Percent)	.5	2.2	1
All test items/questions read aloud (Number)	460	677	1,137
All test items/questions read aloud (Percent)	.5	1.6	.8
Test items/questions signed (Number)	9	6	15
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	53	12	65
Test items/questions interpreted for EL student (Percent)	.1	0	0
Amplification device (Number)	13	15	28
Amplification device (Percent)	0	0	0
Magnification device (Number)	2	10	12
Magnification device (Percent)	0	0	0
Color overlay (Number)	3	N/A	3
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	70	64	134
Other (per Accommodations Guidelines) (Percent)	.1	.1	.1
Spanish version (Number)	1,004	N/A	1,004
Spanish version (Percent)	1.1	N/A	.7
Audio (Number)	N/A	2,489	2,489
Audio (Percent)	N/A	5.8	1.8
Color Chooser (Number)	N/A	66	66
Color Chooser (Percent)	N/A	.2	0
Contrasting Text Chooser (Number)	N/A	71	71
Contrasting Text Chooser (Percent)	N/A	.2	.1
Reverse Contrast (Number)	N/A	1	1
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	2	2
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	3	3
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	92,521	43,081	135,602

Table 10–4L. Incidence of Presentation Accommodations Received on the Spring 2022 Keystone Exam: Literature

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	5	N/A	5
Braille format (Percent)	0	N/A	0
Large print format (Number)	39	N/A	39
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	6	N/A	6
Computer Assistive Technology (Percent)	0	N/A	0
Amplification device (Number)	13	18	31
Amplification device (Percent)	0	0	0
Magnification device (Number)	5	6	11
Magnification device (Percent)	0	0	0
Color overlay (Number)	2	N/A	2
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	112	25	137
Other (per Accommodations Guidelines) (Percent)	.1	.1	.1
Color Chooser (Number)	N/A	54	54
Color Chooser (Percent)	N/A	.1	0
Contrasting Text Chooser (Number)	N/A	57	57
Contrasting Text Chooser (Percent)	N/A	.1	0
Reverse Contrast (Number)	N/A	0	0
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	1	1
Refreshable Braille (Percent)	N/A	0	0
Number of assessed students (Number)	87,899	38,950	126,849

RESPONSE ACCOMMODATIONS RECEIVED

Response accommodations permit students to complete assignments, tests, and activities in different ways and to solve or organize problems using some type of assistive device or organizer. The number of response accommodations provided on the Spring Keystone Exams varied by subject.

The frequency with which these accommodations were utilized is summarized in Tables 10–5A through 10–5L. The actual frequencies are quite low, representing less than one-tenth of one percent of assessed students in nearly all instances, regardless of administration mode. The most common response accommodation for Algebra I and Biology was the use of a translation dictionary, however the percent of test-takers utilizing this accommodation was still very low (approximately 0.2%).

Table 10–5A. Incidence of Response Accommodations Received on the Spring 2022 Keystone Exam: Algebra I

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	30	2	32
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	33	4	37
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	73	3	76
Test administrator transcribed student responses (Percent)	.1	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	1	4	5
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	6	6	12
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	11	N/A	11
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	2	N/A	2
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	1	0	1
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	1	N/A	1
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	292	91	383
Translation dictionary for EL student (Percent)	.3	.2	.2
Other (per Accommodations Guidelines) (Number)	50	6	56
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	111,977	44,635	156,612

Table 10–5B. Incidence of Response Accommodations Received on the Spring 2022 Keystone Exam: Biology

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	41	3	44
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	43	12	55
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	70	11	81
Test administrator transcribed student responses (Percent)	.1	0	.1
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	1	2	3
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	4	7	11
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	25	N/A	25
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	2	N/A	2
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	2	0	2
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	175	72	247
Translation dictionary for EL student (Percent)	.2	.2	.2
Other (per Accommodations Guidelines) (Number)	6	9	15
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	92,521	43,081	135,602

Table 10–5L. Incidence of Response Accommodations Received on the Spring 2022 Keystone Exam: Literature

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	31	3	34
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	47	7	54
Test administrator scribed open-ended responses at student's direction (Percent)	.1	0	0
Test administrator transcribed student responses (Number)	104	6	110
Test administrator transcribed student responses (Percent)	.1	0	.1
Keyboard, word processor, or computer (Number)	62	N/A	62
Keyboard, word processor, or computer (Percent)	.1	N/A	0
Brailler/Notetaker (Number)	2	N/A	2
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	2	0	2
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	4	N/A	4
Computer Assistive Technology (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	27	5	32
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	87,899	38,950	126,849

SETTING ACCOMMODATIONS RECEIVED

Setting accommodations permit a change in the location in which a student receives instruction or participates in an assessment. In the Keystone Exam administration, there were four categories of setting accommodations, which applied to both administration modes and to each subject exam. As depicted in Tables 10–6A through 10–6L, the most common accommodation was small group setting for both PPT and CBT modes of administration, in which 8.5% to 9.5% of assessed students were administered the test in a small group setting.

Table 10–6A. Incidence of Setting Accommodations Received on the Spring 2022 Keystone Exam: Algebra I

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	17	2	19
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	219	29	248
One-on-one setting (Percent)	.2	.1	.2
Small group setting (Number)	9,163	4,158	13,321
Small group setting (Percent)	8.2	9.3	8.5
Other (per Accommodations Guidelines) (Number)	54	48	102
Other (per Accommodations Guidelines) (Percent)	0	.1	.1
Number of assessed students (Number)	111,977	44,635	156,612

Table 10–6B. Incidence of Setting Accommodations Received on the Spring 2022 Keystone Exam: Biology

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	18	3	21
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	223	40	263
One-on-one setting (Percent)	.2	.1	.2
Small group setting (Number)	8,181	4,634	12,815
Small group setting (Percent)	8.8	10.8	9.5
Other (per Accommodations Guidelines) (Number)	36	68	104
Other (per Accommodations Guidelines) (Percent)	0	.2	.1
Number of assessed students (Number)	92,521	43,081	135,602

Table 10–6L. Incidence of Setting Accommodations Received on the Spring 2022 Keystone Exam: Literature

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	17	3	20
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	200	36	236
One-on-one setting (Percent)	.2	.1	.2
Small group setting (Number)	8,045	3,944	11,989
Small group setting (Percent)	9.2	10.1	9.5
Other (per Accommodations Guidelines) (Number)	60	54	114
Other (per Accommodations Guidelines) (Percent)	.1	.1	.1
Number of assessed students (Number)	87,899	38,950	126,849

TIMING ACCOMMODATIONS RECEIVED

Timing accommodations involve a change in the allowable length of time to complete assignments or assessments, including the way in which time is organized. There were four categories of timing accommodations, which applied to both administration modes and to each subject exam. As depicted in Tables 10–7A through 10–7L, the most common accommodation was extended time for both PPT and CBT administration modes with slightly higher percentages for PPT than CBT in Algebra I and Literature.

Table 10–7A. Incidence of Timing Accommodations Received on the Spring 2022 Keystone Exam: Algebra I

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	8,255	2,509	10,764
Extended time (Percent)	7.4	5.6	6.9
Frequent breaks (Number)	526	985	1,511
Frequent breaks (Percent)	.5	2.2	1
Changed test schedule (Number)	138	29	167
Changed test schedule (Percent)	.1	.1	.1
Other (per Accommodations Guidelines) (Number)	13	27	40
Other (per Accommodations Guidelines) (Percent)	0	.1	0
Number of assessed students (Number)	111,977	44,635	156,612

Table 10–7B. Incidence of Timing Accommodations Received on the Spring 2022 Keystone Exam: Biology

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	2,866	2,205	5,071
Extended time (Percent)	3.1	5.1	3.7
Frequent breaks (Number)	629	1,044	1,673
Frequent breaks (Percent)	.7	2.4	1.2
Changed test schedule (Number)	123	31	154
Changed test schedule (Percent)	.1	.1	.1
Other (per Accommodations Guidelines) (Number)	16	30	46
Other (per Accommodations Guidelines) (Percent)	0	.1	0
Number of assessed students (Number)	92,521	43,081	135,602

Table 10–7L. Incidence of Timing Accommodations Received on the Spring 2022 Keystone Exam: Literature

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	6,661	2,082	8,743
Extended time (Percent)	7.6	5.3	6.9
Frequent breaks (Number)	643	884	1,527
Frequent breaks (Percent)	.7	2.3	1.2
Changed test schedule (Number)	109	27	136
Changed test schedule (Percent)	.1	.1	.1
Other (per Accommodations Guidelines) (Number)	16	27	43
Other (per Accommodations Guidelines) (Percent)	0	.1	0
Number of assessed students (Number)	87,899	38,950	126,849

ACCOMMODATION RATE FOR NON-IEP AND IEP STUDENTS

A comparison between students without an IEP (non-IEP Students) and those with an IEP (IEP Students) with regard to having received an accommodation is provided in Table 10–8. In this data, accommodated means that a student received one or more of the total number of accommodations available for a given subject; however, this varies somewhat with administration mode. The category of non-accommodated indicates that a student did not receive any accommodations during testing.

Typically, the general pattern of findings reveals a consistent and substantially higher percentage of students with IEPs receiving an accommodation, in contrast to non-IEP Students. This same pattern typically holds true regardless of test administration mode for the Keystone Exams. Moreover, the comparisons between administration modes revealed that the accommodation rates for IEP students taking a PPT are somewhat lower than accommodation rates for IEP students taking a CBT for Algebra I and Biology, but not Literature.

Table 10–8A. Accommodation Rate for Non-IEP and IEP Students on the Spring 2022 Keystone Exams: Algebra I

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	94,175	36,874	131,049
Non-Accommodated (Number)	86,222	35,192	121,414
Non-Accommodated (Percent)	91.6	95.4	92.6
Accommodated (Number)	7,953	1,682	9,635
Accommodated (Percent)	8.4	4.6	7.4
IEP Students (Number)	17,802	7,761	25,563
Non-Accommodated (Number)	9,327	3,267	12,594
Non-Accommodated (Percent)	52.4	42.1	49.3
Accommodated (Number)	8,475	4,494	12,969
Accommodated (Percent)	47.6	57.9	50.7

Table 10–8B. Accommodation Rate for Non-IEP and IEP Students on the Spring 2022 Keystone Exams: Biology

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	77,214	34,811	112,025
Non-Accommodated (Number)	74,069	33,732	107,801
Non-Accommodated (Percent)	95.9	96.9	96.2
Accommodated (Number)	3,145	1,079	4,224
Accommodated (Percent)	4.1	3.1	3.8
IEP Students (Number)	15,307	8,270	23,577
Non-Accommodated (Number)	7,910	3,261	11,171
Non-Accommodated (Percent)	51.7	39.4	47.4
Accommodated (Number)	7,397	5,009	12,406
Accommodated (Percent)	48.3	60.6	52.6

Table 10–8L. Accommodation Rate for Non-IEP and IEP Students on the Spring 2022 Keystone Exams: Literature

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	72,754	31,285	104,039
Non-Accommodated (Number)	66,651	30,577	97,228
Non-Accommodated (Percent)	91.6	97.7	93.5
Accommodated (Number)	6,103	708	6,811
Accommodated (Percent)	8.4	2.3	6.5
IEP Students (Number)	15,145	7,665	22,810
Non-Accommodated (Number)	7,562	3,758	11,320
Non-Accommodated (Percent)	49.9	49	49.6
Accommodated (Number)	7,583	3,907	11,490
Accommodated (Percent)	50.1	51	50.4

THE INCIDENCE OF ACCOMMODATIONS AND IEP AND EL STATUS

Students with an IEP typically receive an accommodation of some type far more often than non-IEP students. Certain accommodations with very low frequencies are specific to particular disabilities while others are far more common and may also apply to students classified as English Learners (EL). Because the accommodations with the largest frequencies can potentially supply the most stable data when separated out for subgroup analysis, those in most common use are typically selected for display in Tables 10–9A through 10–9L. The most frequently occurring accommodations for assessed students were:

- Some test items/questions read aloud (Algebra I and Biology only)
- All test items/questions read aloud (Algebra I and Biology only)
- Small group setting
- Extended time
- Frequent breaks

Coding for IEP is dichotomous, as students are classified IEP and non-IEP. For purposes of this analysis, an English Learner (EL) is an assessed student classified EL and enrolled in a U.S. school fewer than 12 cumulative months. All other assessed students, including those who have exited an ESL/bilingual program and are in the first or second year of monitoring, are regarded as non-EL.

Customarily, a considerably larger percentage of IEP students receive a given accommodation than non-IEP students. Although less frequent, certain accommodations also have a high frequency rate for EL students. To separate out the effect of being classified IEP or EL, four possible combinations are presented in Tables 10–9A through 10–9L. These include general education students (who are neither IEP nor EL), students who are IEP but non-EL, students who are EL but non-IEP, and students who are both IEP and EL. The bottom row for each administration mode provides the total number of assessed students in each of the four classifications.

For purposes of descriptively comparing the four IEP/EL subgroups with respect to whether a subgroup displayed a larger percentage rate than another subgroup, a choice was made to use a difference of five or more percentage points as a criterion for judging importance. In many instances, the percentage difference between subgroups was of little practical significance (from zero to only several percentage points).

Although the separate presentation of data for PPT and CBT modes provides an impression of overall findings, the much smaller n-counts and accommodation rate by students taking a CBT renders an administration mode comparison less meaningful. Nevertheless, it is possible to make some cautious observations when sufficient n-counts and consistency are present as noted in the summary of findings below. Please refer to Appendix I for winter and summer Keystone Exam results.

SUBGROUP COMPARISONS FOR PPT ADMINISTRATION MODE

Subgroup comparisons were regarded as viable for the PPT administration. There was little differentiation across subgroups for the two accommodations involving items/questions read aloud (Algebra I and Biology) and for frequent breaks (Algebra I, Biology, and Literature). Small group setting are typically the most prevalent accommodation for the IEP/non-EL subgroup followed by the IEP/EL and EL/non-IEP subgroups. This pattern was consistent across all three subject exams. Another consistent pattern was observed for extended time, which was more prevalent for the IEP/non-EL, EL/non-IEP, and IEP/EL subgroups than for the General Education subgroup.

SUBGROUP COMPARISONS FOR CBT ADMINISTRATION MODE

For the CBT administration the EL/Non-IEP and IEP/EL subgroup n-counts were low in prior administrations. Consequently, only the General Education and IEP/non-EL subgroups had a sufficient sample size to support reasonable comparisons. A consistent pattern noted for all three subject exams was the greater prevalence of small group setting, extended time, and frequent breaks by the IEP/non-EL subgroup than for the General Education subgroup.

COMPARISONS BETWEEN PPT AND CBT

The only subgroups for which comparisons between PPT and CBT administration modes were deemed reasonable based on sample size were within the General Education and IEP/non-EL subgroups. The findings are summarized below.

- The General Education subgroup displayed a very low incidence of accommodations, typically less than one percent, in nearly all instances for both PPT and CBT administrations. The accommodation students received the most often is extended time.

Table 10–9A. Incidence of IEP and EL Students Receiving Selected Accommodations on the Spring 2022 Keystone Exam: Algebra I

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	13	36	30	524
PPT - Some test items/questions read aloud (Percent)	2.2	.6	0	3
PPT - All test items/questions read aloud (Number)	8	6	17	338
PPT - All test items/questions read aloud (Percent)	1.3	.1	0	2
PPT - Small group setting (Number)	168	497	925	7,573
PPT - Small group setting (Percent)	28.2	8.5	1	44
PPT - Extended time (Number)	60	536	6,026	1,633
PPT - Extended time (Percent)	10.1	9.2	6.8	9.5
PPT - Frequent breaks (Number)	22	15	49	440
PPT - Frequent breaks (Percent)	3.7	.3	.1	2.6
PPT - Number assessed (Number)	595	5,813	88,362	17,207
CBT - Some test items/questions read aloud (Number)	22	16	19	720
CBT - Some test items/questions read aloud (Percent)	11.1	1.4	.1	9.5
CBT - All test items/questions read aloud (Number)	12	10	17	525
CBT - All test items/questions read aloud (Percent)	6.1	.9	0	6.9
CBT - Small group setting (Number)	71	91	257	3,739
CBT - Small group setting (Percent)	35.9	7.9	.7	49.4
CBT - Extended time (Number)	32	35	833	1,609
CBT - Extended time (Percent)	16.2	3	2.3	21.3
CBT - Frequent breaks (Number)	18	14	80	873
CBT - Frequent breaks (Percent)	9.1	1.2	.2	11.5
CBT - Number assessed (Number)	198	1,148	35,726	7,563
Total - Some test items/questions read aloud (Number)	35	52	49	1,244
Total - Some test items/questions read aloud (Percent)	4.4	.7	0	5
Total - All test items/questions read aloud (Number)	20	16	34	863
Total - All test items/questions read aloud (Percent)	2.5	.2	0	3.5
Total - Small group setting (Number)	239	588	1,182	11,312
Total - Small group setting (Percent)	30.1	8.4	1	45.7
Total - Extended time (Number)	92	571	6,859	3,242
Total - Extended time (Percent)	11.6	8.2	5.5	13.1
Total - Frequent breaks (Number)	40	29	129	1,313
Total - Frequent breaks (Percent)	5	.4	.1	5.3
Total - Number assessed (Number)	793	6,961	124,088	24,770

Table 10–9B. Incidence of IEP and EL Students Receiving Selected Accommodations on the Spring 2022 Keystone Exam: Biology

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	10	20	18	383
PPT - Some test items/questions read aloud (Percent)	2.1	.5	0	2.6
PPT - All test items/questions read aloud (Number)	11	4	17	428
PPT - All test items/questions read aloud (Percent)	2.3	.1	0	2.9
PPT - Small group setting (Number)	155	337	863	6,826
PPT - Small group setting (Percent)	32.4	7.7	1.2	46
PPT - Extended time (Number)	41	247	1,631	947
PPT - Extended time (Percent)	8.6	5.7	2.2	6.4
PPT - Frequent breaks (Number)	24	45	51	509
PPT - Frequent breaks (Percent)	5	1	.1	3.4
PPT - Number assessed (Number)	478	4,349	72,865	14,829
CBT - Some test items/questions read aloud (Number)	17	17	17	888
CBT - Some test items/questions read aloud (Percent)	9.5	1.6	.1	11
CBT - All test items/questions read aloud (Number)	19	8	26	624
CBT - All test items/questions read aloud (Percent)	10.6	.8	.1	7.7
CBT - Small group setting (Number)	73	85	265	4,211
CBT - Small group setting (Percent)	40.8	8.2	.8	52
CBT - Extended time (Number)	32	33	373	1,767
CBT - Extended time (Percent)	17.9	3.2	1.1	21.8
CBT - Frequent breaks (Number)	19	14	83	928
CBT - Frequent breaks (Percent)	10.6	1.4	.2	11.5
CBT - Number assessed (Number)	179	1,037	33,774	8,091
Total - Some test items/questions read aloud (Number)	27	37	35	1,271
Total - Some test items/questions read aloud (Percent)	4.1	.7	0	5.5
Total - All test items/questions read aloud (Number)	30	12	43	1,052
Total - All test items/questions read aloud (Percent)	4.6	.2	0	4.6
Total - Small group setting (Number)	228	422	1,128	11,037
Total - Small group setting (Percent)	34.7	7.8	1.1	48.2
Total - Extended time (Number)	73	280	2,004	2,714
Total - Extended time (Percent)	11.1	5.2	1.9	11.8
Total - Frequent breaks (Number)	43	59	134	1,437
Total - Frequent breaks (Percent)	6.5	1.1	.1	6.3
Total - Number assessed (Number)	657	5,386	106,639	22,920

Table 10–9L. Incidence of IEP and EL Students Receiving Selected Accommodations on the Spring 2022 Keystone Exam: Literature

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Small group setting (Number)	141	177	865	6,862
PPT - Small group setting (Percent)	33	5.3	1.2	46.6
PPT - Extended time (Number)	48	281	4,834	1,498
PPT - Extended time (Percent)	11.2	8.4	7	10.2
PPT - Frequent breaks (Number)	18	7	44	574
PPT - Frequent breaks (Percent)	4.2	.2	.1	3.9
PPT - Number assessed (Number)	427	3,333	69,421	14,718
CBT - Small group setting (Number)	67	73	230	3,574
CBT - Small group setting (Percent)	33.2	7.3	.8	47.9
CBT - Extended time (Number)	34	29	452	1,567
CBT - Extended time (Percent)	16.8	2.9	1.5	21
CBT - Frequent breaks (Number)	18	14	87	765
CBT - Frequent breaks (Percent)	8.9	1.4	.3	10.3
CBT - Number assessed (Number)	202	1,002	30,283	7,463
Total - Small group setting (Number)	208	250	1,095	10,436
Total - Small group setting (Percent)	33.1	5.8	1.1	47
Total - Extended time (Number)	82	310	5,286	3,065
Total - Extended time (Percent)	13	7.2	5.3	13.8
Total - Frequent breaks (Number)	36	21	131	1,339
Total - Frequent breaks (Percent)	5.7	.5	.1	6
Total - Number assessed (Number)	629	4,335	99,704	22,181

GLOSSARY OF ACCOMMODATION TERMS

Table 10–10 provides a brief description of accommodation terms as used in the PSSA and Keystone Exams. Accommodation data was supplied by school personnel as noted in the left column of the table. The right column contains an explanation derived from the PDE publication, *Accommodations Guidelines*. This manual may be found on the PDE website at www.education.pa.gov.

Table 10–10. Glossary of Accommodation Terms as Applied in the PSSA and 2022 Keystone Exams

Type of Testing Accommodation	Explanation
Student used the following Online Presentation Accommodations	
Braille format	Students may use a Braille format of the test. Answers must then be transcribed into the answer booklet without alteration.
Large print format	Students with visual impairments may use a large print format. Answers must then be transcribed into the answer booklet without alteration.
Magnification device	Devices to magnify print may be used for students with visual impairments and/or print disabilities.
Color overlay	Students with visual impairments may place a color overlay on a printed page of the test document to make text more readable.
Computer assistive technology (e.g., electronic screen reader) (PDE approval required)	Students with severe visual disabilities that prevent them from accessing instructional material or performing the skill may use computer assistive technology; however, PDE must approve the program and functions prior to the test window.
Test items/questions/text-dependent analysis signed	Deaf/hearing impaired students may receive test directions from a qualified interpreter. Signing is also permitted for PSSA ELA writing section multiple-choice items, and text-dependent analysis questions and all items in PSSA mathematics and science and for Keystone Algebra and Biology.
Test items/questions/ text-dependent analysis interpreted for EL	A qualified interpreter may translate directions or clarify instructions for the assessments. The interpreter may translate but not define specific words or test questions on the PSSA mathematics, science, ELA writing section multiple-choice items, and text-dependent analysis questions and Keystone Algebra and Biology exams.
Some or all test items/ questions/text-dependent analysis read aloud	Students unable to decode text visually may have items/questions read aloud for PSSA ELA writing section multiple-choice items, and text-dependent analysis questions and all items in PSSA mathematics and science and for Keystone Algebra and Biology; however, words may not be defined.
Amplification device	In addition to using hearing aids, an amplification device to enhance clarity may be required.
Other (PDE approval required)	Other presentation accommodations indicated in the *Accommodations Guidelines* may be provided; however, PDE approval is required prior to the test window.
Spanish version for PSSA (Math and Science) and Keystone (Algebra and Biology)	Students whose first language is Spanish and who have been enrolled in U.S. schools for fewer than three years may take this version.
Student used the following Online Presentation Accommodations	
Audio	The online test form reads permissible test directions and items for a student unable to decode text. The accommodation must be marked within the test engine system. The accommodation is available on PSSA mathematics, science, ELA writing section multiple-choice items, and text-dependent analysis questions and Keystone Algebra and Biology exams.
Video sign language (per *Accommodations Guidelines*)	Eligible students who use a sign language accommodation during instructional periods may use a VSL on the PSSA mathematics and science assessments, or Keystone Algebra I and Biology.
Color chooser or contrasting text chooser	The use of this accommodation enables a visually impaired student to change the background color or text color to make text more readable.
Refreshable Braille	This accommodation allows students to use a screen reader to produce a Braille translation output.

Table 10–10 (continued). Glossary of Accommodation Terms as Applied in the PSSA and 2022 Keystone Exams

Type of Testing Accommodation	Explanation
Student used the following Response Accommodations	
Brailler/Note taker (per *Accommodations Guidelines*)	Students using this device as part of their regular instructional program may use it on the assessments; however, without thesaurus, spelling, or grammar checker.
Test administrator scribed **open-ended** responses at student's direction	A test administrator may record word-for-word exactly what a student dictated directly into the test booklet. This includes MC and OE responses Keystone Algebra, Biology, and Literature tests and PSSA mathematics and science.
Test administrator marked **multiple-choice** responses at student's direction	A test administrator may mark an answer booklet at the direction of a student (e.g., a student may point to an MC answer with the test administrator marking the response in the answer booklet).
Test administrator transcribed student responses (per *Accommodations Guidelines*)	A test administrator may transcribe (copy) a student's written, typed, or keyed response into a standard answer booklet.
Qualified Interpreter translated, transcribed, and/or scribed student's **signed** responses	A qualified interpreter may interpret a student's **signed** responses into written English for Keystone Algebra and Biology exams, and PSSA mathematics and science assessments. Interpreters are not permitted to make corrections or change the meaning of the response.
Qualified Interpreter translated, transcribed, and/or scribed EL student responses	A qualified interpreter may interpret a student's non-English oral responses into written English for Keystone Algebra and Biology exams, and PSSA mathematics and science assessments. Interpreters are not permitted to make corrections or change the meaning of the response.
Augmentative communication device	Students with severe communication difficulties may use a special device to convey responses, which must be transcribed into the answer booklet by the test administrator.
Keyboard, word processor, or computer (per *Accommodations Guidelines*)	This is an allowable accommodation as a typing function only for students with the identified need. Online test should be considered for students who prefer/need to type open-ended responses. Supports such as dictionaries, thesauri, spell checkers, and grammar checkers must be turned off. Answers must then be transcribed into the answer booklet without alteration.
Translation dictionary for EL student	A word-to-word dictionary that translates native language to English (or vice versa) without word definitions or pictures is allowed on any portion of the Keystone Algebra and Biology exams, and PSSA mathematics and science tests.
Computer assistive technology (e.g., electronic screen reader) (PDE approval required)	Students with blindness or extremely low vision may use dictate text into a computer. Responses must be transcribed verbatim into student's regular answer booklet.
Other (per *Accommodations Guidelines* or PDE approval)	Other accommodations may be appropriate and available if they do not compromise the integrity of the assessment. Documentation must be provided to PDE.
Student used the following Setting Accommodations	
Hospital/home testing	A student who is confined to a hospital or to home during the testing window may be tested in that environment.
One-on-one setting	One-on-one settings are necessitated in certain instances, such as to reduce distraction or in the use of certain devices. A separate room may be used to reduce distraction.
Small group setting	Some students may require a test setting with fewer students or a setting apart from all other students to minimize distraction.
Other (per *Accommodations Guidelines* or PDE approval)	Other accommodations may be appropriate and available if they do not compromise the integrity of the assessment. Documentation must be provided to PDE.

Table 10–10 (continued). Glossary of Accommodation Terms as Applied in the PSSA and 2022 Keystone Exams

Type of Testing Accommodation	Explanation
Student used the following Timing Accommodations	
Extended time	Extended time may be allotted for each section of the test as a planned accommodation to enable students to finish.
Frequent breaks	Frequent breaks (breaks within a test section) may be scheduled for the completion of each test section; however, a test section must be completed within one school day.
Changed test schedule	Students whose disabilities prevent them from following a regular, planned test schedule may follow an individual schedule that enables test completion.
Other (per *Accommodations Guidelines* or PDE approval)	Other accommodations may be appropriate and available if they do not compromise the integrity of the assessment. Documentation must be provided to PDE.

CHAPTER ELEVEN: CLASSICAL ITEM STATISTICS

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 following results pertain not only to the operational Keystone Exams items but also to the embedded field-test items. Other statistics such as Rasch item statistics and test-level statistics are discussed in Chapter Twelve and Chapter Seventeen, respectively.

ITEM-LEVEL STATISTICS

Appendix J provides classical item statistics for all items (i.e., operational and embedded field-test items) in the Algebra I, Biology, and Literature Keystone Exams. Results are organized by administration and content area. 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 J include *N*, the number of students taking the test form for which there are valid test scores; *p*-values (denoted as PVal) for multiple-choice (MC) items and item means (denoted as Mean) for constructed-response (CR) items (indicators of item difficulty); proportions of students who chose each response option for MC items (denoted as P(A), P(B), P(C), and P(D)) or gained each score point for CR items (denoted as P(0), P(1), P(2), P(3), and P(4)); proportions of students who omitted an item (denoted as P(-) for MC items and P(B) for CR items); item-total correlations (denoted as Total, indicators of item discrimination); item-total correlations for each response option for MC items (denoted as Corr(A), Corr(B), Corr(C), Corr(D)) and gained score point for CR items (denoted as Corr(1), Corr(2), Corr(3), Corr(4)).

Appendix J also provides the Rasch measurement-based statistics in columns Rasch, Infit, and Outfit. Detailed explanations of these statistics can be found in Chapter Twelve. The differential item functioning (DIF) analysis on the embedded field-test items is provided as well. The detailed explanation of DIF codes can be found in Chapter Five.

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 (*xi*) are summed and then divided by the total number of students (*n*). For MC items, student scores are represented by 0's and 1's (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[1] 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.

For CR items, mean scores can range from the minimum possible score (usually zero) to the maximum possible score (e.g., four points in the case of Algebra I CR items and three points in the case of Biology and Literature CR items). Sometimes a *pseudo p*-value is provided for a CR item by dividing the mean item score by the maximum possible item score.

[1] For MC items with four response options, pure random guessing would lead to an expected *p*-value of 0.25.

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 Keystone Exams because of the various student achievement levels in Pennsylvania (Below Basic, Basic, Proficient, and Advanced). Items that are either very hard or very easy provide little information about student differences in achievement. However, an item answered correctly by a high percentage of students would suggest that the knowledge or skill the item taps has been mastered by most students. Conversely, an item answered correctly by a low percentage of students would suggest that few students have mastered the knowledge or skill the item taps. So, on a criteria-referenced test like the Keystone Exams, a test development goal is to include a wide range of item difficulties.

Utilizing the proportion of students who chose each option can be helpful for verifying keys. For example, if a large proportion of students chose a distractor instead of the correct answer of an MC item, it may indicate that the key is not correct. Proportion of students omitting or not reaching an item is useful for identifying issues related to testing time and item/test layout. Keystone Exams are not speed tests. Therefore, students should have enough time to take the exams. An omit rate greater than 5% for a single item could be an indication that students were not given enough time to take the test or an indication of an item/test layout problem. For example, some students might accidentally skip an item that follows a lengthy stem.

ITEM DISCRIMINATION

At the most general level, item discrimination[2] 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 Keystone Exams overall) would be more likely to answer any given item correctly, while students with low ability (i.e., those who perform poorly on the Keystone Exams overall) would be more likely to answer the same item incorrectly. For the Keystone Exams, Pearson's product-moment correlation coefficient between item scores and test scores is used to indicate discrimination. As commonly practiced, Data Recognition Corporation (DRC) removes the item score from the total score so that the resulting correlations will not be spuriously high. The correlation coefficient can range from negative 1.0 to positive 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) indicating that 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 would be less likely to choose any distractors, while students with low ability 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.[3] In other words, 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., items with extreme *p*-values) can have reduced power to discriminate and thus can have lower correlations.

Discrimination is an important consideration for the operational Keystone Exams because the use of more discriminating items on a test is associated with more reliable test scores. This in turn means that score estimates will be more precise (i.e., there will be smaller confidence intervals around the scores) and, perhaps more importantly, that more accurate performance level placements will be made. The issues of reliability, confidence intervals, and performance level classifications are further discussed in Chapter Eighteen.

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[2] As noted earlier, the discrimination index for dichotomous MC items is typically referred to as the *point-biserial correlation coefficient*. For CR items, the term *item-test correlation* is sometimes used.

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

SCATTER PLOTS OF ITEM DISCRIMINATION AND DIFFICULTY

Figure 11–1 contains a series of scatter plots showing item discrimination (i.e., item-total correlation on *y*-axis) on the item difficulty (i.e., *p*-value on *x*-axis) for the operational items on each exam by test administration. These plots provide information about item discrimination and difficulty in a single visual image for each Keystone Exam. The *x*- and *y*-axes visually represent many important distributional indices, including the distribution of p-values on the x-axis, the distribution of item discrimination on the y-axis, and the relationship between p-values and discrimination as the scatter plot.

It should be noted that pseudo *p*-values are used for CR items in these plots. Of course, the bivariate relationship between discrimination and difficulty is also presented. One does not usually expect any type of trend here. However, as noted earlier, it is often the case that items with extreme difficulties can have lower discrimination values, so this can be revealed in such a plot.

Figure 11–1. Scatter Plots of Item Discrimination and Difficulty

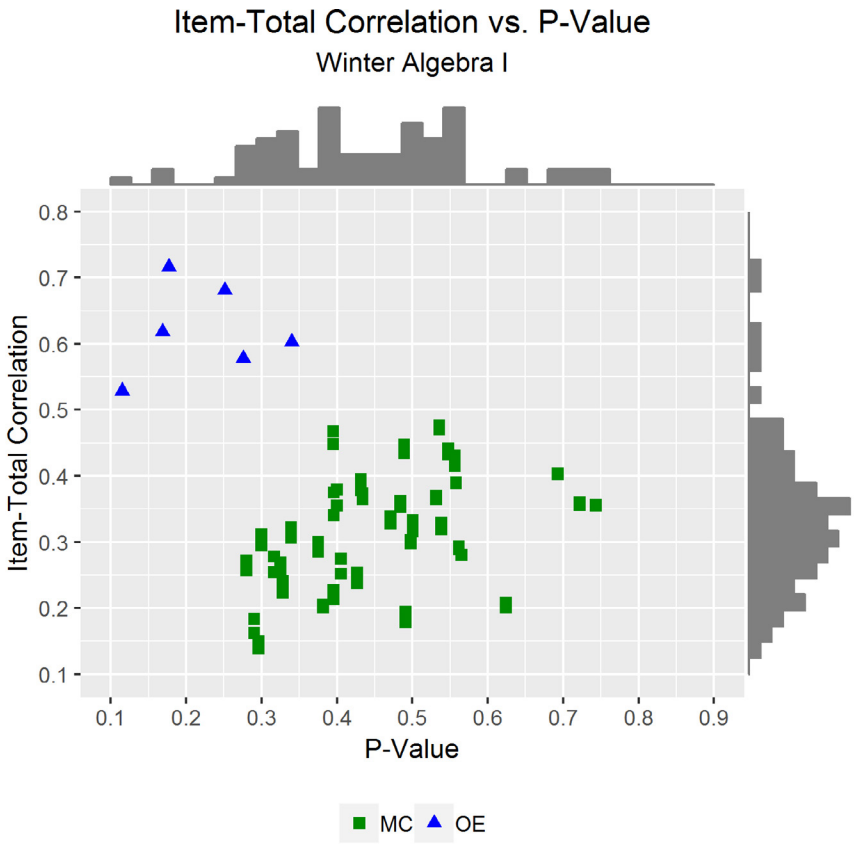
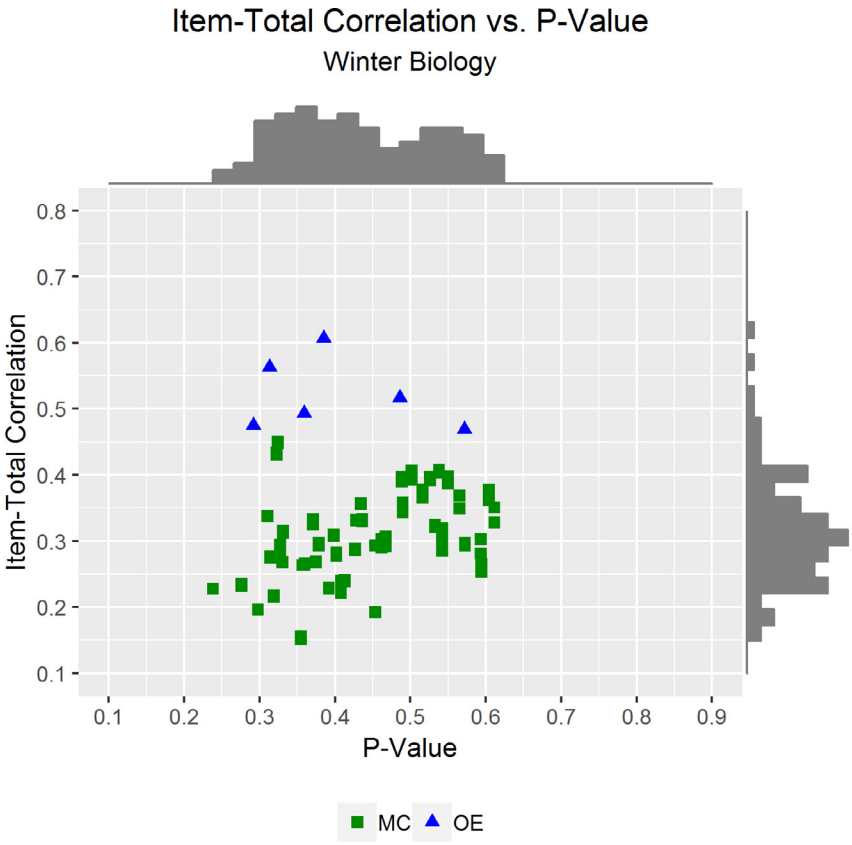


Figure 11–1 (continued). Scatter Plots of Item Discrimination and Difficulty



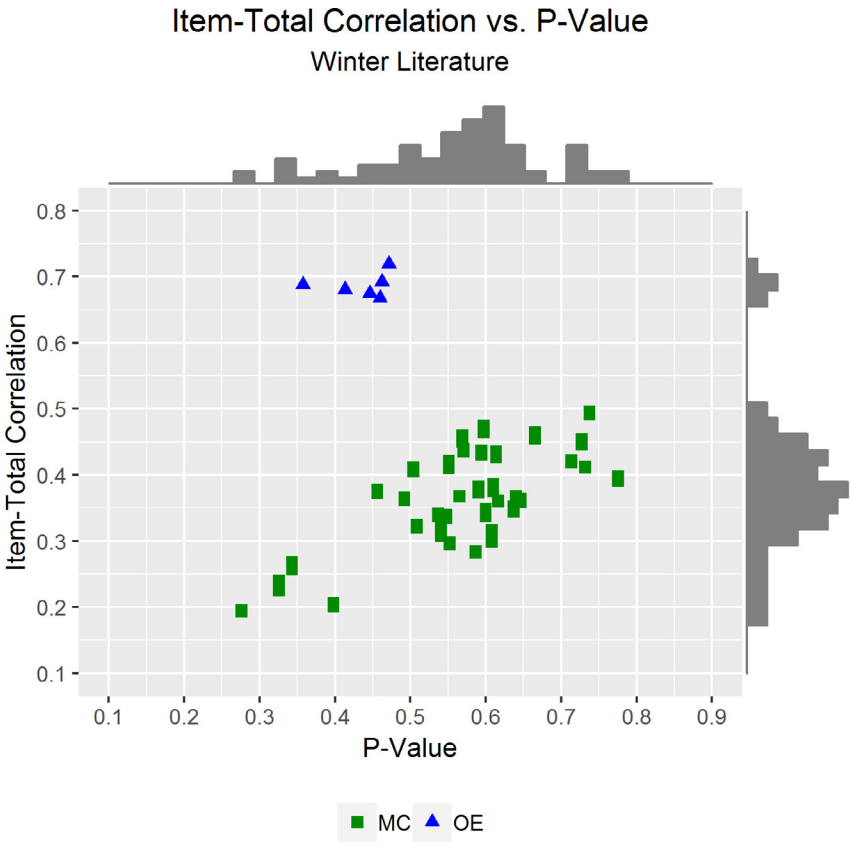
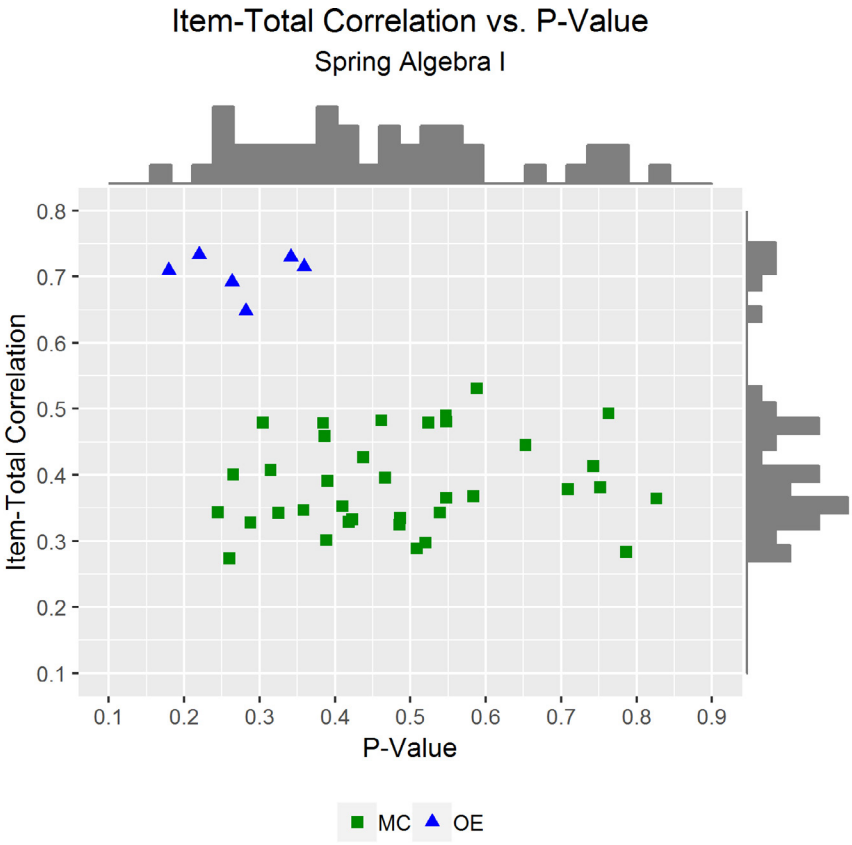


Figure 11–1 (continued). Scatter Plots of Item Discrimination and Difficulty



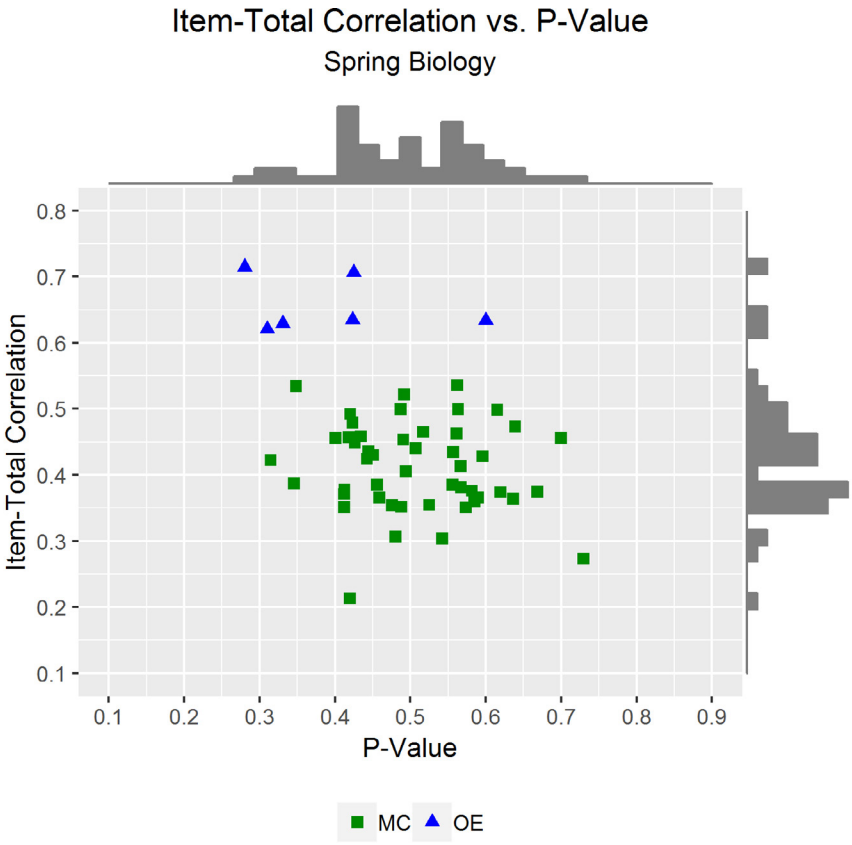
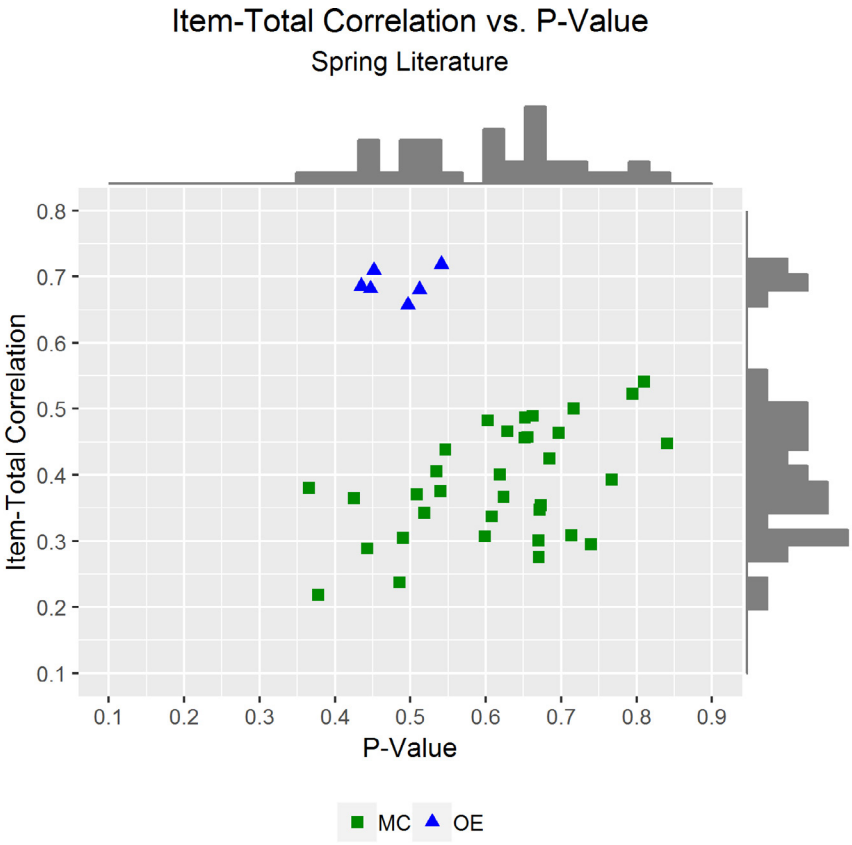


Figure 11–1 (continued). Scatter Plots of Item Discrimination and Difficulty



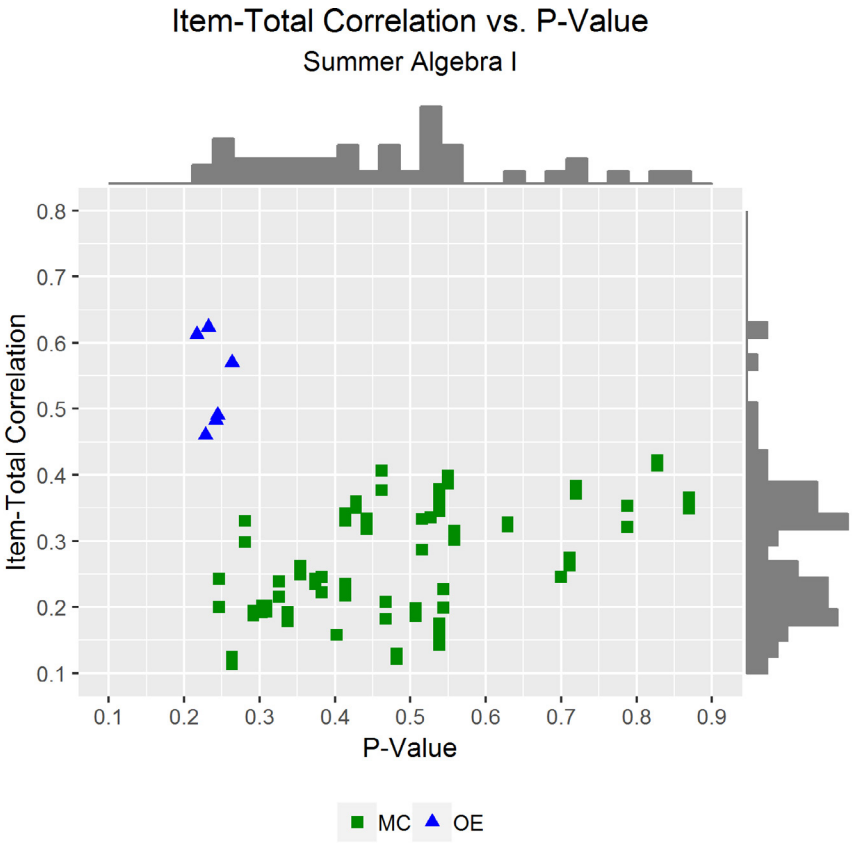
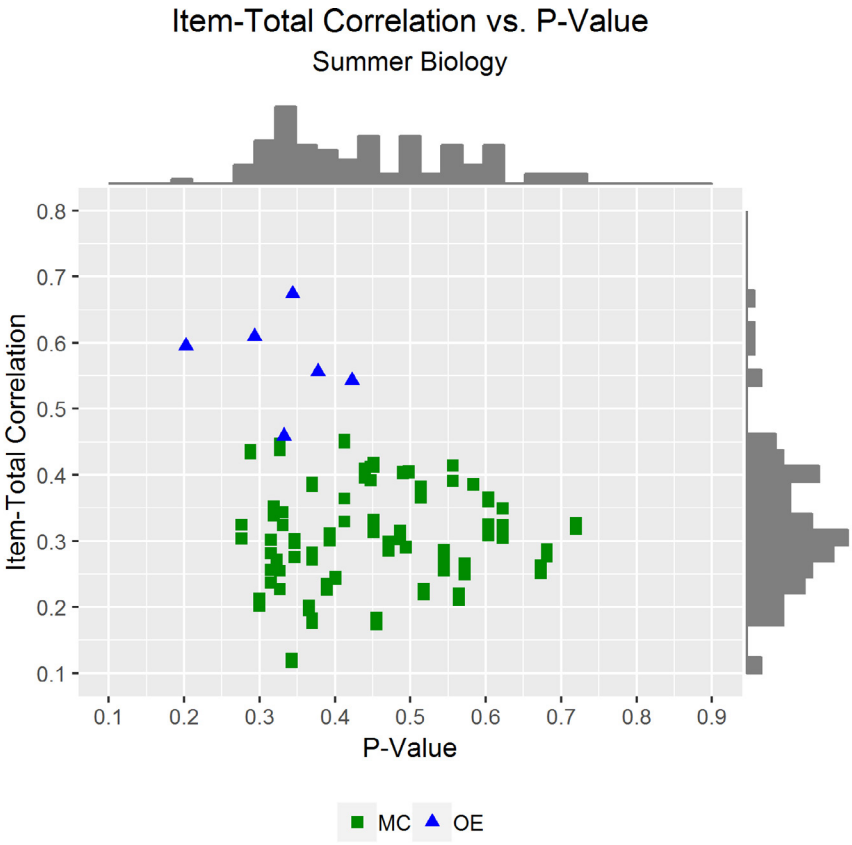
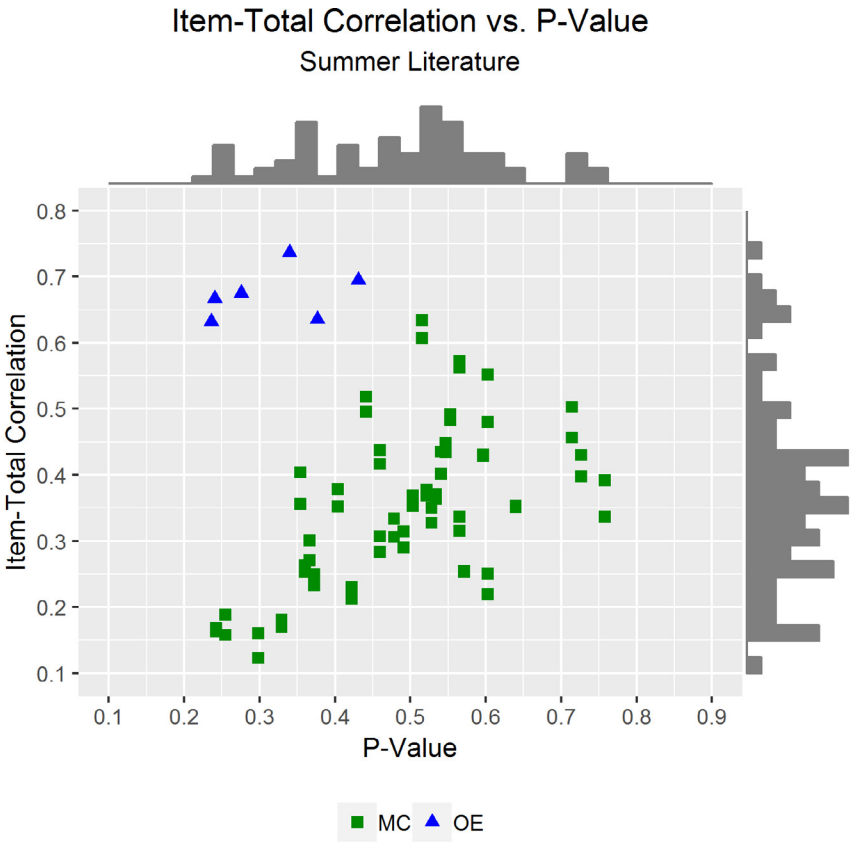


Figure 11–1 (continued). Scatter Plots of Item Discrimination and Difficulty





OBSERVATIONS AND INTERPRETATIONS

Table 11–1 provides the mean and median *p*-values and median[4] item-total correlations for the operational MC and CR items in each content area. The mean *p*-value for the operational MC items ranged from 0.43 to 0.64 with standard deviation (SD) ranging from 0.09 to 0.16, whereas the mean *p*-values for the CR items ranged from about 0.22 to 0.51 with standard deviation ranging from 0.02 to 0.12. The median item-test correlations ranged from 0.25 to 0.45 and 0.51 to 0.77 for the MC and CR items, respectively. The CR correlations tended to be higher than the MC correlations, which is not surprising because the CR items include more score points and tend to be better at discriminating between low and high achieving students than MC items.

It is impossible to make global conclusions about the overall test quality from these item statistics alone. With that caveat in mind, the results presented in this chapter indicate that the item difficulties and discriminations were within expected and acceptable ranges.

Table 11–1. Mean and Median Statistics for Operational MC and CR Items

Administration	Content Area	MC Items Mean *p*-Value	MC Items SD *p*-Value	MC Items Median *p*-Value	MC Items Median I-T Corr.	CR Items Mean *p*-Value	CR Items SD *p*-Value	CR Items Median *p*-Value	CR Items Median I-T Corr.
Winter	Algebra I	0.46	0.12	0.45	0.33	0.22	0.08	0.21	0.61
Winter	Biology	0.43	0.10	0.42	0.30	0.40	0.11	0.37	0.51
Winter	Literature	0.57	0.11	0.59	0.37	0.44	0.04	0.45	0.68
Spring	Algebra I	0.52	0.16	0.50	0.42	0.30	0.07	0.30	0.77
Spring	Biology	0.54	0.09	0.53	0.45	0.43	0.12	0.41	0.68
Spring	Literature	0.64	0.12	0.67	0.42	0.51	0.04	0.50	0.72
Summer	Algebra I	0.49	0.16	0.47	0.25	0.24	0.02	0.24	0.53
Summer	Biology	0.45	0.12	0.44	0.30	0.33	0.08	0.34	0.58
Summer	Literature	0.49	0.13	0.51	0.35	0.32	0.08	0.31	0.67

Note. I-T Corr. is the item-total test score correlation; SD represents the standard deviation.

[4] Given that the value of the item-total correlation coefficient is not a linear function of the magnitude of the relation between the item and total test scores, the median instead of the mean of the item-total correlation was calculated for this statistic.

CHAPTER TWELVE: RASCH ITEM CALIBRATION

The particular item response theory (IRT) model used for the Keystone Exams 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 continually used to calibrate the Pennsylvania System of School Assessment (PSSA) items in recent history. Consequently, this model was also chosen for the Keystone Exams. 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 several strong assumptions related to dimensionality, local item 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 operational Keystone Exams items. Generally, item calibration is the process of assigning a difficulty-parameter estimate to each item on an assessment so that they are placed on a common scale. This chapter briefly introduces the Rasch model, reports the results from evaluations of the adequacy of the Rasch assumptions, and summarizes the Rasch item statistics for the Keystone Exams in Algebra I, Biology, and Literature.

DESCRIPTION OF THE RASCH MODEL

The Rasch partial credit model (RPCM; Wright & Masters, 1982) was used to calibrate Keystone Exams item response data because both multiple-choice (MC) and constructed-response (CR) items were part of the assessment. The RPCM extends the Rasch model (Rasch, 1960) for dichotomous (0, 1) items to accommodate polytomous CR items. Under the RPCM, for a given item *i* with *mi* score categories, the probability of person *n* scoring *x* (*x* = 0, 1, 2,... *mi*) is given by:

$$\pi_{nix} = \frac{\exp \sum_{j=0}^{x} (\beta_n - \delta_{ij})}{\sum_{k=0}^{m_i} \exp \sum_{j=0}^{x} (\beta_n - \delta_{ij})}, \quad x = 0, 1, \ldots, m_i$$

where β_n represents a student's proficiency (ability) level, and δ_{ij} is the step difficulty of the *j*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:

$$\Phi_{ni}\left(X = 1 \mid \beta_n\right) = \frac{\exp\left(\beta_n - \delta_{ij}\right)}{1 + \exp\left(\beta_n - \delta_{ij}\right)}.$$

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. (As noted in Chapter Eleven, interpretation of item *p*-values confounds item difficulty and student ability.)

SOFTWARE AND ESTIMATION ALGORITHM

Item calibration was implemented via WINSTEPS computer program (Linacre, 2019), which employs unconditional (UCON), joint-maximum-likelihood estimation (JMLE).

SAMPLE CHARACTERISTICS

The characteristics of calibration samples are reported in Chapter Nine. These samples only include the students who attempted the tests. All omitted and multiple responses (more than one response selected) for MC items were scored as incorrect answers (coded as 0s) for calibration purposes.

CHECKING RASCH ASSUMPTIONS

Because the Rasch model was the basis of all calibration and equating analyses associated with the Keystone Exams, 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 test data fits the model. 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. It should be noted that only operational items were analyzed since they are the basis of student scores.

Given Keystone Exams use a pre-equating design (see details in Chapter Fifteen), calibrations with and without anchoring all the item parameter estimates were conducted to check the stability of item parameters. After reviewing the analyses results for the winter, spring, and summer administrations, a decision was made to use the item difficulty estimated from the field-test data to generate the raw-to-scaled score conversion tables. In this chapter, the adequacy of the Rasch calibration assumptions was checked with all the item difficulties anchored to the pre-equated values.

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 Keystone Exams, 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, 2019). Table 12–1 presents the PCA results by administration for each content area. The results include the eigenvalues and variance explained by each component. As can been seen from the table, the eigenvalues for the first component are much larger than those for the rest of the components. The first component explained about 22.9 to 46.5 percent of the total variance. The rest of the components explained only a small percentage of variance (less than 5.6%). These results suggest that each of the Keystone Exams essentially measure a single dominant dimension.

Table 12–1. Results from PCA of Residuals in WINSTEPS

Administration/ Content Area	Component	Eigenvalue	Variance Explained
Winter Algebra I	1	27.8	39.8%
Winter Algebra I	2	1.8	2.6%
Winter Algebra I	3	1.6	2.3%
Winter Algebra I	4	1.3	1.8%
Winter Algebra I	5	1.2	1.7%
Winter Biology	1	16.0	22.9%
Winter Biology	2	1.7	2.5%
Winter Biology	3	1.4	2.1%
Winter Biology	4	1.3	1.8%
Winter Biology	5	1.2	1.8%
Winter Literature	1	19.9	33.2%
Winter Literature	2	2.8	4.7%
Winter Literature	3	1.5	2.5%
Winter Literature	4	1.3	2.2%
Winter Literature	5	1.2	2.0%
Spring Algebra I	1	36.5	46.5%
Spring Algebra I	2	2.0	2.6%
Spring Algebra I	3	1.5	1.9%
Spring Algebra I	4	1.3	1.6%
Spring Algebra I	5	1.3	1.6%
Spring Biology	1	28.9	34.9%
Spring Biology	2	1.7	2.0%
Spring Biology	3	1.4	1.7%
Spring Biology	4	1.3	1.6%
Spring Biology	5	1.2	1.4%
Spring Literature	1	21.8	35.3%
Spring Literature	2	2.8	4.5%
Spring Literature	3	1.4	2.3%
Spring Literature	4	1.3	2.1%
Spring Literature	5	1.2	2.0%
Summer Algebra I	1	24.3	36.7%
Summer Algebra I	2	2.1	3.2%
Summer Algebra I	3	1.7	2.6%
Summer Algebra I	4	1.7	2.6%
Summer Biology	1	19.2	26.2%
Summer Biology	2	2.1	2.9%
Summer Biology	3	2.0	2.7%
Summer Biology	4	1.9	2.6%
Summer Biology	5	1.8	2.5%

Table 12–1 (continued). Results from PCA of Residuals in WINSTEPS

Administration/ Content Area	Component	Eigenvalue	Variance Explained
Summer Literature	1	18.8	32.0%
Summer Literature	2	3.3	5.6%
Summer Literature	3	2.0	3.4%
Summer Literature	4	2.0	3.3%
Summer Literature	5	1.8	3.1%

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 composed of items $X_1, X_2, \ldots X_I$ is locally independent with respect to the latent variable δ if, for all $x = (x_1, x_2, \ldots x_I)$ and δ,

$$P_n\left(\mathbf{X} = \mathbf{x} \mid \delta_n\right) = \prod_{i=1}^{I} P\left(X_i = x_i \mid \delta_n\right).$$

This formula essentially states that the probability of any pattern of responses across all items (x), after conditioning on the abilities (δ) 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 shown below. (This is a *weaker* form because higher-order dependencies among items are allowed.) Based on the WLI, the following expression can be derived:

$$P\left(X_i = x_i, X_j = x_j \mid \delta_n\right) = P\left(X_i = x_i \mid \delta_n\right) P\left(X_j = x_j \mid \delta_n\right).$$

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 estimated in WINSTEPS for each item pair were used to assess the local dependence among the Keystone Exams 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, deviations (residuals) 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.

Two types of residual correlations are available in WINSTEPS: raw and standardized residuals. It should be noted that the raw score residual correlation essentially corresponds to Yen's Q_3 index (Yen, 1993), a popular LI statistic. The expected value for the Q_3 statistic is approximately -1/(*k*-1) when no local dependence exists, where *k* is test length. Thus, the expected Q_3 values should be approximately -0.026 or larger for the Keystone Exams (since Literature is the shortest test with 40 items). Index values that are greater than 0.20 indicate a degree of local dependence that probably should be examined by test developers (Chen & Thissen, 1997). Since the two residual correlations are very similar, the default *standardized residual correlation* in WINSTEPS was used for these analyses. Table 12–2 shows the summary statistics—mean, SD, minimum (Min), maximum (Max), and several percentiles (P_{10}, P_{25}, P_{50}, P_{75}, P_{90})—for all the residual correlations for each test. The total number of item pairs (*N*) and the number of pairs with absolute residual correlations greater than 0.20 are also reported in this table. The mean residual correlations were very close to the criteria of -0.02. The correlations were tended to be smaller for Algebra and Biology than Literature, which was likely influenced by the passage-based structure of the examination. There was a higher number of items flagged in the summer administration, which could be related to the sample of test-takers.

Table 12–2. Summary of Item Residual Correlations

Administration	Content Area	N	Mean	SD	Min	P10	P23	P50	P75	P90	Max	Ct > |0.20|
Winter	Algebra I	861	-0.02	0.03	-0.11	-0.06	-0.04	-0.02	-0.01	0.01	0.23	1
Winter	Biology	1431	-0.02	0.02	-0.12	-0.04	-0.03	-0.02	-0.01	0.01	0.09	0
Winter	Literature	780	-0.02	0.05	-0.15	-0.09	-0.05	-0.02	0.00	0.02	0.36	9
Spring	Algebra I	861	-0.02	0.03	-0.15	-0.06	-0.04	-0.02	-0.01	0.02	0.24	1
Spring	Biology	1431	-0.02	0.02	-0.09	-0.04	-0.03	-0.02	-0.01	0.01	0.07	0
Spring	Literature	780	-0.02	0.05	-0.17	-0.09	-0.05	-0.02	0.00	0.02	0.34	8
Summer	Algebra I	861	-0.02	0.06	-0.21	-0.10	-0.06	-0.02	0.02	0.06	0.21	4
Summer	Biology	1431	-0.02	0.07	-0.27	-0.10	-0.06	-0.02	0.03	0.07	0.18	4
Summer	Literature	780	-0.03	0.10	-0.29	-0.15	-0.09	-0.03	0.03	0.09	0.32	32

ITEM FIT

WINSTEPS estimates 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 (Z-standardized with mean = 0 and variance = 1). Mean-square values are more oriented toward practical significance, while Z-standardized values are more oriented toward statistical significance. Though both are informative, the Z-standardized values are very likely too sensitive to the large sample sizes observed on the Keystone Exams. In this situation it is recommended that the Z-standardized values be ignored if the mean-square values are acceptable (Linacre, 2018).

Both infit and outfit mean-square represent 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 mean-square 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 mean-square values vary. More conservative users might prefer items with mean-square 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 results below, values outside of 0.7 to 1.3 are given practical importance.

Table 12–3 presents the summary statistics of infit and outfit mean-square statistics for the Keystone Exams in Algebra I, Biology, and Literature, including the mean, SD, and minimum and maximum values. The number of items within the range of [0.7, 1.3] is also reported in Table 12–3. As can been seen, the mean values for both fit statistics were close to 1.00 for all the exams. Most of the items had mean-squared fit statistics ranging from 0.7 to 1.3.

Table 12–3. Summary of Infit and Outfit Mean-Square (MnSq) Statistics

Admin	Content Area	N	Infit MnSq Mean	Infit MnSq SD	Infit MnSq Min	Infit MnSq Max	Infit MnSq [0.7, 1.3]	Outfit MnSq Mean	Outfit MnSq SD	Outfit MnSq Min	Outfit MnSq Max	Outfit MnSq [0.7, 1.3]
Winter	Algebra I	42	1.01	0.12	0.78	1.30	41	1.03	0.17	0.71	1.51	38
Winter	Biology	54	1.01	0.11	0.81	1.31	53	1.02	0.14	0.82	1.41	51
Winter	Literature	40	1.03	0.14	0.70	1.35	38	1.08	0.22	0.70	1.68	35
Spring	Algebra I	42	1.01	0.13	0.75	1.29	42	1.04	0.22	0.65	1.64	35
Spring	Biology	54	0.99	0.09	0.79	1.31	53	1.00	0.12	0.73	1.42	53
Spring	Literature	40	1.00	0.14	0.63	1.26	38	1.03	0.22	0.62	1.46	30
Summer	Algebra I	42	1.02	0.12	0.79	1.25	42	1.03	0.18	0.64	1.49	38
Summer	Biology	54	1.02	0.10	0.84	1.30	53	1.02	0.14	0.78	1.39	51
Summer	Literature	40	1.02	0.19	0.55	1.49	36	1.09	0.33	0.56	2.12	31

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, regardless of if 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 on any form at zero. Under normal circumstances where all students are administered the same set of items, any item with a *p*-value lower than the average item on the form receives a positive logit and any item with a *p*-value higher than the average receives a negative logit. Consequently, the logits for any calibration relate to an arbitrary origin defined by the center of items on that form. Logits for both item difficulties and student abilities are placed on the same scale and relate to the same mean item difficulty.

There are a number of other choices that could be made for centering the item difficulties. Rather than using all the items, the origin could be defined by content. For the Keystone Exams, all test forms in a particular content area share the same operational item set. All items on each form can then be easily adjusted to a single origin by defining the origin as the mean of the operational items. With this done, the origins for all the forms will be statistically equal. For example, items on any two forms that are equally difficult will now have statistically equal logit difficulties.

Appendix J reports the item statistics including classical and Rasch logit difficulties for all the operational items and the field-test items embedded in the spring forms. Table 12–4 summarizes the Rasch logit difficulties of the operational items on each test for each administration. The mean of MC item difficulty was no longer equal to zero as it was for the 2011 administration. This is because all the item parameter estimates were anchored to the pre-equated values in order to be estimated on the baseline scale. The mean item difficulties for MC items were less than that of CR items. Table 12–4 also shows the mean standard errors (SE) of the item difficulties, which were relatively small, suggesting that items were calibrated with very small errors. The minimum (Min) and maximum (Max) values and standard deviations (SD) suggest the Keystone Exams items covered a relatively wide range of difficulties.

Table 12–4. Summary of Rasch Item Difficulties

Administration/Content Area	Item Types	N	Mean Item Difficulty	Mean SE	SD Item Difficulty	Min Item Difficulty	Max Item Difficulty
Winter Algebra I	All	42	0.39	0.01	0.78	-1.17	2.07
Winter Algebra I	MC	36	0.19	0.01	0.63	-1.17	1.32
Winter Algebra I	CR	6	1.58	0.01	0.47	0.86	2.07
Winter Biology	All	54	0.33	0.01	0.49	-0.67	1.38
Winter Biology	MC	48	0.32	0.01	0.50	-0.67	1.38
Winter Biology	CR	6	0.45	0.01	0.44	-0.11	1.03
Winter Literature	All	40	0.30	0.01	0.70	-1.04	1.74
Winter Literature	MC	34	0.19	0.01	0.70	-1.04	1.74
Winter Literature	CR	6	0.92	0.01	0.12	0.71	1.09
Spring Algebra I	All	42	0.45	0.01	0.94	-1.43	2.03
Spring Algebra I	MC	36	0.27	0.01	0.89	-1.43	1.81
Spring Algebra I	CR	6	1.50	0.00	0.44	0.83	2.03
Spring Biology	All	54	0.26	0.01	0.47	-0.71	1.26
Spring Biology	MC	48	0.20	0.01	0.44	-0.71	1.06
Spring Biology	CR	6	0.73	0.00	0.52	-0.19	1.26
Spring Literature	All	40	0.37	0.01	0.68	-1.20	1.81
Spring Literature	MC	34	0.27	0.01	0.70	-1.20	1.81
Spring Literature	CR	6	0.90	0.00	0.22	0.55	1.20
Summer Algebra I	All	42	0.42	0.11	0.90	-1.92	1.94
Summer Algebra I	MC	36	0.23	0.12	0.83	-1.92	1.61
Summer Algebra I	CR	6	1.54	0.07	0.34	1.07	1.94
Summer Biology	All	54	0.29	0.13	0.56	-1.10	1.37
Summer Biology	MC	48	0.24	0.14	0.56	-1.10	1.22
Summer Biology	CR	6	0.74	0.08	0.36	0.42	1.37
Summer Literature	All	40	0.32	0.17	0.71	-1.08	1.49
Summer Literature	MC	34	0.20	0.18	0.70	-1.08	1.49
Summer Literature	CR	6	0.97	0.12	0.29	0.56	1.38

ITEM DIFFICULTY-STUDENT ABILITY MAP

The distributions of the Rasch item logits (item difficulty estimates) are shown on the item difficulty-student ability maps presented in Figure 12–1. In each item-student map, the top bar graph displays the student distribution on the logit scale, and the bottom displays markers of item difficulty parameter estimates. MC items are represented by a circle and CR items are represented by a square. As noted earlier, the Rasch model enables placement of both items and students on the same scale. Consequently, one can easily visualize information regarding the relationship between the distributions of item difficulty and student ability. The vertical red lines (from left to right) represent the performance cut-points: below basic/basic, basic/proficient, and proficient/advanced. On the top plot, the logit represents lower abilities (negative values) to higher abilities (positive values), whereas on the bottom plot the logit represents easier items (negative values) to harder items (positive values). To achieve precise measures of student ability, the student distribution should mirror the item distribution.

The common pattern seen across all maps was that the item difficulties were comparable to the student ability levels. It is also important to understand where the items are providing more-accurate measurement. This issue is addressed more fully in Chapter Eighteen (see Figure 18–2).

Figure 12–1. Item Difficulty-Student Ability Maps

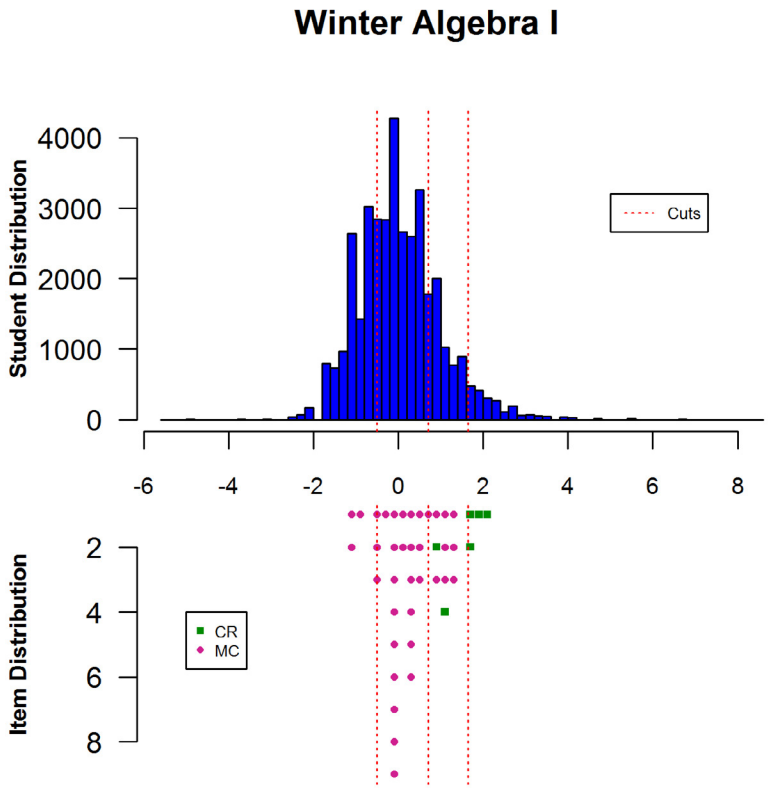
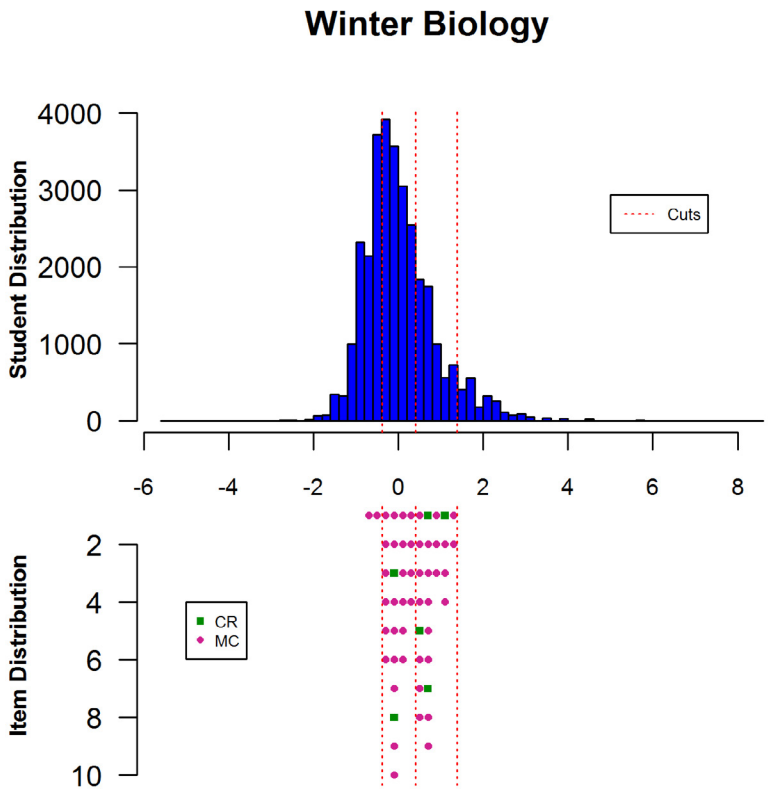


Figure 12–1 (continued). Item Difficulty-Student Ability Maps



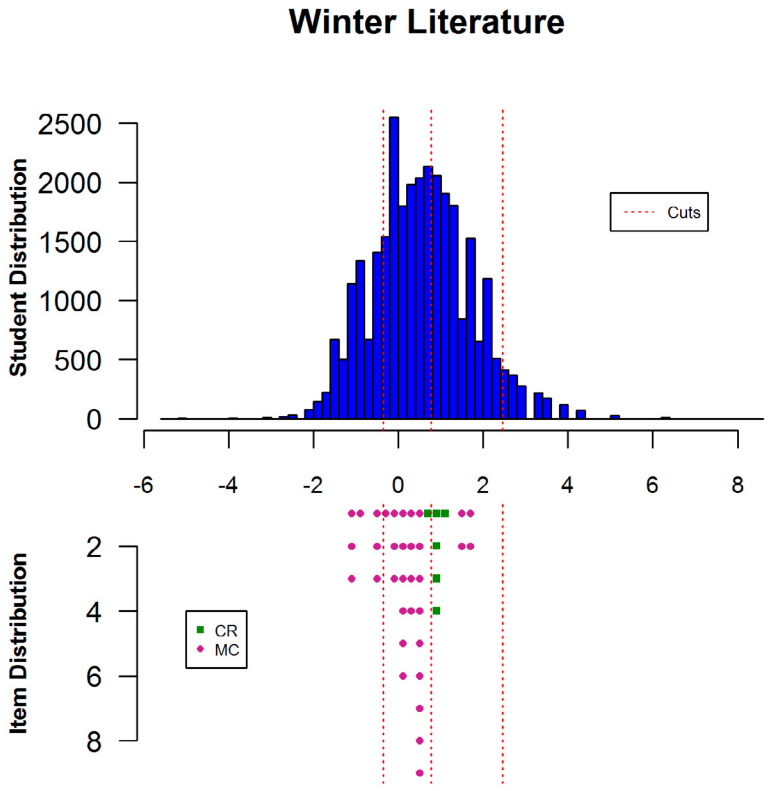
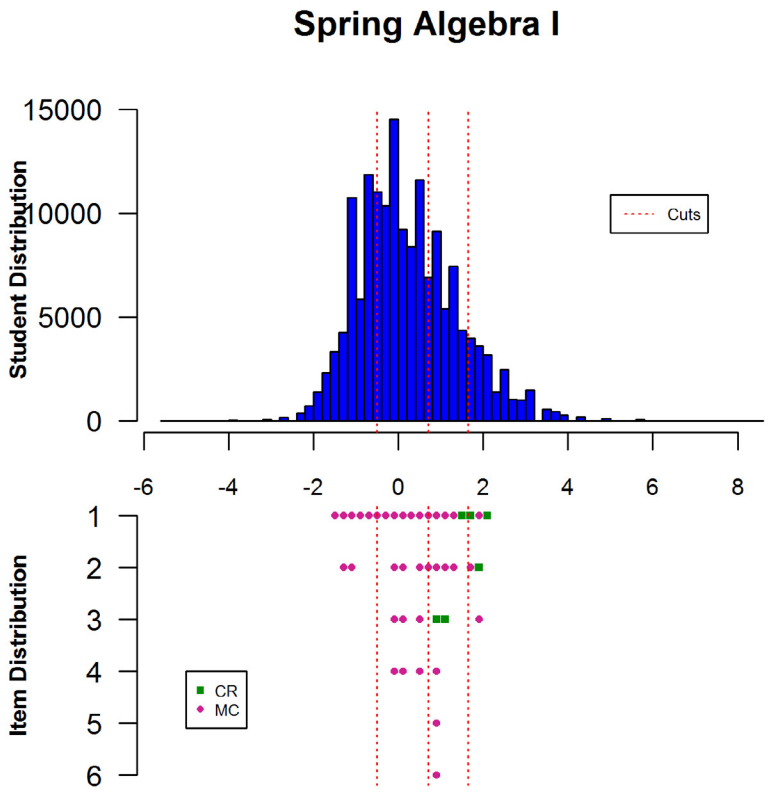


Figure 12–1 (continued). Item Difficulty-Student Ability Maps



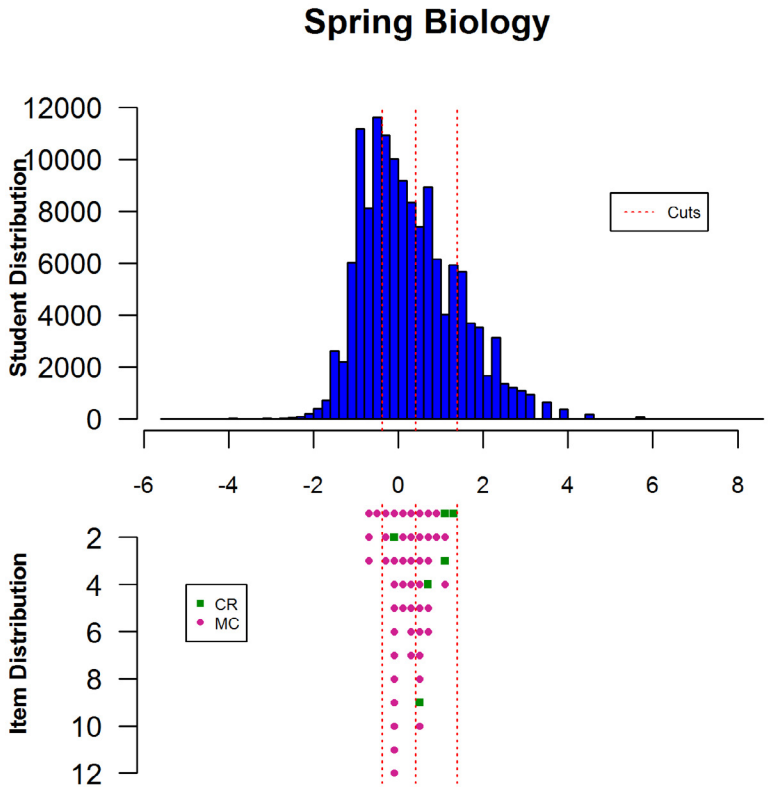
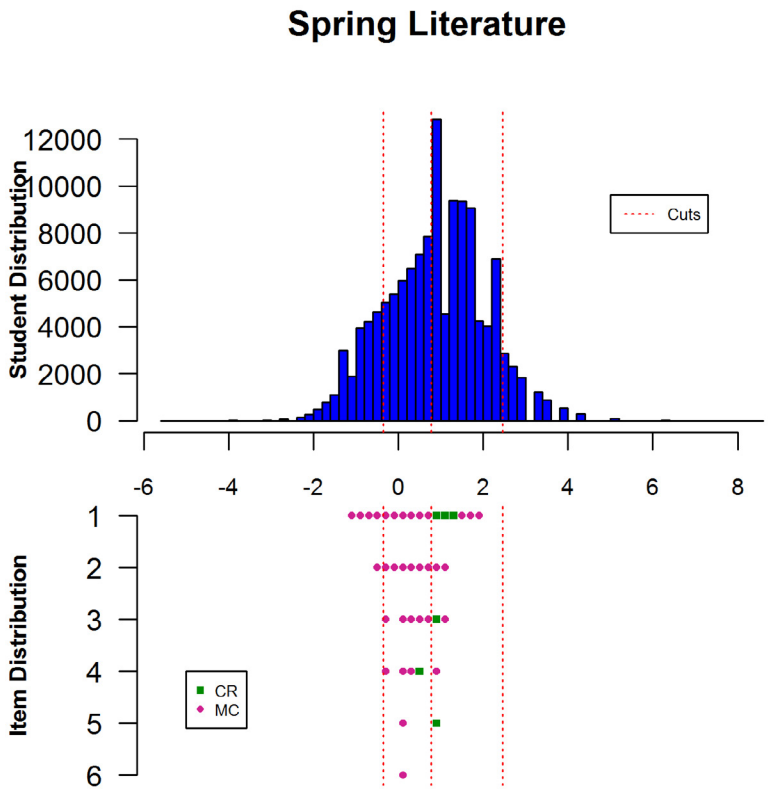


Figure 12–1 (continued). Item Difficulty-Student Ability Maps



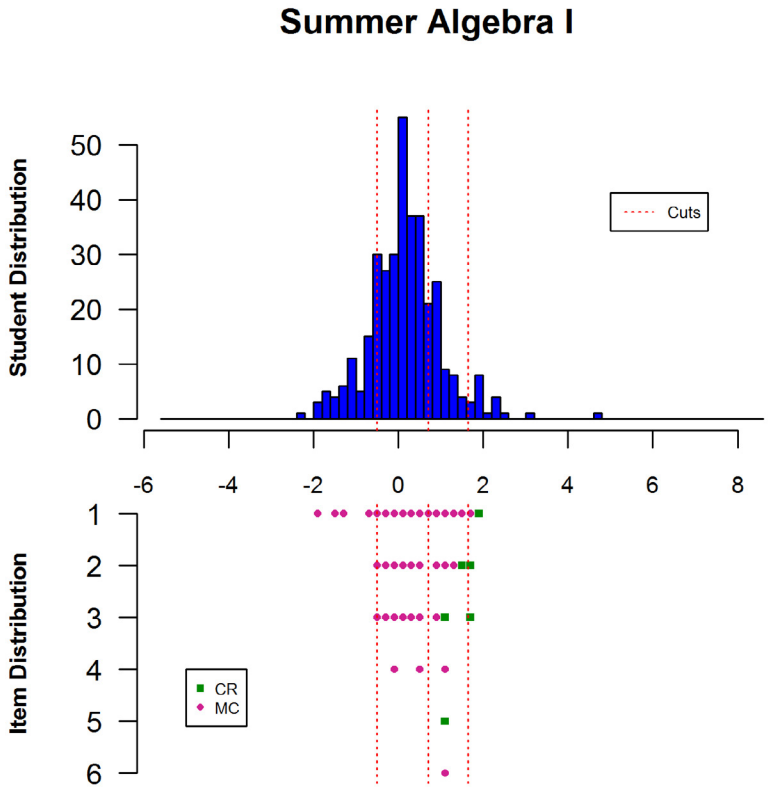
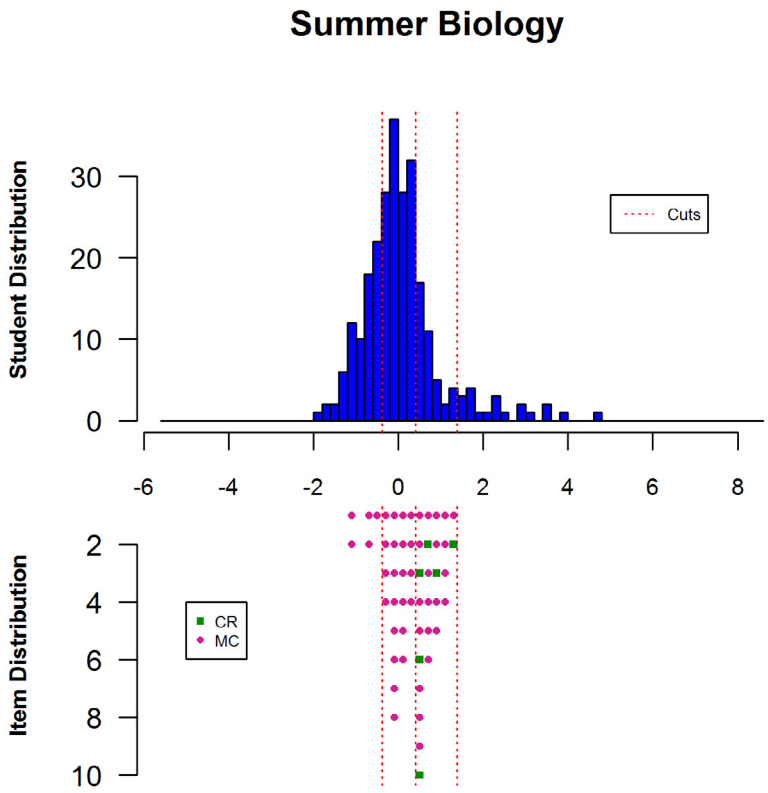
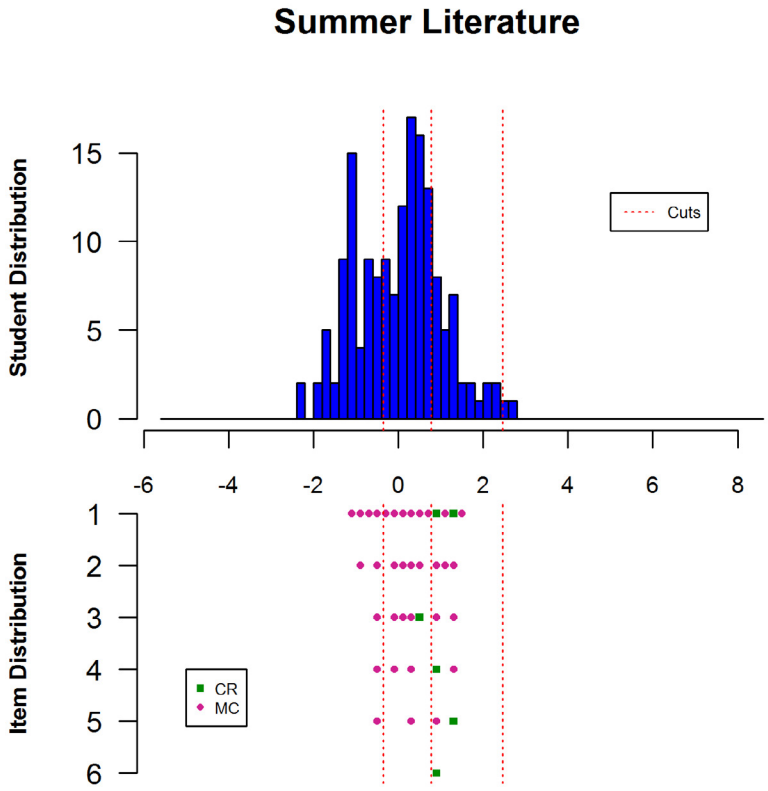


Figure 12–1 (continued). Item Difficulty-Student Ability Maps





CHAPTER THIRTEEN: STANDARD SETTING

STANDARD SETTING AND PERFORMANCE LEVEL DESCRIPTORS

The Keystone Performance Level Descriptors (PLDs) are paragraphs that describe the knowledge and skills expected at different performance levels with respect to the content standards (Pennsylvania Keystone Exams Assessment Anchor Content Standards and Eligible Content) for each of the Keystone Exams. Descriptors must be clearly written to ensure that all stakeholders have a common understanding of what describes expected performance at the various levels (i.e., Below Basic, Basic, Proficient, and Advanced). PLDs were developed, reviewed, and finalized by the PDE/QRT[1] and committees of Pennsylvania educators as required by the Chapter 4 Regulations. After the development and final review by PDE/QRT and Pennsylvania educators, the descriptors were prepared for use during the standard setting workshop. During this meeting, the descriptors were used to guide the standard setting process for each of the Keystone Exams. They were instrumental to the validity and defensibility of the standard setting process.

The standard setting for the Algebra I, Biology, and Literature Keystone Exams was conducted by Data Recognition Corporation (DRC) using a Bookmark procedure (Lewis, Mitzel, & Green, 1996) during a workshop held in Harrisburg, Pennsylvania, June 23–24, 2011. After the standard setting event, the descriptors were finalized. Along with the recommended cut scores, final PLDs for each of the Keystone Exams were submitted to the Pennsylvania Board of Education for final approval.

Below is a summary of the process that was used to guide the development of the Keystone Exams PLDs and a summary of the methodology and results of the standard setting workshop. Additional details about the standard setting event can be found in the *Keystone Standard Setting Technical Report* (Pennsylvania Department of Education, 2011).

DEVELOPMENT OVERVIEW FOR THE PERFORMANCE LEVEL DESCRIPTORS

The Keystone Exams PLDs were developed by Pennsylvania educators during two meetings. The goal of the first meeting was to have Pennsylvania educators review the general Pennsylvania Policy Definitions that describe, at a high level, performance expected for each level and complete an in-depth analysis of the Keystone Exams Assessment Anchors and Eligible Content in order to create a bulleted list describing, in detail, what students are expected to know and be able to do at each performance level. The goal of the second meeting was to have committees of Pennsylvania educators review the Pennsylvania Policy Definitions again and draft general descriptors (paragraphs) that build upon and/or summarize the information from the bulleted lists of what students are expected to know and be able to do at each performance level.

Guiding documents were prepared for each meeting. The guiding documents included the following:

- PowerPoint training presentations
- Meeting agendas
- Assessment Anchors and Eligible Content documents
- Policy definitions
- Other relevant materials as needed to help guide the work of the committees

All meeting materials were submitted to PDE/QRT for review and approval before each Keystone Exams meeting following an agreed-upon development schedule. The following section provides specific information concerning each meeting.

[1] The PDE/QRT includes the representatives from the Pennsylvania Department of Education, members of the Quality Review Team, and/or others appointed by the Quality Review Team.

ROLE OF FACILITATORS AND OBSERVERS FOR THE MEETINGS

The role of the facilitators was to ensure that a fair and orderly consensus process was followed for each meeting, that the committee members' work was adequately documented, and that the process stayed on schedule. The facilitators developed the agenda, prepared all meeting materials such as the PowerPoint training presentations and the task-guiding documents, and provided the initial training on the development of the specific descriptors (meeting 1) and the general descriptors (meeting 2). PDE/QRT members supported the facilitation process and/or served as observers of the process.

The facilitators also served as a resource, answering questions pertaining to the content of the standards (Assessment Anchor Content Standards and Eligible Content) and the documents developed to guide the process. Facilitators also summarized the results of each meeting, finalized the results, and prepared the specific descriptors/bulleted lists (meeting 1) and the general descriptors (meeting 2) for PDE/QRT review and approval.

PERFORMANCE LEVEL DESCRIPTORS MEETING 1

CREATING SPECIFIC LISTS DESCRIBING WHAT STUDENTS SHOULD KNOW AND BE ABLE TO DO AT EACH PERFORMANCE LEVEL

The first PLD meeting for Algebra I, Biology, and Literature Exams was held May 18–19, 2010, in Harrisburg, Pennsylvania. The purpose of the first meeting was to guide Pennsylvania educators in understanding the Assessment Anchors and Eligible Content for Algebra I, Biology, and Literature for what the Commonwealth of Pennsylvania determined students should know and be able to do for a given Keystone Exam subject. Committee members applied this understanding to the development of a bulleted list of specific determinations as to the level of knowledge and skills deemed necessary for each performance level. The section below describes the process used in the first meeting.

TRAINING

Pennsylvania educators received general training on how to develop specific PLDs, including training on how to describe student performance in relation to the Keystone Exams Assessment Anchors and Eligible Content. The training also provided educators with a general overview of the Standards Aligned System (SAS) and the high-level plan for the Keystone Exams. Definitions of key terms (e.g., Assessment Anchor Content Standards, Eligible Content, Performance Level Descriptors) were provided along with information on the background and purpose of the Keystone Exams. Keystone Exams content-specific materials (e.g., Assessment Anchor Content Standards, Eligible Content, other guiding documents) were distributed. The PDE/QRT also provided information on the policy definitions for existing Pennsylvania assessments.

ANALYZING THE ASSESSMENT ANCHORS AND ELIGIBLE CONTENT AND THE GENERAL POLICY DEFINITIONS FOR PENNSYLVANIA ASSESSMENTS

Following the introductory training, educators were divided into groups according to each Keystone Exam. Each group focused specifically on the task at hand—developing the specific PLDs for a given Keystone Exam. Committee members were informed of the format of the specific descriptors (bulleted list) and the number of proposed performance levels for each Keystone Exam (Below Basic, Basic, Proficient, and Advanced). Committee members were then given time to familiarize themselves with the policy definitions and the Assessment Anchors and the Eligible Content for a given Keystone Exam. They were provided with PDE/QRT-approved guiding documents to facilitate the process. Beginning with Proficient, committee members were asked to draft, in bulleted-list format, each performance level for Basic, Proficient, and Advanced, making sure to consider the knowledge and skills required or deemed necessary for each performance level. Note: Educators were not asked to create a specific descriptor for Below Basic.

DRAFTING SPECIFIC DESCRIPTORS

Outlined below is the sequence of steps taken to develop specific descriptors. The sequence was not always followed exactly. For example, some steps occurred simultaneously; other steps were repeated as needed or reordered as necessary.

1. The committee began with the development of the bulleted list for Proficient to serve as a model for the work during the remainder of the development process. As a formative first task using the Assessment Anchors and Eligible Content and the Pennsylvania Policy Definition for Proficient, the committee was asked to discuss, deliberate, and reach consensus on its initial bulleted list of the knowledge and skills needed to be considered Proficient. During this process, members were encouraged to consult all available resources and guiding documents. Particular emphasis was placed on the alignment of the knowledge and skills necessary for Proficient performance with what students are expected to know and be able to do as defined by the Assessment Anchors and Eligible Content for Algebra I, Biology, and Literature.
2. Once the committee drafted a bulleted list of the knowledge and skills needed to describe Proficient performance based upon the Assessment Anchors and Eligible Content, a group discussion took place. In reviewing the bulleted list for Proficient, the educators were specifically asked to determine whether all members agreed that the list included the appropriate knowledge and skills from the Assessment Anchors and Eligible Content to describe the Proficient performance level and that all Assessment Anchors and Eligible Content were sufficiently addressed.
3. The results of the discussion were summarized, and suggested revisions were made. The summary feedback was presented to the committee for additional consideration. An open discussion followed. Committee consensus was reached.
4. Following development of the bulleted list of the knowledge and skills needed for the Proficient performance level as determined by the committee, the committee began the development of the bulleted lists describing the specific knowledge and skills needed for Basic and Advanced. To complete the task, the committee members followed the procedures analogous to those used to develop the specific bulleted list for the Proficient performance level. These procedures included, as a formative first task, the committee's use of the Assessment Anchors and Eligible Content and the Pennsylvania Policy Definitions (e.g., Basic, Advanced) to discuss, deliberate, and reach consensus on its initial bulleted list of the knowledge and skills needed for Basic and then Advanced. This order of development—Proficient first, followed by Basic and then Advanced—was followed throughout the remainder of the process.

Once the initial drafts of the bulleted lists for Basic, Proficient, and Advanced were developed, a group discussion took place. To guide the discussion, the following questions were used to evaluate each specific descriptor (bulleted list) for a given performance level (Basic, Proficient, Advanced):

- Is the description of the performance level appropriate? If not, what revisions need to be made?
- Is the description of the specific Keystone Exam inappropriate because the list of knowledge and skills included in the description of the performance level is too demanding? If so, what revisions need to be made?
- Is the description inappropriate because the knowledge and skills included in the description of the performance level is inconsistent with the expectation of the high standards as reflected in the Policy Definition? If so, what revisions need to be made?
- Is the description inappropriate because the knowledge and skills included in the description of the performance level might be too easy? If so, what revisions need to be made?

5. The results of the discussion were summarized, and suggested revisions were listed. The summary feedback was presented to the committee for additional consideration. An open discussion followed. Depending upon the degree of concurrence, the facilitators proposed revisions based on the committee members' feedback to the specific descriptors (bulleted lists) for each descriptor. Committee consensus was reached.

6. Once consensus was reached, the bulleted lists or specific descriptions for each performance level were reviewed once again to confirm that all Assessment Anchors and Eligible Content were sufficiently addressed for each performance level and that the lists showed a clear progression from one performance level to the next. The results of the discussion were summarized, and suggested revisions were listed. The summary feedback was presented to the committee for additional consideration. An open discussion followed. Depending upon the degree of concurrence, the facilitators proposed revisions to the lists for each descriptor based on the committee members' feedback. Committee consensus was reached.
7. Following completion of the committee's work, the specific PLDs or bulleted lists of the knowledge and skills needed for each descriptor were collected. The bulleted lists were prepared for final review by the PDE/QRT. Upon approval by the PDE/QRT, the bulleted lists of the knowledge and skills describing each performance level were posted on the PDE website for additional review and feedback.

PERFORMANCE LEVEL DESCRIPTORS MEETING 2

CREATING GENERAL DESCRIPTIVE PARAGRAPHS DESCRIBING WHAT STUDENTS SHOULD KNOW AND BE ABLE TO DO AT EACH PERFORMANCE LEVEL

The second meeting for Algebra I, Biology, and Literature Exams took place in Harrisburg, Pennsylvania, on April 27–28, 2011. The second meeting built upon the work completed at the first meeting. The purpose of the second meeting was to guide the committee of Pennsylvania educators in developing general PLDs (paragraphs) for each of the performance levels (Basic, Proficient, and Advanced). These paragraphs were clearly written to ensure all stakeholders have a common understanding of what describes expected performance at the various levels. The paragraphs were not to be as specific as the bulleted lists but were to be aligned to the bulleted lists. In order to complete the task, the educators reviewed the Pennsylvania Policy Definitions for the performance levels.

Table 13–1. Pennsylvania Policy Definitions

Level	Description
Advanced	The Advanced Level reflects superior academic performance. Advanced work indicates an in-depth understanding and exemplary display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content.
Proficient	The Proficient Level reflects satisfactory academic performance. Proficient work indicates a solid understanding and adequate display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content.
Basic	The Basic Level reflects marginal academic performance. Basic work indicates a partial understanding and limited display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content. This work is approaching satisfactory performance, but has not been reached. There is a need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient Level.
Below Basic	The Below Basic Level reflects inadequate academic performance. Below Basic work indicates little understanding and minimal display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content. There is a major need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient Level.

The committee members then reviewed the specific bulleted list describing the knowledge and skills for Proficient based upon the Assessment Anchors and Eligible Content to determine whether the list of knowledge and skills provided in the bulleted list was still in alignment with the Policy Definition for Proficient. This review by the committee also included an in-depth analysis of the Assessment Anchors and Eligible Content. The section below describes, in detail, the process used in the second meeting.

TRAINING

Pennsylvania educators received general training on how to develop general descriptors (paragraphs) that describe performance at the various levels, including training on how to describe student performance in relation to the Keystone Exams Assessment Anchors and Eligible Content. The training also included providing Pennsylvania educators with a general overview of the SAS and the high-level plan for the Keystone Exams. Definitions of key terms (e.g., Assessment Anchor Content Standard, Eligible Content, specific and general Performance Level Descriptors) were provided along with information on the background and purpose of the Keystone Exams. A review of the Pennsylvania Policy Definitions was also included in the training, including a discussion of how the policy definition for Proficient relates to what it means to be Proficient on a given Keystone Exam. Content-specific materials (e.g., Policy Definitions, Assessment Anchor Content Standards and Eligible Content, specific descriptors

or bulleted lists from the first meeting, other guiding documents) were also distributed.

ANALYZING THE ASSESSMENT ANCHORS AND ELIGIBLE CONTENT AND THE POLICY DEFINITION FOR PROFICIENT

Following the introductory training, Pennsylvania educators were divided into groups according to Keystone Exam. Each group focused specifically on the task at hand—developing the general PLD paragraphs (Basic, Proficient, and Advanced) for a given Keystone Exam. To begin the process, educators reviewed the Pennsylvania Policy Definition for Proficient.

DRAFTING GENERAL DESCRIPTOR PARAGRAPHS

Once the committee reviewed the bulleted list for alignment to the Policy Definition for Proficient, committee members were asked to describe, in general terms, the knowledge and skills deemed necessary for each performance level (Basic, Proficient, and Advanced), beginning with Proficient. As a formative first task, committee members were instructed to refer to the bulleted list of the knowledge and skills required or deemed necessary for each performance level. Outlined below is the sequence of steps for the process used to develop the general PLD paragraphs. The sequence was not always followed exactly. For example, some steps occurred simultaneously; other steps were repeated as needed or reordered as necessary.

The committee began with the development of the general descriptor paragraph for the Proficient performance level. This general descriptor served as a model for the committee's work during the remainder of the development process. Using the Assessment Anchors and Eligible Content, the specific descriptors (bulleted list) for Proficient, and the Pennsylvania Policy Definition for Proficient, the committee was asked to discuss, deliberate, and reach consensus on a written description of the knowledge and skills needed for Proficient. During the process, members were encouraged to consult all available resources and guiding documents. Particular emphasis was placed on the alignment of the knowledge and skills necessary for the Proficient performance descriptor to the Assessment Anchors and Eligible Content for the given Keystone Exam.

Note: In order to help guide educators in the development of the general descriptor paragraph for Proficient, samples of descriptor paragraphs for Algebra I, Biology, and Literature (e.g., Georgia, North Carolina) were provided. The committee members were encouraged to approach the task by noting how the sample general descriptors must provide the right words to define performance—having a balance between keeping the description of Proficient general enough yet not as specific as the bulleted list. Committee members were also encouraged not to focus too heavily upon style, grammar, and mechanics at this stage. In other words, committee members were not to serve as "wordsmiths."

1. Once an initial draft paragraph summarizing the knowledge and skills needed to describe Proficient performance was developed, a group discussion took place. Committee members were asked to review the draft paragraph and determine whether the paragraph provided a clear description of what it means to be Proficient on a given Keystone Exam and the Policy Definition for Proficient. The goal of the discussion was to reach consensus.
2. Following development of the general paragraph describing Proficient, the committee began the development of the general paragraph describing Basic performance and the general paragraph describing Advanced performance. To complete the task, the committee members followed the procedures analogous to those used to develop the general paragraph describing Proficient performance on a given Keystone Exam. This process included, as a formative first task, using the Assessment Anchors and Eligible Content, the specific descriptors (bulleted lists), and the Pennsylvania Policy Definitions for a given level (e.g., Basic, Advanced) and discussing, deliberating, and reaching consensus on the knowledge and skills needed for Basic and the knowledge and skills needed for Advanced. This order of development—Proficient first, followed by Basic and then Advanced—was followed throughout the remainder of the process.
3. Once the initial draft paragraphs were developed for the other performance levels, a group discussion took place. In reviewing the state of development of the general PLD paragraphs at this stage, the committee members were asked to consider the following questions:
4. Does each paragraph clearly summarize the knowledge and skills required for a given performance level (Basic, Proficient, and Advanced)? If not, what revisions need to be made?

5. Does each paragraph provide for an appropriate description of the performance level? In other words, does each paragraph provide an overview or summary of the knowledge and skills appropriate for a given performance level? If not, what revisions need to be made?
6. Does any paragraph provide information that should not be included in the description of the performance level? If so, what revisions need to be made?
7. Is there information in any PLD paragraph that does not align well with the Pennsylvania Policy Definitions for a given performance level? If so, what revisions need to be made?
8. Do any paragraphs include information that might be inconsistent with the knowledge and skills defined by the Assessment Anchors and Eligible Content? If so, what revisions need to be made?
9. Does any paragraph include information describing performance that might be too demanding or too easy? If so, what revisions need to be made?
10. The results of the discussion were summarized, and revisions to each general PLD paragraph were made. Committee consensus was reached.
11. Once consensus was reached, the paragraphs describing performance at each level were reviewed again by the committee to confirm the following:
12. The PLD paragraphs show a clear progression from one performance level to the next level.
13. The PLD paragraphs are consistent with the Pennsylvania Policy Definitions.
14. The PLD paragraphs are aligned to the Assessment Anchors and Eligible Content.
15. The results of the discussion were summarized, suggested revisions were made, and committee members' feedback was incorporated into the paragraphs. Committee consensus was reached.
16. Following completion of the committee's work, the general PLD paragraphs were provided to PDE/QRT for final review and feedback. Upon approval by PDE/QRT, the general PLD paragraphs were used to guide the standard setting process.

STANDARD SETTING

A major purpose in the design of the standard setting workshop for the Keystone Exams is to establish procedures to set the performance cuts for the newly developed exams and, at the same time, adhere to the framework required by federal guidelines (USED, 2004) for setting performance levels. Federal guidelines (USED, 2004: Sect 2) specify that the setting of performance standards must involve the following elements:

- Formal adoption of performance categories that comprise at least three levels
- Pluralistic representation by education stakeholders, to include, for example, members of the public, school teachers and administrators, special education teachers, etc.
- Performance standards based primarily on expert judgment regarding content-based expectations of student achievement, but including the consideration of student impact data
- Descriptions of the competencies associated with each performance level

Accordingly, the standard setting workshop is designed to satisfy the following goals:

- A defensible and federally acceptable standard setting methodology that emphasizes a content-based approach for recommending the new performance standards
- The incorporation of PLDs developed by Pennsylvania educators into the standard setting process. (The larger goal around the incorporation of PLDs into the process is to help ensure the alignment of Pennsylvania's content standards to performance expectations as established by the recommended cut scores.)

The panelists were informed that the results from this meeting would be presented to the Board for review and possible adoption.

PANELIST RECRUITMENT

PDE selected committee members for the Algebra I, Biology, and Literature standard setting workshop mostly from members who participated in the May 2010 and April 2011 Performance Level Advisory committees. These committee members were selected as the starting pool because they represented the diversity of the Commonwealth of Pennsylvania, had a mix of teaching and committee experience, and, most importantly, were familiar with the PLDs of the Keystone Exams. From this list, PDE selected a subset of 25 members for Algebra I, 25 members for Biology, and 23 members for Literature to serve as eligible candidates. DRC, in collaboration with PDE and its Technical Advisory Committee (TAC), established a target of 15 to 20 participants for each of the Keystone Exams in Algebra I, Biology, and Literature.

Between March and June 2011, a great effort was made to recruit enough panelists to meet the target number of participants. In accordance with federal guidelines for representative committees and TAC's recommendation of recruiting a few committee members with higher education experience, the following background factors were applied in the recruitment decision:

- Gender
- Ethnicity
- Grade level and higher education experience
- Content expertise
- Geographic location
- Specializations
- Experience in developing state academic standards, state assessments, and other related activities

However, due to the unavailability of and the cancellation by some committee members, a total of 15, 13, and 11 panelists attended the standard setting workshop for Algebra I, Biology, and Literature, respectively. Table 13–2 contains the summary information about the characteristics of the selected panelists for each content area based on their self-reported responses to the Participant Survey. As can be seen from this table, there were committee members who considered themselves minority in the Algebra I and Literature groups. There were also committee members with administration and/or teaching experience in higher education, special education, and/or individualized education plan (IEP); those with experience working in different regions; and those with different lengths of teaching experience.

Table 13–2. Self-Reported Demographic Composition of Panelists by Content Area

Demographic Information	Algebra I Number	Algebra I Percent	Biology Number	Biology Percent	Literature Number	Literature Percent
Gender: Male	9	60.0%	5	38.5%	5	45.5%
Gender: Female	6	40.0%	8	61.5%	6	54.5%
Ethnicity: Asian	1	6.7%	0	0.0%	0	0.0%
Ethnicity: American Indian	0	0.0%	0	0.0%	0	0.0%
Ethnicity: Black	1	6.7%	0	0.0%	1	9.1%
Ethnicity: Latino	0	0.0%	0	0.0%	0	0.0%
Ethnicity: Multi-Race	0	0.0%	0	0.0%	0	0.0%
Ethnicity: White	13	86.7%	13	100.0%	10	90.9%
Role: Classroom Teacher	8	53.3%	9	69.2%	4	36.4%
Role: Educator	3	20.0%	0	0.0%	0	0.0%
Role: Higher Education Educator	3	20.0%	1	7.7%	4	36.4%
Role: Other	1	6.7%	3	23.1%	3	27.3%
Special Education: Yes	7	46.7%	7	53.8%	4	36.4%
Special Education: No	2	13.3%	4	30.8%	3	27.3%
Special Education: N/A	6	40.0%	2	15.4%	4	36.4%
LEP: Yes	4	26.7%	5	38.5%	2	18.2%
LEP: No	4	26.7%	6	46.2%	5	45.5%
LEP: N/A	6	40.0%	2	15.4%	4	36.4%
LEP: Missing	1	6.7%	0	0.0%	0	0.0%
Region: Urban	3	20.0%	2	15.4%	2	18.2%
Region: Suburban	7	46.7%	5	38.5%	5	45.5%
Region: Rural	4	26.7%	6	46.2%	3	27.3%
Region: Other	1	6.7%	0	0.0%	1	9.1%
Experience: Less than 10 years	0	0.0%	5	38.5%	0	0.0%
Experience: 10–20 years	4	26.7%	2	15.4%	4	36.4%
Experience: 20–30 years	8	53.3%	4	30.8%	3	27.3%
Experience: More than 30 years	3	20.0%	2	15.4%	4	36.4%

MATERIALS PREPARATION

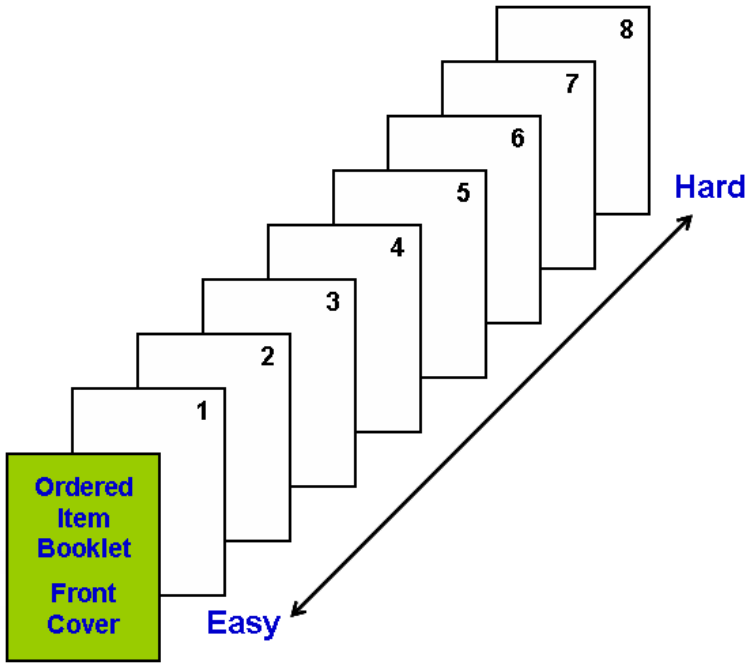
Workshop materials were developed and printed by DRC. The following is a list of materials that were available to panelists during the workshop:

- Item Map
- Item Separation Map
- Ordered Item Booklet (OIB)
- Passages
- Scoring Rubrics
- 2011 Operational Test Form
- PLDs
- Content Standards
- Participant Rating Form
- Participant Survey
- Readiness Form
- Evaluation Form
- Adhesive bookmarks, pens, highlighters, etc.

Item Map. The item map is a summary document displaying relevant information regarding each item. It contains the OIB page number, the original test sequence, item type, key, and content standard. The item map is ordered by difficulty in the same manner as the ordered item booklet. The item separation map is a graphical display of the relative difficulty of each item.

Ordered Item Booklet. The ordered item booklet is composed of all the operational items included in the test given to students in Spring 2011. Items are ordered from the easiest to the hardest. Each page contains an item and a page number. For constructed-response (CR) items, each score point with a sample response has a unique location in the OIB. A visual illustration of the OIB is provided in Figure 13–1.

Figure 13–1. Illustration of Ordered Item Booklet



To ensure there was no item difficulty gap for the items in an OIB, a few field test items were added to the OIBs. Table 13–3 shows the number of items supplemented into the OIBs by content area.

Table 13–3. Number of Score Points in OIB and Number of Items Supplemented

Exam	Number of Score Points in OIB	Number of Items Supplemented
Algebra I	63	3
Biology	69	3
Literature	54	2

Details of all other materials can be found in the *Keystone Standard Setting Technical Report* (Pennsylvania Department of Education, 2011).

DATA PREPARATION

In Bookmark standard setting (Lewis et al., 1996), the locations of items are typically rescaled to produce better alignment with the task of asking panelists what a student should know and be able to do. A probability of 0.67 is often used to find the corresponding item location during rescaling because this probability aligns better with the likelihood panelists use to make their judgment on whether a borderline student should answer the item correctly or receive a score point or higher. For Keystone Exams, the multiple-choice (MC) items were calibrated using the familiar form of the dichotomous Rasch model. The CR items were calibrated using another model in the Rasch family, Master's partial-credit model (Wright & Masters, 1982). The latter model parameterizes each threshold needed to obtain the maximum score on the task. Consequently, there is one item difficulty parameter for each of the n – 1 score transitions (0/1, 1/2, etc.), or thresholds. Using the equated item parameters, the locations of items were rescaled to a response probability of 0.67 (i.e., RP=0.67). For MC items, the item locations were found by solving

$$\Phi_{ni} = \frac{\exp(\beta_n - \delta_i)}{1 + \exp(\beta_n - \delta_i)}$$

for the value of β_n that gives $\Phi_{ni} = 0.67$. Φ_{ni} is the probability that person n scores 1 on item i; β_n is the ability of person n; and δ_i is the difficulty of item i.

For CR items, the probability of person n scoring x on item i is

$$\pi_{nix} = \frac{\exp\sum_{j=0}^{x}(\beta_n - \delta_{ij})}{\sum_{k=0}^{m_i}\exp\sum_{j=0}^{x}(\beta_n - \delta_{ij})}, \quad x = 0, 1, \ldots, m_i$$

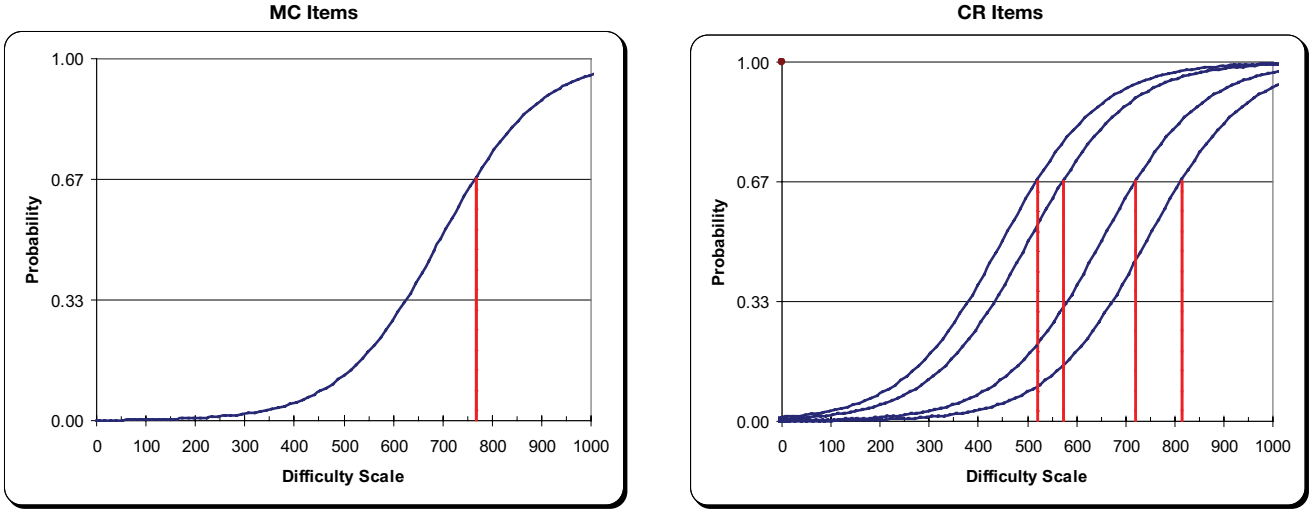
where mi is the number of thresholds and, for notational convenience,

$$\exp\sum_{j=0}^{0}(\beta_n - \delta_j) = 1.$$

This equation expresses the probability of person n scoring x on the m_i threshold of item i as a function of the person's measure (β_n) and the threshold difficulties (δ_{ij}) of the m_i thresholds for item i. The observation x is a count of the successfully completed item thresholds. The item location for a score point is determined by finding the β_n for the person who has a 0.67 probability of earning this score point or higher.

The figure below shows how the difficulty values of MC items and score values for the CR items were treated in determining their respective OIB placements. For an MC item (left plot), the difficulty is the point on the scale at which the examinees have a 0.67 probability of answering the item correctly. For the CR item (right plot), the four illustrated values (e.g., on a 0–1000 scale) indicate where the examinees have a 0.67 probability of earning a particular score point or higher. The item difficulty for the MC item is 768, and the four threshold values for the CR items are 521, 575, 723, and 815. The value of 521 is the location on the scale where examinees have a 0.67 probability of earning a score of 1 or higher (i.e., 2, 3, or 4). The value of 575 is where examinees have a 0.67 probability of earning a score of 2 or higher (i.e., 3 or 4). The value of 723 is where examinees have a 0.67 probability of earning a score of 3 or 4.

Figure 13–2. Example of Obtaining Item Difficulties for MC and CR Items



TRAINING

The overall training was conducted the first morning of the workshop. Participants were informed that they were to

- be responsible for all secure materials,
- verify their individual placements for each round of judgments, and
- participate in a discussion as a large group.

Content-specific training was conducted after content area groups assembled in different rooms. These training materials included the following:

- Item Map
- Item Separation Map
- OIBs
- Training Rubrics and/or Passages
- PLDs
- Rating Form

Panelists were told that the process includes iterations (rounds) of individual judgments, group discussions, and opportunities to revise judgments. In addition, impacts were presented (percentage of students in each performance level) based on the large groups' results and external data.

BOOKMARK PROCEDURE

DRC utilized a Bookmark method to set the performance standards. Bookmark is one in a broad category of methods commonly referred to as item mapping that focus on items rather than examinees. To begin the process, participants were asked to visualize the knowledge and skills of a student who is at the borderline between two performance levels based on the PLDs. Thereafter, participants were given an ordered item booklet (with items ordered from easiest to most difficult) and asked to assess whether this borderline student has a reasonably high probability of answering each item correctly. "Reasonably high" was defined as 0.67. In addition, an item map was presented that contained the response key, the content objective, and the item sequence in the test booklets. An item separation map was also presented that showed the relative difficulty of each item. Panelists were given a rating form to record their individual placements for all performance levels in each round. Before each round, panelists were asked to fill out a readiness form in order to proceed.

Round 1. The Bookmark procedure proceeded in three rounds. Round 1 began following the review and discussion of PLDs facilitated by a DRC test development specialist. Participants then reviewed the OIBs independently. During this review, they were asked to determine what academic knowledge, skills, and competencies were required for a barely Proficient, Basic, or Advanced student to respond correctly to each successively more difficult item.

Training by the overall psychometric lead during the bookmark placement session emphasized the following points:

- The bookmark represents a judgment of the divide between items that a student at the borderline of a performance level should master and those that are not necessary to master.
- Bookmark placement should not be thought of as separating two items but rather two groups of items. In other words, a placement should not hinge on distinctions drawn for adjacent items without some compelling reason, such as a large gap in content difficulty.
- Students with a scaled score at a given cut score should have approximately a 0.67 probability of correctly responding to a MC item or receiving a certain score point and higher for a CR item at the cut score. These same students should have a higher probability of success on easier items (before the bookmark placement) and a lower probability of success on harder items (after the bookmark placement).

- While placing their bookmarks, panelists should consider what students should know and be able to do in the context of the skills implied by the PLDs and the item content.
- Panelists could start with placing the Basic/Proficient cut point, next the Below Basic/Basic cut point, and finally the Proficient/Advanced cut point.

Panelists were asked to record their bookmark placements on the rating form after they filled out a readiness form, which indicated they had completed the training and understood the standard setting process and their roles. Panelists' judgments were entered into a spreadsheet program. The median ratings of all panelists were calculated. The median placements were treated as the recommended cut scores. In addition, the standard errors associated with the recommended bookmark placements were calculated and associated impact data were determined.

Round 2. Round 2 started with a discussion of Round 1 results. The individual panelists' Round 1 bookmark placements, the median bookmark placements, and the percentage of students in each performance level were presented. Panelists were instructed to verify the ratings entered into the program as correct. A large-group discussion followed. The panelists compared their results with others by considering questions such as why they made their Round 1 placements at the locations where they did and what skills and knowledge were required to answer the items. After that, the impact data, based on the median bookmark placement from Round 1 (using the Spring 2011 operational test score distributions), were provided to help panelists frame the effects of their judgments. During Round 2 discussion, there was no attempt by the facilitators to reach consensus.

After Round 2 discussion, panelists were asked to make a second set of bookmark placements. Before they revised their Round 1 placements, they were asked to fill out the readiness form to make sure they understood how to adjust their placements (if they desired to do so) based on Round 1 information. The judgments were entered into the spreadsheet program to calculate the median cut scores for each table and the full panel. The associated impact data were also calculated.

Round 3. Round 3 began with a discussion of Round 2 results. The process followed in Round 2 was used. More specifically, the individual panelist's Round 2 bookmark placements, the median bookmark placements from Round 2, and the percentage of students in each performance level were presented. Panelists were instructed to verify the ratings entered into the program as correct. A table discussion followed. Panelists compared their results with others by considering questions such as why they made their Round 2 placements at the locations where they did and what skills and knowledge were required to answer the questions. The impact data, based on the median bookmark placement from Round 2, were provided to help panelists frame the effects of their judgments.

The Keystone Exams are one component of Pennsylvania's new system of high school graduation requirements. Because of the high-stakes consequences, the TAC strongly recommended bringing in external impact data to provide panelists with a reference outside of the Keystone Exams. The intent was to achieve reasonableness of results rather than to use the external data in a directive manner. DRC investigated Pennsylvania students' performance on the Pennsylvania System of School Assessment (PSSA), National Assessment of Educational Progress (NAEP), and Student Achievement Test (SAT) and presented external data as shown in Figures 13–3A to 13–3C before panelists made their Round 3 judgments. The panelists were informed of the following points:

- The PSSA and NAEP results were based on students' performance in 2009. The PSSA results were from grades 6–8 and 11. The NAEP results were from grade 8.
- All students in grades 6–8 and 11 in Pennsylvania took the PSSA. A sample that represents the Pennsylvania grade 8 students took the NAEP tests.
- The SAT results were based on the performance of students who took the SAT in 2010 or prior years.
- About 99% of students in the 2010 SAT data file indicated their expected graduation dates were in 2010; most of these students were in grade 11 in 2009. Therefore, the 2010 SAT data and the 2009 PSSA data were matched.
- Based on the matched sample, it was found that students with higher PSSA scores were more likely to take the SAT. To represent the full population in terms of demographics and PSSA scores, the matched sample was weighted by students' demographics and PSSA scores when calculating the impacts.

Figure 13–3A. External Impact Data: Algebra I

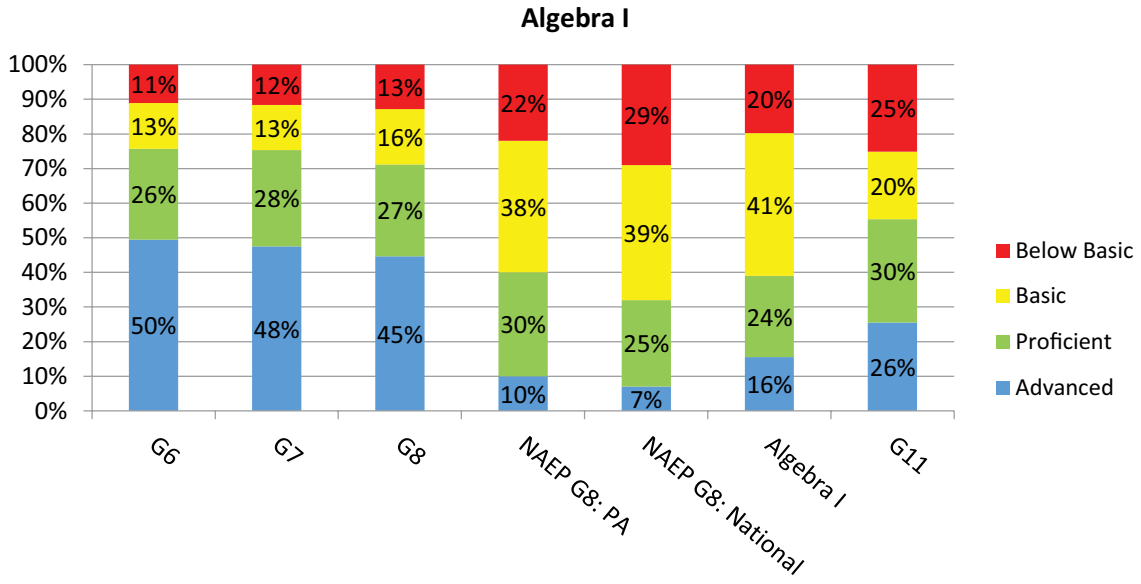


Table 13–4A. Number of Score Points in OIB and Number of Items Supplemented: Algebra I

Performance Level	PSSA G6	PSSA G7	PSSA G8	NAEP G8: PA	NAEP G8: National	KE Alg. I	PSSA G11	College Ready Yes Projected	SAT: College Ready Yes: PA	SAT: College Ready Yes: National
Below Basic	11.1%	11.6%	12.8%	22.0%	29.0%	19.8%	25.1%	0.9%	51.7%	54.0%
Basic	13.2%	13.1%	16.0%	38.0%	39.0%	41.2%	19.5%	7.8%	51.7%	54.0%
Proficient	26.2%	27.8%	26.6%	30.0%	25.0%	23.5%	29.8%	42.2%	51.7%	54.0%
Advanced	49.5%	47.5%	44.7%	10.0%	7.0%	15.5%	25.5%	91.2%	51.7%	54.0%
Below Basic + Basic	24.3%	24.7%	28.8%	60.0%	68.0%	61.0%	44.8%	4.0%	51.7%	54.0%
Proficient + Advanced	**75.7%**	**75.3%**	**71.3%**	**40.0%**	**32.0%**	**39.0%**	**55.3%**	**64.9%**	**51.7%**	**54.0%**
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	38.1%	51.7%	54.0%
Total N	128,421	132,803	135,909	3,600	161,700	93,703	135,676	61,118	65,426	N/A

Figure 13–3B. External Impact Data: Biology

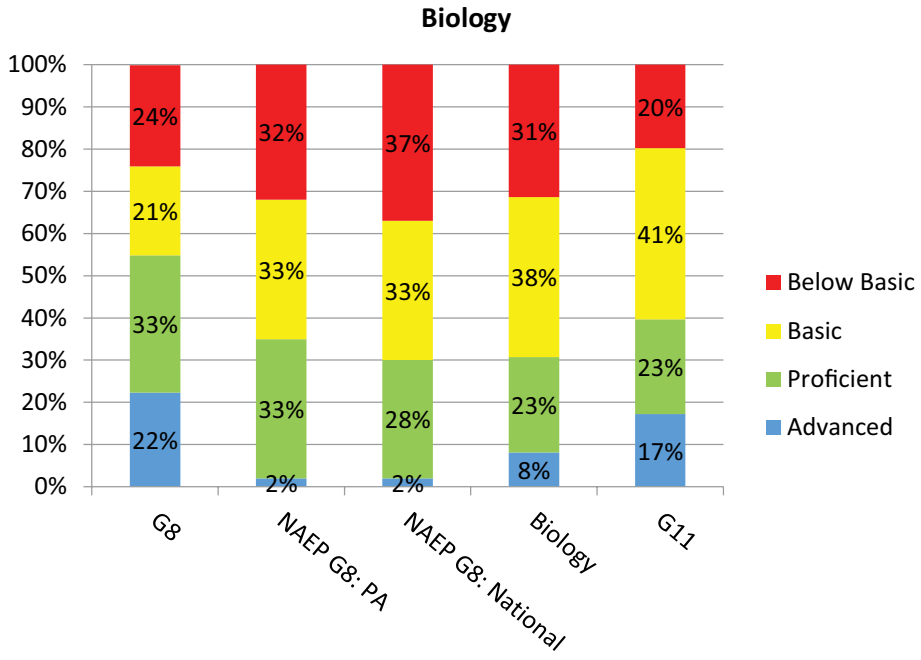


Table 13–4B. Number of Score Points in OIB and Number of Items Supplemented: Biology

Performance Level	PSSA G8	NAEP G8: PA	NAEP G8: National	KE Biology	PSSA G11	College Ready Yes Projected	SAT Math: College Ready Yes: PA	SAT Math: College Ready Yes: National
Below Basic	24.0%	32.0%	37.0%	31.4%	19.8%	1.4%	38.7%	43.0%
Basic	21.1%	33.0%	33.0%	37.9%	40.5%	9.1%	38.7%	43.0%
Proficient	32.5%	33.0%	28.0%	22.6%	22.5%	45.9%	38.7%	43.0%
Advanced	22.3%	2.0%	2.0%	8.1%	17.2%	86.6%	38.7%	43.0%
Below Basic + Basic	45.1%	65.0%	70.0%	69.3%	60.3%	6.6%	38.7%	43.0%
Proficient + Advanced	**54.8%**	**35.0%**	**30.0%**	**30.7%**	**39.7%**	**63.8%**	**38.7%**	**43.0%**
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	29.4%	38.7%	43.0%
Total N	134,969	3,600	151,100	46,394	131,534	60,311	65,426	N/A

Figure 13–3L. External Impact Data: Literature

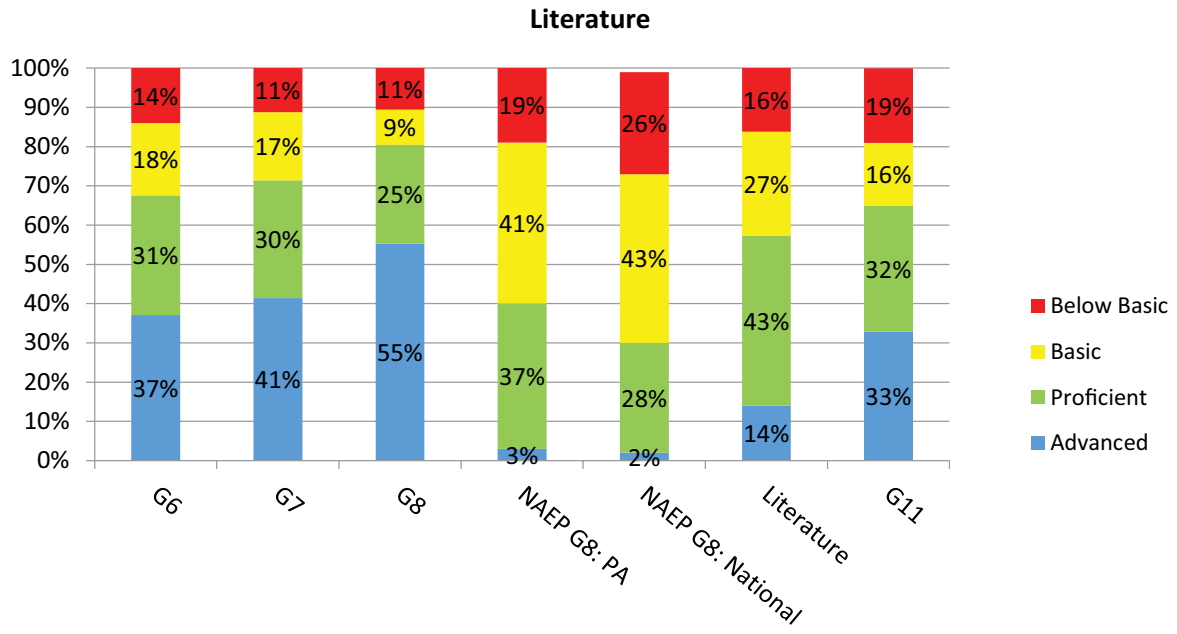


Table 13–4L. Number of Score Points in OIB and Number of Items Supplemented: Literature

Performance Level	PSSA G6	PSSA G7	PSSA G8	NAEP G8: PA	NAEP G8: National	KE Literature	PSSA G11	College Ready Yes: Projected	SAT Math: College Ready Yes: PA	SAT Math: College Ready Yes: National
Below Basic	14.0%	11.2%	10.6%	19.0%	26.0%	16.2%	19.0%	1.2%	46.4%	50.0%
Basic	18.4%	17.4%	8.9%	41.0%	43.0%	26.5%	16.0%	4.7%	46.4%	50.0%
Proficient	30.5%	30.0%	25.2%	37.0%	28.0%	43.3%	32.1%	24.8%	46.4%	50.0%
Advanced	37.1%	41.4%	55.3%	3.0%	2.0%	14.0%	32.9%	76.7%	46.4%	50.0%
Below Basic + Basic	32.4%	28.6%	19.5%	60.0%	69.0%	42.7%	35.1%	2.7%	46.4%	50.0%
Proficient + Advanced	**67.6%**	**71.4%**	**80.5%**	**40.0%**	**30.0%**	**57.3%**	**64.9%**	**51.1%**	**46.4%**	**50.0%**
Total Percentage	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	34.5%	46.4%	50.0%
Total N	128,284	132,641	135,739	3,500	160,900	42,292	135,470	61,081	65,426	N/A

The Keystone Exams and PSSA results were presented to the panelists first. Panelists were encouraged to compare the impact data and discuss whether the results for the Keystone Exams were reasonable. The NAEP results were added next, and the SAT results were introduced last for comparison and discussion. While discussing the external data, panelists were reminded that all these tests were created for different purposes and might cover different content standards.

Before panelists provided their final judgments, they were instructed to fill out the readiness form to make sure they understood how to adjust their placements (if they desired to do so) based on the Round 2 information and external impact data. After their individual bookmark placements, panelists filled out the evaluation form. The judgments were entered into the spreadsheet program to calculate the median placements for the full panel. The associated impact data were also calculated. The Round 3 results were presented to the panelists for their information after the lunch break.

PANELISTS' RECOMMENDATIONS

Table 13–5 provides a summary of each round's median, minimum, and maximum ratings (i.e., bookmark page numbers) of the group.

Table 13–5. Summary of Panelists' Ratings for Each Round

Exam	Round	Bookmark Page Number Median	Bookmark Page Number Min.	Bookmark Page Number Max.	Basic/ Proficient Median	Basic/ Proficient Min.	Basic/ Proficient Max.	Proficient/ Advanced Median	Proficient/ Advanced Min.	Proficient/ Advanced Max.
Alg. I	1	11	6	19	28	14	42	45	33	56
Alg. I	2	11	6	13	26	17	33	42	40	46
Alg. I	3	11	10	12	26	18	30	46	41	46
Bio.	1	9	4	15	26	20	30	56	43	62
Bio.	2	8	7	14	24	21	30	54	50	60
Bio.	3	8	7	12	22	20	30	54	50	60
Lit.	1	8	5	14	27	12	34	47	38	52
Lit.	2	9	8	15	23	15	34	46	38	48
Lit.	3	9	8	15	25	17	34	48	38	48

CUT POINTS AND STANDARD ERRORS

Each bookmark page number is associated with a bookmark difficulty (i.e., logit value). The logit cut is the bookmark difficulty corresponding to the median OIB page number minus one. The logit cut and the standard error (SE) of median logit based on panelists' Round 1 rating were used to establish the 1 and 2 SE confidence intervals. By bracketing the median cut score by 2 SEs, the 95% confidence interval was identified; the confidence interval can be used to estimate the effects of false positives (passing students who may not actually have sufficient knowledge and skills) or false negatives (failing students who do have sufficient knowledge and skills). PDE can use these standard errors to identify the appropriate cut score by taking into consideration the variance in the human judgments. Table 13–6 summarizes the logit cuts associated with Round 3 median ratings, median +/-1 SE, and median +/-2 SE. The corresponding impacts (percentages in performance level) are provided in this table as well. Note that BB represents Below Basic; B represents Basic; P represents Proficient; and A represents Advanced.

Table 13–6. Summary of Logit Cuts and Impacts

Exam	Stats	Logit Cut BB/B	Logit Cut B/P	Logit Cut P/A	Percentage in Performance Level (%) BB	Percentage in Performance Level (%) B	Percentage in Performance Level (%) P	Percentage in Performance Level (%) A	Percentage in Performance Level (%) P+A
Alg. 1	Median-2SE	-0.7273	0.4291	1.3694	14.7	37.3	30.2	17.8	48.0
Alg. 1	Median-1SE	-0.6181	0.5659	1.5041	17.2	37.8	31.6	13.4	45.0
Alg. 1	Median	-0.5090	0.7027	1.6388	19.8	41.2	27.5	11.5	39.0
Alg. 1	Median+1SE	-0.3999	0.8395	1.7735	22.4	44.4	23.5	9.7	33.2
Alg. 1	Median+2SE	-0.2907	0.9763	1.9082	25.2	47.0	19.7	8.1	27.8
Bio.	Median-2SE	-0.5977	0.3098	1.2500	22.5	38.9	27.9	10.7	38.6
Bio.	Median-1SE	-0.4933	0.3564	1.3205	28.3	33.1	29.3	9.3	38.6
Bio.	Median	-0.3888	0.4029	1.3910	31.4	32.7	27.8	8.1	35.9
Bio.	Median+1SE	-0.2843	0.4494	1.4615	34.5	32.2	25.2	8.1	33.3
Bio.	Median+2SE	-0.1799	0.4960	1.5320	40.7	26.0	26.4	6.9	33.3
Lit.	Median-2SE	-0.6561	0.2338	1.7014	12.4	20.9	46.3	20.4	66.7
Lit.	Median-1SE	-0.5545	0.4116	1.9551	14.2	25.3	46.5	14.0	60.5
Lit.	Median	-0.4530	0.5894	2.2088	16.2	26.5	48.4	8.9	57.3
Lit.	Median+1SE	-0.3515	0.7672	2.4625	18.3	31.4	43.6	6.7	50.3
Lit.	Median+2SE	-0.2499	0.9450	2.7162	20.5	36.5	38.2	4.8	43.0

FINAL RESULTS

After reviewing the results in Table 13–6 and considering panelists' discussions at the standard setting workshop, PDE recommended using the logit cut scores associated with the median of panelists' Round 3 ratings for Algebra I and Biology. For Literature, PDE recommended the logits cuts associated with the Round 3 median plus 1 SE.

To avoid negative values on the logit scale, the scaling constants were determined next to linearly convert the logit values to scaled scores. The scaled cut scores for each performance level were obtained by linearly transforming the logit cuts. Details of the scaling process can be found in Chapter Fourteen. A brief description is below.

For Keystone Exams, the linear transformation from logits or Rasch measures to scaled scores was established by anchoring the logit cut for Basic/Proficient to a scaled score 1500 and fixing the slope constant to 50. The intercept constant was calculated next based on the known values 1500, 50, and the logits cut for Basic/Proficient for each content area. In addition, the bottom of the scale was truncated at the lowest obtainable scaled score (LOSS), 1200. The top of the scaled scores was truncated at the highest obtainable scaled score (HOSS), 1800. The recommended scaled score cuts and the corresponding impacts were provided to the Board on July 20, 2011, for approval. Table 13–7 presents the final scaling constants and the Board-approved scaled-score ranges for each performance level.

Table 13–7. Summary of Scaled-Score Ranges and Scaling Constants

Exam	Performance Level Below Basic	Performance Level Basic	Scaling Constants Proficient	Scaling Constants Advanced	Scaling Constants Slope	Scaling Constants Intercept
Algebra I	1200–1438	1439–1499	1500–1545	1546–1800	50	1464.365
Biology	1200–1459	1460–1499	1500–1548	1549–1800	50	1479.355
Literature	1200–1443	1444–1499	1500–1583	1584–1800	50	1461.140

The Keystone Exams are reported by total and modules. Although the panelists made recommendations based on the total test only, the Basic/Proficient cut for the total test is applied directly in setting the passing cut score for each module. In this case, the passing scaled score cut at module level is 1500.

CHAPTER FOURTEEN: SCALING

Scaling is used to transform test score values (i.e., raw scores) onto a scale that can be interpreted by users easily and correctly. Raw scores cannot be used to compare students' achievement across administrations because they depend on the difficulty of the tests. The same student can score higher on an easy test than on a difficult test. To overcome the limitation of raw scores, the scaled scores are introduced to report students' achievement in each Keystone Exam. This chapter describes the two major steps to convert a raw score to a scaled score (SS) and some key considerations for establishing the score scale for Keystone Exams.

RAW SCORES TO RASCH ABILITY ESTIMATES

The pre-equated item parameter estimates for the operational items (further discussed in Chapters Twelve and Fifteen) were used to obtain Rasch person ability estimates and asymptotic standard errors of measurement for each possible raw score value for the overall test, as well as each module. The generation of this raw score-to-Rasch ability was accomplished through application of the fundamental formulas in the Rasch measurement model. The combination of both dichotomously scored multiple-choice (MC) items as well as polytomously scored constructed-response (CR) items requires the use of a partial-credit model (RPCM; Wright & Masters, 1982). The Newton-Raphson iterative procedure is used to obtain precise ability estimates:

$$b_r^{(t+1)} = b_r^t - \frac{r - \sum_i^L \sum_{k=1}^m kP_{rik}^{(t)}}{-\sum_i^L \left[\sum_{k=1}^m k^2 P_{rik}^{(t)} - \left(\sum_{k=1}^m kP_{rik}^{(t)} \right)^2 \right]} \quad r = 1, \ldots, M-1,$$

where b^t_r is the estimated ability of the student with score r after t iterations, k is the number of thresholds, L is the number of items, $M = \sum_i^L m_i$, and $P_{rik}^{(t)}$ is the probability, π_{nix}, defined earlier in Chapter Twelve:

$$\pi_{nix} = \frac{\exp \sum_{j=0}^x (\beta_n - \delta_{ij})}{\sum_{k=0}^{m_i} \exp \sum_{j=0}^x (\beta_n - \delta_{ij})}, \quad x = 0, 1, \ldots, m_i$$

The asymptotic standard error of measurement (SEM) was estimated from the denominator of the final iteration:

$$SE(b_r) = \left[\sum_i^L \left[\sum_{k=1}^m k^2 P_{rik}^{(t)} - \left(\sum_{k=1}^m kP_{rik}^{(t)} \right)^2 \right] \right]^{-1/2}.$$

The Rasch ability estimates and the corresponding SEMs are then transformed to scaled scores and SEMs of scaled scores as discussed in the following section.

ZERO AND PERFECT SCORES

A direct ability estimate for zero (no points earned) or perfect (all points earned) raw scores can't be achieved. Thus, a default procedure for estimating such extreme scores was used for the Keystone Exams. Essentially, a fractional raw score (a value less than one, e.g., 0.3) was added to zero scores and subtracted from perfect scores to determine the corresponding logit values for these extreme scores.

RASCH ABILITY ESTIMATES TO SCALED SCORES

Generally, scaled 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 scaled scores, all reported values can become positive integers, which allows for better interpretation by parents and students. Since Rasch ability estimates are comparable after equating to the base administration/ year, the transformed scaled scores have a common scale across administrations, even though the corresponding raw scores may differ. Refer to Chapter Fifteen for additional details on equating.

Scaled scores are obtained through a linear transformation of Rasch ability estimates that are associated with each raw score point. Before the linear equation is established for each content area, a few points were considered for the Keystone Exams:

- Avoid scales that might be confused with scores for other types of assessment, for example:
    - Scaled scores ranging from 0 to 100 (because this might be confused with percentage correct scores or percentile ranks)
    - Scaled scores ranging from 200 to 800 (because this might be confused with SAT scores)
    - Scaled scores with similar ranges as the ones for the Pennsylvania System of School Assessment (PSSA) or Classroom Diagnostic Tools (CDT)
- Avoid scales similar to raw scores from a base form.
- Avoid scales that might suggest the scores are more precise than they actually are (i.e., suggesting more precision than can actually be supported by the test scores).
- Avoid scales with negative numbers and decimals.

In terms of industry standard practice, a common perspective is that scaled 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[1] (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, the current 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 a criterion-referenced test like the PSSA.

As a result, a scaled score range of 1200 to 1800 and the Proficient scaled cut-score of 1500 was used to establish the scales for each of the Keystone Exams in Algebra I, Biology, and Literature. It is worth noting that, although careful considerations were given to the selection of these values, they are completely arbitrary based on previously discussed considerations. For example, the label of 1500 could have been called 100 or any other value or letter 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 scaled scores for the Keystone Exams 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 the Keystone Exams was derived by anchoring the Proficient cut (i.e., Rasch ability estimate) recommended by the panelists at the standard- setting workshop to the scaled score 1499.5 (i.e., 1500 after rounding), and then set the slope of the line. There could be many lines with different slopes going through the anchor point. However, the slope of the line has influence over the variability of the scaled scores. For Keystone Exams, the slope of 50 was chosen because it results in desired scaled score standard deviation. Once the scaled score, slope, and Rasch ability estimate are determined, the

[1] 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 (Angoff, 1984).

intercept *b* can be derived by the equation above. The final slopes and intercepts for deriving scaled scores for the Keystone Exams are provided in Table 14–1.

Table 14–1. Scaling Constants by Content Area

Exam	Scaling Constants Slope	Scaling Constants Intercept
Algebra I	50	1,464.365
Biology	50	1,479.355
Literature	50	1,461.140

ROUNDING

The linearly transformed scaled scores are always 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.

LOWEST OBTAINABLE SCALED SCORES

The Keystone Exams in Algebra I, Biology, and Literature have a lowest obtainable scaled score (LOSS) of 1200. Any derived scaled score less than 1200 is truncated to this minimum value. The selection of a LOSS is mainly based on two considerations: 1) extreme low scaled scores may have an impact on the average of the scaled scores at school/district level and 2) score truncation makes sense from a score precision perspective given measurement errors at the extremes are large. The LOSS value 1200 is established by giving consideration to *chance* performance over the MC items (e.g., if 40 four-option MCs were on a test, approximately 10 points might be earned on guessing alone) and considering the percentage of students who would be awarded the LOSS values.

HIGHEST OBTAINABLE SCALED SCORES

A highest obtainable scale score (HOSS), 1800, is set for the Keystone Exams for the same reasons described for the LOSS value. However, unlike the LOSS value, which is set initially by giving consideration to guessing over MC items, it is somewhat more difficult to determine what rules should be applied to establish the HOSS. Based on the empirical results, the value 1800 corresponds to a logit value (or Rasch ability estimate) that ranged from 6 to 7, and 0 percent of students received this score.

RAW-TO-SCALED-SCORE TABLES

The final raw-to-scaled score conversion tables can be found in Appendix K. Note that only the raw-to-scaled score tables for each single administration were reported. In other words, these tables cannot be used to look for a student's highest total scaled score to date if it is combined from two different administrations. The conditional standard error of measurement (CSEM, see Chapter Eighteen for detailed discussion) and corresponding confidence intervals based on 1 CSEM are also provided in these tables.

CHAPTER FIFTEEN: EQUATING

Equating is a statistical process that is used to adjust scores on test forms so that scores from two different forms can be used interchangeably (Kolen & Brennan, 2004) even though the test forms consist of different items. In large-scale testing programs, it is a common practice to have different item sets appear in different test forms across administrations. Students' raw scores (or number-correct scores) cannot be compared across forms or administrations because the scores depend on the difficulty of the items on a form. The same student can score higher on an easy test than on a difficult test. Although there are various equating methods available for different psychometric paradigms (IRT and CTT), the Keystone utilizes an IRT approach aligned with the assumptions of the Rasch model, the IRT pre-equating method. The first step in any IRT equating method is to conduct scale linking, in which item difficulties from independent calibrations are transformed onto the same scale (Kolen & Brennan, 2014). Once scale linking is conducted, we can proceed with any IRT-based equating methods.

Since the Keystone's inception, a pre-equating design has been implemented due to the many advantages it offers. Specifically, employing a pre-equating method allows for a shortened turn-around time for score reporting due to the use of previously linked item parameters for test construction and development of raw-to-scaled-score tables. In this chapter, we provide a brief comparison of pre- and post-equating, an explanation of the procedure implemented for the Keystone examinations, and a description of the evaluation of pre-equated and post-equated solutions. Summary results are also presented. The equating design and analyses were conducted for all administrations (winter, spring, and summer) of the Keystone examinations.

PRE- VS. POST-EQUATING

As with other Pennsylvania assessment programs, the Rasch model is used to guide the test design, form construction, calibration, scaling, and equating of the Keystone Exams. The key step of equating test forms using the Rasch model is to place the item parameters from different administrations on the same scale, also referred to as scale linking. Once the item parameters from different operational test forms are on the same scale, the Newton Raphson procedure can be used to convert number-correct scores to scaled scores as described in Chapter Fourteen. As a result, the scaled scores can be compared and used interchangeably within and across administrations.

As is the case with many K–12 large-scale assessment programs, all scored items are field tested prior to operational use. 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, provided the Rasch model fits the data. Based on this theoretical advantage of using the Rasch model, equating can be conducted using the item parameters that were previously calibrated. This statistical procedure is referred to as pre-equating.

In contrast, post-equating requires data from the current administration to be calibrated. Then, newly estimated item parameters are linked and placed on the same scale as banked item parameters, and scores are equated. With this in mind, pre-equating is advantageous because much of the work is completed before test administration, allowing more time for quality control; whereas post-equating relies on the same given timeframe for calibration, scale linking, equating scores, and implementing quality control procedures.

Although in theory the two equating procedures should provide identical results when the model fits the data, each has its own advantages and disadvantages. The use of pre-equating can facilitate the operational process in terms of rapid score reporting, more time for quality control, and more flexibility in the assessment. One successful application of pre-equating is for computer-adaptive tests (CATs) where test questions are tailored to the student's achievement as the test progresses, such as the Pennsylvania Classroom Diagnostic Tools (CDT). The CDT is designed to provide diagnostic information about student performance and is available throughout the school year at no cost. CATs require automated scoring for all item types (including constructed-response) and allow for immediate score reporting upon completion of the test. 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 standalone field tests, which may make the items appear harder in the field test than in the operational test (Eignor, 1985; Eignor & Stocking, 1986; Stocking & Eignor, 1986; Kolen & 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 as with pre-equating. Also, post-equating uses post-administration

data and is thought to yield more accurate analysis results, given that the number of students who take the operational tests is usually large. On the other hand, when the reporting window is extremely tight, as is the case with some graduation or end-of-course exams in various states, post-equating must occur within a very short time, allowing less time for the equating analyses and quality control.

EQUATING DESIGN FOR KEYSTONE EXAMS

The Keystone Exams, like many other graduation or end-of-course exams, require quick turnaround of test results. After the exams are administered, the bulk of the time is consumed by various data-processing steps. As a result, the equating analyses must be produced in a short period of time, which introduces risk of delays in score reporting. In addition, a student's best-score-to-date is calculated as the combination of performance across any administrations (see Chapter Sixteen for details), thus increasing the complexity of equating analyses and score reporting for future administrations. To control the quality and timeliness of post administration processing, pre-equating, one of the most promising applications of Rasch model or item response theory (see Lord, 1980, chap. 13), has been implemented for the Keystone Exams.

To implement the pre-equating model in the Keystone Exams, efforts have been made to enhance the accuracy of pre-equating results based on the findings from the literature. For example, to address the concerns regarding students' motivation to take field tests, stand-alone field tests were not used; rather field-test items were embedded throughout the test so that students would perceive no differences between field-test items and operational items. This approach allows Rasch item difficulty estimates to be used for future pre-equating purposes and is based on the assumption that students should be equally motivated to take the operational and embedded field-test items, especially when they are not aware of which item is a field-test item. To minimize item context and item position effects (i.e., lack of motivation and fatigue), field-test items were interspersed within the operational sections. With this design, students have a smaller chance of knowing the field-test item positions. Fatigue effects due to field-test items being placed in the last section of the operational test can be mitigated in this design as well. To improve the accuracy of the Rasch item difficulties and parameters estimated from the field-test data, DRC scored all MC items and a large sample of CR items given that larger sample sizes can increase the estimation accuracy. The test designs for the operational PSSA mathematics, ELA, and science assessments used multiple test forms that shared several common elements. The operational items were the same on all forms and for all students. Student total raw scores and scaled scores, as well as accountability reporting, were based exclusively on the operational items.

SCALE LINKING

Keystone utilizes a concurrent calibration linking design to obtain item parameters for field-tested items (administered during the spring administration). Results from scale linking are item parameters (Rasch difficulties and thresholds) for field-tested (FT) items that are on the base scale. The chain originates from the scale of measurement defined for each test's base form, which is used as the reference for calibrating all items in the item pool. The base form is usually the form upon which the cut scores were established (see Chapter Thirteen). In the case of the Keystone, scales and cut scores were established for all subjects in 2011; therefore, the examinations are linked to the scales set in 2011.

The Rasch Partial Credit Model (RPCM) is used for the calibrating data, given its flexibility for dichotomously scored (i.e., MC) and polytomously scored (i.e., CR) item types (Masters, 1982). The RPCM is discussed in detail in Chapter Twelve. Without employing scale linking, Rasch difficulties for the field-tested items would not be directly comparable to other items on the base scale. A partially anchored concurrent calibration was employed to estimate all 2022 field-test item parameters for each test on its respective base scale. The following steps are conducted following each spring administration to estimate the FT item parameters.

1. Calibrate OP and MC FT items in a partially-anchored concurrent design to estimate FT MC item parameters.
    a. Anchor OP item parameters to the banked values.
    b. Include all OP and MC FT items.
    c. Include only students who have completed the test and met other criteria described in Chapter Nine.

2. Calibrate OP and FT items in a partially-anchored concurrent design to estimate FT CR item parameters.
    a. Anchor OP item parameters to the banked values.
    b. Anchor MC FT item parameters to those estimated in Step 1.
    c. Include all OP and FT items.
    d. Include only students who have completed the test and met other criteria described in Chapter Nine.
    e. Include students who were selected as a part of the FT sample for handscoring.
    f. The resulting item parameters are banked for future use.

PRE-EQUATING VERIFICATION

Although extra care has been taken to guarantee the success of pre-equating during the test design, form construction, and calibration of embedded field-test items, DRC also ensured that the pre-equated results had reasonable data-model fit during the pre-equating verification process. Once sufficient data was available, pre-equating verification was conducted to assess data-model fit and allow the parameters of any misfitting items to be freely calibrated. Any misfitting item was identified, and parameters were freely estimated in a subsequent calibration (using a partially anchored design) to improve data-model fit. All calibration was conducted using WINSTEPS (Linacre, 2019). Both sets of item parameters were then used to estimate student abilities, which were then transformed to scaled scores. (Transformation formulas are provided in Chapter Fourteen.) The data and results presented in this section refer to misfitting items as those in which infit mean-square values exceeded a criterion of 1.3. The number of items identified during pre-equating verification for each content area is shown in Table 15–1. In Algebra, two misfitting items were identified in winter, but no items were identified in spring or summer. For Biology, four items were identified across all administrations, and for Literature, one item was identified in both winter and summer. Once items were identified, differences were analyzed between fully anchored pre-equated results (hereinafter "pre-equated") and partially anchored pre-equated results (hereinafter "post-equated"). Pre-equating verification analyses were conducted at the item level, person level, and form level. Additional results from the pre-equating verification analyses can be found in Appendix L.

Table 15–1. Number of Misfitting Items Identified during Pre-Equating Verification by Administration and Content Area

Administration	Algebra I N	Biology N	Literature N
Winter	2	1	1
Spring	0	1	0
Summer	0	2	3

At the same time, DRC test development specialists reviewed all misfitting items (infit mean-square values greater than 1.3) and items with large displacement values (absolute value greater than 0.5) to ensure that items were presented in the same manner as their prior administration.

ITEM-LEVEL ANALYSES

Item-level analyses indicate whether the data fit the Rasch model with respect to item-fit statistics and whether the item parameters showed displacement. For item misfit, this included the number of items that had reasonable fit statistics (e.g., greater than 0.7 and less than 1.3) supported by prior literature (Wright & Linacre, 1994). Table 15–2 shows the item fit statistics comparison for each content area and administration. For each administration and content area, both pre-equated and post-equated solutions showed similar fit to the model in terms of infit and outfit statistics. The results support that the data fit the pre-equated solution well.

Table 15–2. Item Infit and Outfit Mean-Square Statistics by Administration and Content Area

Admin.	Content Area	Method	N	Infit Mean	Infit SD	Infit Min	Infit Max	Infit Range [0.7,1.3]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit Range [0.7,1.3]
Winter	Algebra I	Pre	36945	1.02	0.13	0.78	1.46	41/42	1.04	0.19	0.71	1.66	37/42
Winter	Algebra I	Post	36945	1.01	0.11	0.78	1.24	42/42	1.02	0.16	0.72	1.33	38/42
Winter	Biology	Pre	31017	1.01	0.11	0.81	1.31	53/54	1.02	0.13	0.82	1.41	51/54
Winter	Biology	Post	31017	1.01	0.10	0.81	1.27	54/54	1.02	0.13	0.82	1.33	52/54
Winter	Literature	Pre	30413	1.03	0.14	0.70	1.35	38/40	1.08	0.22	0.70	1.68	35/40
Winter	Literature	Post	30413	1.02	0.13	0.70	1.23	39/40	1.07	0.20	0.70	1.57	35/40
Spring	Algebra I	Pre	158888	1.01	0.13	0.75	1.29	42/42	1.04	0.22	0.65	1.64	35/42
Spring	Algebra I	Post	158888	1.01	0.13	0.75	1.29	42/42	1.04	0.22	0.65	1.64	35/42
Spring	Biology	Pre	137374	0.99	0.09	0.79	1.31	53/54	1.00	0.12	0.73	1.42	53/54
Spring	Biology	Post	137374	0.99	0.08	0.79	1.24	54/54	0.99	0.11	0.73	1.31	53/54
Spring	Literature	Pre	128693	1.00	0.14	0.63	1.26	38/40	1.03	0.22	0.62	1.46	30/40
Spring	Literature	Post	128693	1.00	0.14	0.63	1.26	38/40	1.03	0.22	0.62	1.46	30/40
Summer	Algebra I	Pre	352	1.02	0.12	0.79	1.25	42/42	1.03	0.18	0.64	1.49	38/42
Summer	Algebra I	Post	352	1.02	0.12	0.79	1.25	42/42	1.03	0.18	0.64	1.49	38/42
Summer	Biology	Pre	257	1.02	0.11	0.84	1.34	53/54	1.03	0.15	0.78	1.41	50/54
Summer	Biology	Post	257	1.01	0.09	0.84	1.27	54/54	1.02	0.13	0.79	1.39	51/54
Summer	Literature	Pre	161	1.02	0.19	0.55	1.49	36/40	1.09	0.33	0.56	2.12	31/40
Summer	Literature	Post	161	1.00	0.17	0.55	1.27	39/40	1.06	0.3	0.55	2.17	32/40

In addition, the results from the fully-anchored pre-equated calibration were assessed to identify any issues with item parameter stability. Displacement refers to the shift in item parameters between anchored values and values that would have been freely estimated in an unanchored calibration. The items with an absolute displacement value greater than or equal to 0.5 were identified and reviewed by DRC test development specialists. Table 15–3 summarizes the outliers flagged by displacement. These items were reviewed by DRC content specialists, but no obvious reasons were found to explain the item difficulty change.

Table 15–3. Count of Items Flagged for Displacement by Administration and Content Area

Administration	Algebra I N	Biology N	Literature N
Winter	1	0	4
Spring	0	0	1
Summer	0	2	10

PERSON-LEVEL ANALYSES

The second set of analyses conducted consisted of analyzing person-level fit statistics, which can be another indicator of whether the data fit the model. Table 15–4 summarizes the overall person-level infit and outfit statistics by administration and content area for both the pre-equated and post-equated solutions. The table specifies the mean, standard deviation (SD), minimum (Min), maximum (Max), and proportion of persons who had reasonable fit statistics (e.g., greater than 0.5 and less than 1.5)[1] for both infit and outfit statistics. The results in the tables indicate that person-level fit does not vary by equating method.

Furthermore, Appendix L includes the results for the pre-equating verification, including the person infit boxplots for all administrations and content areas for both pre-equated and post-equated solutions. Appendix L also provides boxplots disaggregated by ethnicity, gender, English Learners (ELs), and students with individualized educational programs (IEPs). The person infit plots indicate that the data fits the pre- and post-equated solutions similarly.

Table 15–4. Person Infit and Outfit Mean-Square Statistics by Administration and Content Area

Admin.	Content Area	Method	N	Infit Mean	Infit SD	Infit Min	Infit Max	Infit Range [0.5,1.5]	Outfit Mean	Outfit SD	Outfit Min	Outfit Max	Outfit Range [0.5,1.5]+
Winter	Algebra I	Pre	36945	0.99	0.19	0.22	3.17	98.1%	1.04	0.21	0.06	4.43	96.8%
Winter	Algebra I	Post	36945	0.99	0.19	0.21	3.18	98.1%	1.02	0.2	0.06	4.37	97.5%
Winter	Biology	Pre	31017	0.99	0.14	0.62	2.01	99.7%	1.02	0.14	0.21	2.10	99.3%
Winter	Biology	Post	31017	0.99	0.14	0.61	2.01	99.7%	1.02	0.13	0.20	2.08	99.4%
Winter	Literature	Pre	30413	0.99	0.21	0.31	2.22	97.5%	1.07	0.33	0.14	7.20	90.3%
Winter	Literature	Post	30413	0.99	0.21	0.31	2.21	97.5%	1.07	0.32	0.14	7.13	91.2%
Spring	Algebra I	Pre	158888	0.99	0.21	0.26	3.11	98.0%	1.04	0.31	0.08	9.90	91.5%
Spring	Algebra I	Post	158888	0.99	0.21	0.26	3.11	98.0%	1.04	0.31	0.08	9.90	91.5%
Spring	Biology	Pre	137374	0.98	0.14	0.58	2.86	99.7%	1.00	0.14	0.19	3.53	99.4%
Spring	Biology	Post	137374	0.98	0.14	0.58	2.86	99.7%	0.99	0.13	0.19	3.51	99.4%
Spring	Literature	Pre	128693	0.97	0.22	0.33	2.82	97.6%	1.03	0.32	0.13	7.03	91.6%
Spring	Literature	Post	128693	0.97	0.22	0.33	2.82	97.6%	1.03	0.32	0.13	7.03	91.6%
Summer	Algebra I	Pre	352	1.01	0.22	0.59	1.77	97.2%	1.03	0.23	0.21	2.34	96.9%
Summer	Algebra I	Post	352	1.01	0.22	0.59	1.77	97.2%	1.03	0.23	0.21	2.34	96.9%
Summer	Biology	Pre	257	1.01	0.16	0.70	1.9	98.8%	1.03	0.15	0.26	1.47	99.6%
Summer	Biology	Post	257	1.00	0.16	0.70	1.89	98.8%	1.02	0.15	0.25	1.46	99.6%
Summer	Literature	Pre	161	0.98	0.21	0.43	1.66	96.9%	1.09	0.36	0.38	2.83	90.1%
Summer	Literature	Post	161	0.96	0.21	0.41	1.60	96.9%	1.06	0.33	0.36	2.69	91.9%

[1] While items and persons are on the same scale, items tend to be more stable. As such, stricter rules are applied to item-fit statistics than person-fit statistics in determining reasonable fit.

NORMALIZED SCALED SCORE DIFFERENCES

On the form level, we evaluated differences between pre-equated and post-equated results. Normalized differences were calculated as the difference between the scaled score divided by the average CSEM of pre- and post-equated results at each raw score point (see Equation below). Table 15–5 displays the descriptive statistics of the normalized scaled score differences as well as the normalized scaled score difference at the proficient cut-score. A difference at the proficient cut-score may indicate a difference in performance level classification. Results indicated that normalized differences were all within reasonable expectations (min = 0, max = 0.2), where the largest difference was observed for summer Literature. The plots for normalized scaled score differences are displayed in Appendix L.

$$\text{Normalized Scale Score Difference} = \frac{(SS_{Pre} - SS_{Post})}{((CSEM_{Pre} + CSEM_{Post})/2)}$$

Table 15–5. Normalized Scaled Score Differences Summary by Administration and Content Area

Administration	Content Area	SS Difference Mean	SS Difference Min	SS Difference Max	SS Difference at Prof. Cut
Winter	Algebra I	0.049	0.000	0.071	0.071
Winter	Biology	0.024	0.000	0.077	0.000
Winter	Literature	0.024	0.000	0.067	0.000
Spring	Algebra I	0.000	0.000	0.000	0.000
Spring	Biology	0.013	0.000	0.083	0.000
Spring	Literature	0.000	0.000	0.000	0.000
Summer	Algebra I	0.000	0.000	0.000	0.000
Summer	Biology	0.050	0.000	0.083	0.083
Summer	Literature	0.114	0.011	0.200	0.125

PERFORMANCE LEVEL CLASSIFICATION

Pre-equated solutions were considered reasonable if classification consistency did not change more than 5%. Table 15–6 shows the consistency of classifications with respect to performance levels. The three numeric values within each cell refer to the proportion of students that do not agree at each of the three cuts (Basic, Proficient, and Advanced). If a numeric entry is followed by a negative sign, then pre-equating resulted in a lower percentage of students in the adjacent performance level when compared to post-equating. On the other hand, if the numeric entry is followed by a positive sign, then pre-equating resulted in a higher percentage of students in the adjacent performance level when compared to post-equating.

Performance level classification was identical between the pre- and post-equated solutions for all administrations and content areas except spring Biology, in which 2% of students were classified as Basic when pre-equating was used and Proficient when post-equating was used. Yet these results indicate that the pre-established criterion, in which no more than 5% of performance level classifications changed between the pre- and post-equated solutions, was met. There were no differences observed in performance level classifications for Algebra or Literature. After comparing and evaluating the results, the percentage of students classified differently was less than 5% within each classification. The TAC agreed if classification consistency was less than 5%, then pre-equated solutions should be accepted.

Table 15–6. Performance Level Impact Summary between Pre- and Post-Equated Solutions by Administration and Content Area

Administration	Algebra I	Biology	Literature
Winter	Exact	Exact	Exact
Spring	Exact	Exact	Exact
Summer	Exact	(2+,2+,0)	Exact

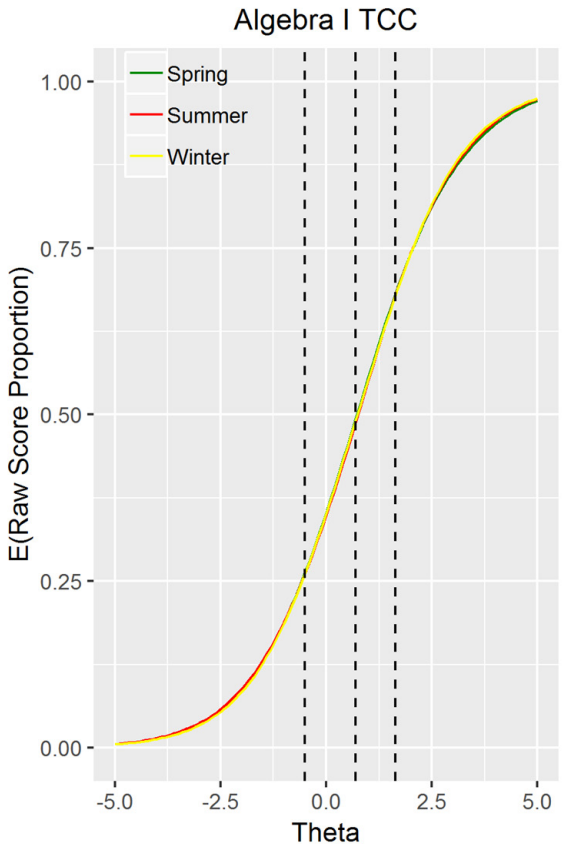
SCALE STABILITY AND MAINTENANCE

Scale stability is a critical component of any testing program. The 2014 Standards of Educational and Psychological Testing state that "Testing programs that attempt to maintain a common scale over time should conduct periodic checks of the stability of the scale on which the scores are reported" (p.103). Conducting item parameter checks, ensuring that item parameters do not drift over time, and potentially updating operational item parameters are a few ways in which testing programs can maintain scale stability. Although many of these aspects are checked during the pre-equating verification process, it is also important to analyze student performance and scale stability following each administration.

TEST CHARACTERISTIC CURVES AND LOGIT PLOTS

Figures 15–1 and 15–2 help one visualize the across-administration differences in the difficulties of operational items. In Figure 15–1, the test characteristic curves (TCCs) for each administration are presented for each content area. These figures show the winter, spring, and summer TCCs and indicate alignment among the 2022 test forms in terms of difficulty in the logit metric. TCCs that are closely aligned translate into similar raw-score cut points and similar test difficulty across years. The three dotted vertical lines represent the Basic, Proficient, and Advanced cut-scores on the logit (theta) scale. All content areas showed very small differences across administrations.

Figure 15–1. Test Characteristic Curves



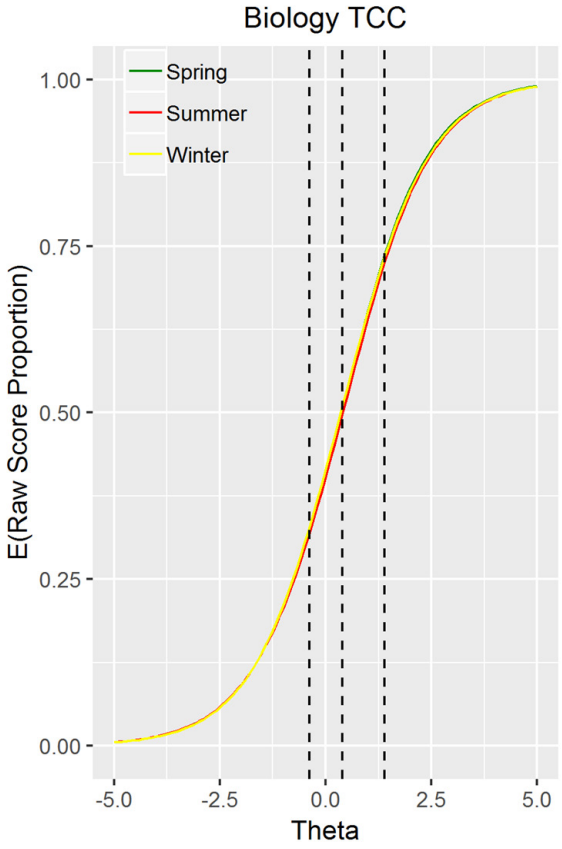


Figure 15–1 (continued). Test Characteristic Curves

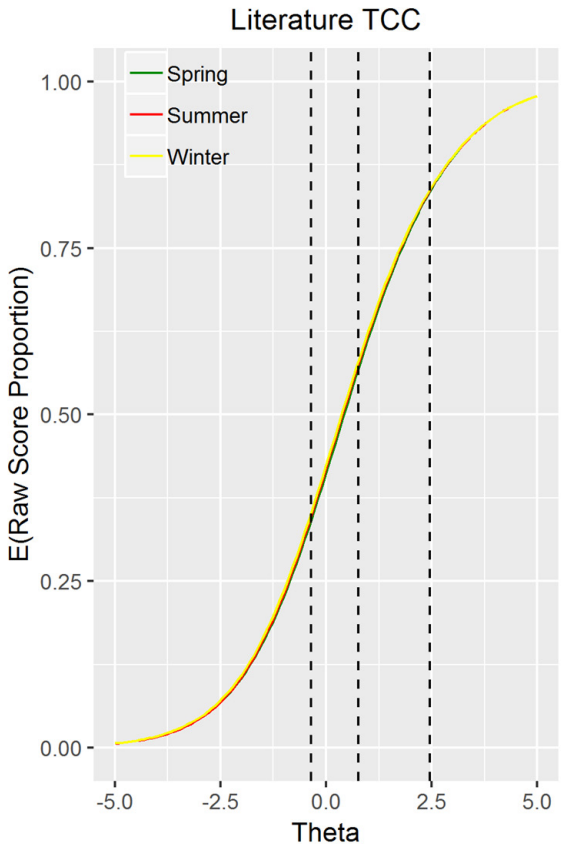
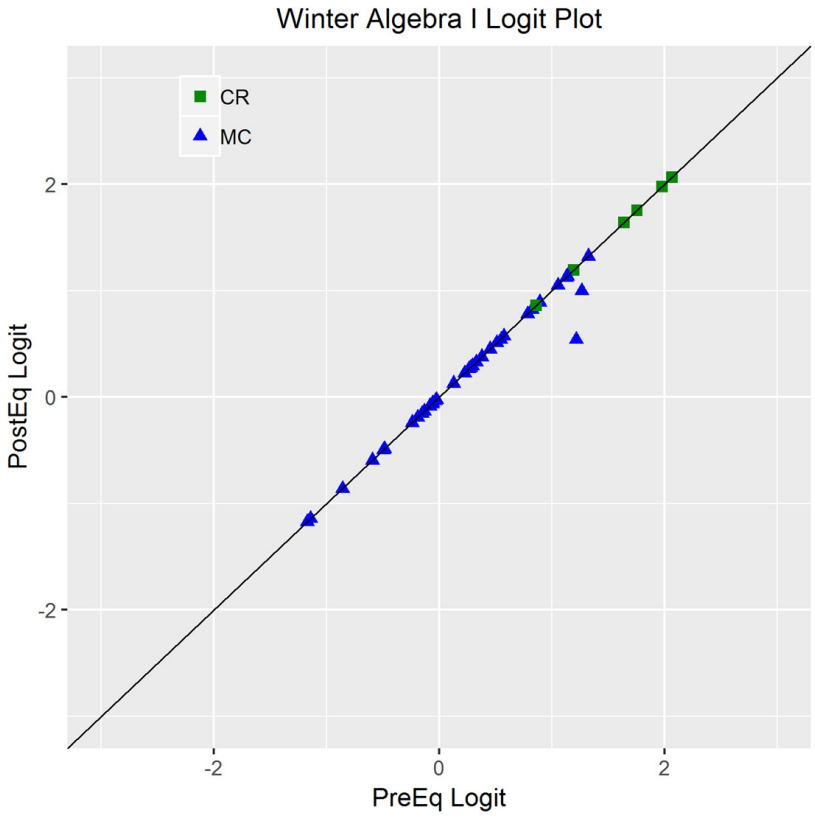


Figure 15–2 displays the relationship between the pre-equated item difficulties (x-axis) and the post-equated item difficulties (y-axis) on the logit (theta) scale. The black line represents the identity line; if points fall on the identity line, it indicates that there is no difference between the pre-equated and post-equated item difficulty. Points that do not fall on the identity line indicate items that were identified as misfitting during the pre-equating verification process and were freely estimated in a subsequent calibration. In all cases, the item difficulties that were freely estimated under the post-equated model were close to the identity line. The plots provide evidence of reasonable across-year stability of item difficulty, meaning the pre-equated item difficulties were similar to the post-equated item difficulties.

Figure 15-2. Logit Plots



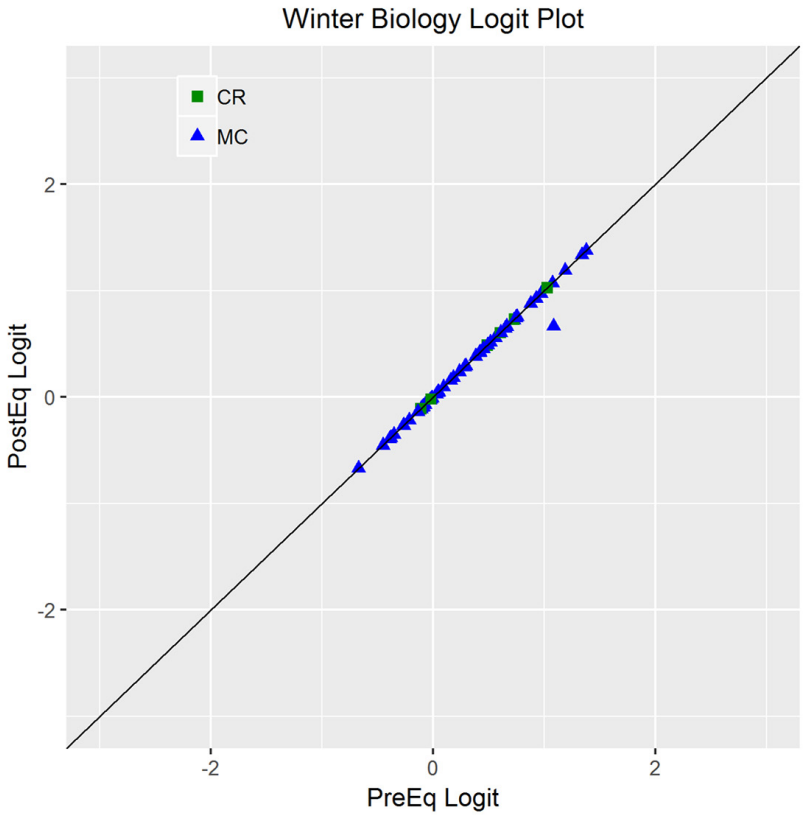
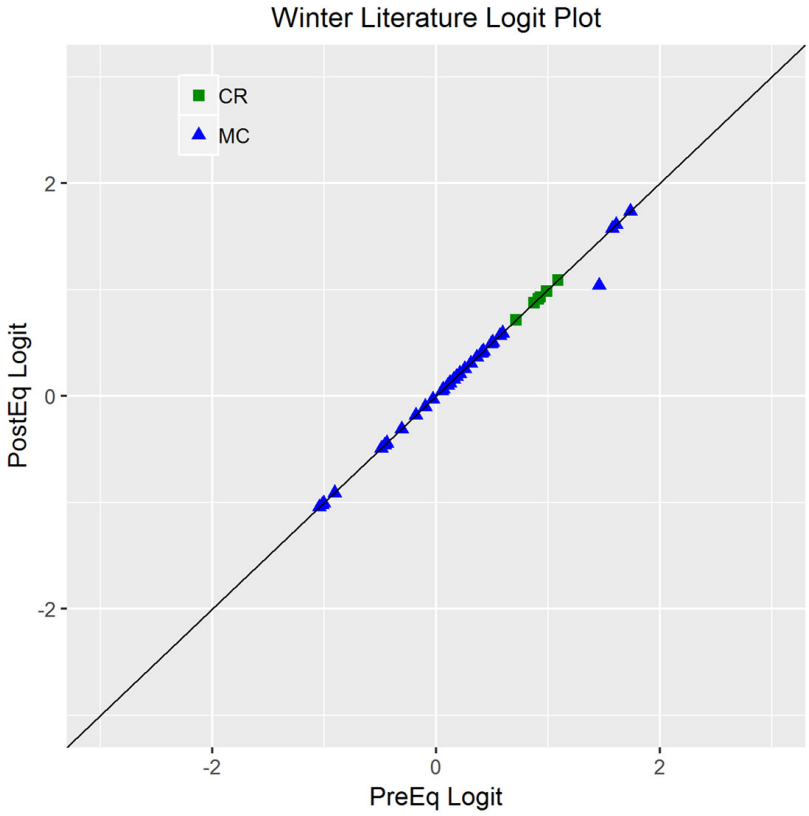


Figure 15-2 (continued). Logit Plots



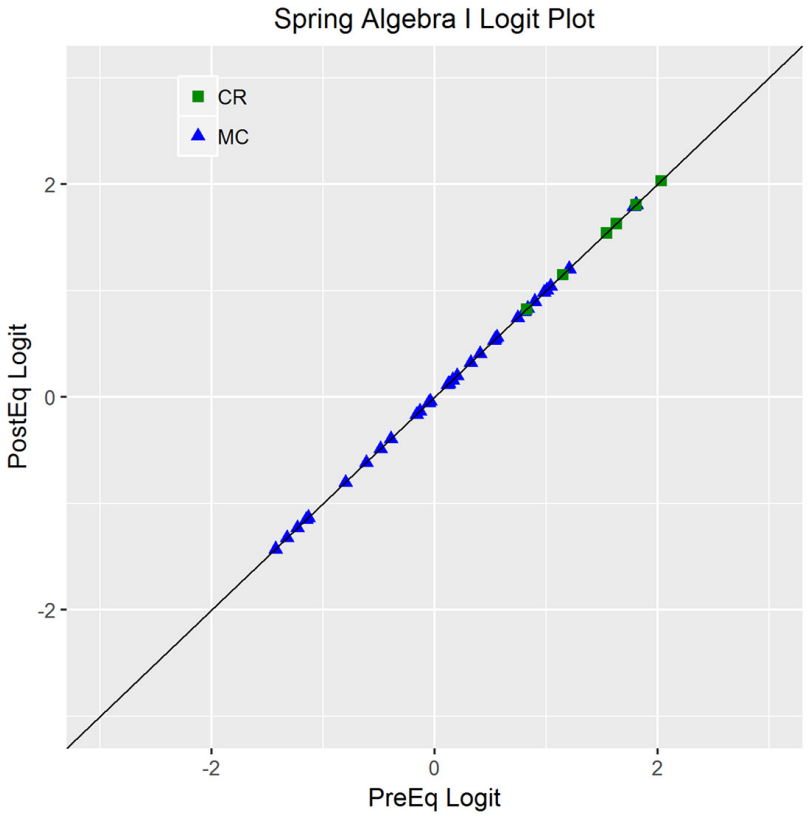
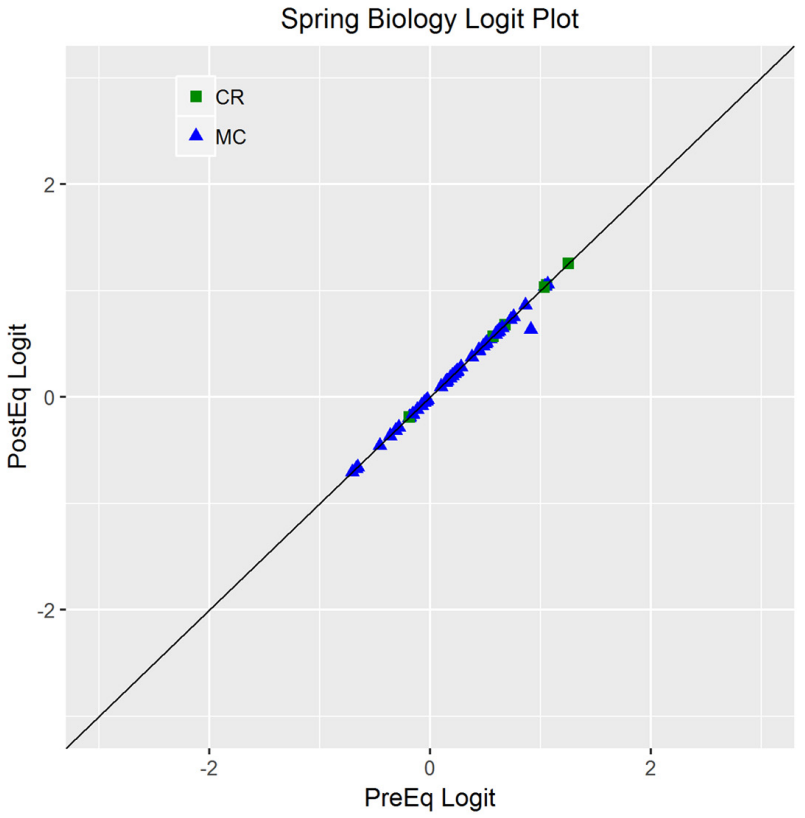


Figure 15-2 (continued). Logit Plots



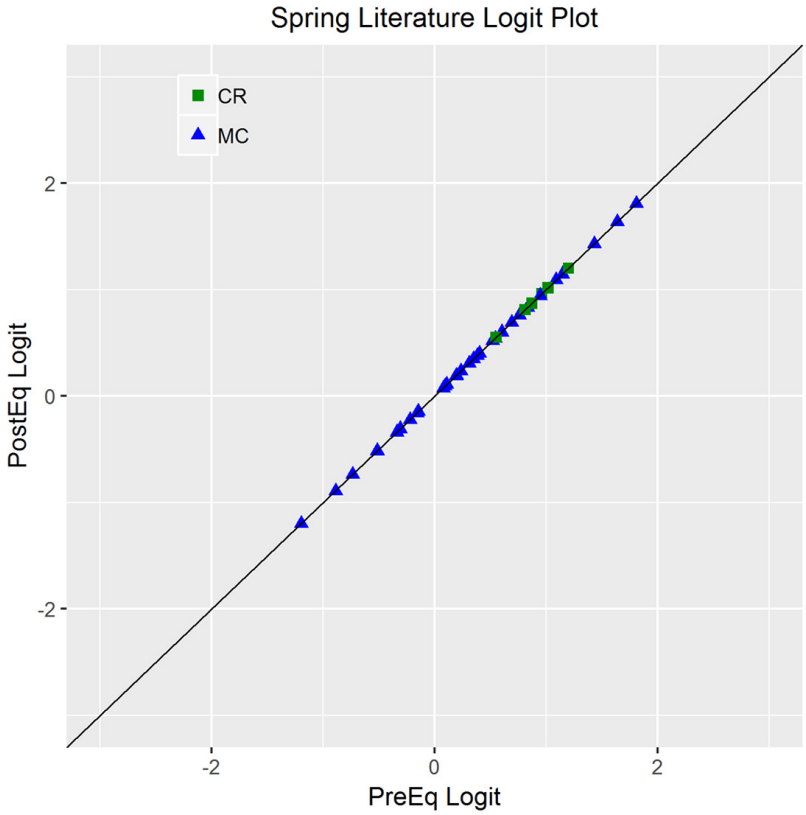
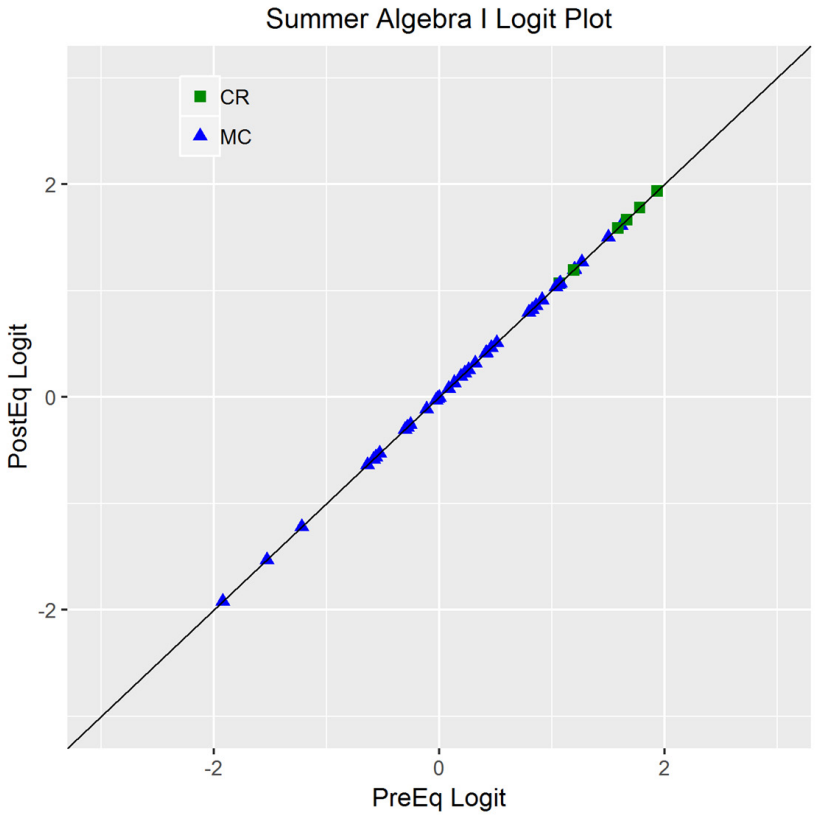


Figure 15-2 (continued). Logit Plots



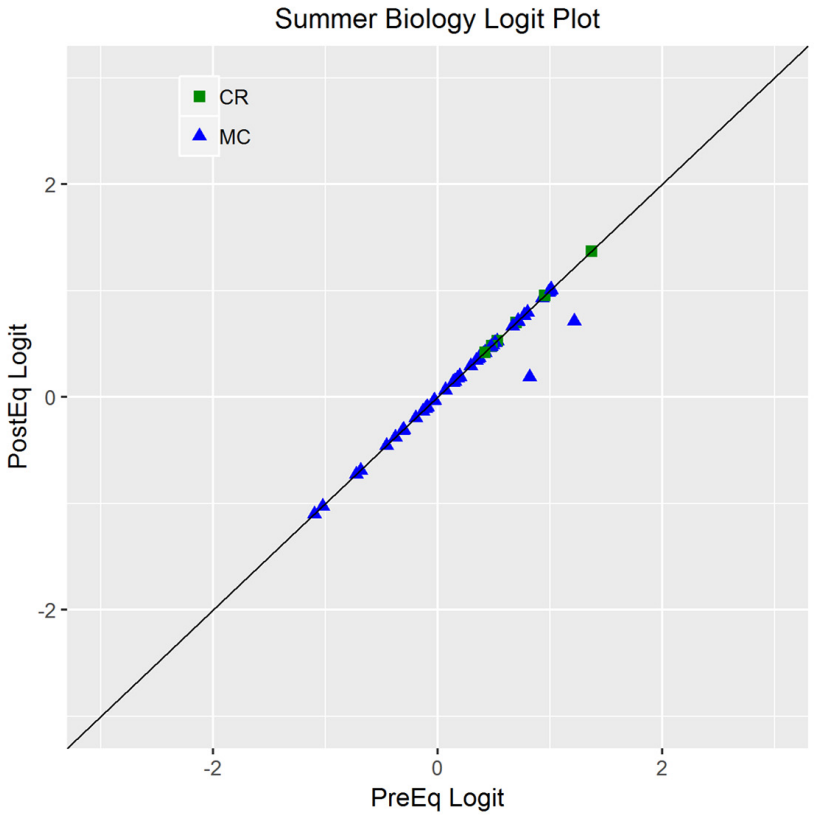
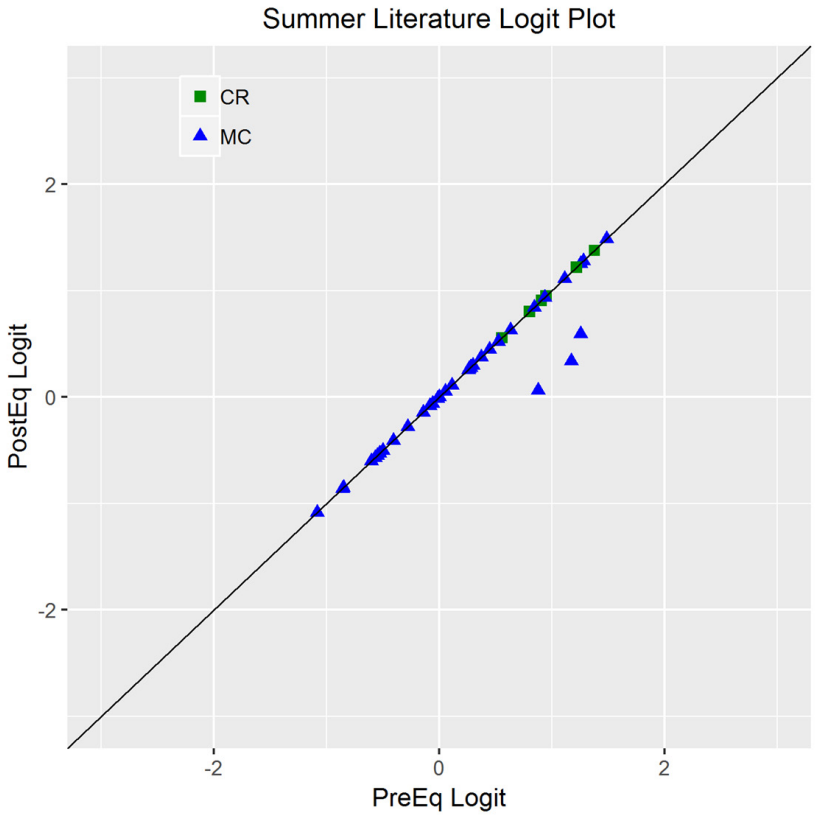


Figure 15-2 (continued). Logit Plots



CHAPTER SIXTEEN: SCORES AND SCORE REPORTS

This chapter provides information about the scores provided for the Pennsylvania Keystone Exams (e.g., scaled scores, performance levels, and module scores), how the scores are presented on score reports, and appropriate and inappropriate uses of the scores.

SCORING

Keystone Exams items include both multiple-choice (MC) and constructed-response (CR) items. Each correct response to an MC item receives a score of 1. Incorrect responses receive a score of 0. Scores on CR items range from 0 to 4, depending on the content area. Table 16–1 summarizes the types of items used in each content-area exam.

Table 16–1. Item Types Used by Content Area

Exam	Item Type MC (1 point)	Item Type CR (3 point)	Item Type CR (4 point)
Algebra I	■		■
Biology	■	■	
Literature	■	■	

DESCRIPTION OF TOTAL-TEST SCORES

Different types of scores have been developed for Keystone Exams reporting. Since the underlying properties of these scores are not necessarily the same, the particular scores used depend on the purposes for which the test has been given. The following types of scores are provided for reporting overall performance on each Keystone Exam:

- Raw scores
- Scaled scores
- Highest total test scaled score to date
- Performance levels

RAW SCORES

A raw score (or number-correct score) is the number of points a student earned over all the operational MC and CR items. By itself, the raw score has very limited utility. One limitation is that it can only be interpreted with reference to the total number of items on a specific exam (e.g., a raw score of 15 on a 20-item exam is different from a raw score of 15 on a 30-item exam). In addition, raw scores depend on the difficulty of test items across test forms (e.g., a raw score of 15 on a test with 20 easy items is different from a raw score of 15 on a test with 20 difficult items). Because the difficulty of the items on a test can change from administration to administration, raw scores should not be compared across administrations.

SCALED SCORES

Scaled scores were introduced in Chapter Fourteen. In the simplest sense, a scaled score is a transformed number-correct score. The specifics of the transformation processes for the Keystone Exams were also discussed in Chapter Fourteen. When all students take the same test items, as with the operational items on the Keystone Exams, the more points the student earns, the higher the associated scaled score will be.

The value of switching to the more abstract scaled-score metric is that it produces more general, interpretable, and equitable results. As noted above, a raw score of 30 is meaningless unless the maximum raw score is known. The difficulty of the test items was also mentioned as an additional challenge with interpreting raw scores. Number-correct scores are transformed to scaled scores to remove the effects of test length and item difficulty. (Strictly speaking, transformation of number-correct scores to percent-correct scores would also remove the effect of test length, but it would do nothing to adjust for the difficulty of the items.)

Another advantage of scaled scores is that they lend themselves to interpretations at what is referred to as an interval level, while raw scores do not. Interval-level scales allow an interpretation of a scaled score difference of 5 points to be the same whether the scores are 1295 vs. 1300 or 1445 vs. 1450. Raw-score differences, in this context, cannot be interpreted in this manner and are thus neither generalizable nor equitable.

A scaled score of 1500—or any other value for a particular content-area exam, such as Algebra I—should have the same absolute meaning in the current administration as it had in previous administrations when test scores are properly equated across administrations. More importantly, a significant increase in the scaled score from the previous administration to the current administration means that student performance improved[1]; it does not say anything about whether this administration's exam is easier or harder than last administration's exam. To make these interpretations requires no information about the length or the difficulty of the exam in either administration, although these variables are essential for the process of deriving the scaled scores.

There is considerable auxiliary information presented in this report that might aid in further contextualizing Keystone Exams scaled scores:

- Chapter Fourteen provides information on the development of the Keystone Exams scaled-score system, including transformation formulas, rounding rules, and general scale characteristics (e.g., minimum values).
- Chapter Seventeen provides total-test score statistics. In particular, Table 17–2 lists the scaled-score means and standard deviations for the testing results.

HIGHEST TOTAL TEST SCALED SCORE TO DATE

After an administration, every test-taker earns an administration-specific scaled score based on their overall performance, as well two scaled scores based on their performance on Module 1 and Module 2. As previously discussed, each examination consists of two modules that measure distinct topics within each content area. For example, for Literature Module 1 represents fiction-based content and Module 2 represents non-fiction-based content. If a student takes a Keystone Exam multiple times, they also receive a highest total test score to date that represents the best combination of performance on Module 1 and Module 2. The advantage of this calculation is to combine Module-level performance from different administrations that may represent a higher total score and performance level (i.e., proficient or advanced). Both the administration-specific scaled scores (Module 1, Module 2, and total) and the highest total test scaled score are included on the score reports (see Figures 16–1 and 16–2).

In this technical report, both administration-specific and highest test scaled score to date information is presented. In general, information about raw scores always represents the administration-specific performance. Meaning, results represent the raw scores earned on that specific administration. On the other hand, information about scaled score performance represents the highest scaled score to date calculation unless otherwise specified. Moreover, information about performance level classifications also represents the performance level that corresponds to the highest total test scaled score to date. Meaning when scaled scores and performance levels are presented, results represent the best combination of Module 1 and Module 2 that yield the highest overall score and performance level classification.

PERFORMANCE LEVELS

Keystone Exams results are also reported using four performance levels: Below Basic, Basic, Proficient, and Advanced. The cut scores on the scaled-score metric (i.e., the lowest possible scaled score to enter the Basic, Proficient, and Advanced levels) were presented earlier in this report. However, the information is repeated below (Table 16–2) for convenience.

[1] This example is not an endorsement of conducting a trend analysis with just two years of results. Further, small differences may not be statistically or practically significant.

Table 16–2. Scaled Score Cuts for Each Performance Level by Content Area

Exam	Min	Scaled Score Cuts BB/B	Scaled Score Cuts B/P	Scaled Score Cuts P/A	Max
Algebra I	1,200	1,439	1,500	1,546	1,800
Biology	1,200	1,460	1,500	1,549	1,800
Literature	1,200	1,444	1,500	1,584	1,800

Note. BB = Below Basic; B = Basic; P = Proficient; and A = Advanced

Performance level descriptors (PLDs) are another way to attach meaning to the scaled-score metric. They associate precise quantitative ranges of scaled scores with verbal, qualitative descriptions of student status. While much less precise, the qualitative description of the levels is one way for parents and teachers to interpret the student scores. They are also useful in assessing the status of the school. The Pennsylvania General PLDs developed by Pennsylvania Department of Education (PDE) and teacher panels are given below. These are also included on student score reports.

- **Advanced:** Superior academic performance indicating an in-depth understanding and exemplary display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content.
- **Proficient:** Satisfactory academic performance indicating a solid understanding and adequate display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content.
- **Basic:** Marginal academic performance indicating work approaching, but not yet reaching, satisfactory performance. Performance indicates a partial understanding and limited display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content. The student may need additional opportunities and/or increased student academic commitment to achieve the Proficient level.
- **Below Basic:** Inadequate academic performance indicating little understanding and minimal display of the skills included in the Keystone Exams Assessment Anchors and Eligible Content. There is a major need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient level.

DESCRIPTION OF MODULE SCORES

Each of the Keystone Exams in Algebra I, Biology, and Literature contains two modules. A module score describes performance of a student, school, or district on a particular module (content standard defined in the exam). The following types of scores are provided for Keystone Exams at module level:

- Raw scores
- Scaled scores
- Performance levels

MODULE RAW SCORES

Raw scores at module and assessment anchor levels were reported in different summary reports. As described earlier, a raw score is the number of points a student earned over all the operational MC and CR items; it depends on the difficulty and length of the test form; and it should not be compared across administrations. In the summary reports, the school, district, and/or state median points earned were reported at module and assessment anchor levels. These raw scores can provide some diagnostic information when they are compared with the minimum estimated points needed to pass. The latter is calculated by summing the probabilities of a barely proficient student answering the items included in a module or assessment anchor correctly. The sum is rounded up to the nearest integer. The probability is derived using the Rasch models discussed in Chapter Twelve.

MODULE SCALED SCORES

The module scaled scores were provided in the individual student report. For the Keystone Exams, the module scaled score represents a student's achievement on each module. They can be compared across administrations because they are statistically equated. However, it is not advisable to compare scores across modules because each module contains varying item content and difficulty. This variation is also the reason the total scaled score is not the average of the two modules' scaled scores.

MODULE PERFORMANCE LEVELS

Based on the testing results at the module level, students can be classified as Passed or Not Passed. The derived scaled score cut is 1500 for both modules. This cut score is determined by panelists' recommendations for the proficient cut of the corresponding total test. Note that a student who does not pass a module can still be Proficient or above on the total test if the student performs very well on the other module. If a student is not proficient on the total test but passes one module, although it is recommended that this student take both modules during retesting, the student can choose to take just the non-passed module because the final score is based on the highest combination of module scores.

APPROPRIATE SCORE USE

INDIVIDUAL STUDENTS

Scaled scores on the Keystone Exams indicate a student's achievement with respect to the Keystone Exams Assessment Anchors and Eligible Content. Scaled scores are primarily used to determine student performance level classifications (i.e., a criterion-referenced inference). Scaled scores that are based on Rasch models are typically assumed to be of the interval type, so comparisons may be made on differences in scaled scores. If this assumption holds, then it would be safe to infer for Algebra I that the ability difference between 1410 and 1420 represents the same ability difference that separates 1550 and 1560. Scaled scores can also be used to compare the performance of an individual student to the performance of a similar demographic or subgroup at a school or district. Test score standard errors (discussed in Chapter Eighteen) should be considered.

GROUPS OF STUDENTS

Test results can be used to evaluate performance over time. Mean scaled scores can be compared across administrations within the same content area to indicate whether a student's performance is improving across years. Generally, such trend analyses benefit from using mean results from as many test administrations as possible. Different cohorts of students are used (i.e., the same student or students are not tracked across grade levels). All scores can be analyzed within the same content area for any single administration to determine which demographic or program group had, for example, the highest average performance or the highest percentage of students at or above Proficient.

Module scores can help evaluate academic areas for relative strengths or weaknesses. These module scores provide information to identify areas where further diagnosis is warranted. Generalizations from test results may be made to the specific content domain represented by the academic standards measured in the Keystone Exams. However, all instruction and program evaluations should include as much information from other sources as possible to provide a complete picture of performance.

CAUTIONS FOR SCORE USE

EXTREME ERROR FOR EXTREME SCORES

Student scores toward the minimum or maximum ends of the score range have very large standard errors of measurement (SEM) and, therefore, should be interpreted very cautiously. The maximum scaled score only provides a very rough estimate of a student's ability. For example, if a student achieved the maximum scaled score (i.e., 1800), it cannot be determined whether this student could have achieved an even higher scaled score. If the test were 10 items longer, a different estimate might have been obtained. Similarly, if the items on a new test are more difficult than the items on a previous administration, the maximum scaled score would likely be higher on the new test because it would take a greater level of achievement to answer the items correctly. In this manner, extreme scaled scores may vary from one administration to the next even if the number of test items does not change. The fluctuation of extreme scaled scores complicates the comparisons of students with scaled scores at the extreme ends of the score distribution. To minimize confusion and potential misinterpretation, the minimum and maximum

scaled scores possible on the Keystone Exams have been fixed (see Table 16–2) so they do not change between administrations.

UNIQUE SCALE FOR EACH CONTENT AREA

Scaling was conducted for each content-area exam separately. Therefore, the scaled scores should be interpreted only within each content area. The scaled scores are not status indicators in the same sense as percentile ranks (or scales that are essentially transformations of percentile ranks) and therefore cannot be used to profile relative strengths and weaknesses across content areas. As an example, the scaled scores of 1450 in Algebra I and 1400 in Biology gained by a student do not necessarily imply that the student performed better in Algebra I than in Biology.

USING KEYSTONE EXAMS RESULTS FOR OTHER PURPOSES

Other uses or inferences based on Keystone Exams results may or may not be valid as the validity evidence and arguments provided in Chapter Nineteen may not necessarily support other score uses and interpretations. According to the *Standards for Educational and Psychological Tests* (AERA, APA, & NCME, 2014), if a test is used in a way that has not been validated, it is incumbent on the user to justify the new use, collecting new evidence if necessary. Finally, a universal caveat for any test's result is that it should not be used for placement and educational planning alone. Instead, other information about the student (e.g., other test performance data) should be included.

REPORT DEVELOPMENT

Several months prior to the first release of reports for the Keystone Exams, PDE and DRC conducted focus groups with Pennsylvania educators and parents/guardians. In the focus groups, educators and parents/guardians provided feedback on sample report for the Keystone Exams. Feedback from the focus groups was used to inform the design and content of the Keystone individual and summary reports. The focus groups targeted educator and parent/guardian constituencies in three geographic regions of the state—the Pittsburgh area, the Harrisburg area, and the Philadelphia area.

Two preliminary educator groups were convened in Harrisburg on November 15 and 17, 2010. These groups, totaling 34 educators, reviewed the student report and provided feedback using both a survey and group discussion. Substantive changes to the individual student report were made as a result of these meetings, with two different versions of the report emerging from these reviews. These two groups did not review the summary reports.

A second set of focus groups were conducted in December 2010 to review the updated reports. For the December meetings there were 35 panelists (22 educators & 13 parents) for six focus groups in Pittsburgh (December 3), Harrisburg (December 6), and King of Prussia (December 7). The three educator groups reviewed the two versions of the student report and the one version of the school summary report. The three parent groups reviewed the two versions of the student report.

Feedback from these two focus groups was taken into consideration during final report development. For more information about the focus groups, please refer to the *Keystone Exams Score Report Focus Group Findings* (Pennsylvania Department of Education, 2011).

REPORTS

The following score reports are provided to students, schools, and districts for the Keystone Exams in Algebra I, Biology, and Literature:

- Parent Letter
- Individual student report
- School summary report
- District summary report
- State summary report
- Report interpretation guide

PARENT LETTER

Parent letters were delivered to Pennsylvania districts when district files were posted after each Keystone administration. This score report provided parents and students with their first glimpse of performance on the Keystone Exams. This report provides results at the student level.

INDIVIDUAL STUDENT REPORT

A student report is provided for all students who took the Keystone Exams. Two copies of the individual student report for all Keystone Exams were sent to each school district and charter school for distribution to parents, teachers, guidance counselors, and/or principals. School districts and charter schools may publish the results of the Keystone Exams school-level reports. This report is a two-page color document that provides the types of scores explained earlier in this chapter. Screenshots of the two pages from a sample individual student report are provided in Figures 16–1 and 16–2. Figure 16–2 displays the second page of the Individual Student Report, including scale score on each module, and the highest total test scale score to date.

Figure 16–1. Page 1 of the Individual Student Report

PENNSYLVANIA KEYSTONE EXAMS

Student Report

Student Name: SAMPLE STUDENT 1

PA Student ID:

School:

District:

Test Date:

Grade:

Content Area:
Biology

Student's Keystone Exam Result			
		Goal Range	
Below Basic	Basic	Proficient	Advanced
		✓	

Dear Parent/Guardian:

On behalf of the Pennsylvania Department of Education, I would like to thank you for taking the time to review this report. Academic success begins at home. Children with parents/guardians who are engaged in their child's academics are more likely to enjoy the learning process and succeed.

This report provides information about your child's recent performance on a Pennsylvania test known as the Keystone Exam. On this page, you can see your child's overall performance – below basic, basic, proficient or advanced.

Within this report, you will find specific information about your child's performance on the Biology Keystone Exam. It displays your child's Highest Total Test Scale Score to Date for Module 1 and Module 2. Module 1 assesses Cells and Cell Processes, and Module 2 assesses Continuity and Unity of Life.

For detailed information about the Keystone exams, please visit the Pennsylvania Department of Education's Standards Aligned System website at www.pdesas.org, or contact your child's school.

Sincerely,

Noe Ortega
Acting Secretary of Education

About the Keystone Exams

The Keystone Exams are end-of-course assessments designed to evaluate student performance on academic content. The purpose of the Algebra I, Biology, and Literature Keystone Exams is to measure student, educator, and school accountability. Keystone Exams are designed to be administered to students at or near the end of a Keystone-related course. Students' results are banked until their junior year for accountability purposes. Keystone Exams are one component of Pennsylvania's system of high school graduation requirements affecting students in the class of 2023 and beyond.

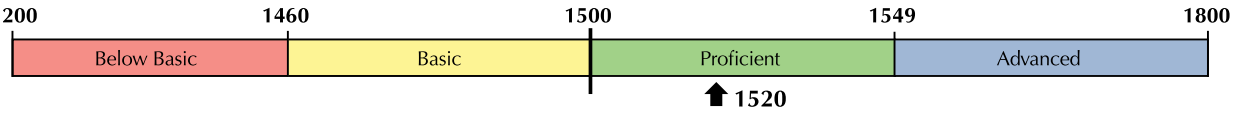
These tests were developed by Pennsylvania educators and were aligned to the standards adopted by the Pennsylvania State Board of Education. The results help students, parents, and educators understand how well rigorous expectations for student achievement in core subject areas are being met.

A Report Interpretation Guide is available at www.education.pa.gov. Type "Keystone Interpretation Guide" in the search field or consult the local school district or school.

Figure 16–2. Page 2 of the Individual Student Report

Performance Level on Total Test

Student's highest total test scale score to date is indicated by the (⬆). If this student were to test again under similar circumstances, his/her score would likely remain in the following range: 1507-1533.



Below Basic	Basic	Proficient	Advanced
Inadequate academic performance that indicates little understanding and minimal display of the skills included in the Keystone Exams Assessment Anchors & Eligible Content. There is a major need for additional instructional opportunities and/or increased student academic commitment to achieve the Proficient level.	Marginal academic performance, work approaching, but not yet reaching, satisfactory performance. Performance indicates a partial understanding and limited display of the skills included in the Keystone Exams Assessment Anchors & Eligible Content. The student may need additional instructional opportunities and/or increased student academic commitment to achieve the Proficient level.	Satisfactory academic performance indicating a solid understanding and adequate display of the skills included in the Keystone Exams Assessment Anchors & Eligible Content.	Superior academic performance indicating an in-depth understanding and exemplary display of the skills included in the Keystone Exams Assessment Anchors & Eligible Content.

Biology SAMPLE STUDENT 1

	Module 1 Cells and Cell Processes			Module 2 Continuity and Unity of Life			Total Test	
	Result	Scale Score	Test Date	Result	Scale Score	Test Date	Scale Score	Performance Level
Highest Total Test Scale Score to Date [1]	**Passed**	**1542**		**Passed**	**1501**		**1520**	**Proficient**
Scores of Three Most Recent Test Events	Passed	1542		Passed	1501			

[1]The highest total test scale score to date is the highest score computed from all possible combinations of module 1 and module 2. The total scale score is not the simple average of the module scale scores. Rather, it is weighted by the relative difficulty of questions from each module.

SUMMARY REPORTS

Summary reports are provided at the school, district, and state levels. These reports contain summary information about the percentage of students in each of the four performance levels. Raw scores are also provided by assessment anchor to allow schools or districts to identify strengths and weaknesses at the content-strand level.

REPORT INTERPRETATION GUIDE

A report interpretation guide is provided to help parents and other Keystone Exams stakeholders better understand test-result information presented in the individual student report. The report interpretation guide can be found on the PDE website at www.education.pa.gov.

CHAPTER SEVENTEEN: OPERATIONAL TEST STATISTICS

This chapter presents various summary statistics for the total-test scores based on the final data file described in Chapter Nine. Related information covered elsewhere in this report includes the item-level statistics that were presented in Chapters Eleven (classical item statistics) and Twelve (Rasch item statistics). Please refer to these chapters for additional consideration as item difficulty distributions can affect total score distributions.

PERFORMANCE LEVEL STATISTICS

Table 17–1 presents performance level percentages by test administration, content area, and student type. Performance level classifications are based on the highest total scaled score to date. As can be seen from the table, the overall percentage in each performance level varied from administration to administration, depending on the ratio of the first-time testers and retesters. In general, retesters had a lower percentage of students in the Proficient and Advanced levels than first-time testers.

Table 17–1A. Performance Level Percentages: All Testers

Administration	Content Area	N	Below Basic (%)	Basic (%)	Proficient (%)	Advanced (%)
Winter	Algebra I	36,950	23.4	53.7	17.2	5.7
Winter	Biology	31,027	23.7	48.2	21.3	6.8
Winter	Literature	30,416	16.9	41.0	36.5	5.6
Spring	Algebra I	158,934	26.6	41.9	19.1	12.4
Spring	Biology	137,405	27.7	31.0	24.3	17.0
Spring	Literature	128,707	14.4	30.1	47.6	7.8
Summer	Algebra I	353	12.7	62.0	19.8	5.4
Summer	Biology	257	19.1	53.7	19.5	7.8
Summer	Literature	161	27.3	46.6	24.8	1.2

Table 17–1B. Performance Level Percentages: First-time Testers

Administration	Content Area	N	Below Basic (%)	Basic (%)	Proficient (%)	Advanced (%)
Winter	Algebra I	13,606	27.2	38.8	20.5	13.5
Winter	Biology	13,301	24.2	30.9	29.6	15.3
Winter	Literature	15,734	16.0	28.6	45.4	10.0
Spring	Algebra I	120,398	27.0	36.4	20.9	15.7
Spring	Biology	112,130	26.5	25.9	26.9	20.7
Spring	Literature	107,815	13.7	26.2	50.9	9.2
Summer	Algebra I	67	44.8	29.9	6.0	19.4
Summer	Biology	61	37.7	14.8	21.3	26.2
Summer	Literature	33	66.7	18.2	9.1	6.1

Table 17–1C. Performance Level Percentages: Retesters

Administration	Content Area	N	Below Basic (%)	Basic (%)	Proficient (%)	Advanced (%)
Winter	Algebra I	23,344	21.1	62.4	15.2	1.2
Winter	Biology	17,726	23.3	61.2	15.0	0.5
Winter	Literature	14,682	17.9	54.3	27.0	0.8
Spring	Algebra I	38,536	25.3	59.2	13.6	1.8
Spring	Biology	25,275	32.8	53.8	12.5	0.9
Spring	Literature	20,892	18.2	50.4	30.7	0.7
Summer	Algebra I	286	5.2	69.6	23.1	2.1
Summer	Biology	196	13.3	65.8	18.9	2.0
Summer	Literature	128	17.2	53.9	28.9	0.0

SCALED SCORES

Table 17–2 provides the scaled score means and standard deviations by test administration, content area, and student type (all testers, first-time testers and retesters). The descriptive statistics are based on the highest total scaled score to date following each administration. As can be seen from the table, first-time testers earned higher scaled scores than retesters.

Table 17–2. Means and Standard Deviations of Scaled Scores

Administration	Content Area	All Testers Mean	All Testers SD	First-Time Testers Mean	First-Time Testers SD	Retesters Mean	Retesters SD
Winter	Algebra I	1471.6	45.1	1479.4	58.5	1467.1	34.1
Winter	Biology	1485.9	38.7	1497.7	49.6	1477.1	24.3
Winter	Literature	1494.3	53.6	1507.8	61.0	1479.8	39.4
Spring	Algebra I	1477.3	56.1	1481.3	60.5	1464.8	36.5
Spring	Biology	1495.9	53.6	1501.3	56.4	1471.9	27.3
Spring	Literature	1505.4	57.0	1510.4	58.5	1479.8	39.5
Summer	Algebra I	1481.4	40.2	1466.3	69.8	1484.9	28.3
Summer	Biology	1491.2	43.5	1504.3	77.3	1487.2	24.1
Summer	Literature	1474.7	45.8	1441.0	61.1	1483.4	36.5

RAW SCORES

SUMMARY STATISTICS

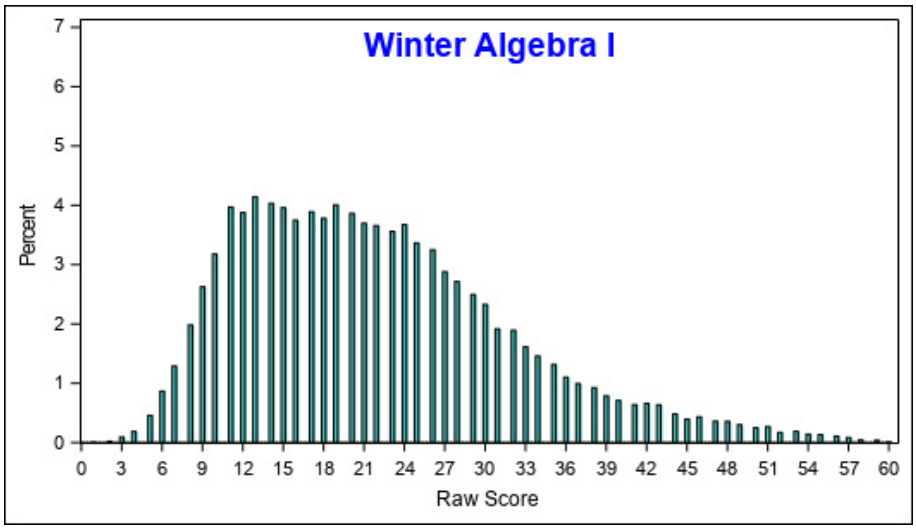
The reader is referred to Appendix M to review summary statistics for the operational raw scores. The statistics reported include number of points possible (Pts.), number of items (Len.), number of students tested (*N*), mean raw score (Mean), standard deviation of raw score (SD), reliability (r), and traditional standard error of measurement (SEM).

SCORE DISTRIBUTIONS

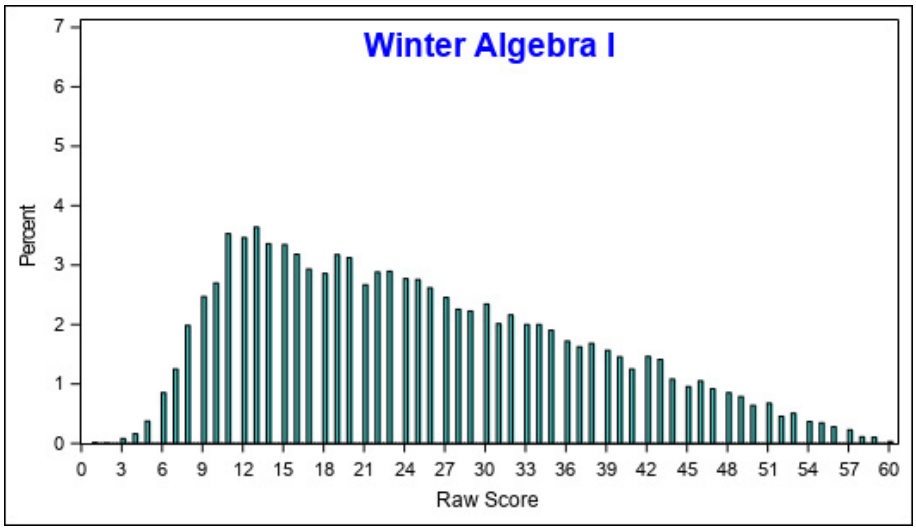
Raw score distributions for each administration and content area are provide in Figure 17–1. Graphs are shown for all test-takers, first-time test-takers, and retesters . As can be seen from the graphs, the retesters tended to score lower than the first-time testers. For all testers, the distribution of raw scores for Algebra I and Biology are positively skewed while the distributions of raw scores for Literature are negatively skewed.

Figure 17–1. Raw Score Distributions

All Testers



First-Time Testers



Retesters

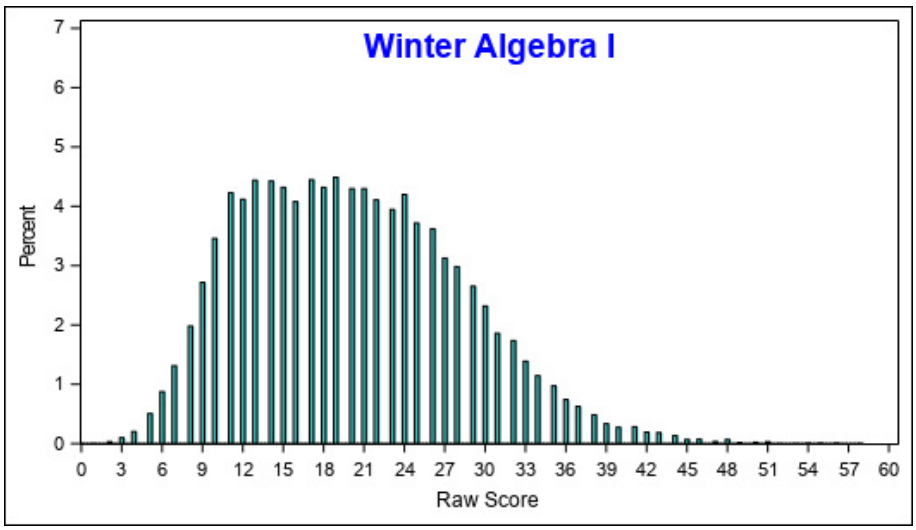
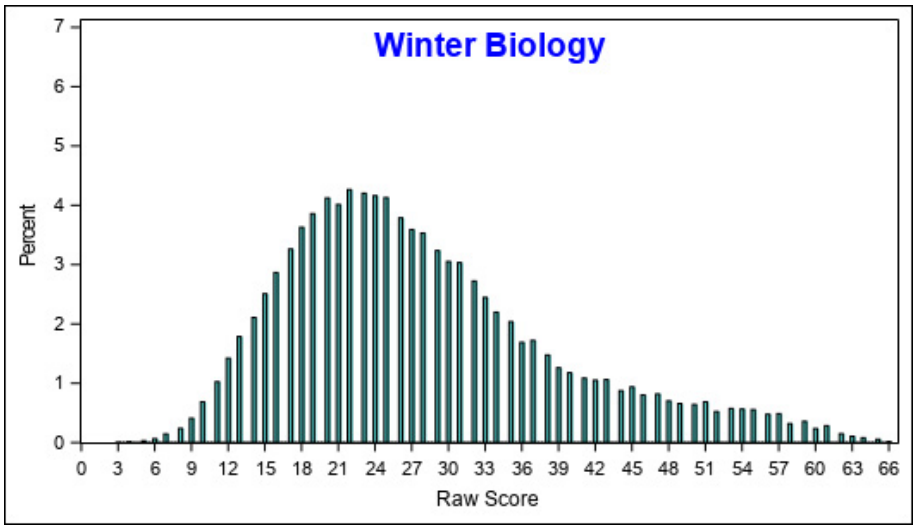
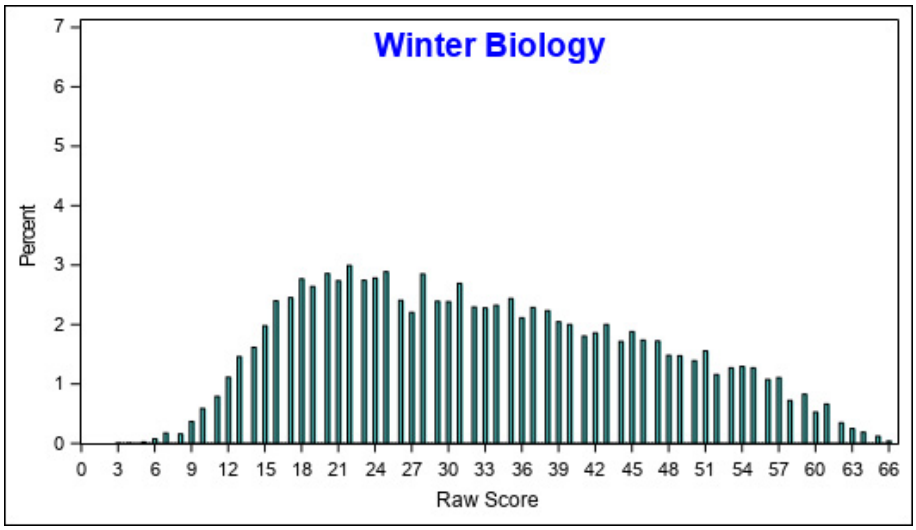


Figure 17–1 (continued). Raw Score Distributions

All Testers



First-Time Testers



Retesters

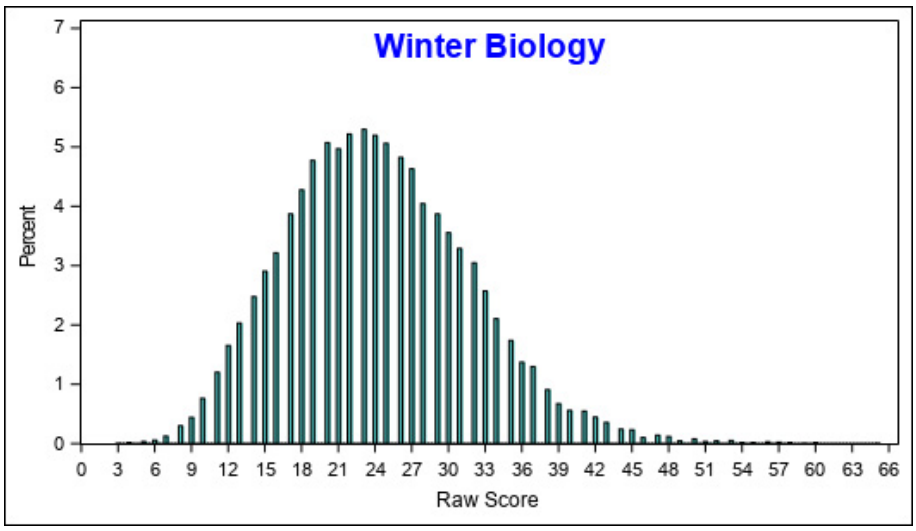
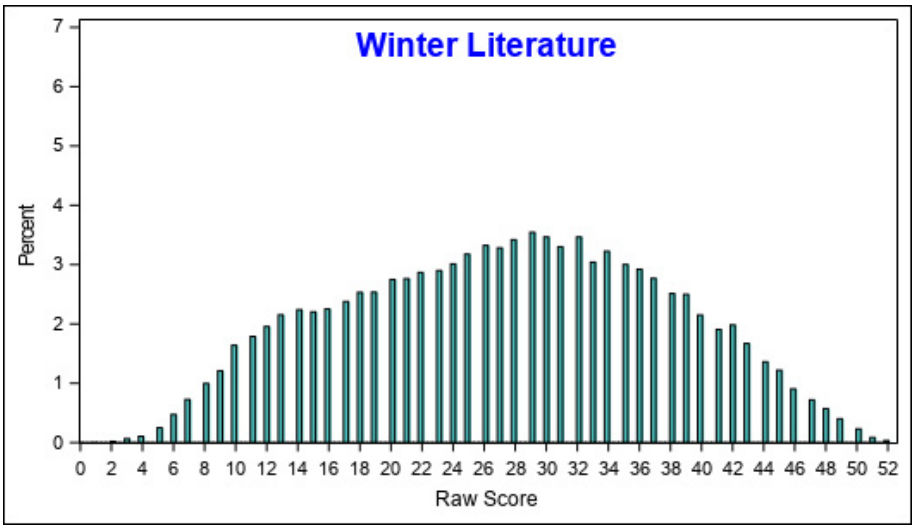
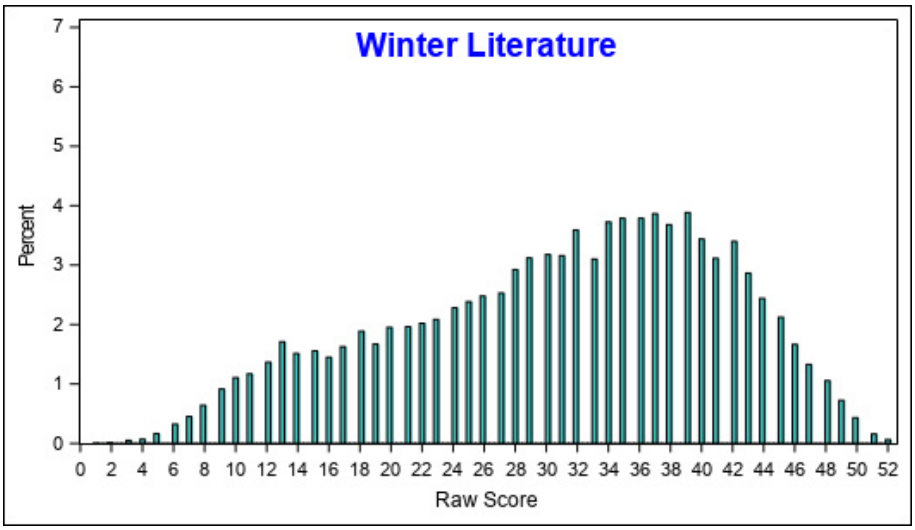


Figure 17–1 (continued). Raw Score Distributions

All Testers



First-Time Testers



Retesters

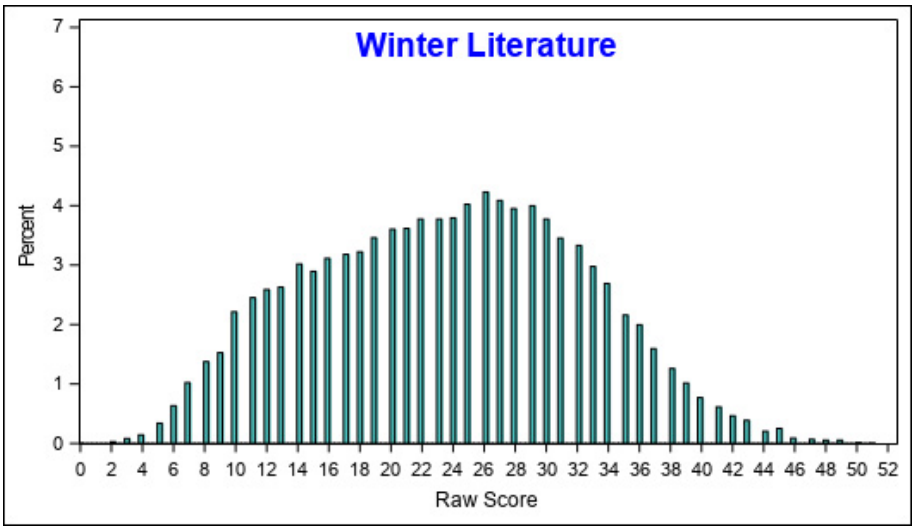
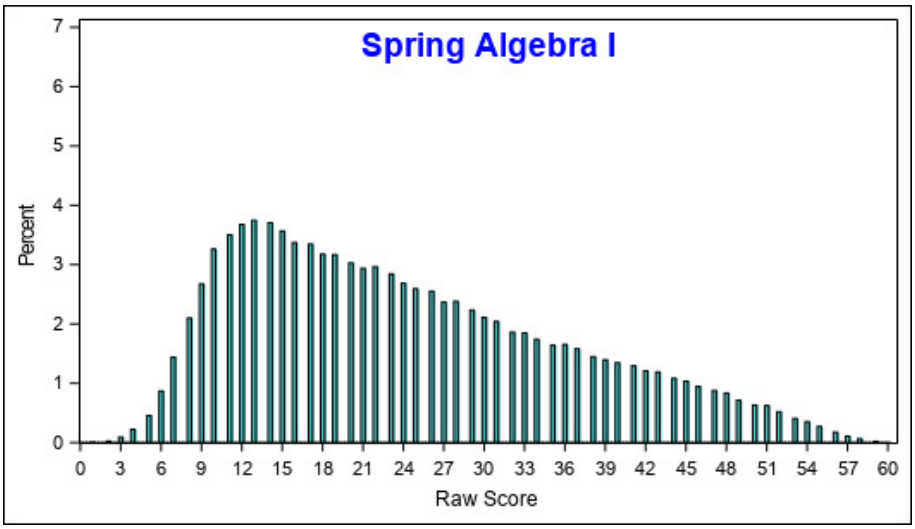
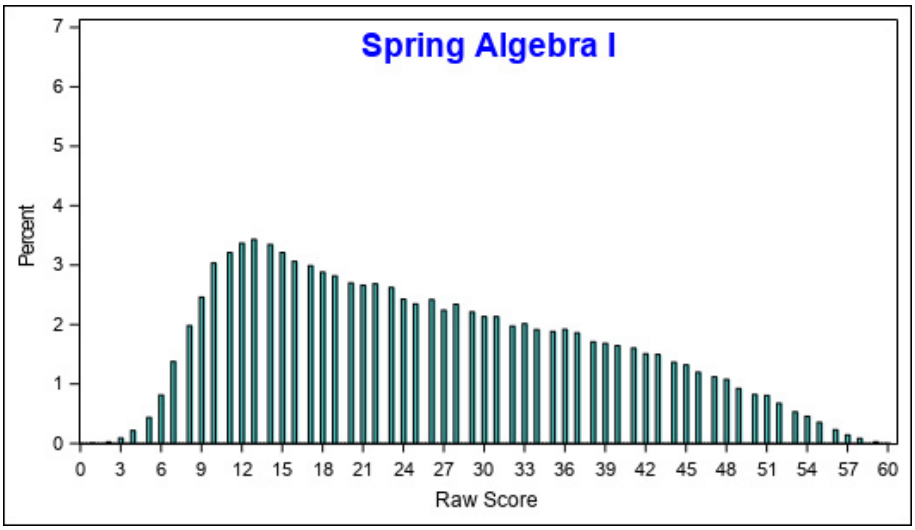


Figure 17–1 (continued). Raw Score Distributions

All Testers



First-Time Testers



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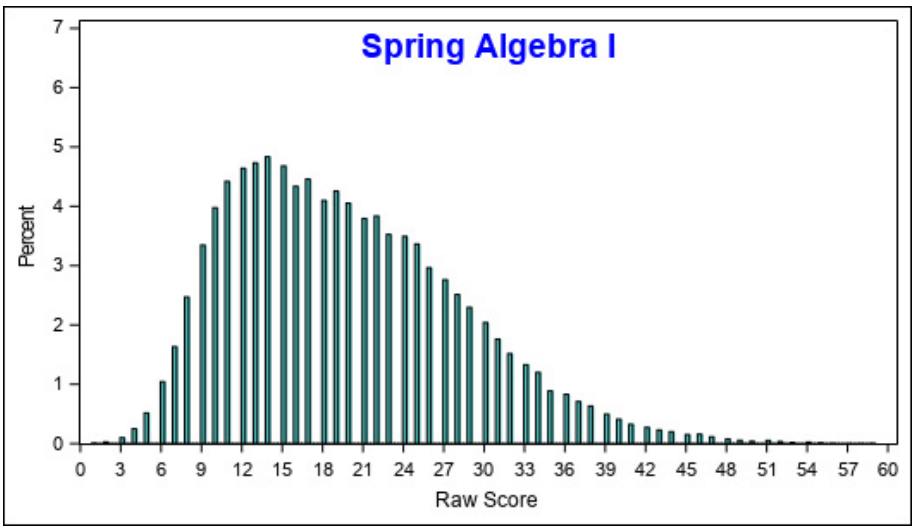
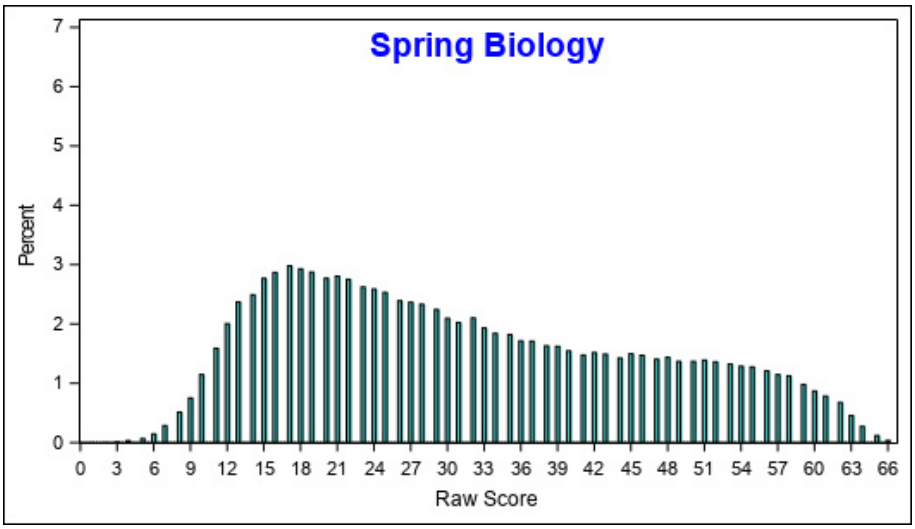


Figure 17–1 (continued). Raw Score Distributions

All Testers



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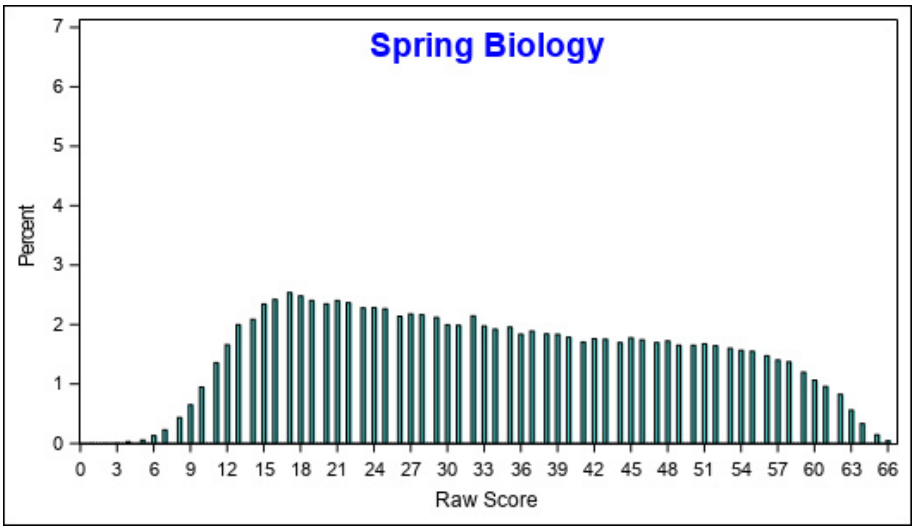

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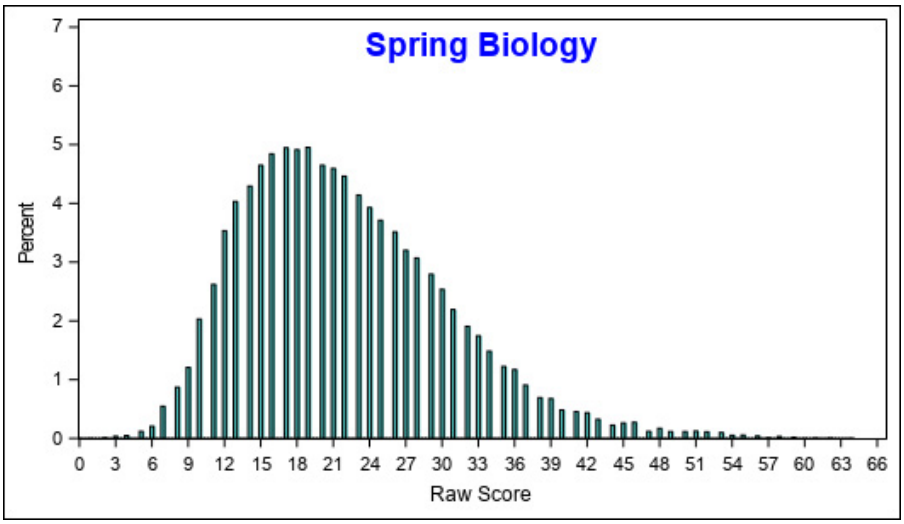
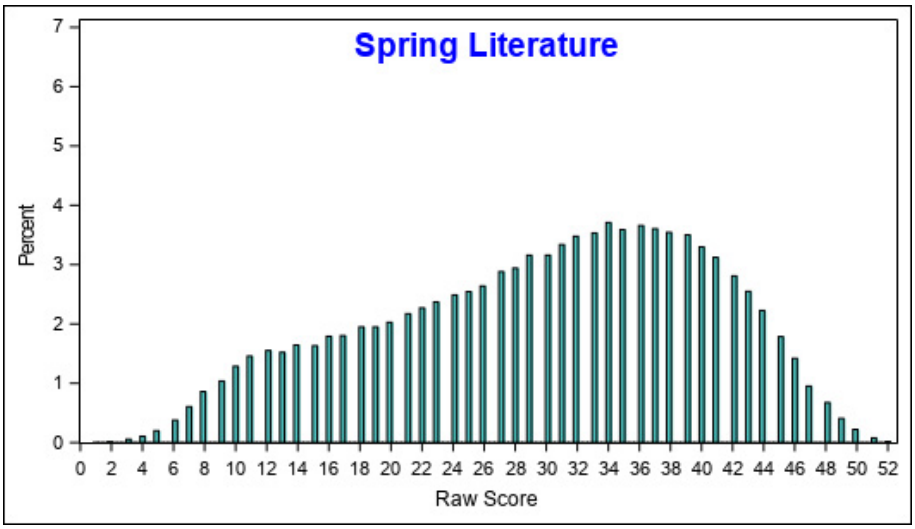
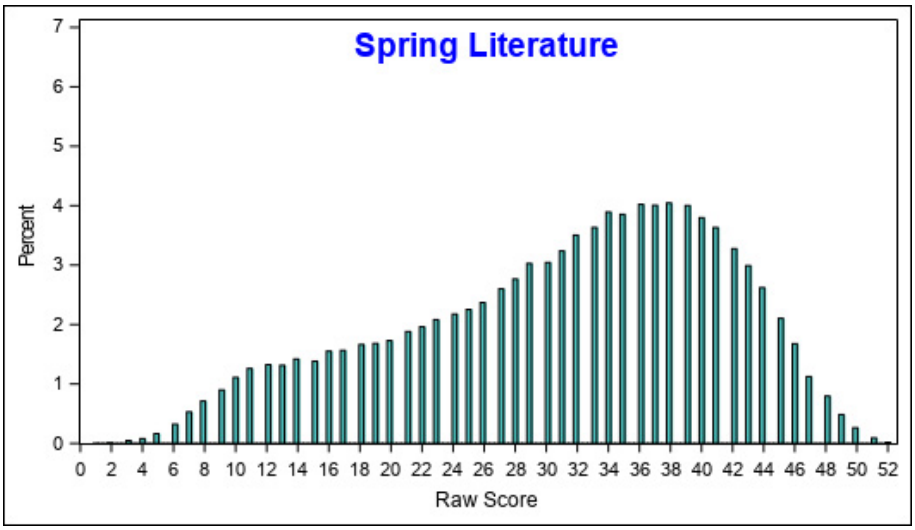


Figure 17–1 (continued). Raw Score Distributions

All Testers



First-Time Testers



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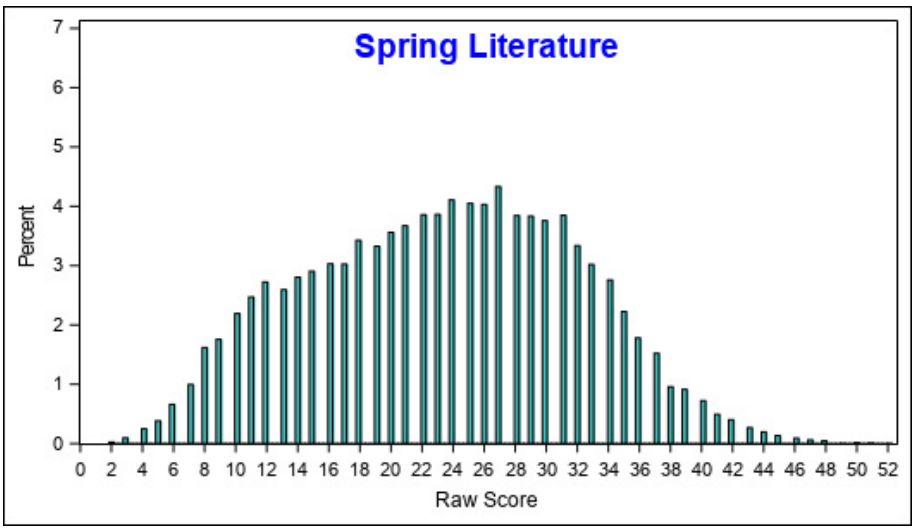
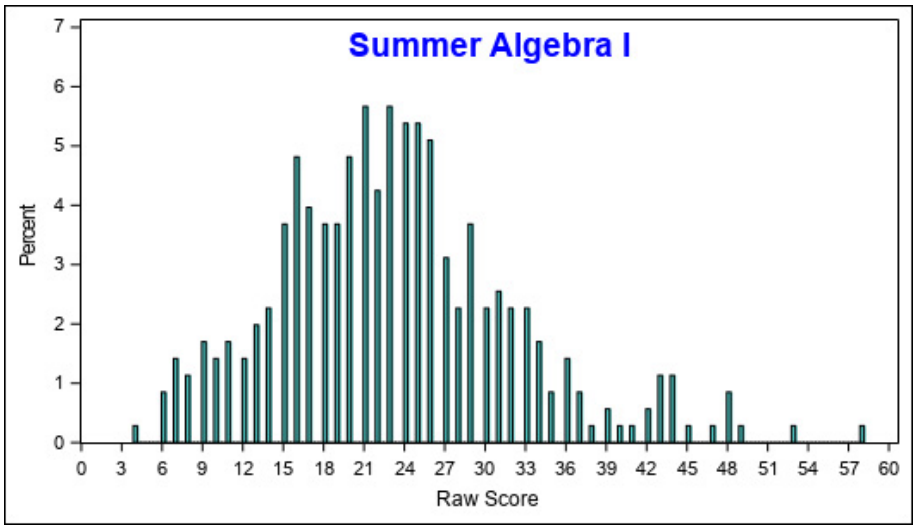


Figure 17–1 (continued). Raw Score Distributions

All Testers



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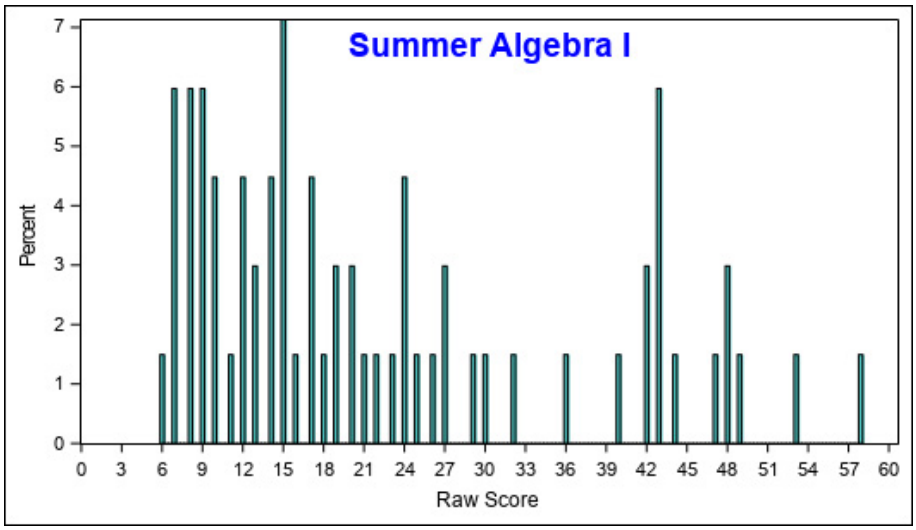

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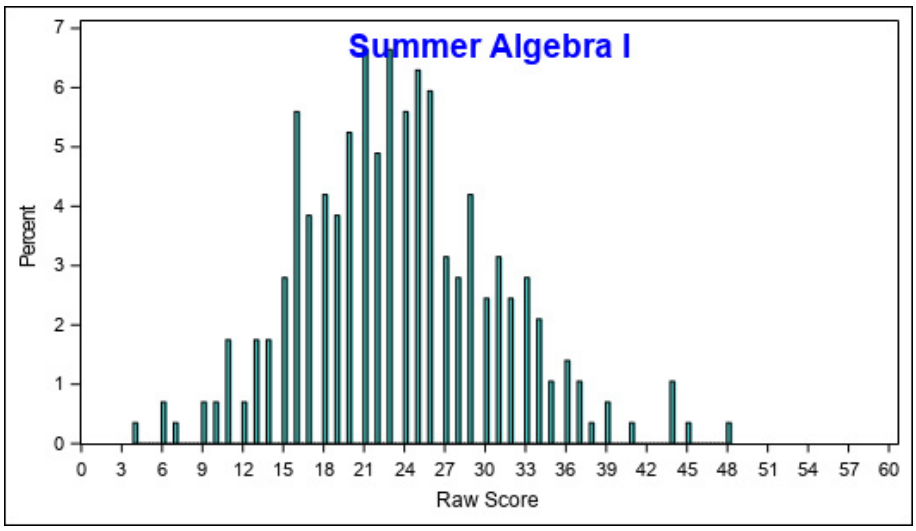
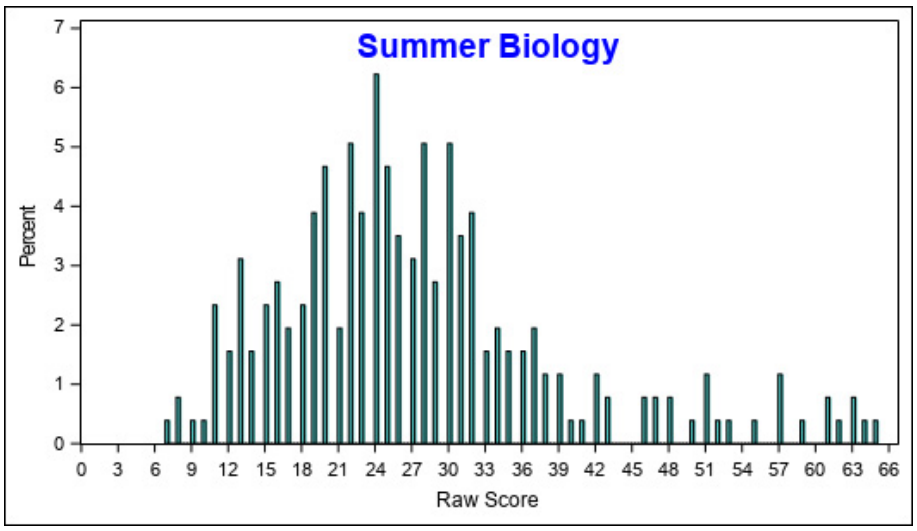
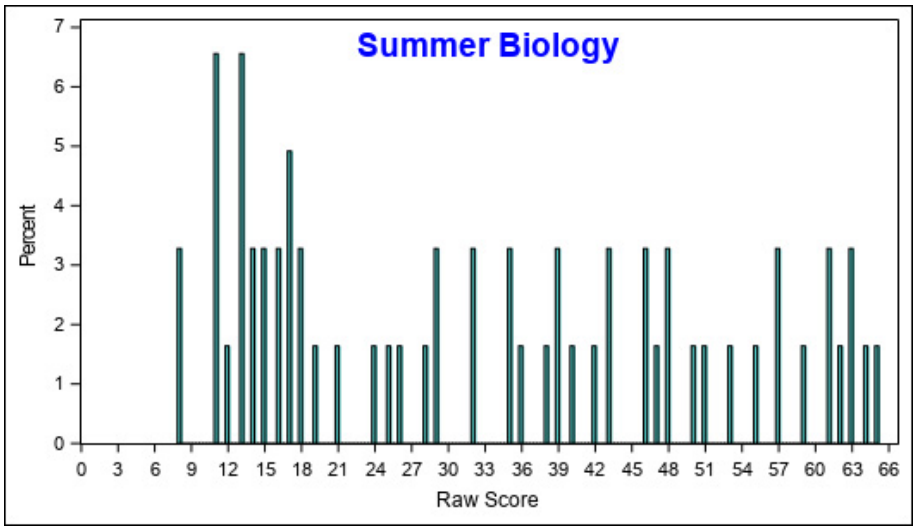


Figure 17–1 (continued). Raw Score Distributions

All Testers



First-Time Testers



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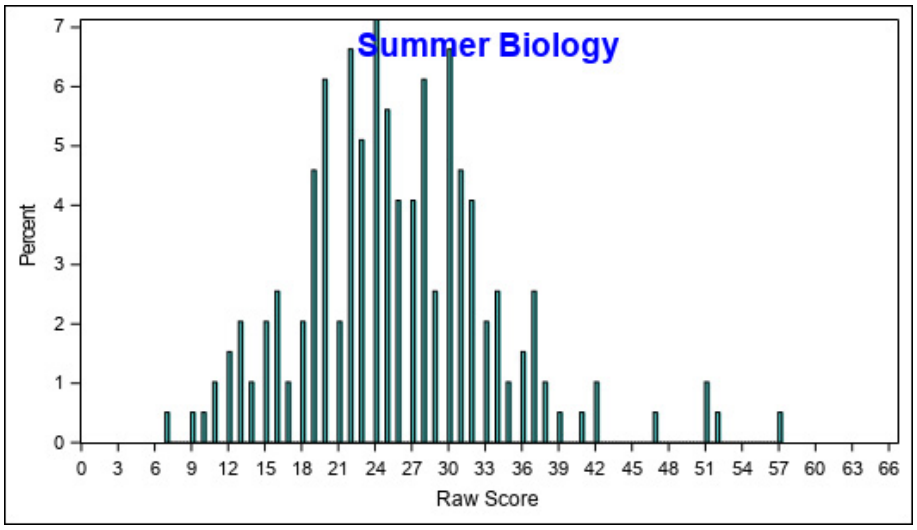
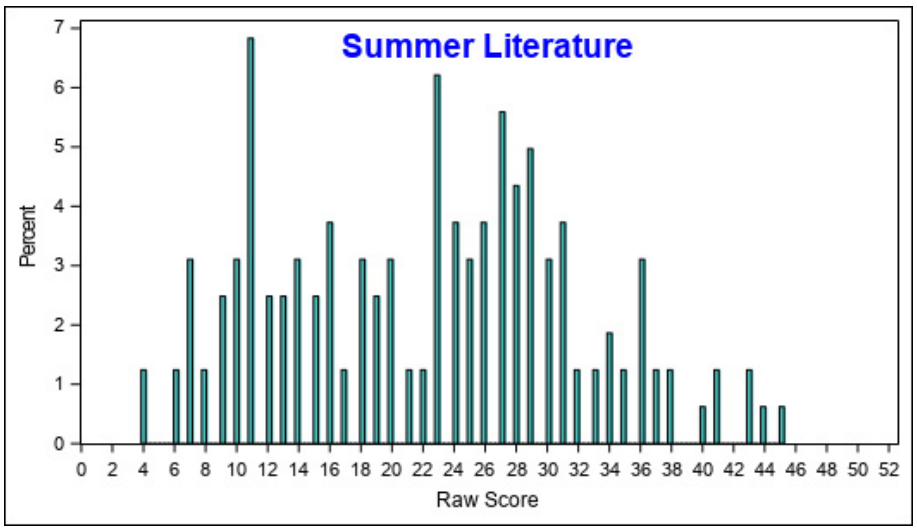


Figure 17–1 (continued). Raw Score Distributions

First-Time Testers



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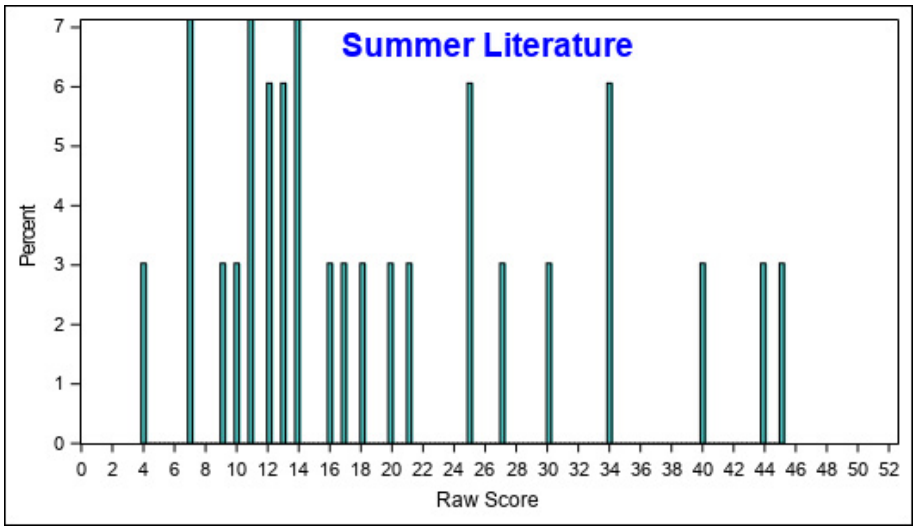

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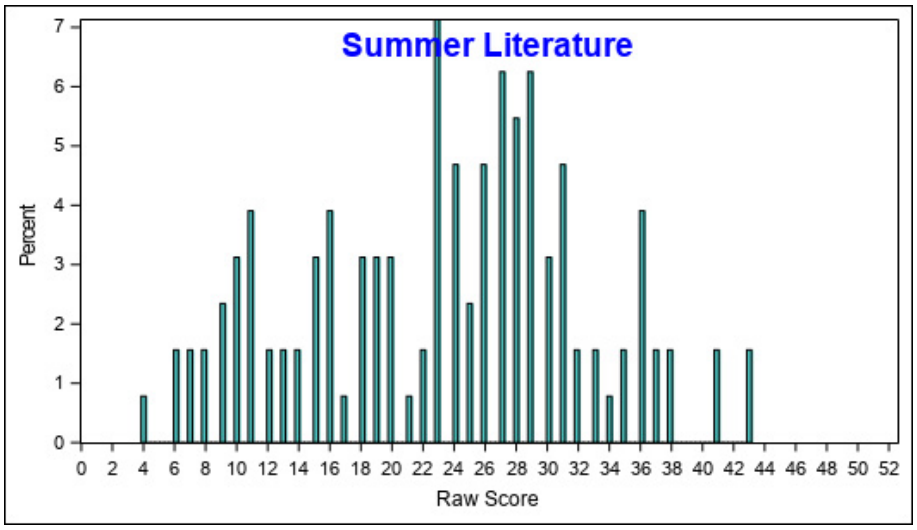


CHAPTER EIGHTEEN: RELIABILITY

This chapter addresses the reliability of Pennsylvania Keystone Exams test scores. According to the *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 2014), reliability refers to

> the degree to which test scores for a group of test takers are consistent over repeated applications of a measurement procedure and hence are inferred to be dependable and consistent for an individual test taker; the degree to which scores are free of random errors of measurement for a given group (p. 222).

Frisbie (2005) highlighted several elements of this definition. 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 definition above yet are still important for test users to understand. While freedom from measurement error is highlighted in the definition, 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 Nineteen.)

Another noteworthy issue is that multiple sources of error exist (e.g., the day of testing, the items used, the raters who score the items). However, most widely used reliability indices only reflect a single type of error. Consequently, it is important for test users to understand which specific type of error is being considered in a reliability study, and equally, if not more importantly, which types are not.

Understanding the distinction between relative error and absolute error is important because 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. 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. Understanding examinee rank-order stability is also important; however, such stability might be well achieved even when the specific score values are considerably different.

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
- Decision consistency
- Rater agreement

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: variance in true scores and variance due to the imperfections in the measurement process. Put differently, total variance equals true score variance plus error variance.[1]

$$\rho_X^2 = \frac{\sigma_T^2}{\sigma_X^2} = \frac{\sigma_T^2}{\sigma_T^2 + \sigma_E^2}$$

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—that is, all measurement error. If the index had a value of 1.0, scores would be perfectly consistent—that is, 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 (e.g., student health, testing environment) or rater inconsistency.

COEFFICIENT ALPHA

Although a number of reliability indices exist, perhaps the most frequently reported for achievement tests is coefficient alpha. Consequently, this index is the one reported for the Keystone Exams (see the column with title "r" in Appendix M). Alpha indicates the internal consistency over the responses to a set of items measuring an underlying trait, in this case, academic achievement, in content areas such as Algebra I, Biology, and Literature.

Alpha 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 achievement 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 18–1. Two Hypothetical Vocabulary Tests

Test One	Test Two
Abase	Abate
Boon	Bilk
Capricious	Circuitous
Deface	Debase
....	....
Zealous	Zenith

[1] A covariance term is not required as true scores and error are assumed to be uncorrelated in classical test theory.

If a representative group of students could take both 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 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 coefficient alpha index for those test scores were high, this would suggest that Test Two would provide a very similar rank ordering of the students if they had taken it instead. If coefficient alpha were low, dissimilar rank orderings would likely be observed—again, relative-error variance is reflected in alpha.

FORMULA

Consider the following data matrix representing the scores of persons (rows) on items (columns):

Table 18–2. Person × Item Score (*Xpi*) Infinite (Population-Universe) Matrix

Person	Item 1	Item 2	Item . . . I	Item . . . k
1	*Y*11	*Y*12	. . . *Y*1*i*	. . . *X*1*k*
2	*Y*21	*Y*22	. . . *Y*2*i*	. . . *X*2*k*
. . . . .				
P	*Yp*1	*Yp*2	. . . *Ypi*	. . . *Xpk*
. . . . .				
N	*YN*1	*YN*2	. . . *YNi*	. . . *XNk*

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), σ^2_X is the variance of the observed total test scores, and σ^2_X is the variance of part i.

FURTHER INTERPRETATIONS

RULES OF THUMB

Which reliability values are considered high enough? Which values are considered too low? Although frequently asked for, any rules of thumb for interpreting the magnitude of reliability indices are mostly arbitrary. Another approach is to research the reliabilities from similar testing instruments to see what values are commonly observed. For the Keystone Exams, comparisons to tests of similar lengths that were administered to similar student populations from other large-scale assessment programs would be relevant. For many other state assessment programs, reliabilities in the low 0.90s are usually the highest ever 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.

IS ALPHA A LOWER LIMIT TO RELIABILITY?

According to Brennan (1998), the conventional wisdom that coefficient alpha is a lower limit to reliability is based largely on a misunderstanding. In reflecting on the 50th anniversary of his seminal 1951 article, Cronbach—in Cronbach and Shavelson (2004)—expressed similar misgivings about this conventional wisdom:

> one could argue that alpha was almost an unbiased estimate of the desired reliability. . . the *almost* in the preceding sentence refers to a small mathematical detail that causes the alpha coefficient to run a trifle lower than the desired value. This detail is of no consequence and does not support the statement made frequently in textbooks or in articles that alpha is a lower value to the reliability coefficient. That statement is justified by reasoning that starts with the definition of the desired coefficient as the expected consistency among measurements that had a higher degree of parallelism than the random parallel concept implied.

The assumptions for three common parallelism models are presented in Table 18–3. Alpha's assumptions come from the Essentially-Tau-Equivalent model, which does not require equal means or equal variances across test parts. Based on this, Brennan (1998) asserts that the lower-limit issue, as conceptualized by many, provides an answer to a question that is of minimal importance. Reframed differently, the goal of selecting a reliability coefficient is not to find the one that provides the highest coefficient, but the one that most accurately reflects the test data under study.

It is important to note that there are factors encountered in practice that may legitimately make coefficient alpha an underestimate of reliability. However, there are also factors that might make coefficient alpha an overestimate of reliability. Both possibilities are discussed further below and generally arise when the Essentially-Tau-Equivalent assumptions are strained.

Table 18–3. Summary of Expectations/Observable Relationships for Different Parallelism Models

Relationship	Degree of Measurement Parallelism* Classically Parallel	Degree of Measurement Parallelism* Essentially-Tau Equivalent	Degree of Measurement Parallelism* Congeneric
Content Similarity	Yes	Yes	Yes
Equal Means across Parts	Yes	No	No
Equal Variances across Parts	Yes	No	No
Equal Covariances across Parts	Yes	Yes	No
Equal Covariances with other Variables	Yes	Yes	No

**Note*. Other models exist but are not considered here due to their limited application in practice.

BIASES THAT MIGHT MAKE ALPHA AN UNDERESTIMATE OF RELIABILITY

There are factors that might negatively bias coefficient alpha, making the apparent reliability lower than it may actually be. In practice, two situations frequently encountered that might cause this include tests that are composed of mixed item types (e.g., MC and CR items) and tests that include a planned stratification of the test items according to topics or subdomains.

Although both situations strictly violate the assumptions used in deriving the coefficient alpha (i.e., the tests are not based on equal part lengths in the former case and are not randomly parallel in the latter case), neither necessarily guarantees that the reliability will be markedly lower. In the latter case, reliability will be underestimated only when strand items are homogeneous enough for the average covariance within strata to exceed the average covariance between strata. Although both are potential influences for the Keystone Exams, the total test score reliabilities (i.e., r) are reported in Appendix M for each administration, content area, and subgroup (ethnicity, gender, EL, IEP, and economically disadvantaged).

BIASES THAT MIGHT MAKE ALPHA AN OVERESTIMATE OF RELIABILITY

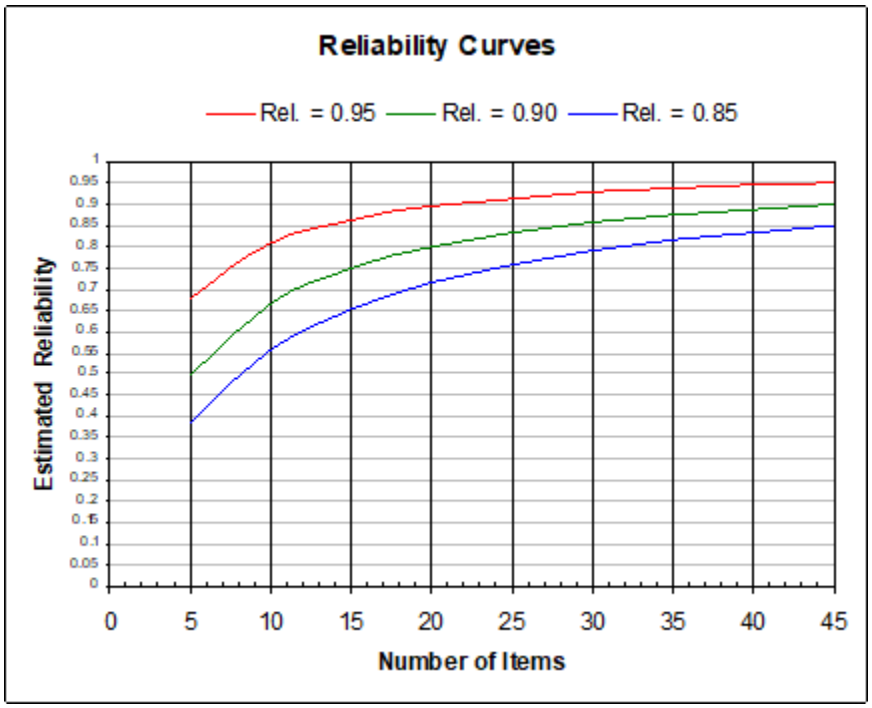
As emphasized in earlier sections, coefficient alpha only takes into account measurement error that arises from the selection of items used on a particular test form. There are other sources of random inaccuracy. One is due to the occasion of testing. Examples of other various random conditions that might affect students on any particular testing occasions include illness, fatigue, and anxiety. Also, when a test includes CR items, another source of random fluctuation can be the CR item scorers. In a sense, alpha may be positively biased because it does not account for other important sources of random error. Actually, any internal consistency reliability index might understate the overall problem of measurement error because they all ignore such sources of random error.

Another positive bias can occur when items are associated (clustered) with a common stimulus. Item bundles and testlets are other frequently used terms for this situation. One concrete example is when multiple reading comprehension items are associated with a common passage selection. Again, such a situation does not guarantee that the reliability estimate will be markedly affected, but the potential exists.

MODULE SCORE RELIABILITY

As noted in the introduction, reliabilities tend to go up in value with an increase in test length and go down in value with a decrease in test length. Figure 18–1 illustrates this relationship for a hypothetical 45-point 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 15-item module would be expected to have a score reliability of 0.75. The use of the Spearman-Brown prophecy formula assumes all items are exchangeable, which in practice they may not be. While such a chart may not perfectly model actual module correlations, the intent is only to illustrate the substantial impact that limited numbers of items in a module can have on module-score reliability. One should not be surprised that module scores with more points tend to show higher reliability coefficients and those with fewer points tend to show lower reliability coefficients.

Figure 18–1. Example of the Relationship Between Test Length and Reliability



As can be seen in Appendix M, the reliability coefficients at the module level ranged from 0.72 to 0.88 and were always less than the total score reliabilities, likely because the number of items at the module level is half of the number of items in the total test.

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 (see Appendix M) is somewhat unwieldy. A beginning point for understanding the concept is as follows. If everyone being tested had the same true score,[2] 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 or the sampling of test items. The standard error is defined as the standard deviation[3] 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.

The SEM formula is provided below.

$$SEM = SD\sqrt{1 - reliability}$$

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. Consider that an SEM of 3.0 on a 10-point test would be very different from an SEM of 3.0 on a 100-point test.

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 ±1 SEM about two-thirds of the time.[4] For ±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 that conditions the SEM on a student's score estimate is described in the next sections.

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.

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[2] True score is the score the person would receive if the measurement process were perfect.

[3] 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.

[4] Some prefer the following interpretation: if a student were tested an infinite number of times, the ±1 SEM confidence intervals constructed for each score would capture the student's true score 68 percent of the time.

RAW SCORE METRIC

The SEM approach is calculated using raw scores, and as such, the resulting confidence interval bands are on the raw score metric. Error bands on the scaled score metric are considered in the next section.

TYPE OF ERROR REFLECTED

The interpretation of the SEM should be driven by the type of score reliability that underpins it. So, the Keystone Exams 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 Keystone Exams. 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.

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 1450 and the SEM band was 1435 to 1465, then a student would be likely to receive a score somewhere between 1435 and 1465 if he or she took a different version of the test.

RESULTS AND OBSERVATIONS

Coefficient alpha results and associated (traditional) SEMs for various Keystone Exam scores are documented in Appendix M. Values were derived using the final data file (see Chapter Nine). The results are organized by administration and then content area. Each table also breaks out the modules and groups of interest such as the total student population (overall), gender, ethnicity, English learners (EL), students with an individualized education plan (IEP), and economically disadvantaged (ED) students. The statistics reported include the number of points possible (Pts.), number of items (Len.), number of students tested (N), mean raw score (Mean), standard deviation of raw score (SD), reliability (r), and traditional standard error of measurement (SEM).

Note that these tables report the standard deviations of observed scores. Assuming normally distributed scores, one would expect about two-thirds of the observations to be within one standard deviation of the mean. An estimate of the standard deviation of the true scores can be computed as

$$\hat{\sigma}_{T} = \sqrt{\hat{\sigma}_{x}^{2} - \hat{\sigma}_{x}^{2}(1 - \hat{\rho}_{x})}$$

For all subjects, the overall test score reliability values are higher than the reliabilities at the module level, likely due to the fact that each module contains half as many items as the entire test. The test score reliabilities for the spring administration were the highest, ranging from 0.91 (Literature) to 0.93 (Biology). The reliabilities ranged from 0.88 to 0.91 and 0.85 to 0.90 for the winter and summer administrations, respectively. The reliability coefficients indicate highly consistent test scores for these instruments.

It was also noted that reliabilities tend to go up in value with an increase in population heterogeneity and go down in value with a decrease in more homogeneous populations. Once again, there is no firm guideline regarding how low is too low. The lower a given reliability coefficient, the greater the potential for over-interpretation. As a point of reference, a reliability coefficient of 0.50 would suggest that there is as much error variance as true-score variance in the scores. It should be noted that the reliability of group mean scores (e.g., school or district means) tends to be higher than that of individual scores, suggesting interpretation of module scores at these aggregate levels is reasonable.

RASCH CONDITIONAL STANDARD ERRORS OF MEASUREMENT

The CSEM also indicates the degree of measurement error but does so in scaled-score units and varies as a function of a student's actual scaled 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 conditional standard error of measurement and $I(\hat{\beta}_n)$ is 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 β_n metric. The conditional standard error on the scaled-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 scaled scores.

$$CSEM(\text{SS}) = CSEM(\hat{\beta}_n) * m$$

Chapter Fourteen provides the linear transformation formulas for each of the Keystone Exams.

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 scaled 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 levels. The magnitude of the CSEM values is U-shaped, with larger CSEM values associated with lower and higher scores.

GROUP SPECIFIC

Assuming reasonable model-data fit—as explored in Chapter Twelve—the Rasch-based CSEMs (conditioned on score level) should not vary across groups.

SCALED-SCORE METRIC

The CSEM and associated confidence interval bands are on the scaled-score metric.

TYPE OF ERROR REFLECTED

The CSEMs documented on the Keystone Exams score reports are the Rasch-based conditional standard errors of measurement described above. These are provided by the program WINSTEPS described in Chapter Twelve. As noted earlier, these CSEMs are based on the concept of statistical information. For the purpose of providing a simpler explanation of CSEMs to test score users, the earlier description of SEMs framed using the idea of internal consistency reliability was provided in the Keystone Exams score report interpretive guide.[5] Score report content is considered in greater detail in Chapter Sixteen.

[5] Because Rasch CSEMs are based on statistical information, it is questionable whether they account for error variance due to items. However, it seems difficult to construct a simple explanation of Rasch CSEMs for the general public.

RESULTS AND OBSERVATIONS

Figure 18–2 shows the Rasch CSEMs associated with each scaled-score level. (This information is also provided in tabular form in Appendix K.) Values were derived using the calibration data file described in Chapter Nine. The scaled scores and associated CSEMs represent the administration-specific scores. The values are fairly consistent across a noticeably large range of the scaled scores, as demonstrated by the relatively flat bottoms of most plots. The values increase at both extremes (i.e., at the lowest and highest observed scaled scores), giving these figures their typical U-shaped pattern. The three red-dashed vertical lines represent the Basic, Proficient, and Advanced scaled cut-scores, respectively, moving from lower to higher scaled score values. CSEM values at the cut score lines are associated with smaller values, indicating more precise measurement occurs at these cuts.

Figure 18–2. Conditional Standard Error Plots for Each Administration and Content Area

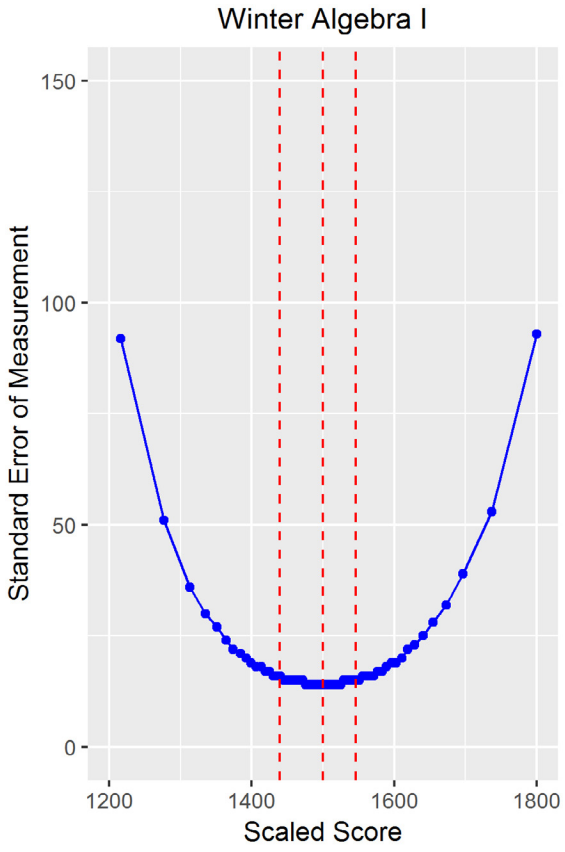
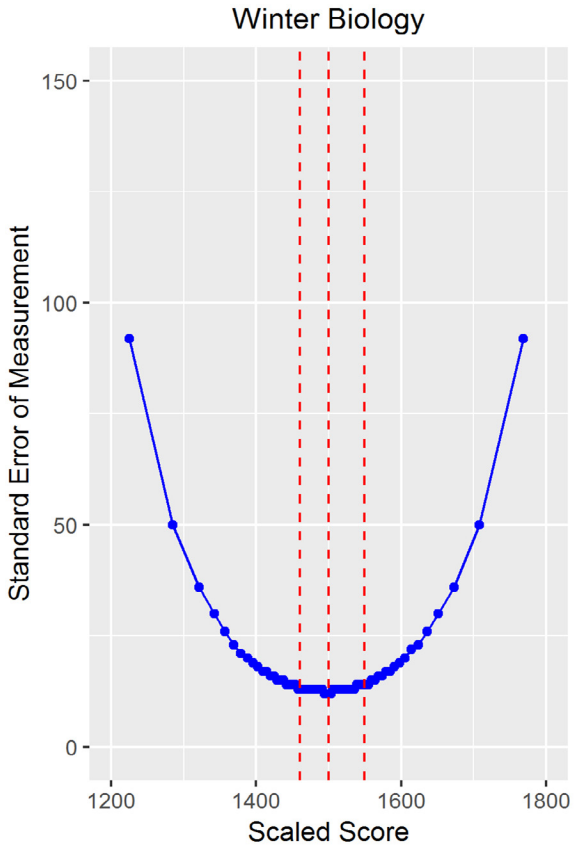


Figure 18–2 (continued). Conditional Standard Error Plots for Each Administration and Content Area



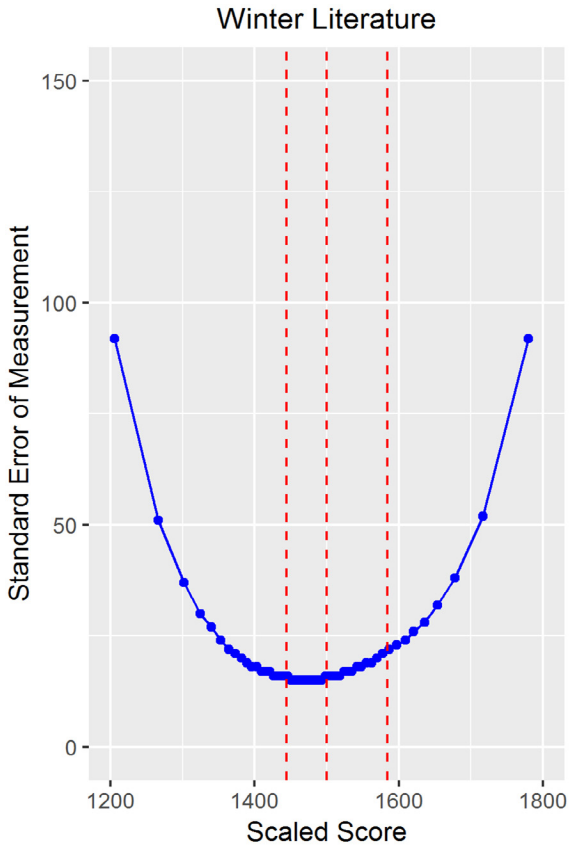
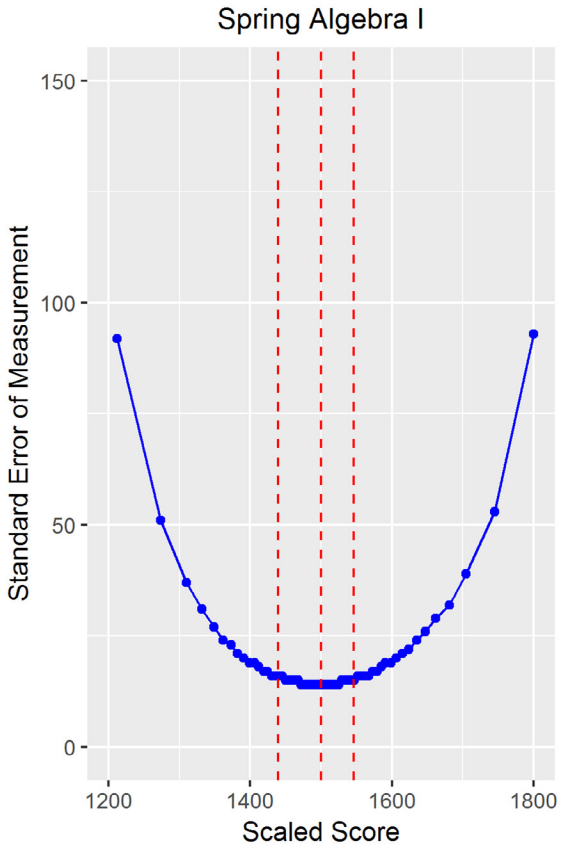


Figure 18–2 (continued). Conditional Standard Error Plots for Each Administration and Content Area



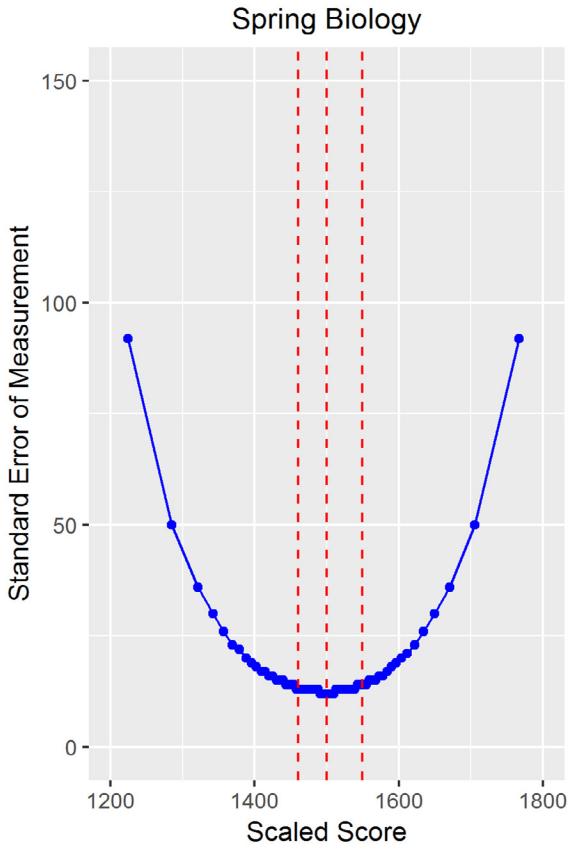
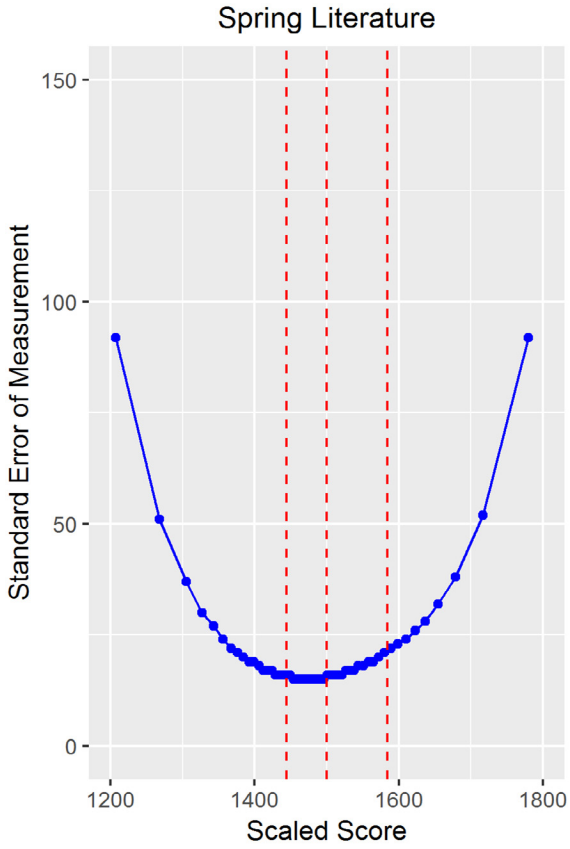


Figure 18–2 (continued). Conditional Standard Error Plots for Each Administration and Content Area



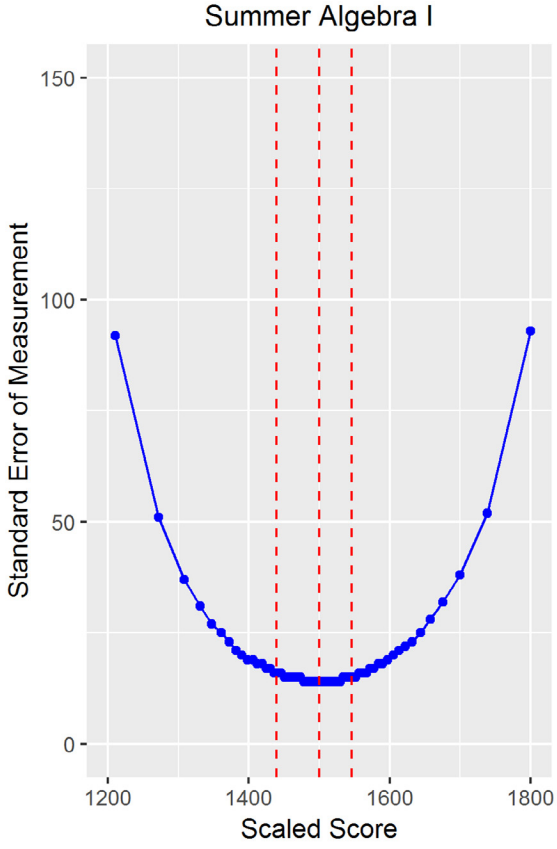
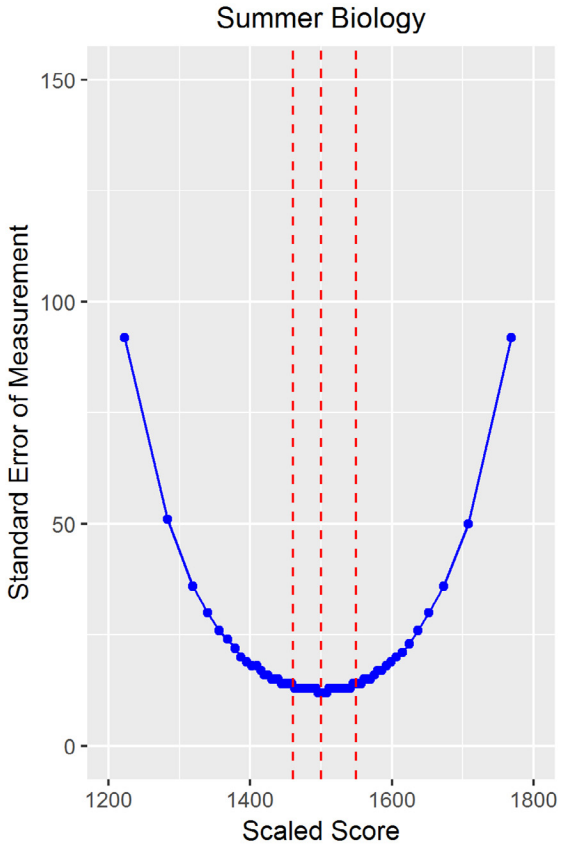
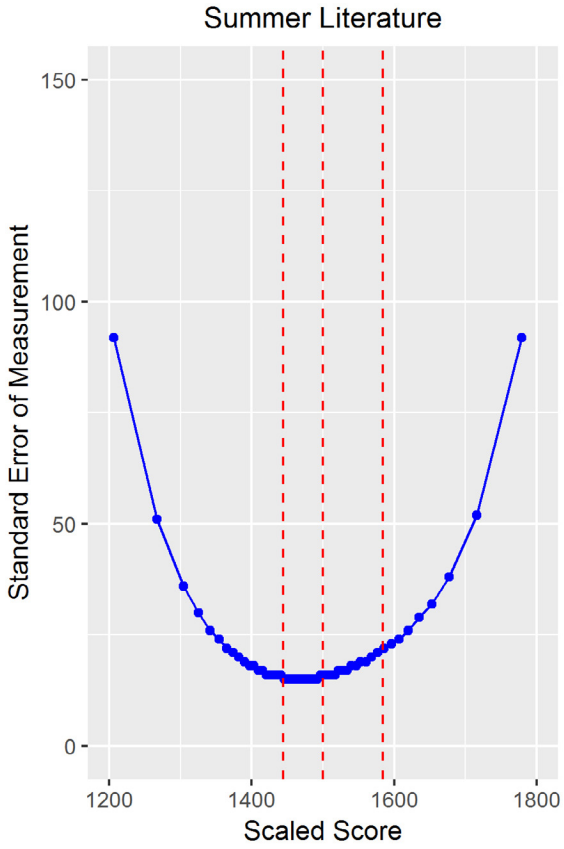


Figure 18–2 (continued). Conditional Standard Error Plots for Each Administration and Content Area





RELIABILITY OF PERFORMANCE LEVEL CLASSIFICATION DECISIONS

Student performance on the Keystone Exams is classified into one of four achievement levels using the cut scores described in Chapter Thirteen. The reliability of the classification decisions can be assessed by two statistics: decision accuracy and decision consistency.

DECISION ACCURACY

Decision accuracy describes the extent to which performance level classification decisions based on the administered test form would agree with the decisions that would be made on the basis of a perfectly reliable test (i.e., if it was possible to know each examinee's true score). Decision accuracy answers the question: How does the actual classification of test takers, based on their single-form scores, agree with the classification that would be made on the basis of their true scores, if their true scores were somehow known?

DECISION CONSISTENCY

Decision consistency describes the extent to which classification decisions based on the administered test form would agree with the decisions made if a parallel alternate form had been administered. Decision consistency answers the question: What is the agreement between the classifications based on two non-overlapping, equally difficult forms of the test?

Since the true scores are unknown and it is not feasible to repeat the Keystone Exams 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). Although a number of procedures are available, two well-known methods were developed by Hanson and Brennan (1990) and Livingston and Lewis (1995), utilizing specific true score models. These approaches are fairly complex, and the cited sources contain details regarding the statistical models used to calculate the decision accuracy and consistency from a single administration.

For Keystone Exams, given the two approaches provide similar results, true scores and single-form scores on forms parallel to the one actually given are estimated following the Livingston and Lewis (1995) method. The decision accuracy is estimated using an estimated joint distribution of reported performance-level classifications on the current form of the exam and the performance-level classifications based on the true score. Decision consistency is estimated using an estimated joint distribution of reported performance-level classifications on the current form of the exam and performance-level classifications on the parallel alternate form. In each case, the proportion of performance-level classifications with exact agreement is the sum of the entries in the diagonal of the contingency table representing the joint distribution. Reliability of classification at each performance-level cut score is estimated by collapsing the joint distribution at the passing score boundary into a 2-by-2 table and summing the two entries.

Several factors might affect the classification decision accuracy and consistency. One important factor is the reliability of the scores. All other things being equal, more reliable test scores tend to result in more similar reclassifications. Another factor is the location of the cut score in the score distribution. More consistent classifications are observed when the cut scores are located away from the mass of the score distribution. For example, when scores are close to being normally distributed, the mass is concentrated in the middle of the distribution, and thus, classifications tend to become more consistent when cut scores go up from 70 percent to 80 percent, or, alternatively, go down from 30 percent to 20 percent. The number of performance levels is also a consideration. Consistency indices for four performance levels should be lower than for those based on two categories. This is not surprising since classification using four levels would allow more opportunity to change achievement levels. Hence, there would be more classification errors with four achievement levels, resulting in lower consistency indices.

The results—derived using the program *BB-Class* (Brennan, 2004)—for the overall accuracy and consistency across all four performance levels as well as for the dichotomies created by the three cut scores are presented in Table 18–4.

Across all administrations and content areas, the overall decision accuracy ranged from 0.72 to 0.82 and the decision consistency ranged from 0.63 to 0.76. Dichotomous decisions have the higher accuracy and consistency values than the overall. The decision accuracy of the Basic/Proficient cut scores ranged from 0.91 to 0.94 and the decision consistency ranged from 0.88 to 0.91. The decision accuracy results indicate that at least 91% of students meeting or exceeding the Proficient cut score would receive the same classification if their true scores were known. If a parallel test were administered, at least 88% of students meeting or exceeding the Proficient cut score would be classified in the same way.

Table 18–4. Reliability of Performance-Level Classification Decisions

Administration	Content Area	Statistic	Overall	Below Basic/ Basic	Basic/Proficient	Proficient/ Advanced
Winter	Algebra I	accuracy	0.79	0.88	0.94	0.98
Winter	Algebra I	consistency	0.71	0.83	0.91	0.97
Winter	Biology	accuracy	0.77	0.86	0.93	0.98
Winter	Biology	consistency	0.68	0.81	0.90	0.97
Winter	Literature	accuracy	0.81	0.93	0.91	0.97
Winter	Literature	consistency	0.73	0.90	0.88	0.95
Spring	Algebra I	accuracy	0.80	0.90	0.93	0.96
Spring	Algebra I	consistency	0.72	0.86	0.91	0.95
Spring	Biology	accuracy	0.81	0.92	0.94	0.96
Spring	Biology	consistency	0.73	0.88	0.91	0.94
Spring	Literature	accuracy	0.81	0.95	0.92	0.94
Spring	Literature	consistency	0.73	0.93	0.88	0.92
Summer	Algebra I	accuracy	0.78	0.88	0.93	0.98
Summer	Algebra I	consistency	0.69	0.83	0.89	0.97
Summer	Biology	accuracy	0.72	0.80	0.94	0.98
Summer	Biology	consistency	0.63	0.75	0.91	0.97
Summer	Literature	accuracy	0.82	0.91	0.93	0.99
Summer	Literature	consistency	0.76	0.87	0.90	0.99

RATER AGREEMENT

Because CR items are included on the Keystone Exams, another source of random error is related to the scorers of those items. Frisbie (2005) noted that "test score reliability differs from scorer reliability" and that "the need for one kind of estimate cannot be satisfied by the other." Additionally, the data most easily obtainable that captures this information comes from the "10 percent read behinds" collected during the scoring process. Partly because of the way these data are obtained and reported (i.e., it's **not** a ratio of true score variance over observed score variance), the term *rater agreement* is used here, not *rater reliability* or *inter-rater reliability* as these terms are somewhat misleading.

The rater agreements for the Keystone Exams are presented in Tables 18–5 to 18–7. In addition, the percentages awarded to each score point are also presented in these tables. As the table shows, the exact inter-rater agreement percentages ranged from 85 to 100 percent for winter and 79 to 100 percent for spring, and 86 to 100 for summer. Overall, Algebra I had the highest exact agreements while Literature tended to have lowest exact agreement. The percentages of exact and adjacent agreement for all content areas were nearly 100.

Table 18–5. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items: Winter

Content Area	Item	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Exact + Adjacent Agreement	% Awarded for Score Point 0	% Awarded for Score Point 1	% Awarded for Score Point 2	% Awarded for Score Point 3	% Awarded for Score Point 4	% Awarded for Score Point B/NS
Algebra I	1	95	5	100	43	29	3	2	14	15
Algebra I	2A	100	0	100	76	6	NA	NA	NA	18
Algebra I	2B	100	0	100	77	5	NA	NA	NA	18
Algebra I	2C	100	0	100	66	16	NA	NA	NA	18
Algebra I	2D	100	0	100	69	13	NA	NA	NA	18
Algebra I	3	94	6	100	23	38	14	6	1	18
Algebra I	4	94	6	100	15	30	29	9	1	16
Algebra I	5	95	5	100	42	24	10	4	1	19
Algebra I	6A	100	0	100	29	53	NA	NA	NA	17
Algebra I	6B	99	1	100	58	24	NA	NA	NA	17
Algebra I	6C	100	0	100	73	10	NA	NA	NA	17
Algebra I	6D	100	0	100	76	7	NA	NA	NA	17
Biology	1	90	10	100	27	26	16	13	NA	17
Biology	2	94	6	100	24	39	15	2	NA	20
Biology	3	88	11	99	33	25	16	8	NA	18
Biology	4	85	15	100	6	24	31	20	NA	18
Biology	5	91	9	100	24	28	21	7	NA	20
Biology	6	90	10	100	11	32	26	13	NA	18
Literature	1	88	12	100	12	34	33	5	NA	16
Literature	2	85	15	100	10	31	35	8	NA	17
Literature	3	86	14	100	16	40	21	4	NA	19
Literature	4	87	13	100	12	28	34	8	NA	18
Literature	5	86	14	100	11	29	34	8	NA	18
Literature	6	88	12	100	9	37	28	5	NA	20

Note. Some of the Algebra I CR items were scored by part. For example, 2A in the second column means part A of item 2. B/NS in the last column represents blank/non-scorable. NA means not applicable.

Table 18–6. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items: Spring

Content Area	Item	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Exact + Adjacent Agreement	% Awarded for Score Point 0	% Awarded for Score Point 1	% Awarded for Score Point 2	% Awarded for Score Point 3	% Awarded for Score Point 4	% Awarded for Score Point B/NS
Algebra I	1A	100	0	100	41	50	NA	NA	NA	10
Algebra I	1B	100	0	100	40	51	NA	NA	NA	10
Algebra I	1C	98	2	100	68	23	NA	NA	NA	10
Algebra I	1D	99	1	100	88	2	NA	NA	NA	10
Algebra I	2	91	9	100	46	23	13	5	1	13
Algebra I	3A	99	1	100	35	53	NA	NA	NA	11
Algebra I	3B	99	1	100	67	21	NA	NA	NA	11
Algebra I	3C	99	1	100	56	32	NA	NA	NA	11
Algebra I	3D	99	1	100	62	26	NA	NA	NA	11
Algebra I	4	82	17	99	27	33	15	10	3	13
Algebra I	5	91	9	100	37	29	14	7	1	13
Algebra I	6A	99	1	100	60	27	NA	NA	NA	13
Algebra I	6B	99	1	100	41	46	NA	NA	NA	13
Algebra I	6C	100	0	100	81	6	NA	NA	NA	13
Algebra I	6D	99	1	100	70	17	NA	NA	NA	13
Biology	1	83	17	100	24	25	27	13	NA	12
Biology	2	91	9	100	26	30	22	5	NA	16
Biology	3	87	13	100	34	26	17	8	NA	14
Biology	4	88	12	100	27	20	20	18	NA	14
Biology	5	88	12	100	10	17	31	28	NA	14
Biology	6	90	10	100	40	22	13	9	NA	16
Literature	1	76	24	100	7	36	36	9	NA	11
Literature	2	81	19	100	9	41	30	6	NA	14
Literature	3	84	16	100	8	37	32	7	NA	15
Literature	4	81	19	100	7	26	39	14	NA	13
Literature	5	81	19	100	6	30	41	9	NA	13
Literature	6	79	21	100	11	34	30	9	NA	15

Note. Some of the Algebra I CR items were scored by part. For example, 1A in the second column means part A of item 1. B/NS in the last column represents blank/non-scorable. NA means not applicable.

Table 18–7. Inter-Rater Agreement and Percentage Awarded for Each Score Point for CR Items: Summer

Content Area	Item	Inter-Rater Agreement % Exact	Inter-Rater Agreement % Adjacent	% Exact + Adjacent Agreement	% Awarded for Score Point 0	% Awarded for Score Point 1	% Awarded for Score Point 2	% Awarded for Score Point 3	% Awarded for Score Point 4	% Awarded for Score Point B/NS
Algebra I	1A	100	0	100	56	33	NA	NA	NA	11
Algebra I	1B	98	2	100	67	22	NA	NA	NA	11
Algebra I	1C	98	2	100	78	11	NA	NA	NA	11
Algebra I	1D	96	4	100	76	13	NA	NA	NA	11
Algebra I	2	93	7	100	25	47	9	4	1	15
Algebra I	3A	98	2	100	62	23	NA	NA	NA	15
Algebra I	3B	100	0	100	50	35	NA	NA	NA	10
Algebra I	3C	100	0	100	73	12	NA	NA	NA	15
Algebra I	3D	100	0	100	77	9	NA	NA	NA	15
Algebra I	4	94	6	100	32	37	13	6	1	11
Algebra I	5A	100	0	100	31	57	NA	NA	NA	12
Algebra I	5B	100	0	100	72	16	NA	NA	NA	12
Algebra I	5C	100	0	100	77	11	NA	NA	NA	12
Algebra I	5D	100	0	100	84	4	NA	NA	NA	12
Algebra I	6	93	7	100	31	26	20	6	3	14
Biology	1	93	7	100	35	29	19	7	NA	11
Biology	2	98	2	100	53	17	12	6	NA	13
Biology	3	96	4	100	32	23	17	13	NA	14
Biology	4	98	2	100	14	38	29	7	NA	12
Biology	5	86	14	100	26	34	17	8	NA	14
Biology	6	98	2	100	29	28	14	15	NA	15
Literature	1	90	10	100	8	26	20	7	NA	38
Literature	2	88	13	100	12	27	19	3	NA	39
Literature	3	93	7	100	18	31	10	0	NA	41
Literature	4	95	5	100	9	32	20	2	NA	39
Literature	5	89	11	100	13	37	9	1	NA	41
Literature	6	100	0	100	22	25	11	0	NA	40

Note. Some of the Algebra I CR items were scored by part. For example, 1A in the second column means part A of item 1. B/NS in the last column represents blank/non-scorable. NA means not applicable.

CHAPTER NINETEEN: VALIDITY

As defined in the *Standards for Educational and Psychological Testing*, validity is "the degree to which evidence and theory support the interpretation of test scores entailed by proposed uses of tests" (AERA, APA, & NCME, 2014, p.11). The *Standards* provide a framework for describing the sources of evidence that should be considered when evaluating validity. These sources include evidence based on test content, response processes, the internal structure of the test, the relationships between test scores and other variables, and the consequences of testing. In addition, when Rasch 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 Keystone Exams in support of their score interpretations and uses. Each of the previous chapters contributes important components that pertain to score validation: test development, test administration, test scoring, item analysis, Rasch calibration, scaling, equating, score reporting, and reliability. This chapter summarizes and synthesizes the evidence based on the framework of the *Standards*. The purposes and intended uses of the Keystone Exams are reviewed first, and then each type of validity evidence is addressed in turn.

PURPOSES AND INTENDED USES OF THE KEYSTONE EXAMS

The *Standards* emphasize that validity pertains to how test scores are used. To help contextualize the evidence that are presented in this chapter, the purposes of the Keystone Exams will be reviewed first. The Keystone Exams, which began in 2010–2011 for Algebra I, Biology, and Literature, are one component of Pennsylvania's system of high school graduation requirements. Students take the exams upon completing specific courses. The Keystone Exams results help schools and districts guide students toward meeting state standards. Students who do not score Proficient or above on a Keystone Exam module may choose to complete a project-based assessment for that module, provided that they meet the requirements detailed below.

- The student has taken the course.
- The student was unsuccessful in achieving a score of Proficient or Advanced on the Keystone Exam after at least two attempts.
- The student has met the district's attendance requirements for the course.
- The student has participated in a satisfactory manner in supplemental instructional services.

EVIDENCE BASED ON TEST CONTENT

Test content validity evidence for the Keystone Exams 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 Keystone Exams Assessment Anchors and Eligible Content. The Keystone Exams are intended to measure the knowledge and skills described in the Assessment Anchors and Eligible Content for Algebra I, Biology, and Literature.

Lane (1999) suggests taking the following steps to support the content validity of an assessment. In the case of Keystone Exams, one should

- Evaluate the degree to which the test specifications represent and align with the knowledge and skills described in the Assessment Anchors and Eligible Content for Algebra I, Biology, and Literature.
- Evaluate the alignment between the Keystone Exams 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 Keystone Exams 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, time limit for the assessment, and training of raters.
- Submit operational tests to third-party independent reviews.

Chapters Two through Eight 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 Keystone Exams Assessment Anchors and Eligible Content for Algebra I, Biology, and Literature. After development, items underwent multiple rounds of content and bias reviews. After being field-tested, items were reviewed with respect to their statistical properties. Items selected for the operational assessment had to pass content, psychometric, and PDE reviews. Tests were administrated 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 Keystone Exams 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 for Algebra I, Biology, and Literature. Appropriateness for the intended students was also considered, as well as DOK, 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 with respect to the following categories:
    - Overall quality and clarity
    - Anchor, Eligible Content, and/or standard alignment
    - Grade-level appropriateness
    - Difficulty level
    - Domain of knowledge (DOK)
    - 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 the prior hurdles were tried out as embedded field-test items in the operational test. Several statistical analyses were conducted on the field-test data including classical item analyses, distractor analyses, and differential item functioning (DIF). 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.
- The Keystone Exams were administered according to standardized procedures with allowable accommodations. Students were given ample time to complete the tests (i.e., there were no speediness issues).
- As described in Chapter Eight, the raters for constructed-response (CR) items were carefully recruited and well trained. Their scoring was monitored throughout the scoring session to ensure that an acceptable level of scoring accuracy was maintained.

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. In addition, when an assessment includes CR items, an examination of the extent to which the raters interpret and apply the scoring criteria accurately when assigning scores to students' responses on CR items also adds response-process validity evidence.

For the operational Keystone Exams offered in winter, spring, and summer, no cognitive lab studies were conducted to collect the response-process evidence. Rather, for all the Keystone Exams, well-organized scorer training and subsequent monitoring of rating accuracy helped ensure that raters strictly followed the scoring criteria and that no features unrelated to the rubric significantly affected their scoring.

EVIDENCE BASED ON INTERNAL STRUCTURE

As described in the *Standards* (2014), internal-structure evidence refers to the degree to which the relationships between test items and test components conform to the construct on which the proposed test interpretations are based. For each Keystone Exam, one total test score as well as module scores were reported (see Chapter Sixteen for more information about the Keystone Exams 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 provided in Appendix J and discussed in Chapter Eleven. All item correlations for operational items were greater than 0, indicating a positive association with the total score.

DIFFERENTIAL ITEM FUNCTIONING (DIF)

DIF analyses with respect to gender, ethnicity, and administration mode address construct-irrelevant variance, which represents an important threat to the validity of achievement tests. As noted in Chapter Five, newly field-test items were screened and reviewed for DIF. Items identified with C-level DIF must be reviewed and approved by teacher committees in order to be used operationally (for scoring purposes). After operational use, DIF analyses were conducted on the operational items again to investigate whether the DIF code changed between field testing and operational use. Table 19–1 shows the number of items in which the DIF codes changed between field testing and operational testing, either from A/B to C-level DIF, or vice versa. There were no items in which the bias code changed from A/B to C, and few items in which the bias code changed from C to A/B. Items with a changed DIF code tended to be in Keystone Literature.

Table 19–1. Summary of Bias Code Change from Field Test to Operational Test

Administration	Content Area	Change	Male/Female	White/Black	PPT/CBT
Winter	Algebra I	C → A/B	0	0	0
Winter	Algebra I	A/B → C	0	0	0
Winter	Biology	C → A/B	0	0	0
Winter	Biology	A/B → C	0	0	0
Winter	Literature	C → A/B	4	0	0
Winter	Literature	A/B → C	0	0	0
Spring	Algebra I	C → A/B	0	0	0
Spring	Algebra I	A/B → C	0	0	0
Spring	Biology	C → A/B	0	0	0
Spring	Biology	A/B → C	0	0	0
Spring	Literature	C → A/B	3	0	0
Spring	Literature	A/B → C	0	0	0
Summer	Algebra I	C → A/B	0	1	0
Summer	Algebra I	A/B → C	0	0	0
Summer	Biology	C → A/B	0	2	0
Summer	Biology	A/B → C	0	0	0
Summer	Literature	C → A/B	1	0	0
Summer	Literature	A/B → C	0	0	0

Note. PPT represents the paper-and-pencil-based test, and CBT represents the computer-based test.

MODULE CORRELATIONS

Correlations and disattenuated correlations among module scores for the Keystone Exams are presented in Table 19-2 and 19-3, respectively. Values were derived from the Keystone final data files (see Chapter Nine). These data can also provide information on score dimensionality that is part of internal-structure evidence. All Keystone Exams have two modules, which represent unique, non-overlapping topics. The intercorrelations between the modules within the content areas were positive and ranged from 0.69 to 0.87. The intercorrelations between modules in different content areas ranged from 0.53 to 0.74.

Table 19–2. Correlations among Algebra I, Biology, and Literature Modules

Administration	Content Area	Module	Algebra I Module 1	Algebra I Module 2	Biology Module 1	Biology Module 2	Literature Module 1	Literature Module 2
Winter	Algebra I	Module 1	-					
Winter	Algebra I	Module 2	0.79	-				
Winter	Biology	Module 1	0.55	0.54	-			
Winter	Biology	Module 2	0.55	0.53	0.78	-		
Winter	Literature	Module 1	0.57	0.54	0.64	0.66	-	
Winter	Literature	Module 2	0.58	0.56	0.65	0.67	0.81	-
Spring	Algebra I	Module 1	-					
Spring	Algebra I	Module 2	0.85	-				
Spring	Biology	Module 1	0.66	0.66	-			
Spring	Biology	Module 2	0.69	0.69	0.87	-		
Spring	Literature	Module 1	0.57	0.55	0.69	0.72	-	
Spring	Literature	Module 2	0.59	0.58	0.71	0.74	0.83	-
Summer	Algebra I	Module 1	-					
Summer	Algebra I	Module 2	0.69	-				
Summer	Biology	Module 1	0.63	0.67	-			
Summer	Biology	Module 2	0.62	0.71	0.81	-		
Summer	Literature	Module 1	0.67	0.58	0.54	0.61	-	
Summer	Literature	Module 2	0.71	0.62	0.53	0.67	0.80	-

The correlations in Table 19–2 are based on the observed module scores. These observed-score correlations are weakened by existing measurement error contained within each module score. As a result, disattenuated correlations could provide an estimate of the relationships among modules 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; Spearman, 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 Module 1 and Module 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 modules are measuring slightly different aspects of the same construct. Values markedly less than 1.00 suggest the modules reflect different constructs.

Table 19–3 shows the corresponding disattenuated correlations for each Keystone Exam. Given that none of these modules had reliabilities of 1 (see Chapter Eighteen), the disattenuated module correlations are higher than their observed score counterparts.

Table 19–3. Disattenuated Correlations among Algebra I, Biology, and Literature Modules

Administration	Content Area	Module	Algebra I Module 1	Algebra I Module 2	Biology Module 1	Biology Module 2	Literature Module 1	Literature Module 2
Winter	Algebra I	Module 1	-					
Winter	Algebra I	Module 2	0.99	-				
Winter	Biology	Module 1	0.68	0.66	-			
Winter	Biology	Module 2	0.70	0.68	0.98	-		
Winter	Literature	Module 1	0.69	0.66	0.77	0.83	-	
Winter	Literature	Module 2	0.71	0.68	0.78	0.83	0.97	-
Spring	Algebra I	Module 1	-					
Spring	Algebra I	Module 2	1.01	-				
Spring	Biology	Module 1	0.77	0.78	-			
Spring	Biology	Module 2	0.80	0.80	1.00	-		
Spring	Literature	Module 1	0.67	0.66	0.81	0.83	-	
Spring	Literature	Module 2	0.70	0.69	0.83	0.85	0.99	-
Summer	Algebra I	Module 1	-					
Summer	Algebra I	Module 2	0.92	-				
Summer	Biology	Module 1	0.82	0.84	-			
Summer	Biology	Module 2	0.82	0.91	1.00	-		
Summer	Literature	Module 1	0.88	0.74	0.67	0.76	-	
Summer	Literature	Module 2	0.92	0.78	0.65	0.83	0.98	-

The within–content area disattenuated correlations were higher for winter and spring than summer administrations.) The higher disattenuated correlations suggest that the within–content area modules might be measuring essentially the same construct. This, in turn, suggests that the within content module scores might not provide unique information about the strengths or weaknesses of many of the students.

On a fairly consistent basis, the disattenuated correlations among the modules within each content area are higher than the correlations among modules across different content areas. In general, within–content area module correlations were greater than 0.97 for winter and spring and greater than 0.92 for summer, while across-content area module disattenuated correlations range from 0.65 to 0.92

It should be noted that some caution is needed when interpreting the disattenuated results because the reliabilities used to calculate the disattenuated correlations are subject to both upward and downward biases. Consequently, some of the values in the table above may be higher or lower than they should be, depending on which bias prevails for any given pair of module scores. When the reliabilities are lower than they should be, the disattenuated correlations will be inflated and, in some instances, can appear higher than the theoretical correlation maximum value of 1.00.

Overall, the internal structure evidence presented supports the assumption that related elements of each of the Keystone Exams are correlated in the intended manner. The modules *within* each content area have stronger relationships than the *across* content area modules, which further supports reporting a total score for each different content area.

The module scores present more of a mixed message. Since the modules in each content area were designed to measure distinct components of the content area, it is reasonable to expect that the inter-content module correlations should be positive and strong but, ideally, not extremely high. However, the disattenuated correlations imply that some modules are essentially measuring the same constructs for most of the students. Consequently, there may be less support for providing results for some module scores beyond the total score. While there is content rationale underlying the creation of the module scores, the empirical correlations illustrate that caution is required when using the module scores to identify a student's strengths and weaknesses. Certainly, instructional programs should not be based on module score information alone, but rather in conjunction with other sources of evidence available (e.g., teacher observations, other exam performance).

EVIDENCE BASED ON RELATIONSHIPS WITH OTHER VARIABLES

As described in the *Standards*, "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" (AERA, APA, & NCME, 2014, 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).

The correlations among students' test scores on different Keystone Exams including Algebra I, Biology, and Literature are shown in Table 19–4 to provide some discriminant validity evidence. In this table, both the observed correlations and the disattenuated correlations (in the parentheses) are reported. Each Keystone Exam measures different constructs, so the correlations among them were not expected to be extremely high. The values in this table are consistent with this expectation. As can be seen, the correlations among the Keystone Exams ranged from 0.64 to 0.78 and the disattenuated correlations ranged from 0.71 to 0.87.

Table 19–4. Correlations Among Student Performance

Administration	Content Area	Algebra I	Biology
Winter	Biology	0.64 (0.73)	
Winter	Literature	0.64 (0.71)	0.74 (0.82)
Spring	Biology	0.75 (0.81)	
Spring	Literature	0.66 (0.72)	0.78 (0.85)
Summer	Biology	0.76 (0.87)	
Summer	Literature	0.75 (0.85)	0.67 (0.75)

External evidence for the Keystone Exams is examined by using students' scores on the 2022 Pennsylvania System of School Assessment (PSSA) as the external criteria. The final 2022 Algebra I, Biology and Literature data files were merged with the PSSA mathematics, science, and ELA data by students' PA secure IDs. Then the correlations between students' scores on the Keystone Exams and on the PSSA were calculated as one component of external evidence. This analysis was attempted for all Keystone administrations. However, only enough students were obtained for the spring administration. Table 19–5 summarizes the sample sizes and correlations by grade and content area after the file merging of the spring Keystone Exams and the PSSA.

Table 19–5. Correlation between Spring Keystone Exam Scores and PSSA Scores by Grade

Keystone Content Area/ PSSA Subject	Grade 7 N	Grade 7 Correlation	Grade 8 N	Grade 8 Correlation
Algebra I/Mathematics	6169	0.81	27498	0.84
Biology/Science	NA	NA	212	0.79
Literature/ELA	NA	NA	3	-

Note. Correlations were not reported for sample sizes less than 10 students.

The correlations within the same content area ranged from 0.79 to 0.84. These results suggest the Keystone Exams measured something similar but not identical to the corresponding PSSA tests. The results also provide external evidence in support of the Keystone Exams as a valid measure of students' achievement.

The collection of external evidence relating to the Keystone Exams is an ongoing process once the data are collected in the future. Other criterion-related evidence can be evaluated by the relationships between the Keystone Exams and criterion variables such as the Scholastic Aptitude Test (SAT), the American College Testing (ACT), or students' Grade Point Average (GPA) in their first college course.

EVIDENCE BASED ON CONSEQUENCES OF TESTS

Based on 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 examining the change in the percentage of students who scored Proficient or Advanced from the inception of the Keystone program in 2011 to the most recent administrations. Table 19–6 provides the percentages of students who scored Proficient or Advanced by administration and content. Values are derived from the first-time test-takers during each spring administration and represent administration-specific performance level classification.

Table 19–6. Percentages of Students earning Proficient or Advanced Performance Level Classifications

Administration	Algebra I Number	Algebra I Percent	Biology Number	Biology Percent	Literature Number	Literature Percent
Spring 2011	94,697	38.6	46,979	35.7	42,808	49.9
Spring 2013	157,811	47.6	134,995	47.2	117,830	63.1
Spring 2014	124,954	51.5	119,274	52.9	113,477	60.9
Spring 2015	121,255	50.1	115,936	58.0	114,387	67.2
Spring 2016	120,104	50.6	116,345	56.8	112,361	65.0
Spring 2017	118,704	51.7	115,473	56.6	110,966	64.5
Spring 2018	117,345	50.6	114,704	57.2	109,387	64.7
Spring 2019	117,677	48.4	113,834	54.7	110,030	63.3
Spring 2020						
Spring 2021	103,296	37.1	98,419	45.6	96,409	57.7
Spring 2022	120398	36.6	112130	47.6	107815	60.1

Note. Spring 2020 data is not available due to school closures and cancellation of Keystone testing in Spring 2020.

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 Sixteen, there are several different types of scores and score reports used for the Keystone Exams. The extent to which various groups of users (e.g., students, teachers) interpret these scores and reports appropriately affects the validity of subsequent uses of these results. Chapter Sixteen is intended to provide accurate and clear test score and report information with the hope that this will help users avoid unintended uses and interpretations of the Keystone Exams results. Nevertheless, evidence pertaining to other consequences of the Keystone Exams needs continued research.

EVIDENCE RELATED TO THE USE OF RASCH MODEL

Since the Rasch model is the basis of all calibration, scaling, and equating analyses associated with the Keystone Exams, 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 Twelve, the underlying assumptions of Rasch models were essentially met for all the Keystone Exams data, indicating the appropriateness of using the Rasch models to analyze the Keystone Exams data.

VALIDITY EVIDENCE SUMMARY

Validity evidence related to test content was reviewed earlier in this chapter. The early chapters of this technical report show that a strong link can be established between each item on the Keystone Exam and its associated Eligible Content. Details regarding how the operational Keystone Exams were assembled to reflect the state content standards and detailed information regarding educator reviews (including content, bias, and sensitivity reviews) are presented in Chapter Six.

Module score intercorrelations were also presented in this chapter. In general, within–content area module scores (e.g., Algebra I Module 1 and Algebra Module 2) were correlated more highly than across-content module scores (e.g., Literature Module 1 and Algebra Module 1). Consequently, this provides some favorable evidence regarding the internal and external relationships between the test components.

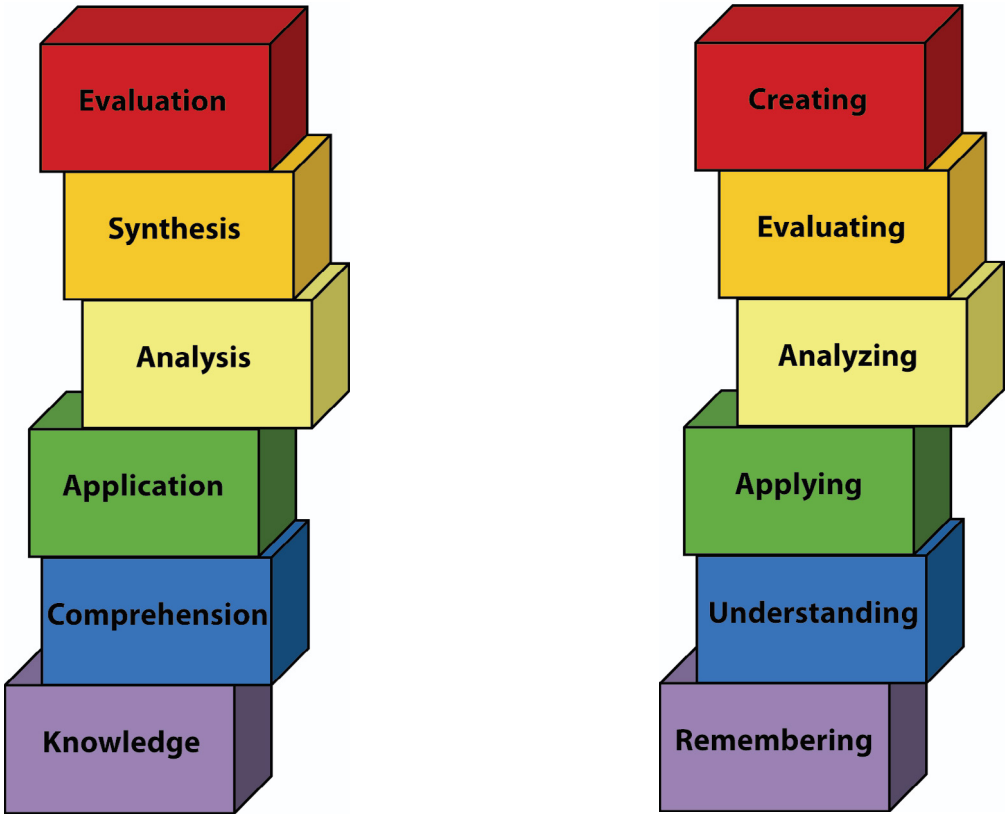
Moreover, validity of score inferences is bolstered when test scores are consistent. Here, the reliabilities of the total test scores presented in Chapter Eighteen were high.

As reported in Chapter Five, DIF with respect to gender, ethnicity, and test administration mode 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 data review committees are eligible for operational use.

APPENDIX A: UNDERSTANDING DEPTH OF KNOWLEDGE AND COGNITIVE COMPLEXITY

One of the steps in the item review process involves Pennsylvania educators' review of items for cognitive complexity or the nature of thinking. One model for classifying thinking into cognitive levels of complexity is Bloom's Taxonomy. Bloom's Taxonomy was first presented in 1956 through the publication, The Taxonomy of Educational Objectives, The Classification of Educational Goals, Handbook I: Cognitive Domain. This taxonomy identifies six levels within the cognitive domain, from the simple recall or recognition of facts, at the lowest level, through increasingly more complex levels, to the highest level which is classified as evaluation.

During the late 1990s, the original Bloom's Taxonomy was revised (Anderson and Krathwohl, 2001). In the 2001 version of Bloom's Taxonomy, the names of the six major cognitive process categories or levels were revised to indicate action (verbs) rather than non-action (nouns) as noted in the graphic below.



Bloom's Taxonomy (1956) **Revised Taxonomy (2001)**

More recently, Webb's Depth-of-Knowledge Levels have also been used in the review of items for cognitive demand. Webb's Depth of Knowledge was created by Norman Webb from the Wisconsin Center for Education Research. Webb's definition of depth of knowledge is the degree or complexity of knowledge that the content curriculum standards and expectations require. Therefore, when reviewing items for depth of knowledge, the item is reviewed to determine whether or not it is as demanding cognitively as what the actual content curriculum standard expects. In the case of the Pennsylvania Keystone items, the item meets the criterion if the depth of knowledge of the item is in alignment with the depth of knowledge of the Assessment Anchor as defined by the Eligible Content.

Webb's Depth of Knowledge includes four levels, from the lowest (basic recall) to the highest (extended thinking). Verb examples that represent each level in Webb's Depth of Knowledge can be found in the information that follows. However, verbs alone do not describe the depth of knowledge. Rather, depth of knowledge also focuses upon how well the students need to know the content before they can respond to a given item.

Because Bloom's Taxonomy (1956) is very familiar to many teachers, information comparing Bloom's Taxonomy and Webb's Depth of Knowledge is provided to Pennsylvania educators during the review of the Keystone items. The comparison serves as a "bridge" for teachers to understand Webb's Depth of Knowledge as compared to Bloom's Taxonomy.

ALGEBRA I DEPTH OF KNOWLEDGE

DEPTH OF KNOWLEDGE GUIDELINES FOR REVIEW OF ALGEBRA I, ALGEBRA II, AND GEOMETRY ITEMS

Committees of Pennsylvania educators review each Keystone Exam item, not only to determine whether or not the item measures what it is intended to measure, but also to determine whether or not the item aligns with the cognitive level or depth of knowledge of the Assessment Anchor as defined by the Eligible Content. The information below provides a definition of the four depth-of-knowledge levels. The charts at the end of the section also provide a comparison between Bloom's Taxonomy and Webb's Depth of Knowledge for mathematics (Algebra I, Algebra II, and Geometry). Included are examples of verbs (i.e., the action). Using this information as well as the charts, Pennsylvania educators are asked to determine the depth of knowledge of each item and to verify that the depth of knowledge of each item is in alignment with the depth of knowledge of the Assessment Anchor as defined by the Eligible Content.

DEFINITIONS OF WEBB'S DEPTH OF KNOWLEDGE

Level 1 (*Recall*) requires the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics, a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify Level 1 include "identify," "recall," "recognize," "use," and "measure." Verbs such as "describe" and "explain" could be classified at different levels, depending on what is to be described and explained.

Level 2 (*Skill/Concept*) requires the engagement of some mental processing beyond a habitual response. A Level 2 item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply more than one step. For example, to compare data requires first identifying characteristics of objects or phenomena and then grouping or ordering the objects. Some action verbs, such as "explain," "describe," or "interpret," could be classified at different levels depending on the object of the action. For example, interpreting information from a simple graph, or reading information from the graph, are also at Level 2. Interpreting information from a complex graph that requires some decisions on what features of the graph need to be considered and how information from the graph can be aggregated is at Level 3. Level 2 activities are not limited only to number skills, but may involve visualization skills and probability skills. Other Level 2 activities include noticing or describing non-trivial patterns; explaining the purpose and use of experimental procedures; carrying out experimental procedures; making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

Level 3 (*Strategic Thinking*) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is at Level 3. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does not result from the fact that there are multiple answers, a possibility for both Levels 1 and 2, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be at Level 3. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and deciding which concepts to apply in order to solve a complex problem.

Level 4 (*Extended Thinking*) requires complex reasoning, planning, developing, and thinking most likely over an extended period of time. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2. However, if the student is to conduct a river study that requires

taking into consideration a number of variables, this would be a Level 4. At Level 4, the cognitive demands of the task should be high and the work should be very complex. Students should be required to make several connections—relate ideas *within* the content area or *among* content areas—and have to select one approach among many alternatives on how the situation should be solved, in order to be at this highest level. Level 4 activities include designing *and* conducting experiments and projects; developing and proving conjectures; making connections between a finding and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs.

Note: Multiple-choice and constructed-response items can be written at a depth-of-knowledge Level 4; however, to design an item in this format is difficult, as it would require research, investigation, and application, often over an extended period of time (e.g., performance-based tasks; portfolios; research studies/projects).

(Webb, N. 1997, 1999, 2002, 2005, 2006)

Table A–1. Bloom's Taxonomy – Algebra I

Categories (1956)	Definition	Examples of Action Words*
Knowledge	Student remembers, or recalls appropriate previously learned information.	define; identify; name; select; state; order; (involves a one-step problem)
Comprehension	Student translates, comprehends, or interprets information based on prior learning.	convert; estimate; explain; express; factor; generalize; give example; identify; indicate; locate; picture; (involves two or more steps)
Application	Student selects, transfers, and uses data and principles to complete a task or problem with minimum directions.	apply; choose; compute; employ; interpret; graph; modify; operate; plot; practice; solve; use; (involves three or more steps)
Analysis	Student distinguishes, classifies, and relates assumptions, hypotheses, evidence, or structure of a statement or question.	compare; contrast; correlate; differentiate; discriminate; examine; infer; maximize; minimize; prioritize; subdivide; test
Synthesis	Student originates, integrates, and combines ideas into a product, plan, or proposal that is new to him or her.	arrange; collect; construct; design; develop; formulate; organize; set up; prepare; plan; propose; create experiment and record data
Evaluation	Student appraises, assesses, or critiques on a basis of specific standards and criteria.	appraise; assess; defend estimate; evaluate; judge; predict; rate; validate; verify

Table A–2. Webb's Depth of Knowledge – Algebra I

Categories	Definition	Example of Action Words*
Recall	Student recalls facts, information, procedures, or definitions.	define; identify; name; select; state; order; one step
Basic Application of Skill/ Concept	Student uses information, conceptual knowledge, and procedures.	apply; choose; compute; employ; interpret; graph; modify; operate; plot; practice; solve; use; two or more steps
Strategic Thinking	Student uses reasoning and develops a plan or sequence of steps; process has some complexity.	compare; contrast; correlate; differentiate; discriminate; examine; infer; maximize; minimize; prioritize; subdivide; test
Extended Thinking	Student conducts an investigation, needs time to think and process multiple conditions of the problem or task. (The item/task generally requires several days or weeks to complete.)	arrange; collect; construct; design; develop; formulate; organize; set up; prepare; plan; propose; create experiment and record data

*Some action words (verbs) can be classified at different depth-of-knowledge levels depending on the context of the item and the complexity of the action.

BIOLOGY DEPTH OF KNOWLEDGE

Note: *"Knowledge" can refer both to content knowledge and knowledge of scientific processes. This meaning of knowledge is consistent with the National Science Education Standards (NSES), which terms "Science as Inquiry" as its first Content Standard.*

Committees of Pennsylvania educators review each Keystone Exam item, not only to determine whether or not the item measures what it is intended to measure, but also to determine whether or not the item aligns with the cognitive level or depth of knowledge of the Assessment Anchor as defined by the Eligible Content. The information below provides a definition of the four depth-of-knowledge levels. The charts at the end of the section also provide a comparison between Bloom's Taxonomy and Webb's Depth of Knowledge for biology. Included are examples of verbs (i.e., the action). Using this information as well as the charts, Pennsylvania educators are asked to determine the depth of knowledge of each item and to verify that the depth of knowledge of each item is in alignment with the depth of knowledge of the Assessment Anchor as defined by the Eligible Content.

DEFINITIONS OF WEBB'S DEPTH OF KNOWLEDGE

Level 1 (*Recall*) requires the recall of information, such as a fact, definition, term, or a simple procedure, as well as performance of a simple science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A "simple" procedure is well defined and typically involves only one step. Verbs such as "identify," "recall," "recognize," "use," "calculate," and "measure" generally represent cognitive work at the recall level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as "describe" and "explain" could be classified at different depth-of-knowledge levels, depending on the complexity of what is to be described and explained.

A student answering a Level 1 item either knows the answer or does not: that is, the item does not need to be "figured out" or "solved." In other words, if the knowledge necessary to answer an item automatically provides the answer to it, then the item is at Level 1. If the knowledge needed to answer the item is not automatically provided in the stem, the item is at least at Level 2. Some examples that represent but do not constitute all Level 1 performance are as follows:

- Recall or recognize a fact, term, or property.
- Represent in words or diagrams a scientific concept or relationship.
- Provide or recognize a standard scientific representation for simple phenomenon.
- Perform a routine procedure, such as measuring length.

Level 2 (*Skills and Concepts*) requires the engagement of some mental processing beyond recalling. The content knowledge or process involved is **more complex** than in Level 1. Items require students to make some decisions as to how to approach the question or problem. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data." These actions imply **more than one step**. For example, to compare data requires first identifying characteristics of the objects or phenomena and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts. Some action verbs, such as "explain," "describe," or "interpret," could be classified at different depth-of-knowledge levels, depending on the complexity of the action. For example, interpreting information from a simple graph, which requires reading information from the graph, is a Level 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at Level 3. Some examples that represent but do not constitute all of Level 2 performance are as follows:

- Specify and explain the relationship between facts, terms, properties, or variables.
- Describe and explain examples and non-examples of science concepts.
- **Select a procedure according to specified criteria and perform it**.

- Formulate a routine problem, given data and conditions.
- Organize, represent, and interpret data.

Level 3 (*Strategic Thinking*) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve non-routine problems. Some examples that represent but do not constitute all Level 3 performance are as follows:

- Identify research questions and design investigations for a scientific problem.
- Solve non-routine problems.
- Develop a scientific model for a complex situation.
- Form conclusions from experimental data.

Level 4 (*Extended Thinking*) requires high cognitive demands and complexity. Students are required to make several connections—relate ideas within the content area or among content areas—and have to select or devise one approach among many alternatives to solve the problem. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. "Develop generalizations of the results obtained and the strategies used and apply them to new problem situations," is an example of a grade 8 objective that is a Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be Level 4.

Level 4 involves complex reasoning, experimental design and planning, and probably will require an extended period of time either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student is asked to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4. Some examples that represent but do not constitute all Level 4 performance are as follows:

- Based on data provided from a complex experiment that is novel to the student, deduct the fundamental relationship between several controlled variables.
- Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions.

Note: Multiple-choice and constructed-response items can be written at a depth-of-knowledge Level 4; however, to design an item in this format is difficult, as it would require research, investigation, and application, often over an extended period of time (e.g. performance-based tasks, portfolios, research studies/projects).

(Webb, N. 1997, 1999, 2002, 2005, 2006)

Table A–3. Bloom's Taxonomy – Biology

Categories (1956)	Definition	Examples of Action Words*
Knowledge	Student remembers or recalls appropriate previously learned information.	identify; recall; observe; recognize; use; calculate; measure; order
Comprehension	Student translates, comprehends, or interprets information based on prior learning.	explain; interpret; describe; classify; identify; recognize; predict
Application	Student selects, transfers, and uses data and principles to complete a task or problem with minimum directions.	apply; classify; experiment; interpret; use; order; calculate
Analysis	Student distinguishes, classifies, and relates assumptions, hypotheses, evidence, or structure of a statement or question.	analyze; order; explain; classify; arrange; compare; contrast; infer; calculate; categorize; examine; experiment; question; test
Synthesis	Student originates, integrates, and combines ideas into a product, plan, or proposal that is new to him or her.	combine; arrange; rearrange; modify; invent; design; construct; organize; predict; infer; conclude; create; experiment and record data
Evaluation	Student appraises, assesses, or critiques on a basis of specific standards and criteria.	evaluate; measure; explain; compare; summarize; predict; test decide; rate; conclude

Table A–4. Webb's Depth of Knowledge – Biology

Categories	Definition	Examples of Action Words*
Recall	Student recalls facts, information, procedures, or definitions.	identify; recall; observe; recognize; use; calculate; measure; order
Basic Application of Skill/ Concept	Student uses information, conceptual knowledge, and procedures.	explain; interpret; describe; classify; identify; order; recognize; predict; apply; use; calculate; organize; estimate; observe; collect; and display data
Strategic Thinking	Student uses reasoning and develops a plan or sequence of steps; process has some complexity.	analyze; order; explain; classify; arrange; compare; contrast; infer; interpret; calculate; categorize; examine; experiment; question; predict; evaluate; test
Extended Thinking	Student conducts an investigation, needs time to think and process multiple conditions of the problem or task. (The item/task generally requires several days or weeks to complete.)	combine; arrange; rearrange; propose; evaluate; modify; invent; design; construct; organize; predict; infer; conclude; evaluate; create; experiment and record data

*Some action words (verbs) can be classified at different depth-of-knowledge levels depending on the context of the item and the complexity of the action.

LITERATURE DEPTH OF KNOWLEDGE

Note: *The levels are based on Valencia and Wixson (2000, pp. 909–935).*

Committees of Pennsylvania educators review each Keystone Exam item, not only to determine whether or not the item measures what it is intended to measure, but also to determine whether or not the item aligns with the cognitive level or depth of knowledge of the Assessment Anchor as defined by the Eligible Content. The information below provides a definition of the four depth-of-knowledge levels. The charts at the end of the section also provide a comparison between Bloom's Taxonomy and Webb's Depth of Knowledge for literature. Included are examples of verbs (i.e., the action). Using this information as well as the charts, Pennsylvania educators are asked to determine the depth of knowledge of each item and to verify that the depth of knowledge of each item is in alignment with the depth of knowledge of the Assessment Anchor as defined by the Eligible Content.

DEFINITIONS OF WEBB'S DEPTH OF KNOWLEDGE

Level 1 requires students to receive or recite facts or to use simple skills or abilities. Oral reading that does not include analysis of the text, as well as basic comprehension of a text, is included. Items require only a shallow understanding of the text presented and often consist of verbatim recall from text, slight paraphrasing of specific details from the text, or simple understanding of a single word or phrase. Some examples that represent but do not constitute all Level 1 performance are as follows:

- Support ideas by reference to verbatim or only slightly paraphrased details from the text.
- Use a dictionary to find the meanings of words.
- Recognize figurative language in a reading passage.

Level 2 requires the engagement of some mental processing beyond recalling or reproducing a response; it requires both comprehension and subsequent processing of text or portions of text. Inter-sentence analysis of inference is required. Some important concepts are covered, but not in a complex way. Content curriculum standards and items at this level may include words such as summarize, interpret, infer, classify, organize, collect, display, compare, and determine whether fact or opinion. Literal main ideas are stressed. A Level 2 item may require students to apply skills and concepts that are covered in Level 1. However, items require closer understanding of text, possibly through the item's paraphrasing of both the question and the answer. Some examples that represent but do not constitute all Level 2 performance are as follows:

- Use context cues to identify the meaning of unfamiliar words, phrases, and expressions that could otherwise have multiple meanings.
- Predict a logical outcome based on information in a selection.
- Identify and summarize the major events in a narrative.

Level 3 requires deeper knowledge. Students are encouraged to go beyond the text; however, they are still required to show understanding of the ideas in the text. Students may be encouraged to explain, generalize, or connect ideas. Content curriculum standards and items (Assessment Anchors as defined by the Eligible Content) at Level 3 involve reasoning and planning. Students must be able to support their thinking. Items may involve abstract theme identification, inference across an entire passage, or students' application of prior knowledge. Items may also involve more superficial connections between texts. Some examples that represent but do not constitute all Level 3 performance are as follows:

- Explain or recognize how the author's purpose affects the interpretation of a selection.
- Summarize information from multiple sources to address a specific topic.
- Analyze and describe the characteristics of various types of literature.

Level 4 requires higher-order thinking and deep knowledge. The content curriculum standard or item at this level will probably require an extended activity, with extended time provided for completing it. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require the application of significant conceptual understanding and higher-order thinking. Students take information from

at least one passage of a text and are asked to apply this information to a new task. They may also be asked to develop hypotheses and perform complex analyses of the connections among texts. Some examples that represent but do not constitute all Level 4 performance are as follows:

- Analyze and synthesize information from more than one source.
- Examine and explain alternative perspectives across a variety of sources.
- Describe and illustrate how common themes are found across texts from different cultures.

Note: Multiple-choice and constructed-response items can be written at a depth-of-knowledge Level 4; however, to design an item in this format is difficult, as it would require research, investigation, and application, often over an extended period of time (e.g. performance-based tasks, portfolios, research studies/projects).

(Webb, N. 2005; Valencia and Wixson, 2000)

Table A–5. Bloom's Taxonomy – Literature

Categories (1956)	Definition	Examples of Action Words*
Knowledge	Student remembers or recalls appropriate previously learned information.	define; identify; name; recall; recognize; select; tell
Comprehension	Student translates, comprehends, or interprets information based on prior learning.	describe; distinguish; explain; identify; indicate; interpret; locate; recognize; restate; summarize
Application	Student selects, transfers, and uses data and principles to complete a task or problem with minimum directions.	apply; choose; demonstrate; determine; interpret; inform; select; show; use
Analysis	Student distinguishes, classifies, and relates assumptions, hypotheses, evidence, or structure of a statement or question.	analyze; characterize; compare; contrast; discriminate; distinguish; explain; infer
Synthesis	Student originates, integrates, and combines ideas into a product, plan, or proposal that is new to him or her.	compose; create; develop; formulate; generalize; organize
Evaluation	Student appraises, assesses, or critiques on a basis of specific standards and criteria.	assess; conclude; convince; defend; evaluate; explain; justify; predict; prove; support

Table A–6. Webb's Depth of Knowledge – Literature

Categories	Definition	Examples of Action Words*
Recall	Student recalls facts, information, procedures, or definitions.	define; identify; locate; name; recall; recognize; sequence; tell
Basic Application of Skill/Concept	Student uses information, conceptual knowledge, and procedures.	apply; compare; comprehend; identify; describe; determine; infer; interpret; predict; summarize; use
Strategic Thinking	Student uses reasoning and develops a plan or sequence of steps; process has some complexity.	analyze; cite evidence; compare; contrast; draw conclusions; explain; generalize; infer; interpret; evaluate; recognize; summarize; support
Extended Thinking	Student conducts an investigation, needs time to think and process multiple conditions of the problem or task. (The item/task generally requires several days or weeks to complete.)	describe and illustrate; evaluate; examine and explain; analyze; synthesize

*Some action words (verbs) can be classified at different depth-of-knowledge levels depending on the context of the item and the complexity of the action.

APPENDIX B: GENERAL SCORING GUIDELINES

ALGEBRA I

4 Points

- The response demonstrates a *thorough* understanding of the mathematical concepts and procedures required by the task.
- The response provides correct answer(s) with clear and complete mathematical procedures shown and a correct explanation, as required by the task. Response may contain a minor "blemish" or omission in work or explanation that does not detract from demonstrating a thorough understanding.

3 Points

- The response demonstrates a *general* understanding of the mathematical concepts and procedures required by the task.
- The response and explanation (as required by the task) are mostly complete and correct. The response may have minor errors or omissions that do not detract from demonstrating a general understanding.

2 Points

- The response demonstrates a *partial* understanding of the mathematical concepts and procedures required by the task.
- The response is somewhat correct with partial understanding of the required mathematical concepts and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1 Point

- The response demonstrates a *minimal* understanding of the mathematical concepts and procedures required by the task.

0 Points

- The response has no correct answer and *insufficient* evidence to demonstrate any understanding of the mathematical concepts and procedures required by the task.

Special Categories within zero reported separately:

Blank	Blank, entirely erased, entirely crossed out, or consists entirely of whitespace
Refusal	Refusal to respond to the task
Off Task	Makes no reference to the item but is not an intentional refusal
Foreign Language	Written entirely in a language other than English
Illegible	Illegible or incoherent

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BIOLOGY

3 Points

- The response demonstrates a *thorough* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response provides a clear, complete, and correct response as required by the task(s). The response may contain a minor blemish or omission in work or explanation that does not detract from demonstrating a thorough understanding.

2 Points

- The response demonstrates a *partial* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response is somewhat correct with partial understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

1 Point

- The response demonstrates a *minimal* understanding of the scientific content, concepts, and/or procedures required by the task(s).
- The response is somewhat correct with minimal understanding of the required scientific content, concepts, and/or procedures demonstrated and/or explained. The response may contain some work that is incomplete or unclear.

0 Points

- The response provides *insufficient* evidence to demonstrate any understanding of the scientific content, concepts, and/or procedures as required by the task(s).
- The response may show only information copied or rephrased from the question or insufficient correct information to receive a score of 1.

Special Categories within zero reported separately:

Blank.....Blank, entirely erased, entirely crossed out, or consists entirely of whitespace

Refusal.....Refusal to respond to the task

Off Task.....Makes no reference to the item but is not an intentional refusal

Foreign Language.....Written entirely in a language other than English

Illegible .....Illegible or incoherent

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LITERATURE

3 Points

- The response provides a clear, complete, and accurate answer to the task.
- The response provides relevant and specific information from the passage.

2 Points

- The response provides a partial answer to the task.
- The response provides limited information from the passage and may include inaccuracies.

1 Point

- The response provides a minimal answer to the task.
- The response provides little or no information from the passage and may include inaccuracies.

OR

- The response relates minimally to the task.

0 Points

- The response is totally incorrect or irrelevant or contains insufficient information to demonstrate comprehension.

  Special Categories within zero reported separately:

  Blank.....Blank, entirely erased, entirely crossed out, or consists entirely of white space

  Refusal.....Refusal to respond to the task

  Off Task.....Makes no reference to the item but is not an intentional refusal

  Foreign Language.....Written entirely in a language other than English

  Illegible .....Illegible or incoherent

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APPENDIX C: ITEM AND TEST DEVELOPMENT PROCESS FOR THE KEYSTONE EXAMS

Table C–1. Item and Test Development Process for the Keystone Exams

Step	Description
1. Review Guiding Documentation	Each year item and test development specialists meet internally to review all guiding documentation related to the Keystone Exams. Documentation reviewed includes the test design blueprints, the Keystone Assessment Anchors and Eligible Content, the test item specifications, the test style specifications (style guide), and all test content descriptions.
2. Meet with PDE to Confirm Understanding of Program	The goal of the meeting each year is to ensure that item and test development teams have a clear understanding of PDE's vision for test development. A successful development cycle requires a clear understanding of Pennsylvania's content-area test specifications and of any unique interpretations of the Keystone Assessment Anchors (if any).
3. Create Preliminary Test Item Development Plan	Item and test development specialists generate a preliminary development plan which includes an overview of the program, the internal and external (PDE) review and approval processes, a projected schedule for development of test items—including the number of test items to be developed for review by PDE and subsequent review by the committees of Pennsylvania educators. Item and test development specialists also generate strategies for securing passages and developing passage-based items, etc.
4. Meet with PDE to Finalize Test Item Development Plan	Over the course of the meeting, item and test development specialists verify all steps in the development process including timelines and schedules for test item/test development.
5. Analyze Item Bank	Existing test items in the current Keystone Exams Item Bank are reviewed for technical psychometric quality as well as for their match to the Assessment Anchors. During this phase, test development specialists also make a tally of the test items by Assessment Anchor—including test development specialists' best thinking regarding the number of usable test items in the existing item bank. A tally is also made of the number of usable passages, as well as other stimulus prompts in the bank, including science scenarios.
6. Refine Test Item Development Plan to Include Writers and Subcontractors	Item and test development specialists identify the writers who will write the test items (test development specialists or other professional item writers, subcontractors, etc.), the estimated number of writers needed, the qualifications of writers, and the approximate number of test items to be submitted by each source.
7. Train Item Writers	Item and test development specialists train item writers, as needed. Item writers who have written for the Keystone Exams in the past receive updated information, as needed.
8. Write and Review Items	Test items are written by item writers after training is complete, and feedback is provided by the item and test development specialists to item writers on a regular basis. As test items are written, they are reviewed and edited in a series of internal reviews. Item and test development specialists review and edit items to include, but not limited to, the following: match to Assessment Anchor/ Eligible Content, relevance to purpose, accuracy of content, item difficulty, interest level, depth of knowledge and cognitive complexity, adherence to the principles of Universal Design, and freedom from issues of bias/fairness/sensitivity. At the same time, the process of procuring permissions also begins, including securing permissions for passages, art, etc.
9. Enter Test Items into Database	Upon acceptance from item writers, test items are entered into the item management system, IDEAS (Item Development and Educational Assessment System). Item data stored in the system database includes, but is not limited to, the following: readability, cognitive level, estimated level of difficulty, alignment to assessment anchors, and correlation to stimulus passages.
10. Prepare Item Set for Sample Item Review by PDE	Item and test development specialists prepare a subset of the items for review by PDE.
11. PDE Conducts Sample Item Review	After a subset of the items is submitted to PDE for review, PDE reviews the items and provides feedback to item and test development teams via a conference call. Items are revised per PDE feedback.

Table C–1 (continued). Item and Test Development Process for the Keystone Exams

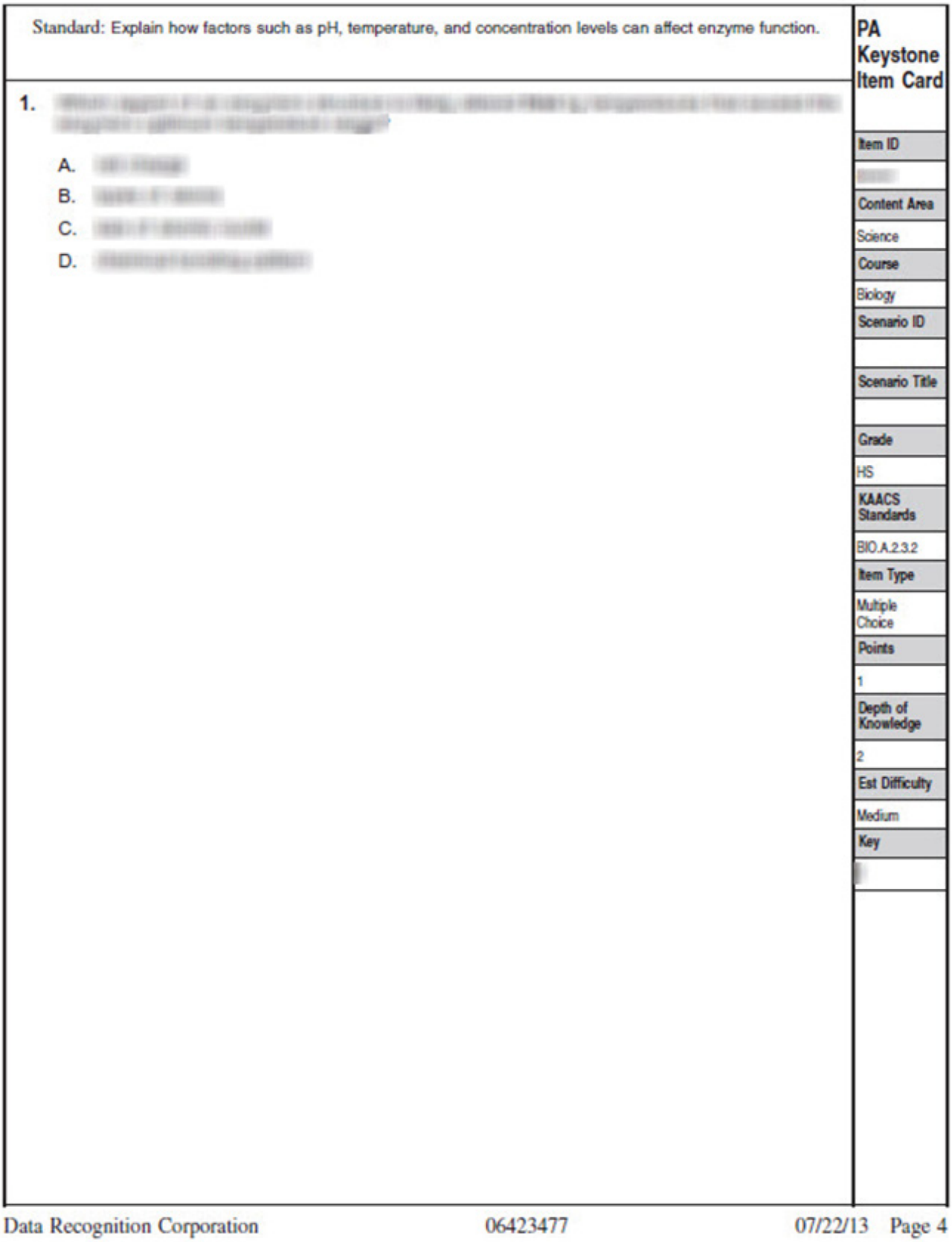
Step	Description
12. Continue to Write and Review Items	The remaining items are written, and feedback is provided by the item and test development specialists to item writers on a regular basis. Items are entered into the item management system, IDEAS (Item Development and Educational Assessment System) (See step 8 and step 9).
13. Review Items Prior to Test Item Review and Validation Sessions	Prior to New Item Content Review, all items are submitted to PDE for review. Item and test development specialists incorporate all PDE feedback, and PDE-requested edits to items are made.
14. Prepare for Test Item Review Sessions (the New Item Content Review and the Bias, Fairness, and Sensitivity Review)	Item and test development specialists prepare all items and stimulus passages for review by the New Item Content Review Committee (consisting of Pennsylvania educators) and by the separate Bias, Fairness, and Sensitivity Committee (consisting of a panel of experts). Item and test development specialists also prepare training materials needed for training committee members to review items for content or for bias, fairness, and sensitivity issues. All training materials and other ancillary materials (e.g. agendas, presentations, etc.) are also developed and then submitted to PDE for review and approval. Invitations are also sent to Pennsylvania educators and national experts from PDE-approved committee lists.
15. Conduct Test Item Review Sessions (the New Item Content Review and the Bias, Fairness, and Sensitivity Review)	Committees of Pennsylvania educators and national experts review items in two meetings: one addressing item content and quality, the other addressing bias, fairness, and sensitivity. PDE, with support from item and test development specialists, presents training on how to review new test items for content considerations or bias/fairness/sensitivity issues. At the New Item Content Review, suggested edits to test items are made and/or replacement test items are written during the actual item review so that both the committee and the PDE are able to observe changes to the test items and approve the test items during the committee review process. At the Bias, Fairness, and Sensitivity Review, experts in bias, fairness, and sensitivity review all test items and passages and come to a consensus about any issues that are noted. At both meetings the results are carefully documented.
16. Conduct Item Review Resolution and Cleanup	Following the conclusion of the New Item Content Review Committee meetings, PDE re-examines the consensus changes suggested by the committee members during the New Item Content Review Committee meetings. DRC item and test development specialists then record all of PDE's follow-up decisions and changes. During this cleanup process, PDE either accepts the changes as requested by the committee, or PDE rejects the decision of the committee. If a committee decision is rejected, PDE provides an alternate decision for DRC to implement. During this cleanup process, PDE also interprets the report from the Bias, Fairness, and Sensitivity Committee meetings and subsequently applies changes to test items and passages. DRC item and test development specialists then apply the changes to the test items and passages per PDE's decisions.
17. Submit Field-Test Items for Final Sign-Off	PDE-approved changes are applied to the items, non-permissioned passages, prompts, etc. (Changes reflect PDE's arbitration of the committee decisions.) Once all revisions to the items, non-permissioned passage text, and/or the art used by test items and passages are completed, the test items are submitted to PDE for final review and sign-off. (Changes requested to permissioned passages are sought from the publisher of record, and, if approved by the copyright holders, changes are implemented.) [PDE's approval process for field-test items generally occurs simultaneously with PDE's approval of the core test forms. See step 25.]
	To follow the path for new field-test items, skip to step 22, or to follow the chronological test development path, continue with step 18.
18. Review Results of the Field Test	Following the administration of a field-test form and the subsequent rangefinding and field-test scoring processes for field-test items, performance data for all field-test items are analyzed by DRC psychometricians and test development specialists. Test item performance data that meet certain triggering criteria are flagged for additional reviews by test development specialists. Flagged field-test items with extreme performance data are considered psychometrically unusable and are removed from future operational consideration. Field-test items with marginal performance data are prepared for the Field-Test Item Data Review meeting.

Table C–1 (continued). Item and Test Development Process for the Keystone Exams

Step	Description
19. Prepare for Field-Test Item Data Review	Test development specialists prepare all items and stimulus passages for review by the Field-Test Item Data Review Committee (which consists of Pennsylvania educators). Psychometricians also prepare training materials needed for training committee members to review items for their performance. All training materials and other ancillary materials (e.g. agendas, presentations, etc.) are submitted to PDE for review and approval. Invitations are also sent to Pennsylvania educators from PDE-approved committee lists.
20. Conduct Field-Test Item Data Review	Committees of Pennsylvania educators review the performance data of flagged field-test items. Psychometricians present training on how to review field-test items based on their performance data. At the Item Data Review, committee members examine the performance of the items and determine whether the field-test item is technically sound and appropriate for use on an operational Keystone Exams test. Since test items cannot be modified at the Field-Test Item Data Review, the committee can either accept an item as is or the committee can reject the item.
21. Conduct Field-Test Item Data Review Reconciliation	Following the conclusion of the Field-Test Item Data Review Committee meetings, PDE re-examines the consensus decisions (accept or reject) suggested by the committee members during the Field-Test Item Data Review Committee meetings. Test development specialists record all of PDE's follow-up decisions and changes. During this cleanup process, PDE either accepts the decisions of the data review committee, or PDE rejects the decisions of the data review committee. If a committee decision is not accepted, PDE provides an alternate decision for test development specialists to implement. All PDE-approved changes to the test items status (accepted or rejected) are incorporated into the Item Development and Educational Assessment System, IDEAS.
22. Select Items to Fill Core, Field-Test, and Equating Block Positions in Core and Field-Test Forms	After the PDE-approved changes to the new field-test items is completed AND the results of the prior field test have been finalized following data review, test development specialists collaborate with psychometricians to follow the Test Design Blueprints and build requirements to make the initial selection of items for core and field-test positions for all test forms. In later administrations, core-to-core linking items will also be selected during this step.
23. Review Core and Equating Block Selections	After test content and psychometric requirements have been achieved for core, the core items are provided to PDE for review and approval. Any changes to the content of the core requested by PDE are balanced with psychometric requirements until all core positions are approved by PDE, test development specialists, and psychometricians.
24. Construct Test Forms	Items, passages, and test components are assembled into forms using the form construction and typesetting function of DRC's Item Development and Educational Assessment System, IDEAS. Forms are reviewed internally for style and formatting requirements.
25. Review Typeset Forms	After forms are constructed in IDEAS, draft hard copies of the forms are produced and presented to PDE for review and approval. Any changes to the content of the core requested by PDE are balanced with psychometric requirements until all core positions are approved by PDE, test development specialists, and psychometricians. PDE also re-reviews all field-test items appearing in the test forms. DRC applies changes to the field-test items as required.
26. Print Test Forms	Following PDE's approval of the test forms, DRC completes a series of final proofing of all test forms. Final forms (along with ancillary materials) are then approved for printing.
27. Assemble Documentation of Test Materials	Metadata for each test item and form is documented and proofed, including: grade, form, session/section, item sequence, reporting category, Assessment Anchor, Descriptor, Eligible Content, number of points, item type, number of answer options, item usage, stimulus ID, etc.
28. Prepare Online Forms	Following approval of the print forms, all online forms are prepared. Forms are rendered in form sets, and items and forms are compared for continuity with the print forms as well as to ensure that all tools and features are functioning as expected.
	To follow the path for new field-test items, return to step 18.

APPENDIX D: ITEM AND DATA REVIEW CARD EXAMPLES

ITEM REVIEW CARD EXAMPLE



Standard: Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

1. [redacted]

A. [redacted]
B. [redacted]
C. [redacted]
D. [redacted]

PA Keystone Item Card

Item ID
[redacted]
Content Area
Science
Course
Biology
Scenario ID
Scenario Title
Grade
HS
KAACS Standards
BIO.A.2.3.2
Item Type
Multiple Choice
Points
1
Depth of Knowledge
2
Est Difficulty
Medium
Key
[redacted]

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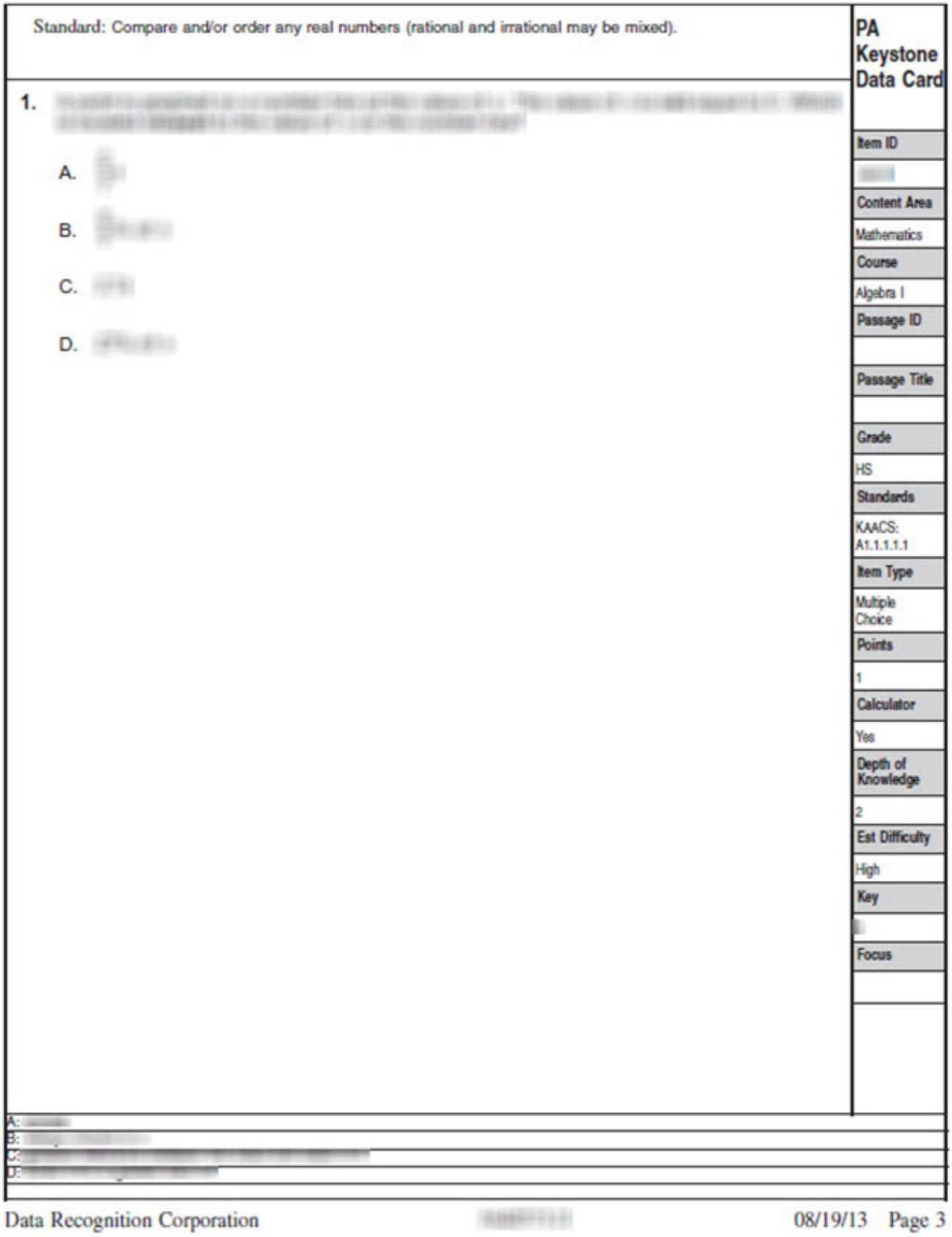
DATA REVIEW CARD EXAMPLE



Standard: Compare and/or order any real numbers (rational and irrational may be mixed).

1.

A.

B.

C.

D.

PA Keystone Data Card
Item ID
Content Area
Mathematics
Course
Algebra I
Passage ID
Passage Title
Grade
HS
Standards
KAACS: A1.1.1.1.1
Item Type
Multiple Choice
Points
1
Calculator
Yes
Depth of Knowledge
2
Est Difficulty
High
Key
Focus

A:
B:
C:
D:

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PA3 - Data Card continued

Administration

Form Name	Use Function	Rptg Flag	Seq	Period	Year	Session	Calc	Model/Ext	Grade
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	1	Yes		HS

Traditional Statistics

N	P-Val	Mean	Item Total Corr
[illegible]	0.34		0.10

Fit Statistics

Outfit t	Infit t	Outfit MnSq	Infit MnSq	Chi-sq	Deg Free	Item Fit	Fit
9.9	9.9	1.28	1.18				

IRT Statistics

Label	Final	Final S.E.	Preliminary	Preliminary S.E.
Location	1.39	0.02		

Distractor/Step Specific

Label	Proportion	Corr	Avg Meas	Threshold
A*	0.34	0.10		
B	0.24	0.11		
C	0.25	-0.22		
D	0.17	0.01		
MULTS	0.00			
OMITS	0.00			

DIF Analysis

Category	Bias Code	Num Value	N - Ref	N - Focal
MALEFEMALE	A-	-0.13	4709	4550
PAPERONLINE	A+	0.15	8242	1029
WHITEBLACK	A-	-0.23	6812	1245
WHITEHISPANIC	A-	-0.16	6812	726

Reviewer Signature: _____

Item Rating Sheet

Content Area: _____ Module: _____

August 2013		Content Alignment	Rigor Level Alignment				Technical Design			Universal Design		STATUS
Harrisburg, PA		Standards	Grade	Difficulty	Depth of Knowledge	Source of Challenge	Correct Answer	Distractors	Graphics	Language Demand	Bias	Acceptance Status
Unique ID	Pg #	—Higher —Lower —None	—Above —At —Below	—High —Medium —Low	—Recall —Application —Strategic Thinking	—Yes —No	—Yes —No	—Yes —No —N/A	—Yes —No —N/A	—Yes —No	—Yes —No	— Approved as is — Accepted with suggested revisions — Dissenting View

The purpose of this form is to provide guidelines to the item review process in terms of item characteristics that are essential in building a fair and balanced assessment. Use these guidelines in conjunction with the Item Rating Sheet when recording your feedback on individual items.

Content Alignment		Options
Standards, Anchors, Eligible Content	Does the content of the item align with the Standard/Anchor/Eligible Content? Each item was written to assess a particular Standard/Anchor/ Eligible Content statement which is indicated on the individual Item Card. Consider the degree to which the item is, in fact, aligned with the indicated eligible content. In making this judgment, it is important to consider whether the **content** is aligned (e.g., do the eligible content and the item both deal with fractions) and whether the required **performance** is aligned (e.g., if the eligible content calls for a comparison to be made, is this reflected in the item).	**HIGHER**—Aligns to the higher level of the EC **LOWER**—Aligns to the lower level of the EC **NONE**—No alignment with EC

Rigor Level Alignment		Options
Grade	Is the item grade-level appropriate? Is the content consistent with the experiences of a student at the grade level assessed? Is the challenge level appropriate for the grade?	**ABOVE** Grade Level **AT** Grade Level **BELOW** Grade Level
Difficulty	Do you agree with the item's difficulty rating? Item Difficulty is indicated as Low, Medium, and High. Is your rating in agreement with the difficulty rating on the Item Form?	**HIGH** **MEDIUM** **LOW**
Depth of Knowledge	Depth of Knowledge is based on the alignment work of Norman Webb. Rate each item based on the cognitive demand, using the following levels: 1. Recall – ***Recall*** of a fact, information, or procedure. 2. Basic Application of Skill or Concept – ***Use*** of information, conceptual knowledge, procedures, two or more steps, etc. 3. Strategic Thinking – Requires reasoning, developing a plan or sequence of steps; has some complexity; more than one possible answer. 4. Extended Thinking – Requires an investigation, time to think and process multiple conditions of the problem or task, and more than 10 minutes to do non-routine manipulations. (This level is generally not assessed in on-demand assessments.)	**4** = Extended Thinking **3** = Strategic Thinking **2** = Basic Application **1** = Recall

Rigor Level Alignment		Options
Source of Challenge	Is the source of challenge appropriately targeted to the content? The hardest part of the item (i.e., source of challenge) should be the content that is targeted. For example, in mathematics, the mathematics should be the major source of challenge rather than the wording or graphic. Students should not give an incorrect answer to a mathematics item because the reading level is too high or a graphic is flawed. Conversely, students should not give correct answers for reasons such as prior knowledge that make the answer to the question obvious (e.g., if the question asks which country has the largest population and students are to read a graph that includes China, there is no need to read the graph to answer the question).	**Y** = Yes **N** = No

Technical Design		Options
Correct Answer	Is there one clear, correct answer option? There should be no other answer that "could" be correct. CAUTION: This does not mean that "good" distractors are unfair.	**Y** = Yes **N** = No
Distractors	Are distractors fair and appropriate? Distractors that are appropriate offer students reasonable choices that can be arrived at by making common errors. There should be no distractors that make no sense at all. It should be possible to examine each option and to reason how a student with some deficiency in knowledge or skill could choose it. The distractors should be formatted according to acceptable standards of test construction (e.g., a phrase that is common to each distractor should be in the stem).	**Y** = Yes **N** = No **N/A** = OE items do not have distractors
Graphics	Are the graphics clear and accurate?	**Y** = Yes **N** = No **N/A** = No graphic

Universal Design		Options
Language Demand	Is language clear, well-formatted, and precise? Does the item use correct terminology for the content area? In order for all students to enter into the questions of the assessment, they must be able to understand them. If the items are formatted poorly, use unnecessarily complex words or phrases, or use figures or layouts that are difficult to understand, some students will give incorrect answers due to these factors rather than the content that is being assessed.	**Y** = Yes **N** = No
Bias	Is the item free of bias? All students will not be able to enter into the assessment if bias considerations are not resolved. Does the item contain clear bias problems? *A thorough, independent bias review* (separate from this meeting) *will be completed for all items*.	**Y** = Yes **N** = No

Status		Options
Acceptance Status	This is an overall judgment about the item. Based on the consensus of the committee, indicate whether the item was approved without revision to the content of the item or whether the item was accepted by the committee after revision of the content of the item. If there is a dissenting view (opposed to the committee consensus), record a	—**Approved** as is —**Accepted** with suggested revisions

	brief explanation of the dissenting view on the back of the Item Rating Sheet.	**—Dissenting View**

NOTES:

- If you leave a box blank on the Item Rating Sheet, it will be recorded to indicate that you did not have any specific feedback for that item or issue.
- If you object to the consensus of the committee, please note this on the item rating sheet and then record a brief explanation of the dissenting view on the back of the Item Rating Sheet.
- **Do NOT remove any items from the item binder at any time.**
- You must sign your item rating sheet.

APPENDIX F: TALLY SHEETS

ALGEBRA I-WINTER 2021/2022

Keystone Exam **Algebra I**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items				Points: Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.1: Operations and Linear Equations & Inequalities	1			**Operations with Real Numbers and Expressions**		1		1		4		4
	1	1	1	Compare and/or order any real numbers.	1			1	1			1
	1	1	2	Simplify square roots.	1			1	1			1
	1	2	1	Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.	1			1	1			1
	1	3	1	Simplify/evaluate expressions involving properties/laws of exponents, roots, and/or absolute values to solve problems.	1			1	1			1
	1	4	1	Use estimation to solve problems.	1			1	1			1
	1	5	1	Add, subtract, and/or multiply polynomial expressions (express answers in simplest form).								
	1	5	2	Factor algebraic expressions, including difference of squares and trinomials.	1			1	1			1
	1	5	3	Simplify/reduce a rational algebraic expression.								
	Total For Assessment Anchor A1.1.1				6	1		7	6	4		10
	2			**Linear Equations**			1	1			4	4
	2	1	1	Write, solve, and/or apply a linear equation.	2			2	2			2
	2	1	2	Use and/or identify an algebraic property to justify any step in an equation-solving process.	1			1	1			1
	2	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	2	2	1	Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination.	1			1	1			1
	2	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.2				6		1	7	6		4	10
	3			**Linear Inequalities**			1	1			4	4
	3	1	1	Write or solve compound inequalities and/or graph their solution sets on a number line .	1			1	1			1
	3	1	2	Identify or graph the solution set to a linear inequality on a number line.	2			2	2			2
	3	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	3	2	1	Write and/or solve a system of linear inequalities using graphing.	1			1	1			1
	3	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.3				6		1	7	6		4	10
Total For Reporting Category A1.1					18	1	2	21	18	4	8	30

Keystone Exam **Algebra I**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items				Points			
					Number of Core Items				Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.2: Linear Functions & Data Organizations	1			**Functions**			1	1			4	4
	1	1	1	Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.	1			1	1			1
	1	1	2	Determine whether a relation is a function, given a set of points or a graph.	2			2	2			2
	1	1	3	Identify the domain or range of a relation.	1			1	1			1
	1	2	1	Create, interpret, and/or use the equation, graph, or table of a linear function.	1			1	1			1
	1	2	2	Translate from one representation of a linear function to another.	1			1	1			1
	Total For Assessment Anchor A1.2.1				6		1	7	6		4	10
	2			**Coordinate Geometry**			1	1			4	4
	2	1	1	Identify, describe, and/or use constant rates of change.	1			1	1			1
	2	1	2	Apply the concept of linear rate of change (slope) to solve problems.	1			1	1			1
	2	1	3	Write or identify a linear equation when given...	2			2	2			2
	2	1	4	Determine the slope and/or y-intercept represented by a linear equation or graph.	1			1	1			1
	2	2	1	Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.	1			1	1			1
	Total For Assessment Anchor A1.2.2				6		1	7	6		4	10
	3			**Data Analysis**		1		1		4		4
	3	1	1	Calculate and/or interpret the range, quartiles, and interquartile range of data.	1			1	1			1
	3	2	1	Estimate or calculate to make predictions based on a circle, line, bar graph, measures of central tendency, or other representations.	1			1	1			1
	3	2	2	Analyze data, make predictions, and/or answer questions based on displayed data.	2			2	2			2
	3	2	3	Make predictions using the equations or graphs of best-fit lines of scatter plots.	1			1	1			1
	3	3	1	Find probabilities for compound events.	1			1	1			1
	Total For Assessment Anchor A1.2.3				6	1		7	6	4		10
Total For Reporting Category A1.2					18	1	2	21	18	4	8	30

ALGEBRA I-SPRING 2022

Keystone Exam **Algebra I**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items				Points			
					Number of Core Items				Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.1: Operations and Linear Equations & Inequalities	1			**Operations with Real Numbers and Expressions**		1		1		4		4
	1	1	1	Compare and/or order any real numbers.	1			1	1			1
	1	1	2	Simplify square roots.	1			1	1			1
	1	2	1	Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.	1			1	1			1
	1	3	1	Simplify/evaluate expressions involving properties/laws of exponents, roots, and/or absolute values to solve problems.								
	1	4	1	Use estimation to solve problems.	1			1	1			1
	1	5	1	Add, subtract, and/or multiply polynomial expressions (express answers in simplest form).	1			1	1			1
	1	5	2	Factor algebraic expressions, including difference of squares and trinomials.								
	1	5	3	Simplify/reduce a rational algebraic expression.	1			1	1			1
	Total For Assessment Anchor A1.1.1				6	1		7	6	4		10
	2			**Linear Equations**			1	1			4	4
	2	1	1	Write, solve, and/or apply a linear equation.	2			2	2			2
	2	1	2	Use and/or identify an algebraic property to justify any step in an equation-solving process.	1			1	1			1
	2	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	2	2	1	Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination.	1			1	1			1
	2	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.2				6		1	7	6		4	10
	3			**Linear Inequalities**		1		1		4		4
	3	1	1	Write or solve compound inequalities and/or graph their solution sets on a number line .	2			2	2			2
	3	1	2	Identify or graph the solution set to a linear inequality on a number line.	1			1	1			1
	3	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	3	2	1	Write and/or solve a system of linear inequalities using graphing.	1			1	1			1
	3	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.3				6	1		7	6	4		10
Total For Reporting Category A1.1					18	2	1	21	18	8	4	30

Keystone Exam **Algebra I**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items				Points: Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.2: Linear Functions & Data Organizations	1			**Functions**		1		1		4		4
	1	1	1	Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.	1			1	1			1
	1	1	2	Determine whether a relation is a function, given a set of points or a graph.	1			1	1			1
	1	1	3	Identify the domain or range of a relation.	2			2	2			2
	1	2	1	Create, interpret, and/or use the equation, graph, or table of a linear function.	1			1	1			1
	1	2	2	Translate from one representation of a linear function to another.	1			1	1			1
	Total For Assessment Anchor A1.2.1				6	1		7	6	4		10
	2			**Coordinate Geometry**			1	1			4	4
	2	1	1	Identify, describe, and/or use constant rates of change.	2			2	2			2
	2	1	2	Apply the concept of linear rate of change (slope) to solve problems.	1			1	1			1
	2	1	3	Write or identify a linear equation when given...	1			1	1			1
	2	1	4	Determine the slope and/or y-intercept represented by a linear equation or graph.	1			1	1			1
	2	2	1	Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.	1			1	1			1
	Total For Assessment Anchor A1.2.2				6		1	7	6		4	10
	3			**Data Analysis**			1	1			4	4
	3	1	1	Calculate and/or interpret the range, quartiles, and interquartile range of data.	1			1	1			1
	3	2	1	Estimate or calculate to make predictions based on a circle, line, bar graph, measures of central tendency, or other representations.	1			1	1			1
	3	2	2	Analyze data, make predictions, and/or answer questions based on displayed data.	2			2	2			2
	3	2	3	Make predictions using the equations or graphs of best-fit lines of scatter plots.	1			1	1			1
	3	3	1	Find probabilities for compound events.	1			1	1			1
	Total For Assessment Anchor A1.2.3 Understand measurable attributes and units, systems, processes of measurement				6		1	7	6		4	10
Total For Reporting Category A1.2					18	1	2	21	18	4	8	30

ALGEBRA I-SUMMER 2022

Keystone Exam **Algebra I**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items				Points			
					Number of Core Items				Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.1: Operations and Linear Equations & Inequalities	1			**Operations with Real Numbers and Expressions**		1		1		4		4
	1	1	1	Compare and/or order any real numbers.	1			1	1			1
	1	1	2	Simplify square roots.	1			1	1			1
	1	2	1	Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.								
	1	3	1	Simplify/evaluate expressions involving properties/laws of exponents, roots, and/or absolute values to solve problems.	1			1	1			1
	1	4	1	Use estimation to solve problems.	1			1	1			1
	1	5	1	Add, subtract, and/or multiply polynomial expressions (express answers in simplest form).	1			1	1			1
	1	5	2	Factor algebraic expressions, including difference of squares and trinomials.	1			1	1			1
	1	5	3	Simplify/reduce a rational algebraic expression.								
	Total For Assessment Anchor A1.1.1				6	1		7	6	4		10
	2			**Linear Equations**		1		1		4		4
	2	1	1	Write, solve, and/or apply a linear equation.	1			1	1			1
	2	1	2	Use and/or identify an algebraic property to justify any step in an equation-solving process.	1			1	1			1
	2	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	2	2	1	Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination.	2			2	2			2
	2	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.2				6	1		7	6	4		10
	3			**Linear Inequalities**			1	1			4	4
	3	1	1	Write or solve compound inequalities and/or graph their solution sets on a number line .	1			1	1			1
	3	1	2	Identify or graph the solution set to a linear inequality on a number line.	2			2	2			2
	3	1	3	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	3	2	1	Write and/or solve a system of linear inequalities using graphing.	1			1	1			1
	3	2	2	Interpret solutions to problems in the context of the problem situation.	1			1	1			1
	Total For Assessment Anchor A1.1.3				6		1	7	6		4	10
Total For Reporting Category A1.1					18	2	1	21	18	8	4	30

Keystone Exam					Algebra I							
					Items				Points			
Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Number of Core Items				Core Points			
					MC	SCR	ECR	Total	MC	SCR	ECR	Total
A1.2: Linear Functions & Data Organizations	1			**Functions**			1	1			4	4
	1	1	1	Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.	1			1	1			1
	1	1	2	Determine whether a relation is a function, given a set of points or a graph.	2			2	2			2
	1	1	3	Identify the domain or range of a relation.	1			1	1			1
	1	2	1	Create, interpret, and/or use the equation, graph, or table of a linear function.	1			1	1			1
	1	2	2	Translate from one representation of a linear function to another.	1			1	1			1
	Total For Assessment Anchor A1.2.1				6		1	7	6		4	10
	2			**Coordinate Geometry**			1	1			4	4
	2	1	1	Identify, describe, and/or use constant rates of change.	1			1	1			1
	2	1	2	Apply the concept of linear rate of change (slope) to solve problems.	1			1	1			1
	2	1	3	Write or identify a linear equation when given...	1			1	1			1
	2	1	4	Determine the slope and/or y-intercept represented by a linear equation or graph.	2			2	2			2
	2	2	1	Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.	1			1	1			1
	Total For Assessment Anchor A1.2.2				6		1	7	6		4	10
	3			**Data Analysis**		1		1		4		4
	3	1	1	Calculate and/or interpret the range, quartiles, and interquartile range of data.	1			1	1			1
	3	2	1	Estimate or calculate to make predictions based on a circle, line, bar graph, measures of central tendency, or other representations.	1			1	1			1
	3	2	2	Analyze data, make predictions, and/or answer questions based on displayed data.	1			1	1			1
	3	2	3	Make predictions using the equations or graphs of best-fit lines of scatter plots.	2			2	2			2
	3	3	1	Find probabilities for compound events.	1			1	1			1
	Total For Assessment Anchor A1.2.3				6	1		7	6	4		10
Total For Reporting Category A1.2					18	1	2	21	18	4	8	30

BIOLOGY-WINTER 2021/2022

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items MC	Items: Number of Core Items CR	Items: Number of Core Items Total	Points: Core Points MC	Points: Core Points CR	Points: Core Points Total
BIO.A: Basic Biological Principles	1			**Basic Biological Principles**						
	1	1	1	Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.	2		2	2		2
	1	2	1	Compare cellular structures and their functions in prokaryotic and eukaryotic cells.	2		2	2		2
	1	2	2	Describe and interpret relationships between structure and function at various levels of biological organization.	2		2	2		2
	Total For Assessment Anchor BIO.A.1				6		6	6		6
	2			**The Chemical Basis for Life**						
	2	1	1	Describe the unique properties of water and how these properties support life on Earth.	2		2	2		2
	2	2	1	Explain how carbon is uniquely suited to form biological macromolecules.	1		1	1		1
	2	2	2	Describe how biological macromolecules form from monomers.	1		1	1		1
	2	2	3	Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.	2		2	2		2
	2	3	1	Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.	1		1	1		1
	2	3	2	Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.	1		1	1		1
	Total For Assessment Anchor BIO.A.2				8		8	8		8
	3			**Bioenergetics**						
	3	1	1	Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.	2		2	2		2
	3	2	1	Compare the basic transformation of energy during photosynthesis and cellular respiration.	2		2	2		2
	3	2	2	Describe the role of ATP in biochemical reactions.	1	1	2	1	3	4
	Total For Assessment Anchor BIO.A.3				5	1	6	5	3	8
	4			**Homeostasis and Transport**						
	4	1	1	Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.	2		2	2		2
	4	1	2	Compare the mechanisms that transport materials across the plasma membrane.	1		1	1		1
	4	1	3	Describe how membrane-bound cellular organelles.	1	1	2	1	3	4
	4	2	1	Explain how organisms maintain homeostasis.	1	1	2	1	3	4
	Total For Assessment Anchor BIO.A.4				5	2	7	5	6	11
Total For Reporting Category BIO.A					24	3	27	24	9	33

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items			Points: Core Points		
					MC	CR	Total	MC	CR	Total
BIO.B: Cell Growth and Reproduction	1			**Cell Growth and Reproduction**						
	1	1	1	Describe the events that occur during the cell cycle: interphase, nuclear division.	2		2	2		2
	1	1	2	Compare the processes and outcomes of mitotic and meiotic nuclear divisions.	1		1	1		1
	1	2	1	Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.	2		2	2		2
	1	2	2	Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.	1		1	1		1
	Total For Assessment Anchor BIO.B.1				6		6	6		6
	2			**Genetics**						
	2	1	1	Describe and/or predict observed patterns of inheritance.	1		1	1		1
	2	1	2	Describe processes that can alter composition or number of chromosomes.	1		1	1		1
	2	2	1	Describe how the processes of transcription and translation are similar in all organisms.	2		2	2		2
	2	2	2	Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.	1		1	1		1
	2	3	1	Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype.	1		1	1		1
	2	4	1	Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.	1		1	1		1
	Total For Assessment Anchor BIO.B.2				7		7	7		7
	3			**Theory of Evolution**						
	3	1	1	Explain how natural selection can impact allele frequencies of a population.	1		1	1		1
	3	1	2	Describe the factors that can contribute to the development of new species.	1		1	1		1
	3	1	3	Explain how genetic mutations may result in genotypic and phenotypic variations within a population.	1		1	1		1
	3	2	1	Interpret evidence supporting the theory of evolution.	1	1	2	1	3	4
	3	3	1	Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.	1		1	1		1
	Total For Assessment Anchor BIO.B.3				5	1	6	5	3	8
	4			**Ecology**						
	4	1	1	Describe the levels of ecological organization.	1		1	1		1
	4	1	2	Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.	1		1	1		1
	4	2	1	Describe how energy flows through an ecosystem.	1		1	1		1
	4	2	2	Describe biotic interactions in an ecosystem.	1	1	2	1	3	4
	4	2	3	Describe how matter recycles through an ecosystem.	1		1	1		1
	4	2	4	Describe how ecosystems change in response to natural and human disturbances.		1	1		3	3
	4	2	5	Describe the effects of limiting factors on population dynamics and potential species extinction.	1		1	1		1
	Total For Assessment Anchor BIO.B.4				6	2	8	6	6	12
Total For Assessment Anchor BIO.B					24	3	27	24	9	33

BIOLOGY-SPRING 2022

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items MC	Items: Number of Core Items CR	Items: Number of Core Items Total	Points: Core Points MC	Points: Core Points CR	Points: Core Points Total
BIO.A: Basic Biological Principles	1			**Basic Biological Principles**						
	1	1	1	Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.	2		2	2		2
	1	2	1	Compare cellular structures and their functions in prokaryotic and eukaryotic cells.	2		2	2		2
	1	2	2	Describe and interpret relationships between structure and function at various levels of biological organization.	2		2	2		2
	Total For Assessment Anchor BIO.A.1				6		6	6		6
	2			**The Chemical Basis for Life**						
	2	1	1	Describe the unique properties of water and how these properties support life on Earth.	2		2	2		2
	2	2	1	Explain how carbon is uniquely suited to form biological macromolecules.	1		1	1		1
	2	2	2	Describe how biological macromolecules form from monomers.	1		1	1		1
	2	2	3	Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.	2		2	2		2
	2	3	1	Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.	1		1	1		1
	2	3	2	Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.		1	1		3	3
	Total For Assessment Anchor BIO.A.2				7	1	8	7	3	10
	3			**Bioenergetics**						
	3	1	1	Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.	2		2	2		2
	3	2	1	Compare the basic transformation of energy during photosynthesis and cellular respiration.	2		2	2		2
	3	2	2	Describe the role of ATP in biochemical reactions.	1	1	2	1	3	4
	Total For Assessment Anchor BIO.A.3				5	1	6	5	3	8
	4			**Homeostasis and Transport**						
	4	1	1	Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.						
	4	1	2	Compare the mechanisms that transport materials across the plasma membrane.	2	1	3	2	3	5
	4	1	3	Describe how membrane-bound cellular organelles.	2		2	2		2
	4	2	1	Explain how organisms maintain homeostasis.	2		2	2		2
	Total For Assessment Anchor BIO.A.4				6	1	7	6	3	9
Total For Reporting Category BIO.A					24	3	27	24	9	33

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items			Points		
					Number of Core Items			Core Points		
					MC	CR	Total	MC	CR	Total
BIO.B: Cell Growth and Reproduction	1			**Cell Growth and Reproduction**						
	1	1	1	Describe the events that occur during the cell cycle: interphase, nuclear division.	2		2	2		2
	1	1	2	Compare the processes and outcomes of mitotic and meiotic nuclear divisions.	1		1	1		1
	1	2	1	Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.	2		2	2		2
	1	2	2	Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.	1		1	1		1
	Total For Assessment Anchor BIO.B.1				6		6	6		6
	2			**Genetics**						
	2	1	1	Describe and/or predict observed patterns of inheritance.	1	1	2	1	3	4
	2	1	2	Describe processes that can alter composition or number of chromosomes.	1		1	1		1
	2	2	1	Describe how the processes of transcription and translation are similar in all organisms.	1		1	1		1
	2	2	2	Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.	1		1	1		1
	2	3	1	Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype.	2		2	2		2
	2	4	1	Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.	1		1	1		1
	Total For Assessment Anchor BIO.B.2				7	1	8	7	3	10
	3			**Theory of Evolution**						
	3	1	1	Explain how natural selection can impact allele frequencies of a population.	2		2	2		2
	3	1	2	Describe the factors that can contribute to the development of new species.	1		1	1		1
	3	1	3	Explain how genetic mutations may result in genotypic and phenotypic variations within a population.						
	3	2	1	Interpret evidence supporting the theory of evolution.	2		2	2		2
	3	3	1	Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.		1	1		3	3
	Total For Assessment Anchor BIO.B.3				5	1	6	5	3	8
	4			**Ecology**						
	4	1	1	Describe the levels of ecological organization.	1		1	1		1
	4	1	2	Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.	1		1	1		1
	4	2	1	Describe how energy flows through an ecosystem.		1	1		3	3
	4	2	2	Describe biotic interactions in an ecosystem.	1		1	1		1
	4	2	3	Describe how matter recycles through an ecosystem.	1		1	1		1
	4	2	4	Describe how ecosystems change in response to natural and human disturbances.	1		1	1		1
	4	2	5	Describe the effects of limiting factors on population dynamics and potential species extinction.	1		1	1		1
	Total For Assessment Anchor BIO.B.4				6	1	7	6	3	9
Total For Assessment Anchor BIO.B					24	3	27	24	9	33

BIOLOGY-SUMMER 2022

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items MC	CR	Total	Points: Core Points MC	CR	Total
BIO.A: Basic Biological Principles	1			**Basic Biological Principles**						
	1	1	1	Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.	1		1	1		1
	1	2	1	Compare cellular structures and their functions in prokaryotic and eukaryotic cells.	1	1	2	1	3	4
	1	2	2	Describe and interpret relationships between structure and function at various levels of biological organization.	3		3	3		3
	Total For Assessment Anchor BIO.A.1				5	1	6	5	3	8
	2			**The Chemical Basis for Life**						
	2	1	1	Describe the unique properties of water and how these properties support life on Earth.	1	1	2	1	3	4
	2	2	1	Explain how carbon is uniquely suited to form biological macromolecules.	2		2	2		2
	2	2	2	Describe how biological macromolecules form from monomers.	1		1	1		1
	2	2	3	Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.	2		2	2		2
	2	3	1	Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.	2		2	2		2
	2	3	2	Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.	1		1	1		1
	Total For Assessment Anchor BIO.A.2				9	1	10	9	3	12
	3			**Bioenergetics**						
	3	1	1	Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations.	2		2	2		2
	3	2	1	Compare the basic transformation of energy during photosynthesis and cellular respiration.	2		2	2		2
	3	2	2	Describe the role of ATP in biochemical reactions.	2		2	2		2
	Total For Assessment Anchor BIO.A.3				6		6	6		6
	4			**Homeostasis and Transport**						
	4	1	1	Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.	1	1	2	1	3	4
	4	1	2	Compare the mechanisms that transport materials across the plasma membrane.	1		1	1		1
	4	1	3	Describe how membrane-bound cellular organelles.	1		1	1		1
	4	2	1	Explain how organisms maintain homeostasis.	1		1	1		1
	Total For Assessment Anchor BIO.A.4				4	1	5	4	3	7
Total For Reporting Category BIO.A					24	3	27	24	9	33

Keystone Exam **Biology**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items			Points		
					Number of Core Items			Core Points		
					MC	CR	Total	MC	CR	Total
BIO.B: Cell Growth and Reproduction	1			**Cell Growth and Reproduction**						
	1	1	1	Describe the events that occur during the cell cycle: interphase, nuclear division.	1		1	1		1
	1	1	2	Compare the processes and outcomes of mitotic and meiotic nuclear divisions.	2		2	2		2
	1	2	1	Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.	2		2	2		2
	1	2	2	Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.	1		1	1		1
	Total For Assessment Anchor BIO.B.1				6		6	6		6
	2			**Genetics**						
	2	1	1	Describe and/or predict observed patterns of inheritance.	1	1	2	1	3	4
	2	1	2	Describe processes that can alter composition or number of chromosomes.	1		1	1		1
	2	2	1	Describe how the processes of transcription and translation are similar in all organisms.	1		1	1		1
	2	2	2	Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.	1		1	1		1
	2	3	1	Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype.	1		1	1		1
	2	4	1	Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture.	1		1	1		1
	Total For Assessment Anchor BIO.B.2				6	1	7	6	3	9
	3			**Theory of Evolution**						
	3	1	1	Explain how natural selection can impact allele frequencies of a population.		1	1		3	3
	3	1	2	Describe the factors that can contribute to the development of new species.	2		2	2		2
	3	1	3	Explain how genetic mutations may result in genotypic and phenotypic variations within a population.	1		1	1		1
	3	2	1	Interpret evidence supporting the theory of evolution.	1		1	1		1
	3	3	1	Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.	1		1	1		1
	Total For Assessment Anchor BIO.B.3				5	1	6	5	3	8
	4			**Ecology**						
	4	1	1	Describe the levels of ecological organization.	1		1	1		1
	4	1	2	Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems.	1		1	1		1
	4	2	1	Describe how energy flows through an ecosystem.		1	1		3	3
	4	2	2	Describe biotic interactions in an ecosystem.	1		1	1		1
	4	2	3	Describe how matter recycles through an ecosystem.	1		1	1		1
	4	2	4	Describe how ecosystems change in response to natural and human disturbances.	2		2	2		2
	4	2	5	Describe the effects of limiting factors on population dynamics and potential species extinction.	1		1	1		1
	Total For Assessment Anchor BIO.B.4				7	1	8	7	3	10
Total For Assessment Anchor BIO.B					24	3	27	24	9	33

LITERATURE-WINTER 2021/2022												
Keystone Exam												**Literature**
Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items			Points		
					Number of Core Items			Core Points		
					MC	CR	Total	MC	CR	Total
L.F: Fiction	1			**Reading for Meaning—Fiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.	1		1	1		1
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.	1	1	2	1	3	4
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of fiction to effectively communicate an idea or concept.		1	1		3	3
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.						
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.						
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.	1		1	1		1
	1	2	4	Draw conclusions about connotations of words.	1		1	1		1
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.						
	1	3	2	Summarize the key details and events of a fictional text, in part or as a whole.	1		1	1		1
	Total For Assessment Anchor L.F.1				5	2	7	5	6	11
	2			**Analyzing and Interpreting Literature—Fiction**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.	2		2	2		2
	2	1	2	Cite evidence from a text to support generalizations.	2		2	2		2
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.	1		1	1		1
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.						
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.						
	2	2	4	Compare and evaluate the characteristics that distinguish narrative, poetry, and drama.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of fiction:	1		1	1		1
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of fiction:	1		1	1		1
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of fiction:	1		1	1		1
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of fiction:		1	1		3	3
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of fiction:						
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of fiction:	1		1	1		1
	2	4	1	Interpret and analyze works from a variety of genres for literary, historical, and/or cultural significance.						
	2	5	1	Identify, explain, interpret, describe, and/or analyze the effects of personification, simile, metaphor, hyperbole, satire, foreshadowing, flashback, imagery, allegory, symbolism, dialect, allusion, and irony in a text.	3		3	3		3
	2	5	2	Identify, explain, and analyze the structure of poems and sound devices.						
	2	5	3	Identify and analyze how stage directions, monologue, dialogue, soliloquy, and dialect support dramatic script.						
	Total For Assessment Anchor L.F.2				12	1	13	12	3	15
Total For Reporting Category L.F					17	3	20	17	9	26

Keystone Exam **Literature**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items			Points: Core Points		
					MC	CR	Total	MC	CR	Total
L.N: Nonfiction	1			**Reading for Meaning—Nonfiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.						
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.						
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of nonfiction to effectively communicate an idea or concept.	2	1	3	2	3	5
	1	1	4	Explain how an author's use of key words or phrases in text informs and influences the reader.						
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.						
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.						
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.	1		1	1		1
	1	2	4	Draw conclusions about connotations of words.	1		1	1		1
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.	1		1	1		1
	1	3	2	Summarize the key details and events of a nonfictional text, in part or as a whole.	1		1	1		1
	1	3	3	Analyze the interrelationships of ideas and events in text to determine how one idea or event may interact and influence another.	1		1	1		1
	Total For Assessment Anchor L.N.1				7	1	8	7	3	10
	2			**Data Analysis**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.	1		1	1		1
	2	1	2	Cite evidence from a text to support generalizations.	1		1	1		1
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.						
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.						
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of nonfiction:		1	1		3	3
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of nonfiction:						
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of nonfiction:						
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of nonfiction:						
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of nonfiction:		1	1		3	3
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of nonfiction:	1		1	1		1
	2	4	1	Identify, analyze, and evaluate the structure and format of complex informational texts.						
	2	4	2	Identify, explain, compare, interpret, describe, and/or analyze the sequence of steps in a list of directions.						
	2	4	3	Explain, interpret, and/or analyze the effect of text organization, including headings, graphics, and charts.	2		2	2		2
	2	4	4	Make connections between a text and the content of graphics and charts.						
	2	4	5	Analyze and evaluate how graphics and charts clarify, simplify, and organize complex informational texts.						
	2	5	1	Differentiate between fact and opinion.	1		1	1		1
	2	5	2	Explain, interpret, describe, and/or analyze the use of facts and opinions in a text.						
	2	5	3	Distinguish essential from nonessential information.	2		2	2		2
	2	5	4	Identify, explain, and/or interpret bias and propaganda techniques in nonfictional text.						
	2	5	5	Explain, describe, and/or analyze the effectiveness of bias (explicit and implicit) and propaganda techniques in nonfictional text.	1		1	1		1
	2	5	6	Explain, interpret, describe, and/or analyze the author's defense of a claim to make a point or construct an argument in nonfictional text.	1		1	1		1
	Total For Assessment Anchor L.N.2				10	2	12	10	6	16
Total For Reporting Category L.N					17	3	20	17	9	26

LITERATURE-SPRING 2022

Keystone Exam **Literature**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items MC	CR	Total	Points: Core Points MC	CR	Total
L.F: Fiction	1			**Reading for Meaning—Fiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.						
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.		1	1		3	3
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of fiction to effectively communicate an idea or concept.	1		1	1		1
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.	1		1	1		1
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.	1		1	1		1
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.						
	1	2	4	Draw conclusions about connotations of words.	1		1	1		1
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.	2		2	2		2
	1	3	2	Summarize the key details and events of a fictional text, in part or as a whole.						
	Total For Assessment Anchor L.F.1				6	1	7	6	3	9
	2			**Analyzing and Interpreting Literature—Fiction**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.	2		2	2		2
	2	1	2	Cite evidence from a text to support generalizations.	1		1	1		1
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.						
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.						
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.						
	2	2	4	Compare and evaluate the characteristics that distinguish narrative, poetry, and drama.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of fiction:		2	2		6	6
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of fiction:	1		1	1		1
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of fiction:						
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of fiction:	1		1	1		1
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of fiction:	1		1	1		1
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of fiction:	2		2	2		2
	2	4	1	Interpret and analyze works from a variety of genres for literary, historical, and/or cultural significance.						
	2	5	1	Identify, explain, interpret, describe, and/or analyze the effects of personification, simile, metaphor, hyperbole, satire, foreshadowing, flashback, imagery, allegory, symbolism, dialect, allusion, and irony in a text.	3		3	3		3
	2	5	2	Identify, explain, and analyze the structure of poems and sound devices.						
	2	5	3	Identify and analyze how stage directions, monologue, dialogue, soliloquy, and dialect support dramatic script.						
	Total For Assessment Anchor L.F.2				11	2	13	11	6	17
Total For Reporting Category L.F					17	3	20	17	9	26

Keystone Exam **Literature**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items			Points		
					Number of Core Items			Core Points		
					MC	CR	Total	MC	CR	Total
L.N: Nonfiction	1			**Reading for Meaning—Nonfiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.	1		1	1		1
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.	1		1	1		1
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of nonfiction to effectively communicate an idea or concept.						
	1	1	4	Explain how an author's use of key words or phrases in text informs and influences the reader.	1		1	1		1
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.	1		1	1		1
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.						
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.						
	1	2	4	Draw conclusions about connotations of words.	1		1	1		1
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.		1	1		3	3
	1	3	2	Summarize the key details and events of a nonfictional text, in part or as a whole.						
	1	3	3	Analyze the interrelationships of ideas and events in text to determine how one idea or event may interact and influence another.	1		1	1		1
	Total For Assessment Anchor L.N.1				6	1	7	6	3	9
	2			**Data Analysis**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.	1		1	1		1
	2	1	2	Cite evidence from a text to support generalizations.	1		1	1		1
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.	1		1	1		1
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.						
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of nonfiction:						
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of nonfiction:						
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of nonfiction:						
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of nonfiction:						
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of nonfiction:	1		1	1		1
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of nonfiction:	1		1	1		1
	2	4	1	Identify, analyze, and evaluate the structure and format of complex informational texts.	1		1	1		1
	2	4	2	Identify, explain, compare, interpret, describe, and/or analyze the sequence of steps in a list of directions.	1		1	1		1
	2	4	3	Explain, interpret, and/or analyze the effect of text organization, including headings, graphics, and charts.	1		1	1		1
	2	4	4	Make connections between a text and the content of graphics and charts.	2		2	2		2
	2	4	5	Analyze and evaluate how graphics and charts clarify, simplify, and organize complex informational texts.						
	2	5	1	Differentiate between fact and opinion.						
	2	5	2	Explain, interpret, describe, and/or analyze the use of facts and opinions in a text.						
	2	5	3	Distinguish essential from nonessential information.						
	2	5	4	Identify, explain, and/or interpret bias and propaganda techniques in nonfictional text.	1		1	1		1
	2	5	5	Explain, describe, and/or analyze the effectiveness of bias (explicit and implicit) and propaganda techniques in nonfictional text.		1	1		3	3
	2	5	6	Explain, interpret, describe, and/or analyze the author's defense of a claim to make a point or construct an argument in nonfictional text.		1	1		3	3
	Total For Assessment Anchor L.N.2				11	2	13	11	6	17
Total For Reporting Category L.N					17	3	20	17	9	26

LITERATURE-SUMMER 2022

Keystone Exam **Literature**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items			Points: Core Points		
					MC	CR	Total	MC	CR	Total
L.F: Fiction	1			**Reading for Meaning—Fiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.	1		1	1		1
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.	1		1	1		1
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of fiction to effectively communicate an idea or concept.	1	1	2	1	3	4
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.						
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.	1		1	1		1
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.	1		1	1		1
	1	2	4	Draw conclusions about connotations of words.						
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.						
	1	3	2	Summarize the key details and events of a fictional text, in part or as a whole.						
	Total For Assessment Anchor L.F.1				5	1	6	5	3	8
	2			**Analyzing and Interpreting Literature—Fiction**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.	1		1	1		1
	2	1	2	Cite evidence from a text to support generalizations.	1		1	1		1
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.	1		1	1		1
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.						
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.	1	1	2	1	3	4
	2	2	4	Compare and evaluate the characteristics that distinguish narrative, poetry, and drama.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of fiction:	1		1	1		1
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of fiction:						
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of fiction:						
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of fiction:	1		1	1		1
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of fiction:	1		1	1		1
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of fiction:	1		1	1		1
	2	4	1	Interpret and analyze works from a variety of genres for literary, historical, and/or cultural significance.	1		1	1		1
	2	5	1	Identify, explain, interpret, describe, and/or analyze the effects of personification, simile, metaphor, hyperbole, satire, foreshadowing, flashback, imagery, allegory, symbolism, dialect, allusion, and irony in a text.	2	1	3	2	3	5
	2	5	2	Identify, explain, and analyze the structure of poems and sound devices.	1		1	1		1
	2	5	3	Identify and analyze how stage directions, monologue, dialogue, soliloquy, and dialect support dramatic script.						
	Total For Assessment Anchor L.F.2				12	2	14	12	6	18
Total For Reporting Category L.F					17	3	20	17	9	26

Keystone Exam **Literature**

Reporting Category	Assessment Anchor	Descriptor (Sub-anchor)	Eligible Content	Focus	Items: Number of Core Items			Points: Core Points		
					MC	CR	Total	MC	CR	Total
L.N: Nonfiction	1			**Reading for Meaning—Nonfiction**						
	1	1	1	Identify and/or analyze the author's intended purpose of a text.						
	1	1	2	Explain, describe, and/or analyze examples of a text that support the author's intended purpose.	1		1	1		1
	1	1	3	Analyze, interpret, and evaluate how authors use techniques and elements of nonfiction to effectively communicate an idea or concept.	2		2	2		2
	1	1	4	Explain how an author's use of key words or phrases in text informs and influences the reader.						
	1	2	1	Identify and/or apply a synonym or antonym of a word used in a text.						
	1	2	2	Identify how the meaning of a word is changed when an affix is added; identify the meaning of a word with an affix from a text.						
	1	2	3	Use context clues to determine or clarify the meaning of unfamiliar, multiple-meaning, or ambiguous words.	1		1	1		1
	1	2	4	Draw conclusions about connotations of words.						
	1	3	1	Identify and/or explain stated or implied main ideas and relevant supporting details from a text.		1	1		3	3
	1	3	2	Summarize the key details and events of a nonfictional text, in part or as a whole.	1		1	1		1
	1	3	3	Analyze the interrelationships of ideas and events in text to determine how one idea or event may interact and influence another.	2		2	2		2
	Total For Assessment Anchor L.N.1				7	1	8	7	3	10
	2			**Data Analysis**						
	2	1	1	Make inferences and/or draw conclusions based on analysis of a text.						
	2	1	2	Cite evidence from a text to support generalizations.	2		2	2		2
	2	2	1	Analyze how literary form relates to and/or influences meaning of a text.	1		1	1		1
	2	2	2	Compare and evaluate the characteristics that distinguish fiction from literary nonfiction.	1		1	1		1
	2	2	3	Explain, interpret, compare, describe, analyze, and/or evaluate connections between texts.						
	2	3	1	Explain, interpret, compare, describe, analyze, and/or evaluate character in a variety of nonfiction:		1	1		3	3
	2	3	2	Explain, interpret, compare, describe, analyze, and/or evaluate setting in a variety of nonfiction:						
	2	3	3	Explain, interpret, compare, describe, analyze, and/or evaluate plot in a variety of nonfiction:						
	2	3	4	Explain, interpret, compare, describe, analyze, and/or evaluate theme in a variety of nonfiction:						
	2	3	5	Explain, interpret, compare, describe, analyze, and/or evaluate tone, style, and/or mood in a variety of nonfiction:	1		1	1		1
	2	3	6	Explain, interpret, compare, describe, analyze, and/or evaluate point of view in a variety of nonfiction:						
	2	4	1	Identify, analyze, and evaluate the structure and format of complex informational texts.	2		2	2		2
	2	4	2	Identify, explain, compare, interpret, describe, and/or analyze the sequence of steps in a list of directions.						
	2	4	3	Explain, interpret, and/or analyze the effect of text organization, including headings, graphics, and charts.	1		1	1		1
	2	4	4	Make connections between a text and the content of graphics and charts.						
	2	4	5	Analyze and evaluate how graphics and charts clarify, simplify, and organize complex informational texts.						
	2	5	1	Differentiate between fact and opinion.						
	2	5	2	Explain, interpret, describe, and/or analyze the use of facts and opinions in a text.	1		1	1		1
	2	5	3	Distinguish essential from nonessential information.						
	2	5	4	Identify, explain, and/or interpret bias and propaganda techniques in nonfictional text.						
	2	5	5	Explain, describe, and/or analyze the effectiveness of bias (explicit and implicit) and propaganda techniques in nonfictional text.						
	2	5	6	Explain, interpret, describe, and/or analyze the author's defense of a claim to make a point or construct an argument in nonfictional text.	1	1	2	1	3	4
	Total For Assessment Anchor L.N.2				10	2	12	10	6	16
Total For Reporting Category L.N					17	3	20	17	9	26

APPENDIX G: KEYSTONE EXAMS MODULE LAYOUT PLANS

Table G–1A. Winter 2021/2022, Spring 2022 and Summer 2022 Algebra I Keystone Exams Section Layout Plan

Module	Number of MC	Estimated MC Item Breakdown	Number of CR	Estimated CR Item Breakdown	Testing Time	Administration Time
1	23	18—Operational (Core) Items; 5—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	75	85–90
2	23	18—Operational (Core) Items; 5—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	75	85–90

Table G–1B. Winter 2021/2022, Spring 2022 and Summer 2022 Biology Keystone Exams Section Layout Plan

Module	Number of MC	Estimated MC Item Breakdown	Number of CR	Estimated CR Item Breakdown	Testing Time	Administration Time
1	32	24—Operational (Core) Items; 8—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	72	82–87
2	32	24—Operational (Core) Items; 8—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	72	82–87

Table G–1L. Winter 2021/2022, Spring 2022 and Summer 2022 Literature Keystone Exams Section Layout Plan

Module	Number of MC	Estimated MC Item Breakdown	Number of CR	Estimated CR Item Breakdown	Testing Time	Administration Time
1	23	17—Operational (Core) Items; 6—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	73	83–88
2	23	17—Operational (Core) Items; 6—Embedded Field-Test Items	4	3—Operational (Core) Items; 1—Embedded Field-Test Items	73	83–88

APPENDIX H: MEAN RAW SCORES BY FORM

Tables in this appendix present the mean raw scores for all forms by content area and is based on the final data (see Chapter Nine). In addition, accommodated forms (i.e., Spanish, Braille, large print, VSL) were removed to best represent comparisons among similar groups of test-takers.

Table H–1. Mean Raw Scores by Form

Column Heading	Definition
Form	Form
N	Number of students
L	Length (Number of Items)
Pts	Points possible
Min	Minimum
Max	Maximum
Mean	Mean
Med	Median
SD	Standard deviation

ALGEBRA I: SPRING

Table H–2. Algebra I Mean Raw Scores by Form Table

Form	N	L	Pts	Min	Max	Mean	Med	SD
All	117367	42	60	0	60	26.0	24	12.7
1	5032	42	60	2	59	25.6	24	12.6
2	4943	42	60	3	58	26.2	24	12.8
3	4948	42	60	3	59	26.1	24	12.8
4	4926	42	60	2	59	25.9	24	12.7
5	4905	42	60	0	59	26.0	24	12.7
6	4819	42	60	3	60	26.3	25	12.6
7	4856	42	60	1	60	26.2	25	12.5
8	4849	42	60	0	59	26.2	24	12.7
9	4917	42	60	3	59	25.9	24	12.4
10	4922	42	60	2	60	26.2	24	12.7
11	4844	42	60	2	59	26.1	24	12.6
12	4927	42	60	2	59	26.0	24	12.7
13	4915	42	60	3	58	25.9	24	12.5
14	4936	42	60	3	57	25.7	24	12.6
15	4823	42	60	2	59	25.9	24	12.7
16	4851	42	60	3	58	26.0	24	12.6
17	4864	42	60	1	59	26.1	24	12.8
18	4905	42	60	1	59	25.8	24	12.6
19	4902	42	60	2	59	25.9	24	12.5
20	4832	42	60	1	59	25.9	24	12.7
21	4866	42	60	2	58	25.8	24	12.7
22	4850	42	60	3	59	25.8	24	12.7
23	4918	42	60	2	58	25.6	24	12.7
24	4817	42	60	2	58	26.0	24	12.7

BIOLOGY: SPRING

Table H–3. Biology Mean Raw Scores by Form Table

Form	N	L	Pts	Min	Max	Mean	Med	SD
All	109181	54	66	0	66	34.0	33	14.8
1	5537	54	66	4	66	33.4	32	14.8
2	5473	54	66	4	66	34.0	33	14.8
3	5501	54	66	3	66	34.2	33	14.9
4	5455	54	66	2	66	34.4	33	15.0
5	5478	54	66	3	66	34.0	33	14.8
6	5438	54	66	4	66	34.0	33	14.8
7	5469	54	66	4	66	34.1	33	14.7
8	5467	54	66	3	66	34.1	33	15.1
9	5510	54	66	3	66	34.3	33	14.8
10	5438	54	66	5	66	34.0	33	14.8
11	5471	54	66	5	66	33.9	32	14.8
12	5393	54	66	4	66	33.8	33	14.6
13	5426	54	66	4	66	34.1	33	14.8
14	5494	54	66	2	66	33.9	33	14.7
15	5401	54	66	4	66	34.1	33	14.9
16	5397	54	66	4	65	34.1	33	14.8
17	5519	54	66	0	66	33.7	32	14.8
18	5460	54	66	4	66	34.3	33	14.8
19	5404	54	66	4	66	34.3	33	14.8
20	5450	54	66	4	66	33.8	33	14.8

LITERATURE: SPRING

Table H–4. Literature Mean Raw Scores by Form Table

Form	N	L	Pts	Min	Max	Mean	Med	SD
All	107779	40	52	1	52	30.8	33	10.4
1	4492	40	52	2	51	31.1	33	10.4
2	4436	40	52	1	52	30.9	33	10.5
3	4507	40	52	2	51	30.6	32	10.3
4	4529	40	52	3	52	30.8	32	10.3
5	4503	40	52	3	51	30.9	33	10.4
6	4549	40	52	2	52	30.8	33	10.5
7	4518	40	52	1	52	30.9	33	10.4
8	4482	40	52	2	52	31.0	33	10.4
9	4444	40	52	3	52	30.9	32	10.3
10	4446	40	52	3	51	30.9	33	10.4
11	4494	40	52	2	52	30.8	32	10.3
12	4551	40	52	1	51	31.0	33	10.1
13	4517	40	52	4	52	31.0	33	10.3
14	4499	40	52	3	52	30.8	32	10.3
15	4506	40	52	3	52	30.8	33	10.5
16	4451	40	52	3	51	31.0	33	10.5
17	4490	40	52	2	52	30.8	32	10.4
18	4455	40	52	3	51	30.9	33	10.3
19	4507	40	52	3	52	30.5	32	10.3
20	4534	40	52	2	52	30.7	33	10.5
21	4464	40	52	3	52	30.9	33	10.5
22	4458	40	52	3	52	30.9	33	10.4
23	4443	40	52	3	52	31.0	33	10.3
24	4504	40	52	2	51	30.6	32	10.4

APPENDIX I: DEMOGRAPHIC AND ACCOMMODATION DATA

WINTER

Table I–1. Students Assessed on the Winter Keystone: Algebra I

Description	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	6	1	38	574	5,779	14,069	8,154	478	29,099
Total number of CBT processed (Number)	0	1	70	411	3,253	5,059	3,045	96	11,935
Total number of tests processed (Number)	6	2	108	985	9,032	19,128	11,199	574	41,034
Total number of tests processed with a score (Number)	4	2	107	962	8,431	17,226	9,623	316	36,671
Total number of tests processed with a score (Percent)	66.7	100	99.1	97.7	93.3	90.1	85.9	55.1	89.4
Total number of tests processed without a score (Number)	2	0	1	23	601	1,902	1,576	258	4,363
Total number of tests processed without a score (Percent)	33.3	0	.9	2.3	6.7	9.9	14.1	44.9	10.6

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–2. Students Assessed on the Winter Keystone: Biology

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	3	1	1,371	10,000	11,219	547	23,141
Total number of CBT processed (Number)	0	0	1,641	5,260	4,547	100	11,548
Total number of tests processed (Number)	3	1	3,012	15,260	15,766	647	34,689
Total number of tests processed with a score (Number)	1	1	2,724	14,177	13,642	301	30,846
Total number of tests processed with a score (Percent)	33.3	100	90.4	92.9	86.5	46.5	88.9
Total number of tests processed without a score (Number)	2	0	288	1,083	2,124	346	3,843
Total number of tests processed without a score (Percent)	66.7	0	9.6	7.1	13.5	53.5	11.1

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–3. Students Assessed on the Winter Keystone: Literature

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	4	0	347	7,878	13,777	279	22,285
Total number of CBT processed (Number)	0	0	128	4,358	6,702	95	11,283
Total number of tests processed (Number)	4	0	475	12,236	20,479	374	33,568
Total number of tests processed with a score (Number)	1	0	374	11,542	17,912	317	30,146
Total number of tests processed with a score (Percent)	25	0	78.7	94.3	87.5	84.8	89.8
Total number of tests processed without a score (Number)	3	0	101	694	2,567	57	3,422
Total number of tests processed without a score (Percent)	75	0	21.3	5.7	12.5	15.2	10.2

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–4. Counts of Students without Scores on the Winter Keystone: Algebra I

Reason for Non-Assessment	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	0	0	0	4	188	655	663	217	1,727
Extended absence from school (Percent)	0	0	0	17.4	31.3	34.4	42.1	84.1	39.6
Non-attempt (Number)	1	0	0	14	141	782	456	17	1,411
Non-attempt (Percent)	50	0	0	60.9	23.5	41.1	28.9	6.6	32.3
Medical emergency (Number)	0	0	0	3	21	40	37	3	104
Medical emergency (Percent)	0	0	0	13	3.5	2.1	2.3	1.2	2.4
Parental request - Chapter 4 (Number)	0	0	0	0	15	34	41	2	92
Parental request - Chapter 4 (Percent)	0	0	0	0	2.5	1.8	2.6	.8	2.1
Parental request - Other reasons (Number)	0	0	1	1	36	113	117	3	271
Parental request - Other reasons (Percent)	0	0	100	4.3	6	5.9	7.4	1.2	6.2
Other reasons (Number)	1	0	0	1	200	278	262	16	758
Other reasons (Percent)	50	0	0	4.3	33.3	14.6	16.6	6.2	17.4
Total not assessed (Number)	2	0	1	23	601	1,902	1,576	258	4,363

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–5. Counts of Students without Scores on the Winter Keystone: Biology

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	1	0	105	377	904	292	1,679
Extended absence from school (Percent)	50	0	36.5	34.8	42.6	84.4	43.7
Non-attempt (Number)	0	0	60	316	652	20	1,048
Non-attempt (Percent)	0	0	20.8	29.2	30.7	5.8	27.3
Medical emergency (Number)	0	0	12	50	62	9	133
Medical emergency (Percent)	0	0	4.2	4.6	2.9	2.6	3.5
Parental request - Chapter 4 (Number)	0	0	7	42	61	4	114
Parental request - Chapter 4 (Percent)	0	0	2.4	3.9	2.9	1.2	3
Parental request - Other reasons (Number)	0	0	7	84	204	4	299
Parental request - Other reasons (Percent)	0	0	2.4	7.8	9.6	1.2	7.8
Other reasons (Number)	1	0	97	214	241	17	570
Other reasons (Percent)	50	0	33.7	19.8	11.3	4.9	14.8
Total not assessed (Number)	2	0	288	1,083	2,124	346	3,843

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–6. Counts of Students without Scores on the Winter Keystone: Literature

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	2	0	56	309	1,077	27	1,471
Extended absence from school (Percent)	66.7	0	55.4	44.5	42	47.4	43
Non-attempt (Number)	0	0	16	165	798	12	991
Non-attempt (Percent)	0	0	15.8	23.8	31.1	21.1	29
EL in first year in U.S. schools (Number)	0	0	0	0	16	0	16
EL in first year in U.S. schools (Percent)	0	0	0	0	.6	0	.5
Medical emergency (Number)	0	0	0	23	79	3	105
Medical emergency (Percent)	0	0	0	3.3	3.1	5.3	3.1
Parental request - Chapter 4 (Number)	0	0	1	20	80	1	102
Parental request - Chapter 4 (Percent)	0	0	1	2.9	3.1	1.8	3
Parental request - Other reasons (Number)	0	0	0	26	204	3	233
Parental request - Other reasons (Percent)	0	0	0	3.7	7.9	5.3	6.8
Other reasons (Number)	1	0	28	151	312	11	503
Other reasons (Percent)	33.3	0	27.7	21.8	12.2	19.3	14.7
Total not assessed (Number)	3	0	101	694	2,567	57	3,422

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–7. Demographic Characteristics of Students taking the Winter Keystone: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	2	0	45	464	4,311	8,475	4,461	148	17,906
Female (Percent)	50	0	42.1	48.2	51.1	49.2	46.4	46.8	48.8
Male (Number)	0	2	62	498	4,119	8,751	5,162	168	18,762
Male (Percent)	0	100	57.9	51.8	48.9	50.8	53.6	53.2	51.2
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	1	1	13	25	21	0	61
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.9	.1	.2	.1	.2	0	.2
Asian (not Hispanic) (Number)	0	1	42	144	363	457	254	4	1,265
Asian (not Hispanic) (Percent)	0	50	39.3	15	4.3	2.7	2.6	1.3	3.4
Black or African American (not Hispanic) (Number)	0	0	3	25	693	2,397	1,352	63	4,533
Black or African American (not Hispanic) (Percent)	0	0	2.8	2.6	8.2	13.9	14	19.9	12.4
Hispanic (any race) (Number)	1	0	6	55	874	2,031	1,635	46	4,648
Hispanic (any race) (Percent)	25	0	5.6	5.7	10.4	11.8	17	14.6	12.7
Multi-Racial (not Hispanic) (Number)	0	0	6	50	352	672	365	10	1,455
Multi-Racial (not Hispanic) (Percent)	0	0	5.6	5.2	4.2	3.9	3.8	3.2	4
White (not Hispanic) (Number)	1	1	49	685	6,127	11,626	5,987	193	24,669
White (not Hispanic) (Percent)	25	50	45.8	71.2	72.7	67.5	62.2	61.1	67.3
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	0	1	8	18	9	0	36
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	.1	.1	.1	.1	0	.1
IEP (not gifted) (Number)	0	1	2	29	617	2,855	2,598	118	6,220
IEP (not gifted) (Percent)	0	50	1.9	3	7.3	16.6	27	37.3	17
Student exited IEP in last 2 years (Number)	0	0	1	6	89	254	91	3	444
Student exited IEP in last 2 years (Percent)	0	0	.9	.6	1.1	1.5	.9	.9	1.2
Title I (Number)	0	0	0	0	0	0	1	0	1
Title I (Percent)	0	0	0	0	0	0	0	0	0
Title III served (Number)	0	0	0	0	0	0	1	0	1
Title III served (Percent)	0	0	0	0	0	0	0	0	0
Title III not served (Number)	0	0	0	0	0	0	0	0	0
Title III not served (Percent)	0	0	0	0	0	0	0	0	0
Migrant student (Number)	0	0	0	0	2	9	19	1	31
Migrant student (Percent)	0	0	0	0	0	.1	.2	.3	.1
EL enrolled first year (Number)	0	0	0	0	2	17	20	1	40
EL enrolled first year (Percent)	0	0	0	0	0	.1	.2	.3	.1
EL enrolled not first year (Number)	0	0	0	2	121	583	646	20	1,372
EL enrolled not first year (Percent)	0	0	0	.2	1.4	3.4	6.7	6.3	3.7
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	0	0	13	32	16	0	61
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	0	0	.2	.2	.2	0	.2

Table I–7 (continued). Demographic Characteristics of Students taking the Winter Keystone: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	0	1	14	37	29	0	81
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	0	.1	.2	.2	.3	0	.2
Former EL no longer monitored (Number)	0	0	2	19	168	296	201	3	689
Former EL no longer monitored (Percent)	0	0	1.9	2	2	1.7	2.1	.9	1.9
LIFE first year (Number)	0	0	0	0	0	0	0	0	0
LIFE first year (Percent)	0	0	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	0	0	8	12	0	20
LIFE not first year (Percent)	0	0	0	0	0	0	.1	0	.1
Former EL exited and in 3rd year of monitoring (Number)	0	0	1	3	7	39	30	0	80
Former EL exited and in 3rd year of monitoring (Percent)	0	0	.9	.3	.1	.2	.3	0	.2
Former EL exited and in 4th year of monitoring (Number)	0	0	1	1	35	33	25	2	97
Former EL exited and in 4th year of monitoring (Percent)	0	0	.9	.1	.4	.2	.3	.6	.3
Foreign exchange student (Number)	0	0	0	0	0	1	2	0	3
Foreign exchange student (Percent)	0	0	0	0	0	0	0	0	0
Economically disadvantaged (Number)	0	0	10	112	2,687	7,667	5,192	194	15,862
Economically disadvantaged (Percent)	0	0	9.3	11.6	31.9	44.5	54	61.4	43.3
Historically Underperforming Subgroup (Number)	0	1	12	140	3,089	9,270	6,482	246	19,240
Historically Underperforming Subgroup (Percent)	0	50	11.2	14.6	36.6	53.8	67.4	77.8	52.5
Enrollment in school of residence after Oct 1 (Number)	0	0	0	5	51	214	206	23	499
Enrollment in school of residence after Oct 1 (Percent)	0	0	0	.5	.6	1.2	2.1	7.3	1.4
Enrollment in district of residence after Oct 1 (Number)	0	0	0	3	41	154	139	17	354
Enrollment in district of residence after Oct 1 (Percent)	0	0	0	.3	.5	.9	1.4	5.4	1
Enrollment as PA resident after Oct 1 (Number)	0	0	0	0	14	54	63	5	136
Enrollment as PA resident after Oct 1 (Percent)	0	0	0	0	.2	.3	.7	1.6	.4
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	59	49	4,349	3,006	2,091	79	9,633
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	55.1	5.1	51.6	17.5	21.7	25	26.3
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	7	29	734	1,310	1,175	71	3,326

Table I–7 (continued). Demographic Characteristics of Students taking the Winter Keystone: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	6.5	3	8.7	7.6	12.2	22.5	9.1
Military family (Number)	0	0	0	0	42	85	43	1	171
Military family (Percent)	0	0	0	0	.5	.5	.4	.3	.5
Homeless (Number)	0	0	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0	0	0
Foster (Number)	0	0	0	1	12	85	70	14	182
Foster (Percent)	0	0	0	.1	.1	.5	.7	4.4	.5
Home schooled (Number)	0	0	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	0	0	7	27	24	30	88
Court/agency placed (Percent)	0	0	0	0	.1	.2	.2	9.5	.2
Number of assessed students (Number)	4	2	107	962	8,431	17,226	9,623	316	36,671

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–8. Demographic Characteristics of Students taking the Winter Keystone: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	1	0	1,362	6,969	6,440	139	14,911
Female (Percent)	100	0	50	49.2	47.2	46.2	48.3
Male (Number)	0	1	1,362	7,208	7,201	162	15,934
Male (Percent)	0	100	50	50.8	52.8	53.8	51.7
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	7	25	20	0	52
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.3	.2	.1	0	.2
Asian (not Hispanic) (Number)	0	1	117	492	304	4	918
Asian (not Hispanic) (Percent)	0	100	4.3	3.5	2.2	1.3	3
Black or African American (not Hispanic) (Number)	0	0	389	1,374	2,013	44	3,820
Black or African American (not Hispanic) (Percent)	0	0	14.3	9.7	14.8	14.6	12.4
Hispanic (any race) (Number)	0	0	530	1,350	2,109	37	4,026
Hispanic (any race) (Percent)	0	0	19.5	9.5	15.5	12.3	13.1
Multi-Racial (not Hispanic) (Number)	0	0	111	538	468	17	1,134
Multi-Racial (not Hispanic) (Percent)	0	0	4.1	3.8	3.4	5.6	3.7
White (not Hispanic) (Number)	1	0	1,568	10,384	8,714	199	20,866
White (not Hispanic) (Percent)	100	0	57.6	73.2	63.9	66.1	67.6
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	2	14	13	0	29
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	.1	.1	.1	0	.1
IEP (not gifted) (Number)	1	0	377	2,315	3,139	89	5,921
IEP (not gifted) (Percent)	100	0	13.8	16.3	23	29.6	19.2
Student exited IEP in last 2 years (Number)	0	0	38	173	102	2	315
Student exited IEP in last 2 years (Percent)	0	0	1.4	1.2	.7	.7	1
Title I (Number)	0	0	0	0	1	0	1
Title I (Percent)	0	0	0	0	0	0	0
Title III served (Number)	0	0	0	0	1	0	1
Title III served (Percent)	0	0	0	0	0	0	0
Title III not served (Number)	0	0	0	0	0	0	0
Title III not served (Percent)	0	0	0	0	0	0	0
Migrant student (Number)	0	0	2	7	23	0	32
Migrant student (Percent)	0	0	.1	0	.2	0	.1
EL enrolled first year (Number)	0	0	0	5	27	0	32
EL enrolled first year (Percent)	0	0	0	0	.2	0	.1
EL enrolled not first year (Number)	0	0	79	279	753	19	1,130
EL enrolled not first year (Percent)	0	0	2.9	2	5.5	6.3	3.7
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	3	23	16	0	42
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	.1	.2	.1	0	.1
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	6	27	33	0	66
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	.2	.2	.2	0	.2

Table I–8 (continued). Demographic Characteristics of Students taking the Winter Keystone: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Former EL no longer monitored (Number)	0	0	85	241	273	5	604
Former EL no longer monitored (Percent)	0	0	3.1	1.7	2	1.7	2
LIFE first year (Number)	0	0	0	1	1	0	2
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	6	6	0	12
LIFE not first year (Percent)	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Number)	0	0	11	24	39	0	74
Former EL exited and in 3rd year of monitoring (Percent)	0	0	.4	.2	.3	0	.2
Former EL exited and in 4th year of monitoring (Number)	0	0	15	26	31	2	74
Former EL exited and in 4th year of monitoring (Percent)	0	0	.6	.2	.2	.7	.2
Foreign exchange student (Number)	0	0	0	1	4	0	5
Foreign exchange student (Percent)	0	0	0	0	0	0	0
Economically disadvantaged (Number)	0	0	1,184	5,199	6,854	179	13,416
Economically disadvantaged (Percent)	0	0	43.5	36.7	50.2	59.5	43.5
Historically Underperforming Subgroup (Number)	1	0	1,365	6,499	8,479	221	16,565
Historically Underperforming Subgroup (Percent)	100	0	50.1	45.8	62.2	73.4	53.7
Enrollment in school of residence after Oct 1 (Number)	0	0	26	130	234	14	404
Enrollment in school of residence after Oct 1 (Percent)	0	0	1	.9	1.7	4.7	1.3
Enrollment in district of residence after Oct 1 (Number)	0	0	17	80	169	11	277
Enrollment in district of residence after Oct 1 (Percent)	0	0	.6	.6	1.2	3.7	.9
Enrollment as PA resident after Oct 1 (Number)	0	0	7	24	81	1	113
Enrollment as PA resident after Oct 1 (Percent)	0	0	.3	.2	.6	.3	.4
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	1,597	1,872	2,262	72	5,803
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	58.6	13.2	16.6	23.9	18.8
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	227	810	1,235	62	2,334
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	8.3	5.7	9.1	20.6	7.6
Military family (Number)	0	0	9	65	43	0	117
Military family (Percent)	0	0	.3	.5	.3	0	.4
Homeless (Number)	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	12	51	80	13	156
Foster (Percent)	0	0	.4	.4	.6	4.3	.5
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	1	15	18	29	63
Court/agency placed (Percent)	0	0	0	.1	.1	9.6	.2
Number of assessed students (Number)	1	1	2,724	14,177	13,642	301	30,846

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–9. Demographic Characteristics of Students taking the Winter Keystone: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	0	0	173	5,680	7,823	136	13,812
Female (Percent)	0	0	46.3	49.2	43.7	42.9	45.8
Male (Number)	0	0	201	5,862	10,089	180	16,332
Male (Percent)	0	0	53.7	50.8	56.3	56.8	54.2
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	2	21	28	0	51
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	.5	.2	.2	0	.2
Asian (not Hispanic) (Number)	0	0	10	387	430	3	830
Asian (not Hispanic) (Percent)	0	0	2.7	3.4	2.4	.9	2.8
Black or African American (not Hispanic) (Number)	0	0	69	1,321	2,456	79	3,925
Black or African American (not Hispanic) (Percent)	0	0	18.4	11.4	13.7	24.9	13
Hispanic (any race) (Number)	0	0	88	1,422	2,630	49	4,189
Hispanic (any race) (Percent)	0	0	23.5	12.3	14.7	15.5	13.9
Multi-Racial (not Hispanic) (Number)	0	0	23	420	642	14	1,099
Multi-Racial (not Hispanic) (Percent)	0	0	6.1	3.6	3.6	4.4	3.6
White (not Hispanic) (Number)	0	0	182	7,960	11,710	171	20,023
White (not Hispanic) (Percent)	0	0	48.7	69	65.4	53.9	66.4
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	0	11	16	0	27
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	.1	.1	0	.1
IEP (not gifted) (Number)	0	0	61	1,717	4,209	95	6,082
IEP (not gifted) (Percent)	0	0	16.3	14.9	23.5	30	20.2
Student exited IEP in last 2 years (Number)	0	0	2	107	202	0	311
Student exited IEP in last 2 years (Percent)	0	0	.5	.9	1.1	0	1
Title I (Number)	0	0	0	0	2	0	2
Title I (Percent)	0	0	0	0	0	0	0
Title III served (Number)	0	0	0	0	0	0	0
Title III served (Percent)	0	0	0	0	0	0	0
Title III not served (Number)	0	0	0	0	0	0	0
Title III not served (Percent)	0	0	0	0	0	0	0
Migrant student (Number)	0	0	1	5	22	0	28
Migrant student (Percent)	0	0	.3	0	.1	0	.1
EL enrolled first year (Number)	0	0	0	1	18	1	20
EL enrolled first year (Percent)	0	0	0	0	.1	.3	.1
EL enrolled not first year (Number)	0	0	3	187	874	13	1,077
EL enrolled not first year (Percent)	0	0	.8	1.6	4.9	4.1	3.6
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	0	14	23	0	37
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	0	.1	.1	0	.1
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	2	21	45	0	68
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	.5	.2	.3	0	.2

Table I–9 (continued). Demographic Characteristics of Students taking the Winter Keystone: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Former EL no longer monitored (Number)	0	0	15	239	335	4	593
Former EL no longer monitored (Percent)	0	0	4	2.1	1.9	1.3	2
LIFE first year (Number)	0	0	0	0	0	0	0
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	4	7	0	11
LIFE not first year (Percent)	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Number)	0	0	1	28	46	0	75
Former EL exited and in 3rd year of monitoring (Percent)	0	0	.3	.2	.3	0	.2
Former EL exited and in 4th year of monitoring (Number)	0	0	0	18	37	2	57
Former EL exited and in 4th year of monitoring (Percent)	0	0	0	.2	.2	.6	.2
Foreign exchange student (Number)	0	0	0	2	5	0	7
Foreign exchange student (Percent)	0	0	0	0	0	0	0
Economically disadvantaged (Number)	0	0	220	4,067	8,853	207	13,347
Economically disadvantaged (Percent)	0	0	58.8	35.2	49.4	65.3	44.3
Historically Underperforming Subgroup (Number)	0	0	234	4,948	10,971	247	16,400
Historically Underperforming Subgroup (Percent)	0	0	62.6	42.9	61.2	77.9	54.4
Enrollment in school of residence after Oct 1 (Number)	0	0	12	151	279	29	471
Enrollment in school of residence after Oct 1 (Percent)	0	0	3.2	1.3	1.6	9.1	1.6
Enrollment in district of residence after Oct 1 (Number)	0	0	8	102	204	17	331
Enrollment in district of residence after Oct 1 (Percent)	0	0	2.1	.9	1.1	5.4	1.1
Enrollment as PA resident after Oct 1 (Number)	0	0	2	39	70	5	116
Enrollment as PA resident after Oct 1 (Percent)	0	0	.5	.3	.4	1.6	.4
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	80	1,495	3,336	90	5,001
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	21.4	13	18.6	28.4	16.6
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	42	666	1,641	84	2,433
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	11.2	5.8	9.2	26.5	8.1
Military family (Number)	0	0	2	72	69	2	145
Military family (Percent)	0	0	.5	.6	.4	.6	.5
Homeless (Number)	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	6	44	96	14	160
Foster (Percent)	0	0	1.6	.4	.5	4.4	.5
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	8	33	26	36	103
Court/agency placed (Percent)	0	0	2.1	.3	.1	11.4	.3
Number of assessed students (Number)	1	0	374	11,542	17,912	317	30,146

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–10. Incidence of Presentation Accommodations Received on the Winter Keystone: Algebra I

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	0	N/A	0
Braille format (Percent)	0	N/A	0
Large print format (Number)	1	N/A	1
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	1	N/A	1
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	112	149	261
Some test items/questions read aloud (Percent)	.4	1.3	.7
All test items/questions read aloud (Number)	92	228	320
All test items/questions read aloud (Percent)	.4	2	.9
Test items/questions signed (Number)	3	1	4
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	1	0	1
Test items/questions interpreted for EL student (Percent)	0	0	0
Amplification device (Number)	2	3	5
Amplification device (Percent)	0	0	0
Magnification device (Number)	1	30	31
Magnification device (Percent)	0	.3	.1
Color overlay (Number)	0	N/A	0
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	5	5	10
Other (per Accommodations Guidelines) (Percent)	0	0	0
Spanish version (Number)	152	N/A	152
Spanish version (Percent)	.6	N/A	.4
Audio (Number)	N/A	394	394
Audio (Percent)	N/A	3.5	1.1
Color Chooser (Number)	N/A	42	42
Color Chooser (Percent)	N/A	.4	.1
Contrasting Text Chooser (Number)	N/A	42	42
Contrasting Text Chooser (Percent)	N/A	.4	.1
Reverse Contrast (Number)	N/A	35	35
Reverse Contrast (Percent)	N/A	.3	.1
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	0	0
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	25,432	11,239	36,671

Table I–11. Incidence of Presentation Accommodations Received on the Winter Keystone: Biology

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	0	N/A	0
Braille format (Percent)	0	N/A	0
Large print format (Number)	3	N/A	3
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	2	N/A	2
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	92	137	229
Some test items/questions read aloud (Percent)	.5	1.3	.7
All test items/questions read aloud (Number)	120	156	276
All test items/questions read aloud (Percent)	.6	1.5	.9
Test items/questions signed (Number)	1	2	3
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	2	0	2
Test items/questions interpreted for EL student (Percent)	0	0	0
Amplification device (Number)	3	0	3
Amplification device (Percent)	0	0	0
Magnification device (Number)	1	18	19
Magnification device (Percent)	0	.2	.1
Color overlay (Number)	0	N/A	0
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	10	6	16
Other (per Accommodations Guidelines) (Percent)	0	.1	.1
Spanish version (Number)	171	N/A	171
Spanish version (Percent)	.9	N/A	.6
Audio (Number)	N/A	494	494
Audio (Percent)	N/A	4.6	1.6
Color Chooser (Number)	N/A	38	38
Color Chooser (Percent)	N/A	.4	.1
Contrasting Text Chooser (Number)	N/A	38	38
Contrasting Text Chooser (Percent)	N/A	.4	.1
Reverse Contrast (Number)	N/A	18	18
Reverse Contrast (Percent)	N/A	.2	.1
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	0	0
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	20,091	10,755	30,846

Table I–12. Incidence of Presentation Accommodations Received on the Winter Keystone: Literature

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	2	N/A	2
Braille format (Percent)	0	N/A	0
Large print format (Number)	7	N/A	7
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Amplification device (Number)	4	2	6
Amplification device (Percent)	0	0	0
Magnification device (Number)	3	10	13
Magnification device (Percent)	0	.1	0
Color overlay (Number)	1	N/A	1
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	3	3	6
Other (per Accommodations Guidelines) (Percent)	0	0	0
Color Chooser (Number)	N/A	39	39
Color Chooser (Percent)	N/A	.4	.1
Contrasting Text Chooser (Number)	N/A	39	39
Contrasting Text Chooser (Percent)	N/A	.4	.1
Reverse Contrast (Number)	N/A	13	13
Reverse Contrast (Percent)	N/A	.1	0
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Number of assessed students (Number)	19,601	10,545	30,146

Table I–13. Incidence of Response Accommodations Received on the Winter Keystone: Algebra I

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	6	0	6
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	3	1	4
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	6	0	6
Test administrator transcribed student responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	1	2	3
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	1	N/A	1
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	0	N/A	0
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	1	N/A	1
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	80	19	99
Translation dictionary for EL student (Percent)	.3	.2	.3
Other (per Accommodations Guidelines) (Number)	7	1	8
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	25,432	11,239	36,671

Table I–14. Incidence of Response Accommodations Received on the Winter Keystone: Biology

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	2	0	2
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	8	1	9
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	15	0	15
Test administrator transcribed student responses (Percent)	.1	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	0	1	1
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	1	4	5
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	6	N/A	6
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	1	N/A	1
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	30	28	58
Translation dictionary for EL student (Percent)	.1	.3	.2
Other (per Accommodations Guidelines) (Number)	9	0	9
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	20,091	10,755	30,846

Table I–15. Incidence of Response Accommodations Received on the Winter Keystone: Literature

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	5	0	5
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	6	1	7
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	21	2	23
Test administrator transcribed student responses (Percent)	.1	0	.1
Keyboard, word processor, or computer (Number)	15	N/A	15
Keyboard, word processor, or computer (Percent)	.1	N/A	0
Brailler/Notetaker (Number)	2	N/A	2
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	2	N/A	2
Computer Assistive Technology (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	3	0	3
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	19,601	10,545	30,146

Table I–16. Incidence of Setting Accommodations Received on the Winter Keystone: Algebra I

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	2	0	2
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	25	8	33
One-on-one setting (Percent)	.1	.1	.1
Small group setting (Number)	2,246	957	3,203
Small group setting (Percent)	8.8	8.5	8.7
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	25,432	11,239	36,671

Table I–17. Incidence of Setting Accommodations Received on the Winter Keystone: Biology

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	4	0	4
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	32	9	41
One-on-one setting (Percent)	.2	.1	.1
Small group setting (Number)	2,044	987	3,031
Small group setting (Percent)	10.2	9.2	9.8
Other (per Accommodations Guidelines) (Number)	7	4	11
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	20,091	10,755	30,846

Table I–18. Incidence of Setting Accommodations Received on the Winter Keystone: Literature

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	4	1	5
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	34	7	41
One-on-one setting (Percent)	.2	.1	.1
Small group setting (Number)	2,104	899	3,003
Small group setting (Percent)	10.7	8.5	10
Other (per Accommodations Guidelines) (Number)	9	6	15
Other (per Accommodations Guidelines) (Percent)	0	.1	0
Number of assessed students (Number)	19,601	10,545	30,146

Table I–19. Incidence of Timing Accommodations Received on the Winter Keystone: Algebra I

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	1,638	615	2,253
Extended time (Percent)	6.4	5.5	6.1
Frequent breaks (Number)	98	148	246
Frequent breaks (Percent)	.4	1.3	.7
Changed test schedule (Number)	33	1	34
Changed test schedule (Percent)	.1	0	.1
Other (per Accommodations Guidelines) (Number)	0	1	1
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	25,432	11,239	36,671

Table I–20. Incidence of Timing Accommodations Received on the Winter Keystone: Biology

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	780	410	1,190
Extended time (Percent)	3.9	3.8	3.9
Frequent breaks (Number)	105	161	266
Frequent breaks (Percent)	.5	1.5	.9
Changed test schedule (Number)	25	3	28
Changed test schedule (Percent)	.1	0	.1
Other (per Accommodations Guidelines) (Number)	4	1	5
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	20,091	10,755	30,846

Table I–21. Incidence of Timing Accommodations Received on the Winter Keystone: Literature

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	1,841	554	2,395
Extended time (Percent)	9.4	5.3	7.9
Frequent breaks (Number)	131	174	305
Frequent breaks (Percent)	.7	1.7	1
Changed test schedule (Number)	26	2	28
Changed test schedule (Percent)	.1	0	.1
Other (per Accommodations Guidelines) (Number)	10	1	11
Other (per Accommodations Guidelines) (Percent)	.1	0	0
Number of assessed students (Number)	19,601	10,545	30,146

Table I–22. Accommodation Rate for Non-IEP and IEP Students on the Winter Keystone Exams: Algebra I

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	21,219	9,232	30,451
Non-Accommodated (Number)	19,567	8,884	28,451
Non-Accommodated (Percent)	92.2	96.2	93.4
Accommodated (Number)	1,652	348	2,000
Accommodated (Percent)	7.8	3.8	6.6
IEP Students (Number)	4,213	2,007	6,220
Non-Accommodated (Number)	2,233	974	3,207
Non-Accommodated (Percent)	53	48.5	51.6
Accommodated (Number)	1,980	1,033	3,013
Accommodated (Percent)	47	51.5	48.4

Table I–23. Accommodation Rate for Non-IEP and IEP Students on the Winter Keystone Exams: Biology

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	16,331	8,594	24,925
Non-Accommodated (Number)	15,559	8,408	23,967
Non-Accommodated (Percent)	95.3	97.8	96.2
Accommodated (Number)	772	186	958
Accommodated (Percent)	4.7	2.2	3.8
IEP Students (Number)	3,760	2,161	5,921
Non-Accommodated (Number)	1,914	1,070	2,984
Non-Accommodated (Percent)	50.9	49.5	50.4
Accommodated (Number)	1,846	1,091	2,937
Accommodated (Percent)	49.1	50.5	49.6

Table I–24. Accommodation Rate for Non-IEP and IEP Students on the Winter Keystone Exams: Literature

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	15,634	8,430	24,064
Non-Accommodated (Number)	14,000	8,148	22,148
Non-Accommodated (Percent)	89.5	96.7	92
Accommodated (Number)	1,634	282	1,916
Accommodated (Percent)	10.5	3.3	8
IEP Students (Number)	3,967	2,115	6,082
Non-Accommodated (Number)	1,977	1,243	3,220
Non-Accommodated (Percent)	49.8	58.8	52.9
Accommodated (Number)	1,990	872	2,862
Accommodated (Percent)	50.2	41.2	47.1

Table I–25. Incidence of IEP and EL Students Receiving Accommodations on the Winter Keystone: Algebra I

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	3	3	5	101
PPT - Some test items/questions read aloud (Percent)	2.9	.3	0	2.5
PPT - All test items/questions read aloud (Number)	2	0	5	85
PPT - All test items/questions read aloud (Percent)	1.9	0	0	2.1
PPT - Small group setting (Number)	33	100	261	1,852
PPT - Small group setting (Percent)	31.7	10.7	1.3	45.1
PPT - Extended time (Number)	11	74	1,218	335
PPT - Extended time (Percent)	10.6	7.9	6	8.2
PPT - Frequent breaks (Number)	5	3	15	75
PPT - Frequent breaks (Percent)	4.8	.3	.1	1.8
PPT - Number assessed (Number)	104	937	20,282	4,109
CBT - Some test items/questions read aloud (Number)	4	2	3	140
CBT - Some test items/questions read aloud (Percent)	7.5	.6	0	7.2
CBT - All test items/questions read aloud (Number)	5	0	2	221
CBT - All test items/questions read aloud (Percent)	9.4	0	0	11.3
CBT - Small group setting (Number)	15	12	56	874
CBT - Small group setting (Percent)	28.3	3.8	.6	44.7
CBT - Extended time (Number)	6	11	233	365
CBT - Extended time (Percent)	11.3	3.5	2.6	18.7
CBT - Frequent breaks (Number)	2	1	12	133
CBT - Frequent breaks (Percent)	3.8	.3	.1	6.8
CBT - Number assessed (Number)	53	318	8,914	1,954
Total - Some test items/questions read aloud (Number)	7	5	8	241
Total - Some test items/questions read aloud (Percent)	4.5	.4	0	4
Total - All test items/questions read aloud (Number)	7	0	7	306
Total - All test items/questions read aloud (Percent)	4.5	0	0	5
Total - Small group setting (Number)	48	112	317	2,726
Total - Small group setting (Percent)	30.6	8.9	1.1	45
Total - Extended time (Number)	17	85	1,451	700
Total - Extended time (Percent)	10.8	6.8	5	11.5
Total - Frequent breaks (Number)	7	4	27	208
Total - Frequent breaks (Percent)	4.5	.3	.1	3.4
Total - Number assessed (Number)	157	1,255	29,196	6,063

Table I–26. Incidence of IEP and EL Students Receiving Accommodations on the Winter Keystone: Biology

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	1	3	1	87
PPT - Some test items/questions read aloud (Percent)	1.1	.4	0	2.4
PPT - All test items/questions read aloud (Number)	0	0	5	115
PPT - All test items/questions read aloud (Percent)	0	0	0	3.1
PPT - Small group setting (Number)	32	77	201	1,734
PPT - Small group setting (Percent)	36.4	10.1	1.3	47.2
PPT - Extended time (Number)	5	35	465	275
PPT - Extended time (Percent)	5.7	4.6	3	7.5
PPT - Frequent breaks (Number)	4	4	13	84
PPT - Frequent breaks (Percent)	4.5	.5	.1	2.3
PPT - Number assessed (Number)	88	763	15,568	3,672
CBT - Some test items/questions read aloud (Number)	7	1	2	127
CBT - Some test items/questions read aloud (Percent)	15.6	.4	0	6
CBT - All test items/questions read aloud (Number)	3	1	4	148
CBT - All test items/questions read aloud (Percent)	6.7	.4	0	7
CBT - Small group setting (Number)	13	20	51	903
CBT - Small group setting (Percent)	28.9	7.5	.6	42.7
CBT - Extended time (Number)	6	6	79	319
CBT - Extended time (Percent)	13.3	2.3	.9	15.1
CBT - Frequent breaks (Number)	3	1	13	144
CBT - Frequent breaks (Percent)	6.7	.4	.2	6.8
CBT - Number assessed (Number)	45	266	8,328	2,116
Total - Some test items/questions read aloud (Number)	8	4	3	214
Total - Some test items/questions read aloud (Percent)	6	.4	0	3.7
Total - All test items/questions read aloud (Number)	3	1	9	263
Total - All test items/questions read aloud (Percent)	2.3	.1	0	4.5
Total - Small group setting (Number)	45	97	252	2,637
Total - Small group setting (Percent)	33.8	9.4	1.1	45.6
Total - Extended time (Number)	11	41	544	594
Total - Extended time (Percent)	8.3	4	2.3	10.3
Total - Frequent breaks (Number)	7	5	26	228
Total - Frequent breaks (Percent)	5.3	.5	.1	3.9
Total - Number assessed (Number)	133	1,029	23,896	5,788

Table I–27. Incidence of IEP and EL Students Receiving Accommodations on the Winter Keystone: Literature

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Small group setting (Number)	48	38	208	1,810
PPT - Small group setting (Percent)	44	5.8	1.4	46.9
PPT - Extended time (Number)	10	31	1,368	432
PPT - Extended time (Percent)	9.2	4.7	9.1	11.2
PPT - Frequent breaks (Number)	5	0	6	120
PPT - Frequent breaks (Percent)	4.6	0	0	3.1
PPT - Number assessed (Number)	109	653	14,981	3,858
CBT - Small group setting (Number)	13	18	61	807
CBT - Small group setting (Percent)	25.5	6.3	.7	39.1
CBT - Extended time (Number)	4	5	201	344
CBT - Extended time (Percent)	7.8	1.8	2.5	16.7
CBT - Frequent breaks (Number)	1	1	8	164
CBT - Frequent breaks (Percent)	2	.4	.1	7.9
CBT - Number assessed (Number)	51	284	8,146	2,064
Total - Small group setting (Number)	61	56	269	2,617
Total - Small group setting (Percent)	38.1	6	1.2	44.2
Total - Extended time (Number)	14	36	1,569	776
Total - Extended time (Percent)	8.8	3.8	6.8	13.1
Total - Frequent breaks (Number)	6	1	14	284
Total - Frequent breaks (Percent)	3.8	.1	.1	4.8
Total - Number assessed (Number)	160	937	23,127	5,922

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Table I–28. Students Assessed on the Summer Keystone: Algebra I

Description	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	0	0	1	21	40	30	43	0	135
Total number of CBT processed (Number)	0	0	4	33	89	86	16	3	231
Total number of tests processed (Number)	0	0	5	54	129	116	59	3	366
Total number of tests processed with a score (Number)	0	0	5	54	127	108	31	3	328
Total number of tests processed with a score (Percent)	0	0	100	100	98.4	93.1	52.5	100	89.6
Total number of tests processed without a score (Number)	0	0	0	0	2	8	28	0	38
Total number of tests processed without a score (Percent)	0	0	0	0	1.6	6.9	47.5	0	10.4

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–29. Students Assessed on the Summer Keystone: Biology

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	0	11	22	52	34	0	119
Total number of CBT processed (Number)	0	1	47	46	26	2	122
Total number of tests processed (Number)	0	12	69	98	60	2	241
Total number of tests processed with a score (Number)	0	12	67	94	60	2	235
Total number of tests processed with a score (Percent)	0	100	97.1	95.9	100	100	97.5
Total number of tests processed without a score (Number)	0	0	2	4	0	0	6
Total number of tests processed without a score (Percent)	0	0	2.9	4.1	0	0	2.5

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–30. Students Assessed on the Summer Keystone: Literature

Description	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Total number of PPT processed (Number)	1	1	1	32	82	0	117
Total number of CBT processed (Number)	0	1	6	49	32	1	89
Total number of tests processed (Number)	1	2	7	81	114	1	206
Total number of tests processed with a score (Number)	1	2	7	74	54	1	139
Total number of tests processed with a score (Percent)	100	100	100	91.4	47.4	100	67.5
Total number of tests processed without a score (Number)	0	0	0	7	60	0	67
Total number of tests processed without a score (Percent)	0	0	0	8.6	52.6	0	32.5

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–31. Counts of Students without Scores on the Summer Keystone: Algebra I

Reason for Non-Assessment	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	0	0	0	0	1	2	26	0	29
Extended absence from school (Percent)	0	0	0	0	50	25	92.9	0	76.3
Non-attempt (Number)	0	0	0	0	1	6	0	0	7
Non-attempt (Percent)	0	0	0	0	50	75	0	0	18.4
Medical emergency (Number)	0	0	0	0	0	0	0	0	0
Medical emergency (Percent)	0	0	0	0	0	0	0	0	0
Parental request - Chapter 4 (Number)	0	0	0	0	0	0	2	0	2
Parental request - Chapter 4 (Percent)	0	0	0	0	0	0	7.1	0	5.3
Parental request - Other reasons (Number)	0	0	0	0	0	0	0	0	0
Parental request - Other reasons (Percent)	0	0	0	0	0	0	0	0	0
Other reasons (Number)	0	0	0	0	0	0	0	0	0
Other reasons (Percent)	0	0	0	0	0	0	0	0	0
Total not assessed (Number)	0	0	0	0	2	8	28	0	38

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–32. Counts of Students without Scores on the Summer Keystone: Biology

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	0	0	0	1	0	0	1
Extended absence from school (Percent)	0	0	0	25	0	0	16.7
Non-attempt (Number)	0	0	2	3	0	0	5
Non-attempt (Percent)	0	0	100	75	0	0	83.3
Medical emergency (Number)	0	0	0	0	0	0	0
Medical emergency (Percent)	0	0	0	0	0	0	0
Parental request - Chapter 4 (Number)	0	0	0	0	0	0	0
Parental request - Chapter 4 (Percent)	0	0	0	0	0	0	0
Parental request - Other reasons (Number)	0	0	0	0	0	0	0
Parental request - Other reasons (Percent)	0	0	0	0	0	0	0
Other reasons (Number)	0	0	0	0	0	0	0
Other reasons (Percent)	0	0	0	0	0	0	0
Total not assessed (Number)	0	0	2	4	0	0	6

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–33. Counts of Students without Scores on the Summer Keystone: Literature

Reason for Non-Assessment	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Extended absence from school (Number)	0	0	0	5	54	0	59
Extended absence from school (Percent)	0	0	0	71.4	90	0	88.1
Non-attempt (Number)	0	0	0	2	1	0	3
Non-attempt (Percent)	0	0	0	28.6	1.7	0	4.5
EL in first year in U.S. schools (Number)	0	0	0	0	0	0	0
EL in first year in U.S. schools (Percent)	0	0	0	0	0	0	0
Medical emergency (Number)	0	0	0	0	0	0	0
Medical emergency (Percent)	0	0	0	0	0	0	0
Parental request - Chapter 4 (Number)	0	0	0	0	5	0	5
Parental request - Chapter 4 (Percent)	0	0	0	0	8.3	0	7.5
Parental request - Other reasons (Number)	0	0	0	0	0	0	0
Parental request - Other reasons (Percent)	0	0	0	0	0	0	0
Other reasons (Number)	0	0	0	0	0	0	0
Other reasons (Percent)	0	0	0	0	0	0	0
Total not assessed (Number)	0	0	0	7	60	0	67

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–34. Demographic Characteristics of Students taking the Summer Keystone: Algebra I

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	0	0	2	27	70	49	11	1	160
Female (Percent)	0	0	40	50	55.1	45.4	35.5	33.3	48.8
Male (Number)	0	0	3	27	57	59	20	2	168
Male (Percent)	0	0	60	50	44.9	54.6	64.5	66.7	51.2
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	0	0	1	0	0	0	1
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	0	0	.8	0	0	0	.3
Asian (not Hispanic) (Number)	0	0	0	6	6	11	1	0	24
Asian (not Hispanic) (Percent)	0	0	0	11.1	4.7	10.2	3.2	0	7.3
Black or African American (not Hispanic) (Number)	0	0	0	3	14	19	4	0	40
Black or African American (not Hispanic) (Percent)	0	0	0	5.6	11	17.6	12.9	0	12.2
Hispanic (any race) (Number)	0	0	0	11	24	18	4	0	57
Hispanic (any race) (Percent)	0	0	0	20.4	18.9	16.7	12.9	0	17.4
Multi-Racial (not Hispanic) (Number)	0	0	1	2	4	4	1	0	12
Multi-Racial (not Hispanic) (Percent)	0	0	20	3.7	3.1	3.7	3.2	0	3.7
White (not Hispanic) (Number)	0	0	4	32	78	55	21	3	193
White (not Hispanic) (Percent)	0	0	80	59.3	61.4	50.9	67.7	100	58.8
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	0	0	0	1	0	0	1
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	0	0	.9	0	0	.3
IEP (not gifted) (Number)	0	0	0	1	12	12	4	1	30
IEP (not gifted) (Percent)	0	0	0	1.9	9.4	11.1	12.9	33.3	9.1
Student exited IEP in last 2 years (Number)	0	0	0	1	0	0	0	0	1
Student exited IEP in last 2 years (Percent)	0	0	0	1.9	0	0	0	0	.3
Title I (Number)	0	0	0	23	27	4	1	0	55
Title I (Percent)	0	0	0	42.6	21.3	3.7	3.2	0	16.8
Title III served (Number)	0	0	0	2	3	2	0	0	7
Title III served (Percent)	0	0	0	3.7	2.4	1.9	0	0	2.1
Title III not served (Number)	0	0	0	17	30	11	2	0	60
Title III not served (Percent)	0	0	0	31.5	23.6	10.2	6.5	0	18.3
Migrant student (Number)	0	0	0	0	0	0	0	0	0
Migrant student (Percent)	0	0	0	0	0	0	0	0	0
EL enrolled first year (Number)	0	0	0	0	1	2	0	0	3
EL enrolled first year (Percent)	0	0	0	0	.8	1.9	0	0	.9
EL enrolled not first year (Number)	0	0	0	3	3	4	1	0	11
EL enrolled not first year (Percent)	0	0	0	5.6	2.4	3.7	3.2	0	3.4
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	0	0	0	0	0	0	0
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	0	0	0	0	0	0	0

Table I–34 (continued). Demographic Characteristics of Students taking the Summer Keystone: Algebra

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	0	0	0	0	0	0	0
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	0	0	0	0	0	0	0
Former EL no longer monitored (Number)	0	0	0	0	1	2	0	0	3
Former EL no longer monitored (Percent)	0	0	0	0	.8	1.9	0	0	.9
LIFE first year (Number)	0	0	0	0	0	0	0	0	0
LIFE first year (Percent)	0	0	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	0	0	0	0	0	0
LIFE not first year (Percent)	0	0	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Number)	0	0	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Percent)	0	0	0	0	0	0	0	0	0
Former EL exited and in 4th year of monitoring (Number)	0	0	0	0	1	0	0	0	1
Former EL exited and in 4th year of monitoring (Percent)	0	0	0	0	.8	0	0	0	.3
Foreign exchange student (Number)	0	0	0	0	0	0	0	0	0
Foreign exchange student (Percent)	0	0	0	0	0	0	0	0	0
Economically disadvantaged (Number)	0	0	0	15	46	38	7	1	107
Economically disadvantaged (Percent)	0	0	0	27.8	36.2	35.2	22.6	33.3	32.6
Historically Underperforming Subgroup (Number)	0	0	0	19	56	45	10	1	131
Historically Underperforming Subgroup (Percent)	0	0	0	35.2	44.1	41.7	32.3	33.3	39.9
Enrollment in school of residence after Oct 1 (Number)	0	0	0	1	2	3	0	0	6
Enrollment in school of residence after Oct 1 (Percent)	0	0	0	1.9	1.6	2.8	0	0	1.8
Enrollment in district of residence after Oct 1 (Number)	0	0	0	0	2	3	0	0	5
Enrollment in district of residence after Oct 1 (Percent)	0	0	0	0	1.6	2.8	0	0	1.5
Enrollment as PA resident after Oct 1 (Number)	0	0	0	0	1	2	0	0	3
Enrollment as PA resident after Oct 1 (Percent)	0	0	0	0	.8	1.9	0	0	.9
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	0	13	46	8	3	0	70
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	0	24.1	36.2	7.4	9.7	0	21.3
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	0	0	13	5	2	0	20
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	0	0	10.2	4.6	6.5	0	6.1
Military family (Number)	0	0	0	0	0	0	0	0	0
Military family (Percent)	0	0	0	0	0	0	0	0	0
Homeless (Number)	0	0	0	0	0	0	0	0	0

Table I–34 (continued). Demographic Characteristics of Students taking the Summer Keystone: Algebra

Demographic or Educational Characteristic	Other*	Gr.6	Gr.7	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Homeless (Percent)	0	0	0	0	0	0	0	0	0
Foster (Number)	0	0	0	0	0	0	1	0	1
Foster (Percent)	0	0	0	0	0	0	3.2	0	.3
Home schooled (Number)	0	0	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	0	0	0	0	0	0	0
Court/agency placed (Percent)	0	0	0	0	0	0	0	0	0
Number of assessed students (Number)	0	0	5	54	127	108	31	3	328

*Other combines students coded as (1) below Grade 6, (2) ungraded, or (3) without a coded grade

Table I–35. Demographic Characteristics of Students taking the Summer Keystone: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	0	6	33	44	33	2	118
Female (Percent)	0	50	49.3	46.8	55	100	50.2
Male (Number)	0	6	34	49	27	0	116
Male (Percent)	0	50	50.7	52.1	45	0	49.4
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	0	1	1	0	2
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	0	1.1	1.7	0	.9
Asian (not Hispanic) (Number)	0	7	2	2	1	0	12
Asian (not Hispanic) (Percent)	0	58.3	3	2.1	1.7	0	5.1
Black or African American (not Hispanic) (Number)	0	0	4	15	9	0	28
Black or African American (not Hispanic) (Percent)	0	0	6	16	15	0	11.9
Hispanic (any race) (Number)	0	0	10	13	1	0	24
Hispanic (any race) (Percent)	0	0	14.9	13.8	1.7	0	10.2
Multi-Racial (not Hispanic) (Number)	0	1	5	5	4	0	15
Multi-Racial (not Hispanic) (Percent)	0	8.3	7.5	5.3	6.7	0	6.4
White (not Hispanic) (Number)	0	4	46	56	44	2	152
White (not Hispanic) (Percent)	0	33.3	68.7	59.6	73.3	100	64.7
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	0	1	0	0	1
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	1.1	0	0	.4
IEP (not gifted) (Number)	0	0	3	14	7	0	24
IEP (not gifted) (Percent)	0	0	4.5	14.9	11.7	0	10.2
Student exited IEP in last 2 years (Number)	0	0	0	1	0	0	1
Student exited IEP in last 2 years (Percent)	0	0	0	1.1	0	0	.4
Title I (Number)	0	0	9	13	1	0	23
Title I (Percent)	0	0	13.4	13.8	1.7	0	9.8
Title III served (Number)	0	0	1	1	0	0	2
Title III served (Percent)	0	0	1.5	1.1	0	0	.9
Title III not served (Number)	0	0	28	27	4	0	59
Title III not served (Percent)	0	0	41.8	28.7	6.7	0	25.1
Migrant student (Number)	0	0	0	0	0	0	0
Migrant student (Percent)	0	0	0	0	0	0	0
EL enrolled first year (Number)	0	0	0	0	0	0	0
EL enrolled first year (Percent)	0	0	0	0	0	0	0
EL enrolled not first year (Number)	0	1	1	1	0	0	3
EL enrolled not first year (Percent)	0	8.3	1.5	1.1	0	0	1.3
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	0	0	0	0	0
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	0	0	0	0	0
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	0	0	0	0	0

Table I–35 (continued). Demographic Characteristics of Students taking the Summer Keystone: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	0	0	0	0	0
Former EL no longer monitored (Number)	0	1	2	4	0	0	7
Former EL no longer monitored (Percent)	0	8.3	3	4.3	0	0	3
LIFE first year (Number)	0	0	0	0	0	0	0
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	0	0	0	0
LIFE not first year (Percent)	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Number)	0	0	0	1	0	0	1
Former EL exited and in 3rd year of monitoring (Percent)	0	0	0	1.1	0	0	.4
Former EL exited and in 4th year of monitoring (Number)	0	0	0	0	0	0	0
Former EL exited and in 4th year of monitoring (Percent)	0	0	0	0	0	0	0
Foreign exchange student (Number)	0	0	0	0	0	0	0
Foreign exchange student (Percent)	0	0	0	0	0	0	0
Economically disadvantaged (Number)	0	1	32	35	20	0	88
Economically disadvantaged (Percent)	0	8.3	47.8	37.2	33.3	0	37.4
Historically Underperforming Subgroup (Number)	0	2	33	40	25	0	100
Historically Underperforming Subgroup (Percent)	0	16.7	49.3	42.6	41.7	0	42.6
Enrollment in school of residence after Oct 1 (Number)	0	0	1	1	0	0	2
Enrollment in school of residence after Oct 1 (Percent)	0	0	1.5	1.1	0	0	.9
Enrollment in district of residence after Oct 1 (Number)	0	0	1	0	0	0	1
Enrollment in district of residence after Oct 1 (Percent)	0	0	1.5	0	0	0	.4
Enrollment as PA resident after Oct 1 (Number)	0	0	0	0	0	0	0
Enrollment as PA resident after Oct 1 (Percent)	0	0	0	0	0	0	0
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	37	15	2	0	54
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	55.2	16	3.3	0	23
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	5	3	1	0	9
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	7.5	3.2	1.7	0	3.8
Military family (Number)	0	0	0	0	0	0	0
Military family (Percent)	0	0	0	0	0	0	0
Homeless (Number)	0	0	0	0	0	0	0
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	0	0	1	0	1
Foster (Percent)	0	0	0	0	1.7	0	.4

Table I–35 (continued). Demographic Characteristics of Students taking the Summer Keystone: Biology

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	0	0	0	0	0
Court/agency placed (Percent)	0	0	0	0	0	0	0
Number of assessed students (Number)	0	12	67	94	60	2	235

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–36. Demographic Characteristics of Students taking the Summer Keystone: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Female (Number)	1	1	3	33	29	1	68
Female (Percent)	100	50	42.9	44.6	53.7	100	48.9
Male (Number)	0	1	4	41	25	0	71
Male (Percent)	0	50	57.1	55.4	46.3	0	51.1
American Indian/Alaskan Native (not Hispanic) (Number)	0	0	0	1	1	0	2
American Indian/Alaskan Native (not Hispanic) (Percent)	0	0	0	1.4	1.9	0	1.4
Asian (not Hispanic) (Number)	0	0	0	1	2	0	3
Asian (not Hispanic) (Percent)	0	0	0	1.4	3.7	0	2.2
Black or African American (not Hispanic) (Number)	0	0	3	20	9	0	32
Black or African American (not Hispanic) (Percent)	0	0	42.9	27	16.7	0	23
Hispanic (any race) (Number)	0	1	3	10	2	1	17
Hispanic (any race) (Percent)	0	50	42.9	13.5	3.7	100	12.2
Multi-Racial (not Hispanic) (Number)	0	0	0	3	4	0	7
Multi-Racial (not Hispanic) (Percent)	0	0	0	4.1	7.4	0	5
White (not Hispanic) (Number)	1	1	1	39	36	0	78
White (not Hispanic) (Percent)	100	50	14.3	52.7	66.7	0	56.1
Native Hawaiian or Other Pacific Islander (not Hispanic) (Number)	0	0	0	0	0	0	0
Native Hawaiian or Other Pacific Islander (not Hispanic) (Percent)	0	0	0	0	0	0	0
IEP (not gifted) (Number)	1	0	0	14	12	0	27
IEP (not gifted) (Percent)	100	0	0	18.9	22.2	0	19.4
Student exited IEP in last 2 years (Number)	0	0	0	0	0	0	0
Student exited IEP in last 2 years (Percent)	0	0	0	0	0	0	0
Title I (Number)	0	1	1	4	5	0	11
Title I (Percent)	0	50	14.3	5.4	9.3	0	7.9
Title III served (Number)	0	0	0	0	2	0	2
Title III served (Percent)	0	0	0	0	3.7	0	1.4
Title III not served (Number)	0	1	1	14	7	0	23
Title III not served (Percent)	0	50	14.3	18.9	13	0	16.5
Migrant student (Number)	0	0	0	0	0	0	0
Migrant student (Percent)	0	0	0	0	0	0	0
EL enrolled first year (Number)	0	0	0	0	0	0	0
EL enrolled first year (Percent)	0	0	0	0	0	0	0
EL enrolled not first year (Number)	0	1	0	3	3	1	8
EL enrolled not first year (Percent)	0	50	0	4.1	5.6	100	5.8
Exited ESL/bilingual program and in first year of monitoring (Number)	0	0	0	0	0	0	0
Exited ESL/bilingual program and in first year of monitoring (Percent)	0	0	0	0	0	0	0

Table I–36 (continued). Demographic Characteristics of Students taking the Summer Keystone: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Exited ESL/bilingual program and in 2nd year of monitoring (Number)	0	0	0	0	0	0	0
Exited ESL/bilingual program and in 2nd year of monitoring (Percent)	0	0	0	0	0	0	0
Former EL no longer monitored (Number)	0	0	0	1	0	0	1
Former EL no longer monitored (Percent)	0	0	0	1.4	0	0	.7
LIFE first year (Number)	0	0	0	0	0	0	0
LIFE first year (Percent)	0	0	0	0	0	0	0
LIFE not first year (Number)	0	0	0	0	0	0	0
LIFE not first year (Percent)	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Number)	0	0	0	0	0	0	0
Former EL exited and in 3rd year of monitoring (Percent)	0	0	0	0	0	0	0
Former EL exited and in 4th year of monitoring (Number)	0	0	0	0	0	0	0
Former EL exited and in 4th year of monitoring (Percent)	0	0	0	0	0	0	0
Foreign exchange student (Number)	0	0	0	0	0	0	0
Foreign exchange student (Percent)	0	0	0	0	0	0	0
Economically disadvantaged (Number)	1	0	7	34	22	0	64
Economically disadvantaged (Percent)	100	0	100	45.9	40.7	0	46
Historically Underperforming Subgroup (Number)	1	1	7	41	33	1	84
Historically Underperforming Subgroup (Percent)	100	50	100	55.4	61.1	100	60.4
Enrollment in school of residence after Oct 1 (Number)	0	1	0	2	0	0	3
Enrollment in school of residence after Oct 1 (Percent)	0	50	0	2.7	0	0	2.2
Enrollment in district of residence after Oct 1 (Number)	0	1	0	2	0	0	3
Enrollment in district of residence after Oct 1 (Percent)	0	50	0	2.7	0	0	2.2
Enrollment as PA resident after Oct 1 (Number)	0	0	0	2	0	0	2
Enrollment as PA resident after Oct 1 (Percent)	0	0	0	2.7	0	0	1.4
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	1	7	7	0	15
Enrollment in school of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	14.3	9.5	13	0	10.8
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Number)	0	0	0	3	3	0	6
Enrollment in district of residence after previous Oct 1 but on/before current Oct 1 (Percent)	0	0	0	4.1	5.6	0	4.3
Military family (Number)	0	0	0	0	0	0	0
Military family (Percent)	0	0	0	0	0	0	0
Homeless (Number)	0	0	0	0	0	0	0

Table I–36 (continued). Demographic Characteristics of Students taking the Summer Keystone: Literature

Demographic or Educational Characteristic	Other*	Gr.8	Gr.9	Gr.10	Gr.11	Gr.12	Total
Homeless (Percent)	0	0	0	0	0	0	0
Foster (Number)	0	0	0	0	1	0	1
Foster (Percent)	0	0	0	0	1.9	0	.7
Home schooled (Number)	0	0	0	0	0	0	0
Home schooled (Percent)	0	0	0	0	0	0	0
Court/agency placed (Number)	0	0	0	0	0	0	0
Court/agency placed (Percent)	0	0	0	0	0	0	0
Number of assessed students (Number)	1	2	7	74	54	1	139

*Other combines students coded as (1) below Grade 8, (2) ungraded, or (3) without a coded grade

Table I–37. Incidence of Presentation Accommodations Received on the Summer Keystone: Algebra I

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	0	N/A	0
Braille format (Percent)	0	N/A	0
Large print format (Number)	0	N/A	0
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	0	0	0
Some test items/questions read aloud (Percent)	0	0	0
All test items/questions read aloud (Number)	0	0	0
All test items/questions read aloud (Percent)	0	0	0
Test items/questions signed (Number)	0	0	0
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	0	0	0
Test items/questions interpreted for EL student (Percent)	0	0	0
Amplification device (Number)	0	0	0
Amplification device (Percent)	0	0	0
Magnification device (Number)	0	0	0
Magnification device (Percent)	0	0	0
Color overlay (Number)	0	N/A	0
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Spanish version (Number)	0	N/A	0
Spanish version (Percent)	0	N/A	0
Audio (Number)	N/A	0	0
Audio (Percent)	N/A	0	0
Color Chooser (Number)	N/A	0	0
Color Chooser (Percent)	N/A	0	0
Contrasting Text Chooser (Number)	N/A	0	0
Contrasting Text Chooser (Percent)	N/A	0	0
Reverse Contrast (Number)	N/A	0	0
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	0	0
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	103	225	328

Table I–38. Incidence of Presentation Accommodations Received on the Summer Keystone: Biology

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	0	N/A	0
Braille format (Percent)	0	N/A	0
Large print format (Number)	0	N/A	0
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Some test items/questions read aloud (Number)	0	0	0
Some test items/questions read aloud (Percent)	0	0	0
All test items/questions read aloud (Number)	0	0	0
All test items/questions read aloud (Percent)	0	0	0
Test items/questions signed (Number)	0	0	0
Test items/questions signed (Percent)	0	0	0
Test items/questions interpreted for EL student (Number)	0	0	0
Test items/questions interpreted for EL student (Percent)	0	0	0
Amplification device (Number)	0	0	0
Amplification device (Percent)	0	0	0
Magnification device (Number)	0	0	0
Magnification device (Percent)	0	0	0
Color overlay (Number)	0	N/A	0
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Spanish version (Number)	0	N/A	0
Spanish version (Percent)	0	N/A	0
Audio (Number)	N/A	0	0
Audio (Percent)	N/A	0	0
Color Chooser (Number)	N/A	0	0
Color Chooser (Percent)	N/A	0	0
Contrasting Text Chooser (Number)	N/A	0	0
Contrasting Text Chooser (Percent)	N/A	0	0
Reverse Contrast (Number)	N/A	0	0
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Video Sign Language (Number)	N/A	0	0
Video Sign Language (Percent)	N/A	0	0
Number of assessed students (Number)	117	118	235

Table I–39. Incidence of Presentation Accommodations Received on the Summer Keystone: Literature

Type of Presentation Accommodation	PPT	CBT	Total
Braille format (Number)	0	N/A	0
Braille format (Percent)	0	N/A	0
Large print format (Number)	0	N/A	0
Large print format (Percent)	0	N/A	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Amplification device (Number)	0	0	0
Amplification device (Percent)	0	0	0
Magnification device (Number)	0	0	0
Magnification device (Percent)	0	0	0
Color overlay (Number)	0	N/A	0
Color overlay (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Color Chooser (Number)	N/A	0	0
Color Chooser (Percent)	N/A	0	0
Contrasting Text Chooser (Number)	N/A	0	0
Contrasting Text Chooser (Percent)	N/A	0	0
Reverse Contrast (Number)	N/A	0	0
Reverse Contrast (Percent)	N/A	0	0
Refreshable Braille (Number)	N/A	0	0
Refreshable Braille (Percent)	N/A	0	0
Number of assessed students (Number)	52	87	139

Table I–40. Incidence of Response Accommodations Received on the Summer Keystone: Algebra I

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	0	0	0
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	0	0	0
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	1	0	1
Test administrator transcribed student responses (Percent)	1	0	.3
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	0	N/A	0
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	0	N/A	0
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	0	0	0
Translation dictionary for EL student (Percent)	0	0	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	103	225	328

Table I–41. Incidence of Response Accommodations Received on the Summer Keystone: Biology

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	0	0	0
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	0	0	0
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	1	0	1
Test administrator transcribed student responses (Percent)	.9	0	.4
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Number)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed student's signed responses (Percent)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Number)	0	0	0
Qualified interpreter translated, transcribed, and/or scribed EL student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	0	N/A	0
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	0	N/A	0
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Translation dictionary for EL student (Number)	0	0	0
Translation dictionary for EL student (Percent)	0	0	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	117	118	235

Table I–42. Incidence of Response Accommodations Received on the Summer Keystone: Literature

Type of Response Accommodation	PPT	CBT	Total
Test administrator marked multiple-choice responses at student's direction (Number)	0	0	0
Test administrator marked multiple-choice responses at student's direction (Percent)	0	0	0
Test administrator scribed open-ended responses at student's direction (Number)	0	0	0
Test administrator scribed open-ended responses at student's direction (Percent)	0	0	0
Test administrator transcribed student responses (Number)	0	0	0
Test administrator transcribed student responses (Percent)	0	0	0
Keyboard, word processor, or computer (Number)	0	N/A	0
Keyboard, word processor, or computer (Percent)	0	N/A	0
Brailler/Notetaker (Number)	0	N/A	0
Brailler/Notetaker (Percent)	0	N/A	0
Augmentative communication device (Number)	0	0	0
Augmentative communication device (Percent)	0	0	0
Computer Assistive Technology (Number)	0	N/A	0
Computer Assistive Technology (Percent)	0	N/A	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	52	87	139

Table I–43. Incidence of Setting Accommodations Received on the Summer Keystone: Algebra I

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	0	0	0
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	0	0	0
One-on-one setting (Percent)	0	0	0
Small group setting (Number)	0	1	1
Small group setting (Percent)	0	.4	.3
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	103	225	328

Table I–44. Incidence of Setting Accommodations Received on the Summer Keystone: Biology

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	0	0	0
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	0	0	0
One-on-one setting (Percent)	0	0	0
Small group setting (Number)	10	1	11
Small group setting (Percent)	8.5	.8	4.7
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	117	118	235

Table I–45. Incidence of Setting Accommodations Received on the Summer Keystone: Literature

Type of Setting Accommodation	PPT	CBT	Total
Hospital/home setting (Number)	0	0	0
Hospital/home setting (Percent)	0	0	0
One-on-one setting (Number)	0	0	0
One-on-one setting (Percent)	0	0	0
Small group setting (Number)	2	0	2
Small group setting (Percent)	3.8	0	1.4
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	52	87	139

Table I–46. Incidence of Timing Accommodations Received on the Summer Keystone: Algebra I

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	0	3	3
Extended time (Percent)	0	1.3	.9
Frequent breaks (Number)	0	2	2
Frequent breaks (Percent)	0	.9	.6
Changed test schedule (Number)	0	0	0
Changed test schedule (Percent)	0	0	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	103	225	328

Table I–47. Incidence of Timing Accommodations Received on the Summer Keystone: Biology

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	2	0	2
Extended time (Percent)	1.7	0	.9
Frequent breaks (Number)	0	0	0
Frequent breaks (Percent)	0	0	0
Changed test schedule (Number)	0	0	0
Changed test schedule (Percent)	0	0	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	117	118	235

Table I–48. Incidence of Timing Accommodations Received on the Summer Keystone: Literature

Type of Timing Accommodation	PPT	CBT	Total
Extended time (Number)	0	0	0
Extended time (Percent)	0	0	0
Frequent breaks (Number)	0	0	0
Frequent breaks (Percent)	0	0	0
Changed test schedule (Number)	0	0	0
Changed test schedule (Percent)	0	0	0
Other (per Accommodations Guidelines) (Number)	0	0	0
Other (per Accommodations Guidelines) (Percent)	0	0	0
Number of assessed students (Number)	52	87	139

Table I–49. Accommodation Rate for Non-IEP and IEP Students on the Summer Keystone Exams: Algebra I

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	91	207	298
Non-Accommodated (Number)	90	206	296
Non-Accommodated (Percent)	98.9	99.5	99.3
Accommodated (Number)	1	1	2
Accommodated (Percent)	1.1	.5	.7
IEP Students (Number)	12	18	30
Non-Accommodated (Number)	12	16	28
Non-Accommodated (Percent)	100	88.9	93.3
Accommodated (Number)	0	2	2
Accommodated (Percent)	0	11.1	6.7

Table I–50. Accommodation Rate for Non-IEP and IEP Students on the Summer Keystone Exams: Biology

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	107	104	211
Non-Accommodated (Number)	95	104	199
Non-Accommodated (Percent)	88.8	100	94.3
Accommodated (Number)	12	0	12
Accommodated (Percent)	11.2	0	5.7
IEP Students (Number)	10	14	24
Non-Accommodated (Number)	9	13	22
Non-Accommodated (Percent)	90	92.9	91.7
Accommodated (Number)	1	1	2
Accommodated (Percent)	10	7.1	8.3

Table I–51. Accommodation Rate for Non-IEP and IEP Students on the Summer Keystone Exams: Literature

Student Subgroup Tested	PPT	CBT	Total
Non-IEP Students (Number)	40	72	112
Non-Accommodated (Number)	40	72	112
Non-Accommodated (Percent)	100	100	100
Accommodated (Number)	0	0	0
Accommodated (Percent)	0	0	0
IEP Students (Number)	12	15	27
Non-Accommodated (Number)	10	15	25
Non-Accommodated (Percent)	83.3	100	92.6
Accommodated (Number)	2	0	2
Accommodated (Percent)	16.7	0	7.4

Table I–52. Incidence of IEP and EL Students Receiving Accommodations on the Summer Keystone: Algebra I

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	0	0	0	0
PPT - Some test items/questions read aloud (Percent)	0	0	0	0
PPT - All test items/questions read aloud (Number)	0	0	0	0
PPT - All test items/questions read aloud (Percent)	0	0	0	0
PPT - Small group setting (Number)	0	0	0	0
PPT - Small group setting (Percent)	0	0	0	0
PPT - Extended time (Number)	0	0	0	0
PPT - Extended time (Percent)	0	0	0	0
PPT - Frequent breaks (Number)	0	0	0	0
PPT - Frequent breaks (Percent)	0	0	0	0
PPT - Number assessed (Number)	0	1	90	12
CBT - Some test items/questions read aloud (Number)	0	0	0	0
CBT - Some test items/questions read aloud (Percent)	0	0	0	0
CBT - All test items/questions read aloud (Number)	0	0	0	0
CBT - All test items/questions read aloud (Percent)	0	0	0	0
CBT - Small group setting (Number)	0	0	0	1
CBT - Small group setting (Percent)	0	0	0	5.6
CBT - Extended time (Number)	0	0	1	2
CBT - Extended time (Percent)	0	0	.5	11.1
CBT - Frequent breaks (Number)	0	0	0	2
CBT - Frequent breaks (Percent)	0	0	0	11.1
CBT - Number assessed (Number)	0	13	194	18
Total - Some test items/questions read aloud (Number)	0	0	0	0
Total - Some test items/questions read aloud (Percent)	0	0	0	0
Total - All test items/questions read aloud (Number)	0	0	0	0
Total - All test items/questions read aloud (Percent)	0	0	0	0
Total - Small group setting (Number)	0	0	0	1
Total - Small group setting (Percent)	0	0	0	3.3
Total - Extended time (Number)	0	0	1	2
Total - Extended time (Percent)	0	0	.4	6.7
Total - Frequent breaks (Number)	0	0	0	2
Total - Frequent breaks (Percent)	0	0	0	6.7
Total - Number assessed (Number)	0	14	284	30

Table I–53. Incidence of IEP and EL Students Receiving Accommodations on the Summer Keystone: Biology

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Some test items/questions read aloud (Number)	0	0	0	0
PPT - Some test items/questions read aloud (Percent)	0	0	0	0
PPT - All test items/questions read aloud (Number)	0	0	0	0
PPT - All test items/questions read aloud (Percent)	0	0	0	0
PPT - Small group setting (Number)	0	0	9	1
PPT - Small group setting (Percent)	0	0	8.6	10
PPT - Extended time (Number)	0	0	2	0
PPT - Extended time (Percent)	0	0	1.9	0
PPT - Frequent breaks (Number)	0	0	0	0
PPT - Frequent breaks (Percent)	0	0	0	0
PPT - Number assessed (Number)	0	2	105	10
CBT - Some test items/questions read aloud (Number)	0	0	0	0
CBT - Some test items/questions read aloud (Percent)	0	0	0	0
CBT - All test items/questions read aloud (Number)	0	0	0	0
CBT - All test items/questions read aloud (Percent)	0	0	0	0
CBT - Small group setting (Number)	0	0	0	1
CBT - Small group setting (Percent)	0	0	0	7.1
CBT - Extended time (Number)	0	0	0	0
CBT - Extended time (Percent)	0	0	0	0
CBT - Frequent breaks (Number)	0	0	0	0
CBT - Frequent breaks (Percent)	0	0	0	0
CBT - Number assessed (Number)	0	1	103	14
Total - Some test items/questions read aloud (Number)	0	0	0	0
Total - Some test items/questions read aloud (Percent)	0	0	0	0
Total - All test items/questions read aloud (Number)	0	0	0	0
Total - All test items/questions read aloud (Percent)	0	0	0	0
Total - Small group setting (Number)	0	0	9	2
Total - Small group setting (Percent)	0	0	4.3	8.3
Total - Extended time (Number)	0	0	2	0
Total - Extended time (Percent)	0	0	1	0
Total - Frequent breaks (Number)	0	0	0	0
Total - Frequent breaks (Percent)	0	0	0	0
Total - Number assessed (Number)	0	3	208	24

Table I–54. Incidence of IEP and EL Students Receiving Accommodations on the Summer Keystone: Literature

Accommodation Received by Administration Mode	Both IEP and EL	EL and non-IEP	General Education (non-IEP or EL)	IEP and non-EL
PPT - Small group setting (Number)	0	0	0	2
PPT - Small group setting (Percent)	0	0	0	16.7
PPT - Extended time (Number)	0	0	0	0
PPT - Extended time (Percent)	0	0	0	0
PPT - Frequent breaks (Number)	0	0	0	0
PPT - Frequent breaks (Percent)	0	0	0	0
PPT - Number assessed (Number)	0	2	38	12
CBT - Small group setting (Number)	0	0	0	0
CBT - Small group setting (Percent)	0	0	0	0
CBT - Extended time (Number)	0	0	0	0
CBT - Extended time (Percent)	0	0	0	0
CBT - Frequent breaks (Number)	0	0	0	0
CBT - Frequent breaks (Percent)	0	0	0	0
CBT - Number assessed (Number)	1	5	67	14
Total - Small group setting (Number)	0	0	0	2
Total - Small group setting (Percent)	0	0	0	7.7
Total - Extended time (Number)	0	0	0	0
Total - Extended time (Percent)	0	0	0	0
Total - Frequent breaks (Number)	0	0	0	0
Total - Frequent breaks (Percent)	0	0	0	0
Total - Number assessed (Number)	1	7	105	26

APPENDIX J: ITEM STATISTICS

Appendix J contains item statistics for each item type (multiple-choice, and constructed-response) by content area and administration (winter, spring, and summer).

Table J–1. Item Statistics

Column Heading	Definition
Ref	Reference line number
PubID	Item ID
Form	Test form
N	Number of students
PVal	*P*-Value
P( )	Proportion selecting given response ('-' represents omitted responses and '*' represents multiple responses)
ITCorr	Item total correlation
Corr( )	Correlation of options/points and total test score ('-' represents omitted responses and '*' represents multiple responses)
Meas	Rasch item difficulty measure estimate
SEM	Standard error of Rasch item difficulty measure estimate
z-Infit	*z* infit statistic
MS-Infit	Mean square infit statistic
z-Outfit	*z* outfit statistic
MS-Outfit	Mean square outfit statistic
M/F	Male/Female DIF code
W/B	White/Black DIF code
W/H	White/Hispanic DIF code
O/P	Online computer-based test/paper-pencil-based test DIF code

MULTIPLE-CHOICE ITEMS

Table J–2. Algebra I Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	303981	0	36950	0.43	0.19	0.18	0.19	0.43	0.01	0.00	0.40	-0.23	-0.20	-0.06	0.40	0.29	0.01	-9.90	0.96	-8.77	0.95
2	304006	0	36950	0.69	0.07	0.11	0.69	0.11	0.01	0.00	0.40	-0.19	-0.22	0.40	-0.19	-1.17	0.01	-3.62	0.98	-7.80	0.92
3	311987	0	36950	0.49	0.49	0.16	0.25	0.09	0.00	0.00	0.19	0.19	-0.13	-0.06	-0.08	0.13	0.01	9.90	1.15	9.90	1.19
4	312261	0	36950	0.30	0.32	0.24	0.14	0.30	0.00	0.00	0.31	-0.01	-0.16	-0.20	0.31	1.13	0.01	9.90	1.09	9.90	1.14
5	312381	0	36950	0.50	0.50	0.22	0.13	0.15	0.00	0.00	0.33	0.33	-0.16	-0.14	-0.15	-0.03	0.01	2.31	1.01	2.10	1.01
6	313797	0	36950	0.38	0.18	0.25	0.19	0.38	0.01	0.00	0.30	-0.18	-0.19	0.03	0.30	0.33	0.01	4.59	1.02	5.81	1.04
7	324144	0	36950	0.50	0.22	0.50	0.22	0.06	0.00	0.00	0.30	-0.18	0.30	-0.09	-0.17	-0.03	0.01	9.21	1.04	9.90	1.07
8	336707	0	36950	0.40	0.40	0.19	0.24	0.16	0.01	0.00	0.23	0.23	-0.13	-0.08	-0.05	0.51	0.01	9.90	1.12	9.90	1.16
9	400153	0	36950	0.32	0.12	0.21	0.32	0.35	0.00	0.00	0.28	-0.21	-0.02	0.28	-0.11	0.82	0.01	8.69	1.05	9.90	1.11
10	417140	0	36950	0.38	0.35	0.38	0.14	0.12	0.01	0.00	0.21	0.03	0.21	-0.18	-0.13	1.22	0.01	9.90	1.46	9.90	1.66
11	418267	0	36950	0.56	0.10	0.56	0.20	0.13	0.01	0.00	0.39	-0.12	0.39	-0.21	-0.19	-0.24	0.01	-9.90	0.94	-9.90	0.93
12	418776	0	36950	0.40	0.40	0.25	0.26	0.08	0.00	0.00	0.37	0.37	-0.18	-0.15	-0.14	0.38	0.01	-7.38	0.97	-6.76	0.96
13	419059	0	36950	0.41	0.27	0.15	0.17	0.41	0.01	0.00	0.27	0.00	-0.18	-0.17	0.27	0.45	0.01	9.90	1.08	9.90	1.10
14	419199	0	36950	0.56	0.10	0.23	0.56	0.11	0.00	0.00	0.43	-0.22	-0.25	0.43	-0.13	-0.59	0.01	-5.92	0.98	-7.85	0.94
15	419613	0	36950	0.30	0.18	0.34	0.30	0.18	0.00	0.00	0.15	-0.09	0.02	0.15	-0.11	1.26	0.01	9.90	1.30	9.90	1.50
16	419617	0	36950	0.43	0.18	0.25	0.43	0.15	0.00	0.00	0.25	-0.09	-0.09	0.25	-0.14	0.78	0.01	9.90	1.23	9.90	1.32
17	471075	0	36950	0.57	0.25	0.09	0.57	0.09	0.00	0.00	0.28	-0.09	-0.21	0.28	-0.14	-0.08	0.01	9.90	1.05	9.90	1.07
18	495144	0	36950	0.47	0.47	0.20	0.20	0.13	0.00	0.00	0.34	0.34	-0.14	-0.20	-0.09	0.27	0.01	6.96	1.03	5.08	1.03
19	495173	0	36950	0.62	0.16	0.62	0.11	0.11	0.00	0.00	0.21	-0.10	0.21	-0.15	-0.06	-0.13	0.01	9.90	1.10	9.90	1.12
20	496411	0	36950	0.54	0.54	0.13	0.12	0.21	0.00	0.00	0.48	0.48	-0.20	-0.18	-0.26	-0.50	0.01	-9.90	0.93	-9.90	0.88
21	498167	0	36950	0.53	0.19	0.17	0.53	0.10	0.00	0.00	0.37	-0.16	-0.23	0.37	-0.10	-0.19	0.01	-7.48	0.97	-4.79	0.97
22	503099	0	36950	0.40	0.17	0.20	0.23	0.40	0.00	0.00	0.47	-0.24	-0.14	-0.19	0.47	0.13	0.01	-9.90	0.89	-9.90	0.86
23	506323	0	36950	0.56	0.07	0.56	0.16	0.20	0.00	0.00	0.29	-0.14	0.29	-0.21	-0.07	-0.06	0.01	9.90	1.04	8.32	1.05
24	567107	0	36950	0.54	0.13	0.54	0.14	0.19	0.00	0.00	0.33	-0.10	0.33	-0.20	-0.15	-0.06	0.01	2.36	1.01	2.13	1.01
25	575139	0	36950	0.49	0.13	0.18	0.20	0.49	0.00	0.00	0.45	-0.23	-0.11	-0.26	0.45	-0.03	0.01	-9.90	0.91	-9.90	0.88
26	575144	0	36950	0.43	0.43	0.31	0.13	0.12	0.00	0.00	0.37	0.37	-0.16	-0.15	-0.18	0.22	0.01	-6.54	0.97	-4.51	0.97
27	577157	0	36950	0.29	0.22	0.19	0.29	0.29	0.01	0.00	0.18	-0.06	-0.12	0.18	-0.01	0.89	0.01	9.90	1.10	9.90	1.21
28	578519	0	36950	0.34	0.11	0.32	0.34	0.20	0.01	0.01	0.32	-0.14	-0.08	0.32	-0.17	0.57	0.01	-1.68	0.99	2.44	1.02
29	578520	0	36950	0.72	0.07	0.72	0.09	0.11	0.00	0.00	0.36	-0.10	0.36	-0.24	-0.20	-0.86	0.01	-9.90	0.87	-9.90	0.82
30	579836	0	36950	0.40	0.40	0.16	0.10	0.34	0.00	0.00	0.38	0.38	-0.14	-0.10	-0.21	0.28	0.01	-9.78	0.96	-7.87	0.95
31	582772	0	36950	0.48	0.48	0.19	0.22	0.10	0.01	0.00	0.36	0.36	-0.04	-0.27	-0.15	-0.15	0.01	-2.20	0.99	1.17	1.01

Table J–2 (continued). Algebra I Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
32	583354	0	36950	0.33	0.13	0.21	0.33	0.33	0.00	0.00	0.24	-0.11	-0.18	0.01	0.24	1.05	0.01	9.90	1.18	9.90	1.27
33	583996	0	36950	0.74	0.09	0.74	0.13	0.03	0.00	0.00	0.36	-0.20	0.36	-0.22	-0.13	-1.14	0.01	-9.90	0.89	-9.90	0.83
34	584012	0	36950	0.33	0.43	0.10	0.14	0.33	0.00	0.00	0.27	-0.05	-0.18	-0.14	0.27	1.14	0.01	9.90	1.19	9.90	1.32
35	584136	0	36950	0.28	0.09	0.28	0.28	0.35	0.00	0.00	0.27	-0.12	-0.19	0.27	0.00	1.32	0.01	9.90	1.16	9.90	1.32
36	593279	0	36950	0.55	0.10	0.12	0.22	0.55	0.01	0.00	0.44	-0.21	-0.22	-0.19	0.44	-0.49	0.01	-9.90	0.94	-9.90	0.91

Table J–3. Biology Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	274086	0	31027	0.38	0.38	0.17	0.16	0.28	0.01	0.00	0.30	0.30	-0.14	-0.17	-0.05	0.29	0.01	-3.80	0.98	-2.57	0.99
2	274331	0	31027	0.49	0.16	0.14	0.21	0.49	0.00	0.00	0.36	-0.11	-0.17	-0.20	0.36	-0.03	0.01	-9.90	0.95	-6.75	0.96
3	278873	0	31027	0.46	0.46	0.11	0.26	0.17	0.01	0.00	0.30	0.30	-0.19	-0.06	-0.16	-0.14	0.01	3.28	1.01	9.90	1.06
4	278881	0	31027	0.40	0.15	0.33	0.40	0.11	0.00	0.00	0.31	-0.11	-0.12	0.31	-0.16	0.18	0.01	-4.17	0.98	-3.92	0.98
5	314612	0	31027	0.61	0.06	0.61	0.21	0.11	0.01	0.00	0.35	-0.19	0.35	-0.16	-0.17	-0.39	0.01	-9.90	0.93	-9.90	0.91
6	314619	0	31027	0.37	0.37	0.23	0.24	0.16	0.00	0.00	0.27	0.27	-0.14	-0.11	-0.07	0.56	0.01	6.65	1.03	7.57	1.05
7	314933	0	31027	0.36	0.22	0.22	0.20	0.36	0.00	0.00	0.27	-0.08	-0.06	-0.16	0.27	0.65	0.01	7.73	1.04	9.12	1.06
8	314936	0	31027	0.41	0.15	0.24	0.20	0.41	0.00	0.00	0.23	-0.12	-0.04	-0.13	0.23	0.75	0.01	9.90	1.17	9.90	1.21
9	321597	0	31027	0.33	0.15	0.32	0.20	0.33	0.01	0.00	0.29	-0.21	-0.11	-0.01	0.29	0.97	0.01	9.90	1.08	9.90	1.10
10	334707	0	31027	0.41	0.18	0.41	0.18	0.22	0.00	0.00	0.24	-0.09	0.24	-0.10	-0.11	0.61	0.01	9.90	1.11	9.90	1.14
11	341355	0	31027	0.36	0.16	0.17	0.36	0.30	0.01	0.00	0.26	-0.06	-0.08	0.26	-0.14	0.49	0.01	1.68	1.01	2.59	1.02
12	341686	0	31027	0.39	0.18	0.23	0.39	0.19	0.00	0.00	0.23	-0.07	-0.10	0.23	-0.10	0.76	0.01	9.90	1.15	9.90	1.20
13	342311	0	31027	0.47	0.11	0.47	0.15	0.26	0.00	0.00	0.31	-0.16	0.31	-0.06	-0.18	0.24	0.01	2.72	1.01	4.29	1.02
14	409450	0	31027	0.52	0.10	0.52	0.18	0.21	0.00	0.00	0.38	-0.09	0.38	-0.23	-0.18	-0.01	0.01	-9.90	0.94	-9.90	0.94
15	409868	0	31027	0.31	0.14	0.17	0.37	0.31	0.00	0.00	0.28	-0.05	-0.13	-0.12	0.28	1.07	0.01	9.90	1.10	9.90	1.17
16	411155	0	31027	0.53	0.13	0.13	0.21	0.53	0.00	0.00	0.40	-0.19	-0.22	-0.14	0.40	-0.38	0.01	-9.90	0.96	-9.90	0.93
17	416412	0	31027	0.30	0.28	0.11	0.30	0.30	0.00	0.00	0.20	-0.04	-0.25	0.20	0.02	0.66	0.01	3.92	1.02	5.92	1.04
18	468394	0	31027	0.32	0.32	0.22	0.24	0.21	0.01	0.00	0.45	0.45	-0.10	-0.25	-0.13	0.49	0.01	-9.90	0.84	-9.90	0.82
19	468405	0	31027	0.54	0.16	0.54	0.16	0.14	0.01	0.00	0.41	-0.13	0.41	-0.22	-0.20	-0.67	0.01	9.90	1.04	-0.30	1.00
20	468412	0	31027	0.54	0.54	0.17	0.18	0.11	0.00	0.00	0.30	0.30	-0.15	-0.16	-0.10	0.16	0.01	8.58	1.03	3.39	1.02
21	468413	0	31027	0.49	0.49	0.12	0.14	0.25	0.01	0.00	0.40	0.40	-0.17	-0.26	-0.11	-0.10	0.01	-9.90	0.93	-9.90	0.92
22	468419	0	31027	0.33	0.20	0.26	0.33	0.21	0.00	0.00	0.32	-0.15	-0.09	0.32	-0.12	0.72	0.01	-3.82	0.98	-0.29	1.00
23	468421	0	31027	0.43	0.43	0.19	0.25	0.14	0.00	0.00	0.29	0.29	-0.11	-0.12	-0.13	0.45	0.01	9.81	1.04	8.32	1.05
24	468423	0	31027	0.35	0.35	0.17	0.12	0.35	0.00	0.00	0.16	0.01	-0.11	-0.11	0.16	1.08	0.01	9.90	1.31	9.90	1.41
25	468425	0	31027	0.40	0.25	0.40	0.19	0.15	0.00	0.00	0.28	-0.12	0.28	-0.10	-0.11	0.10	0.01	4.09	1.02	2.31	1.01
26	469114	0	31027	0.59	0.08	0.14	0.19	0.59	0.00	0.00	0.27	-0.15	-0.12	-0.12	0.27	-0.27	0.01	-1.72	0.99	4.93	1.03
27	469133	0	31027	0.50	0.50	0.22	0.11	0.17	0.00	0.00	0.41	0.41	-0.21	-0.21	-0.14	-0.11	0.01	-9.90	0.92	-9.90	0.90
28	471906	0	31027	0.41	0.21	0.25	0.41	0.13	0.01	0.00	0.24	-0.14	-0.04	0.24	-0.10	0.42	0.01	9.90	1.06	9.90	1.08
29	471924	0	31027	0.45	0.13	0.36	0.06	0.45	0.00	0.00	0.19	-0.07	-0.05	-0.19	0.19	0.51	0.01	9.90	1.17	9.90	1.20
30	477358	0	31027	0.28	0.23	0.28	0.29	0.20	0.00	0.00	0.23	-0.11	0.23	-0.08	-0.05	1.34	0.01	9.90	1.17	9.90	1.29
31	479240	0	31027	0.53	0.17	0.17	0.13	0.53	0.00	0.00	0.32	-0.12	-0.15	-0.18	0.32	-0.09	0.01	-6.17	0.98	-6.34	0.96
32	479983	0	31027	0.54	0.12	0.23	0.54	0.11	0.00	0.00	0.32	-0.21	-0.11	0.32	-0.14	0.03	0.01	-2.79	0.99	-2.08	0.99
33	480330	0	31027	0.35	0.10	0.32	0.35	0.23	0.00	0.00	0.08	-0.09	0.08	0.08	-0.12	0.88	0.01	9.90	1.25	9.90	1.32

Table J–3 (continued). Biology Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	492416	0	31027	0.32	0.32	0.26	0.31	0.11	0.00	0.00	0.22	0.22	-0.02	-0.14	-0.08	1.19	0.01	9.90	1.24	9.90	1.33
35	492734	0	31027	0.44	0.13	0.11	0.31	0.44	0.01	0.00	0.33	-0.15	-0.20	-0.10	0.33	0.05	0.01	-5.31	0.98	-6.71	0.96
36	566406	0	31027	0.45	0.45	0.12	0.25	0.18	0.00	0.00	0.29	0.29	-0.13	-0.12	-0.13	0.29	0.01	5.89	1.02	3.45	1.02
37	566505	0	31027	0.55	0.16	0.20	0.55	0.08	0.00	0.00	0.40	-0.16	-0.22	0.40	-0.16	-0.27	0.01	-9.90	0.92	-9.90	0.89
38	566508	0	31027	0.37	0.30	0.37	0.17	0.16	0.01	0.00	0.33	-0.13	0.33	-0.15	-0.11	0.42	0.01	-9.42	0.96	-7.19	0.96
39	574710	0	31027	0.31	0.17	0.16	0.35	0.31	0.01	0.00	0.34	-0.08	-0.11	-0.17	0.34	0.93	0.01	-2.86	0.98	2.23	1.02
40	574723	0	31027	0.57	0.10	0.57	0.21	0.11	0.01	0.00	0.30	-0.09	0.30	-0.14	-0.18	-0.35	0.01	-2.31	0.99	1.02	1.01
41	574774	0	31027	0.60	0.14	0.10	0.60	0.16	0.00	0.00	0.38	-0.19	-0.23	0.38	-0.13	-0.45	0.01	-9.90	0.92	-9.90	0.88
42	575004	0	31027	0.43	0.43	0.18	0.22	0.16	0.00	0.00	0.36	0.36	-0.19	-0.15	-0.10	0.05	0.01	-9.90	0.96	-9.90	0.94
43	575005	0	31027	0.24	0.24	0.19	0.35	0.21	0.01	0.00	0.23	0.23	-0.13	-0.02	-0.07	1.38	0.01	9.36	1.08	9.90	1.21
44	575122	0	31027	0.59	0.59	0.07	0.17	0.17	0.00	0.00	0.30	0.30	-0.23	-0.05	-0.19	-0.07	0.01	-3.70	0.99	-0.84	1.00
45	577995	0	31027	0.57	0.13	0.57	0.15	0.15	0.00	0.00	0.37	-0.18	0.37	-0.19	-0.15	-0.22	0.01	-9.90	0.93	-9.90	0.92
46	578320	0	31027	0.32	0.28	0.26	0.32	0.13	0.01	0.00	0.43	-0.15	-0.23	0.43	-0.08	0.38	0.01	-9.90	0.85	-9.90	0.84
47	578634	0	31027	0.33	0.28	0.33	0.24	0.15	0.00	0.00	0.27	0.04	0.27	-0.18	-0.19	0.65	0.01	0.04	1.00	3.14	1.02
48	581071	0	31027	0.43	0.10	0.43	0.38	0.09	0.00	0.00	0.33	-0.16	0.33	-0.14	-0.17	-0.02	0.01	-3.30	0.99	-4.78	0.97

Table J–4. Literature Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	498160	0	30416	0.57	0.16	0.09	0.17	0.57	0.00	0.00	0.46	-0.21	-0.23	-0.21	0.46	0.05	0.01	-6.65	0.97	-7.04	0.94
2	498163	0	30416	0.57	0.13	0.57	0.17	0.12	0.00	0.00	0.44	-0.20	0.44	-0.20	-0.21	-0.10	0.01	4.21	1.02	0.61	1.01
3	498164	0	30416	0.60	0.60	0.12	0.13	0.16	0.00	0.00	0.48	0.48	-0.25	-0.28	-0.16	-0.18	0.01	-5.44	0.97	-2.36	0.98
4	498176	0	30416	0.61	0.22	0.08	0.61	0.08	0.00	0.00	0.39	-0.10	-0.27	0.39	-0.24	0.06	0.01	2.48	1.01	1.90	1.02
5	498177	0	30416	0.60	0.05	0.60	0.06	0.29	0.00	0.00	0.34	-0.25	0.34	-0.24	-0.11	0.21	0.01	9.90	1.07	9.90	1.09
6	498178	0	30416	0.46	0.09	0.24	0.21	0.46	0.00	0.00	0.37	-0.25	-0.09	-0.17	0.37	0.57	0.01	9.23	1.05	9.90	1.12
7	498179	0	30416	0.55	0.28	0.07	0.10	0.55	0.00	0.00	0.34	-0.06	-0.28	-0.22	0.34	0.40	0.01	9.90	1.08	9.90	1.13
8	498180	0	30416	0.49	0.49	0.19	0.10	0.22	0.01	0.00	0.36	0.36	-0.13	-0.26	-0.12	0.49	0.01	9.90	1.06	9.90	1.11
9	528510	0	30416	0.33	0.33	0.12	0.32	0.23	0.00	0.00	0.22	0.22	-0.11	-0.05	-0.10	1.61	0.01	9.90	1.23	9.90	1.56
10	528511	0	30416	0.61	0.14	0.61	0.18	0.08	0.00	0.00	0.30	-0.13	0.30	-0.15	-0.16	0.41	0.01	9.90	1.13	9.90	1.16
11	528512	0	30416	0.54	0.15	0.16	0.54	0.15	0.00	0.00	0.34	-0.15	-0.15	0.34	-0.17	0.50	0.01	9.90	1.08	9.90	1.12
12	528513	0	30416	0.59	0.14	0.19	0.59	0.09	0.00	0.00	0.28	-0.09	-0.20	0.28	-0.10	0.26	0.01	9.90	1.14	9.90	1.16
13	528516	0	30416	0.28	0.28	0.19	0.38	0.16	0.00	0.00	0.19	0.19	-0.09	0.04	-0.19	1.74	0.01	9.90	1.19	9.90	1.52
14	528517	0	30416	0.65	0.22	0.07	0.05	0.65	0.00	0.00	0.36	-0.10	-0.26	-0.26	0.36	0.16	0.01	3.98	1.02	3.50	1.03
15	528519	0	30416	0.64	0.10	0.64	0.13	0.13	0.00	0.00	0.37	-0.17	0.37	-0.18	-0.19	0.18	0.01	3.10	1.02	3.15	1.03
16	528520	0	30416	0.59	0.59	0.11	0.14	0.15	0.00	0.00	0.37	0.37	-0.22	-0.17	-0.14	0.36	0.01	7.36	1.04	3.56	1.03
17	528521	0	30416	0.64	0.14	0.64	0.17	0.06	0.00	0.00	0.35	-0.23	0.35	-0.14	-0.14	-0.03	0.01	6.31	1.03	7.10	1.07
18	528635	0	30416	0.54	0.07	0.28	0.54	0.10	0.00	0.00	0.32	-0.28	-0.06	0.32	-0.19	0.50	0.01	9.90	1.11	9.90	1.17
19	528637	0	30416	0.59	0.18	0.59	0.16	0.06	0.00	0.00	0.44	-0.18	0.44	-0.24	-0.22	-0.46	0.01	9.90	1.13	9.90	1.13
20	528639	0	30416	0.73	0.73	0.06	0.08	0.12	0.00	0.00	0.41	0.41	-0.25	-0.25	-0.14	-1.02	0.02	9.37	1.08	9.90	1.21
21	528640	0	30416	0.51	0.19	0.05	0.25	0.51	0.00	0.00	0.33	-0.19	-0.24	-0.07	0.33	0.12	0.01	9.90	1.15	9.90	1.27
22	528641	0	30416	0.67	0.11	0.08	0.67	0.14	0.01	0.00	0.46	-0.24	-0.26	0.46	-0.19	-0.91	0.01	9.90	1.19	9.90	1.16
23	528642	0	30416	0.57	0.57	0.26	0.08	0.09	0.01	0.00	0.37	0.37	-0.07	-0.25	-0.27	0.10	0.01	9.90	1.06	9.90	1.14
24	528644	0	30416	0.74	0.08	0.74	0.09	0.08	0.00	0.00	0.50	-0.26	0.50	-0.30	-0.19	-1.00	0.02	-3.56	0.97	-8.49	0.87
25	528645	0	30416	0.61	0.09	0.10	0.19	0.61	0.00	0.00	0.44	-0.21	-0.28	-0.16	0.44	-0.31	0.01	4.75	1.03	5.23	1.06
26	581352	0	30416	0.40	0.16	0.24	0.40	0.20	0.00	0.00	0.21	-0.11	-0.11	0.21	-0.03	1.46	0.01	9.90	1.35	9.90	1.68
27	581353	0	30416	0.78	0.05	0.78	0.09	0.09	0.00	0.00	0.40	-0.22	0.40	-0.23	-0.19	-1.04	0.02	-4.38	0.97	-5.72	0.91
28	581356	0	30416	0.55	0.55	0.16	0.13	0.16	0.00	0.00	0.41	0.41	-0.21	-0.19	-0.17	0.31	0.01	0.80	1.00	-1.23	0.99
29	581357	0	30416	0.71	0.71	0.05	0.14	0.10	0.00	0.00	0.42	0.42	-0.22	-0.29	-0.15	-0.44	0.01	-9.90	0.92	-9.90	0.86
30	581359	0	30416	0.62	0.15	0.16	0.62	0.08	0.00	0.00	0.36	-0.15	-0.15	0.36	-0.25	0.50	0.01	9.90	1.07	9.90	1.12
31	581360	0	30416	0.55	0.19	0.11	0.15	0.55	0.00	0.00	0.30	-0.10	-0.20	-0.13	0.30	0.59	0.01	9.90	1.15	9.90	1.24
32	581362	0	30416	0.73	0.11	0.09	0.73	0.07	0.00	0.00	0.45	-0.29	-0.23	0.45	-0.17	-0.49	0.01	-9.90	0.86	-9.90	0.82
33	581363	0	30416	0.34	0.31	0.34	0.14	0.20	0.00	0.00	0.26	-0.13	0.26	-0.13	-0.04	1.58	0.01	9.90	1.21	9.90	1.51

Table J–4 (continued). Literature Multiple-Choice Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	581364	0	30416	0.50	0.50	0.17	0.22	0.10	0.00	0.00	0.41	0.41	-0.22	-0.13	-0.21	0.42	0.01	2.83	1.01	2.54	1.02

Table J–5. Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	274472	0	119316	0.34	0.12	0.29	0.23	0.34	0.01	0.00	0.53	-0.07	-0.33	-0.17	0.53					1.04	0.01	-9.90	0.90	-9.90	0.90
2	312184	0	119316	0.42	0.11	0.26	0.22	0.42	0.00	0.00	0.44	-0.14	-0.27	-0.13	0.44					0.80	0.01	9.90	1.06	9.90	1.08
3	312470	0	119316	0.30	0.18	0.30	0.26	0.25	0.01	0.00	0.47	-0.25	0.47	-0.22	-0.02					1.81	0.01	9.90	1.12	9.90	1.42
4	324104	0	119316	0.56	0.11	0.56	0.26	0.07	0.00	0.00	0.39	-0.28	0.39	-0.15	-0.16					0.12	0.01	9.90	1.08	9.82	1.08
5	324161	0	119316	0.48	0.19	0.16	0.18	0.48	0.00	0.00	0.48	-0.10	-0.26	-0.27	0.48					0.53	0.01	3.73	1.02	2.68	1.02
6	324177	0	119316	0.27	0.31	0.23	0.19	0.27	0.00	0.00	0.40	-0.20	-0.12	-0.09	0.40					1.81	0.01	9.90	1.12	9.90	1.42
7	324179	0	119316	0.49	0.09	0.32	0.49	0.09	0.01	0.00	0.45	-0.25	-0.16	0.45	-0.24					0.55	0.01	9.25	1.05	8.06	1.06
8	336736	0	119316	0.57	0.25	0.57	0.11	0.07	0.00	0.00	0.42	-0.14	0.42	-0.28	-0.22					-0.06	0.01	9.90	1.06	7.17	1.06
9	416609	0	119316	0.43	0.13	0.19	0.43	0.24	0.01	0.00	0.41	-0.18	-0.20	0.41	-0.13					0.80	0.01	9.90	1.10	9.90	1.16
10	417692	0	119316	0.34	0.30	0.20	0.34	0.16	0.01	0.00	0.47	-0.22	-0.27	0.47	-0.01					1.21	0.01	-0.16	1.00	9.90	1.11
11	417695	0	119316	0.62	0.62	0.15	0.15	0.08	0.01	0.00	0.57	0.57	-0.28	-0.36	-0.17					-0.62	0.01	-9.90	0.92	-9.90	0.87
12	417722	0	119316	0.73	0.73	0.14	0.05	0.07	0.01	0.00	0.41	0.41	-0.18	-0.24	-0.24					-0.80	0.01	-9.90	0.93	-1.72	0.98
13	418775	0	119316	0.51	0.17	0.19	0.12	0.51	0.00	0.00	0.38	-0.14	-0.15	-0.23	0.38					0.33	0.01	9.90	1.12	9.90	1.14
14	418785	0	119316	0.36	0.36	0.36	0.13	0.14	0.01	0.00	0.40	-0.08	0.40	-0.19	-0.23					0.90	0.01	9.90	1.07	9.90	1.13
15	419062	0	119316	0.38	0.17	0.23	0.22	0.38	0.01	0.00	0.40	-0.13	-0.16	-0.18	0.40					0.98	0.01	9.90	1.09	9.90	1.14
16	419063	0	119316	0.84	0.07	0.84	0.07	0.02	0.00	0.00	0.40	-0.23	0.40	-0.24	-0.18					-1.43	0.01	-9.90	0.78	-9.90	0.68
17	419064	0	119316	0.28	0.32	0.28	0.25	0.15	0.01	0.00	0.33	-0.18	0.33	-0.08	-0.06					1.79	0.01	9.90	1.25	9.90	1.55
18	419072	0	119316	0.53	0.53	0.13	0.10	0.24	0.00	0.00	0.35	0.35	-0.27	-0.27	0.00					0.13	0.01	9.90	1.14	9.90	1.23
19	419193	0	119316	0.77	0.77	0.11	0.09	0.02	0.00	0.00	0.42	0.42	-0.22	-0.29	-0.16					-1.15	0.01	-9.90	0.92	-9.63	0.86
20	419865	0	119316	0.31	0.31	0.20	0.27	0.21	0.01	0.00	0.39	0.39	-0.17	-0.14	-0.11					1.21	0.01	6.99	1.04	9.90	1.16
21	493933	0	119316	0.46	0.16	0.46	0.17	0.20	0.00	0.00	0.39	-0.16	0.39	-0.25	-0.10					0.75	0.01	9.90	1.13	9.90	1.19
22	495376	0	119316	0.58	0.58	0.13	0.17	0.11	0.01	0.00	0.54	0.54	-0.28	-0.27	-0.19					-0.16	0.01	-9.90	0.91	-9.90	0.87
23	495377	0	119316	0.61	0.61	0.29	0.05	0.06	0.00	0.00	0.42	0.42	-0.24	-0.18	-0.24					-0.13	0.01	5.61	1.03	1.14	1.01
24	496131	0	119316	0.77	0.07	0.77	0.07	0.08	0.01	0.00	0.45	-0.25	0.45	-0.19	-0.25					-1.23	0.01	-9.90	0.93	-8.54	0.87
25	496392	0	119316	0.44	0.11	0.40	0.44	0.05	0.00	0.00	0.38	-0.12	-0.24	0.38	-0.14					1.01	0.01	9.90	1.19	9.90	1.28
26	497683	0	119316	0.41	0.41	0.21	0.21	0.15	0.01	0.00	0.36	0.36	-0.08	-0.23	-0.11					0.83	0.01	9.90	1.16	9.90	1.23
27	498169	0	119316	0.53	0.07	0.08	0.53	0.32	0.00	0.00	0.34	-0.24	-0.28	0.34	-0.07					0.41	0.01	9.90	1.18	9.90	1.23
28	500000	0	119316	0.41	0.41	0.22	0.28	0.07	0.01	0.00	0.51	0.51	-0.11	-0.36	-0.13					0.74	0.01	-8.82	0.95	-6.02	0.95
29	501541	0	119316	0.49	0.14	0.19	0.17	0.49	0.01	0.00	0.54	-0.20	-0.24	-0.26	0.54					0.16	0.01	-9.90	0.94	-9.90	0.91
30	503100	0	119316	0.52	0.13	0.24	0.52	0.11	0.00	0.00	0.39	-0.16	-0.20	0.39	-0.18					-0.04	0.01	9.90	1.12	9.90	1.17
31	505338	0	119316	0.55	0.19	0.14	0.55	0.11	0.00	0.00	0.53	-0.23	-0.31	0.53	-0.20					0.20	0.01	-9.90	0.92	-9.90	0.89
32	577153	0	119316	0.42	0.25	0.16	0.17	0.42	0.00	0.00	0.53	-0.20	-0.24	-0.23	0.53					0.56	0.01	-9.90	0.92	-9.90	0.90
33	577980	0	119316	0.68	0.11	0.68	0.11	0.09	0.00	0.00	0.49	-0.18	0.49	-0.30	-0.26					-0.49	0.01	-9.90	0.89	-9.90	0.83

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	584271	0	119316	0.58	0.10	0.24	0.58	0.08	0.01	0.00	0.53	-0.21	-0.33	0.53	-0.19					-0.39	0.01	-2.98	0.99	-7.53	0.93
35	584400	0	119316	0.80	0.09	0.80	0.07	0.05	0.00	0.00	0.32	-0.12	0.32	-0.25	-0.14					-1.13	0.01	-9.37	0.94	5.18	1.08
36	587125	0	119316	0.78	0.04	0.78	0.13	0.03	0.01	0.00	0.53	-0.22	0.53	-0.38	-0.20					-1.32	0.01	-9.90	0.82	-9.90	0.61
37	613768	1	6991	0.43	0.20	0.16	0.21	0.43	0.00	0.00	0.48	-0.23	-0.25	-0.12	0.48	A+	A-	A-	A-	0.35	0.06	-1.56	0.96	-0.59	0.98
38	618953	1	6991	0.50	0.19	0.50	0.18	0.13	0.01	0.00	0.31	-0.12	0.31	-0.15	-0.13	A-	A-	A-	A+	0.01	0.06	7.16	1.17	6.40	1.25
39	621619	1	6991	0.28	0.16	0.28	0.30	0.27	0.00	0.00	0.35	-0.05	0.35	-0.19	-0.11	A+	A-	A+	A-	1.22	0.07	1.77	1.06	3.06	1.16
40	624126	1	6991	0.13	0.13	0.07	0.18	0.60	0.00	0.00	0.18	0.18	-0.11	-0.33	0.20	A-	A+	A+	A-	2.36	0.08	3.11	1.17	7.53	1.93
41	635800	1	6991	0.33	0.26	0.17	0.23	0.33	0.00	0.00	0.35	-0.08	-0.15	-0.17	0.35	A+	A-	A-	A-	0.88	0.06	2.46	1.08	3.05	1.13
42	663492	1	6991	0.36	0.24	0.36	0.24	0.16	0.00	0.00	0.34	-0.21	0.34	-0.21	0.04	A-	A+	A-	A+	0.70	0.06	3.68	1.11	3.80	1.16
43	663499	1	6991	0.33	0.17	0.26	0.33	0.23	0.01	0.00	0.20	-0.21	-0.03	0.20	0.01	A-	A+	A-	A+	0.87	0.06	6.66	1.21	6.41	1.29
44	664758	1	6991	0.51	0.14	0.51	0.22	0.13	0.01	0.00	0.52	-0.22	0.52	-0.26	-0.22	A+	A+	A+	A+	-0.04	0.06	-5.13	0.89	-4.41	0.85
45	665944	1	6991	0.52	0.07	0.12	0.28	0.52	0.00	0.00	0.28	-0.16	-0.21	-0.06	0.28	A+	A+	A-	A+	-0.10	0.06	7.91	1.19	6.14	1.25
46	667533	1	6991	0.43	0.30	0.10	0.16	0.43	0.00	0.00	0.45	-0.21	-0.17	-0.20	0.45	A+	A-	A-	A-	0.35	0.06	0.33	1.01	0.18	1.01
47	623230	2	4943	0.23	0.25	0.28	0.24	0.23	0.00	0.00	0.22	0.01	-0.10	-0.12	0.22	A-	A+	A+	A-	1.93	0.07	4.35	1.17	5.40	1.40
48	635936	2	4943	0.50	0.08	0.38	0.50	0.04	0.00	0.00	0.55	-0.23	-0.41	0.55	-0.07	A-	A-	A-	A+	0.37	0.06	-5.85	0.86	-5.19	0.82
49	651327	2	4943	0.47	0.47	0.17	0.11	0.24	0.00	0.00	0.44	0.44	-0.14	-0.30	-0.16	A+	A-	A+	A-	0.49	0.06	-0.44	0.99	-0.87	0.97
50	661904	2	4943	0.64	0.13	0.07	0.15	0.64	0.00	0.00	0.51	-0.19	-0.25	-0.32	0.51	A+	A-	A-	A+	-0.38	0.06	-5.94	0.86	-5.08	0.76
51	663710	2	4943	0.37	0.18	0.37	0.26	0.19	0.00	0.00	0.39	-0.06	0.39	-0.15	-0.25	A-	A+	A+	A+	1.04	0.06	1.99	1.06	3.33	1.14
52	664129	2	4943	0.33	0.07	0.33	0.15	0.44	0.00	0.00	0.42	-0.15	0.42	-0.25	-0.13	A+	A+	A-	A+	1.25	0.06	0.16	1.00	2.30	1.11
53	665418	2	4943	0.50	0.30	0.50	0.13	0.07	0.00	0.00	0.49	-0.30	0.49	-0.22	-0.12	A-	A-	A-	A+	0.35	0.06	-3.35	0.92	-2.50	0.91
54	665948	2	4943	0.40	0.27	0.18	0.14	0.40	0.00	0.00	0.39	-0.18	-0.16	-0.13	0.39	A-	A-	A-	A+	0.88	0.06	1.30	1.04	2.58	1.10
55	665991	2	4943	0.30	0.29	0.23	0.30	0.18	0.00	0.00	0.13	0.00	-0.23	0.13	0.09	A+	A+	A-	A+	1.46	0.06	9.90	1.39	9.90	1.68
56	666880	2	4943	0.62	0.08	0.12	0.62	0.18	0.00	0.00	0.41	-0.24	-0.27	0.41	-0.11	A+	A+	A+	A+	-0.29	0.06	0.69	1.02	0.95	1.05
57	651332	3	4948	0.72	0.72	0.06	0.14	0.07	0.00	0.00	0.42	0.42	-0.23	-0.26	-0.16	A+	A-	A-	A-	-0.84	0.06	-1.86	0.95	-0.71	0.96
58	651424	3	4948	0.50	0.21	0.09	0.19	0.50	0.00	0.00	0.26	-0.07	-0.16	-0.13	0.26	A+	A-	A+	A-	0.32	0.06	9.15	1.23	7.87	1.31
59	661906	3	4948	0.45	0.45	0.16	0.27	0.12	0.00	0.00	0.37	0.37	-0.22	-0.07	-0.20	A-	A-	A-	A+	0.62	0.06	4.56	1.12	4.55	1.17
60	662599	3	4948	0.55	0.08	0.55	0.24	0.12	0.00	0.00	0.45	-0.17	0.45	-0.22	-0.25	A-	A-	A+	A+	0.06	0.06	-1.51	0.96	-1.46	0.94
61	663642	3	4948	0.56	0.11	0.24	0.56	0.09	0.00	0.00	0.45	-0.24	-0.26	0.45	-0.11	A-	A-	A+	A+	0.04	0.06	0.81	1.02	0.25	1.01
62	663704	3	4948	0.32	0.42	0.14	0.11	0.32	0.00	0.00	0.52	-0.32	-0.12	-0.12	0.52	A+	A-	A+	A+	1.31	0.06	-3.71	0.89	-2.62	0.88
63	664103	3	4948	0.65	0.65	0.12	0.10	0.12	0.00	0.00	0.42	0.42	-0.20	-0.19	-0.23	A-	A-	A+	A-	-0.46	0.06	-1.42	0.96	-0.15	0.99
64	665918	3	4948	0.49	0.17	0.49	0.27	0.07	0.01	0.00	0.36	-0.26	0.36	-0.08	-0.19	A-	A-	A-	A-	0.40	0.06	3.97	1.10	4.29	1.16
65	667245	3	4948	0.49	0.13	0.49	0.19	0.17	0.00	0.00	0.47	-0.23	0.47	-0.14	-0.25	A+	A+	A+	A+	0.38	0.06	-0.35	0.99	-0.54	0.98
66	574507	3	4948	0.67	0.11	0.67	0.10	0.11	0.00	0.00	0.41	-0.14	0.41	-0.27	-0.21	A+	A-	A+	A+	-0.58	0.06	-1.06	0.97	-1.65	0.91

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
67	618740	4	4925	0.49	0.08	0.49	0.22	0.20	0.00	0.00	0.41	-0.23	0.41	-0.26	-0.07	A-	A+	A+	A+	0.36	0.06	1.03	1.02	0.67	1.02
68	624119	4	4925	0.32	0.32	0.35	0.18	0.14	0.00	0.00	0.26	0.26	0.17	-0.30	-0.25	A-	A-	A+	A-	1.31	0.06	5.74	1.18	5.81	1.30
69	629867	4	4925	0.49	0.22	0.14	0.14	0.49	0.00	0.00	0.49	-0.24	-0.19	-0.22	0.49	A-	A+	A-	A-	0.36	0.06	-3.83	0.91	-3.19	0.89
70	661909	4	4925	0.40	0.15	0.40	0.24	0.21	0.00	0.00	0.40	-0.22	0.40	-0.02	-0.26	A-	A-	A-	A+	0.86	0.06	3.13	1.08	4.26	1.17
71	663457	4	4925	0.69	0.07	0.11	0.69	0.12	0.00	0.00	0.46	-0.22	-0.19	0.46	-0.28	A+	A-	A-	A+	-0.67	0.06	-3.30	0.92	-3.28	0.83
72	663490	4	4925	0.37	0.37	0.48	0.09	0.05	0.00	0.00	0.43	0.43	-0.18	-0.25	-0.19	A+	A-	A+	A-	0.99	0.06	0.60	1.02	0.65	1.03
73	664753	4	4925	0.28	0.28	0.18	0.32	0.22	0.00	0.00	0.18	0.18	-0.04	-0.01	-0.13	A-	A-	A+	A+	1.57	0.07	5.37	1.19	6.80	1.42
74	666494	4	4925	0.67	0.09	0.67	0.16	0.07	0.00	0.00	0.51	-0.26	0.51	-0.28	-0.23	A+	A-	A+	A+	-0.60	0.06	-5.65	0.86	-4.61	0.78
75	666496	4	4925	0.53	0.53	0.21	0.17	0.08	0.00	0.00	0.45	0.45	-0.15	-0.26	-0.22	A+	A-	A-	A+	0.17	0.06	1.12	1.03	0.52	1.02
76	666864	4	4925	0.53	0.09	0.20	0.53	0.17	0.00	0.00	0.39	-0.20	-0.16	0.39	-0.18	A+	A+	A+	A+	0.15	0.06	3.54	1.08	2.10	1.08
77	619193	5	4905	0.41	0.32	0.41	0.16	0.10	0.00	0.00	0.35	-0.04	0.35	-0.29	-0.13	A-	A-	A+	A+	0.79	0.06	3.95	1.10	4.64	1.18
78	621920	5	4905	0.54	0.54	0.15	0.22	0.09	0.00	0.00	0.45	0.45	-0.18	-0.24	-0.20	A+	A-	A+	A+	0.14	0.06	-0.56	0.99	-1.08	0.96
79	622274	5	4905	0.39	0.39	0.26	0.12	0.22	0.00	0.00	0.50	0.50	-0.16	-0.24	-0.23	A-	A+	A+	A+	0.88	0.06	-3.37	0.91	-1.55	0.94
80	624117	5	4905	0.34	0.34	0.31	0.16	0.19	0.01	0.00	0.16	0.16	0.05	-0.15	-0.11	A-	A-	A-	A-	1.18	0.06	9.90	1.32	9.27	1.46
81	633810	5	4905	0.31	0.19	0.20	0.30	0.31	0.00	0.00	0.27	-0.18	-0.18	0.05	0.27	A-	A+	A+	A-	1.38	0.06	6.84	1.22	6.95	1.38
82	651333	5	4905	0.52	0.52	0.17	0.10	0.21	0.00	0.00	0.44	0.44	-0.22	-0.22	-0.17	A+	A-	A-	A-	0.21	0.06	-0.55	0.99	-1.29	0.95
83	661911	5	4905	0.58	0.11	0.21	0.58	0.10	0.00	0.00	0.41	-0.15	-0.28	0.41	-0.13	A-	A+	A-	A+	-0.07	0.06	1.40	1.03	0.41	1.02
84	665915	5	4905	0.26	0.30	0.30	0.14	0.26	0.00	0.00	0.07	0.07	0.00	-0.17	0.07	A+	A+	A+	A-	1.70	0.07	9.90	1.39	9.90	1.86
85	666495	5	4905	0.71	0.08	0.07	0.71	0.13	0.01	0.00	0.44	-0.18	-0.22	0.44	-0.25	A+	A+	A+	A+	-0.76	0.06	-3.78	0.90	-4.20	0.77
86	584272	5	4905	0.46	0.09	0.46	0.16	0.28	0.00	0.00	0.31	-0.17	0.31	-0.18	-0.08	A-	A-	A-	A+	0.54	0.06	5.43	1.14	4.73	1.18
87	614822	6	4819	0.33	0.24	0.30	0.12	0.33	0.00	0.00	0.47	-0.22	-0.17	-0.13	0.47	A-	A-	A+	A+	1.28	0.06	-2.72	0.92	-0.50	0.98
88	618958	6	4819	0.73	0.08	0.73	0.11	0.08	0.00	0.00	0.47	-0.25	0.47	-0.24	-0.23	A+	A-	A-	A+	-0.89	0.06	-3.54	0.90	-3.26	0.80
89	662603	6	4819	0.51	0.11	0.12	0.51	0.26	0.00	0.00	0.42	-0.14	-0.22	0.42	-0.20	A-	A+	A+	A+	0.31	0.06	2.72	1.07	1.39	1.05
90	663712	6	4819	0.45	0.37	0.45	0.13	0.05	0.00	0.00	0.26	-0.17	0.26	-0.05	-0.14	A-	A+	A+	A+	0.63	0.06	9.55	1.26	9.35	1.38
91	664101	6	4819	0.60	0.24	0.14	0.60	0.02	0.00	0.00	0.56	-0.38	-0.27	0.56	-0.11	A+	A-	A-	A+	-0.14	0.06	-8.12	0.82	-5.97	0.76
92	665415	6	4819	0.58	0.20	0.58	0.10	0.11	0.00	0.00	0.45	-0.18	0.45	-0.28	-0.19	A+	A+	A-	A+	-0.06	0.06	-0.47	0.99	-0.26	0.99
93	667249	6	4819	0.17	0.53	0.16	0.13	0.17	0.00	0.00	0.12	0.30	-0.29	-0.24	0.12	A-	A-	A-	A-	2.37	0.08	6.22	1.30	9.90	2.15
94	667529	6	4819	0.65	0.65	0.07	0.16	0.11	0.00	0.00	0.51	0.51	-0.23	-0.26	-0.28	A+	A-	A-	A+	-0.45	0.06	-4.87	0.88	-4.20	0.80
95	667536	6	4819	0.58	0.19	0.58	0.12	0.10	0.01	0.00	0.47	-0.23	0.47	-0.24	-0.20	A-	A-	A-	A+	-0.08	0.06	-2.08	0.95	-2.27	0.91
96	566671	6	4819	0.58	0.15	0.58	0.11	0.15	0.00	0.00	0.40	-0.12	0.40	-0.25	-0.21	A-	A-	A-	A+	-0.07	0.06	0.60	1.01	-0.26	0.99
97	629870	7	4855	0.62	0.08	0.14	0.62	0.15	0.00	0.00	0.39	-0.22	-0.22	0.39	-0.14	A-	A-	A-	A+	-0.27	0.06	0.39	1.01	0.77	1.04
98	630392	7	4855	0.08	0.08	0.06	0.09	0.76	0.00	0.00	0.03	0.03	-0.21	-0.21	0.25	B-	A-	A+	A-	3.31	0.10	1.69	1.12	8.73	2.80
99	630394	7	4855	0.37	0.29	0.19	0.37	0.15	0.00	0.00	0.29	-0.14	-0.16	0.29	-0.03	A+	A+	A+	A-	1.03	0.06	5.79	1.16	5.64	1.25

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
100	634334	7	4855	0.48	0.48	0.21	0.16	0.15	0.01	0.00	0.31	0.31	-0.12	-0.20	-0.07	A-	A+	A-	A-	0.46	0.06	6.82	1.17	4.92	1.20
101	663260	7	4855	0.33	0.19	0.23	0.24	0.33	0.00	0.00	0.36	-0.18	-0.19	-0.04	0.36	A+	A-	A-	A+	1.23	0.06	4.48	1.13	6.65	1.33
102	664105	7	4855	0.52	0.12	0.52	0.13	0.23	0.00	0.00	0.47	-0.22	0.47	-0.26	-0.17	A-	A-	A-	A+	0.23	0.06	-1.35	0.97	-0.26	0.99
103	664244	7	4855	0.53	0.08	0.28	0.53	0.11	0.00	0.00	0.53	-0.17	-0.37	0.53	-0.17	A-	A-	A-	A+	0.19	0.06	-4.57	0.90	-3.62	0.86
104	665909	7	4855	0.43	0.11	0.43	0.13	0.33	0.00	0.00	0.24	-0.15	0.24	-0.22	0.01	A+	A-	A+	A+	0.71	0.06	9.90	1.29	9.90	1.44
105	666887	7	4855	0.56	0.14	0.16	0.56	0.13	0.00	0.00	0.49	-0.30	-0.20	0.49	-0.19	A-	A-	A-	A+	0.03	0.06	-1.92	0.96	-1.65	0.93
106	667532	7	4855	0.36	0.31	0.10	0.36	0.23	0.00	0.00	0.26	-0.04	-0.19	0.26	-0.11	A-	A-	A+	A+	1.08	0.06	7.07	1.20	7.26	1.34
107	635793	8	4849	0.57	0.08	0.06	0.27	0.57	0.00	0.00	0.47	-0.28	-0.24	-0.21	0.47	A-	A+	A+	A+	-0.03	0.06	-1.71	0.96	-0.88	0.96
108	662602	8	4849	0.39	0.39	0.31	0.12	0.18	0.00	0.00	0.45	0.45	-0.08	-0.25	-0.24	A+	A-	A-	A-	0.93	0.06	0.24	1.01	1.24	1.05
109	663262	8	4849	0.63	0.07	0.63	0.08	0.22	0.00	0.00	0.43	-0.10	0.43	-0.21	-0.29	A-	A+	A+	A+	-0.31	0.06	0.05	1.00	-0.61	0.97
110	664133	8	4849	0.57	0.12	0.57	0.15	0.15	0.00	0.00	0.44	-0.23	0.44	-0.22	-0.16	A+	A+	A+	A+	-0.02	0.06	-0.55	0.99	-1.30	0.95
111	665911	8	4849	0.83	0.04	0.06	0.83	0.07	0.00	0.00	0.38	-0.19	-0.22	0.38	-0.20	A+	A+	A+	A+	-1.62	0.07	-1.98	0.92	-1.30	0.88
112	666488	8	4849	0.34	0.24	0.24	0.18	0.34	0.00	0.00	0.40	-0.16	-0.30	0.03	0.40	A-	A+	A+	A+	1.20	0.06	0.61	1.02	1.70	1.08
113	666492	8	4849	0.52	0.52	0.12	0.26	0.09	0.00	0.00	0.55	0.55	-0.25	-0.28	-0.24	A-	A+	A+	A-	0.24	0.06	-4.81	0.89	-4.65	0.83
114	666493	8	4849	0.68	0.10	0.12	0.68	0.09	0.00	0.00	0.22	-0.20	-0.03	0.22	-0.09	A+	A-	A+	A+	-0.62	0.06	6.54	1.19	7.45	1.48
115	705652	8	4849	0.48	0.17	0.23	0.48	0.12	0.00	0.00	0.40	-0.19	-0.27	0.40	-0.05	A-	A-	A+	A+	0.44	0.06	3.43	1.09	2.82	1.11
116	569281	8	4849	0.26	0.26	0.26	0.30	0.17	0.00	0.00	0.05	-0.07	0.05	0.02	0.01	A+	A+	A+	A-	1.69	0.07	9.90	1.38	9.90	1.77
117	621615	9	4916	0.52	0.07	0.25	0.52	0.16	0.00	0.00	0.36	-0.17	-0.22	0.36	-0.10	A-	A-	A+	A+	0.22	0.06	1.88	1.04	1.42	1.06
118	621628	9	4916	0.38	0.29	0.38	0.21	0.12	0.00	0.00	0.41	-0.11	0.41	-0.23	-0.16	A+	A-	A-	A+	0.96	0.06	2.66	1.07	2.21	1.09
119	629864	9	4916	0.49	0.17	0.18	0.16	0.49	0.00	0.00	0.50	-0.27	-0.26	-0.13	0.50	A+	A-	A-	A+	0.39	0.06	-3.06	0.93	-2.32	0.91
120	633236	9	4916	0.56	0.08	0.23	0.12	0.56	0.00	0.00	0.47	-0.25	-0.22	-0.20	0.47	A+	A+	A-	A+	0.02	0.06	-2.23	0.95	-2.22	0.91
121	651421	9	4916	0.57	0.57	0.17	0.15	0.11	0.01	0.00	0.48	0.48	-0.27	-0.16	-0.24	A+	A+	A+	A+	-0.03	0.06	-4.43	0.90	-3.60	0.85
122	663259	9	4916	0.59	0.16	0.16	0.59	0.09	0.00	0.00	0.40	-0.23	-0.14	0.40	-0.21	A-	A-	A-	A+	-0.11	0.06	0.76	1.02	-0.12	0.99
123	665917	9	4916	0.51	0.10	0.29	0.51	0.09	0.00	0.00	0.39	-0.06	-0.29	0.39	-0.14	A-	A-	A+	A+	0.28	0.06	3.84	1.09	2.56	1.10
124	667537	9	4916	0.66	0.12	0.12	0.11	0.66	0.00	0.00	0.44	-0.14	-0.26	-0.26	0.44	A-	A-	A-	A+	-0.48	0.06	-2.82	0.93	2.04	1.11
125	668407	9	4916	0.73	0.73	0.09	0.09	0.08	0.00	0.00	0.44	0.44	-0.22	-0.25	-0.21	A-	A+	A+	A+	-0.93	0.06	-2.85	0.92	-1.78	0.89
126	574496	9	4916	0.42	0.19	0.24	0.42	0.14	0.00	0.00	0.38	-0.13	-0.24	0.38	-0.09	B-	A-	A-	A+	0.74	0.06	2.42	1.06	2.43	1.10
127	618117	10	4922	0.43	0.43	0.39	0.12	0.07	0.00	0.00	0.46	0.46	-0.27	-0.17	-0.18	A+	A-	A-	A+	0.72	0.06	-1.42	0.96	-1.69	0.94
128	621620	10	4922	0.30	0.49	0.13	0.30	0.08	0.00	0.00	0.07	0.17	-0.18	0.07	-0.21	A+	A-	A+	A-	1.43	0.06	9.90	1.41	9.90	1.70
129	629872	10	4922	0.57	0.20	0.06	0.16	0.57	0.00	0.00	0.38	-0.27	-0.16	-0.10	0.38	A-	A-	A+	A+	-0.02	0.06	2.78	1.07	0.77	1.03
130	651417	10	4922	0.57	0.04	0.57	0.30	0.09	0.00	0.00	0.42	-0.16	0.42	-0.24	-0.24	A-	A-	A-	A+	-0.02	0.06	0.60	1.01	1.50	1.07
131	663265	10	4922	0.52	0.28	0.05	0.15	0.52	0.00	0.00	0.51	-0.27	-0.14	-0.28	0.51	A+	A-	A+	A+	0.25	0.06	-2.26	0.95	-2.28	0.91
132	663494	10	4922	0.21	0.24	0.41	0.14	0.21	0.00	0.00	0.15	-0.22	0.19	-0.18	0.15	A+	A-	A+	A-	2.04	0.07	5.38	1.21	8.16	1.66

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
133	664134	10	4922	0.59	0.08	0.59	0.18	0.15	0.01	0.00	0.46	-0.17	0.46	-0.36	-0.12	A+	A-	A-	A+	-0.09	0.06	-2.05	0.95	-1.83	0.92
134	664757	10	4922	0.55	0.55	0.08	0.27	0.09	0.00	0.00	0.35	0.35	-0.17	-0.13	-0.23	A-	A+	A+	A+	0.09	0.06	5.28	1.13	4.15	1.18
135	584270	10	4922	0.45	0.10	0.45	0.15	0.30	0.00	0.00	0.28	-0.19	0.28	-0.25	0.02	A+	A-	A+	A+	0.61	0.06	7.34	1.19	6.16	1.24
136	584397	10	4922	0.39	0.06	0.17	0.39	0.37	0.01	0.00	0.46	-0.08	-0.19	0.46	-0.27	A-	A-	A+	A-	0.90	0.06	-1.57	0.96	-0.46	0.98
137	633231	11	4843	0.39	0.39	0.25	0.23	0.13	0.00	0.00	0.43	0.43	-0.18	-0.15	-0.21	A-	A-	A-	A+	0.91	0.06	0.17	1.00	1.35	1.05
138	633815	11	4843	0.55	0.14	0.16	0.55	0.15	0.00	0.00	0.42	-0.18	-0.21	0.42	-0.19	A+	A-	A+	A+	0.09	0.06	-0.74	0.98	-1.35	0.95
139	663460	11	4843	0.31	0.30	0.15	0.24	0.31	0.00	0.00	0.41	-0.23	-0.09	-0.10	0.41	A-	A+	A+	A+	1.39	0.06	0.14	1.00	1.46	1.07
140	664109	11	4843	0.59	0.59	0.10	0.22	0.09	0.00	0.00	0.53	0.53	-0.20	-0.31	-0.23	A-	A+	A+	A-	-0.12	0.06	-5.64	0.87	-5.00	0.80
141	664111	11	4843	0.28	0.21	0.37	0.28	0.13	0.01	0.00	0.24	-0.08	-0.08	0.24	-0.10	A-	A-	A-	A-	1.56	0.07	5.93	1.21	7.56	1.47
142	664126	11	4843	0.24	0.08	0.49	0.18	0.24	0.00	0.00	0.24	-0.12	0.07	-0.27	0.24	A+	A-	A-	A-	1.80	0.07	5.65	1.22	7.61	1.56
143	664239	11	4843	0.35	0.35	0.14	0.34	0.17	0.00	0.00	0.50	0.50	-0.15	-0.20	-0.22	A+	B+	A+	A+	1.16	0.06	-1.71	0.95	-0.78	0.97
144	664749	11	4843	0.30	0.28	0.18	0.23	0.30	0.00	0.00	0.30	-0.10	-0.11	-0.11	0.30	A+	A-	A+	A-	1.42	0.06	6.16	1.21	7.52	1.43
145	667241	11	4843	0.44	0.17	0.44	0.31	0.08	0.00	0.00	0.42	-0.20	0.42	-0.15	-0.22	A-	A+	A+	A+	0.65	0.06	1.58	1.04	1.55	1.06
146	566670	11	4843	0.11	0.09	0.60	0.11	0.20	0.00	0.00	0.12	0.00	0.04	0.12	-0.14	A-	A-	A-	A-	2.97	0.09	1.98	1.13	8.15	2.35
147	613766	12	4927	0.24	0.24	0.19	0.36	0.21	0.00	0.00	0.27	0.27	-0.25	0.17	-0.25	A-	A-	A-	A-	1.79	0.07	5.92	1.23	7.85	1.58
148	635938	12	4927	0.68	0.20	0.06	0.68	0.06	0.00	0.00	0.48	-0.29	-0.22	0.48	-0.23	A+	A-	A-	A+	-0.60	0.06	-3.20	0.92	-3.65	0.81
149	663269	12	4927	0.55	0.15	0.55	0.19	0.10	0.00	0.00	0.44	-0.23	0.44	-0.16	-0.22	A+	A-	A-	A+	0.09	0.06	0.63	1.02	0.51	1.02
150	663454	12	4927	0.42	0.42	0.12	0.30	0.16	0.00	0.00	0.37	0.37	-0.14	-0.19	-0.13	A+	A-	A+	A+	0.75	0.06	2.04	1.05	1.96	1.08
151	663493	12	4927	0.49	0.15	0.15	0.20	0.49	0.01	0.00	0.53	-0.26	-0.25	-0.20	0.53	A-	A+	A+	A+	0.39	0.06	-3.70	0.91	-3.14	0.89
152	664243	12	4927	0.39	0.43	0.08	0.39	0.09	0.01	0.00	0.30	-0.06	-0.22	0.30	-0.19	A-	A-	A+	A+	0.91	0.06	7.59	1.22	7.57	1.34
153	665577	12	4927	0.70	0.10	0.09	0.11	0.70	0.00	0.00	0.46	-0.21	-0.26	-0.23	0.46	A-	A-	A-	A+	-0.73	0.06	-4.25	0.89	-2.57	0.86
154	665947	12	4927	0.26	0.31	0.29	0.26	0.14	0.00	0.00	0.05	0.20	-0.16	0.05	-0.12	A-	A+	A+	A+	1.67	0.07	9.90	1.44	9.90	2.04
155	667247	12	4927	0.33	0.25	0.24	0.18	0.33	0.00	0.00	0.39	-0.12	-0.18	-0.14	0.39	A-	A-	A-	A+	1.26	0.06	2.21	1.07	3.72	1.19
156	584067	12	4927	0.25	0.25	0.18	0.33	0.24	0.00	0.00	0.18	0.18	-0.05	-0.06	-0.06	A+	A-	A-	A-	1.73	0.07	6.18	1.23	8.69	1.63
157	618110	13	4915	0.45	0.21	0.07	0.45	0.26	0.00	0.00	0.46	-0.29	-0.21	0.46	-0.12	B-	A-	A-	A+	0.57	0.06	0.62	1.01	1.34	1.05
158	624124	13	4915	0.39	0.13	0.39	0.27	0.22	0.00	0.00	0.20	-0.14	0.20	-0.08	-0.02	A+	A+	A+	A+	0.92	0.06	9.06	1.26	8.23	1.35
159	651420	13	4915	0.49	0.49	0.15	0.26	0.09	0.00	0.00	0.47	0.47	-0.15	-0.25	-0.23	A-	A-	A+	A-	0.36	0.06	-2.79	0.94	-1.81	0.94
160	661910	13	4915	0.76	0.76	0.04	0.10	0.10	0.00	0.00	0.50	0.50	-0.20	-0.30	-0.27	A-	A-	A-	A-	-1.10	0.07	-5.35	0.84	-5.07	0.68
161	663261	13	4915	0.66	0.66	0.11	0.16	0.08	0.00	0.00	0.50	0.50	-0.23	-0.26	-0.26	A+	A+	A-	A+	-0.47	0.06	-5.02	0.88	-4.18	0.81
162	663455	13	4915	0.32	0.14	0.33	0.32	0.21	0.00	0.00	0.30	-0.07	0.03	0.30	-0.31	A+	A-	A-	A-	1.30	0.06	5.40	1.17	7.93	1.42
163	663463	13	4915	0.31	0.27	0.31	0.22	0.20	0.00	0.00	0.17	-0.14	0.17	-0.02	-0.02	A-	A-	A-	A+	1.32	0.06	8.92	1.29	9.53	1.52
164	663501	13	4915	0.22	0.13	0.22	0.58	0.07	0.00	0.00	-0.03	-0.21	-0.03	0.24	-0.14	A-	A+	A+	A+	1.95	0.07	9.90	1.50	9.90	2.29
165	665914	13	4915	0.37	0.25	0.19	0.37	0.19	0.00	0.00	0.35	-0.20	-0.27	0.35	0.07	A+	A-	A-	A+	1.01	0.06	2.70	1.07	3.99	1.17

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
166	667244	13	4915	0.71	0.08	0.06	0.71	0.15	0.00	0.00	0.29	-0.18	-0.21	0.29	-0.09	A-	A-	A-	A+	-0.77	0.06	2.50	1.07	4.34	1.27
167	623497	14	4936	0.55	0.10	0.26	0.55	0.08	0.00	0.00	0.50	-0.23	-0.27	0.50	-0.20	A-	A+	A+	A+	0.03	0.06	-3.07	0.93	-3.93	0.86
168	661907	14	4936	0.45	0.19	0.14	0.45	0.22	0.00	0.00	0.36	-0.14	-0.24	0.36	-0.10	A-	A+	A-	A+	0.58	0.06	3.49	1.09	3.82	1.14
169	662604	14	4936	0.41	0.19	0.23	0.18	0.41	0.00	0.00	0.50	-0.21	-0.15	-0.26	0.50	A-	A-	A+	A+	0.79	0.06	-2.01	0.95	-0.52	0.98
170	663458	14	4936	0.52	0.10	0.21	0.17	0.52	0.00	0.00	0.38	-0.16	-0.16	-0.20	0.38	A-	A-	A-	A+	0.20	0.06	2.31	1.05	1.80	1.06
171	663707	14	4936	0.82	0.10	0.82	0.04	0.04	0.00	0.00	0.36	-0.21	0.36	-0.19	-0.20	A+	A+	A-	A+	-1.56	0.07	-1.96	0.92	-1.04	0.91
172	664110	14	4936	0.49	0.19	0.18	0.49	0.14	0.00	0.00	0.34	-0.18	-0.27	0.34	0.02	A-	A+	A+	A+	0.36	0.06	4.47	1.11	4.81	1.18
173	664234	14	4936	0.64	0.11	0.64	0.11	0.13	0.00	0.00	0.53	-0.25	0.53	-0.22	-0.31	A+	A-	A-	A+	-0.43	0.06	-5.26	0.88	-3.40	0.85
174	665421	14	4936	0.23	0.11	0.27	0.23	0.39	0.00	0.00	0.08	-0.11	0.21	0.08	-0.19	A-	A-	A+	A-	1.88	0.07	9.90	1.43	9.90	1.99
175	665984	14	4936	0.54	0.23	0.09	0.54	0.13	0.00	0.00	0.43	-0.20	-0.23	0.43	-0.18	A+	A+	A+	A+	0.08	0.06	0.08	1.00	-0.66	0.98
176	667527	14	4936	0.49	0.15	0.49	0.22	0.14	0.00	0.00	0.43	-0.12	0.43	-0.25	-0.17	A+	A-	A+	A+	0.38	0.06	0.82	1.02	0.71	1.02
177	624279	15	4823	0.56	0.15	0.56	0.18	0.11	0.00	0.00	0.49	-0.28	0.49	-0.20	-0.21	A+	A+	A-	A+	0.04	0.06	-2.47	0.94	-2.18	0.92
178	634333	15	4823	0.50	0.07	0.08	0.35	0.50	0.00	0.00	0.29	-0.17	-0.23	-0.08	0.29	A+	A-	A-	A+	0.30	0.06	7.06	1.18	7.80	1.30
179	651336	15	4823	0.61	0.61	0.12	0.14	0.13	0.01	0.00	0.43	0.43	-0.19	-0.28	-0.13	A-	A-	A-	A-	-0.23	0.06	1.80	1.04	1.94	1.09
180	651423	15	4823	0.33	0.40	0.09	0.17	0.33	0.00	0.00	0.35	-0.18	-0.20	-0.05	0.35	A-	A+	A-	A+	1.24	0.06	1.96	1.06	3.22	1.15
181	661912	15	4823	0.32	0.32	0.32	0.11	0.24	0.00	0.00	-0.10	0.06	-0.10	-0.13	0.14	A+	A+	A+	A+	1.26	0.06	9.90	1.64	9.90	2.02
182	663708	15	4823	0.57	0.21	0.08	0.57	0.13	0.00	0.00	0.37	-0.12	-0.24	0.37	-0.19	A+	A+	A+	A+	-0.04	0.06	1.77	1.04	1.55	1.06
183	664102	15	4823	0.69	0.11	0.13	0.07	0.69	0.00	0.00	0.53	-0.21	-0.34	-0.25	0.53	A+	A-	A+	A-	-0.68	0.06	-7.15	0.82	-4.98	0.75
184	666489	15	4823	0.38	0.38	0.13	0.28	0.19	0.01	0.00	0.43	0.43	-0.22	-0.10	-0.21	A+	A-	A-	A+	0.93	0.06	0.53	1.01	2.36	1.09
185	666865	15	4823	0.47	0.47	0.12	0.23	0.17	0.00	0.00	0.44	0.44	-0.22	-0.18	-0.18	A-	A+	A-	A+	0.45	0.06	-0.18	1.00	0.50	1.02
186	667240	15	4823	0.59	0.15	0.59	0.17	0.08	0.00	0.00	0.54	-0.26	0.54	-0.28	-0.23	A+	A+	A+	A+	-0.15	0.06	-6.61	0.85	-6.10	0.77
187	630387	16	4850	0.47	0.16	0.23	0.47	0.14	0.01	0.00	0.36	-0.19	-0.09	0.36	-0.21	A+	A+	A+	A-	0.49	0.06	3.88	1.10	3.13	1.11
188	633063	16	4850	0.40	0.40	0.50	0.06	0.04	0.00	0.00	0.50	0.50	-0.29	-0.24	-0.21	A-	A-	A-	A-	0.83	0.06	-2.95	0.93	-2.89	0.90
189	633237	16	4850	0.48	0.13	0.29	0.10	0.48	0.00	0.00	0.38	-0.29	-0.02	-0.27	0.38	A-	A-	A+	A-	0.45	0.06	3.17	1.08	2.30	1.08
190	633811	16	4850	0.10	0.32	0.37	0.21	0.10	0.00	0.00	-0.14	-0.16	0.38	-0.16	-0.14	A-	A+	A-	B-	3.03	0.09	7.92	1.59	9.90	4.12
191	651419	16	4850	0.39	0.37	0.39	0.16	0.07	0.00	0.00	0.37	-0.10	0.37	-0.27	-0.12	A-	A-	A+	A+	0.92	0.06	3.52	1.10	3.47	1.14
192	664754	16	4850	0.33	0.15	0.33	0.25	0.27	0.00	0.00	0.27	-0.14	0.27	-0.16	-0.01	A-	A+	A-	A+	1.26	0.06	7.39	1.23	8.49	1.43
193	665470	16	4850	0.46	0.46	0.18	0.23	0.12	0.00	0.00	0.42	0.42	-0.20	-0.11	-0.25	A-	A-	A+	A+	0.54	0.06	0.44	1.01	0.35	1.01
194	667246	16	4850	0.52	0.09	0.21	0.18	0.52	0.00	0.00	0.33	-0.14	-0.14	-0.17	0.33	A+	A-	A-	A-	0.22	0.06	4.44	1.11	3.78	1.14
195	667248	16	4850	0.43	0.07	0.41	0.43	0.07	0.00	0.00	0.34	-0.15	-0.18	0.34	-0.15	A-	A-	A-	A+	0.67	0.06	5.50	1.14	5.11	1.19
196	582444	16	4850	0.43	0.43	0.07	0.28	0.22	0.00	0.00	0.33	0.33	-0.09	-0.17	-0.15	A-	A+	A-	A+	0.72	0.06	4.98	1.13	4.11	1.15
197	613764	17	4863	0.46	0.46	0.14	0.16	0.23	0.00	0.00	0.33	0.33	-0.25	-0.16	-0.04	A+	A-	A-	A+	0.53	0.06	6.62	1.17	5.91	1.23
198	629873	17	4863	0.48	0.19	0.48	0.16	0.17	0.01	0.00	0.26	-0.07	0.26	-0.10	-0.16	A+	A+	A+	A+	0.47	0.06	8.88	1.23	8.08	1.32

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
199	630391	17	4863	0.61	0.16	0.09	0.61	0.13	0.01	0.00	0.43	-0.18	-0.26	0.43	-0.19	A+	A+	A+	A+	-0.23	0.06	-1.43	0.97	-0.49	0.98
200	633061	17	4863	0.39	0.13	0.22	0.39	0.26	0.00	0.00	0.30	-0.12	-0.21	0.30	-0.03	A+	A+	A+	A+	0.94	0.06	5.96	1.17	6.65	1.29
201	651329	17	4863	0.47	0.24	0.47	0.21	0.08	0.00	0.00	0.23	-0.03	0.23	-0.14	-0.17	A-	A+	A+	A+	0.49	0.06	8.57	1.22	8.59	1.34
202	651331	17	4863	0.28	0.36	0.21	0.14	0.28	0.00	0.00	0.52	-0.28	-0.13	-0.13	0.52	B-	A-	A-	A+	1.53	0.07	-3.16	0.90	-2.22	0.89
203	663462	17	4863	0.39	0.39	0.22	0.26	0.12	0.00	0.00	0.30	0.30	0.04	-0.21	-0.20	A-	A-	A-	A+	0.90	0.06	7.74	1.22	7.03	1.30
204	664240	17	4863	0.67	0.07	0.11	0.15	0.67	0.00	0.00	0.56	-0.23	-0.28	-0.32	0.56	A+	A-	A-	A-	-0.54	0.06	-8.85	0.79	-7.27	0.66
205	665981	17	4863	0.33	0.33	0.27	0.21	0.19	0.00	0.00	0.23	0.23	-0.09	-0.09	-0.08	A+	A+	A+	A-	1.27	0.06	8.19	1.27	7.80	1.40
206	667242	17	4863	0.66	0.10	0.06	0.66	0.18	0.00	0.00	0.44	-0.12	-0.23	0.44	-0.30	A+	A+	A-	A-	-0.52	0.06	-2.87	0.93	-1.89	0.90
207	618124	18	4904	0.54	0.19	0.14	0.12	0.54	0.01	0.00	0.38	-0.17	-0.14	-0.22	0.38	A+	A-	A-	A+	0.07	0.06	4.24	1.11	2.83	1.12
208	624282	18	4904	0.64	0.64	0.19	0.08	0.08	0.00	0.00	0.51	0.51	-0.31	-0.25	-0.20	A-	A-	A-	A+	-0.45	0.06	-4.91	0.88	-3.78	0.82
209	635937	18	4904	0.51	0.17	0.51	0.18	0.14	0.00	0.00	0.52	-0.17	0.52	-0.26	-0.27	A+	A+	A+	A+	0.28	0.06	-3.81	0.91	-3.41	0.87
210	663500	18	4904	0.59	0.10	0.10	0.20	0.59	0.00	0.00	0.56	-0.24	-0.30	-0.27	0.56	A+	A+	A-	A-	-0.16	0.06	-6.59	0.85	-5.49	0.77
211	665578	18	4904	0.76	0.10	0.76	0.07	0.06	0.00	0.00	0.44	-0.22	0.44	-0.25	-0.20	A-	A-	A-	A+	-1.14	0.07	-1.50	0.95	-1.69	0.88
212	665983	18	4904	0.78	0.03	0.13	0.05	0.78	0.00	0.00	0.29	-0.19	-0.10	-0.23	0.29	A+	A+	A+	A-	-1.30	0.07	0.08	1.00	2.33	1.20
213	665989	18	4904	0.64	0.10	0.10	0.64	0.14	0.01	0.00	0.57	-0.22	-0.30	0.57	-0.32	A+	A+	A-	A+	-0.45	0.06	-9.07	0.78	-6.58	0.69
214	667530	18	4904	0.67	0.10	0.67	0.11	0.12	0.00	0.00	0.47	-0.20	0.47	-0.30	-0.20	A+	A-	A-	A+	-0.57	0.06	-3.73	0.90	-2.92	0.85
215	569309	18	4904	0.33	0.33	0.28	0.24	0.15	0.00	0.00	0.27	0.27	-0.07	-0.09	-0.14	A+	A-	A+	A+	1.23	0.06	5.63	1.17	6.80	1.35
216	583353	18	4904	0.31	0.31	0.36	0.17	0.16	0.00	0.00	0.34	0.34	-0.28	-0.04	0.00	A-	A-	A-	A+	1.38	0.06	5.17	1.17	6.80	1.38
217	633059	19	4902	0.46	0.46	0.09	0.32	0.14	0.00	0.00	0.49	0.49	-0.22	-0.24	-0.20	A-	A+	A+	A-	0.54	0.06	-1.63	0.96	-0.98	0.97
218	651326	19	4902	0.21	0.21	0.52	0.10	0.17	0.00	0.00	0.23	0.23	0.14	-0.26	-0.22	A-	A-	A-	A-	2.00	0.07	3.20	1.13	6.12	1.50
219	651335	19	4902	0.38	0.17	0.38	0.29	0.16	0.00	0.00	0.39	-0.20	0.39	-0.13	-0.14	A+	A-	A-	A+	0.96	0.06	3.88	1.11	4.80	1.20
220	662598	19	4902	0.71	0.71	0.12	0.11	0.06	0.00	0.00	0.49	0.49	-0.28	-0.23	-0.24	A+	A+	A+	A-	-0.79	0.06	-3.02	0.92	-2.99	0.84
221	663263	19	4902	0.57	0.15	0.13	0.57	0.15	0.00	0.00	0.36	-0.18	-0.13	0.36	-0.19	A+	A+	A-	A+	-0.02	0.06	5.74	1.14	3.74	1.15
222	663461	19	4902	0.41	0.13	0.41	0.15	0.30	0.00	0.00	0.28	-0.20	0.28	-0.19	0.00	A-	A-	A+	A-	0.78	0.06	6.93	1.19	7.58	1.31
223	663491	19	4902	0.23	0.25	0.26	0.26	0.23	0.00	0.00	0.29	-0.08	-0.11	-0.07	0.29	A-	A-	A+	A-	1.89	0.07	1.87	1.07	4.36	1.32
224	663711	19	4902	0.73	0.05	0.73	0.16	0.06	0.01	0.00	0.52	-0.22	0.52	-0.35	-0.23	A+	A+	A-	A+	-0.92	0.06	-6.85	0.81	-6.33	0.66
225	665985	19	4902	0.51	0.10	0.20	0.20	0.51	0.01	0.00	0.45	-0.22	-0.16	-0.24	0.45	A-	A-	A-	A+	0.29	0.06	0.12	1.00	-0.39	0.99
226	577987	19	4902	0.58	0.58	0.16	0.17	0.09	0.00	0.00	0.55	0.55	-0.26	-0.28	-0.23	A-	A+	A+	A-	-0.08	0.06	-6.93	0.84	-6.30	0.77
227	622281	20	4832	0.63	0.05	0.63	0.13	0.18	0.00	0.00	0.45	-0.18	0.45	-0.17	-0.30	A+	A-	A-	A+	-0.38	0.06	-3.10	0.92	-0.61	0.97
228	635797	20	4832	0.39	0.17	0.39	0.23	0.20	0.00	0.00	0.20	-0.12	0.20	-0.06	-0.06	A-	A-	A-	A+	0.89	0.06	9.90	1.31	9.90	1.48
229	651416	20	4832	0.48	0.25	0.20	0.48	0.07	0.00	0.00	0.37	-0.17	-0.17	0.37	-0.15	A+	A+	A+	A-	0.43	0.06	4.36	1.11	3.66	1.14
230	662605	20	4832	0.46	0.46	0.22	0.24	0.08	0.00	0.00	0.50	0.50	-0.32	-0.22	-0.07	A-	A-	A-	A+	0.53	0.06	-2.40	0.94	-1.73	0.94
231	663706	20	4832	0.72	0.09	0.72	0.09	0.10	0.00	0.00	0.44	-0.19	0.44	-0.27	-0.21	A+	A-	A-	A+	-0.86	0.06	-2.91	0.92	-2.94	0.82

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
232	664755	20	4832	0.21	0.07	0.18	0.21	0.53	0.00	0.00	0.21	-0.15	-0.21	0.21	0.08	A-	A-	A-	A-	2.02	0.07	4.36	1.18	7.40	1.62
233	665987	20	4832	0.37	0.26	0.21	0.16	0.37	0.00	0.00	0.45	-0.24	-0.07	-0.22	0.45	A+	A-	A+	A+	1.03	0.06	-0.14	1.00	1.24	1.05
234	704216	20	4832	0.67	0.07	0.15	0.11	0.67	0.00	0.00	0.45	-0.21	-0.24	-0.22	0.45	A+	A-	A-	A-	-0.57	0.06	-2.83	0.93	-0.47	0.97
235	577160	20	4832	0.26	0.26	0.11	0.29	0.34	0.00	0.00	0.42	0.42	-0.14	-0.10	-0.19	A-	A-	A+	A+	1.66	0.07	-0.89	0.97	2.74	1.16
236	579400	20	4832	0.49	0.22	0.16	0.13	0.49	0.00	0.00	0.47	-0.19	-0.19	-0.24	0.47	A+	A+	A+	A+	0.37	0.06	-1.32	0.97	-1.79	0.93
237	614774	21	4866	0.26	0.09	0.21	0.44	0.26	0.00	0.00	0.32	-0.09	0.02	-0.24	0.32	A-	A+	A-	A+	1.62	0.07	2.73	1.09	3.29	1.19
238	614787	21	4866	0.34	0.18	0.18	0.29	0.34	0.00	0.00	0.28	-0.24	-0.16	0.06	0.28	A-	A-	A+	A+	1.14	0.06	7.73	1.23	7.36	1.34
239	630386	21	4866	0.43	0.43	0.14	0.28	0.14	0.00	0.00	0.40	0.40	-0.18	-0.13	-0.21	A+	A+	A-	A+	0.65	0.06	2.89	1.07	2.65	1.10
240	661903	21	4866	0.69	0.08	0.69	0.15	0.08	0.00	0.00	0.45	-0.15	0.45	-0.29	-0.24	A+	A-	A-	A+	-0.69	0.06	-3.40	0.91	-3.13	0.83
241	664130	21	4866	0.50	0.33	0.10	0.07	0.50	0.00	0.00	0.58	-0.39	-0.23	-0.14	0.58	A-	A-	A+	A+	0.31	0.06	-6.82	0.85	-5.91	0.81
242	664132	21	4866	0.75	0.04	0.13	0.75	0.09	0.00	0.00	0.32	-0.14	-0.18	0.32	-0.17	A-	A-	A-	A+	-1.03	0.07	0.55	1.02	0.31	1.02
243	666490	21	4866	0.70	0.14	0.70	0.07	0.09	0.00	0.00	0.39	-0.15	0.39	-0.24	-0.23	A-	A+	A-	A+	-0.74	0.06	-1.25	0.97	-0.75	0.96
244	667250	21	4866	0.44	0.23	0.44	0.19	0.13	0.00	0.00	0.10	0.03	0.10	-0.01	-0.15	A-	A-	A-	A+	0.62	0.06	9.90	1.42	9.90	1.56
245	667528	21	4866	0.53	0.14	0.15	0.53	0.17	0.00	0.00	0.41	-0.20	-0.14	0.41	-0.21	A+	A-	A+	A+	0.18	0.06	1.82	1.04	2.03	1.08
246	667535	21	4866	0.48	0.13	0.07	0.31	0.48	0.00	0.00	0.16	-0.10	-0.19	0.02	0.16	A+	A+	A+	A-	0.41	0.06	9.90	1.33	9.90	1.41
247	624558	22	4849	0.50	0.22	0.16	0.50	0.12	0.00	0.00	0.50	-0.19	-0.28	0.50	-0.21	A+	A+	A-	A+	0.33	0.06	-3.22	0.92	-3.18	0.89
248	651425	22	4849	0.42	0.28	0.42	0.11	0.18	0.00	0.00	0.36	-0.16	0.36	-0.15	-0.14	A+	A-	A+	A+	0.72	0.06	4.40	1.12	3.73	1.15
249	662596	22	4849	0.34	0.20	0.27	0.34	0.18	0.00	0.00	0.22	-0.13	-0.02	0.22	-0.11	A-	A+	A+	A+	1.16	0.06	8.79	1.28	9.07	1.46
250	663459	22	4849	0.57	0.15	0.12	0.57	0.16	0.00	0.00	0.35	-0.13	-0.19	0.35	-0.17	A+	A+	A-	A+	-0.06	0.06	1.94	1.05	2.11	1.09
251	663495	22	4849	0.62	0.19	0.06	0.62	0.12	0.00	0.00	0.50	-0.25	-0.22	0.50	-0.26	A-	A+	A-	A+	-0.32	0.06	-3.56	0.92	-3.55	0.84
252	664236	22	4849	0.51	0.13	0.18	0.18	0.51	0.00	0.00	0.56	-0.28	-0.27	-0.21	0.56	A+	A-	A+	A-	0.28	0.06	-6.51	0.85	-5.45	0.81
253	665414	22	4849	0.40	0.40	0.23	0.21	0.15	0.00	0.00	0.37	0.37	-0.14	-0.12	-0.21	A-	A-	A+	A+	0.82	0.06	4.24	1.12	4.31	1.18
254	665980	22	4849	0.36	0.19	0.18	0.36	0.26	0.00	0.00	0.27	-0.15	-0.01	0.27	-0.14	A+	A-	A-	A+	1.04	0.06	9.15	1.29	9.68	1.47
255	666886	22	4849	0.27	0.07	0.28	0.38	0.27	0.00	0.00	0.26	-0.08	-0.25	0.05	0.26	A-	A-	A-	A+	1.62	0.07	6.94	1.26	8.55	1.57
256	587126	22	4849	0.54	0.54	0.19	0.17	0.11	0.00	0.00	0.52	0.52	-0.20	-0.34	-0.16	A-	A-	A-	A-	0.13	0.06	-4.01	0.91	-3.03	0.89
257	622280	23	4917	0.47	0.24	0.47	0.19	0.09	0.01	0.00	0.37	-0.11	0.37	-0.20	-0.18	A-	A-	A-	A+	0.43	0.06	2.85	1.07	2.26	1.08
258	622282	23	4917	0.72	0.72	0.11	0.08	0.08	0.00	0.00	0.47	0.47	-0.24	-0.26	-0.23	A+	A+	A+	A+	-0.91	0.06	-5.14	0.86	-2.98	0.83
259	623493	23	4917	0.12	0.44	0.08	0.37	0.12	0.00	0.00	-0.03	0.05	-0.15	0.05	-0.03	A-	A+	A+	A-	2.83	0.09	4.57	1.29	9.90	2.95
260	630388	23	4917	0.38	0.20	0.18	0.23	0.38	0.00	0.00	0.39	-0.18	-0.16	-0.12	0.39	A-	A-	A-	A-	0.91	0.06	1.07	1.03	0.92	1.04
261	663498	23	4917	0.58	0.58	0.11	0.11	0.20	0.00	0.00	0.46	0.46	-0.24	-0.31	-0.14	A+	A-	A-	A-	-0.12	0.06	-2.95	0.93	-1.06	0.96
262	664238	23	4917	0.61	0.17	0.07	0.61	0.14	0.00	0.00	0.34	-0.08	-0.24	0.34	-0.21	A-	A+	A+	A-	-0.29	0.06	2.74	1.07	2.77	1.12
263	665416	23	4917	0.27	0.29	0.27	0.27	0.17	0.00	0.00	0.18	0.11	0.18	-0.16	-0.15	A-	A+	A+	A+	1.58	0.07	8.31	1.30	9.32	1.61
264	567159	23	4917	0.34	0.34	0.24	0.27	0.15	0.00	0.00	0.24	0.24	-0.19	-0.02	-0.06	A+	A+	A+	A-	1.17	0.06	8.25	1.25	9.90	1.50

Table J–5 (continued). Algebra I Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
265	574490	23	4917	0.68	0.12	0.68	0.11	0.09	0.01	0.00	0.48	-0.24	0.48	-0.25	-0.22	A-	A-	A+	A+	-0.64	0.06	-4.42	0.89	-3.19	0.84
266	583356	23	4917	0.48	0.04	0.07	0.48	0.41	0.00	0.00	0.49	-0.18	-0.18	0.49	-0.33	A-	B-	A-	A+	0.40	0.06	-1.99	0.95	-1.08	0.96
267	618119	24	4816	0.57	0.57	0.29	0.09	0.05	0.00	0.00	0.50	0.50	-0.32	-0.24	-0.14	A-	A-	A-	A-	-0.05	0.06	-5.04	0.89	-4.42	0.83
268	624287	24	4816	0.22	0.22	0.35	0.24	0.19	0.00	0.00	0.11	0.11	-0.07	-0.03	0.00	A-	A-	A-	A-	1.96	0.07	6.75	1.29	8.78	1.74
269	661902	24	4816	0.42	0.42	0.05	0.11	0.42	0.00	0.00	0.33	0.33	-0.23	-0.27	-0.06	A-	A-	A-	A-	0.75	0.06	5.15	1.14	4.69	1.19
270	662606	24	4816	0.64	0.06	0.18	0.64	0.12	0.00	0.00	0.30	-0.21	-0.03	0.30	-0.24	A-	A-	A-	A+	-0.37	0.06	3.16	1.08	5.85	1.31
271	663456	24	4816	0.64	0.20	0.64	0.09	0.07	0.00	0.00	0.44	-0.23	0.44	-0.27	-0.16	A+	A-	A-	A+	-0.42	0.06	-1.34	0.97	-2.00	0.90
272	664241	24	4816	0.49	0.13	0.22	0.16	0.49	0.00	0.00	0.42	-0.20	-0.25	-0.10	0.42	A+	A-	A-	A+	0.40	0.06	0.47	1.01	-0.23	0.99
273	666885	24	4816	0.55	0.08	0.55	0.24	0.12	0.00	0.00	0.38	-0.15	0.38	-0.16	-0.23	A-	A+	A-	A+	0.05	0.06	2.32	1.05	2.75	1.11
274	667531	24	4816	0.67	0.12	0.07	0.14	0.67	0.00	0.00	0.49	-0.25	-0.24	-0.25	0.49	A+	A-	A-	A+	-0.57	0.06	-4.33	0.89	-3.90	0.80
275	705083	24	4816	0.55	0.09	0.18	0.18	0.55	0.00	0.00	0.57	-0.26	-0.29	-0.25	0.57	A-	A-	A-	A+	0.10	0.06	-7.64	0.83	-5.93	0.79
276	579397	24	4816	0.43	0.18	0.21	0.43	0.18	0.00	0.00	0.33	-0.12	-0.10	0.33	-0.18	A-	A-	A-	A+	0.69	0.06	6.27	1.16	6.22	1.25

Table J–6. Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	243374	0	111271	0.54	0.54	0.18	0.14	0.13	0.00	0.00	0.48	0.48	-0.25	-0.23	-0.18					0.10	0.01	-5.16	0.98	-7.82	0.94
2	273851	0	111271	0.48	0.12	0.25	0.48	0.14	0.00	0.00	0.47	-0.15	-0.26	0.47	-0.21					0.51	0.01	-6.33	0.97	-5.83	0.96
3	277973	0	111271	0.65	0.65	0.10	0.16	0.09	0.00	0.00	0.40	0.40	-0.17	-0.25	-0.16					-0.31	0.01	0.60	1.00	3.47	1.03
4	303147	0	111271	0.40	0.14	0.28	0.18	0.40	0.00	0.00	0.56	-0.15	-0.24	-0.30	0.56					0.62	0.01	-9.90	0.85	-9.90	0.83
5	313498	0	111271	0.61	0.14	0.61	0.13	0.12	0.00	0.00	0.40	-0.16	0.40	-0.29	-0.13					-0.04	0.01	2.72	1.01	1.95	1.02
6	313968	0	111271	0.53	0.53	0.19	0.13	0.14	0.00	0.00	0.49	0.49	-0.24	-0.23	-0.20					0.23	0.01	-9.90	0.95	-9.90	0.92
7	314164	0	111271	0.53	0.15	0.53	0.18	0.14	0.00	0.00	0.45	-0.20	0.45	-0.19	-0.20					0.14	0.01	0.83	1.00	-1.26	0.99
8	314611	0	111271	0.61	0.61	0.08	0.11	0.19	0.00	0.00	0.39	0.39	-0.23	-0.22	-0.14					0.22	0.01	4.46	1.02	-0.24	1.00
9	334723	0	111271	0.59	0.13	0.59	0.12	0.16	0.00	0.00	0.47	-0.18	0.47	-0.27	-0.21					0.14	0.01	-9.90	0.95	-6.14	0.95
10	335285	0	111271	0.53	0.26	0.08	0.53	0.13	0.00	0.00	0.57	-0.24	-0.27	0.57	-0.31					-0.03	0.01	-9.90	0.90	-9.90	0.84
11	335479	0	111271	0.64	0.16	0.12	0.08	0.64	0.00	0.00	0.45	-0.13	-0.33	-0.22	0.45					-0.19	0.01	-9.90	0.95	-7.75	0.93
12	336832	0	111271	0.60	0.10	0.60	0.16	0.14	0.00	0.00	0.38	-0.07	0.38	-0.25	-0.20					0.15	0.01	8.28	1.04	9.90	1.09
13	336858	0	111271	0.35	0.35	0.28	0.22	0.15	0.00	0.00	0.47	0.47	-0.21	-0.17	-0.14					1.04	0.01	-9.90	0.92	-6.93	0.94
14	342281	0	111271	0.52	0.11	0.15	0.22	0.52	0.00	0.00	0.39	-0.20	-0.11	-0.20	0.39					0.18	0.01	9.90	1.07	9.90	1.09
15	342307	0	111271	0.49	0.13	0.49	0.19	0.19	0.00	0.00	0.42	-0.22	0.42	-0.23	-0.11					0.38	0.01	4.95	1.02	6.69	1.05
16	399949	0	111271	0.47	0.47	0.27	0.09	0.16	0.00	0.00	0.46	0.46	-0.29	-0.18	-0.13					0.55	0.01	-3.66	0.98	-3.95	0.97
17	399950	0	111271	0.75	0.08	0.02	0.75	0.15	0.00	0.00	0.30	-0.16	-0.18	0.30	-0.17					-0.71	0.01	-0.53	1.00	-1.51	0.98
18	400679	0	111271	0.47	0.08	0.21	0.24	0.47	0.00	0.00	0.50	-0.20	-0.29	-0.18	0.50					0.61	0.01	-9.90	0.95	-9.13	0.94
19	400680	0	111271	0.55	0.15	0.18	0.55	0.12	0.00	0.00	0.39	-0.14	-0.19	0.39	-0.22					0.44	0.01	9.90	1.07	9.90	1.08
20	408859	0	111271	0.60	0.10	0.60	0.07	0.23	0.00	0.00	0.41	-0.18	0.41	-0.24	-0.20					-0.18	0.01	5.56	1.03	9.90	1.12
21	409182	0	111271	0.61	0.08	0.14	0.61	0.16	0.00	0.00	0.49	-0.26	-0.29	0.49	-0.17					-0.16	0.01	-9.90	0.94	-9.90	0.90
22	409453	0	111271	0.61	0.17	0.09	0.61	0.11	0.00	0.00	0.40	-0.11	-0.18	0.40	-0.31					-0.05	0.01	0.33	1.00	-1.18	0.99
23	409679	0	111271	0.59	0.59	0.17	0.12	0.11	0.00	0.00	0.42	0.42	-0.34	-0.09	-0.14					-0.12	0.01	5.17	1.03	8.78	1.08
24	409870	0	111271	0.60	0.09	0.12	0.60	0.19	0.00	0.00	0.45	-0.22	-0.28	0.45	-0.17					-0.08	0.01	-5.73	0.97	-7.49	0.94
25	410271	0	111271	0.68	0.07	0.68	0.15	0.10	0.00	0.00	0.50	-0.27	0.50	-0.26	-0.24					-0.66	0.01	-9.73	0.94	-8.82	0.90
26	410606	0	111271	0.44	0.10	0.22	0.24	0.44	0.00	0.00	0.41	-0.22	-0.14	-0.17	0.41					0.73	0.01	6.34	1.03	6.97	1.05
27	411169	0	111271	0.46	0.16	0.23	0.15	0.46	0.00	0.00	0.50	-0.27	-0.17	-0.20	0.50					0.51	0.01	-9.90	0.94	-9.90	0.92
28	411173	0	111271	0.57	0.14	0.14	0.57	0.15	0.00	0.00	0.33	-0.08	-0.17	0.33	-0.21					0.25	0.01	9.90	1.10	9.90	1.15
29	413633	0	111271	0.73	0.09	0.06	0.73	0.12	0.00	0.00	0.48	-0.25	-0.28	0.48	-0.23					-0.46	0.01	-9.90	0.82	-9.90	0.75
30	416130	0	111271	0.44	0.25	0.17	0.14	0.44	0.00	0.00	0.42	-0.12	-0.23	-0.21	0.42					0.28	0.01	7.36	1.04	3.59	1.03
31	468396	0	111271	0.46	0.18	0.10	0.25	0.46	0.00	0.00	0.52	-0.26	-0.24	-0.19	0.52					0.76	0.01	-9.90	0.93	-9.90	0.93
32	471923	0	111271	0.66	0.14	0.09	0.12	0.66	0.00	0.00	0.39	-0.09	-0.24	-0.27	0.39					-0.16	0.01	-4.29	0.98	-0.46	1.00
33	479412	0	111271	0.57	0.06	0.17	0.57	0.21	0.00	0.00	0.50	-0.22	-0.29	0.50	-0.21					-0.03	0.01	-9.79	0.95	-9.90	0.91

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	479984	0	111271	0.44	0.44	0.15	0.21	0.20	0.01	0.00	0.50	0.50	-0.29	-0.20	-0.14					0.59	0.01	-9.90	0.92	-9.90	0.90
35	480270	0	111271	0.49	0.16	0.13	0.49	0.23	0.00	0.00	0.41	-0.07	-0.19	0.41	-0.27					0.48	0.01	6.93	1.04	4.14	1.03
36	480316	0	111271	0.50	0.06	0.29	0.14	0.50	0.00	0.00	0.39	-0.19	-0.15	-0.23	0.39					0.20	0.01	9.90	1.06	7.18	1.06
37	487601	0	111271	0.53	0.10	0.18	0.18	0.53	0.00	0.00	0.54	-0.24	-0.19	-0.30	0.54					0.24	0.01	-9.90	0.90	-9.90	0.86
38	566399	0	111271	0.37	0.37	0.19	0.33	0.11	0.00	0.00	0.43	0.43	-0.16	-0.20	-0.15					1.06	0.01	1.28	1.01	5.80	1.05
39	566411	0	111271	0.44	0.15	0.15	0.25	0.44	0.00	0.00	0.38	-0.21	-0.18	-0.11	0.38					0.87	0.01	9.90	1.10	9.90	1.14
40	569372	0	111271	0.66	0.66	0.12	0.11	0.11	0.00	0.00	0.53	0.53	-0.25	-0.31	-0.21					-0.36	0.01	-9.90	0.88	-9.90	0.83
41	569377	0	111271	0.48	0.16	0.48	0.15	0.21	0.00	0.00	0.48	-0.21	0.48	-0.27	-0.14					0.50	0.01	-9.11	0.95	-8.29	0.94
42	574708	0	111271	0.46	0.15	0.46	0.14	0.25	0.00	0.00	0.54	-0.22	0.54	-0.23	-0.24					0.44	0.01	-9.90	0.89	-9.90	0.86
43	574773	0	111271	0.70	0.12	0.70	0.12	0.06	0.00	0.00	0.40	-0.27	0.40	-0.19	-0.14					-0.67	0.01	-1.12	0.99	5.76	1.07
44	575002	0	111271	0.61	0.11	0.14	0.14	0.61	0.00	0.00	0.57	-0.25	-0.30	-0.27	0.57					-0.29	0.01	-9.90	0.88	-9.90	0.80
45	575110	0	111271	0.50	0.50	0.16	0.22	0.12	0.00	0.00	0.34	0.34	-0.17	-0.09	-0.22					0.65	0.01	9.90	1.16	9.90	1.21
46	578604	0	111271	0.61	0.61	0.12	0.20	0.07	0.00	0.00	0.52	0.52	-0.30	-0.31	-0.13					-0.08	0.01	-9.90	0.89	-9.90	0.84
47	578605	0	111271	0.47	0.15	0.47	0.15	0.23	0.00	0.00	0.49	-0.19	0.49	-0.25	-0.19					0.44	0.01	-9.90	0.95	-9.90	0.93
48	581588	0	111271	0.44	0.18	0.44	0.05	0.33	0.00	0.00	0.25	-0.14	0.25	-0.22	-0.04					0.91	0.01	9.90	1.25	9.90	1.33
49	655211	1	7630	0.37	0.37	0.23	0.21	0.19	0.00	0.00	0.43	0.43	-0.17	-0.14	-0.20	A+	A-	A-	A-	0.80	0.06	-0.75	0.98	-0.17	0.99
50	658120	1	7630	0.42	0.16	0.18	0.24	0.42	0.00	0.00	0.47	-0.25	-0.23	-0.12	0.47	A+	A-	A-	A+	0.53	0.06	-3.42	0.92	-2.44	0.93
51	658123	1	7630	0.32	0.32	0.29	0.26	0.12	0.00	0.00	0.15	0.15	0.04	-0.09	-0.13	A-	A-	A-	A-	1.07	0.06	9.17	1.29	9.45	1.43
52	658137	1	7630	0.44	0.24	0.44	0.21	0.11	0.00	0.00	0.23	-0.12	0.23	-0.05	-0.14	A-	A-	A-	A+	0.42	0.06	8.18	1.20	7.81	1.26
53	658140	1	7630	0.44	0.21	0.22	0.44	0.13	0.00	0.00	0.15	-0.06	0.03	0.15	-0.18	A+	A+	A-	A-	0.42	0.06	9.90	1.29	9.90	1.39
54	658177	1	7630	0.30	0.16	0.30	0.36	0.18	0.00	0.00	0.13	-0.21	0.13	0.16	-0.14	A-	A+	A-	A-	1.15	0.06	8.95	1.30	9.05	1.44
55	658184	1	7630	0.38	0.13	0.30	0.38	0.19	0.00	0.00	0.16	-0.08	-0.04	0.16	-0.08	A+	A+	A+	A+	0.71	0.06	9.90	1.30	9.90	1.39
56	659554	1	7630	0.49	0.15	0.22	0.49	0.14	0.00	0.00	0.44	-0.16	-0.23	0.44	-0.19	A+	A+	A-	A-	0.19	0.06	-1.89	0.96	-1.92	0.94
57	659564	1	7630	0.68	0.68	0.09	0.13	0.10	0.00	0.00	0.54	0.54	-0.27	-0.29	-0.26	A+	A+	A+	B-	-0.76	0.06	-8.34	0.81	-6.64	0.72
58	659700	1	7630	0.48	0.23	0.48	0.14	0.14	0.00	0.00	0.44	-0.12	0.44	-0.27	-0.20	A+	A-	A+	A+	0.22	0.06	-0.91	0.98	-1.04	0.97
59	662975	1	7630	0.50	0.50	0.12	0.27	0.11	0.00	0.00	0.47	0.47	-0.30	-0.11	-0.27	A-	A-	A-	A-	0.12	0.06	-5.10	0.90	-3.82	0.89
60	663981	1	7630	0.38	0.14	0.17	0.31	0.38	0.00	0.00	0.34	-0.18	-0.15	-0.10	0.34	A+	A-	A-	A+	0.74	0.06	3.96	1.10	3.96	1.14
61	664174	1	7630	0.34	0.16	0.27	0.24	0.34	0.00	0.00	0.12	-0.11	-0.05	0.02	0.12	A+	A-	A-	A-	0.96	0.06	8.96	1.27	8.42	1.36
62	664815	1	7630	0.43	0.14	0.30	0.43	0.12	0.00	0.00	0.28	-0.10	-0.10	0.28	-0.18	A-	A+	A-	A+	0.45	0.06	5.94	1.14	4.89	1.16
63	664819	1	7630	0.51	0.12	0.13	0.51	0.24	0.00	0.00	0.39	-0.27	-0.30	0.39	-0.01	A+	A+	A+	A-	0.10	0.06	1.29	1.03	2.14	1.07
64	665514	1	7630	0.58	0.13	0.12	0.16	0.58	0.00	0.00	0.45	-0.21	-0.19	-0.23	0.45	A+	A+	A+	A-	-0.28	0.06	-2.83	0.94	-2.15	0.93
65	634709	2	5472	0.61	0.09	0.22	0.07	0.61	0.00	0.00	0.40	-0.22	-0.20	-0.19	0.40	A+	A-	A+	A+	-0.13	0.06	-0.59	0.99	-0.83	0.97
66	654027	2	5472	0.54	0.15	0.54	0.20	0.10	0.00	0.00	0.29	-0.01	0.29	-0.15	-0.26	A-	A+	A+	A-	0.22	0.06	4.61	1.10	3.99	1.14

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
67	654387	2	5472	0.32	0.42	0.32	0.13	0.13	0.00	0.00	0.29	-0.09	0.29	-0.15	-0.13	A-	A+	A+	A+	1.38	0.06	3.22	1.10	6.23	1.29
68	654390	2	5472	0.38	0.29	0.20	0.38	0.13	0.00	0.00	0.17	0.17	-0.17	0.17	-0.26	A+	A+	A+	A+	1.01	0.06	8.51	1.23	9.51	1.37
69	656088	2	5472	0.36	0.17	0.36	0.35	0.11	0.00	0.00	0.20	-0.22	0.20	0.07	-0.14	A-	A+	A+	A+	1.14	0.06	8.47	1.24	8.37	1.35
70	658138	2	5472	0.49	0.19	0.49	0.20	0.12	0.00	0.00	0.48	-0.21	0.48	-0.24	-0.18	A-	A+	A-	A-	0.46	0.06	-3.83	0.92	-3.96	0.88
71	658141	2	5472	0.23	0.16	0.47	0.23	0.14	0.00	0.00	0.17	-0.22	0.10	0.17	-0.12	A-	A-	A-	A-	1.91	0.07	4.99	1.19	7.91	1.55
72	658181	2	5472	0.48	0.48	0.28	0.14	0.10	0.00	0.00	0.51	0.51	-0.15	-0.30	-0.28	A+	A-	A-	A-	0.51	0.06	-5.08	0.89	-4.66	0.86
73	658185	2	5472	0.48	0.21	0.48	0.15	0.16	0.00	0.00	0.35	-0.16	0.35	-0.24	-0.04	A+	A+	A+	A+	0.52	0.06	3.34	1.08	2.49	1.08
74	659556	2	5472	0.38	0.11	0.13	0.37	0.38	0.00	0.00	0.24	-0.25	-0.15	0.04	0.24	A-	A-	A+	A-	1.02	0.06	6.69	1.18	6.15	1.23
75	659560	2	5472	0.48	0.11	0.48	0.34	0.07	0.00	0.00	0.34	-0.23	0.34	-0.06	-0.26	A+	A-	A-	A-	0.50	0.06	3.38	1.08	3.35	1.11
76	659693	2	5472	0.56	0.13	0.12	0.56	0.19	0.00	0.00	0.40	-0.17	-0.24	0.40	-0.15	A-	A-	A-	A+	0.15	0.06	0.23	1.00	1.55	1.05
77	660366	2	5472	0.42	0.21	0.42	0.14	0.22	0.00	0.00	0.36	-0.09	0.36	-0.24	-0.12	A-	A-	A-	A+	0.82	0.06	1.39	1.03	1.87	1.06
78	663623	2	5472	0.28	0.24	0.25	0.22	0.28	0.00	0.00	0.28	0.02	-0.21	-0.09	0.28	A-	A-	A-	A-	1.57	0.06	3.46	1.11	3.92	1.20
79	665500	2	5472	0.29	0.29	0.24	0.29	0.18	0.00	0.00	0.34	0.34	-0.25	-0.08	-0.02	B-	A+	A+	A-	1.52	0.06	1.98	1.06	2.65	1.13
80	665506	2	5472	0.50	0.50	0.11	0.18	0.20	0.00	0.00	0.39	0.39	-0.25	-0.22	-0.07	A-	A-	A+	A+	0.44	0.06	0.49	1.01	-0.05	1.00
81	653084	3	5501	0.55	0.09	0.18	0.55	0.17	0.00	0.00	0.47	-0.19	-0.27	0.47	-0.18	A+	A+	A+	A+	0.20	0.06	-2.80	0.94	-2.92	0.90
82	656217	3	5501	0.49	0.49	0.14	0.25	0.12	0.00	0.00	0.43	0.43	-0.23	-0.12	-0.23	A+	A-	A-	A-	0.52	0.06	-1.41	0.97	-1.50	0.95
83	658124	3	5501	0.72	0.13	0.72	0.04	0.11	0.00	0.00	0.38	-0.22	0.38	-0.23	-0.16	A+	A-	A-	A+	-0.68	0.06	-1.76	0.95	-1.29	0.93
84	658139	3	5501	0.36	0.21	0.21	0.36	0.22	0.00	0.00	0.20	-0.12	-0.04	0.20	-0.07	A+	A-	A+	A-	1.18	0.06	6.68	1.20	7.79	1.33
85	658142	3	5501	0.42	0.17	0.09	0.32	0.42	0.00	0.00	0.43	-0.23	-0.26	-0.11	0.43	A+	A-	A-	A+	0.87	0.06	-2.16	0.95	-1.38	0.95
86	658152	3	5501	0.64	0.12	0.64	0.12	0.12	0.00	0.00	0.44	-0.17	0.44	-0.27	-0.20	A-	A-	A-	A+	-0.26	0.06	-1.29	0.97	-1.05	0.96
87	659515	3	5501	0.38	0.13	0.24	0.38	0.25	0.00	0.00	0.12	-0.19	0.01	0.12	0.01	A-	A+	A-	A-	1.07	0.06	9.90	1.33	9.90	1.44
88	659517	3	5501	0.39	0.16	0.13	0.32	0.39	0.00	0.00	0.42	-0.23	-0.28	-0.05	0.42	A+	A-	A-	A-	0.99	0.06	-0.21	0.99	0.91	1.03
89	659529	3	5501	0.32	0.27	0.19	0.32	0.22	0.00	0.00	0.25	-0.17	-0.05	0.25	-0.05	A-	A+	A+	A+	1.37	0.06	5.79	1.18	7.20	1.34
90	659558	3	5501	0.40	0.16	0.40	0.11	0.33	0.00	0.00	0.21	-0.21	0.21	-0.24	0.11	A-	A+	A-	A-	0.95	0.06	9.27	1.26	8.68	1.33
91	659562	3	5501	0.56	0.56	0.13	0.19	0.13	0.00	0.00	0.47	0.47	-0.29	-0.18	-0.20	A-	A+	A+	A-	0.16	0.06	-2.35	0.95	-0.85	0.97
92	659665	3	5501	0.51	0.23	0.08	0.17	0.51	0.00	0.00	0.52	-0.34	-0.18	-0.17	0.52	A+	A-	A-	A+	0.38	0.06	-4.85	0.90	-4.98	0.85
93	659692	3	5501	0.35	0.15	0.35	0.33	0.17	0.00	0.00	0.23	-0.13	0.23	-0.05	-0.10	A-	A-	A-	A-	1.21	0.06	6.93	1.21	7.51	1.32
94	659698	3	5501	0.33	0.33	0.09	0.53	0.05	0.00	0.00	0.28	0.28	-0.24	-0.02	-0.23	A+	A-	A-	A-	1.32	0.06	4.30	1.13	5.05	1.23
95	663977	3	5501	0.48	0.22	0.48	0.17	0.13	0.00	0.00	0.41	-0.11	0.41	-0.22	-0.22	A-	A-	A-	A-	0.53	0.06	1.04	1.02	0.81	1.03
96	666019	3	5501	0.63	0.63	0.12	0.11	0.14	0.00	0.00	0.32	0.32	-0.14	-0.14	-0.18	A-	A-	A-	A-	-0.23	0.06	1.73	1.04	1.72	1.07
97	655213	4	5455	0.56	0.56	0.20	0.14	0.09	0.00	0.00	0.36	0.36	-0.11	-0.23	-0.18	A-	A-	A-	A+	0.16	0.06	0.81	1.02	0.77	1.03
98	655219	4	5455	0.33	0.23	0.20	0.23	0.33	0.00	0.00	0.20	-0.23	-0.10	0.11	0.20	A+	A-	A+	A-	1.33	0.06	7.92	1.24	7.04	1.32
99	656081	4	5455	0.76	0.11	0.09	0.76	0.04	0.00	0.00	0.49	-0.26	-0.29	0.49	-0.22	A+	A-	A-	A+	-0.96	0.07	-4.67	0.86	-4.49	0.74

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
100	656095	4	5455	0.39	0.39	0.20	0.21	0.19	0.00	0.00	0.34	0.34	-0.03	-0.23	-0.15	A+	A+	A-	A+	1.02	0.06	3.29	1.09	4.07	1.15
101	656097	4	5455	0.46	0.46	0.09	0.34	0.11	0.00	0.00	0.09	0.09	-0.16	0.10	-0.13	A-	A+	A-	A-	0.65	0.06	9.90	1.42	9.90	1.54
102	656121	4	5455	0.49	0.17	0.49	0.09	0.25	0.00	0.00	0.44	-0.15	0.44	-0.29	-0.19	A-	A+	A-	A-	0.53	0.06	-1.27	0.97	-1.75	0.95
103	656123	4	5455	0.37	0.37	0.29	0.26	0.08	0.00	0.00	0.21	0.21	0.00	-0.10	-0.19	A+	A+	A+	A-	1.13	0.06	9.90	1.31	9.90	1.44
104	656226	4	5455	0.55	0.19	0.55	0.14	0.13	0.00	0.00	0.50	-0.20	0.50	-0.24	-0.26	A-	A+	A+	A-	0.23	0.06	-4.70	0.90	-4.57	0.86
105	656230	4	5455	0.39	0.31	0.10	0.20	0.39	0.00	0.00	0.40	-0.15	-0.17	-0.18	0.40	B-	A-	A+	A-	1.04	0.06	1.53	1.04	2.66	1.10
106	656237	4	5455	0.54	0.18	0.10	0.54	0.18	0.00	0.00	0.41	-0.10	-0.27	0.41	-0.21	A+	A+	A+	A+	0.26	0.06	1.61	1.04	1.19	1.04
107	658119	4	5455	0.49	0.49	0.14	0.15	0.22	0.00	0.00	0.38	0.38	-0.17	-0.19	-0.14	A-	A-	A-	A-	0.53	0.06	0.23	1.01	-0.02	1.00
108	658156	4	5455	0.27	0.18	0.22	0.33	0.27	0.00	0.00	0.27	-0.11	-0.19	0.01	0.27	A-	A-	A-	A+	1.70	0.06	1.99	1.07	3.98	1.22
109	659681	4	5455	0.29	0.12	0.29	0.26	0.32	0.00	0.00	0.08	-0.12	0.08	-0.04	0.05	A-	A+	A+	A-	1.55	0.06	9.90	1.37	9.90	1.63
110	659690	4	5455	0.50	0.20	0.15	0.14	0.50	0.00	0.00	0.48	-0.13	-0.27	-0.26	0.48	A+	A+	A+	A-	0.43	0.06	-1.46	0.97	-1.90	0.94
111	663983	4	5455	0.65	0.07	0.65	0.20	0.08	0.00	0.00	0.53	-0.25	0.53	-0.29	-0.26	A+	A-	A-	A+	-0.29	0.06	-5.34	0.88	-5.11	0.80
112	666021	4	5455	0.24	0.11	0.24	0.54	0.11	0.00	0.00	0.17	-0.23	0.17	0.15	-0.23	A-	A+	A-	A-	1.91	0.07	5.76	1.22	9.63	1.69
113	620407	5	5478	0.64	0.64	0.10	0.17	0.10	0.00	0.00	0.47	0.47	-0.20	-0.24	-0.26	A-	A-	A-	A+	-0.27	0.06	-3.14	0.93	-1.80	0.92
114	635453	5	5478	0.44	0.14	0.23	0.20	0.44	0.00	0.00	0.29	-0.21	-0.19	0.02	0.29	A+	A+	A-	A-	0.73	0.06	5.44	1.14	4.88	1.17
115	654385	5	5478	0.74	0.06	0.10	0.10	0.74	0.00	0.00	0.40	-0.14	-0.22	-0.24	0.40	A+	A-	A-	A-	-0.86	0.06	-2.61	0.93	-0.91	0.94
116	656094	5	5478	0.72	0.05	0.72	0.05	0.17	0.00	0.00	0.45	-0.22	0.45	-0.26	-0.25	A+	A-	A+	A-	-0.73	0.06	-3.79	0.90	-2.96	0.84
117	656096	5	5478	0.35	0.36	0.15	0.35	0.12	0.00	0.00	0.14	-0.01	-0.06	0.14	-0.11	A+	A-	A-	A-	1.19	0.06	9.36	1.28	9.90	1.45
118	656118	5	5478	0.28	0.26	0.31	0.14	0.28	0.00	0.00	0.25	-0.20	0.04	-0.11	0.25	A-	A-	A-	A+	1.58	0.06	4.70	1.16	7.71	1.43
119	656119	5	5478	0.44	0.24	0.20	0.44	0.11	0.00	0.00	0.27	-0.05	-0.16	0.27	-0.15	A+	A+	A-	A-	0.70	0.06	6.38	1.16	5.64	1.20
120	656216	5	5478	0.52	0.52	0.14	0.19	0.15	0.00	0.00	0.45	0.45	-0.16	-0.23	-0.22	A+	A+	A+	A-	0.33	0.06	-1.51	0.97	-1.80	0.94
121	656219	5	5478	0.35	0.35	0.20	0.10	0.35	0.00	0.00	0.29	0.29	-0.15	-0.15	-0.06	A-	A-	A+	A+	1.20	0.06	4.56	1.13	6.13	1.27
122	658158	5	5478	0.44	0.20	0.12	0.44	0.23	0.00	0.00	0.42	-0.19	-0.18	0.42	-0.17	A-	A-	A+	A+	0.71	0.06	0.40	1.01	0.87	1.03
123	659662	5	5478	0.57	0.17	0.57	0.15	0.10	0.00	0.00	0.44	-0.18	0.44	-0.22	-0.22	A-	A+	A+	A-	0.08	0.06	-0.70	0.98	-1.42	0.95
124	659668	5	5478	0.47	0.16	0.19	0.47	0.17	0.00	0.00	0.41	-0.11	-0.25	0.41	-0.16	A+	A+	A+	A+	0.55	0.06	0.66	1.02	0.81	1.03
125	659736	5	5478	0.44	0.24	0.14	0.18	0.44	0.00	0.00	0.37	-0.08	-0.24	-0.17	0.37	A+	A+	A+	A-	0.72	0.06	2.22	1.05	1.76	1.06
126	660368	5	5478	0.67	0.67	0.13	0.12	0.08	0.00	0.00	0.52	0.52	-0.23	-0.28	-0.27	A-	A+	A-	A-	-0.44	0.06	-6.66	0.85	-4.83	0.78
127	660381	5	5478	0.80	0.08	0.80	0.06	0.07	0.00	0.00	0.51	-0.27	0.51	-0.27	-0.28	A+	A+	A+	A+	-1.24	0.07	-4.66	0.84	-5.56	0.63
128	665504	5	5478	0.43	0.11	0.28	0.19	0.43	0.00	0.00	0.45	-0.26	-0.07	-0.28	0.45	A-	A+	A-	A+	0.79	0.06	-0.89	0.98	-0.20	0.99
129	653086	6	5438	0.75	0.13	0.04	0.08	0.75	0.00	0.00	0.35	-0.14	-0.24	-0.18	0.35	A-	A-	A-	A+	-0.87	0.06	-0.22	0.99	0.45	1.02
130	654812	6	5438	0.61	0.61	0.08	0.08	0.22	0.00	0.00	0.40	0.40	-0.26	-0.26	-0.11	A-	A-	A-	A-	-0.11	0.06	-0.98	0.98	-1.80	0.94
131	656098	6	5438	0.24	0.32	0.14	0.29	0.24	0.00	0.00	0.11	0.09	-0.17	-0.06	0.11	A-	A-	A-	A+	1.85	0.07	6.35	1.24	6.94	1.44
132	656099	6	5438	0.55	0.14	0.12	0.55	0.20	0.00	0.00	0.35	-0.20	-0.27	0.35	-0.05	A-	A-	A-	A-	0.21	0.06	1.84	1.04	2.90	1.09

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
133	656120	6	5438	0.49	0.12	0.49	0.21	0.17	0.00	0.00	0.30	-0.15	0.30	-0.15	-0.10	A+	A-	A-	A+	0.48	0.06	4.65	1.10	3.95	1.12
134	656122	6	5438	0.28	0.23	0.17	0.28	0.32	0.00	0.00	0.15	-0.04	-0.13	0.15	0.00	A-	A+	A-	A+	1.59	0.06	7.26	1.25	9.12	1.50
135	656218	6	5438	0.28	0.06	0.47	0.18	0.28	0.00	0.00	0.02	-0.21	0.29	-0.25	0.02	A+	A+	A-	A-	1.60	0.06	9.90	1.43	9.90	1.62
136	656239	6	5438	0.43	0.43	0.26	0.09	0.21	0.00	0.00	0.21	0.21	-0.11	-0.20	0.01	A+	A+	A-	A-	0.75	0.06	7.45	1.18	6.20	1.20
137	659667	6	5438	0.43	0.11	0.16	0.43	0.29	0.00	0.00	0.24	-0.14	-0.10	0.24	-0.08	A+	A+	A+	A-	0.75	0.06	6.34	1.15	5.69	1.18
138	659675	6	5438	0.52	0.14	0.20	0.52	0.14	0.00	0.00	0.34	-0.17	-0.12	0.34	-0.17	A+	A+	A+	A+	0.34	0.06	2.11	1.05	2.15	1.07
139	659682	6	5438	0.50	0.21	0.50	0.14	0.15	0.00	0.00	0.38	-0.13	0.38	-0.22	-0.17	A+	A-	A-	A-	0.43	0.06	1.79	1.04	1.13	1.03
140	660383	6	5438	0.67	0.13	0.67	0.10	0.11	0.00	0.00	0.52	-0.27	0.52	-0.31	-0.20	A-	A-	A-	A-	-0.40	0.06	-6.85	0.85	-6.23	0.76
141	664171	6	5438	0.27	0.41	0.18	0.14	0.27	0.01	0.00	0.31	-0.12	-0.15	-0.04	0.31	A-	A-	A-	A-	1.65	0.06	1.65	1.05	3.20	1.17
142	665978	6	5438	0.37	0.19	0.37	0.26	0.18	0.00	0.00	0.28	-0.08	0.28	-0.16	-0.07	A+	A-	A-	A-	1.09	0.06	3.83	1.10	4.98	1.19
143	666015	6	5438	0.24	0.25	0.22	0.24	0.29	0.00	0.00	0.12	-0.11	-0.02	0.12	0.01	A-	A+	A-	A+	1.83	0.07	5.42	1.20	8.11	1.52
144	666017	6	5438	0.10	0.16	0.36	0.38	0.10	0.00	0.00	-0.07	-0.13	0.08	0.07	-0.07	A+	A-	A-	A+	3.03	0.09	3.67	1.25	9.90	2.71
145	634710	7	5469	0.44	0.44	0.17	0.20	0.19	0.00	0.00	0.36	0.36	-0.13	-0.19	-0.14	A+	A+	A+	A-	0.75	0.06	2.58	1.06	2.15	1.07
146	654031	7	5469	0.57	0.14	0.10	0.57	0.19	0.00	0.00	0.43	-0.20	-0.25	0.43	-0.16	A+	A+	A-	A+	0.11	0.06	-0.16	1.00	-0.67	0.98
147	654808	7	5469	0.45	0.13	0.21	0.20	0.45	0.00	0.00	0.47	-0.23	-0.14	-0.24	0.47	A+	A-	A-	A-	0.67	0.06	-2.32	0.95	-2.01	0.94
148	655212	7	5469	0.47	0.47	0.10	0.31	0.11	0.00	0.00	0.45	0.45	-0.17	-0.21	-0.21	A-	A+	A+	A-	0.58	0.06	-1.65	0.96	-1.72	0.95
149	655221	7	5469	0.61	0.15	0.13	0.61	0.11	0.00	0.00	0.40	-0.22	-0.12	0.40	-0.24	A+	A-	A+	A+	-0.12	0.06	-0.41	0.99	0.48	1.02
150	656084	7	5469	0.78	0.04	0.78	0.06	0.12	0.00	0.00	0.38	-0.23	0.38	-0.24	-0.16	A-	A-	A-	A+	-1.07	0.07	-4.06	0.87	-3.52	0.77
151	659709	7	5469	0.27	0.11	0.27	0.32	0.30	0.00	0.00	0.02	-0.20	0.02	-0.03	0.14	A+	A+	A+	A+	1.69	0.07	9.90	1.40	9.90	1.82
152	659711	7	5469	0.38	0.08	0.36	0.18	0.38	0.00	0.00	0.25	-0.22	0.06	-0.25	0.25	A+	A-	A+	A+	1.02	0.06	7.26	1.20	7.00	1.27
153	660380	7	5469	0.83	0.06	0.83	0.06	0.05	0.00	0.00	0.46	-0.25	0.46	-0.24	-0.24	A+	A-	A-	A+	-1.44	0.07	-3.27	0.87	-4.01	0.69
154	663571	7	5469	0.42	0.20	0.16	0.42	0.21	0.00	0.00	0.28	-0.12	-0.16	0.28	-0.06	A+	A-	A-	A+	0.81	0.06	4.92	1.13	4.75	1.17
155	663573	7	5469	0.60	0.11	0.60	0.15	0.14	0.00	0.00	0.42	-0.23	0.42	-0.22	-0.16	A+	A+	A+	A-	-0.04	0.06	-1.20	0.97	-1.34	0.95
156	663978	7	5469	0.54	0.54	0.11	0.28	0.07	0.00	0.00	0.41	0.41	-0.24	-0.16	-0.22	A+	A+	A-	A+	0.23	0.06	0.92	1.02	0.55	1.02
157	663982	7	5469	0.69	0.05	0.11	0.69	0.15	0.00	0.00	0.30	-0.24	-0.16	0.30	-0.11	A+	A-	A+	A+	-0.53	0.06	0.94	1.02	2.28	1.12
158	665501	7	5469	0.24	0.09	0.24	0.53	0.14	0.00	0.00	0.09	-0.26	0.09	0.24	-0.23	A-	A-	A+	A-	1.85	0.07	8.26	1.33	9.90	1.79
159	665508	7	5469	0.50	0.50	0.11	0.28	0.11	0.00	0.00	0.28	0.28	-0.24	-0.03	-0.16	A+	A-	A-	A-	0.44	0.06	5.27	1.12	3.86	1.13
160	665926	7	5469	0.58	0.58	0.25	0.09	0.08	0.00	0.00	0.43	0.43	-0.17	-0.27	-0.21	A-	A+	A+	A+	0.06	0.06	-1.24	0.97	-2.01	0.93
161	634395	8	5467	0.23	0.23	0.14	0.28	0.35	0.00	0.00	0.45	0.45	-0.17	-0.10	-0.17	A-	A+	A+	A-	1.94	0.07	-3.28	0.89	-0.09	0.99
162	653079	8	5467	0.67	0.17	0.67	0.08	0.08	0.00	0.00	0.47	-0.22	0.47	-0.28	-0.22	A-	A-	A-	A-	-0.43	0.06	-4.83	0.89	-4.53	0.79
163	654809	8	5467	0.44	0.14	0.23	0.19	0.44	0.00	0.00	0.45	-0.23	-0.14	-0.22	0.45	A-	A+	A+	A-	0.73	0.06	-1.22	0.97	-1.03	0.97
164	656086	8	5467	0.47	0.06	0.27	0.19	0.47	0.00	0.00	0.33	-0.24	-0.18	-0.06	0.33	A-	A-	A-	A-	0.60	0.06	3.90	1.10	3.22	1.11
165	658154	8	5467	0.53	0.53	0.34	0.07	0.05	0.00	0.00	0.47	0.47	-0.26	-0.24	-0.21	A-	A-	A-	A-	0.27	0.06	-2.03	0.95	-3.21	0.89

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
166	659660	8	5467	0.53	0.53	0.13	0.20	0.14	0.00	0.00	0.46	0.46	-0.20	-0.23	-0.18	A-	A-	A-	A+	0.29	0.06	-2.63	0.94	-2.56	0.91
167	659672	8	5467	0.51	0.13	0.09	0.27	0.51	0.00	0.00	0.36	-0.12	-0.20	-0.19	0.36	A+	A-	A-	A+	0.40	0.06	3.32	1.08	3.48	1.12
168	659689	8	5467	0.46	0.24	0.46	0.16	0.13	0.00	0.00	0.39	-0.11	0.39	-0.24	-0.16	A+	A-	A+	A-	0.61	0.06	1.46	1.04	1.49	1.05
169	659708	8	5467	0.41	0.14	0.19	0.26	0.41	0.00	0.00	0.33	-0.23	-0.17	-0.02	0.33	A+	A-	A+	A+	0.91	0.06	6.43	1.18	6.22	1.24
170	659712	8	5467	0.38	0.14	0.38	0.21	0.26	0.00	0.00	0.32	-0.13	0.32	-0.17	-0.09	A-	A+	A-	A-	1.06	0.06	6.58	1.19	6.36	1.26
171	660370	8	5467	0.64	0.11	0.64	0.12	0.11	0.00	0.00	0.50	-0.30	0.50	-0.23	-0.21	A+	A-	A+	A-	-0.30	0.06	-4.62	0.89	-4.50	0.81
172	662980	8	5467	0.33	0.23	0.21	0.33	0.24	0.00	0.00	0.32	-0.14	-0.18	0.32	-0.04	A+	A+	A+	A-	1.35	0.06	3.75	1.12	5.97	1.28
173	663570	8	5467	0.47	0.15	0.15	0.22	0.47	0.00	0.00	0.29	-0.20	-0.19	-0.02	0.29	A+	A-	A+	A-	0.57	0.06	7.49	1.19	6.65	1.24
174	663574	8	5467	0.38	0.26	0.21	0.38	0.16	0.00	0.00	0.15	0.01	-0.03	0.15	-0.17	A-	A+	A+	A-	1.07	0.06	9.90	1.32	9.90	1.45
175	664820	8	5467	0.57	0.57	0.13	0.15	0.15	0.00	0.00	0.46	0.46	-0.25	-0.23	-0.17	A+	A-	A-	A-	0.09	0.06	-2.38	0.95	-2.22	0.92
176	665927	8	5467	0.53	0.18	0.10	0.19	0.53	0.00	0.00	0.50	-0.18	-0.21	-0.29	0.50	A+	A-	A-	A+	0.28	0.06	-3.28	0.93	-3.47	0.88
177	654025	9	5510	0.40	0.40	0.14	0.22	0.24	0.00	0.00	0.41	0.41	-0.27	-0.07	-0.18	A+	A+	A-	A-	0.94	0.06	0.34	1.01	0.76	1.03
178	654810	9	5510	0.56	0.07	0.56	0.29	0.07	0.00	0.00	0.27	-0.23	0.27	-0.05	-0.19	A+	A-	A-	A-	0.12	0.06	7.37	1.18	8.63	1.34
179	656089	9	5510	0.74	0.74	0.10	0.10	0.05	0.00	0.00	0.52	0.52	-0.24	-0.32	-0.24	A+	A-	A+	A+	-0.85	0.06	-6.61	0.81	-6.16	0.66
180	656238	9	5510	0.55	0.11	0.11	0.55	0.23	0.00	0.00	0.44	-0.26	-0.29	0.44	-0.11	A-	A-	A-	A+	0.17	0.06	-0.48	0.99	-1.14	0.96
181	658178	9	5510	0.61	0.08	0.61	0.13	0.18	0.00	0.00	0.35	-0.27	0.35	-0.14	-0.12	A-	A-	A-	A-	-0.11	0.06	1.49	1.03	2.17	1.09
182	658180	9	5510	0.34	0.25	0.34	0.14	0.27	0.00	0.00	0.19	-0.08	0.19	-0.27	0.09	A+	A-	A+	A+	1.27	0.06	8.41	1.26	9.32	1.43
183	659670	9	5510	0.44	0.36	0.44	0.12	0.07	0.00	0.00	0.41	-0.12	0.41	-0.27	-0.21	A-	A+	A+	A-	0.76	0.06	0.35	1.01	0.78	1.03
184	659688	9	5510	0.35	0.22	0.19	0.24	0.35	0.00	0.00	0.23	-0.08	-0.13	-0.06	0.23	A+	A-	A+	A-	1.22	0.06	6.68	1.20	7.32	1.32
185	659691	9	5510	0.63	0.14	0.15	0.63	0.08	0.00	0.00	0.34	-0.04	-0.24	0.34	-0.24	A+	A-	A-	A-	-0.21	0.06	2.95	1.07	3.76	1.17
186	659707	9	5510	0.38	0.16	0.20	0.26	0.38	0.00	0.00	0.37	-0.23	-0.10	-0.12	0.37	A-	A+	A-	A-	1.08	0.06	3.04	1.08	4.74	1.19
187	659710	9	5510	0.45	0.45	0.25	0.15	0.15	0.00	0.00	0.41	0.41	-0.21	-0.23	-0.07	A-	A-	A-	A-	0.72	0.06	-0.09	1.00	0.23	1.01
188	663572	9	5510	0.50	0.50	0.21	0.14	0.15	0.00	0.00	0.38	0.38	-0.13	-0.20	-0.18	A+	A+	A+	A-	0.42	0.06	2.24	1.05	1.08	1.04
189	663575	9	5510	0.45	0.45	0.19	0.23	0.13	0.00	0.00	0.44	0.44	-0.18	-0.17	-0.21	A+	A-	A+	A-	0.71	0.06	-0.02	1.00	0.51	1.02
190	664263	9	5510	0.44	0.44	0.17	0.24	0.14	0.00	0.00	0.38	0.38	-0.22	-0.13	-0.13	A-	A+	A+	A+	0.73	0.06	0.57	1.01	1.35	1.04
191	664812	9	5510	0.52	0.19	0.14	0.52	0.16	0.00	0.00	0.29	-0.17	-0.03	0.29	-0.19	A+	A-	A-	A+	0.37	0.06	6.19	1.15	4.83	1.17
192	665979	9	5510	0.63	0.15	0.63	0.13	0.09	0.00	0.00	0.53	-0.25	0.53	-0.28	-0.24	A+	A-	A+	A+	-0.20	0.06	-5.58	0.87	-4.04	0.84
193	621675	10	5437	0.32	0.32	0.21	0.39	0.08	0.00	0.00	0.10	0.10	-0.18	0.10	-0.07	A-	A-	A+	A-	1.37	0.06	9.63	1.31	9.50	1.47
194	654384	10	5437	0.33	0.33	0.17	0.20	0.30	0.00	0.00	0.44	0.44	-0.22	-0.22	-0.08	A-	A+	A-	A-	1.29	0.06	-0.92	0.97	2.05	1.09
195	656229	10	5437	0.34	0.27	0.20	0.34	0.19	0.00	0.00	0.24	-0.04	-0.13	0.24	-0.10	A+	A-	A-	A-	1.25	0.06	6.55	1.19	7.70	1.34
196	659519	10	5437	0.41	0.16	0.16	0.28	0.41	0.00	0.00	0.44	-0.20	-0.16	-0.18	0.44	A+	A-	A-	A+	0.90	0.06	-0.87	0.98	-0.09	1.00
197	659533	10	5437	0.27	0.17	0.27	0.25	0.31	0.00	0.00	0.25	0.08	0.25	-0.21	-0.09	A-	A+	A-	A-	1.69	0.07	3.49	1.12	5.24	1.30
198	659537	10	5437	0.71	0.06	0.06	0.17	0.71	0.00	0.00	0.53	-0.22	-0.29	-0.31	0.53	A-	A-	A-	A+	-0.65	0.06	-6.57	0.84	-5.97	0.73

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
199	659661	10	5437	0.63	0.08	0.63	0.20	0.09	0.00	0.00	0.50	-0.23	0.50	-0.28	-0.22	A-	A+	A+	A+	-0.23	0.06	-3.61	0.92	-4.09	0.85
200	659666	10	5437	0.57	0.57	0.11	0.20	0.12	0.00	0.00	0.42	0.42	-0.24	-0.16	-0.21	A+	A-	A-	A+	0.09	0.06	-1.11	0.98	-0.86	0.97
201	659699	10	5437	0.69	0.08	0.09	0.69	0.13	0.00	0.00	0.47	-0.26	-0.24	0.47	-0.22	A+	A+	A+	A+	-0.55	0.06	-4.38	0.89	-3.91	0.82
202	660367	10	5437	0.50	0.50	0.18	0.24	0.08	0.00	0.00	0.27	0.27	-0.19	0.00	-0.22	A+	A+	A-	A-	0.42	0.06	5.33	1.12	5.17	1.17
203	663576	10	5437	0.53	0.10	0.26	0.11	0.53	0.00	0.00	0.46	-0.25	-0.21	-0.19	0.46	A-	A-	A+	A+	0.29	0.06	-1.85	0.96	-1.58	0.95
204	663580	10	5437	0.80	0.06	0.05	0.08	0.80	0.00	0.00	0.53	-0.28	-0.26	-0.30	0.53	A+	A+	A-	A-	-1.24	0.07	-6.22	0.79	-6.72	0.59
205	664170	10	5437	0.38	0.38	0.22	0.23	0.16	0.00	0.00	0.33	0.33	-0.16	-0.04	-0.19	A+	A-	A+	A-	1.02	0.06	3.85	1.10	4.17	1.15
206	664817	10	5437	0.40	0.17	0.20	0.23	0.40	0.00	0.00	0.36	-0.14	-0.12	-0.17	0.36	A-	A-	A-	A+	0.94	0.06	3.56	1.09	4.65	1.17
207	664832	10	5437	0.25	0.29	0.15	0.25	0.31	0.00	0.00	0.01	0.10	-0.15	0.01	0.01	A-	A-	A-	A-	1.78	0.07	9.69	1.37	9.90	1.75
208	664833	10	5437	0.40	0.23	0.19	0.18	0.40	0.00	0.00	0.32	-0.12	-0.15	-0.12	0.32	A-	A-	A-	A+	0.95	0.06	4.01	1.10	4.68	1.17
209	654032	11	5471	0.24	0.17	0.41	0.18	0.24	0.00	0.00	0.07	-0.07	0.11	-0.15	0.07	A-	A-	A+	A-	1.83	0.07	8.26	1.32	9.90	1.73
210	654386	11	5471	0.38	0.36	0.14	0.38	0.13	0.00	0.00	0.25	-0.02	-0.18	0.25	-0.15	A+	A+	A-	A+	1.04	0.06	5.23	1.14	6.43	1.24
211	655218	11	5471	0.34	0.17	0.34	0.11	0.38	0.00	0.00	0.06	-0.30	0.06	-0.16	0.27	A+	A+	A+	A-	1.21	0.06	9.90	1.34	9.90	1.48
212	656085	11	5471	0.73	0.08	0.07	0.11	0.73	0.00	0.00	0.45	-0.21	-0.23	-0.25	0.45	A+	A-	A+	A+	-0.80	0.06	-3.03	0.92	-2.07	0.89
213	656093	11	5471	0.56	0.56	0.11	0.23	0.10	0.00	0.00	0.21	0.21	-0.18	0.03	-0.19	A+	A+	A-	A+	0.13	0.06	8.34	1.19	7.38	1.26
214	656245	11	5471	0.44	0.25	0.14	0.44	0.16	0.00	0.00	0.33	-0.21	-0.18	0.33	-0.03	A-	A-	A-	A-	0.72	0.06	3.32	1.08	3.91	1.13
215	656295	11	5471	0.30	0.30	0.12	0.30	0.28	0.00	0.00	0.26	0.26	-0.25	-0.15	0.08	A-	A+	A+	A-	1.47	0.06	3.69	1.12	6.89	1.34
216	659531	11	5471	0.20	0.30	0.29	0.20	0.21	0.00	0.00	0.04	0.18	-0.08	0.04	-0.15	A-	A+	A-	A+	2.08	0.07	7.89	1.34	9.90	1.92
217	659683	11	5471	0.44	0.18	0.15	0.24	0.44	0.00	0.00	0.50	-0.20	-0.22	-0.21	0.50	A+	A+	A+	A-	0.74	0.06	-3.44	0.92	-2.88	0.91
218	660382	11	5471	0.37	0.04	0.07	0.37	0.51	0.00	0.00	0.23	-0.22	-0.23	0.23	-0.01	A-	A+	A+	A+	1.05	0.06	5.99	1.16	6.54	1.25
219	663578	11	5471	0.43	0.12	0.43	0.26	0.19	0.00	0.00	0.31	-0.23	0.31	-0.08	-0.10	A-	A+	A+	A-	0.75	0.06	4.15	1.10	3.85	1.12
220	663581	11	5471	0.57	0.16	0.13	0.57	0.13	0.00	0.00	0.46	-0.24	-0.21	0.46	-0.18	A-	A+	A+	A-	0.06	0.06	-4.42	0.91	-3.37	0.89
221	663622	11	5471	0.58	0.58	0.13	0.10	0.19	0.00	0.00	0.39	0.39	-0.23	-0.25	-0.09	A-	A-	A-	A+	0.02	0.06	0.34	1.01	0.51	1.02
222	664834	11	5471	0.38	0.28	0.16	0.38	0.18	0.00	0.00	0.17	0.04	-0.17	0.17	-0.09	A+	A+	A+	A+	1.01	0.06	9.21	1.25	8.64	1.33
223	664835	11	5471	0.39	0.39	0.15	0.15	0.31	0.00	0.00	0.42	0.42	-0.24	-0.25	-0.06	A-	A+	A+	A-	0.98	0.06	-1.34	0.97	0.53	1.02
224	666016	11	5471	0.70	0.70	0.10	0.13	0.07	0.00	0.00	0.55	0.55	-0.24	-0.33	-0.25	A+	A-	A-	A-	-0.59	0.06	-6.02	0.85	-4.50	0.79
225	624990	12	5393	0.56	0.16	0.17	0.56	0.10	0.00	0.00	0.53	-0.25	-0.26	0.53	-0.23	A-	A-	A-	A-	0.12	0.06	-6.70	0.86	-6.14	0.81
226	654811	12	5393	0.58	0.58	0.09	0.28	0.06	0.00	0.00	0.36	0.36	-0.18	-0.17	-0.19	A+	A-	A-	A+	0.04	0.06	0.40	1.01	1.65	1.06
227	654813	12	5393	0.24	0.24	0.25	0.21	0.31	0.00	0.00	0.18	0.18	-0.15	-0.08	0.05	A-	A-	A-	A-	1.85	0.07	3.60	1.13	6.38	1.42
228	656222	12	5393	0.16	0.26	0.33	0.25	0.16	0.00	0.00	-0.06	-0.08	0.04	0.09	-0.06	A-	A-	A+	A+	2.46	0.08	6.39	1.33	9.90	2.38
229	656242	12	5393	0.35	0.14	0.11	0.35	0.40	0.00	0.00	0.24	-0.19	-0.15	0.24	0.00	A-	A-	A+	A+	1.19	0.06	5.12	1.15	6.22	1.26
230	658182	12	5393	0.55	0.12	0.17	0.15	0.55	0.00	0.00	0.50	-0.20	-0.25	-0.24	0.50	A+	A+	A+	A-	0.14	0.06	-2.55	0.95	-2.34	0.92
231	659532	12	5393	0.39	0.39	0.17	0.19	0.24	0.00	0.00	0.33	0.33	-0.10	-0.23	-0.08	A-	A+	A+	A+	0.94	0.06	3.05	1.08	3.62	1.13

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
232	659535	12	5393	0.34	0.50	0.07	0.34	0.09	0.00	0.00	0.16	0.11	-0.26	0.16	-0.22	A+	A+	A-	A+	1.24	0.06	7.39	1.22	8.39	1.37
233	659701	12	5393	0.63	0.21	0.07	0.63	0.08	0.00	0.00	0.43	-0.23	-0.24	0.43	-0.17	A+	A-	A-	A+	-0.23	0.06	-3.33	0.93	-2.50	0.90
234	660371	12	5393	0.49	0.10	0.14	0.49	0.27	0.00	0.00	0.32	-0.23	-0.16	0.32	-0.07	A+	A+	A+	A+	0.47	0.06	3.51	1.08	2.58	1.08
235	662914	12	5393	0.72	0.10	0.72	0.11	0.07	0.00	0.00	0.48	-0.25	0.48	-0.26	-0.21	A-	A-	A+	A+	-0.70	0.06	-3.79	0.90	-3.57	0.82
236	663588	12	5393	0.46	0.46	0.19	0.19	0.16	0.00	0.00	0.39	0.39	-0.20	-0.19	-0.11	A+	A+	A+	A-	0.61	0.06	0.40	1.01	0.01	1.00
237	663593	12	5393	0.35	0.09	0.18	0.35	0.38	0.00	0.00	0.08	-0.18	-0.14	0.08	0.14	A-	A-	A-	A+	1.18	0.06	9.90	1.38	9.90	1.51
238	664831	12	5393	0.53	0.08	0.27	0.12	0.53	0.00	0.00	0.36	-0.24	-0.07	-0.26	0.36	A+	A-	A+	A-	0.26	0.06	2.80	1.06	3.03	1.10
239	664836	12	5393	0.31	0.13	0.31	0.24	0.32	0.00	0.00	0.21	-0.15	0.21	-0.09	-0.02	A+	A+	A+	A-	1.41	0.06	6.39	1.20	7.40	1.36
240	665977	12	5393	0.53	0.13	0.53	0.24	0.10	0.00	0.00	0.46	-0.24	0.46	-0.20	-0.19	A+	A+	A+	A+	0.28	0.06	-3.36	0.93	-3.70	0.89
241	634557	13	5426	0.39	0.24	0.39	0.19	0.17	0.00	0.00	0.36	-0.19	0.36	-0.10	-0.13	A-	A+	A+	A-	0.96	0.06	1.17	1.03	1.60	1.06
242	653087	13	5426	0.61	0.06	0.07	0.61	0.26	0.00	0.00	0.46	-0.22	-0.20	0.46	-0.27	A-	A-	A-	A-	-0.11	0.06	-2.16	0.95	-2.40	0.91
243	654028	13	5426	0.56	0.09	0.18	0.56	0.17	0.00	0.00	0.42	-0.21	-0.24	0.42	-0.15	A+	A-	A-	A+	0.14	0.06	-0.54	0.99	-1.68	0.94
244	656083	13	5426	0.26	0.29	0.21	0.24	0.26	0.00	0.00	0.17	0.01	0.04	-0.21	0.17	A+	A+	A+	A+	1.74	0.07	5.65	1.21	8.13	1.50
245	658176	13	5426	0.38	0.24	0.16	0.21	0.38	0.00	0.00	0.26	-0.03	-0.18	-0.10	0.26	A+	A-	A+	A+	1.04	0.06	4.84	1.13	5.01	1.19
246	658179	13	5426	0.47	0.15	0.47	0.25	0.13	0.00	0.00	0.44	-0.20	0.44	-0.19	-0.19	A-	A+	A+	A-	0.58	0.06	-2.63	0.94	-2.50	0.92
247	659684	13	5426	0.47	0.47	0.03	0.12	0.38	0.00	0.00	0.26	0.26	-0.18	-0.19	-0.06	A+	A-	A-	A+	0.59	0.06	8.05	1.20	8.08	1.28
248	659703	13	5426	0.45	0.14	0.19	0.22	0.45	0.00	0.00	0.22	-0.06	-0.09	-0.12	0.22	A+	A-	A+	A+	0.68	0.06	9.89	1.25	9.24	1.33
249	659737	13	5426	0.64	0.08	0.21	0.07	0.64	0.00	0.00	0.54	-0.23	-0.33	-0.24	0.54	A-	B-	A-	A+	-0.25	0.06	-7.26	0.84	-6.53	0.75
250	663590	13	5426	0.23	0.15	0.09	0.23	0.54	0.00	0.00	-0.02	-0.14	-0.27	-0.02	0.27	A+	A-	A-	A+	1.95	0.07	8.30	1.34	9.90	1.82
251	663592	13	5426	0.71	0.71	0.12	0.08	0.08	0.00	0.00	0.38	0.38	-0.17	-0.25	-0.16	A+	A+	A-	A-	-0.67	0.06	-0.90	0.98	1.93	1.11
252	663594	13	5426	0.50	0.50	0.09	0.09	0.31	0.00	0.00	0.30	0.30	-0.24	-0.22	-0.03	A-	A-	A+	A-	0.44	0.06	5.46	1.13	4.54	1.15
253	663598	13	5426	0.50	0.10	0.14	0.50	0.26	0.00	0.00	0.39	-0.24	-0.11	0.39	-0.18	A+	A+	A+	A-	0.44	0.06	0.64	1.01	0.48	1.02
254	663624	13	5426	0.44	0.17	0.22	0.16	0.44	0.00	0.00	0.40	-0.18	-0.10	-0.23	0.40	A-	A+	A+	A+	0.71	0.06	0.36	1.01	0.78	1.03
255	665507	13	5426	0.22	0.22	0.26	0.25	0.27	0.00	0.00	0.15	0.15	-0.14	-0.11	0.11	A-	A-	A+	A-	1.97	0.07	5.48	1.22	8.86	1.65
256	665512	13	5426	0.46	0.18	0.46	0.18	0.17	0.00	0.00	0.37	-0.12	0.37	-0.24	-0.11	A+	A+	A+	A-	0.62	0.06	2.38	1.06	2.03	1.07
257	623293	14	5494	0.51	0.09	0.08	0.32	0.51	0.00	0.00	0.37	-0.24	-0.21	-0.13	0.37	A-	A+	A+	A-	0.34	0.06	1.45	1.03	0.26	1.01
258	635330	14	5494	0.48	0.15	0.19	0.18	0.48	0.00	0.00	0.40	-0.11	-0.27	-0.14	0.40	A+	A+	A+	A-	0.52	0.06	1.09	1.02	0.38	1.01
259	653088	14	5494	0.79	0.79	0.07	0.07	0.06	0.00	0.00	0.51	0.51	-0.27	-0.29	-0.26	A+	A-	A-	A+	-1.18	0.07	-6.39	0.79	-6.54	0.59
260	656224	14	5494	0.26	0.33	0.26	0.30	0.11	0.00	0.00	0.29	-0.01	0.29	-0.12	-0.21	A-	A+	A+	A+	1.69	0.07	1.07	1.04	6.17	1.36
261	656241	14	5494	0.37	0.37	0.18	0.19	0.26	0.00	0.00	0.23	0.23	-0.09	-0.04	-0.14	A-	A+	A-	A+	1.06	0.06	7.75	1.22	7.78	1.31
262	658121	14	5494	0.26	0.22	0.14	0.38	0.26	0.00	0.00	0.30	-0.10	-0.22	-0.03	0.30	A-	A+	A+	A-	1.71	0.07	1.85	1.06	2.46	1.13
263	659521	14	5494	0.36	0.14	0.17	0.33	0.36	0.00	0.00	0.23	-0.23	-0.13	0.04	0.23	A+	A+	A+	A-	1.15	0.06	7.38	1.22	7.51	1.32
264	659534	14	5494	0.49	0.11	0.17	0.49	0.23	0.00	0.00	0.20	-0.14	-0.13	0.20	-0.01	A-	A+	A-	A-	0.46	0.06	9.90	1.27	9.90	1.36

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
265	659679	14	5494	0.64	0.18	0.04	0.14	0.64	0.00	0.00	0.23	-0.14	-0.21	-0.04	0.23	A+	A-	A-	A+	-0.28	0.06	6.36	1.15	5.94	1.28
266	660374	14	5494	0.37	0.07	0.44	0.37	0.11	0.00	0.00	0.41	-0.26	-0.13	0.41	-0.21	A+	A-	A-	A+	1.05	0.06	-0.71	0.98	0.17	1.01
267	662913	14	5494	0.75	0.10	0.75	0.10	0.05	0.00	0.00	0.46	-0.26	0.46	-0.22	-0.25	A+	A+	A-	A+	-0.88	0.06	-5.22	0.85	-3.50	0.80
268	663595	14	5494	0.25	0.13	0.25	0.39	0.23	0.00	0.00	0.09	-0.10	0.09	0.14	-0.16	A-	A-	A-	A-	1.78	0.07	7.89	1.30	9.86	1.65
269	663596	14	5494	0.29	0.13	0.12	0.45	0.29	0.00	0.00	0.37	-0.16	-0.18	-0.11	0.37	A-	A-	A-	A-	1.50	0.06	-0.61	0.98	0.91	1.04
270	663804	14	5494	0.60	0.15	0.60	0.18	0.07	0.00	0.00	0.55	-0.23	0.55	-0.35	-0.21	A+	A-	A-	A-	-0.07	0.06	-7.17	0.85	-5.12	0.81
271	663809	14	5494	0.58	0.58	0.16	0.15	0.11	0.00	0.00	0.42	0.42	-0.16	-0.22	-0.22	A-	A-	A+	A-	0.02	0.06	0.17	1.00	0.43	1.02
272	665505	14	5494	0.69	0.12	0.69	0.11	0.07	0.00	0.00	0.54	-0.30	0.54	-0.27	-0.25	A+	A+	A-	A-	-0.59	0.06	-7.26	0.83	-6.37	0.70
273	634547	15	5400	0.47	0.26	0.16	0.47	0.11	0.01	0.00	0.39	-0.13	-0.17	0.39	-0.24	A-	A-	A-	A+	0.59	0.06	0.10	1.00	0.27	1.01
274	654026	15	5400	0.72	0.04	0.19	0.72	0.05	0.00	0.00	0.38	-0.23	-0.19	0.38	-0.22	A-	A-	A-	A-	-0.70	0.06	-0.81	0.98	0.03	1.00
275	654393	15	5400	0.63	0.06	0.13	0.63	0.17	0.00	0.00	0.25	-0.16	-0.22	0.25	-0.01	A+	A-	A-	A+	-0.20	0.06	4.81	1.11	6.59	1.27
276	656221	15	5400	0.30	0.17	0.39	0.14	0.30	0.00	0.00	0.35	-0.19	0.01	-0.27	0.35	A-	A-	A+	A-	1.48	0.06	0.70	1.02	3.11	1.15
277	656235	15	5400	0.52	0.20	0.15	0.13	0.52	0.00	0.00	0.42	-0.16	-0.18	-0.23	0.42	A-	A-	A-	A-	0.35	0.06	1.04	1.02	0.30	1.01
278	656244	15	5400	0.35	0.14	0.18	0.33	0.35	0.00	0.00	0.39	-0.28	-0.13	-0.08	0.39	A-	A-	A+	A-	1.20	0.06	1.56	1.04	1.67	1.07
279	659536	15	5400	0.58	0.12	0.14	0.58	0.16	0.00	0.00	0.45	-0.21	-0.20	0.45	-0.22	A-	A-	A-	A+	0.04	0.06	-1.38	0.97	-1.32	0.96
280	659671	15	5400	0.47	0.13	0.14	0.26	0.47	0.00	0.00	0.37	-0.02	-0.17	-0.27	0.37	A+	A-	A-	A+	0.61	0.06	1.07	1.02	1.32	1.04
281	660385	15	5400	0.66	0.66	0.15	0.11	0.08	0.00	0.00	0.48	0.48	-0.24	-0.31	-0.17	A-	A-	A-	A+	-0.37	0.06	-2.88	0.93	-1.36	0.94
282	663597	15	5400	0.47	0.21	0.47	0.18	0.13	0.00	0.00	0.38	-0.24	0.38	-0.17	-0.07	A+	A+	A+	A-	0.57	0.06	2.00	1.05	1.48	1.05
283	663599	15	5400	0.23	0.25	0.07	0.23	0.44	0.00	0.00	0.11	-0.23	-0.23	0.11	0.23	A+	A-	A-	A+	1.89	0.07	7.19	1.28	8.97	1.62
284	663806	15	5400	0.31	0.37	0.18	0.31	0.14	0.00	0.00	0.01	0.21	-0.18	0.01	-0.11	A+	A+	A+	A-	1.45	0.06	9.90	1.42	9.90	1.65
285	663808	15	5400	0.49	0.49	0.19	0.18	0.13	0.00	0.00	0.34	0.34	-0.12	-0.13	-0.21	A-	A+	A+	A-	0.46	0.06	3.35	1.08	3.56	1.11
286	664286	15	5400	0.59	0.59	0.07	0.14	0.19	0.00	0.00	0.33	0.33	-0.21	-0.13	-0.15	A-	A-	A+	A+	-0.03	0.06	4.03	1.09	2.53	1.09
287	664818	15	5400	0.35	0.40	0.35	0.14	0.11	0.00	0.00	0.15	0.09	0.15	-0.21	-0.13	A+	A+	A-	A-	1.21	0.06	7.27	1.21	6.96	1.29
288	665511	15	5400	0.38	0.19	0.38	0.12	0.31	0.00	0.00	0.25	-0.07	0.25	-0.18	-0.08	A+	A-	A+	A+	1.05	0.06	6.78	1.19	6.90	1.26
289	617584	16	5397	0.35	0.18	0.35	0.17	0.29	0.00	0.00	0.24	-0.17	0.24	-0.13	0.01	A-	A+	A+	A-	1.19	0.06	5.88	1.17	6.90	1.30
290	634398	16	5397	0.42	0.33	0.42	0.11	0.14	0.00	0.00	0.31	0.04	0.31	-0.29	-0.22	A-	A+	A+	A-	0.86	0.06	5.11	1.13	5.51	1.20
291	635239	16	5397	0.70	0.06	0.14	0.70	0.09	0.00	0.00	0.44	-0.22	-0.20	0.44	-0.26	A+	A+	A+	A+	-0.63	0.06	-3.28	0.92	-2.02	0.89
292	654388	16	5397	0.64	0.18	0.08	0.64	0.10	0.00	0.00	0.43	-0.16	-0.23	0.43	-0.26	A-	A-	A-	A+	-0.25	0.06	-1.29	0.97	-2.10	0.91
293	654395	16	5397	0.72	0.72	0.16	0.07	0.04	0.00	0.00	0.46	0.46	-0.25	-0.27	-0.20	A-	A-	A-	A+	-0.73	0.06	-2.26	0.94	-2.45	0.87
294	656082	16	5397	0.34	0.20	0.32	0.14	0.34	0.00	0.00	0.30	-0.07	-0.10	-0.19	0.30	A+	A+	A-	A-	1.26	0.06	3.54	1.11	4.60	1.20
295	656087	16	5397	0.62	0.17	0.10	0.62	0.10	0.00	0.00	0.50	-0.24	-0.26	0.50	-0.24	A-	A-	A+	A+	-0.17	0.06	-5.96	0.87	-5.11	0.80
296	659525	16	5397	0.64	0.14	0.08	0.64	0.15	0.00	0.00	0.42	-0.18	-0.25	0.42	-0.20	A+	A-	A-	A+	-0.26	0.06	-2.32	0.95	-0.68	0.97
297	659685	16	5397	0.44	0.12	0.44	0.30	0.14	0.00	0.00	0.33	-0.20	0.33	-0.14	-0.09	A+	A+	A+	A+	0.76	0.06	4.01	1.10	4.01	1.14

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
298	663568	16	5397	0.46	0.25	0.46	0.13	0.15	0.00	0.00	0.36	-0.11	0.36	-0.21	-0.16	A-	A-	A-	A+	0.63	0.06	3.99	1.10	4.42	1.15
299	663569	16	5397	0.44	0.17	0.44	0.23	0.16	0.00	0.00	0.43	-0.15	0.43	-0.20	-0.19	A-	A+	A-	A-	0.75	0.06	-0.59	0.99	0.20	1.01
300	663805	16	5397	0.34	0.25	0.30	0.34	0.11	0.00	0.00	0.32	-0.17	-0.03	0.32	-0.20	A+	A-	A+	A+	1.25	0.06	2.66	1.08	4.97	1.21
301	663807	16	5397	0.61	0.12	0.15	0.12	0.61	0.00	0.00	0.53	-0.28	-0.25	-0.24	0.53	A+	A-	A-	A-	-0.11	0.06	-6.33	0.87	-5.74	0.79
302	663988	16	5397	0.58	0.17	0.58	0.14	0.10	0.00	0.00	0.46	-0.18	0.46	-0.22	-0.25	A-	A-	A-	A+	0.02	0.06	-1.62	0.97	-1.96	0.93
303	665499	16	5397	0.60	0.09	0.09	0.60	0.22	0.00	0.00	0.43	-0.17	-0.18	0.43	-0.25	A-	A+	A-	A+	-0.07	0.06	-0.21	1.00	-0.21	0.99
304	666018	16	5397	0.36	0.31	0.11	0.21	0.36	0.00	0.00	0.09	-0.01	-0.19	0.05	0.09	A+	A-	A-	A+	1.16	0.06	9.90	1.37	9.90	1.49
305	624359	17	5519	0.55	0.11	0.55	0.21	0.13	0.00	0.00	0.39	-0.15	0.39	-0.20	-0.19	A-	A-	A+	A-	0.14	0.06	1.94	1.04	0.67	1.02
306	635242	17	5519	0.57	0.14	0.16	0.57	0.13	0.00	0.00	0.42	-0.22	-0.17	0.42	-0.19	A+	A+	A-	A+	0.07	0.06	0.35	1.01	-0.80	0.97
307	635459	17	5519	0.50	0.11	0.11	0.50	0.27	0.00	0.00	0.44	-0.17	-0.22	0.44	-0.21	A-	A+	A+	A-	0.38	0.06	1.55	1.03	2.86	1.10
308	656227	17	5519	0.61	0.07	0.12	0.61	0.19	0.00	0.00	0.44	-0.14	-0.22	0.44	-0.25	A+	A+	A+	A+	-0.17	0.06	-1.78	0.96	-1.25	0.95
309	658151	17	5519	0.52	0.23	0.15	0.52	0.09	0.00	0.00	0.32	-0.17	-0.10	0.32	-0.17	A+	A-	A-	A+	0.29	0.06	4.92	1.11	4.84	1.18
310	659523	17	5519	0.34	0.31	0.34	0.14	0.21	0.00	0.00	0.21	0.12	0.21	-0.19	-0.21	A-	A+	A-	A-	1.25	0.06	8.24	1.25	7.83	1.36
311	659686	17	5519	0.34	0.34	0.23	0.24	0.19	0.00	0.00	0.22	0.22	-0.08	-0.14	-0.01	A-	A+	A+	A+	1.24	0.06	5.25	1.15	5.00	1.22
312	659735	17	5519	0.42	0.17	0.23	0.18	0.42	0.00	0.00	0.31	-0.10	-0.11	-0.17	0.31	A+	A+	A+	A+	0.80	0.06	4.87	1.12	4.15	1.15
313	660375	17	5519	0.56	0.56	0.17	0.13	0.13	0.00	0.00	0.48	0.48	-0.21	-0.29	-0.18	A-	A-	A-	A+	0.09	0.06	-3.83	0.92	-3.82	0.86
314	663567	17	5519	0.30	0.19	0.25	0.25	0.30	0.00	0.00	0.31	-0.12	-0.12	-0.09	0.31	A-	A-	A-	A-	1.46	0.06	3.24	1.10	2.96	1.14
315	663629	17	5519	0.66	0.11	0.10	0.13	0.66	0.00	0.00	0.54	-0.25	-0.27	-0.27	0.54	A+	A-	A+	A-	-0.42	0.06	-5.68	0.87	-4.98	0.77
316	663995	17	5519	0.39	0.30	0.14	0.16	0.39	0.00	0.00	0.25	0.04	-0.21	-0.18	0.25	A-	A+	A+	A-	0.93	0.06	7.79	1.21	7.07	1.28
317	663997	17	5519	0.47	0.12	0.19	0.47	0.22	0.00	0.00	0.37	-0.21	-0.16	0.37	-0.13	A-	A-	A+	A-	0.53	0.06	3.52	1.08	3.65	1.13
318	664816	17	5519	0.24	0.33	0.32	0.12	0.24	0.00	0.00	0.29	-0.01	-0.11	-0.21	0.29	A-	A-	A-	A+	1.85	0.07	1.77	1.06	4.48	1.29
319	665975	17	5519	0.71	0.06	0.12	0.11	0.71	0.00	0.00	0.56	-0.24	-0.31	-0.30	0.56	A-	A-	A-	A+	-0.68	0.06	-8.41	0.79	-6.75	0.66
320	666022	17	5519	0.73	0.12	0.09	0.73	0.07	0.00	0.00	0.49	-0.23	-0.29	0.49	-0.23	A+	A-	A-	A+	-0.79	0.06	-7.03	0.81	-4.26	0.76
321	620408	18	5460	0.46	0.46	0.25	0.20	0.10	0.00	0.00	0.40	0.40	-0.07	-0.27	-0.20	A+	A-	A-	A-	0.67	0.06	1.82	1.04	1.40	1.05
322	621667	18	5460	0.55	0.55	0.09	0.22	0.14	0.00	0.00	0.54	0.54	-0.22	-0.33	-0.21	A-	A-	A-	A-	0.19	0.06	-6.90	0.86	-5.89	0.80
323	625835	18	5460	0.63	0.15	0.15	0.07	0.63	0.00	0.00	0.29	-0.18	-0.04	-0.23	0.29	A+	A-	A+	A+	-0.21	0.06	2.92	1.07	3.91	1.18
324	633579	18	5460	0.37	0.17	0.21	0.37	0.24	0.00	0.00	0.42	-0.18	-0.10	0.42	-0.22	A-	A-	A+	A+	1.11	0.06	-0.80	0.98	0.28	1.01
325	653083	18	5460	0.81	0.04	0.05	0.81	0.10	0.00	0.00	0.34	-0.18	-0.18	0.34	-0.19	A-	A-	A-	A+	-1.26	0.07	-2.00	0.93	-0.90	0.93
326	659527	18	5460	0.45	0.45	0.25	0.14	0.16	0.00	0.00	0.45	0.45	-0.09	-0.24	-0.26	A+	A+	A-	A-	0.71	0.06	-1.12	0.97	-0.85	0.97
327	659540	18	5460	0.73	0.12	0.07	0.08	0.73	0.00	0.00	0.48	-0.18	-0.26	-0.31	0.48	A-	A-	A-	A+	-0.73	0.06	-5.36	0.86	-3.35	0.81
328	659673	18	5460	0.46	0.16	0.46	0.23	0.15	0.00	0.00	0.30	-0.09	0.30	-0.10	-0.20	A+	A+	A-	A+	0.67	0.06	5.02	1.12	4.21	1.15
329	659694	18	5460	0.48	0.17	0.20	0.48	0.14	0.00	0.00	0.36	-0.13	-0.10	0.36	-0.25	A-	A-	A+	A+	0.54	0.06	2.99	1.07	2.17	1.07
330	662919	18	5460	0.61	0.14	0.61	0.12	0.12	0.00	0.00	0.44	-0.17	0.44	-0.20	-0.26	A+	A-	A+	A-	-0.13	0.06	-1.44	0.97	-2.22	0.91

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
331	662923	18	5460	0.46	0.46	0.27	0.16	0.11	0.00	0.00	0.36	0.36	-0.07	-0.19	-0.25	A-	A-	A+	A-	0.66	0.06	2.44	1.06	2.19	1.07
332	662976	18	5460	0.43	0.21	0.43	0.21	0.14	0.00	0.00	0.28	-0.03	0.28	-0.19	-0.13	A-	A-	A-	A-	0.79	0.06	5.97	1.15	5.24	1.19
333	663618	18	5460	0.36	0.36	0.28	0.18	0.18	0.00	0.00	0.34	0.34	-0.14	-0.15	-0.10	A-	A-	A+	A+	1.19	0.06	1.45	1.04	2.13	1.08
334	663992	18	5460	0.32	0.11	0.46	0.11	0.32	0.00	0.00	0.15	-0.20	0.14	-0.24	0.15	A+	A+	A-	A-	1.40	0.06	9.42	1.30	9.84	1.49
335	663996	18	5460	0.54	0.13	0.13	0.54	0.19	0.00	0.00	0.45	-0.23	-0.24	0.45	-0.16	A-	A-	A+	A-	0.24	0.06	-1.59	0.97	-1.71	0.94
336	665929	18	5460	0.70	0.70	0.07	0.17	0.05	0.00	0.00	0.38	0.38	-0.26	-0.14	-0.24	A-	A-	A+	A-	-0.61	0.06	-0.94	0.97	2.49	1.14
337	625825	19	5404	0.69	0.12	0.10	0.69	0.09	0.00	0.00	0.49	-0.27	-0.29	0.49	-0.18	A+	A-	A+	A-	-0.52	0.06	-4.81	0.88	-4.03	0.81
338	635463	19	5404	0.40	0.31	0.15	0.40	0.14	0.00	0.00	0.38	-0.18	-0.17	0.38	-0.12	A+	A+	A-	A-	0.94	0.06	1.17	1.03	2.15	1.08
339	654394	19	5404	0.52	0.08	0.10	0.29	0.52	0.01	0.00	0.34	-0.24	-0.24	-0.06	0.34	A+	A-	A-	A-	0.33	0.06	3.13	1.07	3.54	1.12
340	655216	19	5404	0.66	0.06	0.21	0.66	0.06	0.00	0.00	0.30	-0.02	-0.26	0.30	-0.11	A+	A-	A-	A+	-0.37	0.06	3.36	1.08	1.94	1.09
341	656228	19	5404	0.47	0.10	0.47	0.11	0.32	0.00	0.00	0.25	-0.12	0.25	-0.25	-0.02	A-	A+	A-	A+	0.60	0.06	8.35	1.20	7.82	1.27
342	656232	19	5404	0.32	0.12	0.25	0.31	0.32	0.00	0.00	0.09	-0.16	-0.05	0.08	0.09	A+	A-	A+	A+	1.40	0.06	9.90	1.39	9.90	1.60
343	659676	19	5404	0.49	0.49	0.33	0.11	0.07	0.00	0.00	0.46	0.46	-0.23	-0.25	-0.17	A-	A-	A+	A+	0.50	0.06	-2.48	0.95	-2.49	0.92
344	660369	19	5404	0.77	0.08	0.77	0.09	0.07	0.00	0.00	0.44	-0.27	0.44	-0.23	-0.20	A+	A-	A-	A-	-1.01	0.07	-2.22	0.93	-3.01	0.81
345	662915	19	5404	0.61	0.08	0.07	0.61	0.24	0.00	0.00	0.42	-0.29	-0.26	0.42	-0.13	A-	A+	A+	A+	-0.12	0.06	-0.69	0.98	-1.08	0.96
346	662916	19	5404	0.61	0.61	0.17	0.11	0.11	0.00	0.00	0.46	0.46	-0.23	-0.25	-0.19	A-	A-	A-	A+	-0.10	0.06	-2.14	0.95	-2.57	0.90
347	662918	19	5404	0.44	0.21	0.20	0.15	0.44	0.00	0.00	0.34	-0.10	-0.15	-0.20	0.34	A+	A+	A-	A-	0.75	0.06	2.95	1.07	2.25	1.07
348	662922	19	5404	0.68	0.68	0.10	0.11	0.11	0.00	0.00	0.48	0.48	-0.26	-0.25	-0.21	A+	A+	A-	B-	-0.49	0.06	-3.31	0.92	-3.05	0.86
349	663998	19	5404	0.49	0.17	0.16	0.49	0.17	0.00	0.00	0.39	-0.19	-0.21	0.39	-0.12	A+	A-	A-	A+	0.48	0.06	0.14	1.00	-0.27	0.99
350	664000	19	5404	0.43	0.19	0.14	0.23	0.43	0.00	0.00	0.35	-0.05	-0.21	-0.19	0.35	A+	A-	A-	A+	0.79	0.06	2.43	1.06	3.00	1.10
351	664173	19	5404	0.60	0.14	0.60	0.13	0.13	0.00	0.00	0.41	-0.22	0.41	-0.20	-0.16	A+	A+	A+	A+	-0.05	0.06	-0.37	0.99	-0.75	0.97
352	704495	19	5404	0.39	0.12	0.13	0.35	0.39	0.00	0.00	0.19	-0.20	-0.09	0.02	0.19	A-	A-	A+	A-	1.02	0.06	9.03	1.25	9.03	1.36
353	630593	20	5450	0.48	0.16	0.13	0.48	0.23	0.00	0.00	0.46	-0.08	-0.24	0.46	-0.27	A+	A-	A+	A+	0.53	0.06	-3.04	0.93	-2.73	0.91
354	632272	20	5450	0.50	0.15	0.20	0.50	0.15	0.00	0.00	0.37	-0.13	-0.18	0.37	-0.18	A-	A-	A+	A+	0.42	0.06	2.28	1.05	1.33	1.04
355	654024	20	5450	0.34	0.21	0.34	0.34	0.11	0.00	0.00	0.31	-0.16	0.31	-0.05	-0.16	A-	A+	A+	A-	1.25	0.06	2.88	1.08	4.26	1.19
356	655222	20	5450	0.67	0.16	0.08	0.09	0.67	0.00	0.00	0.47	-0.16	-0.26	-0.31	0.47	A-	A+	A+	A+	-0.45	0.06	-4.85	0.89	-2.96	0.86
357	656091	20	5450	0.64	0.16	0.06	0.64	0.14	0.00	0.00	0.40	-0.22	-0.23	0.40	-0.16	A-	A-	A+	A+	-0.29	0.06	-1.43	0.97	-1.33	0.94
358	658127	20	5450	0.34	0.14	0.15	0.37	0.34	0.00	0.00	0.38	-0.21	-0.17	-0.09	0.38	A-	A-	A+	A+	1.25	0.06	0.29	1.01	2.27	1.10
359	658155	20	5450	0.66	0.66	0.09	0.07	0.17	0.00	0.00	0.45	0.45	-0.27	-0.26	-0.17	A-	A-	A-	A-	-0.42	0.06	-1.91	0.95	-2.40	0.89
360	658183	20	5450	0.54	0.21	0.14	0.54	0.12	0.00	0.00	0.39	-0.14	-0.28	0.39	-0.12	A+	A+	A+	A+	0.23	0.06	0.06	1.00	-0.78	0.97
361	659702	20	5450	0.71	0.11	0.09	0.71	0.08	0.00	0.00	0.52	-0.24	-0.24	0.52	-0.31	A+	A+	A+	A+	-0.70	0.06	-6.07	0.85	-4.18	0.78
362	660372	20	5450	0.42	0.42	0.33	0.12	0.12	0.00	0.00	0.26	0.26	0.03	-0.28	-0.15	A-	A+	A+	A-	0.81	0.06	6.37	1.16	7.03	1.26
363	660378	20	5450	0.65	0.09	0.15	0.10	0.65	0.00	0.00	0.35	-0.19	-0.13	-0.21	0.35	A-	A-	A-	A-	-0.37	0.06	0.77	1.02	0.55	1.03

Table J–6 (continued). Biology Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
364	662979	20	5450	0.45	0.16	0.45	0.25	0.13	0.00	0.00	0.25	-0.22	0.25	0.00	-0.11	A+	A-	A-	A+	0.67	0.06	8.32	1.21	7.32	1.26
365	663999	20	5450	0.39	0.08	0.33	0.39	0.20	0.00	0.00	0.24	-0.24	-0.09	0.24	-0.02	A+	A+	A+	A-	0.98	0.06	6.61	1.18	6.29	1.25
366	664003	20	5450	0.41	0.25	0.41	0.22	0.12	0.00	0.00	0.41	-0.15	0.41	-0.15	-0.22	A-	A-	A-	A-	0.87	0.06	-1.61	0.96	-0.77	0.97
367	664840	20	5450	0.50	0.20	0.12	0.18	0.50	0.00	0.00	0.41	-0.09	-0.27	-0.20	0.41	A-	A+	A+	A-	0.43	0.06	0.18	1.00	-0.53	0.98
368	664841	20	5450	0.30	0.21	0.30	0.30	0.19	0.00	0.00	0.17	0.06	-0.12	0.17	-0.11	A-	A-	A-	A+	1.49	0.06	8.03	1.27	9.39	1.51

Table J–7. Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	398587	0	107813	0.64	0.14	0.09	0.64	0.12	0.00	0.00	0.44	-0.17	-0.24	0.44	-0.25					0.19	0.01	4.82	1.03	2.05	1.02
2	398590	0	107813	0.62	0.12	0.06	0.62	0.20	0.00	0.00	0.35	-0.16	-0.18	0.35	-0.18					0.60	0.01	9.90	1.12	9.90	1.17
3	398591	0	107813	0.69	0.14	0.69	0.09	0.08	0.00	0.00	0.35	-0.17	0.35	-0.15	-0.20					0.31	0.01	9.90	1.08	9.33	1.08
4	398592	0	107813	0.68	0.14	0.10	0.08	0.68	0.00	0.00	0.49	-0.29	-0.21	-0.23	0.49					0.08	0.01	-8.88	0.95	-7.57	0.93
5	398593	0	107813	0.86	0.86	0.06	0.05	0.03	0.00	0.00	0.48	0.48	-0.30	-0.26	-0.22					-0.89	0.02	-9.90	0.76	-9.90	0.59
6	398594	0	107813	0.73	0.08	0.11	0.73	0.08	0.00	0.00	0.34	-0.19	-0.19	0.34	-0.14					-0.34	0.01	9.90	1.14	9.90	1.33
7	398596	0	107813	0.71	0.06	0.14	0.09	0.71	0.00	0.00	0.46	-0.27	-0.16	-0.30	0.46					0.09	0.01	-9.90	0.94	-9.18	0.91
8	398597	0	107813	0.79	0.12	0.06	0.04	0.79	0.00	0.00	0.42	-0.17	-0.27	-0.26	0.42					-0.51	0.01	-7.06	0.95	0.53	1.01
9	398598	0	107813	0.66	0.66	0.11	0.09	0.14	0.00	0.00	0.50	0.50	-0.29	-0.19	-0.26					0.52	0.01	-9.90	0.91	-9.90	0.92
10	426254	0	107813	0.75	0.17	0.75	0.05	0.03	0.00	0.00	0.32	-0.15	0.32	-0.22	-0.19					0.11	0.01	3.21	1.02	9.90	1.12
11	426255	0	107813	0.82	0.05	0.07	0.06	0.82	0.00	0.00	0.55	-0.26	-0.26	-0.37	0.55					-0.51	0.01	-9.90	0.71	-9.90	0.60
12	426256	0	107813	0.68	0.07	0.16	0.68	0.09	0.00	0.00	0.49	-0.31	-0.23	0.49	-0.23					0.23	0.01	-9.90	0.92	-9.90	0.87
13	426257	0	107813	0.74	0.10	0.09	0.06	0.74	0.00	0.00	0.53	-0.23	-0.30	-0.32	0.53					-0.73	0.01	9.90	1.09	1.26	1.02
14	426259	0	107813	0.53	0.31	0.07	0.53	0.09	0.00	0.00	0.42	-0.15	-0.27	0.42	-0.25					0.76	0.01	9.90	1.05	9.90	1.09
15	426260	0	107813	0.56	0.56	0.17	0.18	0.09	0.00	0.00	0.42	0.42	-0.21	-0.16	-0.24					0.69	0.01	9.90	1.05	9.90	1.08
16	426264	0	107813	0.51	0.12	0.51	0.17	0.20	0.00	0.00	0.35	-0.20	0.35	-0.23	-0.05					0.83	0.01	9.90	1.16	9.90	1.25
17	426265	0	107813	0.68	0.11	0.15	0.68	0.05	0.00	0.00	0.53	-0.30	-0.24	0.53	-0.27					-0.16	0.01	-2.59	0.98	-4.77	0.95
18	426266	0	107813	0.69	0.04	0.14	0.13	0.69	0.00	0.00	0.38	-0.28	-0.12	-0.23	0.38					-0.31	0.01	9.90	1.19	9.90	1.36
19	580143	0	107813	0.63	0.12	0.63	0.10	0.15	0.00	0.00	0.38	-0.09	0.38	-0.17	-0.28					0.20	0.01	9.90	1.14	9.90	1.23
20	580145	0	107813	0.63	0.04	0.14	0.19	0.63	0.00	0.00	0.52	-0.28	-0.27	-0.25	0.52					0.38	0.01	-9.90	0.92	-9.90	0.92
21	580147	0	107813	0.69	0.22	0.06	0.69	0.02	0.00	0.00	0.53	-0.33	-0.27	0.53	-0.24					-0.22	0.01	0.66	1.00	-2.41	0.97
22	580148	0	107813	0.58	0.58	0.11	0.14	0.18	0.00	0.00	0.48	0.48	-0.22	-0.24	-0.22					0.40	0.01	4.79	1.03	1.44	1.01
23	580151	0	107813	0.46	0.12	0.06	0.46	0.35	0.00	0.00	0.34	-0.14	-0.21	0.34	-0.14					1.43	0.01	9.90	1.14	9.90	1.32
24	580152	0	107813	0.56	0.07	0.21	0.15	0.56	0.00	0.00	0.45	-0.20	-0.22	-0.21	0.45					0.54	0.01	7.97	1.04	7.06	1.06
25	580154	0	107813	0.54	0.54	0.33	0.07	0.06	0.00	0.00	0.39	0.39	-0.18	-0.23	-0.18					0.95	0.01	9.90	1.09	9.90	1.15
26	580155	0	107813	0.39	0.13	0.14	0.33	0.39	0.00	0.00	0.26	-0.20	-0.21	0.05	0.26					1.64	0.01	9.90	1.23	9.90	1.41
27	584090	0	107813	0.45	0.21	0.08	0.26	0.45	0.00	0.00	0.41	-0.05	-0.31	-0.22	0.41					1.15	0.01	8.69	1.04	9.90	1.10
28	584091	0	107813	0.72	0.11	0.13	0.72	0.03	0.00	0.00	0.50	-0.31	-0.23	0.50	-0.23					-0.31	0.01	-3.49	0.98	-1.43	0.98
29	584092	0	107813	0.83	0.06	0.83	0.05	0.05	0.00	0.00	0.57	-0.32	0.57	-0.30	-0.30					-1.20	0.02	-9.82	0.90	-9.90	0.64
30	584094	0	107813	0.65	0.10	0.65	0.12	0.13	0.00	0.00	0.40	-0.24	0.40	-0.16	-0.19					0.35	0.01	9.90	1.06	9.90	1.09
31	584095	0	107813	0.69	0.16	0.10	0.69	0.05	0.00	0.00	0.38	-0.12	-0.23	0.38	-0.28					0.19	0.01	6.83	1.04	9.90	1.14
32	584096	0	107813	0.39	0.39	0.22	0.21	0.18	0.00	0.00	0.43	0.43	-0.12	-0.20	-0.20					1.81	0.01	7.97	1.04	9.90	1.25
33	584098	0	107813	0.68	0.68	0.07	0.14	0.10	0.00	0.00	0.31	0.31	-0.28	-0.14	-0.06					-0.14	0.01	9.90	1.23	9.90	1.49

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	584102	0	107813	0.50	0.32	0.50	0.08	0.09	0.00	0.00	0.29	-0.12	0.29	-0.19	-0.11					1.09	0.01	9.90	1.20	9.90	1.31
35	661600	1	4528	0.62	0.19	0.08	0.62	0.10	0.00	0.00	0.29	-0.04	-0.30	0.29	-0.15	A+	A-	A-	A+	0.38	0.06	4.47	1.12	4.36	1.20
36	661601	1	4528	0.86	0.03	0.05	0.05	0.86	0.00	0.00	0.46	-0.23	-0.24	-0.28	0.46	A+	B-	A-	A-	-1.28	0.08	-2.21	0.89	-3.54	0.67
37	661606	1	4528	0.67	0.15	0.67	0.07	0.11	0.00	0.00	0.38	-0.22	0.38	-0.25	-0.11	A+	A-	A-	A+	0.11	0.06	1.68	1.05	0.82	1.04
38	661607	1	4528	0.48	0.05	0.35	0.48	0.12	0.00	0.00	0.22	-0.30	0.04	0.22	-0.20	A+	A+	A+	A-	1.14	0.06	8.08	1.19	7.39	1.30
39	661610	1	4528	0.79	0.79	0.06	0.13	0.02	0.00	0.00	0.50	0.50	-0.28	-0.32	-0.20	A-	A-	A-	B-	-0.65	0.07	-4.20	0.84	-4.98	0.67
40	661613	1	4528	0.71	0.71	0.11	0.09	0.09	0.00	0.00	0.49	0.49	-0.16	-0.32	-0.28	A+	A-	A-	A-	-0.15	0.06	-3.25	0.90	-1.05	0.94
41	666978	1	4528	0.72	0.10	0.07	0.72	0.10	0.00	0.00	0.50	-0.29	-0.16	0.50	-0.30	A-	A+	A-	A+	-0.19	0.06	-3.82	0.88	-2.04	0.88
42	666981	1	4528	0.62	0.09	0.05	0.24	0.62	0.00	0.00	0.41	-0.27	-0.31	-0.12	0.41	A-	A+	A-	A-	0.38	0.06	1.57	1.04	1.91	1.08
43	666985	1	4528	0.79	0.06	0.79	0.07	0.08	0.00	0.00	0.44	-0.26	0.44	-0.19	-0.24	A+	A-	A+	A+	-0.62	0.07	-1.26	0.95	-0.18	0.99
44	666986	1	4528	0.73	0.73	0.12	0.08	0.08	0.00	0.00	0.48	0.48	-0.33	-0.25	-0.14	A-	A-	A-	A-	-0.21	0.07	-3.31	0.89	-2.92	0.84
45	666988	1	4528	0.75	0.09	0.75	0.12	0.03	0.00	0.00	0.47	-0.17	0.47	-0.31	-0.26	A-	B-	A-	A+	-0.38	0.07	-2.91	0.90	-2.85	0.82
46	667171	1	4528	0.75	0.08	0.75	0.05	0.13	0.00	0.00	0.40	-0.26	0.40	-0.32	-0.09	A-	A+	A+	A+	-0.34	0.07	1.60	1.06	3.50	1.24
47	661602	2	4436	0.78	0.78	0.08	0.07	0.06	0.00	0.00	0.42	0.42	-0.20	-0.25	-0.21	A+	A+	A-	A-	-0.63	0.07	-0.15	0.99	0.00	1.00
48	661604	2	4436	0.85	0.06	0.85	0.06	0.03	0.00	0.00	0.46	-0.30	0.46	-0.21	-0.23	A+	A+	A+	A+	-1.15	0.08	-4.02	0.82	-3.83	0.67
49	661605	2	4436	0.54	0.02	0.54	0.24	0.20	0.00	0.00	0.43	-0.22	0.43	-0.27	-0.17	A+	A-	A-	A+	0.80	0.06	0.85	1.02	1.04	1.04
50	661608	2	4436	0.74	0.09	0.11	0.74	0.06	0.00	0.00	0.37	-0.22	-0.14	0.37	-0.22	A+	A-	A-	A+	-0.31	0.07	-0.73	0.98	-0.15	0.99
51	661609	2	4436	0.63	0.19	0.06	0.12	0.63	0.00	0.00	0.47	-0.31	-0.22	-0.15	0.47	A+	A+	A+	A-	0.32	0.06	-1.84	0.95	-1.33	0.94
52	665136	2	4436	0.65	0.04	0.65	0.03	0.27	0.00	0.00	0.05	-0.20	0.05	-0.13	0.10	A-	A-	A-	A+	0.20	0.06	9.90	1.44	9.90	1.74
53	666977	2	4436	0.75	0.75	0.07	0.15	0.03	0.00	0.00	0.45	0.45	-0.30	-0.22	-0.22	A-	A-	A-	A-	-0.40	0.07	-0.79	0.97	0.46	1.03
54	666979	2	4436	0.69	0.05	0.09	0.16	0.69	0.00	0.00	0.54	-0.28	-0.26	-0.29	0.54	A+	A-	A-	A-	-0.02	0.06	-3.51	0.90	-3.91	0.81
55	666980	2	4436	0.43	0.04	0.47	0.43	0.05	0.00	0.00	0.36	-0.30	-0.13	0.36	-0.22	A+	A+	A+	A-	1.35	0.06	1.93	1.04	4.27	1.17
56	666984	2	4436	0.36	0.43	0.09	0.11	0.36	0.00	0.00	0.20	-0.02	-0.24	-0.03	0.20	A-	A-	A-	A-	1.70	0.06	7.62	1.20	9.55	1.49
57	666989	2	4436	0.69	0.04	0.06	0.20	0.69	0.00	0.00	0.38	-0.23	-0.27	-0.14	0.38	A+	A-	A-	A+	-0.04	0.06	3.29	1.10	3.62	1.20
58	667386	2	4436	0.91	0.03	0.03	0.91	0.02	0.00	0.00	0.46	-0.27	-0.26	0.46	-0.22	A-	A-	A-	B+	-1.81	0.10	-3.13	0.80	-4.44	0.51
59	664112	3	4507	0.64	0.06	0.64	0.23	0.06	0.00	0.00	0.38	-0.24	0.38	-0.15	-0.22	A+	A+	A+	A+	0.21	0.06	2.38	1.07	2.44	1.11
60	664113	3	4507	0.82	0.05	0.09	0.82	0.03	0.00	0.00	0.50	-0.28	-0.31	0.50	-0.20	A-	A-	A+	A-	-0.97	0.07	-5.35	0.78	-4.72	0.65
61	664114	3	4507	0.89	0.89	0.04	0.03	0.03	0.00	0.00	0.49	0.49	-0.31	-0.24	-0.23	A+	B-	A-	A+	-1.67	0.09	-4.69	0.74	-4.85	0.51
62	664115	3	4507	0.77	0.12	0.06	0.05	0.77	0.00	0.00	0.42	-0.20	-0.19	-0.29	0.42	A+	A-	A+	A+	-0.56	0.07	-0.56	0.98	0.77	1.05
63	664122	3	4507	0.87	0.87	0.03	0.06	0.04	0.00	0.00	0.48	0.48	-0.25	-0.30	-0.24	A-	A-	A-	A+	-1.43	0.08	-3.98	0.80	-5.32	0.52
64	664124	3	4507	0.53	0.04	0.53	0.39	0.03	0.00	0.00	0.31	-0.20	0.31	-0.13	-0.24	A-	A-	A-	A+	0.79	0.06	5.95	1.14	5.69	1.21
65	666744	3	4507	0.39	0.04	0.33	0.39	0.24	0.00	0.00	0.28	-0.24	-0.10	0.28	-0.09	A-	A-	A-	A+	1.54	0.06	4.49	1.11	6.66	1.30
66	666745	3	4507	0.77	0.15	0.05	0.77	0.04	0.00	0.00	0.37	-0.13	-0.28	0.37	-0.26	A+	A+	A-	A-	-0.56	0.07	1.14	1.04	2.26	1.16

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
67	666746	3	4507	0.53	0.33	0.53	0.07	0.07	0.00	0.00	0.44	-0.16	0.44	-0.29	-0.26	A+	A+	A+	A+	0.79	0.06	-0.85	0.98	0.02	1.00
68	666748	3	4507	0.67	0.67	0.10	0.06	0.17	0.00	0.00	0.32	0.32	-0.24	-0.27	-0.03	A+	A+	A+	A-	0.05	0.06	2.26	1.07	2.33	1.11
69	666753	3	4507	0.73	0.06	0.73	0.06	0.14	0.00	0.00	0.45	-0.23	0.45	-0.29	-0.20	A+	A+	A-	A+	-0.31	0.07	-2.01	0.94	-2.02	0.89
70	666755	3	4507	0.58	0.20	0.13	0.58	0.09	0.00	0.00	0.38	-0.17	-0.16	0.38	-0.22	A+	A-	A-	A-	0.56	0.06	2.91	1.07	3.27	1.13
71	664116	4	4529	0.67	0.04	0.67	0.05	0.24	0.00	0.00	0.43	-0.29	0.43	-0.28	-0.18	A+	A+	A+	A+	0.11	0.06	-0.95	0.97	-1.05	0.95
72	664118	4	4529	0.73	0.09	0.06	0.11	0.73	0.00	0.00	0.48	-0.17	-0.28	-0.30	0.48	A+	A+	A+	A-	-0.28	0.07	-1.40	0.95	-0.72	0.96
73	664120	4	4529	0.68	0.03	0.20	0.09	0.68	0.00	0.00	0.50	-0.23	-0.25	-0.32	0.50	A-	A-	A+	A+	0.05	0.06	-2.46	0.93	-1.95	0.91
74	664121	4	4529	0.80	0.80	0.03	0.04	0.12	0.00	0.00	0.39	0.39	-0.26	-0.28	-0.15	A-	A-	A-	A-	-0.77	0.07	-0.73	0.97	-0.31	0.97
75	664123	4	4529	0.81	0.05	0.05	0.81	0.08	0.00	0.00	0.59	-0.27	-0.32	0.59	-0.34	A-	A+	A-	A-	-0.87	0.07	-6.68	0.74	-6.48	0.56
76	665227	4	4529	0.70	0.13	0.70	0.04	0.12	0.00	0.00	0.33	-0.18	0.33	-0.26	-0.09	A-	A-	A-	A-	-0.07	0.06	3.50	1.11	2.48	1.13
77	666743	4	4529	0.52	0.08	0.23	0.16	0.52	0.00	0.00	0.31	-0.06	-0.15	-0.19	0.31	A+	A-	A-	A-	0.86	0.06	4.48	1.11	3.38	1.12
78	666747	4	4529	0.68	0.16	0.68	0.08	0.09	0.00	0.00	0.47	-0.24	0.47	-0.21	-0.24	A-	A-	A-	A-	0.04	0.06	-1.65	0.95	-0.23	0.99
79	666749	4	4529	0.52	0.52	0.13	0.28	0.06	0.00	0.00	0.44	0.44	-0.24	-0.23	-0.14	A-	A+	A+	A+	0.88	0.06	-2.85	0.94	-1.40	0.95
80	666752	4	4529	0.55	0.03	0.18	0.23	0.55	0.00	0.00	0.30	-0.21	0.00	-0.25	0.30	A-	A-	A-	A+	0.71	0.06	5.91	1.15	5.50	1.21
81	666754	4	4529	0.69	0.69	0.08	0.08	0.15	0.00	0.00	0.36	0.36	-0.19	-0.21	-0.15	A+	A+	A+	A+	-0.02	0.06	3.36	1.10	4.83	1.26
82	667336	4	4529	0.88	0.88	0.05	0.03	0.05	0.00	0.00	0.38	0.38	-0.22	-0.22	-0.20	A-	B-	B-	A+	-1.44	0.09	-1.26	0.93	-1.40	0.85
83	664461	5	4503	0.67	0.67	0.12	0.15	0.06	0.00	0.00	0.45	0.45	-0.25	-0.23	-0.19	A+	A-	A+	A-	0.08	0.06	-0.03	1.00	-0.93	0.96
84	664462	5	4503	0.80	0.07	0.80	0.05	0.07	0.00	0.00	0.51	-0.29	0.51	-0.30	-0.22	A+	A+	A+	A+	-0.72	0.07	-2.75	0.89	-4.02	0.72
85	664463	5	4503	0.45	0.09	0.20	0.45	0.26	0.00	0.00	0.29	-0.16	-0.11	0.29	-0.11	A-	A-	A-	A-	1.24	0.06	5.94	1.14	6.61	1.26
86	664465	5	4503	0.47	0.30	0.16	0.07	0.47	0.00	0.00	0.41	-0.21	-0.11	-0.24	0.41	A+	A-	A-	A-	1.13	0.06	0.55	1.01	2.62	1.10
87	664469	5	4503	0.46	0.46	0.16	0.29	0.08	0.00	0.00	0.24	0.24	-0.09	-0.15	-0.04	A+	A-	A-	A-	1.18	0.06	8.05	1.20	7.48	1.30
88	664472	5	4503	0.67	0.19	0.06	0.08	0.67	0.00	0.00	0.46	-0.26	-0.22	-0.21	0.46	A+	A-	A-	A-	0.13	0.06	-1.68	0.95	-2.09	0.91
89	665235	5	4503	0.60	0.60	0.12	0.25	0.03	0.00	0.00	0.37	0.37	-0.17	-0.18	-0.26	A-	A-	A-	A+	0.46	0.06	3.67	1.10	3.88	1.16
90	665239	5	4503	0.37	0.08	0.48	0.37	0.07	0.00	0.00	0.11	-0.25	0.16	0.11	-0.25	A-	A-	A-	A+	1.66	0.06	9.90	1.37	9.90	1.71
91	665240	5	4503	0.79	0.06	0.07	0.08	0.79	0.00	0.00	0.52	-0.31	-0.27	-0.25	0.52	A-	A-	A-	A-	-0.63	0.07	-5.28	0.81	-4.54	0.71
92	665242	5	4503	0.50	0.50	0.25	0.16	0.08	0.00	0.00	0.26	0.26	0.03	-0.23	-0.18	A-	A-	A-	A-	0.99	0.06	8.61	1.22	8.28	1.32
93	665243	5	4503	0.73	0.15	0.08	0.73	0.03	0.00	0.00	0.49	-0.28	-0.23	0.49	-0.26	A-	A-	A-	A+	-0.26	0.07	-3.71	0.88	-4.25	0.77
94	666202	5	4503	0.81	0.81	0.07	0.08	0.04	0.00	0.00	0.49	0.49	-0.21	-0.29	-0.28	A-	A-	A-	A+	-0.83	0.07	-3.83	0.85	-4.33	0.69
95	664464	6	4549	0.35	0.08	0.05	0.35	0.51	0.00	0.00	0.05	-0.21	-0.27	0.05	0.20	A+	A+	A+	A-	1.77	0.06	9.90	1.40	9.90	1.73
96	664466	6	4549	0.64	0.64	0.08	0.19	0.09	0.00	0.00	0.34	0.34	-0.26	-0.18	-0.07	A-	A-	A-	A-	0.26	0.06	3.32	1.09	2.90	1.12
97	664468	6	4549	0.58	0.03	0.06	0.33	0.58	0.00	0.00	0.30	-0.22	-0.26	-0.09	0.30	A-	A-	A-	A-	0.59	0.06	4.38	1.11	3.80	1.14
98	664470	6	4549	0.31	0.12	0.31	0.24	0.33	0.00	0.00	0.20	-0.21	0.20	0.03	-0.07	A-	A+	A+	A-	1.98	0.06	5.31	1.15	7.58	1.42
99	664471	6	4549	0.38	0.17	0.37	0.38	0.08	0.00	0.00	0.13	-0.07	0.01	0.13	-0.15	A+	A+	A-	A+	1.57	0.06	8.80	1.22	9.26	1.41

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
100	665236	6	4549	0.79	0.06	0.79	0.08	0.07	0.00	0.00	0.51	-0.27	0.51	-0.29	-0.25	A-	A-	A-	A+	-0.66	0.07	-4.40	0.84	-5.13	0.68
101	665237	6	4549	0.67	0.15	0.04	0.67	0.14	0.00	0.00	0.48	-0.21	-0.28	0.48	-0.26	A-	A+	A+	A-	0.13	0.06	-2.24	0.94	-2.47	0.89
102	665238	6	4549	0.53	0.06	0.16	0.24	0.53	0.00	0.00	0.48	-0.24	-0.19	-0.25	0.48	B-	A-	A-	A+	0.83	0.06	-2.00	0.95	-1.65	0.95
103	665241	6	4549	0.42	0.34	0.42	0.15	0.08	0.00	0.00	0.23	0.05	0.23	-0.22	-0.20	A+	A-	A+	A-	1.38	0.06	7.87	1.19	9.24	1.37
104	665244	6	4549	0.48	0.26	0.20	0.06	0.48	0.00	0.00	0.16	0.01	-0.06	-0.23	0.16	A+	A-	A+	A-	1.07	0.06	9.90	1.29	9.90	1.40
105	665247	6	4549	0.71	0.71	0.06	0.09	0.15	0.00	0.00	0.41	0.41	-0.28	-0.23	-0.15	A-	A+	A+	A-	-0.12	0.06	0.44	1.01	-0.25	0.99
106	665935	6	4549	0.60	0.07	0.60	0.05	0.27	0.00	0.00	0.30	-0.22	0.30	-0.18	-0.10	C-	A+	A-	A+	0.48	0.06	5.15	1.13	3.70	1.14
107	664880	7	4518	0.83	0.83	0.10	0.05	0.02	0.00	0.00	0.53	0.53	-0.35	-0.29	-0.23	A-	A-	A-	A+	-1.01	0.08	-3.90	0.83	-5.01	0.62
108	664881	7	4518	0.73	0.10	0.73	0.04	0.13	0.00	0.00	0.52	-0.32	0.52	-0.29	-0.22	A+	A-	A-	A-	-0.27	0.07	-4.35	0.86	-3.70	0.80
109	664886	7	4518	0.85	0.05	0.85	0.05	0.05	0.00	0.00	0.50	-0.29	0.50	-0.25	-0.27	A-	A-	A-	A+	-1.13	0.08	-3.11	0.86	-3.05	0.74
110	664887	7	4518	0.21	0.21	0.05	0.13	0.61	0.00	0.00	0.00	0.00	-0.18	-0.21	0.24	B+	A+	A-	A+	2.62	0.07	7.36	1.29	9.90	2.36
111	664889	7	4518	0.80	0.80	0.05	0.07	0.07	0.00	0.00	0.55	0.55	-0.32	-0.31	-0.24	A-	A-	A-	A+	-0.72	0.07	-3.92	0.85	-4.22	0.72
112	666231	7	4518	0.87	0.03	0.04	0.87	0.06	0.00	0.00	0.47	-0.23	-0.29	0.47	-0.24	A-	A-	A-	A+	-1.42	0.08	-2.93	0.85	-4.03	0.62
113	666627	7	4518	0.64	0.64	0.10	0.22	0.04	0.00	0.00	0.36	0.36	-0.18	-0.19	-0.20	A+	A+	A+	A-	0.26	0.06	3.64	1.10	2.48	1.11
114	666632	7	4518	0.47	0.07	0.47	0.33	0.12	0.00	0.00	0.09	-0.22	0.09	0.18	-0.20	A+	A+	A+	A+	1.14	0.06	9.90	1.39	9.90	1.64
115	666634	7	4518	0.87	0.05	0.03	0.87	0.04	0.00	0.00	0.46	-0.26	-0.28	0.46	-0.23	A+	A+	A+	A+	-1.40	0.08	-3.14	0.84	-3.45	0.67
116	666637	7	4518	0.43	0.27	0.43	0.06	0.25	0.00	0.00	0.40	-0.19	0.40	-0.19	-0.15	A-	A-	A-	A-	1.37	0.06	0.77	1.02	4.58	1.19
117	667073	7	4518	0.56	0.10	0.04	0.56	0.30	0.00	0.00	0.40	-0.27	-0.28	0.40	-0.13	A-	C-	B-	A+	0.70	0.06	2.24	1.06	2.72	1.10
118	667075	7	4518	0.58	0.58	0.24	0.03	0.15	0.00	0.00	0.21	0.21	-0.07	-0.23	-0.08	A+	A+	A-	A+	0.58	0.06	9.90	1.28	8.93	1.37
119	664882	8	4482	0.72	0.06	0.10	0.72	0.11	0.00	0.00	0.50	-0.25	-0.29	0.50	-0.23	A+	A-	A+	A+	-0.21	0.07	-1.90	0.94	-2.28	0.87
120	664883	8	4482	0.55	0.20	0.09	0.16	0.55	0.00	0.00	0.37	-0.14	-0.27	-0.14	0.37	A-	A+	A-	A+	0.76	0.06	3.08	1.08	2.81	1.11
121	664884	8	4482	0.62	0.22	0.09	0.07	0.62	0.00	0.00	0.41	-0.19	-0.15	-0.30	0.41	A-	A-	A-	A-	0.37	0.06	0.43	1.01	0.47	1.02
122	664885	8	4482	0.81	0.08	0.06	0.81	0.06	0.00	0.00	0.35	-0.23	-0.18	0.35	-0.14	A-	A-	B-	A+	-0.83	0.07	1.21	1.05	2.68	1.24
123	664888	8	4482	0.68	0.68	0.10	0.17	0.04	0.00	0.00	0.22	0.22	-0.16	-0.04	-0.18	A+	A+	A-	A-	0.03	0.06	7.95	1.26	7.93	1.47
124	664892	8	4482	0.63	0.20	0.63	0.09	0.07	0.00	0.00	0.49	-0.28	0.49	-0.26	-0.18	A-	A-	A-	A-	0.33	0.06	-2.55	0.93	-2.37	0.90
125	666626	8	4482	0.85	0.85	0.08	0.03	0.03	0.00	0.00	0.37	0.37	-0.15	-0.22	-0.27	A+	A-	A-	A+	-1.17	0.08	-1.09	0.95	2.32	1.25
126	666628	8	4482	0.81	0.04	0.81	0.08	0.07	0.00	0.00	0.44	-0.22	0.44	-0.30	-0.19	A+	B+	A+	A-	-0.82	0.07	-1.67	0.93	-2.05	0.84
127	666630	8	4482	0.49	0.40	0.06	0.05	0.49	0.00	0.00	0.25	-0.01	-0.27	-0.24	0.25	A+	A-	A+	A-	1.04	0.06	7.31	1.17	6.24	1.24
128	666631	8	4482	0.53	0.53	0.24	0.18	0.05	0.00	0.00	0.40	0.40	-0.21	-0.16	-0.22	A+	A-	A+	A-	0.85	0.06	0.72	1.02	1.60	1.06
129	666633	8	4482	0.80	0.08	0.07	0.05	0.80	0.00	0.00	0.42	-0.28	-0.22	-0.17	0.42	A+	A-	A-	A+	-0.71	0.07	-1.78	0.93	-1.25	0.90
130	666638	8	4482	0.80	0.09	0.04	0.06	0.80	0.00	0.00	0.49	-0.33	-0.23	-0.20	0.49	A+	A+	A-	A+	-0.76	0.07	-2.74	0.89	-3.16	0.76
131	666814	9	4444	0.80	0.10	0.08	0.80	0.01	0.00	0.00	0.40	-0.33	-0.12	0.40	-0.22	A+	A-	A-	A+	-0.76	0.07	-0.98	0.96	0.53	1.04
132	666817	9	4444	0.25	0.25	0.10	0.49	0.16	0.00	0.00	-0.05	-0.05	-0.14	0.29	-0.22	A+	A+	A+	A-	2.35	0.07	9.90	1.54	9.90	2.49

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
133	666818	9	4444	0.67	0.04	0.67	0.24	0.05	0.00	0.00	0.27	-0.19	0.27	-0.12	-0.19	A+	A-	A-	A-	0.08	0.06	5.89	1.18	6.94	1.36
134	666819	9	4444	0.77	0.11	0.77	0.09	0.03	0.00	0.00	0.34	-0.06	0.34	-0.30	-0.21	A+	A+	A-	A-	-0.50	0.07	0.32	1.01	3.20	1.22
135	666823	9	4444	0.90	0.03	0.04	0.90	0.03	0.00	0.00	0.45	-0.27	-0.29	0.45	-0.18	B+	A-	A+	A-	-1.63	0.09	-2.72	0.84	-3.33	0.64
136	666825	9	4444	0.83	0.04	0.07	0.05	0.83	0.00	0.00	0.45	-0.25	-0.24	-0.24	0.45	A+	A+	A+	A-	-1.01	0.08	-2.61	0.89	-1.43	0.88
137	666991	9	4444	0.67	0.06	0.67	0.12	0.15	0.00	0.00	0.37	-0.20	0.37	-0.10	-0.27	A+	A-	A-	A-	0.10	0.06	1.87	1.05	2.87	1.14
138	666995	9	4444	0.82	0.11	0.03	0.04	0.82	0.00	0.00	0.48	-0.29	-0.22	-0.27	0.48	A-	A-	A+	A-	-0.90	0.07	-2.59	0.89	-3.23	0.76
139	666997	9	4444	0.86	0.04	0.86	0.07	0.03	0.00	0.00	0.43	-0.23	0.43	-0.25	-0.21	A+	A+	A+	A-	-1.23	0.08	-0.71	0.96	-1.38	0.87
140	666998	9	4444	0.70	0.70	0.07	0.18	0.04	0.00	0.00	0.43	0.43	-0.12	-0.30	-0.25	A-	A-	A+	A+	-0.09	0.06	0.10	1.00	1.38	1.07
141	666999	9	4444	0.72	0.07	0.72	0.12	0.08	0.00	0.00	0.52	-0.33	0.52	-0.19	-0.31	A-	A-	A-	A+	-0.18	0.06	-3.62	0.89	-2.62	0.86
142	667395	9	4444	0.84	0.84	0.06	0.05	0.05	0.00	0.00	0.48	0.48	-0.25	-0.23	-0.28	A-	A-	A+	A-	-1.07	0.08	-3.91	0.83	-4.14	0.67
143	666813	10	4446	0.70	0.04	0.12	0.14	0.70	0.00	0.00	0.49	-0.25	-0.22	-0.30	0.49	A+	A-	A-	A-	-0.09	0.06	-3.93	0.89	-3.91	0.81
144	666816	10	4446	0.80	0.07	0.07	0.05	0.80	0.00	0.00	0.30	-0.14	-0.15	-0.19	0.30	B+	A+	A+	A+	-0.75	0.07	0.59	1.02	4.65	1.40
145	666820	10	4446	0.72	0.72	0.13	0.07	0.08	0.00	0.00	0.42	0.42	-0.21	-0.25	-0.20	A+	A-	A-	A-	-0.19	0.06	-0.58	0.98	0.10	1.00
146	666824	10	4446	0.45	0.35	0.08	0.45	0.12	0.00	0.00	0.26	-0.07	-0.19	0.26	-0.12	A+	A-	A-	A-	1.23	0.06	5.82	1.14	6.11	1.24
147	666992	10	4446	0.67	0.13	0.11	0.67	0.10	0.00	0.00	0.41	-0.27	-0.18	0.41	-0.17	A+	A-	A-	A-	0.12	0.06	1.79	1.05	1.32	1.06
148	666994	10	4446	0.70	0.70	0.05	0.10	0.15	0.00	0.00	0.47	0.47	-0.25	-0.26	-0.23	A+	A+	A+	A+	-0.09	0.06	-2.23	0.93	-2.18	0.89
149	666996	10	4446	0.49	0.06	0.09	0.49	0.35	0.00	0.00	0.23	-0.27	-0.26	0.23	0.06	A-	A-	A-	A-	1.02	0.06	9.90	1.27	9.54	1.37
150	667000	10	4446	0.73	0.07	0.08	0.12	0.73	0.00	0.00	0.53	-0.31	-0.25	-0.26	0.53	A+	A-	A+	A-	-0.24	0.06	-3.75	0.88	-4.46	0.77
151	667001	10	4446	0.68	0.17	0.09	0.68	0.06	0.00	0.00	0.41	-0.21	-0.20	0.41	-0.23	A-	A+	A+	A-	0.04	0.06	0.15	1.00	-0.32	0.98
152	667352	10	4446	0.36	0.15	0.36	0.22	0.27	0.00	0.00	0.27	-0.10	0.27	-0.24	0.02	A+	A-	A+	A+	1.71	0.06	4.79	1.13	7.86	1.40
153	667355	10	4446	0.73	0.73	0.07	0.05	0.14	0.00	0.00	0.40	0.40	-0.27	-0.26	-0.13	A+	A-	A-	A+	-0.27	0.06	1.68	1.06	1.17	1.07
154	667392	10	4446	0.90	0.03	0.90	0.03	0.04	0.00	0.00	0.40	-0.21	0.40	-0.23	-0.22	A-	A-	A+	A+	-1.65	0.09	-1.67	0.90	-3.15	0.65
155	662926	11	4494	0.45	0.14	0.14	0.27	0.45	0.00	0.00	0.32	-0.24	-0.11	-0.07	0.32	A-	A-	A-	A-	1.24	0.06	3.18	1.07	5.07	1.18
156	662927	11	4494	0.61	0.19	0.10	0.09	0.61	0.00	0.00	0.42	-0.25	-0.15	-0.20	0.42	A-	A+	A+	A+	0.43	0.06	-1.87	0.96	-1.96	0.93
157	662928	11	4494	0.49	0.49	0.18	0.25	0.08	0.00	0.00	0.13	0.13	-0.12	-0.01	-0.06	A-	A+	A+	A-	1.03	0.06	9.90	1.29	9.90	1.40
158	662931	11	4494	0.78	0.05	0.78	0.13	0.03	0.00	0.00	0.33	-0.26	0.33	-0.14	-0.15	A-	A-	A-	A+	-0.61	0.07	0.82	1.03	-0.38	0.97
159	662934	11	4494	0.37	0.37	0.11	0.14	0.37	0.00	0.00	0.21	0.21	-0.17	-0.15	0.02	A-	A-	A-	A-	1.61	0.06	7.10	1.17	8.99	1.40
160	662936	11	9045	0.57	0.13	0.57	0.15	0.15	0.00	0.00	0.11	-0.18	0.11	-0.01	0.05	A+	A+	A-	A+	0.65	0.04	9.90	1.34	9.90	1.46
160	662936	11	9045	0.57	0.13	0.57	0.15	0.15	0.00	0.00	0.11	-0.18	0.11	-0.01	0.05	A+	A+	A-	A+	0.65	0.04	9.90	1.34	9.90	1.46
161	666039	11	4494	0.81	0.04	0.81	0.09	0.05	0.00	0.00	0.53	-0.20	0.53	-0.35	-0.27	A-	A-	A-	A+	-0.81	0.07	-3.28	0.87	-4.35	0.71
162	666041	11	4494	0.37	0.38	0.37	0.19	0.06	0.00	0.00	0.17	-0.03	0.17	-0.07	-0.16	A+	A-	A+	A+	1.62	0.06	8.40	1.21	8.28	1.36
163	666042	11	4494	0.71	0.10	0.07	0.71	0.11	0.00	0.00	0.47	-0.23	-0.28	0.47	-0.21	B-	A-	A-	A+	-0.16	0.06	-2.35	0.93	-3.48	0.83
164	666046	11	4494	0.52	0.23	0.10	0.52	0.14	0.00	0.00	0.33	-0.06	-0.29	0.33	-0.12	A-	A-	A+	A-	0.87	0.06	4.33	1.10	4.69	1.16

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
165	666048	11	4494	0.57	0.33	0.57	0.04	0.05	0.00	0.00	0.14	0.10	0.14	-0.28	-0.25	A+	A+	A+	A+	0.63	0.06	9.90	1.28	9.90	1.46
166	666574	11	4494	0.92	0.05	0.92	0.02	0.01	0.00	0.00	0.44	-0.30	0.44	-0.23	-0.19	A+	A+	A-	B+	-1.89	0.10	-2.84	0.81	-4.49	0.50
167	662925	12	4551	0.72	0.06	0.19	0.72	0.02	0.00	0.00	0.38	-0.26	-0.18	0.38	-0.21	A-	A+	A-	A-	-0.16	0.06	-0.03	1.00	-1.12	0.94
168	662929	12	4551	0.80	0.04	0.07	0.80	0.09	0.00	0.00	0.36	-0.19	-0.25	0.36	-0.14	A+	A-	A-	A+	-0.70	0.07	0.59	1.02	0.65	1.05
169	662932	12	4551	0.49	0.19	0.49	0.16	0.16	0.00	0.00	0.38	-0.15	0.38	-0.22	-0.13	A-	A+	A+	A-	1.06	0.06	1.52	1.03	2.45	1.08
170	662935	12	4551	0.52	0.09	0.15	0.23	0.52	0.00	0.00	0.34	-0.08	-0.21	-0.16	0.34	A+	A-	A-	A+	0.88	0.06	4.35	1.10	5.66	1.20
171	662936	12	9045	0.57	0.13	0.57	0.15	0.15	0.00	0.00	0.11	-0.18	0.11	-0.01	0.05	A+	A+	A-	A+	0.65	0.04	9.90	1.34	9.90	1.46
171	662936	12	9045	0.57	0.13	0.57	0.15	0.15	0.00	0.00	0.11	-0.18	0.11	-0.01	0.05	A+	A+	A-	A+	0.65	0.04	9.90	1.34	9.90	1.46
172	665153	12	4551	0.39	0.39	0.33	0.10	0.18	0.00	0.00	0.21	0.21	-0.08	-0.09	-0.10	A+	A-	A-	A+	1.54	0.06	8.05	1.20	9.06	1.40
173	666037	12	4551	0.91	0.03	0.03	0.03	0.91	0.00	0.00	0.46	-0.22	-0.27	-0.28	0.46	A-	A-	A+	A+	-1.77	0.10	-2.91	0.81	-4.44	0.53
174	666038	12	4551	0.69	0.05	0.14	0.69	0.12	0.00	0.00	0.43	-0.27	-0.17	0.43	-0.24	A-	A-	A-	A-	0.04	0.06	0.01	1.00	2.17	1.11
175	666040	12	4551	0.81	0.81	0.12	0.04	0.03	0.00	0.00	0.28	0.28	-0.10	-0.26	-0.16	A-	A-	A-	A-	-0.75	0.07	0.62	1.03	3.29	1.27
176	666047	12	4551	0.75	0.75	0.04	0.06	0.14	0.00	0.00	0.25	0.25	-0.26	-0.27	0.02	A+	A+	A-	A-	-0.38	0.07	2.09	1.07	8.55	1.61
177	666049	12	4551	0.55	0.19	0.12	0.13	0.55	0.00	0.00	0.32	0.00	-0.23	-0.24	0.32	A+	A-	A+	A+	0.73	0.06	5.20	1.12	4.79	1.17
178	666576	12	4551	0.69	0.09	0.14	0.69	0.08	0.00	0.00	0.35	-0.19	-0.17	0.35	-0.18	A-	A+	A-	A+	0.03	0.06	3.50	1.10	3.04	1.15
179	666325	13	4517	0.80	0.05	0.07	0.08	0.80	0.00	0.00	0.55	-0.25	-0.32	-0.29	0.55	A-	A-	A-	A-	-0.72	0.07	-5.22	0.80	-5.79	0.61
180	666329	13	4517	0.59	0.59	0.14	0.10	0.17	0.00	0.00	0.43	0.43	-0.19	-0.25	-0.18	A-	A+	A-	A+	0.55	0.06	-0.36	0.99	-0.14	0.99
181	666330	13	4517	0.60	0.22	0.08	0.10	0.60	0.00	0.00	0.23	0.04	-0.26	-0.20	0.23	A+	A-	A-	A-	0.51	0.06	9.90	1.28	9.56	1.43
182	666334	13	4517	0.71	0.71	0.08	0.12	0.09	0.00	0.00	0.50	0.50	-0.28	-0.22	-0.27	A-	A-	A-	A+	-0.10	0.06	-3.25	0.90	-2.95	0.85
183	666731	13	4517	0.93	0.93	0.02	0.02	0.02	0.00	0.00	0.42	0.42	-0.23	-0.25	-0.20	A-	B-	B-	A+	-2.20	0.11	-2.58	0.80	-4.24	0.44
184	666733	13	4517	0.89	0.04	0.89	0.04	0.02	0.00	0.00	0.45	-0.25	0.45	-0.27	-0.22	A+	A-	B-	A-	-1.60	0.09	-3.45	0.80	-3.47	0.62
185	667421	13	4517	0.36	0.09	0.39	0.15	0.36	0.00	0.00	0.33	-0.16	-0.09	-0.18	0.33	A-	A-	A-	A-	1.71	0.06	1.98	1.05	3.44	1.16
186	667423	13	4517	0.84	0.05	0.84	0.07	0.04	0.00	0.00	0.49	-0.26	0.49	-0.28	-0.25	A+	A+	A-	A+	-1.03	0.08	-2.63	0.88	-3.85	0.68
187	667426	13	4517	0.72	0.72	0.15	0.07	0.06	0.00	0.00	0.40	0.40	-0.26	-0.20	-0.14	A-	A+	A-	A-	-0.19	0.07	2.06	1.07	0.19	1.01
188	667427	13	4517	0.60	0.60	0.06	0.05	0.29	0.00	0.00	0.26	0.26	-0.31	-0.29	0.01	A+	A+	A+	A-	0.47	0.06	7.09	1.19	8.02	1.36
189	667430	13	4517	0.50	0.06	0.17	0.26	0.50	0.00	0.00	0.34	-0.09	-0.14	-0.21	0.34	A+	A-	A-	A-	1.01	0.06	2.92	1.07	4.10	1.15
190	668392	13	4517	0.53	0.08	0.53	0.27	0.13	0.00	0.00	0.31	-0.27	0.31	-0.06	-0.15	B-	A+	A-	A+	0.88	0.06	8.00	1.20	7.91	1.31
191	666326	14	4499	0.52	0.04	0.18	0.52	0.26	0.00	0.00	0.34	-0.25	-0.24	0.34	-0.06	A-	B-	A-	A+	0.91	0.06	4.31	1.10	5.58	1.21
192	666328	14	4499	0.46	0.21	0.06	0.46	0.26	0.00	0.00	0.39	-0.25	-0.28	0.39	-0.05	A-	A-	A-	A+	1.16	0.06	2.28	1.05	2.62	1.10
193	666331	14	4499	0.81	0.06	0.81	0.09	0.04	0.00	0.00	0.52	-0.30	0.52	-0.31	-0.21	A-	A-	A+	A+	-0.80	0.07	-3.80	0.85	-4.87	0.66
194	666332	14	4499	0.61	0.61	0.16	0.13	0.10	0.00	0.00	0.37	0.37	-0.14	-0.26	-0.12	B-	B-	A-	A-	0.43	0.06	2.43	1.06	2.73	1.12
195	666333	14	4499	0.89	0.03	0.03	0.05	0.89	0.00	0.00	0.40	-0.22	-0.23	-0.23	0.40	B-	C-	C-	A+	-1.52	0.09	-0.93	0.95	-1.15	0.87
196	666336	14	4499	0.76	0.10	0.04	0.10	0.76	0.00	0.00	0.47	-0.31	-0.25	-0.20	0.47	A-	A-	A-	A+	-0.46	0.07	-3.15	0.89	-3.14	0.80

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
197	667422	14	4499	0.74	0.16	0.05	0.74	0.05	0.00	0.00	0.32	-0.10	-0.22	0.32	-0.24	A+	A+	A+	A+	-0.35	0.07	1.77	1.06	1.82	1.12
198	667424	14	4499	0.38	0.38	0.08	0.35	0.18	0.00	0.00	0.26	0.26	-0.16	-0.03	-0.18	A-	A+	A+	A-	1.58	0.06	7.73	1.20	8.96	1.43
199	667425	14	4499	0.63	0.05	0.15	0.63	0.17	0.00	0.00	0.32	-0.30	-0.10	0.32	-0.14	A-	A+	A+	A+	0.30	0.06	3.92	1.11	3.35	1.15
200	667431	14	4499	0.74	0.07	0.74	0.11	0.08	0.00	0.00	0.49	-0.19	0.49	-0.30	-0.27	A+	A+	A-	A-	-0.34	0.07	-2.45	0.92	-2.40	0.86
201	667432	14	4499	0.70	0.11	0.70	0.08	0.10	0.00	0.00	0.45	-0.19	0.45	-0.27	-0.24	A+	A+	A+	A-	-0.08	0.06	-0.93	0.97	-0.62	0.97
202	668391	14	4499	0.62	0.62	0.07	0.25	0.06	0.00	0.00	0.29	0.29	-0.19	-0.14	-0.12	A+	A-	A-	A-	0.34	0.06	7.61	1.21	6.56	1.31
203	663325	15	4506	0.61	0.18	0.07	0.13	0.61	0.00	0.00	0.31	-0.12	-0.25	-0.11	0.31	A+	A-	A-	A-	0.43	0.06	5.10	1.14	4.83	1.20
204	663327	15	4506	0.78	0.03	0.10	0.78	0.09	0.00	0.00	0.39	-0.24	-0.31	0.39	-0.07	A+	A-	A+	A-	-0.61	0.07	-1.99	0.93	0.14	1.01
205	663329	15	4506	0.87	0.04	0.87	0.04	0.05	0.00	0.00	0.44	-0.23	0.44	-0.24	-0.24	B+	C+	A+	A-	-1.38	0.08	-3.85	0.81	-3.92	0.64
206	663333	15	4506	0.61	0.05	0.21	0.61	0.13	0.00	0.00	0.26	-0.20	-0.15	0.26	-0.05	A+	A+	A+	A-	0.41	0.06	6.78	1.19	6.50	1.27
207	663336	15	4506	0.78	0.78	0.05	0.11	0.06	0.00	0.00	0.50	0.50	-0.25	-0.27	-0.28	A+	A+	A-	A-	-0.63	0.07	-3.21	0.88	-3.89	0.75
208	663964	15	4506	0.54	0.04	0.54	0.40	0.02	0.00	0.00	0.06	-0.27	0.06	0.11	-0.17	A+	A+	A-	A-	0.79	0.06	9.90	1.43	9.90	1.58
209	663967	15	4506	0.35	0.12	0.22	0.30	0.35	0.00	0.00	0.14	-0.12	-0.13	0.07	0.14	A-	A+	A+	A-	1.72	0.06	9.90	1.28	9.90	1.52
210	663968	15	4506	0.58	0.58	0.10	0.13	0.19	0.00	0.00	0.37	0.37	-0.24	-0.08	-0.20	A-	A-	A-	A-	0.57	0.06	1.42	1.04	2.08	1.08
211	663969	15	4506	0.71	0.09	0.07	0.71	0.13	0.00	0.00	0.28	-0.20	-0.27	0.28	0.00	A+	A+	A+	A-	-0.13	0.06	4.86	1.16	4.63	1.26
212	663970	15	4506	0.74	0.09	0.74	0.04	0.14	0.00	0.00	0.46	-0.33	0.46	-0.27	-0.16	A-	A+	A+	A+	-0.30	0.07	-2.40	0.92	-0.51	0.97
213	663973	15	4506	0.34	0.23	0.24	0.19	0.34	0.00	0.00	0.13	0.01	-0.04	-0.11	0.13	A-	A-	A-	A-	1.80	0.06	8.99	1.24	9.90	1.55
214	665193	15	4506	0.80	0.80	0.04	0.11	0.05	0.00	0.00	0.35	0.35	-0.22	-0.17	-0.18	A+	A-	A+	A-	-0.74	0.07	1.04	1.04	0.00	1.00
215	663324	16	4451	0.88	0.07	0.88	0.03	0.02	0.00	0.00	0.45	-0.27	0.45	-0.27	-0.21	A-	A+	A-	A-	-1.51	0.09	-3.46	0.81	-4.57	0.55
216	663326	16	4451	0.65	0.09	0.24	0.65	0.02	0.00	0.00	0.38	-0.35	-0.12	0.38	-0.22	A+	A-	A+	A-	0.21	0.06	3.62	1.11	4.43	1.21
217	663328	16	4451	0.80	0.80	0.08	0.05	0.07	0.00	0.00	0.53	0.53	-0.29	-0.31	-0.25	A+	A+	A+	A-	-0.70	0.07	-5.46	0.79	-5.34	0.64
218	663330	16	4451	0.45	0.07	0.43	0.04	0.45	0.00	0.00	0.24	-0.24	-0.02	-0.23	0.24	A-	A-	A+	A-	1.26	0.06	8.14	1.20	7.82	1.32
219	663332	16	4451	0.65	0.14	0.65	0.15	0.06	0.00	0.00	0.39	-0.17	0.39	-0.21	-0.20	A+	A+	A+	A+	0.23	0.06	2.22	1.06	1.79	1.08
220	663335	16	4451	0.80	0.05	0.12	0.80	0.03	0.00	0.00	0.44	-0.27	-0.24	0.44	-0.23	A+	B+	A+	A-	-0.75	0.07	-2.59	0.90	-2.76	0.80
221	663965	16	4451	0.79	0.05	0.06	0.79	0.10	0.00	0.00	0.47	-0.24	-0.20	0.47	-0.30	A-	A-	A+	A-	-0.66	0.07	-1.84	0.93	-1.78	0.87
222	663966	16	4451	0.83	0.83	0.06	0.03	0.07	0.00	0.00	0.53	0.53	-0.30	-0.29	-0.28	A-	A+	A-	A+	-0.98	0.08	-5.42	0.77	-5.76	0.57
223	663971	16	4451	0.44	0.10	0.23	0.22	0.44	0.00	0.00	0.35	-0.26	-0.17	-0.05	0.35	A-	A-	A+	A+	1.34	0.06	2.33	1.05	4.36	1.18
224	663972	16	4451	0.66	0.07	0.66	0.11	0.16	0.00	0.00	0.36	-0.26	0.36	-0.26	-0.06	A-	A-	A-	A-	0.19	0.06	3.22	1.10	4.01	1.19
225	663975	16	4451	0.52	0.52	0.08	0.16	0.24	0.00	0.00	0.23	0.23	-0.25	-0.26	0.12	A-	A+	A-	A+	0.94	0.06	6.99	1.17	7.94	1.31
226	665262	16	4451	0.66	0.18	0.06	0.66	0.10	0.00	0.00	0.49	-0.25	-0.27	0.49	-0.22	A-	A-	A-	A-	0.18	0.06	-2.89	0.92	-2.96	0.87
227	666340	17	4489	0.55	0.55	0.09	0.19	0.16	0.00	0.00	0.40	0.40	-0.22	-0.27	-0.07	B-	A-	A-	A-	0.76	0.06	1.03	1.02	1.14	1.04
228	666343	17	4489	0.58	0.19	0.12	0.10	0.58	0.00	0.00	0.53	-0.27	-0.25	-0.22	0.53	C-	A-	A-	A+	0.56	0.06	-4.27	0.90	-4.20	0.86
229	666346	17	4489	0.81	0.03	0.05	0.10	0.81	0.00	0.00	0.41	-0.23	-0.27	-0.19	0.41	A-	A-	A-	B+	-0.80	0.07	-2.11	0.92	-0.33	0.97

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
230	666349	17	4489	0.37	0.20	0.17	0.37	0.26	0.00	0.00	0.22	-0.11	-0.16	0.22	0.01	A-	A-	A+	A-	1.64	0.06	5.88	1.15	8.78	1.41
231	666350	17	4489	0.72	0.03	0.14	0.10	0.72	0.00	0.00	0.48	-0.20	-0.31	-0.21	0.48	B-	A-	A+	A+	-0.20	0.06	-2.14	0.93	-2.06	0.89
232	666740	17	4489	0.63	0.08	0.13	0.63	0.16	0.00	0.00	0.42	-0.31	-0.17	0.42	-0.17	C-	A-	B-	A+	0.30	0.06	-1.48	0.96	-2.09	0.92
233	667214	17	4489	0.53	0.10	0.17	0.20	0.53	0.00	0.00	0.34	-0.17	-0.15	-0.15	0.34	A+	A-	A-	A+	0.84	0.06	4.15	1.10	4.50	1.16
234	667215	17	4489	0.28	0.28	0.32	0.11	0.28	0.00	0.00	0.25	-0.04	-0.07	-0.18	0.25	A-	A-	A-	A+	2.14	0.06	2.11	1.06	7.23	1.45
235	667219	17	4489	0.82	0.82	0.10	0.04	0.03	0.00	0.00	0.40	0.40	-0.26	-0.23	-0.13	A+	A-	A+	A-	-0.92	0.07	-1.94	0.92	-1.38	0.89
236	667220	17	4489	0.50	0.16	0.50	0.08	0.25	0.00	0.00	0.20	-0.07	0.20	-0.17	-0.06	A-	A+	A-	A+	0.97	0.06	9.90	1.24	9.90	1.36
237	667222	17	4489	0.52	0.52	0.11	0.17	0.20	0.00	0.00	0.27	0.27	-0.16	-0.09	-0.11	A-	A+	A+	A-	0.90	0.06	7.85	1.19	7.63	1.27
238	667911	17	4489	0.41	0.11	0.41	0.11	0.37	0.00	0.00	0.24	-0.19	0.24	-0.07	-0.07	C-	A+	A+	A+	1.44	0.06	6.77	1.16	6.76	1.27
239	666339	18	4455	0.68	0.06	0.68	0.19	0.06	0.00	0.00	0.40	-0.20	0.40	-0.20	-0.23	A-	A-	A-	A+	0.03	0.06	0.60	1.02	0.02	1.00
240	666344	18	4455	0.72	0.72	0.11	0.07	0.10	0.00	0.00	0.37	0.37	-0.29	-0.18	-0.08	A-	A-	A+	A+	-0.17	0.06	1.37	1.04	1.06	1.06
241	666345	18	4455	0.51	0.12	0.06	0.51	0.31	0.00	0.00	0.26	-0.19	-0.31	0.26	0.03	A-	A-	A-	A+	0.95	0.06	7.08	1.17	6.33	1.23
242	666347	18	4455	0.57	0.57	0.09	0.23	0.10	0.00	0.00	0.39	0.39	-0.29	-0.14	-0.16	A-	A+	A-	A+	0.64	0.06	1.02	1.02	1.77	1.06
243	666348	18	4455	0.44	0.25	0.44	0.08	0.23	0.00	0.00	0.35	-0.15	0.35	-0.21	-0.11	A-	A+	B+	A-	1.28	0.06	2.05	1.05	2.74	1.10
244	666351	18	4455	0.62	0.62	0.11	0.15	0.11	0.00	0.00	0.37	0.37	-0.17	-0.10	-0.27	A-	A+	A-	A-	0.37	0.06	1.10	1.03	1.78	1.07
245	667213	18	4455	0.91	0.03	0.03	0.91	0.03	0.00	0.00	0.35	-0.23	-0.13	0.35	-0.22	A+	A-	A-	A+	-1.75	0.10	-1.52	0.90	-0.72	0.90
246	667217	18	4455	0.34	0.24	0.34	0.16	0.26	0.01	0.00	0.14	0.13	0.14	-0.22	-0.09	A-	A-	A-	A+	1.80	0.06	7.39	1.20	8.35	1.41
247	667218	18	4455	0.47	0.16	0.47	0.30	0.06	0.00	0.00	0.26	0.02	0.26	-0.18	-0.21	A-	B-	A-	A+	1.14	0.06	7.15	1.17	7.61	1.28
248	667221	18	4455	0.64	0.15	0.15	0.64	0.06	0.00	0.00	0.34	-0.19	-0.15	0.34	-0.16	A+	A-	A-	A+	0.29	0.06	2.94	1.08	1.94	1.08
249	667223	18	4455	0.45	0.21	0.19	0.45	0.15	0.00	0.00	0.31	-0.13	-0.20	0.31	-0.05	A-	A-	A-	A+	1.25	0.06	3.50	1.08	4.46	1.16
250	667225	18	4455	0.44	0.05	0.44	0.37	0.13	0.00	0.00	0.27	-0.12	0.27	-0.11	-0.16	A-	A-	A+	A-	1.30	0.06	7.52	1.18	7.51	1.28
251	665516	19	4507	0.74	0.03	0.19	0.74	0.05	0.00	0.00	0.50	-0.23	-0.33	0.50	-0.25	A+	A-	A-	A+	-0.32	0.07	-3.55	0.89	-4.49	0.76
252	665518	19	4507	0.50	0.31	0.50	0.03	0.15	0.00	0.00	0.36	-0.07	0.36	-0.28	-0.26	A+	A-	A-	A-	0.93	0.06	3.33	1.08	4.05	1.14
253	665520	19	4507	0.40	0.16	0.39	0.40	0.05	0.00	0.00	0.25	-0.19	0.01	0.25	-0.23	A+	A+	A+	A-	1.46	0.06	4.69	1.11	6.26	1.25
254	665522	19	4507	0.89	0.89	0.06	0.04	0.01	0.00	0.00	0.44	0.44	-0.27	-0.25	-0.21	A-	A+	A+	A-	-1.54	0.09	-2.91	0.84	-3.36	0.66
255	665524	19	4507	0.31	0.10	0.23	0.36	0.31	0.00	0.00	0.18	-0.13	-0.09	-0.01	0.18	A-	A-	A-	A-	1.93	0.06	5.41	1.15	8.32	1.46
256	666025	19	4507	0.65	0.10	0.65	0.14	0.10	0.00	0.00	0.31	-0.15	0.31	-0.18	-0.12	A-	A-	B-	A-	0.17	0.06	4.75	1.14	4.20	1.19
257	666030	19	4507	0.67	0.04	0.10	0.67	0.19	0.00	0.00	0.29	-0.26	-0.20	0.29	-0.06	A-	A+	A-	A-	0.08	0.06	5.02	1.15	6.74	1.33
258	666031	19	4507	0.72	0.13	0.12	0.04	0.72	0.00	0.00	0.52	-0.27	-0.28	-0.27	0.52	B-	B-	A-	A+	-0.20	0.06	-3.80	0.88	-4.21	0.79
259	666033	19	4507	0.38	0.14	0.15	0.38	0.33	0.00	0.00	0.12	-0.15	-0.11	0.12	0.07	A+	A+	A+	A+	1.53	0.06	9.90	1.26	9.90	1.45
260	666036	19	4507	0.39	0.31	0.10	0.20	0.39	0.00	0.00	0.18	0.11	-0.21	-0.19	0.18	A-	A+	A+	A-	1.50	0.06	9.90	1.28	9.90	1.45
261	666451	19	4507	0.91	0.03	0.91	0.03	0.03	0.00	0.00	0.37	-0.21	0.37	-0.19	-0.23	A+	A-	A+	A+	-1.88	0.10	-0.39	0.97	-1.03	0.86
262	666681	19	4507	0.83	0.83	0.03	0.03	0.11	0.00	0.00	0.31	0.31	-0.19	-0.25	-0.13	A-	A-	A-	A+	-1.04	0.08	0.34	1.02	2.86	1.27

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
263	665515	20	4534	0.19	0.28	0.47	0.05	0.19	0.00	0.00	-0.12	0.22	0.01	-0.23	-0.12	A+	A-	A-	A-	2.69	0.07	9.38	1.41	9.90	2.71
264	665517	20	4534	0.66	0.66	0.15	0.10	0.09	0.00	0.00	0.21	0.21	0.02	-0.18	-0.18	A-	A-	A+	A+	0.14	0.06	6.52	1.19	5.92	1.28
265	665519	20	4534	0.86	0.04	0.06	0.04	0.86	0.00	0.00	0.43	-0.21	-0.20	-0.29	0.43	A+	A+	A+	A-	-1.23	0.08	-2.82	0.86	-1.93	0.83
266	665523	20	4534	0.52	0.07	0.52	0.39	0.02	0.00	0.00	0.05	-0.12	0.05	0.07	-0.15	A+	A-	A-	A-	0.87	0.06	9.90	1.43	9.90	1.66
267	665525	20	4534	0.60	0.20	0.60	0.15	0.05	0.00	0.00	0.17	0.00	0.17	-0.08	-0.21	A+	A+	A+	A-	0.48	0.06	9.90	1.28	9.90	1.41
268	665527	20	4534	0.74	0.02	0.20	0.04	0.74	0.00	0.00	0.39	-0.24	-0.22	-0.22	0.39	A+	A-	A-	A-	-0.34	0.07	2.41	1.08	0.78	1.04
269	666024	20	4534	0.68	0.68	0.24	0.04	0.03	0.00	0.00	0.36	0.36	-0.15	-0.31	-0.23	A-	A+	A+	A+	0.02	0.06	2.65	1.08	1.86	1.09
270	666027	20	4534	0.58	0.03	0.04	0.58	0.34	0.00	0.00	0.31	-0.20	-0.29	0.31	-0.12	B-	A-	A+	A+	0.55	0.06	4.70	1.12	4.71	1.18
271	666029	20	4534	0.73	0.17	0.73	0.04	0.07	0.00	0.00	0.50	-0.32	0.50	-0.28	-0.19	A-	A-	A+	A-	-0.26	0.06	-2.93	0.91	-2.84	0.85
272	666034	20	4534	0.58	0.06	0.58	0.24	0.11	0.00	0.00	0.40	-0.19	0.40	-0.30	-0.07	A-	A-	A-	A+	0.54	0.06	0.59	1.01	1.69	1.06
273	666035	20	4534	0.53	0.53	0.29	0.10	0.08	0.00	0.00	0.28	0.28	-0.12	-0.12	-0.18	B-	A-	A-	A-	0.82	0.06	7.29	1.17	6.78	1.24
274	666683	20	4534	0.71	0.10	0.08	0.71	0.10	0.00	0.00	0.42	-0.16	-0.32	0.42	-0.16	B-	A+	A+	A-	-0.17	0.06	0.18	1.01	0.15	1.01
275	632795	21	4464	0.66	0.05	0.16	0.66	0.13	0.00	0.00	0.49	-0.27	-0.25	0.49	-0.23	A+	A+	A-	A-	0.17	0.06	-1.52	0.96	-1.43	0.94
276	632797	21	4464	0.74	0.74	0.08	0.14	0.04	0.00	0.00	0.48	0.48	-0.26	-0.24	-0.27	A+	A-	A-	A-	-0.29	0.07	-3.33	0.89	-4.00	0.79
277	632799	21	4464	0.73	0.12	0.73	0.11	0.04	0.00	0.00	0.43	-0.24	0.43	-0.21	-0.23	A-	A+	A+	A-	-0.25	0.07	-0.34	0.99	-1.27	0.93
278	632802	21	4464	0.73	0.04	0.08	0.15	0.73	0.00	0.00	0.53	-0.23	-0.29	-0.31	0.53	A+	A-	A-	A-	-0.22	0.07	-3.75	0.88	-4.47	0.77
279	632803	21	4464	0.77	0.77	0.06	0.04	0.14	0.00	0.00	0.49	0.49	-0.30	-0.30	-0.23	A-	A-	A-	A-	-0.51	0.07	-2.80	0.90	-3.22	0.80
280	632867	21	4464	0.48	0.11	0.11	0.48	0.29	0.00	0.00	0.21	-0.22	-0.23	0.21	0.10	A-	A+	A-	A-	1.10	0.06	9.90	1.29	9.90	1.48
281	635297	21	4464	0.67	0.08	0.17	0.67	0.09	0.00	0.00	0.28	-0.23	-0.17	0.28	-0.01	A-	A+	A+	A+	0.14	0.06	6.81	1.21	7.55	1.37
282	635302	21	4464	0.77	0.12	0.05	0.77	0.06	0.00	0.00	0.39	-0.18	-0.22	0.39	-0.22	A+	A-	A+	A-	-0.55	0.07	0.43	1.02	0.07	1.00
283	635303	21	4464	0.38	0.03	0.38	0.29	0.30	0.00	0.00	0.15	-0.17	0.15	-0.16	0.07	A-	A-	A+	A+	1.61	0.06	9.56	1.24	9.55	1.45
284	635304	21	4464	0.80	0.06	0.80	0.09	0.05	0.00	0.00	0.29	-0.17	0.29	-0.07	-0.23	A+	A+	A-	A-	-0.75	0.07	2.57	1.11	5.93	1.51
285	635305	21	4464	0.26	0.42	0.12	0.26	0.20	0.00	0.00	0.09	-0.04	-0.03	0.09	-0.01	A-	A-	A-	A+	2.29	0.06	9.08	1.30	9.90	2.07
286	636805	21	4464	0.59	0.23	0.12	0.59	0.06	0.00	0.00	0.35	-0.16	-0.13	0.35	-0.25	A-	A-	A-	A-	0.55	0.06	3.88	1.10	3.06	1.12
287	632794	22	4458	0.89	0.04	0.05	0.89	0.02	0.00	0.00	0.43	-0.28	-0.18	0.43	-0.26	B+	A+	A+	A+	-1.61	0.09	-2.92	0.83	-2.68	0.69
288	632796	22	4458	0.83	0.07	0.07	0.83	0.02	0.00	0.00	0.47	-0.30	-0.24	0.47	-0.22	A+	A+	A+	A+	-0.99	0.08	-2.71	0.88	-2.94	0.75
289	632800	22	4458	0.38	0.38	0.05	0.17	0.39	0.00	0.00	0.14	0.14	-0.29	-0.16	0.13	A-	A+	A+	A+	1.62	0.06	9.90	1.25	9.90	1.61
290	632801	22	4458	0.73	0.15	0.73	0.06	0.06	0.00	0.00	0.47	-0.20	0.47	-0.34	-0.23	A-	A-	A-	A+	-0.29	0.07	-2.00	0.93	-1.90	0.89
291	632804	22	4458	0.70	0.12	0.70	0.06	0.11	0.00	0.00	0.49	-0.27	0.49	-0.25	-0.23	A-	A-	A-	A+	-0.09	0.06	-2.10	0.93	-2.17	0.89
292	635298	22	4458	0.35	0.35	0.10	0.11	0.44	0.00	0.00	0.14	0.14	-0.16	-0.06	0.01	A-	A-	A-	A-	1.79	0.06	9.36	1.25	9.42	1.50
293	635299	22	4458	0.61	0.61	0.06	0.24	0.09	0.00	0.00	0.28	0.28	-0.27	-0.05	-0.16	A-	A-	A+	A+	0.44	0.06	6.72	1.19	7.29	1.33
294	635300	22	4458	0.81	0.08	0.09	0.81	0.02	0.00	0.00	0.33	-0.26	-0.14	0.33	-0.12	A+	A+	A-	A-	-0.84	0.07	2.91	1.13	1.98	1.17
295	635301	22	4458	0.82	0.10	0.05	0.03	0.82	0.00	0.00	0.44	-0.24	-0.26	-0.23	0.44	A+	A-	A-	A+	-0.92	0.08	-2.68	0.88	-1.54	0.87

Table J–7 (continued). Literature Multiple-Choice Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
296	635308	22	4458	0.80	0.08	0.06	0.06	0.80	0.00	0.00	0.48	-0.24	-0.23	-0.29	0.48	A+	A+	A-	A+	-0.72	0.07	-0.87	0.96	-1.05	0.92
297	635309	22	4458	0.87	0.03	0.87	0.07	0.03	0.00	0.00	0.38	-0.22	0.38	-0.21	-0.20	A+	A+	A+	A-	-1.34	0.08	-2.18	0.89	-0.48	0.94
298	635924	22	4458	0.92	0.03	0.92	0.03	0.02	0.00	0.00	0.42	-0.22	0.42	-0.25	-0.22	A+	A+	A-	A-	-1.92	0.10	-3.38	0.77	-3.75	0.54
299	621289	23	4442	0.54	0.24	0.11	0.54	0.11	0.00	0.00	0.39	-0.15	-0.22	0.39	-0.19	A-	A-	A-	A+	0.79	0.06	1.34	1.03	1.38	1.05
300	621292	23	4442	0.48	0.12	0.48	0.17	0.22	0.00	0.00	0.27	-0.10	0.27	-0.17	-0.08	A+	A+	A+	A+	1.10	0.06	7.23	1.17	7.72	1.28
301	621293	23	4442	0.33	0.51	0.09	0.06	0.33	0.00	0.00	0.07	0.18	-0.21	-0.24	0.07	A+	A+	A+	A+	1.88	0.06	9.90	1.31	9.90	1.56
302	621297	23	4442	0.87	0.08	0.02	0.03	0.87	0.00	0.00	0.46	-0.28	-0.25	-0.24	0.46	A-	A-	A-	A+	-1.35	0.08	-3.05	0.84	-3.67	0.66
303	621299	23	4442	0.79	0.05	0.79	0.10	0.05	0.00	0.00	0.26	-0.16	0.26	-0.13	-0.13	A+	A+	A+	A-	-0.62	0.07	1.68	1.07	4.57	1.35
304	621302	23	4442	0.70	0.05	0.70	0.22	0.03	0.00	0.00	0.41	-0.22	0.41	-0.24	-0.21	C-	A-	A-	A+	-0.07	0.06	0.79	1.02	-0.06	1.00
305	632767	23	4442	0.58	0.05	0.13	0.23	0.58	0.00	0.00	0.36	-0.26	-0.19	-0.12	0.36	A-	A+	A-	A-	0.61	0.06	2.77	1.07	2.62	1.09
306	632772	23	4442	0.71	0.71	0.04	0.12	0.13	0.00	0.00	0.43	0.43	-0.28	-0.22	-0.19	A+	A+	A+	A+	-0.10	0.06	1.85	1.06	1.87	1.10
307	632773	23	4442	0.25	0.25	0.15	0.25	0.35	0.00	0.00	-0.04	-0.04	0.02	0.03	0.00	A+	A-	A-	A+	2.36	0.07	9.90	1.39	9.90	2.21
308	632776	23	4442	0.77	0.07	0.77	0.08	0.07	0.00	0.00	0.55	-0.20	0.55	-0.36	-0.29	A+	A+	A+	A+	-0.51	0.07	-5.66	0.81	-5.38	0.69
309	632777	23	4442	0.67	0.13	0.67	0.12	0.08	0.00	0.00	0.43	-0.33	0.43	-0.10	-0.21	A-	A-	A-	A+	0.13	0.06	-1.56	0.96	-1.64	0.93
310	635749	23	4442	0.68	0.12	0.68	0.07	0.13	0.00	0.00	0.37	-0.22	0.37	-0.23	-0.12	A+	A+	A+	A+	0.07	0.06	1.65	1.05	1.14	1.05
311	621288	24	4504	0.71	0.05	0.16	0.71	0.07	0.00	0.00	0.44	-0.18	-0.27	0.44	-0.22	A-	A-	A-	A+	-0.18	0.06	-0.13	1.00	-0.82	0.95
312	621290	24	4504	0.66	0.66	0.15	0.08	0.11	0.00	0.00	0.38	0.38	-0.09	-0.18	-0.31	A-	A-	A-	A-	0.14	0.06	0.13	1.00	2.16	1.10
313	621295	24	4504	0.69	0.08	0.03	0.20	0.69	0.00	0.00	0.46	-0.25	-0.23	-0.26	0.46	A-	A-	A-	A-	-0.03	0.06	-0.36	0.99	0.45	1.02
314	621300	24	4504	0.54	0.54	0.30	0.11	0.05	0.00	0.00	0.26	0.26	0.04	-0.29	-0.26	A-	A+	A-	A-	0.75	0.06	8.12	1.21	8.61	1.35
315	621304	24	4504	0.93	0.02	0.03	0.93	0.02	0.00	0.00	0.44	-0.25	-0.25	0.44	-0.23	A-	B-	B-	A+	-2.12	0.10	-1.90	0.86	-4.56	0.43
316	621407	24	4504	0.66	0.23	0.08	0.03	0.66	0.00	0.00	0.48	-0.25	-0.30	-0.23	0.48	A-	A-	A-	A-	0.12	0.06	-2.99	0.92	-2.68	0.88
317	632769	24	4504	0.82	0.04	0.06	0.82	0.07	0.00	0.00	0.46	-0.26	-0.27	0.46	-0.23	A-	A-	A-	A+	-0.97	0.07	-2.40	0.90	-2.55	0.79
318	632770	24	4504	0.67	0.11	0.08	0.67	0.14	0.00	0.00	0.43	-0.17	-0.26	0.43	-0.22	A-	A-	A-	A+	0.09	0.06	0.16	1.00	-0.47	0.98
319	632774	24	4504	0.78	0.05	0.10	0.06	0.78	0.00	0.00	0.48	-0.23	-0.27	-0.27	0.48	A+	A+	A+	A-	-0.65	0.07	-2.54	0.91	-3.18	0.78
320	632775	24	4504	0.24	0.69	0.24	0.04	0.02	0.00	0.00	0.19	0.02	0.19	-0.27	-0.25	A-	A-	A-	A-	2.42	0.07	3.69	1.13	6.60	1.53
321	632778	24	4504	0.77	0.06	0.14	0.77	0.02	0.00	0.00	0.48	-0.25	-0.33	0.48	-0.16	A+	A+	A-	A+	-0.55	0.07	-2.81	0.90	-1.58	0.89
322	632779	24	4504	0.53	0.53	0.15	0.13	0.19	0.00	0.00	0.45	0.45	-0.28	-0.30	-0.06	A-	A+	A-	A-	0.84	0.06	0.18	1.00	1.13	1.04

Table J–8. Algebra I Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	312384	0	353	0.26	0.16	0.26	0.38	0.19	0.00	0.00	0.12	-0.07	0.12	0.02	-0.09	1.50	0.13	2.67	1.20	4.14	1.49
2	313803	0	353	0.54	0.10	0.54	0.26	0.10	0.00	0.00	0.18	0.01	0.18	-0.10	-0.14	-0.01	0.11	2.75	1.10	1.87	1.11
3	324101	0	353	0.37	0.37	0.21	0.25	0.16	0.00	0.00	0.24	0.24	-0.17	-0.04	-0.08	1.20	0.13	3.90	1.25	3.40	1.32
4	400468	0	353	0.54	0.26	0.10	0.54	0.09	0.01	0.00	0.38	-0.18	-0.22	0.38	-0.13	0.00	0.11	-1.81	0.94	-1.57	0.91
5	417687	0	353	0.71	0.71	0.04	0.22	0.02	0.00	0.00	0.27	0.27	-0.11	-0.18	-0.18	-0.53	0.12	-1.82	0.92	-1.52	0.89
6	417688	0	353	0.33	0.08	0.33	0.20	0.38	0.01	0.00	0.24	-0.10	0.24	-0.17	0.00	1.20	0.13	2.28	1.14	2.13	1.19
7	417689	0	353	0.47	0.47	0.11	0.30	0.11	0.01	0.00	0.21	0.21	-0.21	-0.11	0.06	0.51	0.12	2.72	1.11	2.47	1.15
8	417693	0	353	0.38	0.30	0.18	0.14	0.38	0.00	0.00	0.24	-0.03	-0.09	-0.18	0.24	0.86	0.12	1.79	1.09	2.40	1.17
9	417720	0	353	0.54	0.15	0.15	0.54	0.16	0.00	0.00	0.36	-0.09	-0.25	0.36	-0.15	0.46	0.12	0.49	1.02	0.10	1.00
10	418246	0	353	0.44	0.44	0.31	0.13	0.10	0.01	0.00	0.33	0.33	-0.11	-0.12	-0.20	0.42	0.11	-0.62	0.98	-0.74	0.96
11	418249	0	353	0.41	0.15	0.41	0.14	0.28	0.01	0.00	0.22	-0.15	0.22	-0.17	0.04	0.32	0.11	1.45	1.05	0.90	1.05
12	418253	0	353	0.55	0.13	0.12	0.20	0.55	0.00	0.00	0.39	-0.12	-0.18	-0.22	0.39	-0.26	0.12	-1.26	0.95	-1.02	0.93
13	418376	0	353	0.28	0.37	0.15	0.28	0.19	0.00	0.00	0.33	-0.12	-0.13	0.33	-0.09	1.06	0.12	-1.27	0.93	-1.72	0.87
14	418757	0	353	0.43	0.17	0.18	0.43	0.20	0.01	0.00	0.35	-0.16	-0.22	0.35	-0.03	0.19	0.11	-1.11	0.96	-1.05	0.94
15	419614	0	353	0.40	0.26	0.13	0.20	0.40	0.00	0.00	0.16	0.04	-0.18	-0.08	0.16	0.80	0.12	3.61	1.17	2.82	1.20
16	420042	0	353	0.52	0.09	0.28	0.11	0.52	0.00	0.00	0.33	-0.16	-0.19	-0.09	0.33	0.26	0.11	-0.43	0.98	-0.30	0.98
17	420392	0	353	0.46	0.22	0.15	0.17	0.46	0.00	0.00	0.41	-0.03	-0.27	-0.24	0.41	0.08	0.11	-2.15	0.93	-1.76	0.90
18	420435	0	353	0.29	0.42	0.15	0.14	0.29	0.00	0.00	0.19	0.03	-0.13	-0.16	0.19	1.27	0.13	1.83	1.12	2.48	1.24
19	492754	0	353	0.48	0.13	0.48	0.29	0.10	0.00	0.00	0.13	-0.07	0.13	-0.03	-0.09	0.41	0.11	4.14	1.16	3.43	1.21
20	495136	0	353	0.87	0.87	0.06	0.03	0.03	0.01	0.00	0.35	0.35	-0.25	-0.14	-0.17	-1.92	0.16	-1.39	0.85	-2.19	0.67
21	495138	0	353	0.53	0.22	0.14	0.10	0.53	0.01	0.00	0.34	-0.18	-0.11	-0.14	0.34	-0.03	0.11	-0.79	0.97	-0.76	0.96
22	495141	0	353	0.54	0.13	0.11	0.54	0.21	0.01	0.00	0.23	-0.16	-0.18	0.23	0.00	-0.30	0.12	2.30	1.09	1.60	1.11
23	496382	0	353	0.56	0.56	0.31	0.05	0.08	0.00	0.00	0.31	0.31	-0.18	-0.16	-0.13	-0.29	0.12	0.15	1.01	-0.02	1.00
24	497682	0	353	0.83	0.09	0.03	0.83	0.05	0.01	0.00	0.42	-0.24	-0.19	0.42	-0.23	-1.53	0.14	-2.68	0.79	-3.00	0.64
25	498170	0	353	0.41	0.41	0.16	0.26	0.16	0.01	0.00	0.34	0.34	-0.14	-0.22	-0.04	0.23	0.11	-1.05	0.96	-0.95	0.95
26	499995	0	353	0.51	0.51	0.21	0.21	0.07	0.01	0.00	0.20	0.20	-0.13	-0.05	-0.06	0.13	0.11	2.45	1.09	2.05	1.12
27	501550	0	353	0.72	0.14	0.72	0.09	0.05	0.00	0.00	0.38	-0.14	0.38	-0.24	-0.23	-0.64	0.12	-3.82	0.83	-2.93	0.78
28	502437	0	353	0.63	0.09	0.06	0.21	0.63	0.01	0.00	0.33	-0.14	-0.16	-0.16	0.33	-0.56	0.12	-0.39	0.98	-0.20	0.98
29	505202	0	353	0.35	0.38	0.12	0.35	0.14	0.00	0.00	0.26	-0.09	-0.15	0.26	-0.07	1.07	0.12	1.99	1.11	3.06	1.26
30	575142	0	353	0.25	0.32	0.19	0.24	0.25	0.00	0.00	0.24	-0.05	-0.11	-0.08	0.24	1.61	0.14	1.65	1.13	2.42	1.29
31	577163	0	353	0.79	0.04	0.79	0.09	0.08	0.00	0.00	0.35	-0.19	0.35	-0.25	-0.10	-1.22	0.13	-1.85	0.87	-2.17	0.77
32	582449	0	353	0.30	0.30	0.31	0.25	0.13	0.00	0.00	0.20	0.20	-0.04	-0.04	-0.15	1.04	0.12	1.12	1.06	0.81	1.06
33	583820	0	353	0.34	0.20	0.34	0.28	0.18	0.01	0.00	0.19	0.01	0.19	-0.15	-0.04	0.91	0.12	1.58	1.08	2.13	1.16

Table J–8 (continued). Algebra I Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	583994	0	353	0.31	0.24	0.12	0.31	0.32	0.00	0.00	0.20	-0.05	-0.03	0.20	-0.13	0.82	0.12	0.39	1.02	1.20	1.08
35	584581	0	353	0.70	0.05	0.70	0.20	0.05	0.01	0.00	0.25	-0.13	0.25	-0.14	-0.12	-0.58	0.12	-1.00	0.95	-0.35	0.97
36	593285	0	353	0.54	0.08	0.27	0.54	0.10	0.01	0.00	0.17	-0.05	-0.04	0.17	-0.14	-0.11	0.11	3.07	1.11	3.07	1.20

Table J–9. Biology Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	277954	0	257	0.56	0.56	0.19	0.15	0.11	0.00	0.00	0.41	0.41	-0.15	-0.23	-0.21	0.18	0.13	-1.12	0.95	-1.03	0.92
2	278528	0	257	0.54	0.14	0.09	0.54	0.23	0.00	0.00	0.29	-0.21	-0.21	0.29	-0.03	-0.13	0.13	0.54	1.02	-0.04	0.99
3	279238	0	257	0.57	0.05	0.12	0.57	0.25	0.00	0.00	0.27	-0.15	-0.19	0.27	-0.07	-0.32	0.13	0.24	1.01	0.56	1.05
4	283568	0	257	0.45	0.19	0.45	0.17	0.19	0.00	0.00	0.31	-0.04	0.31	-0.10	-0.26	0.53	0.14	1.55	1.08	1.27	1.10
5	302707	0	257	0.39	0.39	0.23	0.23	0.14	0.00	0.00	0.30	0.30	-0.16	-0.18	0.01	0.47	0.14	0.45	1.02	0.02	1.00
6	314608	0	257	0.44	0.15	0.44	0.18	0.23	0.01	0.00	0.41	-0.15	0.41	-0.25	-0.10	0.20	0.13	-1.94	0.92	-1.66	0.88
7	314613	0	257	0.32	0.32	0.16	0.33	0.19	0.00	0.00	0.10	0.10	-0.15	0.06	-0.04	0.71	0.14	2.66	1.16	4.18	1.39
8	335286	0	257	0.40	0.16	0.40	0.22	0.23	0.00	0.00	0.24	-0.15	0.24	-0.14	-0.02	0.49	0.14	1.53	1.08	1.19	1.09
9	339648	0	257	0.68	0.03	0.07	0.68	0.22	0.00	0.00	0.29	-0.08	-0.21	0.29	-0.16	-1.03	0.14	0.69	1.04	0.60	1.08
10	339656	0	257	0.41	0.15	0.41	0.20	0.24	0.00	0.00	0.36	-0.16	0.36	-0.18	-0.10	-0.03	0.13	-0.55	0.98	-0.85	0.93
11	339660	0	257	0.52	0.14	0.17	0.17	0.52	0.00	0.00	0.23	-0.16	-0.20	0.07	0.23	0.15	0.13	2.16	1.09	1.13	1.09
12	339675	0	257	0.67	0.09	0.13	0.67	0.11	0.00	0.00	0.25	-0.12	-0.11	0.25	-0.13	-0.69	0.14	-0.31	0.98	-0.56	0.93
13	340999	0	257	0.72	0.06	0.15	0.07	0.72	0.00	0.00	0.33	-0.19	-0.21	-0.11	0.33	-1.10	0.15	-0.97	0.94	-0.61	0.91
14	341103	0	257	0.37	0.23	0.37	0.20	0.19	0.00	0.00	0.18	-0.11	0.18	-0.04	-0.05	0.36	0.14	1.83	1.09	2.68	1.22
15	341465	0	257	0.32	0.26	0.29	0.13	0.32	0.00	0.00	0.26	-0.06	-0.09	-0.12	0.26	0.77	0.14	0.78	1.05	1.27	1.11
16	408525	0	257	0.45	0.45	0.20	0.08	0.26	0.01	0.00	0.41	0.41	-0.27	-0.19	-0.08	-0.03	0.13	-2.07	0.92	-1.10	0.91
17	409190	0	257	0.46	0.46	0.20	0.18	0.15	0.01	0.00	0.18	0.18	-0.03	-0.11	-0.08	0.82	0.14	4.95	1.34	4.21	1.41
18	410546	0	257	0.32	0.31	0.21	0.16	0.32	0.00	0.00	0.35	-0.09	-0.18	-0.12	0.35	0.29	0.14	-1.59	0.93	-0.97	0.93
19	410625	0	257	0.49	0.10	0.30	0.49	0.12	0.00	0.00	0.32	-0.10	-0.23	0.32	-0.07	-0.20	0.13	0.63	1.02	-0.30	0.97
20	411171	0	257	0.58	0.13	0.13	0.16	0.58	0.00	0.00	0.39	-0.08	-0.21	-0.24	0.39	-0.73	0.14	0.21	1.01	-0.07	0.99
21	419036	0	257	0.51	0.14	0.16	0.18	0.51	0.00	0.00	0.38	-0.23	-0.21	-0.09	0.38	-0.31	0.13	-0.74	0.97	-0.89	0.92
22	421197	0	257	0.32	0.43	0.13	0.32	0.12	0.00	0.00	0.30	-0.08	-0.16	0.30	-0.13	1.01	0.15	0.88	1.06	1.47	1.15
23	456492	0	257	0.30	0.37	0.09	0.30	0.24	0.00	0.00	0.20	0.07	-0.17	0.20	-0.17	0.98	0.15	1.55	1.11	1.94	1.19
24	456495	0	257	0.62	0.11	0.62	0.19	0.08	0.00	0.00	0.35	-0.14	0.35	-0.16	-0.22	-0.46	0.14	-1.62	0.93	-1.30	0.87
25	468403	0	257	0.54	0.09	0.15	0.54	0.20	0.01	0.00	0.27	-0.19	-0.03	0.27	-0.14	-0.10	0.13	0.49	1.02	0.64	1.05
26	468408	0	257	0.50	0.50	0.26	0.12	0.12	0.00	0.00	0.41	0.41	-0.15	-0.20	-0.22	0.46	0.14	0.52	1.02	-0.19	0.98
27	468411	0	257	0.49	0.09	0.18	0.49	0.24	0.00	0.00	0.29	-0.06	-0.08	0.29	-0.23	-0.11	0.13	0.64	1.02	0.49	1.04
28	468429	0	257	0.37	0.14	0.27	0.37	0.22	0.00	0.00	0.28	-0.05	-0.09	0.28	-0.18	0.80	0.14	1.52	1.10	1.65	1.15
29	468953	0	257	0.29	0.29	0.16	0.27	0.27	0.00	0.00	0.43	0.43	-0.18	-0.18	-0.09	1.01	0.15	-1.46	0.90	-0.40	0.96
30	469808	0	257	0.47	0.14	0.47	0.23	0.16	0.00	0.00	0.30	-0.13	0.30	-0.09	-0.16	0.07	0.13	0.41	1.02	-0.32	0.97
31	471909	0	257	0.37	0.37	0.25	0.16	0.23	0.00	0.00	0.39	0.39	-0.13	-0.19	-0.15	0.42	0.14	-1.62	0.92	-0.92	0.93
32	471910	0	257	0.60	0.18	0.60	0.09	0.13	0.00	0.00	0.33	-0.21	0.33	-0.13	-0.13	-0.38	0.13	-0.90	0.96	-0.91	0.91
33	471920	0	257	0.39	0.39	0.19	0.19	0.23	0.00	0.00	0.23	0.23	-0.16	-0.07	-0.03	0.14	0.13	1.60	1.07	0.84	1.06

Table J–9 (continued). Biology Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	480272	0	257	0.34	0.21	0.16	0.34	0.29	0.00	0.00	0.12	0.08	-0.03	0.12	-0.15	0.72	0.14	2.99	1.18	3.37	1.31
35	480292	0	257	0.60	0.21	0.60	0.13	0.05	0.00	0.00	0.37	-0.26	0.37	-0.16	-0.08	-0.30	0.13	-2.16	0.92	-1.27	0.89
36	480313	0	257	0.56	0.56	0.13	0.21	0.10	0.00	0.00	0.22	0.22	-0.18	-0.06	-0.09	0.07	0.13	2.24	1.09	0.98	1.08
37	480333	0	257	0.33	0.33	0.24	0.23	0.19	0.00	0.00	0.45	0.45	-0.09	-0.15	-0.26	0.41	0.14	-3.31	0.85	-2.21	0.84
38	480334	0	257	0.33	0.33	0.05	0.37	0.25	0.00	0.00	0.26	0.26	-0.19	-0.07	-0.09	0.67	0.14	0.56	1.03	0.26	1.02
39	493646	0	257	0.33	0.28	0.17	0.22	0.33	0.00	0.00	0.32	-0.08	-0.16	-0.13	0.32	0.93	0.15	0.71	1.05	1.06	1.10
40	566400	0	257	0.62	0.08	0.15	0.62	0.15	0.00	0.00	0.32	-0.05	-0.19	0.32	-0.18	-0.13	0.13	-0.86	0.97	-0.58	0.95
41	566408	0	257	0.35	0.07	0.42	0.16	0.35	0.00	0.00	0.30	-0.20	-0.12	-0.07	0.30	1.01	0.15	1.95	1.15	1.66	1.17
42	566409	0	257	0.35	0.14	0.18	0.32	0.35	0.01	0.00	0.30	-0.15	-0.11	-0.11	0.30	1.22	0.15	3.30	1.29	2.38	1.28
43	566695	0	257	0.45	0.26	0.45	0.20	0.09	0.00	0.00	0.41	-0.13	0.41	-0.25	-0.14	0.37	0.14	-1.11	0.95	-1.20	0.91
44	569373	0	257	0.32	0.29	0.21	0.32	0.16	0.01	0.00	0.27	-0.08	-0.11	0.27	-0.10	0.51	0.14	-0.20	0.99	0.27	1.02
45	578427	0	257	0.37	0.28	0.09	0.26	0.37	0.00	0.00	0.20	-0.07	-0.19	-0.01	0.20	1.00	0.15	3.40	1.26	3.52	1.37
46	581417	0	257	0.41	0.14	0.41	0.16	0.28	0.00	0.00	0.45	-0.13	0.45	-0.17	-0.24	0.34	0.14	-2.44	0.89	-1.72	0.87
47	582650	0	257	0.49	0.09	0.21	0.21	0.49	0.00	0.00	0.40	-0.17	-0.18	-0.19	0.40	-0.09	0.13	-1.90	0.93	-1.42	0.88
48	582656	0	257	0.28	0.28	0.41	0.12	0.19	0.00	0.00	0.32	0.32	0.00	-0.15	-0.23	1.00	0.15	-0.40	0.97	0.21	1.02

Table J–10. Literature Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	496815	0	161	0.57	0.12	0.57	0.25	0.06	0.00	0.00	0.57	-0.31	0.57	-0.27	-0.27	-0.85	0.18	-0.52	0.96	-0.82	0.89
2	496816	0	161	0.42	0.39	0.13	0.42	0.06	0.00	0.00	0.21	0.12	-0.33	0.21	-0.24	1.17	0.19	4.76	1.49	4.36	1.82
3	496819	0	161	0.25	0.07	0.17	0.49	0.25	0.01	0.00	0.16	-0.19	-0.11	0.07	0.16	1.49	0.20	2.10	1.24	2.76	1.59
4	496820	0	161	0.55	0.55	0.24	0.14	0.06	0.01	0.00	0.48	0.48	-0.25	-0.19	-0.26	-0.14	0.17	-1.76	0.89	-1.26	0.89
5	496821	0	161	0.71	0.05	0.71	0.11	0.12	0.00	0.00	0.50	-0.26	0.50	-0.29	-0.24	-1.08	0.19	-1.84	0.84	-1.76	0.75
6	496824	0	161	0.53	0.18	0.53	0.12	0.17	0.00	0.00	0.36	-0.16	0.36	-0.14	-0.20	0.28	0.18	1.00	1.07	1.03	1.10
7	496825	0	161	0.55	0.09	0.06	0.30	0.55	0.00	0.00	0.43	-0.27	-0.13	-0.24	0.43	-0.53	0.18	-0.01	1.00	-0.25	0.97
8	496826	0	161	0.57	0.08	0.57	0.14	0.22	0.00	0.00	0.34	-0.16	0.34	-0.15	-0.17	-0.06	0.17	0.67	1.04	0.72	1.06
9	496827	0	161	0.73	0.73	0.12	0.05	0.10	0.00	0.01	0.43	0.43	-0.15	-0.23	-0.32	-0.86	0.18	-1.80	0.86	-2.03	0.75
10	516243	0	161	0.24	0.27	0.39	0.24	0.09	0.01	0.00	0.17	-0.02	0.01	0.17	-0.22	1.25	0.19	1.04	1.10	1.61	1.27
11	516244	0	161	0.36	0.14	0.19	0.30	0.36	0.01	0.00	0.26	-0.15	-0.12	-0.04	0.26	0.84	0.18	1.57	1.12	2.12	1.28
12	516245	0	161	0.30	0.30	0.29	0.28	0.11	0.02	0.00	0.12	0.12	-0.08	0.06	-0.13	0.94	0.19	2.29	1.19	2.35	1.34
13	516246	0	161	0.60	0.17	0.14	0.07	0.60	0.01	0.00	0.55	-0.31	-0.21	-0.29	0.55	-0.57	0.18	-2.22	0.84	-2.14	0.78
14	516249	0	161	0.46	0.14	0.16	0.46	0.23	0.01	0.00	0.28	-0.13	-0.20	0.28	-0.03	-0.08	0.17	1.72	1.12	1.39	1.13
15	516250	0	161	0.44	0.04	0.29	0.22	0.44	0.01	0.00	0.50	-0.19	-0.21	-0.25	0.50	-0.28	0.18	-0.52	0.96	-0.69	0.93
16	516253	0	161	0.35	0.19	0.35	0.25	0.20	0.01	0.00	0.40	-0.12	0.40	-0.26	-0.07	0.37	0.18	-0.94	0.94	-0.50	0.95
17	516254	0	161	0.49	0.19	0.49	0.11	0.20	0.01	0.00	0.29	-0.17	0.29	-0.18	-0.04	0.52	0.18	2.51	1.18	2.60	1.29
18	584414	0	161	0.52	0.12	0.19	0.52	0.17	0.01	0.00	0.38	-0.24	-0.15	0.38	-0.15	0.11	0.17	0.28	1.02	0.19	1.01
19	584416	0	161	0.23	0.30	0.32	0.23	0.14	0.01	0.00	-0.08	0.11	0.02	-0.08	-0.07	1.28	0.20	2.53	1.26	5.29	2.12
20	584417	0	161	0.60	0.11	0.15	0.14	0.60	0.01	0.00	0.43	-0.25	-0.12	-0.23	0.43	-0.01	0.17	-0.64	0.96	-0.88	0.92
21	584418	0	161	0.54	0.54	0.10	0.09	0.27	0.01	0.00	0.40	0.40	-0.19	-0.31	-0.15	-0.60	0.18	0.85	1.06	1.09	1.12
22	584419	0	161	0.52	0.18	0.52	0.16	0.14	0.00	0.00	0.63	-0.32	0.63	-0.27	-0.27	-0.41	0.18	-3.01	0.80	-2.90	0.73
23	584421	0	161	0.37	0.37	0.12	0.22	0.29	0.00	0.00	0.25	0.25	-0.31	-0.04	-0.01	1.26	0.20	3.59	1.38	3.49	1.66
24	584422	0	161	0.40	0.12	0.24	0.40	0.23	0.00	0.00	0.35	-0.10	-0.23	0.35	-0.09	0.26	0.18	0.19	1.01	0.93	1.09
25	584423	0	161	0.46	0.46	0.25	0.16	0.13	0.00	0.00	0.42	0.42	-0.12	-0.26	-0.17	0.27	0.18	-0.45	0.97	-0.20	0.98
26	584425	0	161	0.48	0.14	0.11	0.27	0.48	0.00	0.00	0.31	-0.21	-0.19	-0.05	0.31	0.88	0.18	3.69	1.32	3.64	1.53
27	593118	0	161	0.60	0.60	0.18	0.09	0.13	0.00	0.00	0.22	0.22	-0.07	-0.12	-0.14	-0.50	0.18	1.92	1.14	2.40	1.27
28	593120	0	161	0.37	0.33	0.19	0.37	0.11	0.01	0.00	0.30	0.03	-0.19	0.30	-0.24	0.63	0.18	1.05	1.08	0.48	1.05
29	593122	0	161	0.64	0.64	0.16	0.07	0.13	0.00	0.00	0.35	0.35	-0.27	-0.18	-0.07	0.05	0.17	0.97	1.06	1.44	1.13
30	593123	0	161	0.50	0.24	0.50	0.07	0.18	0.01	0.00	0.37	-0.15	0.37	-0.20	-0.17	0.30	0.18	0.69	1.05	0.78	1.07
31	593125	0	161	0.53	0.07	0.35	0.05	0.53	0.00	0.00	0.33	-0.17	-0.16	-0.20	0.33	0.45	0.18	2.21	1.16	1.58	1.16
32	593127	0	161	0.76	0.06	0.09	0.76	0.09	0.00	0.00	0.39	-0.18	-0.17	0.39	-0.27	-0.55	0.18	-1.97	0.86	-2.01	0.79
33	593128	0	161	0.33	0.12	0.20	0.34	0.33	0.00	0.00	0.18	-0.21	-0.12	0.07	0.18	1.11	0.19	2.60	1.24	3.42	1.58

Table J–10 (continued). Literature Multiple-Choice Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(A)	P(B)	P(C)	P(D)	P(-)	P(*)	ITCorr	Corr(A)	Corr(B)	Corr(C)	Corr(D)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	593129	0	161	0.57	0.09	0.10	0.57	0.24	0.00	0.00	0.26	0.02	-0.20	0.26	-0.17	0.00	0.17	2.03	1.14	1.32	1.12

CONSTRUCTED-RESPONSE ITEMS

Table J–11. Algebra I Constructed-Response Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(4)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Corr(4)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	272719	0	36950	0.17	0.48	0.27	0.11	0.04	0.01	0.06	0.62	-0.39	0.14	0.29	0.34	0.27	1.98	0.01	5.60	1.05	0.98	1.01
2	301616	0	36950	0.18	0.49	0.32	0.10	0.03	0.02	0.03	0.72	-0.53	0.20	0.34	0.34	0.32	1.76	0.01	-9.90	0.79	-9.90	0.71
3	313886	0	36950	0.11	0.60	0.23	0.07	0.02	0.01	0.06	0.53	-0.29	0.14	0.29	0.28	0.23	2.07	0.01	-9.90	0.84	-9.90	0.77
4	314642	0	36950	0.34	0.17	0.35	0.33	0.10	0.01	0.03	0.60	-0.37	-0.15	0.23	0.38	0.22	1.64	0.01	-8.08	0.95	-7.90	0.95
5	334676	0	36950	0.28	0.27	0.39	0.19	0.06	0.04	0.05	0.58	-0.26	-0.14	0.20	0.29	0.40	0.86	0.01	-9.90	0.90	-9.90	0.87
6	339442	0	36950	0.25	0.26	0.43	0.16	0.06	0.02	0.06	0.68	-0.43	-0.01	0.30	0.39	0.27	1.19	0.01	-9.90	0.78	-9.90	0.77

Table J–12. Biology Constructed-Response Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	342566	0	31027	0.29	0.28	0.45	0.17	0.02	0.05	0.48	-0.13	-0.17	0.37	0.36	0.73	0.01	-9.90	0.85	-9.90	0.83
2	413175	0	31027	0.38	0.32	0.30	0.19	0.16	0.02	0.61	-0.38	-0.08	0.17	0.50	0.49	0.01	-9.04	0.93	-9.90	0.91
3	413176	0	31027	0.31	0.38	0.30	0.19	0.09	0.03	0.56	-0.28	-0.10	0.21	0.51	0.60	0.01	-9.90	0.86	-9.90	0.84
4	477350	0	31027	0.36	0.28	0.33	0.24	0.09	0.04	0.49	-0.29	-0.04	0.28	0.30	1.03	0.01	9.90	1.26	9.90	1.26
5	487597	0	31027	0.57	0.08	0.28	0.37	0.23	0.02	0.47	-0.23	-0.21	0.11	0.34	-0.11	0.02	-9.90	0.89	-9.90	0.92
6	582764	0	31027	0.49	0.12	0.37	0.31	0.15	0.02	0.52	-0.20	-0.25	0.16	0.42	-0.02	0.02	-9.90	0.81	-9.90	0.84

Table J–13. Literature Constructed-Response Item Statistics: Winter

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	504140	0	30416	0.46	0.12	0.33	0.39	0.09	0.04	0.69	-0.37	-0.25	0.41	0.39	0.88	0.02	-9.90	0.75	-9.90	0.74
2	504142	0	30416	0.41	0.10	0.43	0.33	0.05	0.07	0.68	-0.33	-0.21	0.47	0.34	0.71	0.02	-9.90	0.75	-9.90	0.75
3	528769	0	30416	0.47	0.11	0.35	0.40	0.09	0.04	0.72	-0.39	-0.27	0.42	0.40	0.99	0.02	-9.90	0.79	-9.90	0.79
4	528770	0	30416	0.36	0.18	0.46	0.25	0.04	0.06	0.69	-0.43	-0.04	0.47	0.30	1.09	0.02	2.14	1.02	3.15	1.03
5	528811	0	30416	0.45	0.12	0.39	0.39	0.06	0.03	0.68	-0.36	-0.27	0.45	0.34	0.93	0.02	-9.90	0.70	-9.90	0.70
6	584961	0	30416	0.46	0.14	0.33	0.39	0.09	0.03	0.67	-0.34	-0.25	0.39	0.38	0.92	0.02	-9.90	0.79	-9.90	0.78

Table J–14. Algebra I Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(4)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Corr(4)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	273336	0	119316	0.39	0.23	0.26	0.20	0.16	0.10	0.04	0.78	-0.47	-0.23	0.12	0.38	0.51					0.83	0.01	-9.90	0.93	-9.90	0.89
2	314205	0	119316	0.20	0.46	0.25	0.16	0.06	0.01	0.04	0.76	-0.58	0.15	0.42	0.39	0.23					2.03	0.01	-9.90	0.78	-9.90	0.69
3	330194	0	119316	0.30	0.32	0.27	0.21	0.11	0.04	0.04	0.76	-0.49	-0.10	0.26	0.44	0.38					1.15	0.01	-9.90	0.91	-9.90	0.87
4	569441	0	119316	0.25	0.37	0.31	0.17	0.09	0.02	0.03	0.78	-0.57	0.04	0.38	0.45	0.25					1.81	0.01	-9.90	0.84	-9.90	0.79
5	580186	0	119316	0.36	0.27	0.20	0.28	0.21	0.02	0.01	0.78	-0.59	-0.16	0.19	0.57	0.21					1.54	0.01	-9.90	0.80	-9.90	0.78
6	580197	0	119316	0.31	0.27	0.35	0.18	0.13	0.04	0.03	0.71	-0.45	-0.12	0.29	0.41	0.31					1.63	0.01	9.90	1.13	9.90	1.09
7	668367	1	1493	0.11	0.61	0.29	0.03	0.03	0.00	0.02	0.60	-0.53	0.45	0.20	0.28	0.09	A-	A-	NA	A+	3.09	0.06	1.91	1.10	-1.50	0.92
8	575217	1	1493	0.17	0.41	0.51	0.05	0.02	0.00	0.01	0.64	-0.50	0.29	0.35	0.28	0.10	A-	A-	NA	A-	2.81	0.06	-4.95	0.82	-5.69	0.81
9	664848	2	1495	0.24	0.38	0.33	0.13	0.09	0.03	0.03	0.77	-0.59	0.09	0.35	0.41	0.30	A+	A-	NA	A-	1.86	0.06	-5.91	0.78	-7.68	0.71
10	667467	2	1495	0.23	0.42	0.29	0.18	0.06	0.03	0.02	0.64	-0.50	0.08	0.32	0.28	0.29	A+	A-	NA	A-	1.98	0.06	1.44	1.06	0.92	1.04
11	618264	3	1498	0.25	0.46	0.18	0.13	0.13	0.04	0.03	0.70	-0.55	0.08	0.24	0.43	0.30	A+	A+	NA	A-	1.66	0.07	0.01	1.00	-1.76	0.90
12	663745	3	1498	0.13	0.70	0.09	0.06	0.08	0.02	0.03	0.60	-0.45	0.10	0.23	0.41	0.26	A+	A-	NA	A-	2.33	0.08	1.07	1.06	-0.42	0.94
13	623096	4	1509	0.31	0.26	0.38	0.22	0.09	0.04	0.02	0.74	-0.47	-0.17	0.32	0.40	0.36	A-	A-	A-	A+	1.42	0.07	-7.12	0.76	-7.59	0.75
14	664307	4	1509	0.33	0.43	0.15	0.11	0.16	0.12	0.03	0.69	-0.51	-0.05	0.09	0.34	0.46	A+	A-	A-	A-	1.08	0.07	2.96	1.12	1.01	1.06
15	651617	5	1498	0.16	0.52	0.32	0.08	0.04	0.01	0.03	0.54	-0.36	0.13	0.30	0.31	0.15	A-	A+	A+	A+	2.60	0.06	1.88	1.08	1.41	1.07
16	668363	5	1498	0.40	0.27	0.21	0.20	0.17	0.12	0.02	0.80	-0.56	-0.18	0.10	0.36	0.53	A+	A-	A+	A-	0.81	0.07	-8.54	0.72	-8.14	0.70
17	664846	6	1498	0.23	0.40	0.35	0.10	0.08	0.03	0.03	0.66	-0.43	0.00	0.28	0.36	0.33	A+	A+	NA	A-	1.86	0.06	-0.93	0.96	-1.32	0.94
18	664849	6	1498	0.06	0.79	0.13	0.03	0.01	0.00	0.03	0.51	-0.37	0.37	0.26	0.19	0.12	A+	A+	NA	A-	3.50	0.08	-0.56	0.96	-3.52	0.66
19	664847	7	1498	0.42	0.14	0.26	0.36	0.16	0.06	0.01	0.72	-0.46	-0.27	0.15	0.38	0.36	A+	A-	NA	A-	0.90	0.08	-5.41	0.82	-5.16	0.83
20	667563	7	1498	0.18	0.48	0.32	0.17	0.01	0.01	0.01	0.68	-0.57	0.19	0.48	0.11	0.24	A-	A-	NA	A+	2.39	0.06	-4.24	0.84	-5.66	0.77
21	621843	8	1496	0.13	0.63	0.23	0.08	0.03	0.01	0.01	0.62	-0.51	0.27	0.30	0.31	0.21	A-	A+	NA	A-	2.69	0.07	-2.96	0.86	-1.18	0.92
22	663750	8	1496	0.32	0.32	0.26	0.23	0.14	0.04	0.02	0.71	-0.50	-0.13	0.24	0.46	0.29	A-	A-	NA	A-	1.46	0.07	-2.25	0.92	-2.85	0.89
23	667561	9	1498	0.36	0.22	0.23	0.43	0.09	0.02	0.01	0.66	-0.50	-0.12	0.24	0.37	0.28	A-	A-	NA	A+	1.42	0.07	-3.53	0.88	-3.45	0.88
24	418190	9	1498	0.38	0.23	0.34	0.12	0.16	0.11	0.02	0.70	-0.45	-0.21	0.17	0.38	0.39	A-	A-	NA	A-	0.88	0.07	0.87	1.03	-0.70	0.97
25	663747	10	1499	0.33	0.35	0.22	0.20	0.10	0.10	0.02	0.78	-0.61	-0.02	0.27	0.31	0.46	A+	A-	NA	A+	1.29	0.07	-5.31	0.81	-5.33	0.78
26	663749	10	1499	0.34	0.26	0.34	0.17	0.11	0.09	0.02	0.74	-0.50	-0.12	0.24	0.35	0.42	A+	A+	NA	A-	1.25	0.07	-3.03	0.89	-4.24	0.84
27	667464	11	1497	0.40	0.26	0.23	0.19	0.17	0.12	0.02	0.73	-0.49	-0.18	0.16	0.32	0.45	A+	A-	A+	A+	0.80	0.07	-1.26	0.95	-1.72	0.93
28	667468	11	1497	0.24	0.32	0.40	0.23	0.02	0.00	0.02	0.57	-0.41	0.02	0.37	0.27	0.13	A+	A-	A-	A-	2.44	0.06	0.72	1.02	0.58	1.02
29	663748	12	1500	0.23	0.39	0.39	0.10	0.04	0.06	0.02	0.68	-0.51	0.10	0.32	0.27	0.37	A-	A+	NA	A-	1.70	0.06	-1.23	0.95	-2.08	0.91
30	667465	12	1500	0.32	0.22	0.38	0.24	0.12	0.02	0.03	0.74	-0.48	-0.17	0.32	0.46	0.22	A+	A+	NA	A+	1.67	0.07	-6.10	0.80	-6.57	0.79
31	666620	13	1499	0.07	0.76	0.15	0.03	0.02	0.00	0.03	0.59	-0.48	0.40	0.29	0.26	0.14	A-	A-	NA	A-	3.22	0.07	-4.32	0.75	-5.70	0.56
32	667466	13	1499	0.38	0.22	0.31	0.16	0.22	0.06	0.02	0.56	-0.42	-0.07	0.13	0.30	0.28	A+	A-	NA	A+	1.01	0.07	9.26	1.37	8.82	1.38

Table J–14 (continued). Algebra I Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(4)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Corr(4)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
33	664311	14	1499	0.32	0.19	0.40	0.27	0.08	0.03	0.02	0.71	-0.42	-0.22	0.35	0.40	0.28	B-	A-	A-	A-	1.43	0.07	-5.83	0.81	-6.12	0.80
34	667560	14	1499	0.34	0.19	0.37	0.30	0.10	0.02	0.01	0.66	-0.46	-0.14	0.28	0.35	0.27	A-	A-	A-	A-	1.44	0.07	-2.77	0.91	-3.06	0.90
35	651619	15	1495	0.28	0.35	0.37	0.11	0.08	0.08	0.02	0.72	-0.59	0.07	0.32	0.26	0.41	A-	A-	NA	A+	1.38	0.06	-1.20	0.95	-2.84	0.88
36	666622	15	1495	0.09	0.75	0.11	0.07	0.02	0.01	0.03	0.61	-0.52	0.34	0.37	0.23	0.22	A-	A+	NA	A-	2.73	0.08	-3.68	0.79	-4.98	0.54
37	664850	16	1498	0.27	0.49	0.10	0.17	0.05	0.12	0.04	0.75	-0.56	0.02	0.30	0.25	0.52	A-	A-	A-	A-	1.31	0.07	-3.42	0.86	-4.44	0.71
38	667559	16	1498	0.21	0.38	0.38	0.17	0.04	0.00	0.02	0.71	-0.58	0.16	0.44	0.28	0.14	A+	A-	A-	A-	2.53	0.06	-5.48	0.81	-6.45	0.77
39	615350	17	1498	0.12	0.64	0.20	0.09	0.04	0.00	0.03	0.66	-0.54	0.27	0.42	0.32	0.07	A+	A+	NA	A-	3.15	0.07	-3.00	0.86	-4.45	0.72
40	668364	17	1498	0.09	0.74	0.13	0.05	0.02	0.01	0.03	0.62	-0.52	0.34	0.35	0.26	0.24	A+	A-	NA	A-	2.76	0.08	-3.20	0.81	-5.18	0.57
41	666625	18	1500	0.19	0.51	0.24	0.10	0.10	0.01	0.03	0.65	-0.49	0.14	0.28	0.44	0.14	A+	A+	A-	A-	2.48	0.06	0.75	1.03	-0.72	0.96
42	668362	18	1500	0.24	0.42	0.30	0.11	0.08	0.05	0.03	0.71	-0.55	0.12	0.29	0.37	0.33	A+	A-	A-	A-	1.75	0.06	-1.42	0.94	-3.97	0.82
43	630783	19	1497	0.20	0.48	0.26	0.18	0.02	0.03	0.03	0.68	-0.56	0.15	0.45	0.20	0.27	A+	A-	NA	A-	1.97	0.06	-2.00	0.92	-4.53	0.79
44	664851	19	1497	0.10	0.74	0.14	0.07	0.03	0.00	0.02	0.56	-0.50	0.28	0.35	0.28	0.05	A-	A-	NA	A-	3.45	0.07	-0.31	0.98	-2.43	0.78
45	651615	20	1497	0.52	0.17	0.19	0.14	0.33	0.16	0.02	0.70	-0.45	-0.30	0.02	0.30	0.45	A+	NA	NA	A-	0.35	0.08	-3.26	0.89	-1.41	0.94
46	651618	20	1497	0.13	0.61	0.27	0.07	0.03	0.01	0.01	0.62	-0.52	0.28	0.32	0.29	0.20	A-	NA	NA	A-	2.77	0.06	-3.17	0.85	-3.61	0.81
47	664309	21	1498	0.21	0.49	0.24	0.15	0.07	0.02	0.02	0.70	-0.60	0.19	0.34	0.36	0.23	A-	NA	NA	A-	2.09	0.06	-1.61	0.93	-4.10	0.80
48	667564	21	1498	0.27	0.27	0.44	0.18	0.09	0.00	0.01	0.70	-0.49	-0.08	0.38	0.45	0.05	A-	NA	NA	A+	2.51	0.07	-5.71	0.81	-6.14	0.80
49	664308	22	1492	0.29	0.39	0.23	0.17	0.11	0.06	0.03	0.78	-0.61	0.01	0.29	0.38	0.42	A+	A+	NA	A+	1.44	0.06	-5.70	0.79	-6.77	0.72
50	666623	22	1492	0.20	0.43	0.34	0.12	0.04	0.02	0.03	0.68	-0.46	0.08	0.40	0.32	0.27	A+	A+	NA	A+	2.18	0.06	-4.02	0.84	-3.45	0.86
51	651616	23	1498	0.26	0.47	0.17	0.17	0.13	0.04	0.02	0.70	-0.52	-0.03	0.29	0.42	0.30	A+	A-	NA	A-	1.62	0.07	-1.18	0.95	-2.32	0.87
52	667562	23	1498	0.25	0.38	0.29	0.25	0.06	0.01	0.02	0.53	-0.38	0.04	0.21	0.36	0.18	C-	A-	NA	A-	2.06	0.06	5.12	1.20	3.44	1.14
53	663746	24	1496	0.39	0.25	0.23	0.25	0.20	0.06	0.01	0.75	-0.51	-0.20	0.11	0.44	0.40	A-	A-	NA	A-	0.99	0.07	-5.36	0.82	-5.60	0.80
54	668365	24	1496	0.34	0.19	0.44	0.20	0.10	0.05	0.02	0.74	-0.42	-0.24	0.24	0.41	0.40	A+	A-	NA	A-	1.21	0.07	-6.09	0.79	-6.26	0.78

Table J–15. Biology Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	278281	0	111271	0.63	0.09	0.17	0.34	0.35	0.03	0.68	-0.36	-0.28	0.01	0.56					-0.19	0.02	-8.99	0.93	-8.43	0.93
2	412913	0	111271	0.46	0.23	0.26	0.31	0.17	0.02	0.68	-0.46	-0.13	0.22	0.50					0.68	0.01	-9.11	0.93	-5.09	0.96
3	469076	0	111271	0.34	0.35	0.29	0.21	0.11	0.04	0.67	-0.42	-0.03	0.29	0.49					1.26	0.01	-4.04	0.97	7.37	1.09
4	477360	0	111271	0.47	0.26	0.22	0.24	0.24	0.03	0.74	-0.53	-0.12	0.25	0.54					0.57	0.01	-9.90	0.88	-9.90	0.87
5	578199	0	111271	0.36	0.26	0.33	0.27	0.07	0.05	0.66	-0.43	-0.01	0.37	0.38					1.06	0.01	-9.90	0.88	-9.90	0.89
6	583799	0	111271	0.32	0.39	0.25	0.17	0.12	0.04	0.75	-0.52	0.03	0.37	0.50					1.03	0.01	-9.90	0.80	-9.90	0.75
7	658169	1	1490	0.40	0.25	0.28	0.23	0.15	0.06	0.63	-0.40	-0.14	0.24	0.50	A-	B-	NA	A-	0.59	0.06	-1.04	0.96	-0.97	0.96
8	659539	1	1490	0.52	0.20	0.21	0.23	0.29	0.02	0.68	-0.41	-0.23	0.11	0.58	A+	A-	NA	A-	0.03	0.07	-4.78	0.85	-3.49	0.86
9	654030	2	1496	0.28	0.36	0.32	0.09	0.11	0.10	0.64	-0.40	0.10	0.26	0.47	A+	NA	NA	A-	1.36	0.06	-1.80	0.93	-2.96	0.87
10	656075	2	1496	0.40	0.37	0.16	0.18	0.22	0.05	0.72	-0.56	0.03	0.23	0.55	A+	NA	NA	A-	0.80	0.07	-3.24	0.88	-3.42	0.83
11	658150	3	1499	0.14	0.65	0.10	0.10	0.04	0.09	0.56	-0.32	0.22	0.36	0.30	A+	NA	NA	A-	2.30	0.07	0.72	1.04	-0.74	0.92
12	664015	3	1499	0.31	0.33	0.38	0.18	0.06	0.04	0.51	-0.31	-0.01	0.34	0.28	A+	NA	NA	A+	1.48	0.06	5.37	1.20	4.15	1.16
13	621824	4	1497	0.32	0.39	0.20	0.20	0.12	0.07	0.69	-0.48	0.04	0.36	0.45	A+	NA	NA	A+	1.30	0.06	-2.58	0.91	-3.36	0.84
14	659669	4	1497	0.41	0.37	0.16	0.13	0.27	0.04	0.72	-0.51	-0.04	0.15	0.62	A+	NA	NA	A+	0.75	0.07	-1.73	0.93	-2.77	0.84
15	635235	5	1498	0.41	0.22	0.33	0.20	0.17	0.07	0.64	-0.40	-0.11	0.20	0.51	A+	NA	NA	A+	0.79	0.06	0.77	1.03	0.27	1.01
16	656077	5	1498	0.18	0.61	0.16	0.09	0.06	0.05	0.60	-0.39	0.16	0.32	0.41	A-	NA	NA	A-	1.97	0.07	-2.70	0.87	-0.67	0.95
17	659659	6	1498	0.36	0.34	0.21	0.18	0.17	0.09	0.72	-0.49	-0.03	0.29	0.54	A-	NA	NA	A-	0.99	0.06	-4.59	0.84	-5.03	0.78
18	664016	6	1498	0.40	0.34	0.19	0.27	0.15	0.03	0.63	-0.44	-0.11	0.33	0.41	A+	NA	NA	A-	0.90	0.06	0.93	1.03	-0.40	0.98
19	658170	7	1498	0.33	0.28	0.35	0.15	0.12	0.09	0.66	-0.36	-0.07	0.34	0.47	A+	A-	NA	A-	1.21	0.06	-1.55	0.94	-2.62	0.90
20	664017	7	1498	0.34	0.37	0.21	0.19	0.14	0.05	0.71	-0.48	0.03	0.30	0.51	A-	A-	NA	A-	1.13	0.06	-4.00	0.86	-4.93	0.78
21	658122	8	1499	0.29	0.40	0.23	0.16	0.10	0.09	0.59	-0.40	0.10	0.34	0.35	A+	NA	NA	A-	1.49	0.06	5.30	1.22	2.56	1.13
22	658174	8	1499	0.41	0.28	0.24	0.24	0.17	0.05	0.73	-0.49	-0.06	0.32	0.50	A+	NA	NA	A-	0.89	0.07	-4.28	0.86	-4.57	0.82
23	654023	9	1495	0.38	0.33	0.21	0.16	0.20	0.09	0.73	-0.49	-0.03	0.22	0.58	A+	NA	A-	A-	0.94	0.06	-3.90	0.86	-3.71	0.82
24	655220	9	1495	0.46	0.23	0.22	0.27	0.21	0.05	0.63	-0.47	-0.07	0.24	0.43	B+	NA	A-	A-	0.63	0.07	1.87	1.06	2.14	1.09
25	621826	10	1497	0.55	0.10	0.22	0.39	0.21	0.07	0.52	-0.31	-0.25	0.22	0.33	A+	NA	NA	A-	0.25	0.08	3.00	1.10	4.04	1.15
26	656079	10	1497	0.41	0.29	0.24	0.22	0.18	0.05	0.70	-0.47	-0.08	0.28	0.51	A+	NA	NA	A+	0.78	0.06	-4.40	0.85	-5.06	0.80
27	630627	11	1500	0.28	0.36	0.30	0.17	0.07	0.08	0.62	-0.38	0.05	0.39	0.36	A+	NA	NA	A-	1.52	0.06	-1.29	0.95	-2.71	0.89
28	660373	11	1500	0.29	0.37	0.36	0.14	0.08	0.04	0.63	-0.43	0.09	0.33	0.39	A+	NA	NA	A-	1.42	0.06	-1.95	0.93	-2.92	0.89
29	654392	12	1498	0.38	0.22	0.31	0.32	0.06	0.08	0.50	-0.33	0.00	0.28	0.28	A-	NA	NA	A+	1.24	0.06	4.89	1.17	4.57	1.17
30	660379	12	1498	0.49	0.15	0.31	0.33	0.17	0.03	0.69	-0.40	-0.24	0.24	0.50	A-	NA	NA	A-	0.48	0.07	-5.80	0.82	-5.83	0.82
31	663984	13	1499	0.63	0.10	0.16	0.35	0.34	0.03	0.63	-0.36	-0.28	0.01	0.52	A-	NA	A+	A-	-0.14	0.08	-4.02	0.87	-1.97	0.92
32	664014	13	1499	0.35	0.38	0.17	0.19	0.16	0.08	0.63	-0.45	0.04	0.26	0.46	A-	NA	A-	A+	1.07	0.06	3.15	1.12	1.97	1.10
33	656243	14	1498	0.26	0.43	0.20	0.14	0.10	0.10	0.69	-0.49	0.11	0.39	0.44	A-	A-	NA	A-	1.52	0.06	-3.17	0.87	-4.58	0.76

Table J–15 (continued). Biology Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	664018	14	1498	0.32	0.37	0.28	0.19	0.10	0.04	0.64	-0.44	0.02	0.31	0.43	A+	A-	NA	A+	1.30	0.06	-0.12	1.00	-1.22	0.95
35	653080	15	1497	0.32	0.36	0.22	0.20	0.11	0.08	0.74	-0.56	0.08	0.39	0.46	A-	NA	NA	A-	1.23	0.06	-6.82	0.77	-7.50	0.69
36	664020	15	1497	0.52	0.20	0.20	0.30	0.25	0.03	0.69	-0.41	-0.22	0.16	0.55	A+	NA	NA	A-	0.36	0.07	-4.23	0.86	-4.08	0.85
37	660376	16	1496	0.60	0.17	0.16	0.24	0.39	0.03	0.49	-0.34	-0.01	-0.15	0.48	A+	NA	A-	C+	0.00	0.07	7.76	1.29	9.90	1.70
38	664013	16	1496	0.29	0.35	0.31	0.19	0.06	0.07	0.65	-0.46	0.12	0.39	0.35	A+	NA	A+	A+	1.60	0.06	-2.19	0.92	-2.83	0.89
39	656090	17	1497	0.35	0.37	0.25	0.19	0.14	0.03	0.67	-0.50	0.03	0.29	0.46	A-	NA	A-	A-	1.08	0.06	-0.73	0.97	-1.22	0.95
40	659664	17	1497	0.25	0.44	0.20	0.18	0.07	0.09	0.64	-0.42	0.14	0.36	0.39	A-	NA	A+	A-	1.69	0.06	-1.03	0.96	-2.16	0.88
41	660384	18	1500	0.43	0.23	0.30	0.25	0.16	0.04	0.61	-0.40	-0.11	0.27	0.42	A+	NA	NA	A-	0.79	0.07	1.77	1.06	1.88	1.07
42	664011	18	1500	0.36	0.30	0.26	0.20	0.14	0.09	0.69	-0.45	-0.03	0.31	0.49	A+	NA	NA	A-	1.13	0.06	-3.16	0.89	-3.57	0.85
43	655214	19	1499	0.28	0.46	0.21	0.15	0.11	0.05	0.62	-0.46	0.15	0.32	0.38	B+	A-	NA	A-	1.40	0.06	1.66	1.07	1.07	1.06
44	664172	19	1499	0.42	0.25	0.21	0.24	0.19	0.09	0.62	-0.38	-0.08	0.25	0.44	A+	A-	NA	A+	0.78	0.06	2.18	1.08	1.63	1.07
45	656234	20	1499	0.30	0.28	0.42	0.15	0.06	0.08	0.63	-0.33	-0.02	0.39	0.39	A+	NA	NA	A-	1.51	0.06	-2.67	0.91	-3.32	0.88
46	662911	20	1499	0.42	0.19	0.36	0.29	0.10	0.04	0.58	-0.40	-0.04	0.29	0.33	A-	NA	NA	A-	0.91	0.07	1.12	1.04	1.14	1.04

Table J–16. Literature Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	400272	0	107813	0.52	0.07	0.36	0.42	0.12	0.02	0.70	-0.41	-0.32	0.39	0.35					0.96	0.02	-9.90	0.70	-9.90	0.70
2	426275	0	107813	0.57	0.07	0.26	0.45	0.18	0.02	0.76	-0.40	-0.38	0.30	0.46					0.81	0.02	-9.90	0.61	-9.90	0.62
3	584176	0	107813	0.48	0.10	0.35	0.37	0.11	0.05	0.72	-0.40	-0.24	0.41	0.38					0.87	0.02	-4.72	0.97	-5.82	0.96
4	584186	0	107813	0.54	0.06	0.30	0.48	0.12	0.03	0.72	-0.34	-0.39	0.40	0.39					0.55	0.02	-9.90	0.88	-9.90	0.87
5	594107	0	107813	0.46	0.09	0.42	0.37	0.07	0.03	0.72	-0.40	-0.27	0.48	0.33					1.20	0.02	-9.90	0.65	-9.90	0.66
6	594137	0	107813	0.48	0.08	0.38	0.38	0.09	0.05	0.75	-0.41	-0.28	0.46	0.36					1.02	0.02	-9.90	0.91	-9.90	0.91
7	665137	1	1499	0.55	0.06	0.30	0.45	0.14	0.02	0.72	-0.38	-0.33	0.33	0.42	B+	NA	NA	A-	0.79	0.10	-8.67	0.73	-8.74	0.72
8	666982	1	1499	0.51	0.06	0.35	0.44	0.10	0.03	0.71	-0.37	-0.29	0.39	0.36	B+	NA	NA	A-	0.98	0.09	-8.44	0.73	-8.45	0.73
9	661612	2	1497	0.48	0.11	0.37	0.40	0.09	0.01	0.67	-0.42	-0.24	0.41	0.32	B+	A+	NA	C-	1.13	0.09	-5.85	0.81	-6.02	0.81
10	667388	2	1497	0.51	0.07	0.40	0.39	0.12	0.01	0.70	-0.39	-0.30	0.36	0.38	B+	A-	NA	B-	0.90	0.10	-7.88	0.75	-7.84	0.75
11	665233	3	1498	0.56	0.09	0.24	0.46	0.17	0.02	0.71	-0.44	-0.29	0.28	0.43	B+	A-	NA	A-	0.68	0.09	-7.48	0.76	-7.62	0.75
12	667344	3	1498	0.49	0.13	0.31	0.43	0.10	0.02	0.74	-0.48	-0.27	0.47	0.34	B+	A+	NA	A-	1.12	0.08	-9.71	0.70	-9.87	0.69
13	665234	4	1499	0.52	0.08	0.33	0.45	0.11	0.02	0.69	-0.42	-0.29	0.37	0.36	A+	NA	NA	A-	0.88	0.10	-7.16	0.77	-7.16	0.77
14	667341	4	1499	0.51	0.11	0.32	0.42	0.12	0.02	0.72	-0.48	-0.24	0.38	0.37	A+	NA	NA	A-	0.99	0.09	-8.57	0.73	-8.65	0.73
15	664467	5	1500	0.53	0.13	0.27	0.40	0.17	0.02	0.75	-0.48	-0.26	0.33	0.44	B+	A-	NA	A-	0.88	0.08	-9.41	0.71	-9.64	0.70
16	665245	5	1500	0.51	0.06	0.40	0.39	0.12	0.02	0.69	-0.34	-0.33	0.39	0.36	A+	A+	NA	A-	0.86	0.10	-6.90	0.78	-6.96	0.78
17	665938	6	1495	0.47	0.18	0.29	0.36	0.13	0.02	0.74	-0.52	-0.15	0.39	0.41	B+	NA	NA	A-	1.22	0.07	-9.90	0.70	-9.90	0.68
18	666209	6	1495	0.49	0.09	0.38	0.38	0.11	0.02	0.72	-0.41	-0.25	0.41	0.37	A+	NA	NA	A+	1.09	0.09	-8.72	0.73	-8.71	0.73
19	664891	7	1499	0.53	0.04	0.37	0.44	0.11	0.02	0.74	-0.35	-0.42	0.42	0.38	A+	NA	NA	A-	0.75	0.11	-9.90	0.68	-9.90	0.69
20	667078	7	1499	0.50	0.05	0.41	0.41	0.09	0.02	0.71	-0.36	-0.38	0.47	0.32	B+	NA	NA	A-	0.90	0.10	-8.46	0.73	-8.49	0.73
21	666251	8	1499	0.49	0.11	0.35	0.38	0.13	0.02	0.74	-0.50	-0.23	0.41	0.37	A+	NA	NA	A-	1.12	0.08	-9.90	0.69	-9.90	0.69
22	667076	8	1499	0.61	0.02	0.29	0.50	0.18	0.01	0.68	-0.25	-0.52	0.27	0.42	B+	NA	NA	B-	0.16	0.16	-8.14	0.74	-8.19	0.74
23	667361	9	1496	0.55	0.10	0.28	0.42	0.18	0.01	0.74	-0.50	-0.27	0.28	0.45	B+	NA	NA	A-	0.74	0.09	-9.82	0.70	-9.86	0.70
24	667399	9	1496	0.47	0.13	0.38	0.37	0.10	0.02	0.68	-0.39	-0.28	0.44	0.35	B+	NA	NA	A-	1.22	0.08	-7.01	0.78	-7.22	0.77
25	667002	10	1499	0.50	0.11	0.33	0.42	0.11	0.02	0.72	-0.44	-0.30	0.43	0.37	B+	A-	NA	A-	1.06	0.09	-8.43	0.74	-8.62	0.73
26	667363	10	1499	0.55	0.08	0.32	0.39	0.18	0.01	0.73	-0.39	-0.33	0.27	0.47	B+	A+	NA	A-	0.69	0.09	-9.08	0.72	-9.19	0.72
27	662924	11	1499	0.51	0.06	0.38	0.46	0.08	0.01	0.70	-0.36	-0.38	0.45	0.33	B+	NA	NA	B-	0.95	0.10	-9.27	0.71	-9.25	0.71
28	666045	11	1499	0.49	0.12	0.32	0.36	0.14	0.03	0.68	-0.38	-0.26	0.35	0.41	A+	NA	NA	A-	1.07	0.08	-6.28	0.80	-6.76	0.79
29	662933	12	1500	0.52	0.10	0.35	0.40	0.13	0.01	0.72	-0.43	-0.31	0.37	0.41	A+	NA	NA	A-	0.91	0.09	-9.63	0.71	-9.74	0.70
30	666579	12	1500	0.54	0.07	0.36	0.39	0.15	0.01	0.74	-0.40	-0.39	0.36	0.43	A+	NA	NA	A-	0.74	0.10	-9.90	0.68	-9.90	0.68
31	666327	13	1499	0.52	0.08	0.37	0.38	0.14	0.02	0.71	-0.35	-0.36	0.35	0.42	A+	A+	NA	A-	0.87	0.10	-7.89	0.76	-7.88	0.76
32	668394	13	1499	0.52	0.10	0.30	0.39	0.16	0.02	0.76	-0.47	-0.28	0.35	0.45	B+	A+	NA	B-	0.93	0.09	-9.90	0.66	-9.90	0.66
33	666337	14	1498	0.47	0.10	0.37	0.40	0.08	0.02	0.72	-0.40	-0.27	0.45	0.35	A+	NA	NA	A+	1.22	0.08	-8.81	0.73	-8.94	0.72

Table J–16 (continued). Literature Constructed-Response Item Statistics: Spring

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	M/F	W/B	W/H	O/P	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
34	668396	14	1498	0.53	0.09	0.32	0.39	0.16	0.02	0.73	-0.41	-0.33	0.34	0.43	C+	NA	NA	A-	0.80	0.09	-8.92	0.73	-9.05	0.72
35	663334	15	1499	0.53	0.06	0.35	0.44	0.12	0.02	0.71	-0.40	-0.36	0.39	0.36	B+	A+	NA	B-	0.77	0.10	-8.75	0.73	-8.69	0.73
36	665267	15	1499	0.56	0.10	0.22	0.45	0.18	0.02	0.75	-0.47	-0.30	0.30	0.46	A+	A-	NA	A-	0.75	0.09	-9.90	0.69	-9.83	0.69
37	665196	16	1497	0.51	0.07	0.38	0.41	0.12	0.01	0.71	-0.40	-0.35	0.40	0.37	C+	A+	NA	B-	0.91	0.10	-8.80	0.73	-8.82	0.73
38	665265	16	1497	0.54	0.10	0.29	0.37	0.20	0.02	0.73	-0.40	-0.30	0.28	0.47	A+	A+	NA	A-	0.80	0.09	-7.76	0.76	-8.09	0.75
39	666342	17	1497	0.51	0.12	0.31	0.39	0.15	0.02	0.69	-0.43	-0.24	0.34	0.39	A+	NA	NA	A-	0.98	0.08	-6.18	0.80	-6.42	0.80
40	667923	17	1497	0.52	0.10	0.33	0.42	0.13	0.01	0.73	-0.46	-0.31	0.38	0.40	A+	NA	NA	A-	0.90	0.09	-9.29	0.71	-9.27	0.72
41	666767	18	1499	0.47	0.12	0.38	0.33	0.12	0.03	0.72	-0.45	-0.19	0.38	0.39	A+	A-	NA	A-	1.21	0.08	-8.84	0.73	-9.20	0.72
42	667946	18	1499	0.54	0.07	0.30	0.47	0.13	0.02	0.71	-0.39	-0.34	0.37	0.37	B+	A+	NA	A-	0.85	0.10	-7.96	0.75	-7.83	0.75
43	666026	19	1500	0.56	0.08	0.31	0.40	0.18	0.01	0.75	-0.44	-0.35	0.32	0.44	A+	NA	NA	A-	0.67	0.10	-9.90	0.69	-9.90	0.69
44	666453	19	1500	0.57	0.04	0.31	0.48	0.15	0.01	0.70	-0.35	-0.43	0.34	0.39	C+	NA	NA	B-	0.53	0.12	-8.18	0.74	-8.14	0.74
45	665521	20	1498	0.60	0.03	0.26	0.52	0.17	0.01	0.71	-0.31	-0.49	0.30	0.41	A+	NA	NA	A-	0.32	0.13	-9.29	0.70	-9.30	0.70
46	666687	20	1498	0.53	0.07	0.32	0.44	0.13	0.02	0.69	-0.40	-0.30	0.35	0.37	B+	NA	NA	A-	0.82	0.09	-6.87	0.78	-6.95	0.78
47	632793	21	1497	0.53	0.06	0.32	0.49	0.09	0.02	0.73	-0.40	-0.36	0.45	0.33	B+	A+	NA	A-	0.92	0.10	-9.67	0.69	-9.64	0.69
48	635306	21	1497	0.54	0.07	0.33	0.45	0.13	0.02	0.71	-0.41	-0.35	0.40	0.36	B+	B+	NA	B-	0.80	0.10	-8.64	0.73	-8.63	0.73
49	635925	22	1499	0.60	0.03	0.27	0.46	0.21	0.02	0.70	-0.29	-0.45	0.25	0.44	B+	NA	NA	A-	0.37	0.12	-7.59	0.76	-7.66	0.76
50	636806	22	1499	0.54	0.07	0.33	0.43	0.14	0.01	0.71	-0.41	-0.34	0.36	0.38	B+	NA	NA	B-	0.80	0.10	-8.18	0.74	-8.24	0.74
51	621896	23	1499	0.54	0.09	0.30	0.43	0.15	0.01	0.72	-0.45	-0.29	0.36	0.39	B+	NA	NA	A-	0.82	0.09	-8.83	0.73	-8.97	0.72
52	632768	23	1499	0.58	0.06	0.25	0.46	0.19	0.01	0.74	-0.41	-0.37	0.28	0.45	B+	NA	NA	A+	0.56	0.10	-9.27	0.71	-9.28	0.71
53	621888	24	1498	0.55	0.07	0.29	0.45	0.15	0.02	0.73	-0.37	-0.37	0.35	0.42	A+	NA	NA	A-	0.71	0.10	-8.71	0.73	-8.95	0.72
54	635824	24	1498	0.55	0.07	0.29	0.43	0.17	0.02	0.72	-0.40	-0.35	0.35	0.40	B+	NA	NA	A-	0.68	0.10	-7.57	0.76	-7.64	0.76

Table J–17. Algebra I Constructed-Response Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(4)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Corr(4)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	314422	0	353	0.26	0.34	0.31	0.22	0.07	0.03	0.03	0.57	-0.32	-0.02	0.17	0.29	0.39	1.20	0.12	-2.25	0.84	-2.10	0.83
2	339445	0	353	0.23	0.35	0.41	0.15	0.06	0.01	0.01	0.62	-0.36	-0.03	0.24	0.48	0.17	1.67	0.12	-2.64	0.81	-2.98	0.78
3	418599	0	353	0.23	0.44	0.29	0.15	0.07	0.03	0.01	0.46	-0.30	-0.03	0.20	0.25	0.26	1.59	0.12	2.80	1.25	2.45	1.24
4	492922	0	353	0.24	0.36	0.35	0.17	0.05	0.03	0.03	0.48	-0.27	0.00	0.22	0.28	0.21	1.07	0.13	0.74	1.05	-0.14	0.99
5	497693	0	353	0.22	0.29	0.51	0.09	0.05	0.01	0.04	0.61	-0.37	0.11	0.33	0.27	0.24	1.94	0.12	-2.22	0.83	-2.74	0.79
6	505391	0	353	0.24	0.29	0.48	0.15	0.05	0.01	0.02	0.49	-0.23	-0.08	0.23	0.33	0.20	1.78	0.14	0.72	1.05	0.13	1.01

Table J–18. Biology Constructed-Response Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	337632	0	257	0.42	0.15	0.43	0.30	0.08	0.03	0.54	-0.25	-0.11	0.08	0.56	0.48	0.16	-2.08	0.84	-1.95	0.84
2	408325	0	257	0.20	0.55	0.19	0.12	0.05	0.05	0.60	-0.29	0.03	0.28	0.50	1.37	0.15	0.11	1.01	0.03	1.00
3	409269	0	257	0.33	0.27	0.38	0.19	0.08	0.05	0.46	-0.17	0.00	0.17	0.36	0.95	0.14	2.51	1.23	2.55	1.24
4	410302	0	257	0.34	0.34	0.24	0.18	0.15	0.06	0.67	-0.35	0.02	0.13	0.60	0.70	0.14	-1.57	0.87	-2.26	0.78
5	410543	0	257	0.38	0.29	0.31	0.16	0.17	0.04	0.56	-0.28	-0.03	0.13	0.47	0.42	0.14	-0.85	0.93	0.41	1.04
6	480281	0	257	0.29	0.37	0.30	0.18	0.07	0.06	0.61	-0.28	-0.01	0.17	0.59	0.53	0.15	-1.09	0.92	-1.35	0.89

Table J–19. Literature Constructed-Response Item Statistics: Summer

Ref	PubID	Form	*N*	Pval	P(0)	P(1)	P(2)	P(3)	P(B)	ITCorr	Corr(0)	Corr(1)	Corr(2)	Corr(3)	Meas	SEM	*z*-Infit	MS-Infit	*z*-Outfit	MS-Outfit
1	504385	0	161	0.38	0.13	0.45	0.31	0.02	0.05	0.64	-0.41	-0.02	0.45	0.18	0.91	0.22	-2.29	0.78	-2.34	0.78
2	528163	0	161	0.24	0.30	0.38	0.16	0.01	0.11	0.63	-0.33	0.19	0.49	0.09	1.38	0.19	-2.90	0.72	-3.21	0.68
3	528166	0	161	0.28	0.18	0.55	0.12	0.01	0.09	0.68	-0.46	0.34	0.34	0.19	1.22	0.19	-5.15	0.55	-4.96	0.56
4	594333	0	161	0.24	0.26	0.45	0.12	0.01	0.11	0.67	-0.30	0.21	0.49	0.16	0.95	0.20	-2.12	0.80	-2.28	0.77
5	594334	0	161	0.34	0.18	0.40	0.25	0.04	0.09	0.74	-0.42	0.02	0.49	0.33	0.56	0.22	-2.76	0.74	-2.86	0.73
6	594591	0	161	0.43	0.12	0.39	0.30	0.10	0.04	0.69	-0.44	-0.11	0.42	0.33	0.80	0.21	-0.73	0.92	-0.89	0.91

APPENDIX K: RAW-TO-SCALE SCORE CONVERSION TABLES

Appendix K provides the raw-to-scaled score conversion tables for each administration and content area. The scaled score conversions are administration specific and therefore cannot be used for highest total scaled score to date.

Table K–1. Raw-to-Scaled Score Conversion Tables

Column Heading	Definition
Raw	Raw score
SS	Scaled score
CSEM	Conditional standard error of measurement
LCI	Lower confidence interval
UCI	Upper confidence interval

WINTER

Table K–2. Algebra I Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1216	92	1200	1308
1	1277	51	1226	1328
2	1314	36	1278	1350
3	1335	30	1305	1365
4	1351	27	1324	1378
5	1364	24	1340	1388
6	1375	22	1353	1397
7	1384	21	1363	1405
8	1393	20	1373	1413
9	1400	19	1381	1419
10	1407	18	1389	1425
11	1413	18	1395	1431
12	1420	17	1403	1437
13	1425	17	1408	1442
14	1431	16	1415	1447
15	1436	16	1420	1452
16	1441	16	1425	1457
17	1446	15	1431	1461
18	1450	15	1435	1465
19	1455	15	1440	1470
20	1460	15	1445	1475
21	1464	15	1449	1479
22	1468	15	1453	1483
23	1473	15	1458	1488
24	1477	14	1463	1491
25	1481	14	1467	1495
26	1485	14	1471	1499
27	1489	14	1475	1503
28	1493	14	1479	1507
29	1497	14	1483	1511
30	1501	14	1487	1515
31	1505	14	1491	1519
32	1509	14	1495	1523
33	1514	14	1500	1528
34	1518	14	1504	1532
35	1522	14	1508	1536
36	1526	14	1512	1540
37	1530	15	1515	1545
38	1534	15	1519	1549
39	1539	15	1524	1554
40	1543	15	1528	1558
41	1548	15	1533	1563

Table K–2 (continued). Algebra I Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
42	1552	15	1537	1567
43	1557	16	1541	1573
44	1562	16	1546	1578
45	1567	16	1551	1583
46	1572	16	1556	1588
47	1578	17	1561	1595
48	1584	17	1567	1601
49	1590	18	1572	1608
50	1597	19	1578	1616
51	1604	19	1585	1623
52	1612	20	1592	1632
53	1620	22	1598	1642
54	1630	23	1607	1653
55	1642	25	1617	1667
56	1656	28	1628	1684
57	1673	32	1641	1705
58	1698	39	1659	1737
59	1738	53	1685	1791
60	1800	93	1707	1800

Table K–3. Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1225	92	1200	1317
1	1286	50	1236	1336
2	1321	36	1285	1357
3	1342	30	1312	1372
4	1358	26	1332	1384
5	1370	23	1347	1393
6	1380	21	1359	1401
7	1388	20	1368	1408
8	1396	19	1377	1415
9	1403	18	1385	1421
10	1409	17	1392	1426
11	1415	17	1398	1432
12	1420	16	1404	1436
13	1425	16	1409	1441
14	1430	15	1415	1445
15	1434	15	1419	1449
16	1439	15	1424	1454
17	1443	14	1429	1457
18	1447	14	1433	1461
19	1451	14	1437	1465
20	1454	14	1440	1468
21	1458	13	1445	1471
22	1461	13	1448	1474
23	1465	13	1452	1478
24	1468	13	1455	1481
25	1472	13	1459	1485
26	1475	13	1462	1488
27	1478	13	1465	1491
28	1481	13	1468	1494
29	1485	13	1472	1498
30	1488	13	1475	1501
31	1491	13	1478	1504
32	1494	12	1482	1506
33	1497	12	1485	1509
34	1500	12	1488	1512
35	1503	13	1490	1516
36	1507	13	1494	1520
37	1510	13	1497	1523
38	1513	13	1500	1526
39	1516	13	1503	1529
40	1519	13	1506	1532
41	1523	13	1510	1536
42	1526	13	1513	1539

Table K–3 (continued). Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1529	13	1516	1542
44	1533	13	1520	1546
45	1536	13	1523	1549
46	1540	14	1526	1554
47	1544	14	1530	1558
48	1547	14	1533	1561
49	1551	14	1537	1565
50	1555	15	1540	1570
51	1560	15	1545	1575
52	1564	15	1549	1579
53	1569	16	1553	1585
54	1574	16	1558	1590
55	1579	17	1562	1596
56	1585	17	1568	1602
57	1591	18	1573	1609
58	1598	19	1579	1617
59	1606	20	1586	1626
60	1614	22	1592	1636
61	1625	23	1602	1648
62	1637	26	1611	1663
63	1652	30	1622	1682
64	1673	36	1637	1709
65	1709	50	1659	1759
66	1769	92	1677	1800

Table K–4. Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1205	92	1200	1297
1	1266	51	1215	1317
2	1302	37	1265	1339
3	1324	30	1294	1354
4	1340	27	1313	1367
5	1353	24	1329	1377
6	1364	22	1342	1386
7	1373	21	1352	1394
8	1382	20	1362	1402
9	1390	19	1371	1409
10	1397	18	1379	1415
11	1403	18	1385	1421
12	1409	17	1392	1426
13	1415	17	1398	1432
14	1421	17	1404	1438
15	1426	16	1410	1442
16	1432	16	1416	1448
17	1437	16	1421	1453
18	1442	16	1426	1458
19	1447	16	1431	1463
20	1451	15	1436	1466
21	1456	15	1441	1471
22	1461	15	1446	1476
23	1465	15	1450	1480
24	1470	15	1455	1485
25	1475	15	1460	1490
26	1479	15	1464	1494
27	1484	15	1469	1499
28	1489	15	1474	1504
29	1493	16	1477	1509
30	1498	16	1482	1514
31	1503	16	1487	1519
32	1508	16	1492	1524
33	1514	16	1498	1530
34	1519	16	1503	1535
35	1524	17	1507	1541
36	1530	17	1513	1547
37	1536	17	1519	1553
38	1542	18	1524	1560
39	1549	18	1531	1567
40	1556	19	1537	1575
41	1563	19	1544	1582
42	1571	20	1551	1591

Table K–4 (continued). Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1579	21	1558	1600
44	1588	22	1566	1610
45	1598	23	1575	1621
46	1609	24	1585	1633
47	1622	26	1596	1648
48	1637	28	1609	1665
49	1655	32	1623	1687
50	1679	38	1641	1717
51	1717	52	1665	1769
52	1780	92	1688	1800

SPRING

Table K–5. Algebra I Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1212	92	1200	1304
1	1273	51	1222	1324
2	1310	37	1273	1347
3	1332	31	1301	1363
4	1349	27	1322	1376
5	1362	24	1338	1386
6	1373	23	1350	1396
7	1382	21	1361	1403
8	1391	20	1371	1411
9	1399	19	1380	1418
10	1406	19	1387	1425
11	1412	18	1394	1430
12	1419	17	1402	1436
13	1424	17	1407	1441
14	1430	16	1414	1446
15	1435	16	1419	1451
16	1440	16	1424	1456
17	1445	16	1429	1461
18	1450	15	1435	1465
19	1455	15	1440	1470
20	1459	15	1444	1474
21	1464	15	1449	1479
22	1468	15	1453	1483
23	1472	14	1458	1486
24	1476	14	1462	1490
25	1480	14	1466	1494
26	1485	14	1471	1499
27	1489	14	1475	1503
28	1493	14	1479	1507
29	1497	14	1483	1511
30	1501	14	1487	1515
31	1505	14	1491	1519
32	1509	14	1495	1523
33	1513	14	1499	1527
34	1517	14	1503	1531
35	1521	14	1507	1535
36	1525	14	1511	1539
37	1529	15	1514	1544
38	1534	15	1519	1549
39	1538	15	1523	1553
40	1542	15	1527	1557
41	1547	15	1532	1562

Table K–5 (continued). Algebra I Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
42	1552	16	1536	1568
43	1557	16	1541	1573
44	1562	16	1546	1578
45	1567	16	1551	1583
46	1573	17	1556	1590
47	1579	17	1562	1596
48	1585	18	1567	1603
49	1591	19	1572	1610
50	1599	19	1580	1618
51	1606	20	1586	1626
52	1615	21	1594	1636
53	1624	22	1602	1646
54	1635	24	1611	1659
55	1647	26	1621	1673
56	1662	29	1633	1691
57	1681	32	1649	1713
58	1705	39	1666	1744
59	1745	53	1692	1798
60	1800	93	1707	1800

Table K–6. Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1224	92	1200	1316
1	1285	50	1235	1335
2	1321	36	1285	1357
3	1342	30	1312	1372
4	1357	26	1331	1383
5	1369	23	1346	1392
6	1379	22	1357	1401
7	1388	20	1368	1408
8	1396	19	1377	1415
9	1403	18	1385	1421
10	1409	17	1392	1426
11	1415	17	1398	1432
12	1420	16	1404	1436
13	1425	16	1409	1441
14	1430	15	1415	1445
15	1434	15	1419	1449
16	1439	15	1424	1454
17	1443	14	1429	1457
18	1447	14	1433	1461
19	1451	14	1437	1465
20	1454	14	1440	1468
21	1458	13	1445	1471
22	1462	13	1449	1475
23	1465	13	1452	1478
24	1469	13	1456	1482
25	1472	13	1459	1485
26	1475	13	1462	1488
27	1479	13	1466	1492
28	1482	13	1469	1495
29	1485	13	1472	1498
30	1488	13	1475	1501
31	1491	12	1479	1503
32	1494	12	1482	1506
33	1497	12	1485	1509
34	1500	12	1488	1512
35	1504	12	1492	1516
36	1507	12	1495	1519
37	1510	13	1497	1523
38	1513	13	1500	1526
39	1516	13	1503	1529
40	1519	13	1506	1532
41	1523	13	1510	1536
42	1526	13	1513	1539

Table K–6 (continued). Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1529	13	1516	1542
44	1533	13	1520	1546
45	1536	13	1523	1549
46	1540	13	1527	1553
47	1543	14	1529	1557
48	1547	14	1533	1561
49	1551	14	1537	1565
50	1555	14	1541	1569
51	1559	15	1544	1574
52	1563	15	1548	1578
53	1568	15	1553	1583
54	1573	16	1557	1589
55	1578	16	1562	1594
56	1584	17	1567	1601
57	1590	18	1572	1608
58	1597	19	1578	1616
59	1604	20	1584	1624
60	1613	21	1592	1634
61	1623	23	1600	1646
62	1635	26	1609	1661
63	1650	30	1620	1680
64	1671	36	1635	1707
65	1706	50	1656	1756
66	1767	92	1675	1800

Table K–7. Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1207	92	1200	1299
1	1268	51	1217	1319
2	1305	37	1268	1342
3	1327	30	1297	1357
4	1343	27	1316	1370
5	1356	24	1332	1380
6	1367	22	1345	1389
7	1376	21	1355	1397
8	1384	20	1364	1404
9	1392	19	1373	1411
10	1399	19	1380	1418
11	1406	18	1388	1424
12	1412	17	1395	1429
13	1418	17	1401	1435
14	1424	17	1407	1441
15	1429	16	1413	1445
16	1434	16	1418	1450
17	1440	16	1424	1456
18	1445	16	1429	1461
19	1449	16	1433	1465
20	1454	15	1439	1469
21	1459	15	1444	1474
22	1464	15	1449	1479
23	1468	15	1453	1483
24	1473	15	1458	1488
25	1478	15	1463	1493
26	1482	15	1467	1497
27	1487	15	1472	1502
28	1492	15	1477	1507
29	1496	15	1481	1511
30	1501	16	1485	1517
31	1506	16	1490	1522
32	1511	16	1495	1527
33	1516	16	1500	1532
34	1521	16	1505	1537
35	1527	17	1510	1544
36	1533	17	1516	1550
37	1538	17	1521	1555
38	1544	18	1526	1562
39	1551	18	1533	1569
40	1558	19	1539	1577
41	1565	19	1546	1584
42	1572	20	1552	1592

Table K–7 (continued). Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1580	21	1559	1601
44	1589	22	1567	1611
45	1599	23	1576	1622
46	1610	24	1586	1634
47	1623	26	1597	1649
48	1637	28	1609	1665
49	1655	32	1623	1687
50	1679	38	1641	1717
51	1717	52	1665	1769
52	1780	92	1688	1800

SUMMER

Table K–8. Algebra Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1210	92	1200	1302
1	1272	51	1221	1323
2	1308	37	1271	1345
3	1331	31	1300	1362
4	1347	27	1320	1374
5	1361	25	1336	1386
6	1372	23	1349	1395
7	1382	21	1361	1403
8	1390	20	1370	1410
9	1398	19	1379	1417
10	1406	19	1387	1425
11	1412	18	1394	1430
12	1419	18	1401	1437
13	1425	17	1408	1442
14	1430	17	1413	1447
15	1436	16	1420	1452
16	1441	16	1425	1457
17	1446	16	1430	1462
18	1451	15	1436	1466
19	1456	15	1441	1471
20	1460	15	1445	1475
21	1465	15	1450	1480
22	1469	15	1454	1484
23	1473	15	1458	1488
24	1478	14	1464	1492
25	1482	14	1468	1496
26	1486	14	1472	1500
27	1490	14	1476	1504
28	1494	14	1480	1508
29	1498	14	1484	1512
30	1502	14	1488	1516
31	1506	14	1492	1520
32	1510	14	1496	1524
33	1514	14	1500	1528
34	1518	14	1504	1532
35	1522	14	1508	1536
36	1526	14	1512	1540
37	1530	14	1516	1544
38	1534	15	1519	1549
39	1539	15	1524	1554
40	1543	15	1528	1558
41	1548	15	1533	1563

Table K–8 (continued). Algebra Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
42	1552	15	1537	1567
43	1557	16	1541	1573
44	1562	16	1546	1578
45	1567	16	1551	1583
46	1572	17	1555	1589
47	1578	17	1561	1595
48	1584	18	1566	1602
49	1590	18	1572	1608
50	1597	19	1578	1616
51	1605	20	1585	1625
52	1613	21	1592	1634
53	1622	22	1600	1644
54	1632	23	1609	1655
55	1644	25	1619	1669
56	1658	28	1630	1686
57	1676	32	1644	1708
58	1700	38	1662	1738
59	1739	52	1687	1791
60	1800	93	1707	1800

Table K–9. Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1223	92	1200	1315
1	1284	51	1233	1335
2	1320	36	1284	1356
3	1341	30	1311	1371
4	1357	26	1331	1383
5	1369	24	1345	1393
6	1379	22	1357	1401
7	1388	20	1368	1408
8	1396	19	1377	1415
9	1403	18	1385	1421
10	1409	18	1391	1427
11	1415	17	1398	1432
12	1421	16	1405	1437
13	1426	16	1410	1442
14	1431	15	1416	1446
15	1436	15	1421	1451
16	1440	15	1425	1455
17	1444	14	1430	1458
18	1448	14	1434	1462
19	1452	14	1438	1466
20	1456	14	1442	1470
21	1460	14	1446	1474
22	1464	13	1451	1477
23	1467	13	1454	1480
24	1471	13	1458	1484
25	1474	13	1461	1487
26	1477	13	1464	1490
27	1481	13	1468	1494
28	1484	13	1471	1497
29	1487	13	1474	1500
30	1490	13	1477	1503
31	1493	13	1480	1506
32	1497	13	1484	1510
33	1500	12	1488	1512
34	1503	12	1491	1515
35	1506	12	1494	1518
36	1509	13	1496	1522
37	1512	13	1499	1525
38	1515	13	1502	1528
39	1518	13	1505	1531
40	1522	13	1509	1535
41	1525	13	1512	1538
42	1528	13	1515	1541

Table K–9 (continued). Biology Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1532	13	1519	1545
44	1535	13	1522	1548
45	1538	13	1525	1551
46	1542	13	1529	1555
47	1546	14	1532	1560
48	1550	14	1536	1564
49	1553	14	1539	1567
50	1557	14	1543	1571
51	1562	15	1547	1577
52	1566	15	1551	1581
53	1571	15	1556	1586
54	1576	16	1560	1592
55	1581	17	1564	1598
56	1587	17	1570	1604
57	1593	18	1575	1611
58	1600	19	1581	1619
59	1607	20	1587	1627
60	1616	21	1595	1637
61	1626	23	1603	1649
62	1638	26	1612	1664
63	1653	30	1623	1683
64	1674	36	1638	1710
65	1710	50	1660	1760
66	1770	92	1678	1800

Table K–10. Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
0	1207	92	1200	1299
1	1269	51	1218	1320
2	1305	36	1269	1341
3	1327	30	1297	1357
4	1343	27	1316	1370
5	1355	24	1331	1379
6	1366	22	1344	1388
7	1375	21	1354	1396
8	1384	20	1364	1404
9	1391	19	1372	1410
10	1398	18	1380	1416
11	1405	18	1387	1423
12	1411	17	1394	1428
13	1417	17	1400	1434
14	1422	17	1405	1439
15	1428	16	1412	1444
16	1433	16	1417	1449
17	1438	16	1422	1454
18	1443	16	1427	1459
19	1448	15	1433	1463
20	1453	15	1438	1468
21	1457	15	1442	1472
22	1462	15	1447	1477
23	1467	15	1452	1482
24	1471	15	1456	1486
25	1476	15	1461	1491
26	1480	15	1465	1495
27	1485	15	1470	1500
28	1490	15	1475	1505
29	1495	15	1480	1510
30	1499	16	1483	1515
31	1504	16	1488	1520
32	1509	16	1493	1525
33	1515	16	1499	1531
34	1520	16	1504	1536
35	1525	17	1508	1542
36	1531	17	1514	1548
37	1537	17	1520	1554
38	1543	18	1525	1561
39	1549	18	1531	1567
40	1556	19	1537	1575
41	1563	19	1544	1582
42	1571	20	1551	1591

Table K–10 (continued). Literature Raw-to-Scaled Score Conversion Table

Raw	SS	CSEM	LCI	UCI
43	1580	21	1559	1601
44	1589	22	1567	1611
45	1598	23	1575	1621
46	1610	24	1586	1634
47	1622	26	1596	1648
48	1637	28	1609	1665
49	1655	32	1623	1687
50	1679	38	1641	1717
51	1718	52	1666	1770
52	1781	92	1689	1800

APPENDIX L: PRE-EQUATING VERIFICATION RESULTS

Appendix L contains additional information and results based on the data used for the pre-equating verification. Results are presented for the fully-anchored pre-equating solution (hereinafter "pre-equating") and the partially anchored pre-equating solution when misfitting items were freely calibrated (hereinafter "post-equating"). The results presented in this appendix provide support for utilizing the pre-equated solution for all student reporting. A complete description of the pre-equating verification process is discussed in Chapter Fifteen.

Appendix L includes person fit summary box plots, normalized scale score difference plots, and raw to scale score table comparisons generated during the pre-equating verification process. Figures L–1, L–3, and L–5 present the person infit boxplots for the pre-equated (left) and post-equated (right) solutions by content area for winter, spring, and summer, respectively. Results are presented for each of the following subgroups: race/ethnicity, gender, IEP, and EL status. Figures L–2, L–4, and L–6 present the normalized scale score difference plots that show this difference between the pre-equated and post-equated solutions by content area for winter, spring, and summer, respectively. The horizontal reference line represents no differences in normalized scaled scores between the pre-equated and post-equated solutions. The vertical dashed lines depict the raw cut-scores based on the pre-equated solution.

Tables L–1 through L-9 show both the pre-equated and post-equated raw-to-scaled score conversion tables. Tables provide details for both pre-equated (Pre) and post-equated (Post) solutions with respect to the scaled score (SS), standard error of measurement (SEM), performance level (PL), overall proportion of students earning each raw score, and whether there were differences in the performance level classification for pre- and post-equated solutions (Same PL). All student reporting is based on the tables in Appendix K, which use the pre-equated solutions.

Results are presented for each administration separately.

WINTER

Figure L–1. Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter

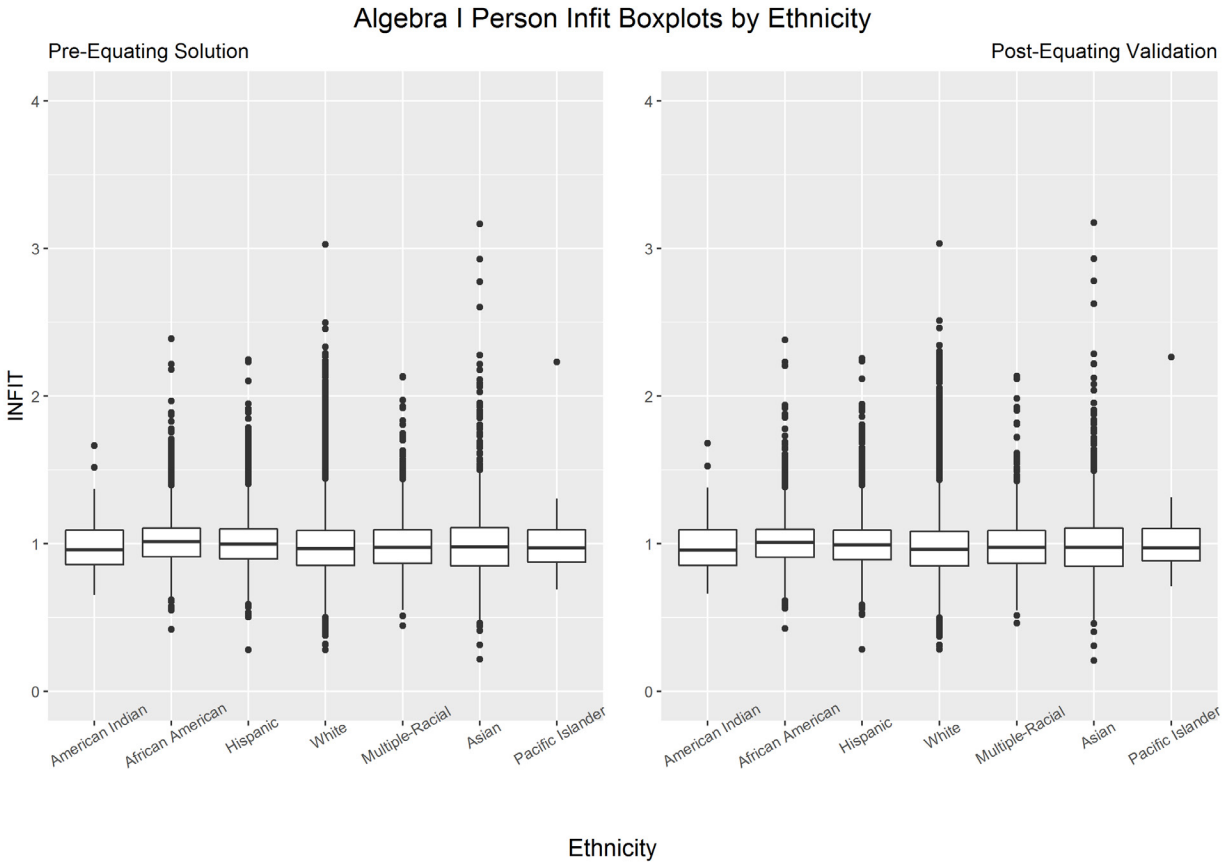
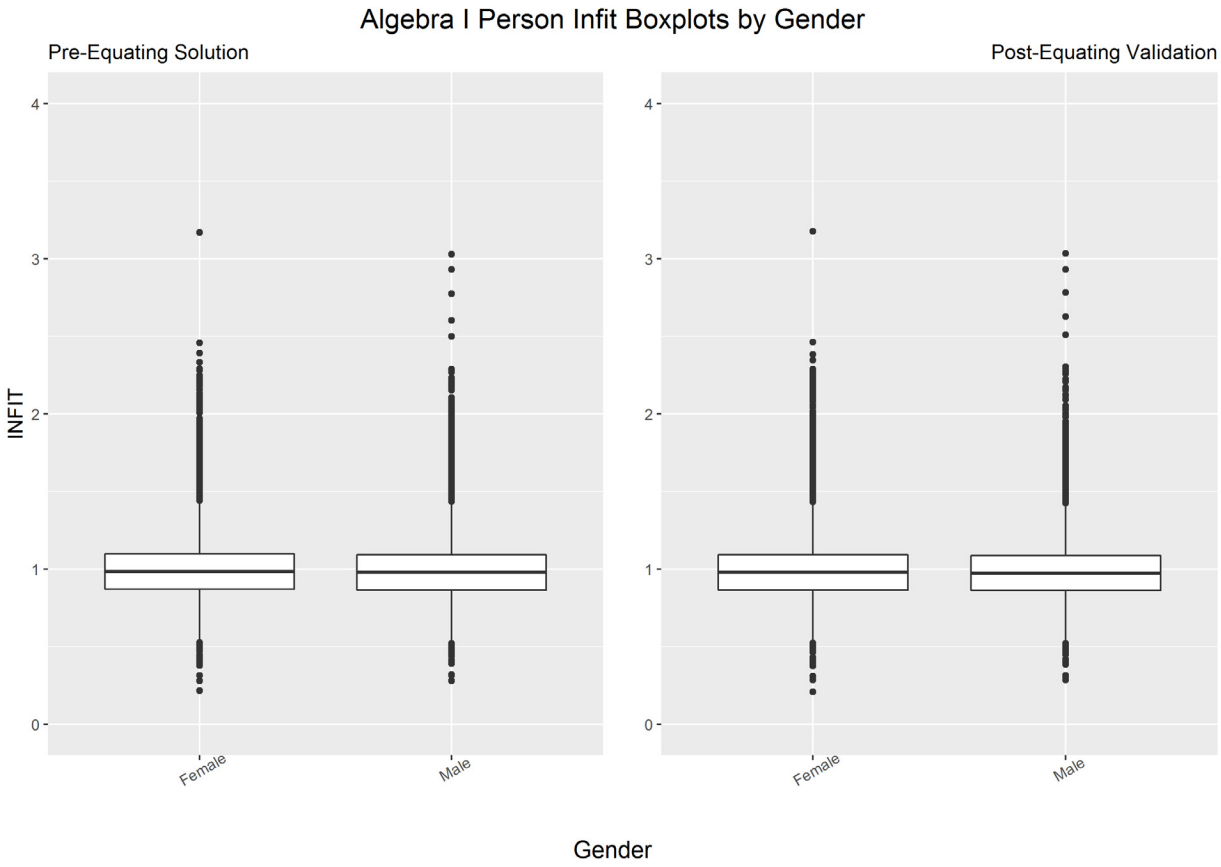


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



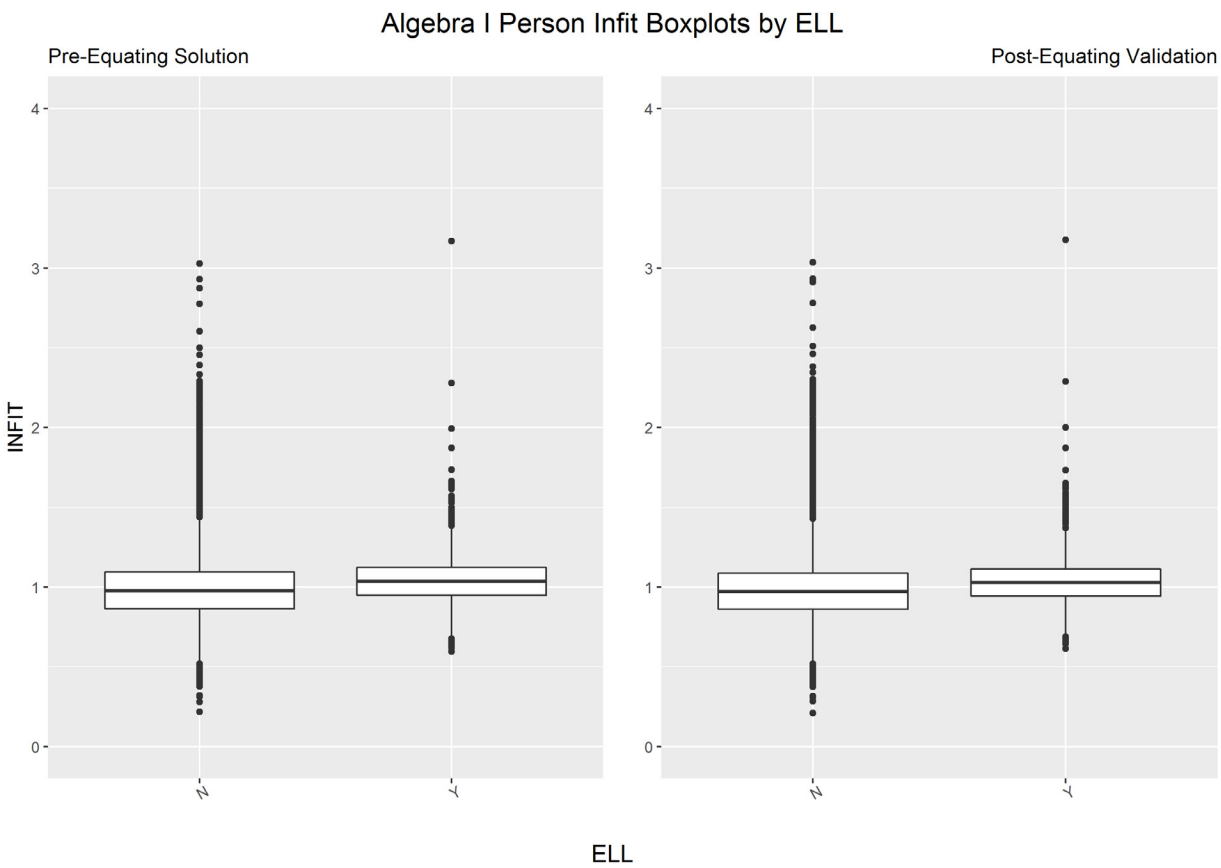
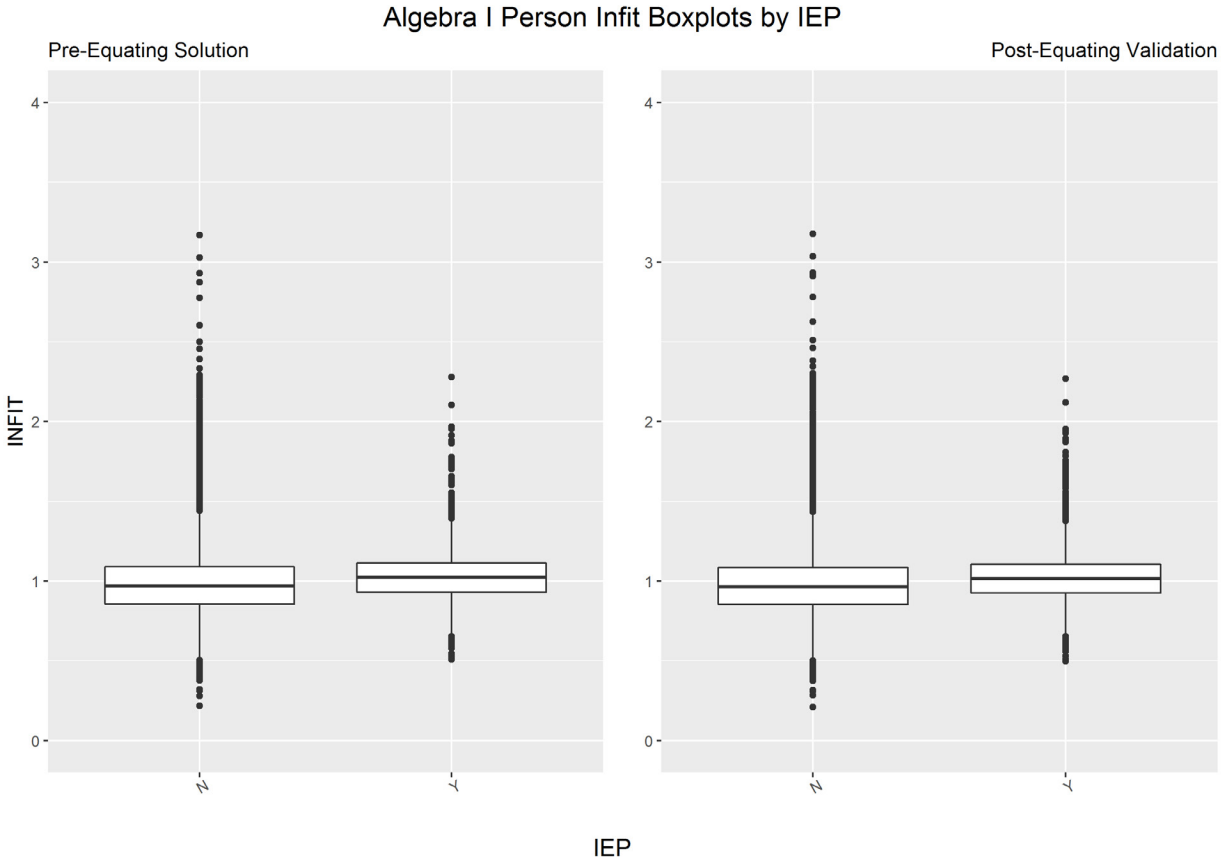


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



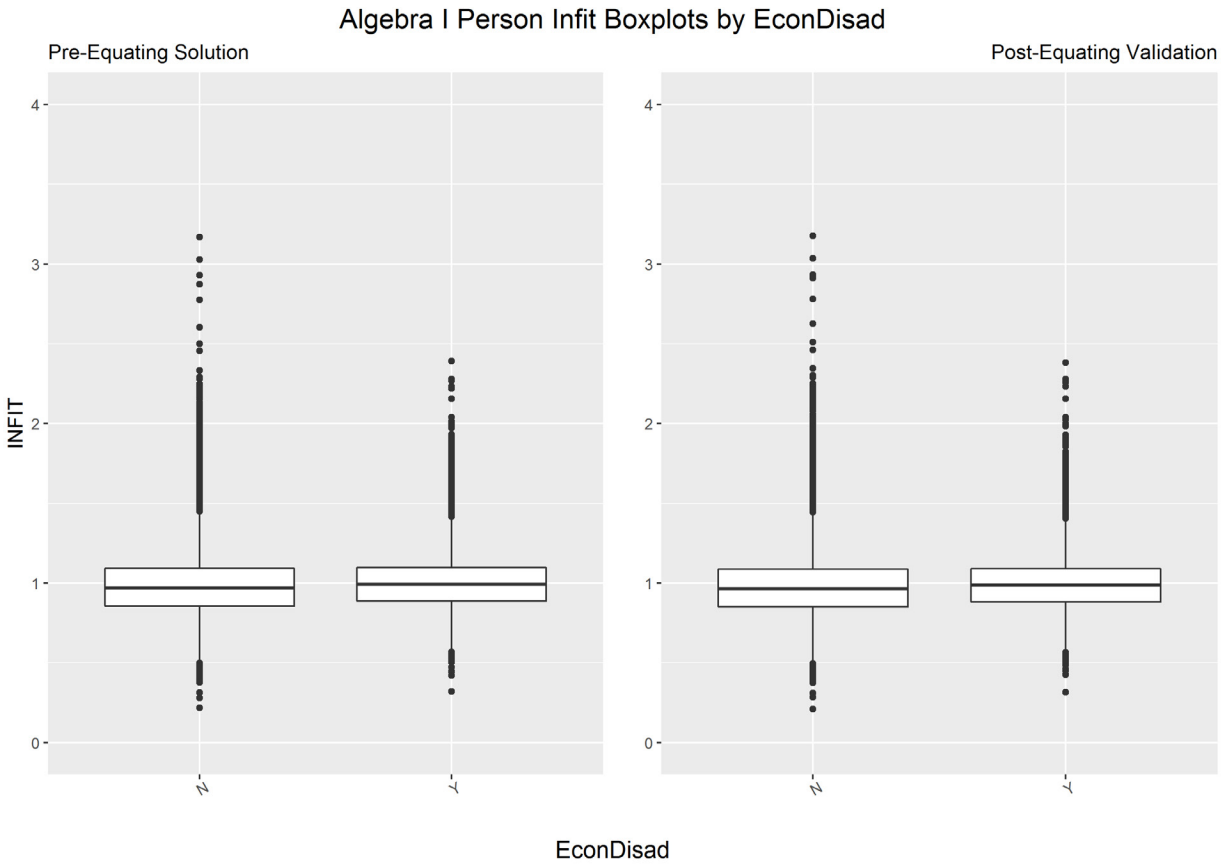


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter

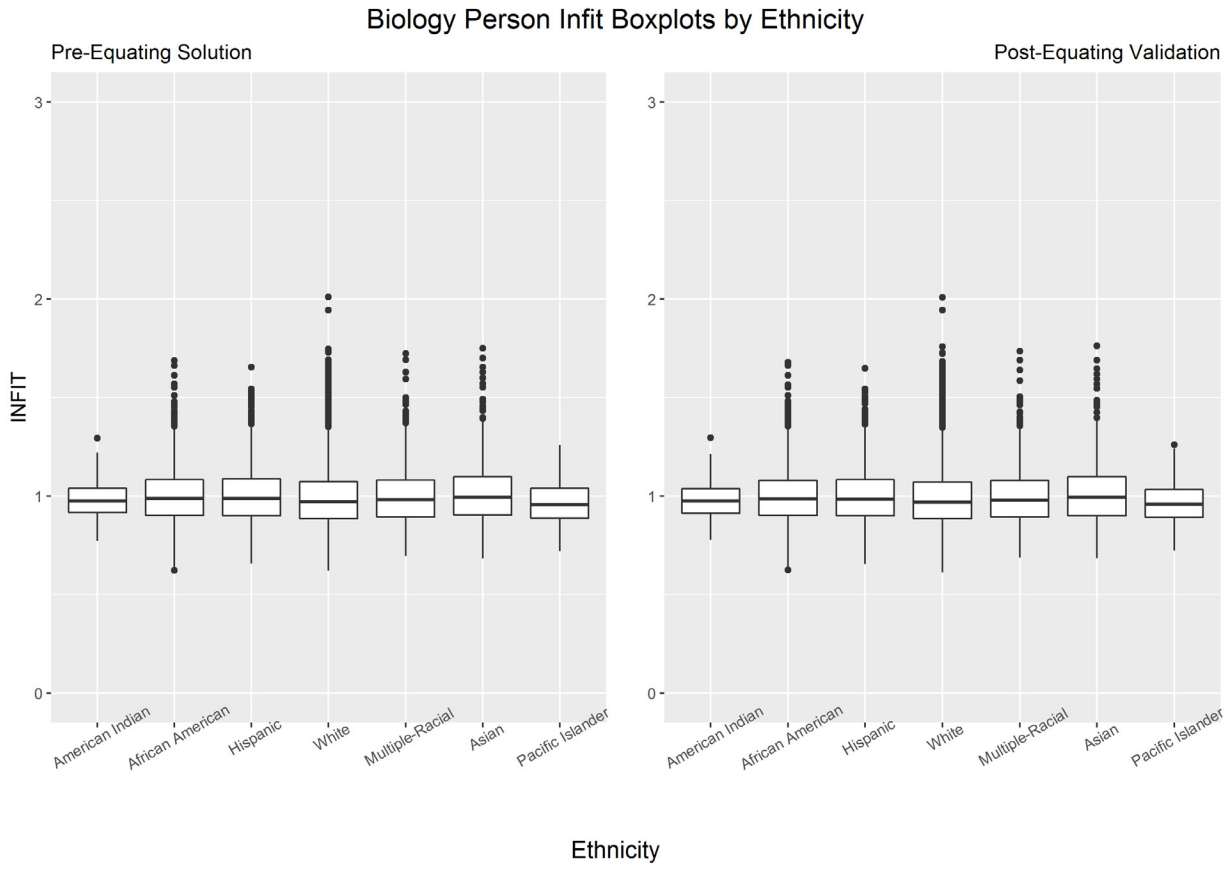
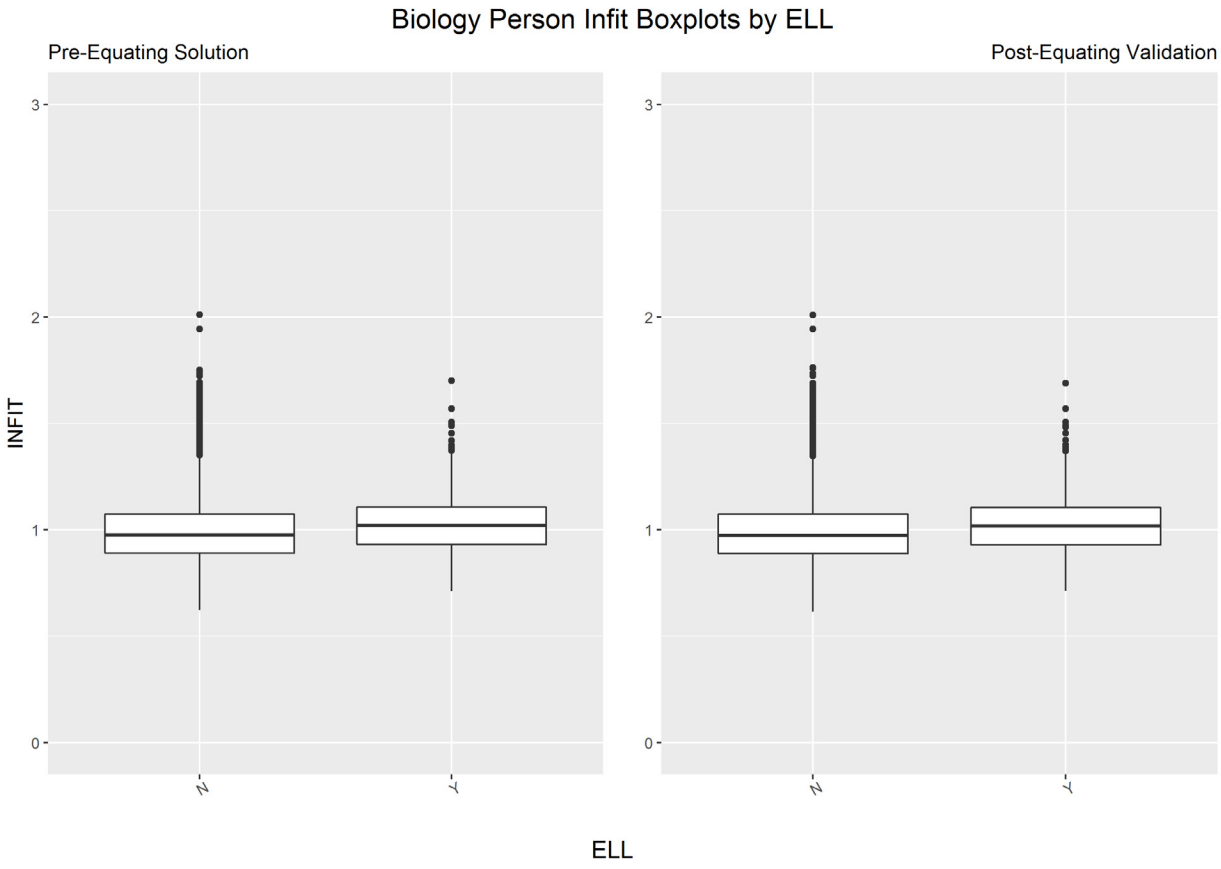


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



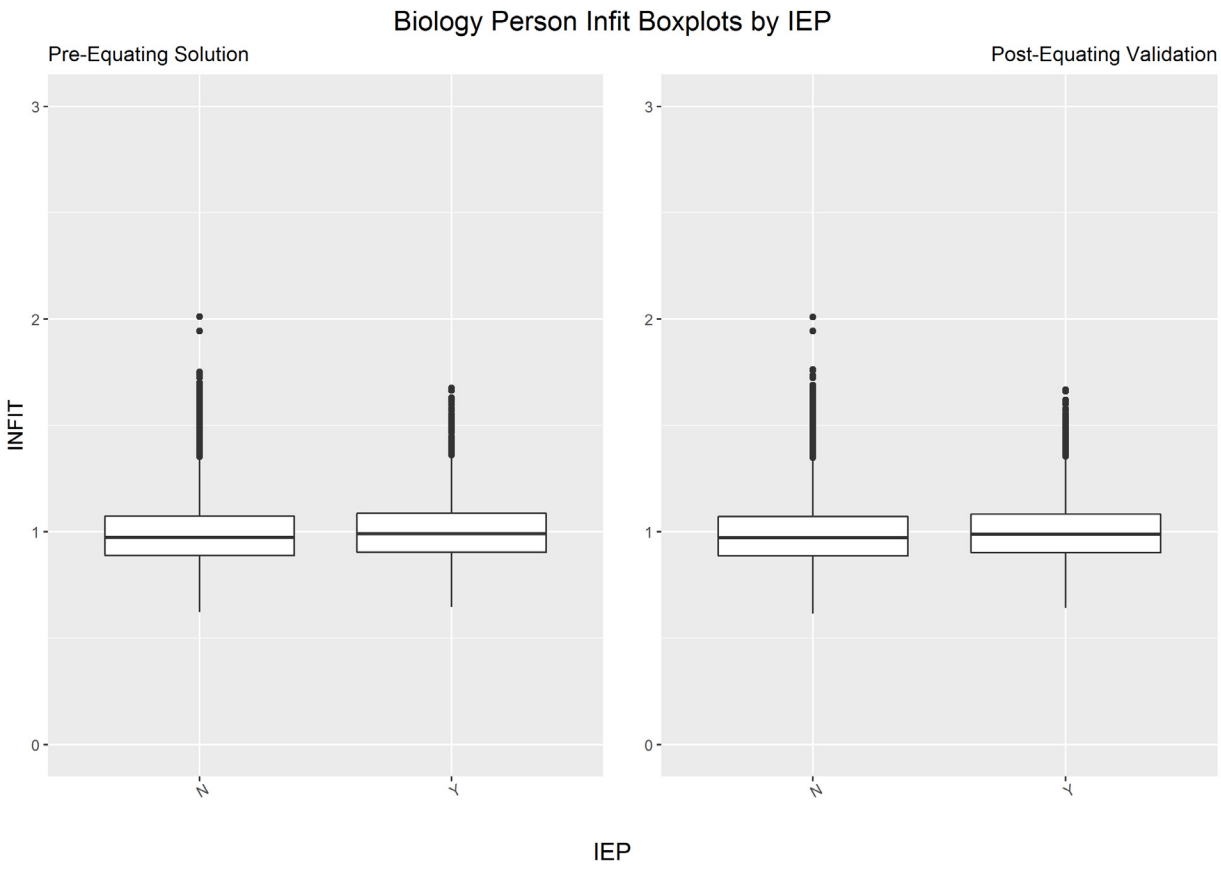
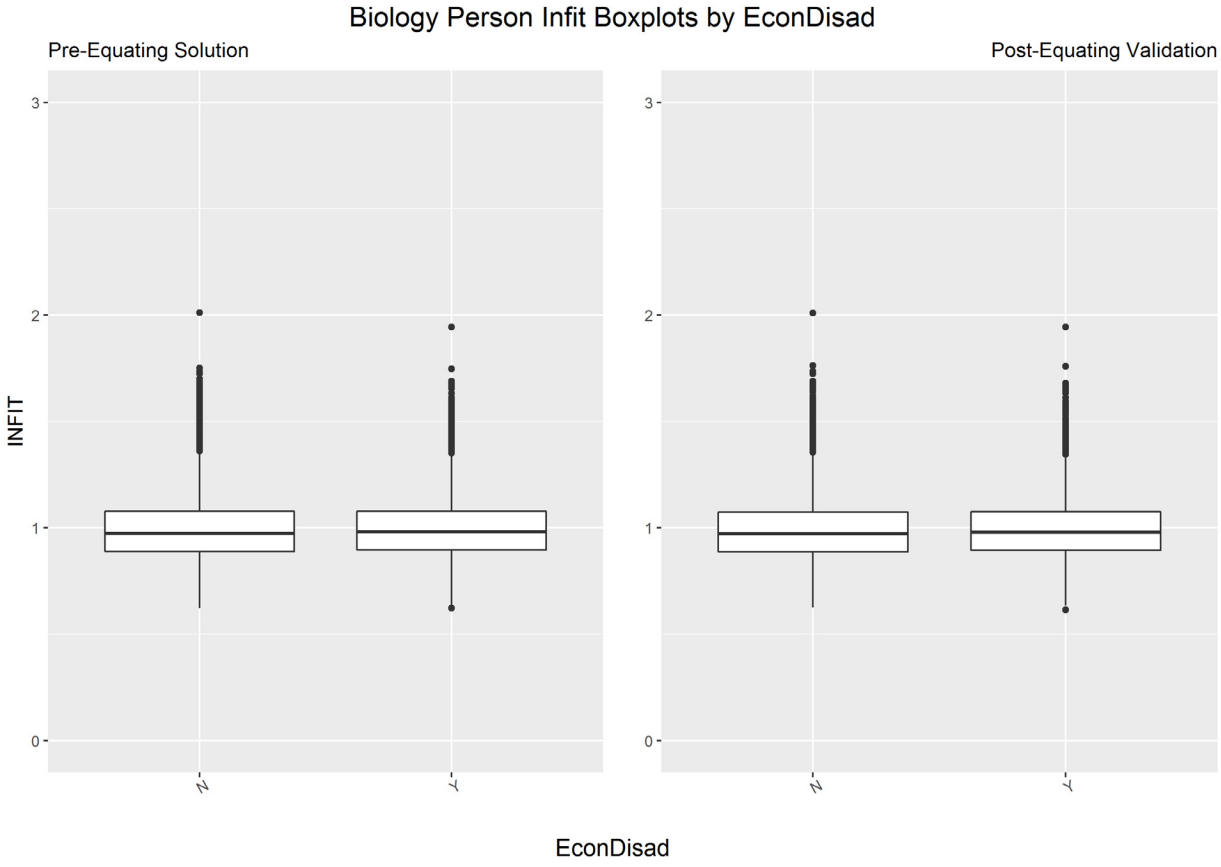


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



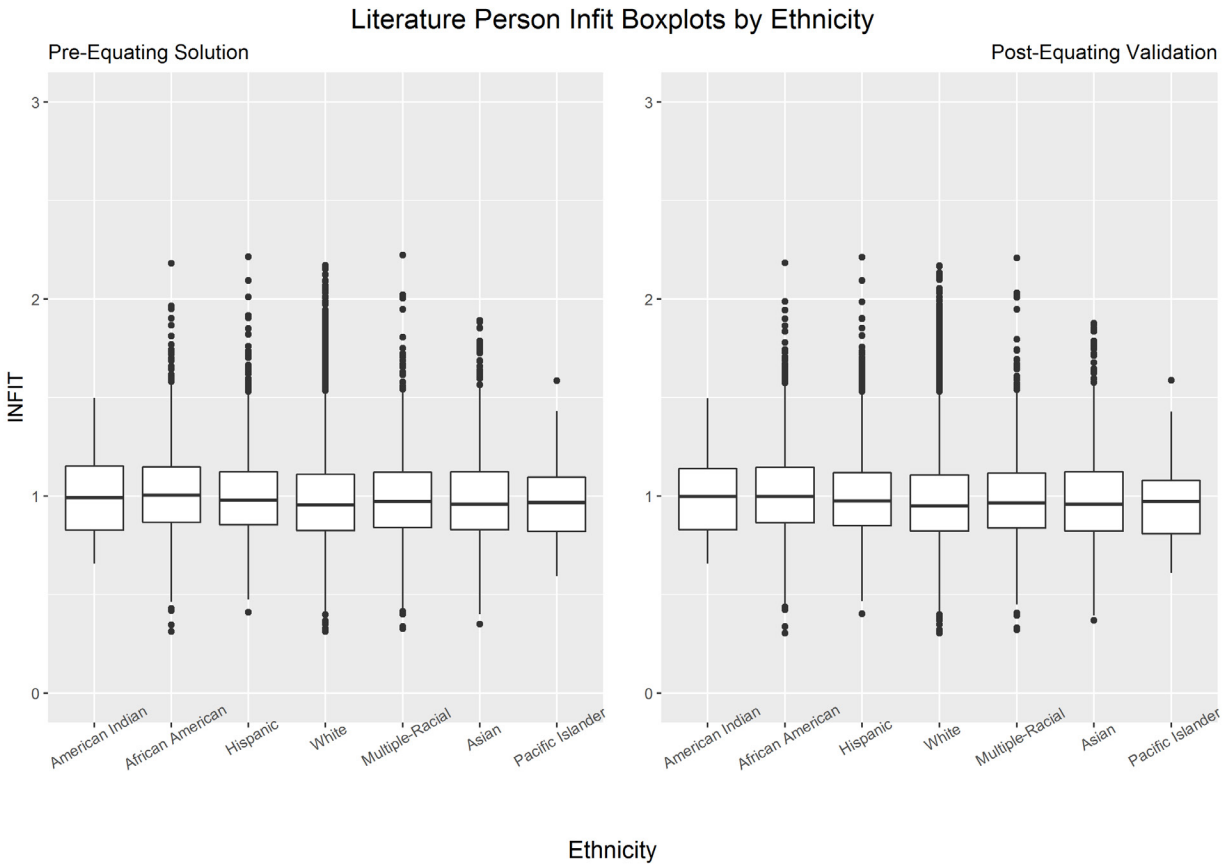
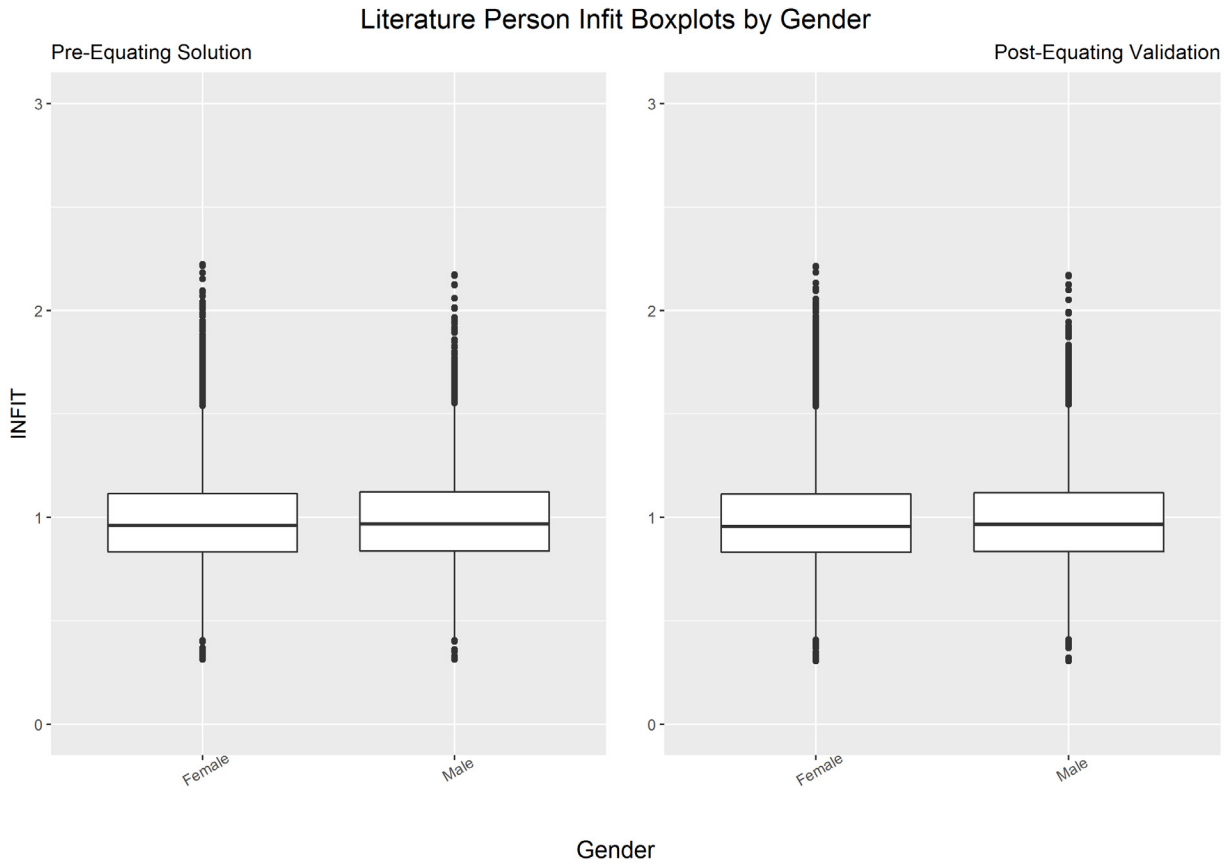


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



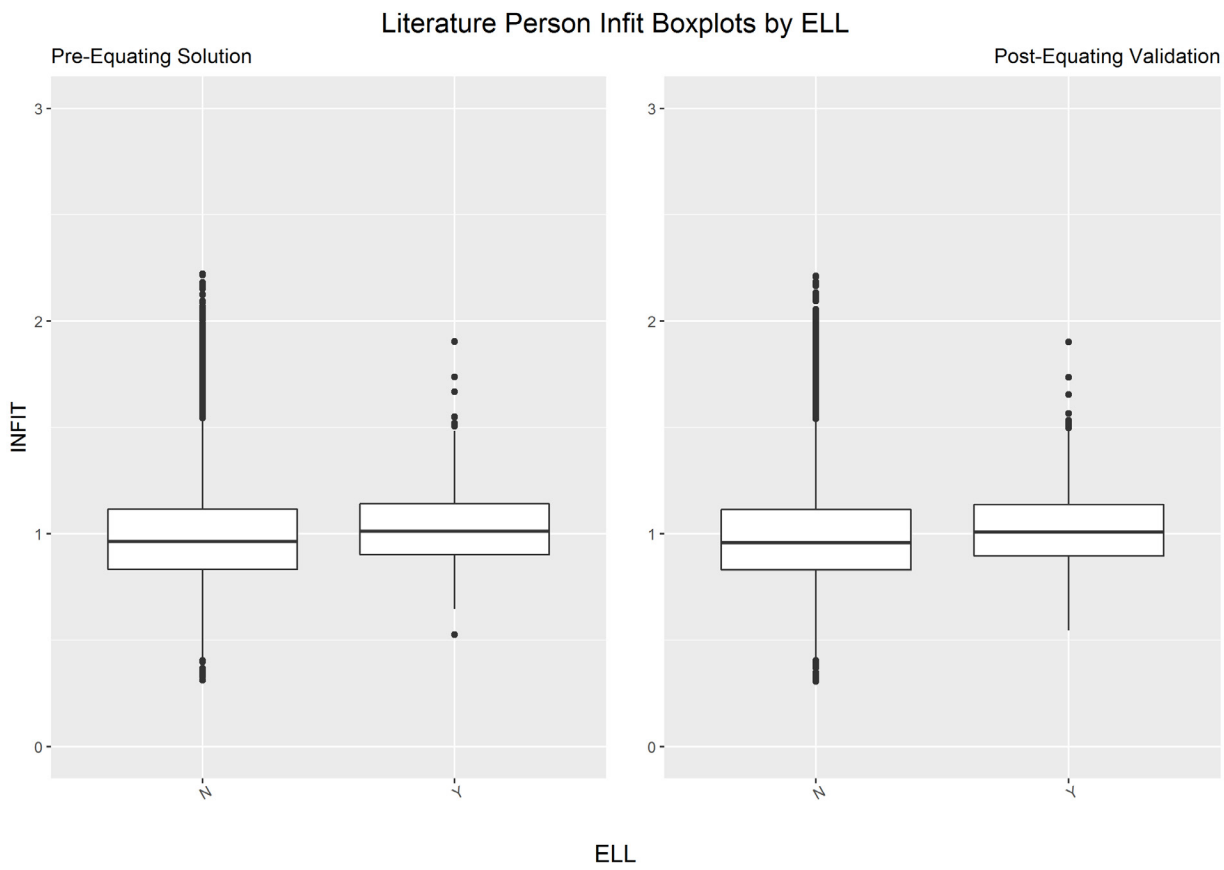
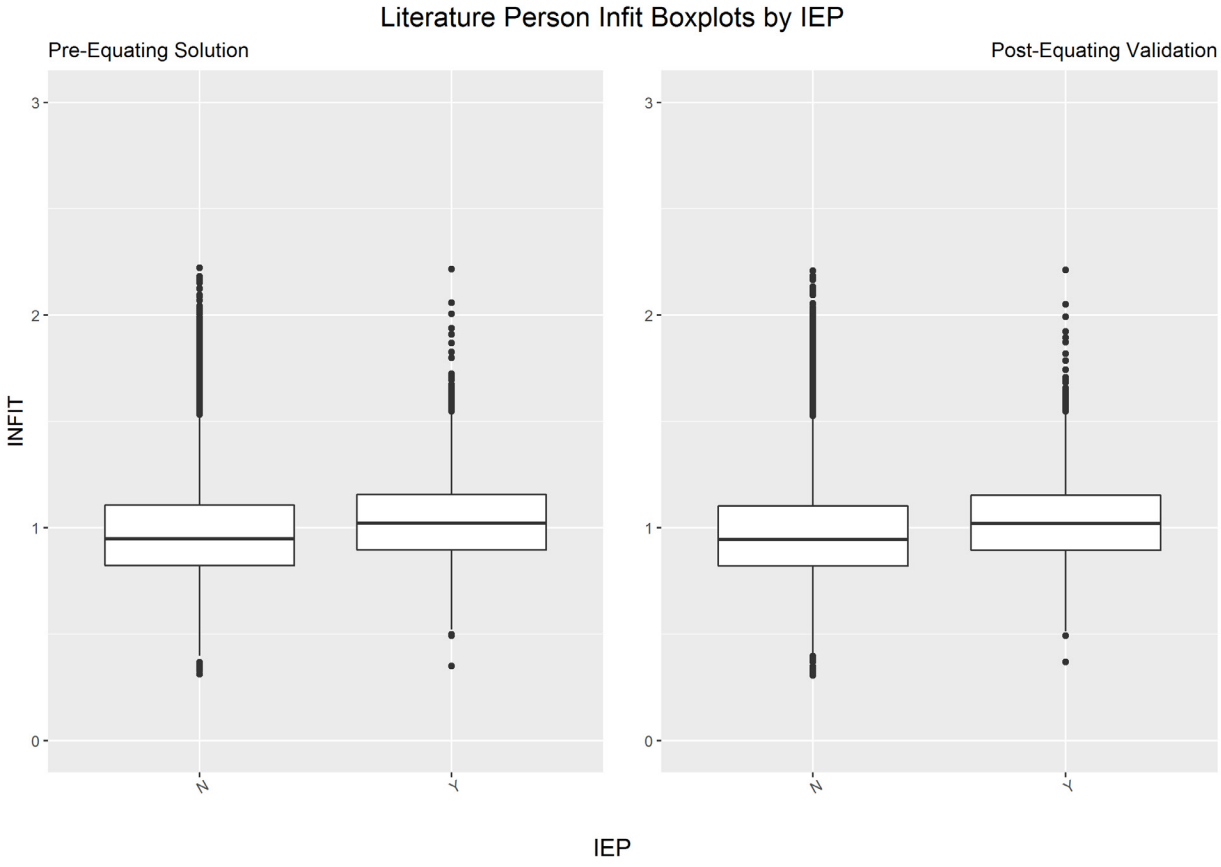


Figure L–1 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Winter



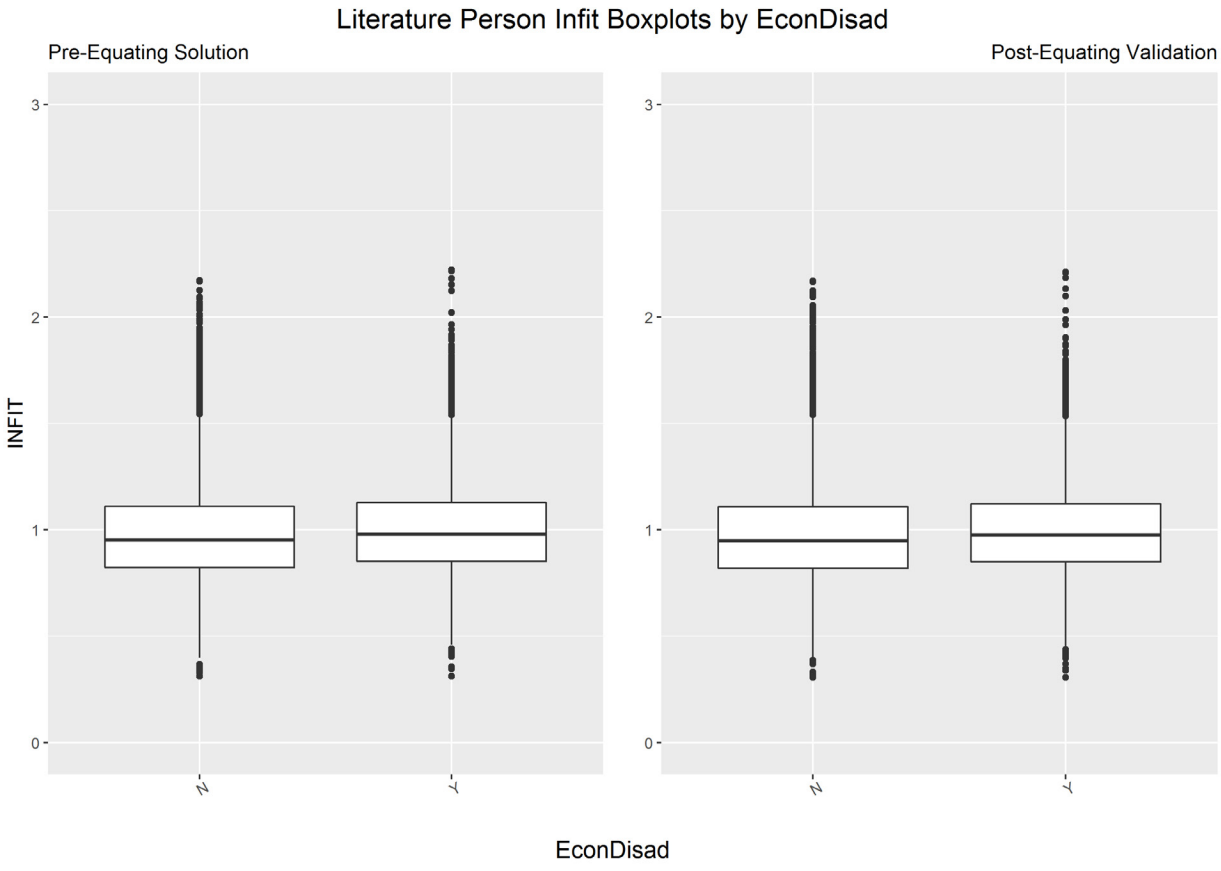
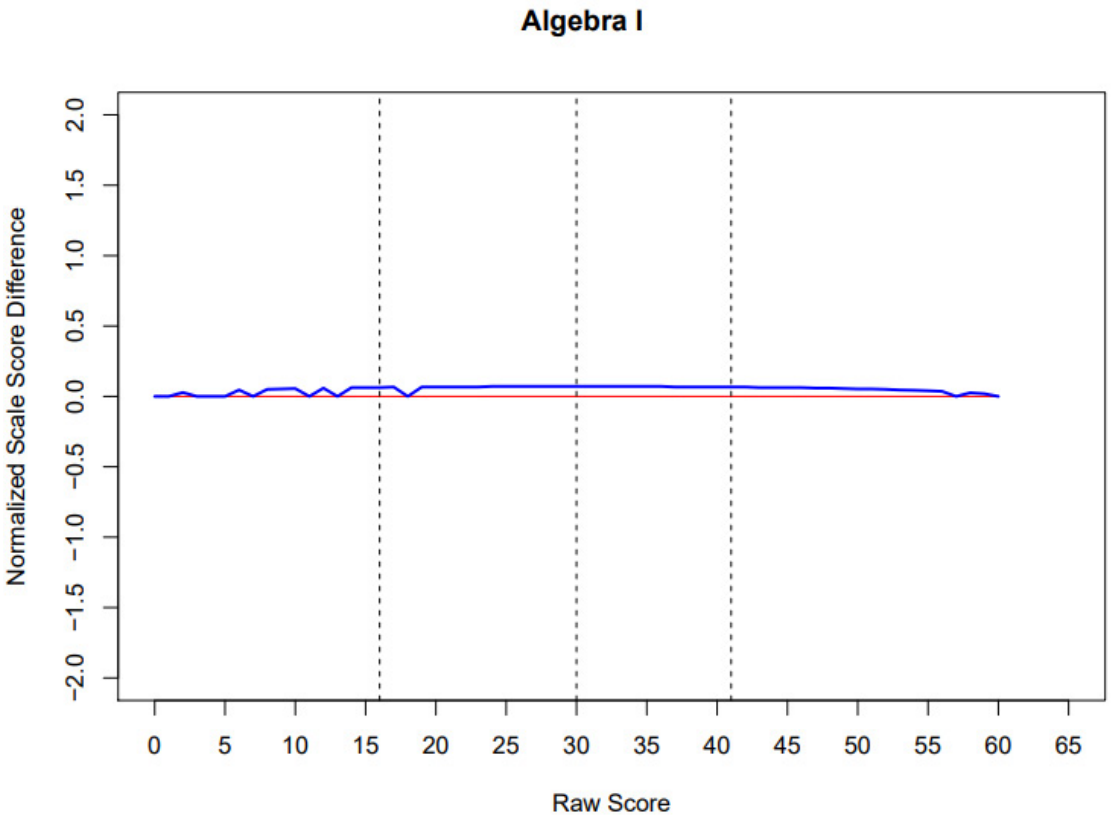


Figure L–2. Normalized Scale Score Differences by Content Area: Winter



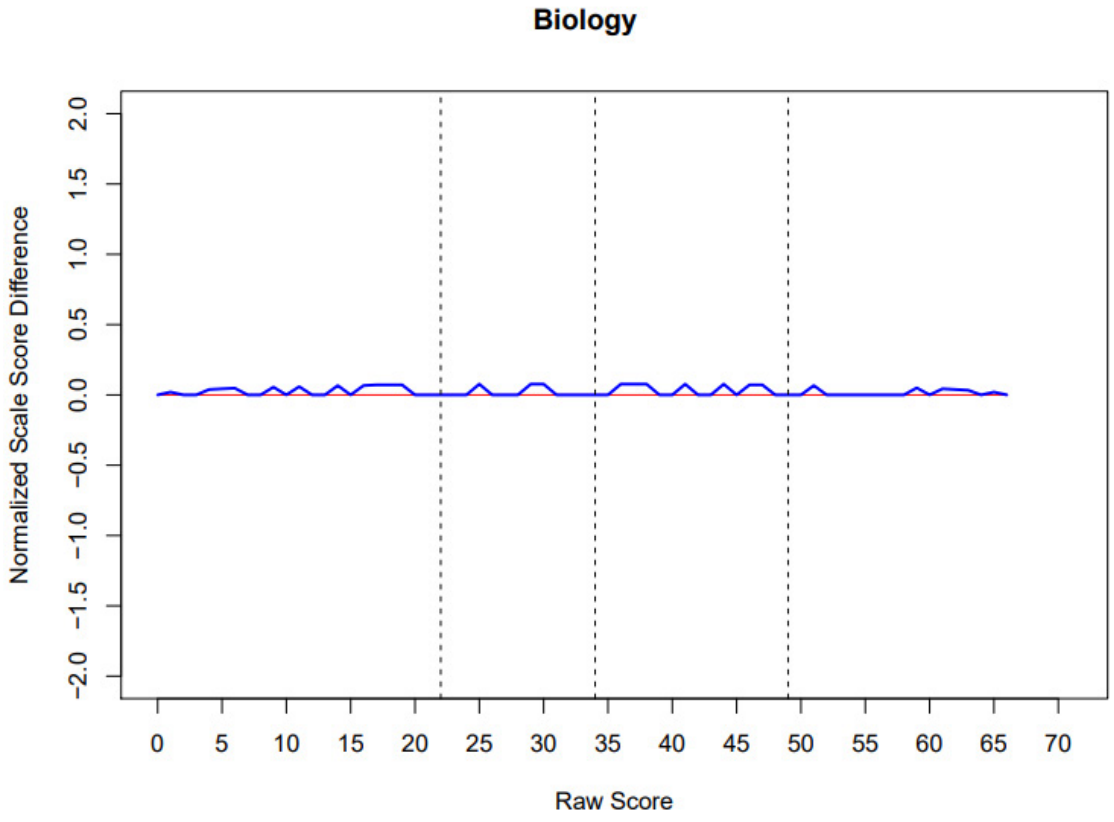


Figure L–2 (continued). Normalized Scale Score Differences by Content Area: Winter

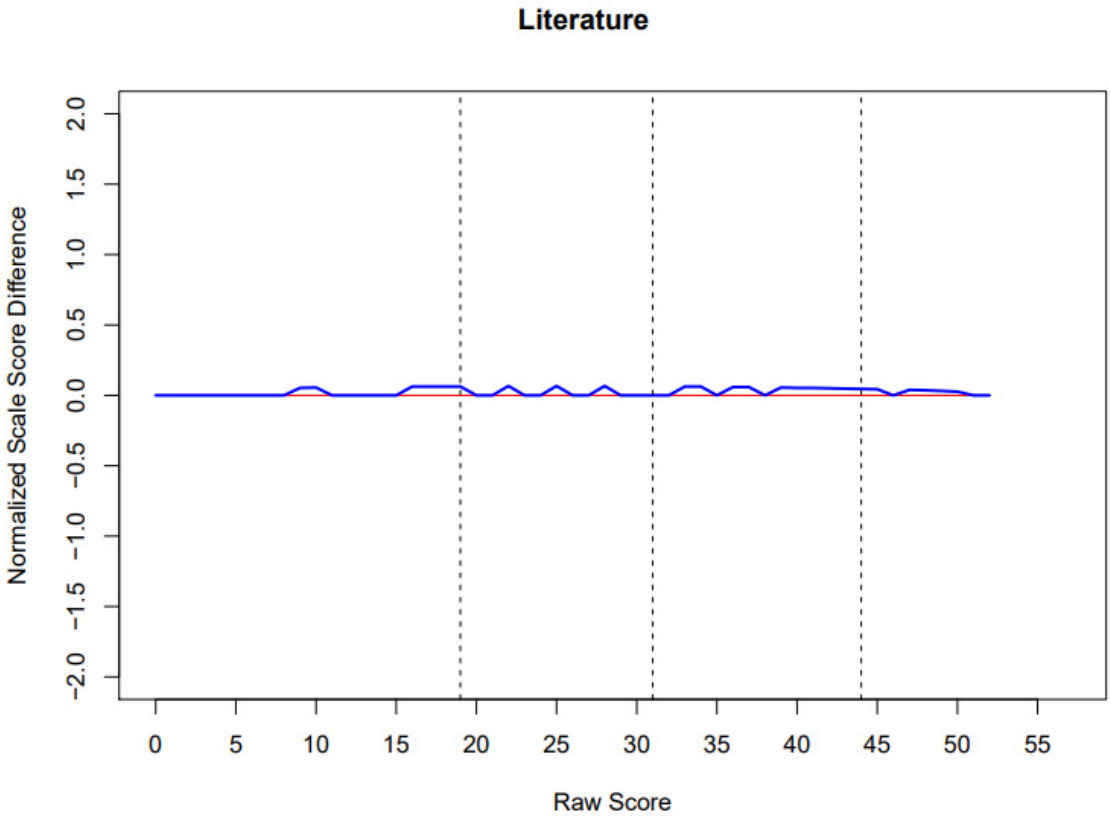


Table L–1. Winter Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1216	1216	92	92	BB	BB	0.0	TRUE
1	1277	1277	51	51	BB	BB	0.0	TRUE
2	1314	1313	36	36	BB	BB	0.0	TRUE
3	1335	1335	30	30	BB	BB	0.1	TRUE
4	1351	1351	27	27	BB	BB	0.2	TRUE
5	1364	1364	24	24	BB	BB	0.5	TRUE
6	1375	1374	22	22	BB	BB	0.9	TRUE
7	1384	1384	21	21	BB	BB	1.3	TRUE
8	1393	1392	20	20	BB	BB	2.0	TRUE
9	1400	1399	19	19	BB	BB	2.6	TRUE
10	1407	1406	18	18	BB	BB	3.2	TRUE
11	1413	1413	18	18	BB	BB	4.0	TRUE
12	1420	1419	17	17	BB	BB	3.9	TRUE
13	1425	1425	17	17	BB	BB	4.1	TRUE
14	1431	1430	16	16	BB	BB	4.0	TRUE
15	1436	1435	16	16	BB	BB	4.0	TRUE
16	1441	1440	16	16	B	B	3.7	TRUE
17	1446	1445	15	15	B	B	3.9	TRUE
18	1450	1450	15	15	B	B	3.8	TRUE
19	1455	1454	15	15	B	B	4.0	TRUE
20	1460	1459	15	15	B	B	3.9	TRUE
21	1464	1463	15	15	B	B	3.7	TRUE
22	1468	1467	15	15	B	B	3.7	TRUE
23	1473	1472	15	15	B	B	3.6	TRUE
24	1477	1476	14	14	B	B	3.7	TRUE
25	1481	1480	14	14	B	B	3.4	TRUE
26	1485	1484	14	14	B	B	3.3	TRUE
27	1489	1488	14	14	B	B	2.9	TRUE
28	1493	1492	14	14	B	B	2.7	TRUE
29	1497	1496	14	14	B	B	2.5	TRUE
30	1501	1500	14	14	P	P	2.3	TRUE
31	1505	1504	14	14	P	P	1.9	TRUE
32	1509	1508	14	14	P	P	1.9	TRUE
33	1514	1513	14	14	P	P	1.6	TRUE
34	1518	1517	14	14	P	P	1.5	TRUE
35	1522	1521	14	14	P	P	1.3	TRUE
36	1526	1525	14	14	P	P	1.1	TRUE
37	1530	1529	15	15	P	P	1.0	TRUE
38	1534	1533	15	15	P	P	0.9	TRUE
39	1539	1538	15	15	P	P	0.8	TRUE
40	1543	1542	15	15	P	P	0.7	TRUE
41	1548	1547	15	15	A	A	0.6	TRUE

Table L–1 (continued). Winter Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1552	1551	15	15	A	A	0.7	TRUE
43	1557	1556	16	16	A	A	0.6	TRUE
44	1562	1561	16	16	A	A	0.5	TRUE
45	1567	1566	16	16	A	A	0.4	TRUE
46	1572	1571	16	16	A	A	0.4	TRUE
47	1578	1577	17	17	A	A	0.4	TRUE
48	1584	1583	17	17	A	A	0.4	TRUE
49	1590	1589	18	18	A	A	0.3	TRUE
50	1597	1596	19	19	A	A	0.2	TRUE
51	1604	1603	19	19	A	A	0.3	TRUE
52	1612	1611	20	20	A	A	0.2	TRUE
53	1620	1619	22	22	A	A	0.2	TRUE
54	1630	1629	23	23	A	A	0.1	TRUE
55	1642	1641	25	25	A	A	0.1	TRUE
56	1656	1655	28	28	A	A	0.1	TRUE
57	1673	1673	32	32	A	A	0.1	TRUE
58	1698	1697	39	39	A	A	0.0	TRUE
59	1738	1737	53	53	A	A	0.0	TRUE
60	1800	1800	93	93	A	A	0.0	TRUE

Table L–2. Winter Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1225	1225	92	92	BB	BB	0.0	TRUE
1	1286	1285	50	50	BB	BB	0.0	TRUE
2	1321	1321	36	36	BB	BB	0.0	TRUE
3	1342	1342	30	30	BB	BB	0.0	TRUE
4	1358	1357	26	26	BB	BB	0.0	TRUE
5	1370	1369	23	23	BB	BB	0.0	TRUE
6	1380	1379	21	21	BB	BB	0.1	TRUE
7	1388	1388	20	20	BB	BB	0.1	TRUE
8	1396	1396	19	19	BB	BB	0.2	TRUE
9	1403	1402	18	18	BB	BB	0.4	TRUE
10	1409	1409	17	17	BB	BB	0.7	TRUE
11	1415	1414	17	17	BB	BB	1.0	TRUE
12	1420	1420	16	16	BB	BB	1.4	TRUE
13	1425	1425	16	16	BB	BB	1.8	TRUE
14	1430	1429	15	15	BB	BB	2.1	TRUE
15	1434	1434	15	15	BB	BB	2.5	TRUE
16	1439	1438	15	15	BB	BB	2.9	TRUE
17	1443	1442	14	14	BB	BB	3.3	TRUE
18	1447	1446	14	14	BB	BB	3.6	TRUE
19	1451	1450	14	14	BB	BB	3.9	TRUE
20	1454	1454	14	14	BB	BB	4.1	TRUE
21	1458	1458	13	13	BB	BB	4.0	TRUE
22	1461	1461	13	13	B	B	4.3	TRUE
23	1465	1465	13	13	B	B	4.2	TRUE
24	1468	1468	13	13	B	B	4.2	TRUE
25	1472	1471	13	13	B	B	4.1	TRUE
26	1475	1475	13	13	B	B	3.8	TRUE
27	1478	1478	13	13	B	B	3.6	TRUE
28	1481	1481	13	13	B	B	3.5	TRUE
29	1485	1484	13	13	B	B	3.2	TRUE
30	1488	1487	13	13	B	B	3.1	TRUE
31	1491	1491	13	13	B	B	3.0	TRUE
32	1494	1494	12	12	B	B	2.7	TRUE
33	1497	1497	12	12	B	B	2.4	TRUE
34	1500	1500	12	12	P	P	2.2	TRUE
35	1503	1503	13	12	P	P	2.0	TRUE
36	1507	1506	13	13	P	P	1.7	TRUE
37	1510	1509	13	13	P	P	1.7	TRUE
38	1513	1512	13	13	P	P	1.5	TRUE
39	1516	1516	13	13	P	P	1.3	TRUE
40	1519	1519	13	13	P	P	1.2	TRUE
41	1523	1522	13	13	P	P	1.1	TRUE

Table L–2 (continued). Winter Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1526	1526	13	13	P	P	1.1	TRUE
43	1529	1529	13	13	P	P	1.1	TRUE
44	1533	1532	13	13	P	P	0.9	TRUE
45	1536	1536	13	13	P	P	0.9	TRUE
46	1540	1539	14	14	P	P	0.8	TRUE
47	1544	1543	14	14	P	P	0.8	TRUE
48	1547	1547	14	14	P	P	0.7	TRUE
49	1551	1551	14	14	A	A	0.7	TRUE
50	1555	1555	15	14	A	A	0.6	TRUE
51	1560	1559	15	15	A	A	0.7	TRUE
52	1564	1564	15	15	A	A	0.5	TRUE
53	1569	1569	16	16	A	A	0.6	TRUE
54	1574	1574	16	16	A	A	0.6	TRUE
55	1579	1579	17	17	A	A	0.6	TRUE
56	1585	1585	17	17	A	A	0.5	TRUE
57	1591	1591	18	18	A	A	0.5	TRUE
58	1598	1598	19	19	A	A	0.3	TRUE
59	1606	1605	20	20	A	A	0.4	TRUE
60	1614	1614	22	22	A	A	0.2	TRUE
61	1625	1624	23	23	A	A	0.3	TRUE
62	1637	1636	26	26	A	A	0.1	TRUE
63	1652	1651	30	30	A	A	0.1	TRUE
64	1673	1673	36	36	A	A	0.1	TRUE
65	1709	1708	50	50	A	A	0.1	TRUE
66	1769	1769	92	92	A	A	0.0	TRUE

Table L–3. Winter Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1205	1205	92	92	BB	BB	0.0	TRUE
1	1266	1266	51	51	BB	BB	0.0	TRUE
2	1302	1302	37	37	BB	BB	0.0	TRUE
3	1324	1324	30	30	BB	BB	0.1	TRUE
4	1340	1340	27	27	BB	BB	0.1	TRUE
5	1353	1353	24	24	BB	BB	0.2	TRUE
6	1364	1364	22	22	BB	BB	0.5	TRUE
7	1373	1373	21	21	BB	BB	0.7	TRUE
8	1382	1382	20	20	BB	BB	1.0	TRUE
9	1390	1389	19	19	BB	BB	1.2	TRUE
10	1397	1396	18	18	BB	BB	1.6	TRUE
11	1403	1403	18	18	BB	BB	1.8	TRUE
12	1409	1409	17	17	BB	BB	2.0	TRUE
13	1415	1415	17	17	BB	BB	2.2	TRUE
14	1421	1421	17	17	BB	BB	2.2	TRUE
15	1426	1426	16	16	BB	BB	2.2	TRUE
16	1432	1431	16	16	BB	BB	2.3	TRUE
17	1437	1436	16	16	BB	BB	2.4	TRUE
18	1442	1441	16	16	BB	BB	2.5	TRUE
19	1447	1446	16	16	B	B	2.5	TRUE
20	1451	1451	15	15	B	B	2.7	TRUE
21	1456	1456	15	15	B	B	2.8	TRUE
22	1461	1460	15	15	B	B	2.9	TRUE
23	1465	1465	15	15	B	B	2.9	TRUE
24	1470	1470	15	15	B	B	3.0	TRUE
25	1475	1474	15	15	B	B	3.2	TRUE
26	1479	1479	15	15	B	B	3.3	TRUE
27	1484	1484	15	15	B	B	3.3	TRUE
28	1489	1488	15	15	B	B	3.4	TRUE
29	1493	1493	16	15	B	B	3.5	TRUE
30	1498	1498	16	16	B	B	3.5	TRUE
31	1503	1503	16	16	P	P	3.3	TRUE
32	1508	1508	16	16	P	P	3.5	TRUE
33	1514	1513	16	16	P	P	3.0	TRUE
34	1519	1518	16	16	P	P	3.2	TRUE
35	1524	1524	17	17	P	P	3.0	TRUE
36	1530	1529	17	17	P	P	2.9	TRUE
37	1536	1535	17	17	P	P	2.8	TRUE
38	1542	1542	18	18	P	P	2.5	TRUE
39	1549	1548	18	18	P	P	2.5	TRUE
40	1556	1555	19	19	P	P	2.2	TRUE
41	1563	1562	19	19	P	P	1.9	TRUE

Table L–3 (continued). Winter Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1571	1570	20	20	P	P	2.0	TRUE
43	1579	1578	21	21	P	P	1.7	TRUE
44	1588	1587	22	22	A	A	1.4	TRUE
45	1598	1597	23	23	A	A	1.2	TRUE
46	1609	1609	24	24	A	A	0.9	TRUE
47	1622	1621	26	26	A	A	0.7	TRUE
48	1637	1636	28	28	A	A	0.6	TRUE
49	1655	1654	32	32	A	A	0.4	TRUE
50	1679	1678	38	38	A	A	0.2	TRUE
51	1717	1717	52	52	A	A	0.1	TRUE
52	1780	1780	92	92	A	A	0.0	TRUE

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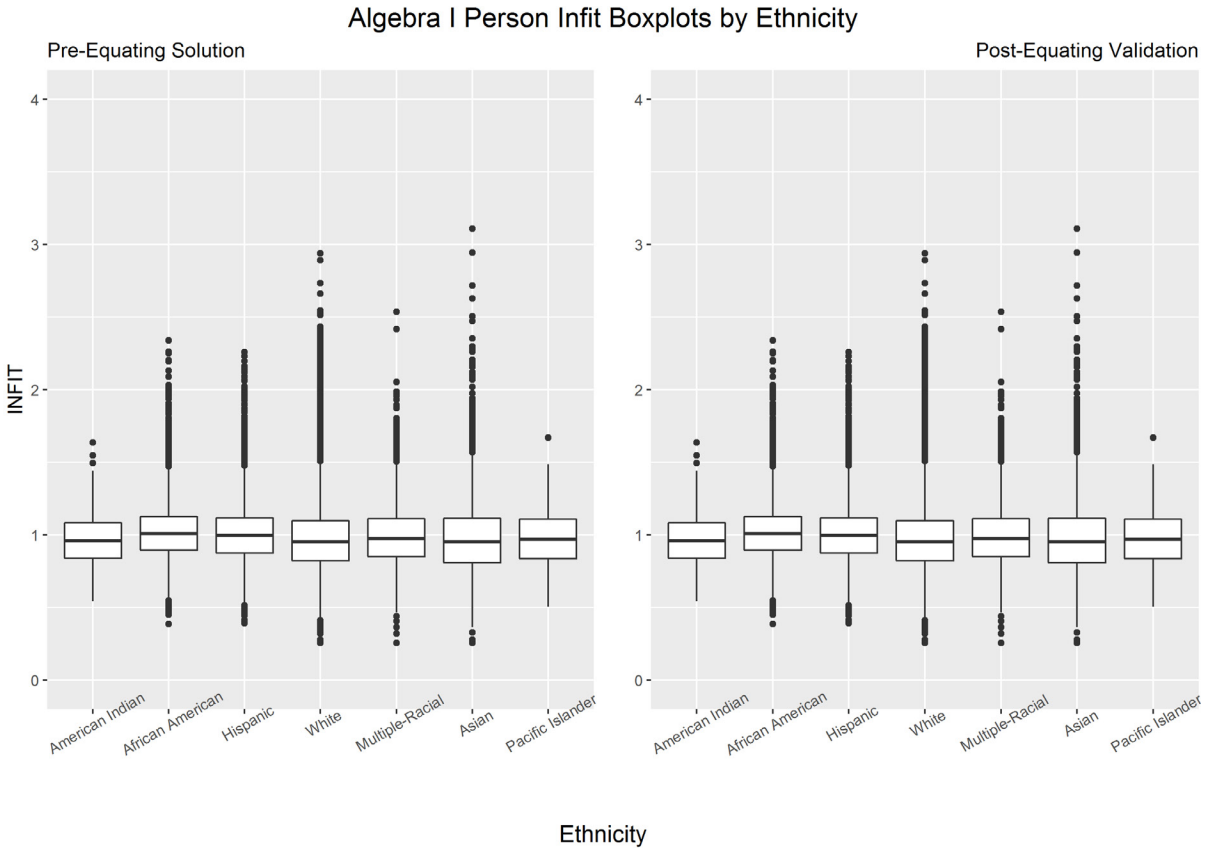
Figure L–3. Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



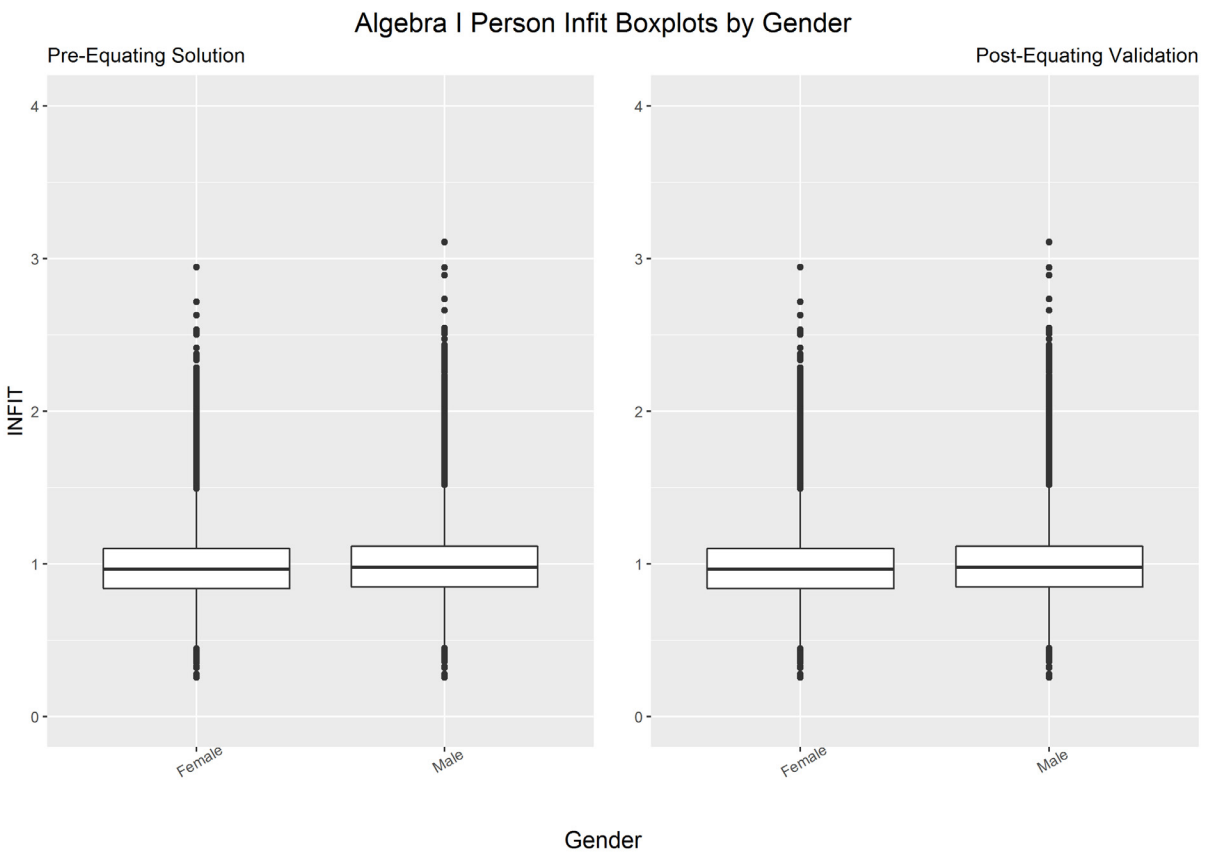
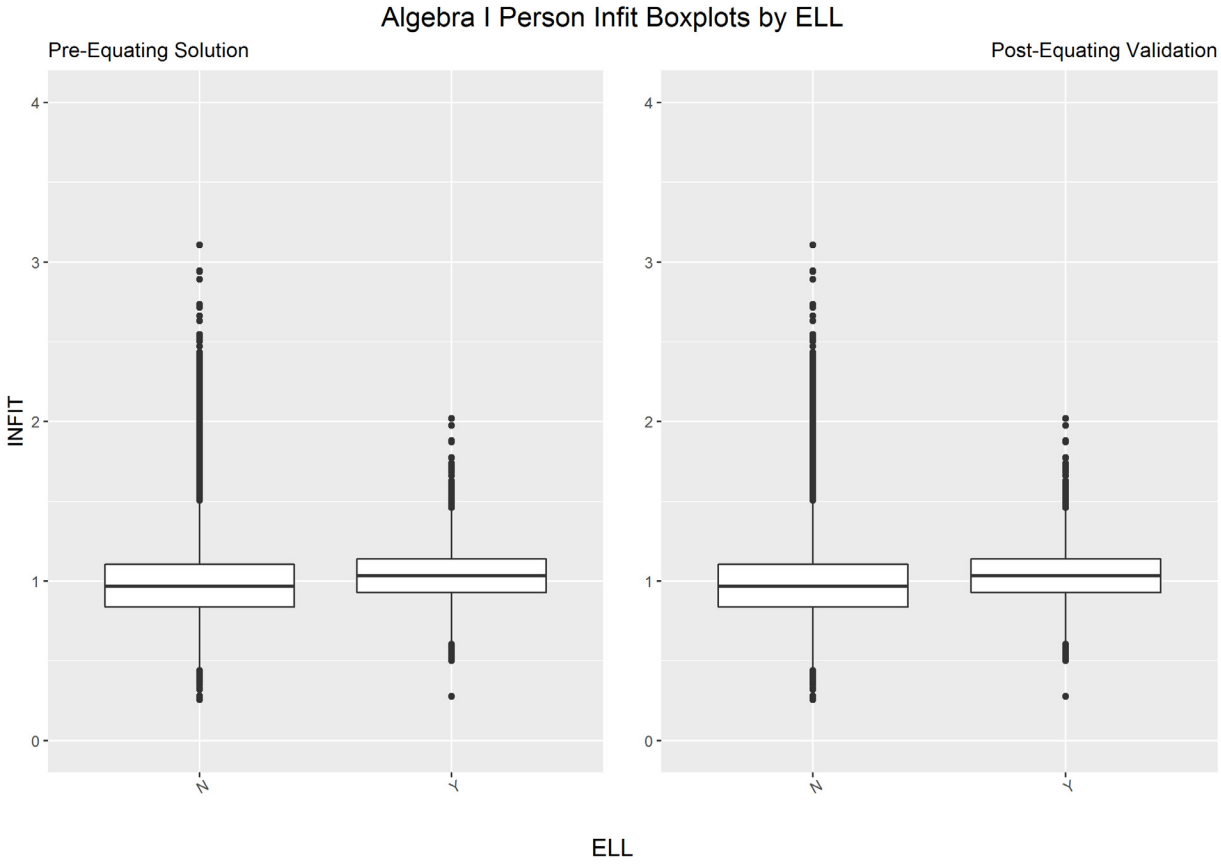


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



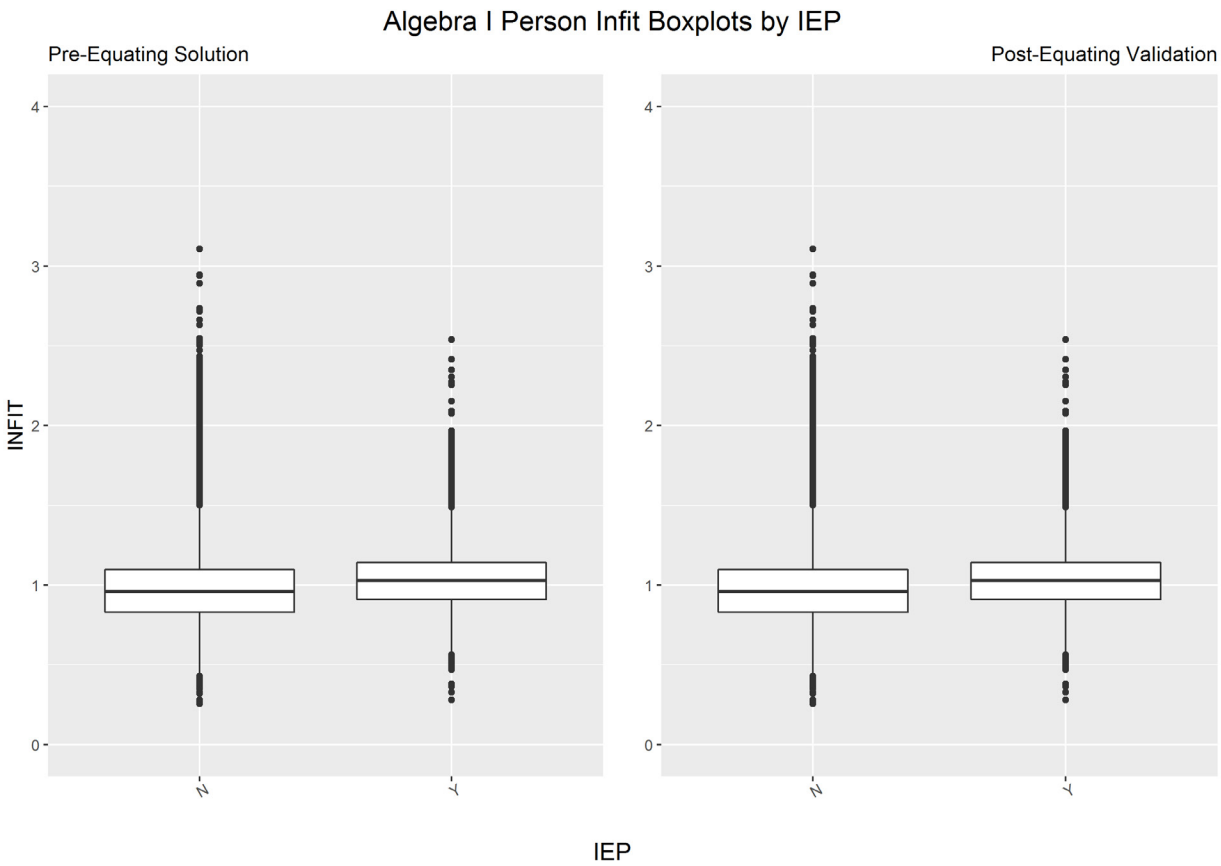
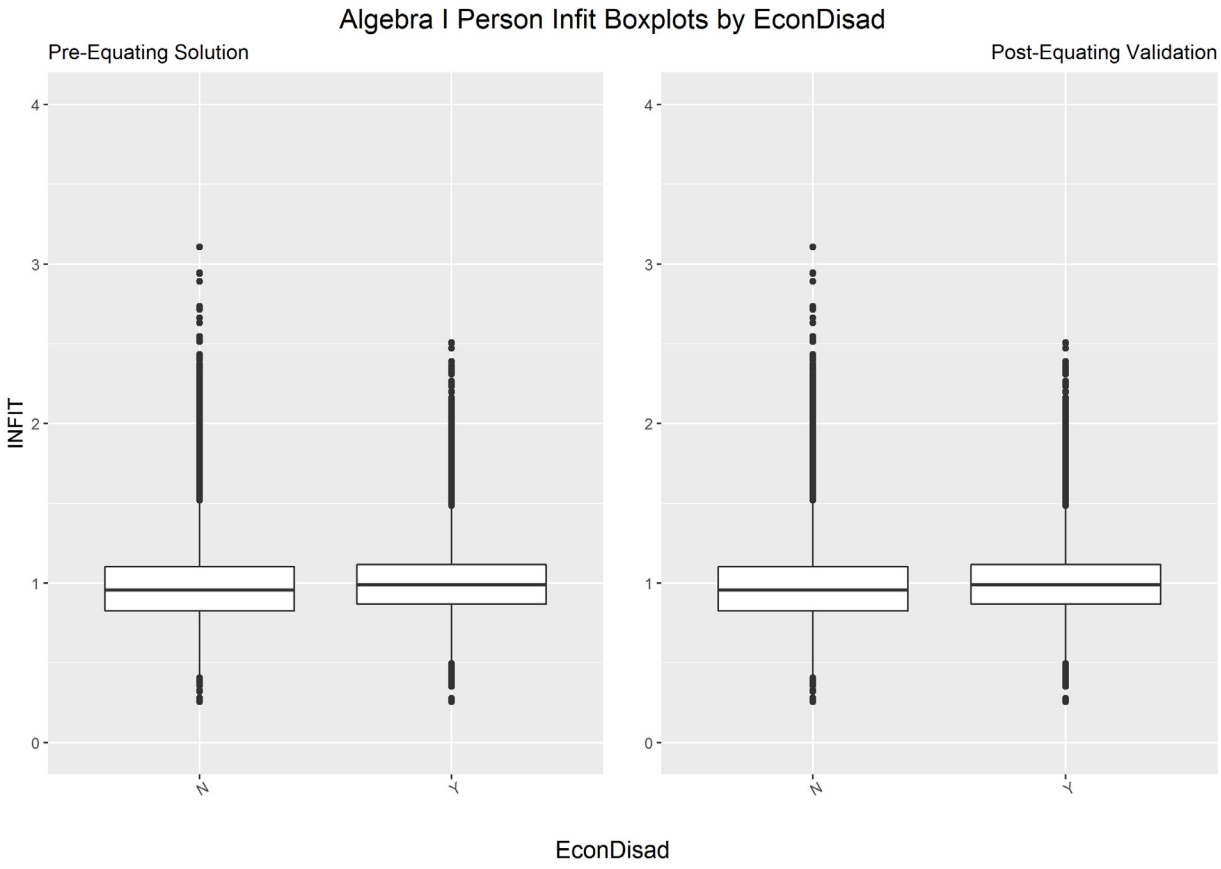


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



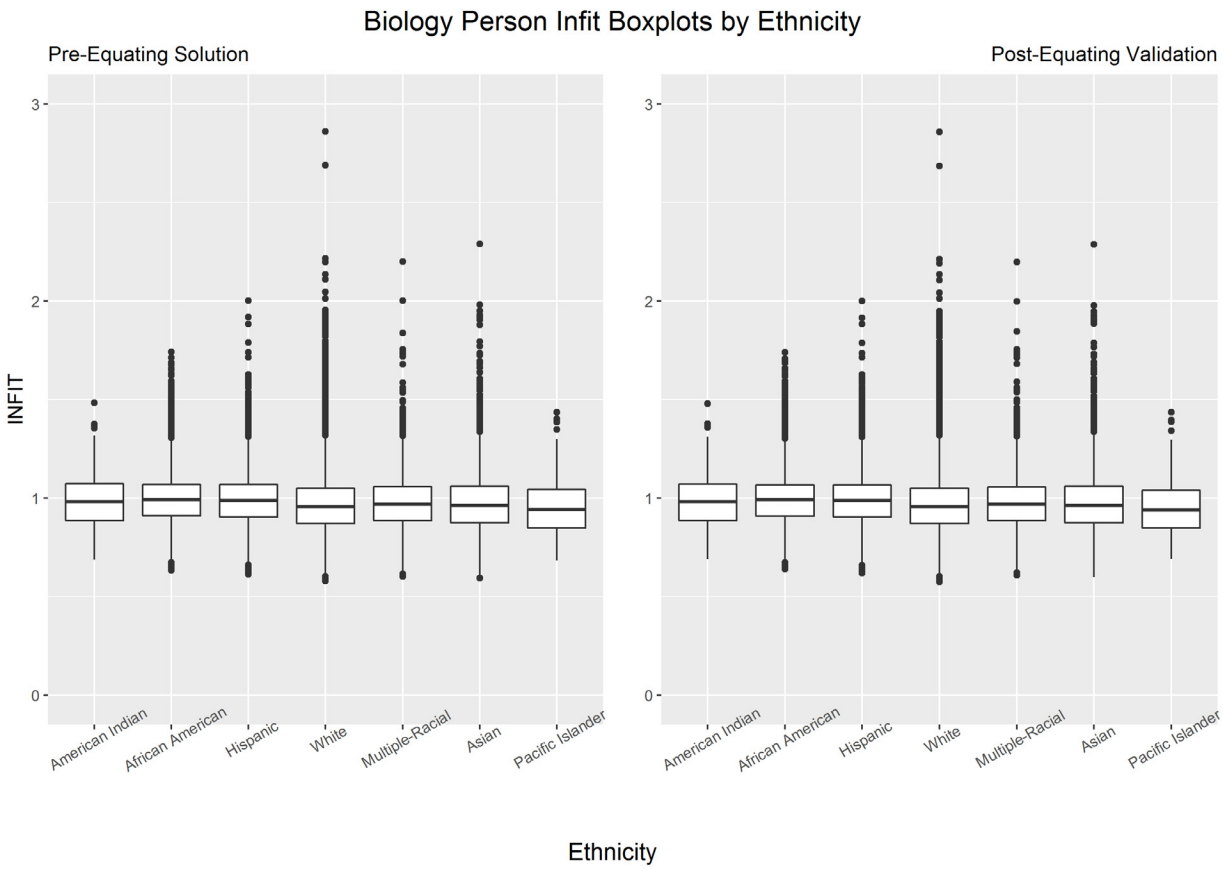


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring

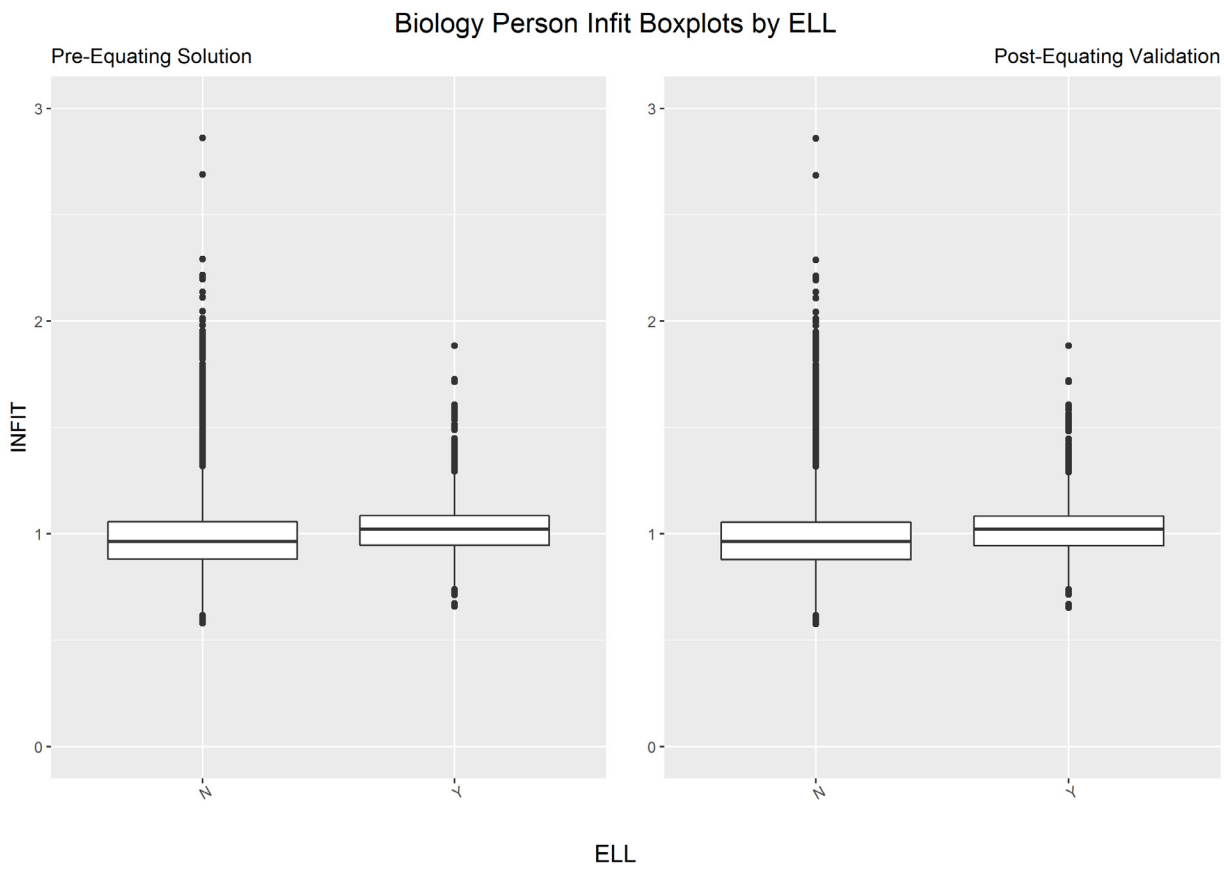
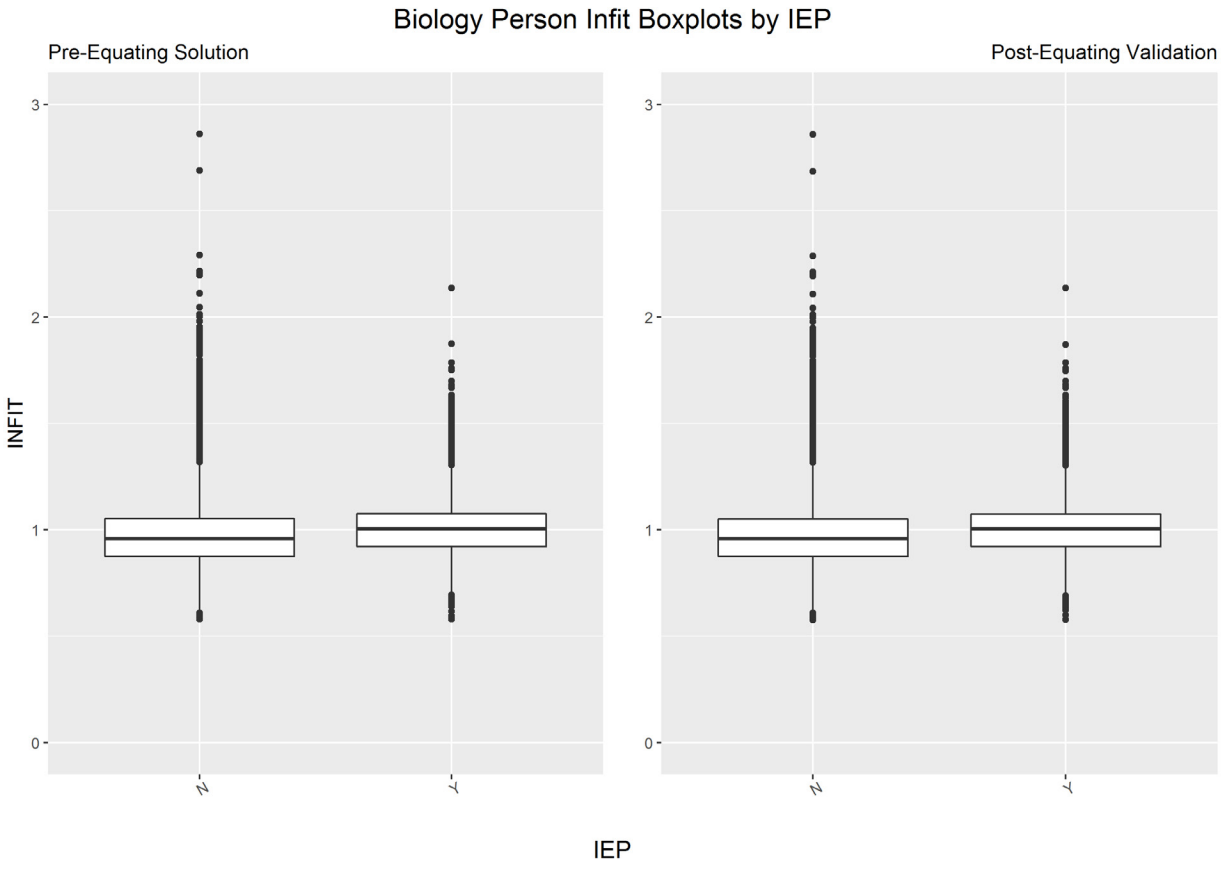


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



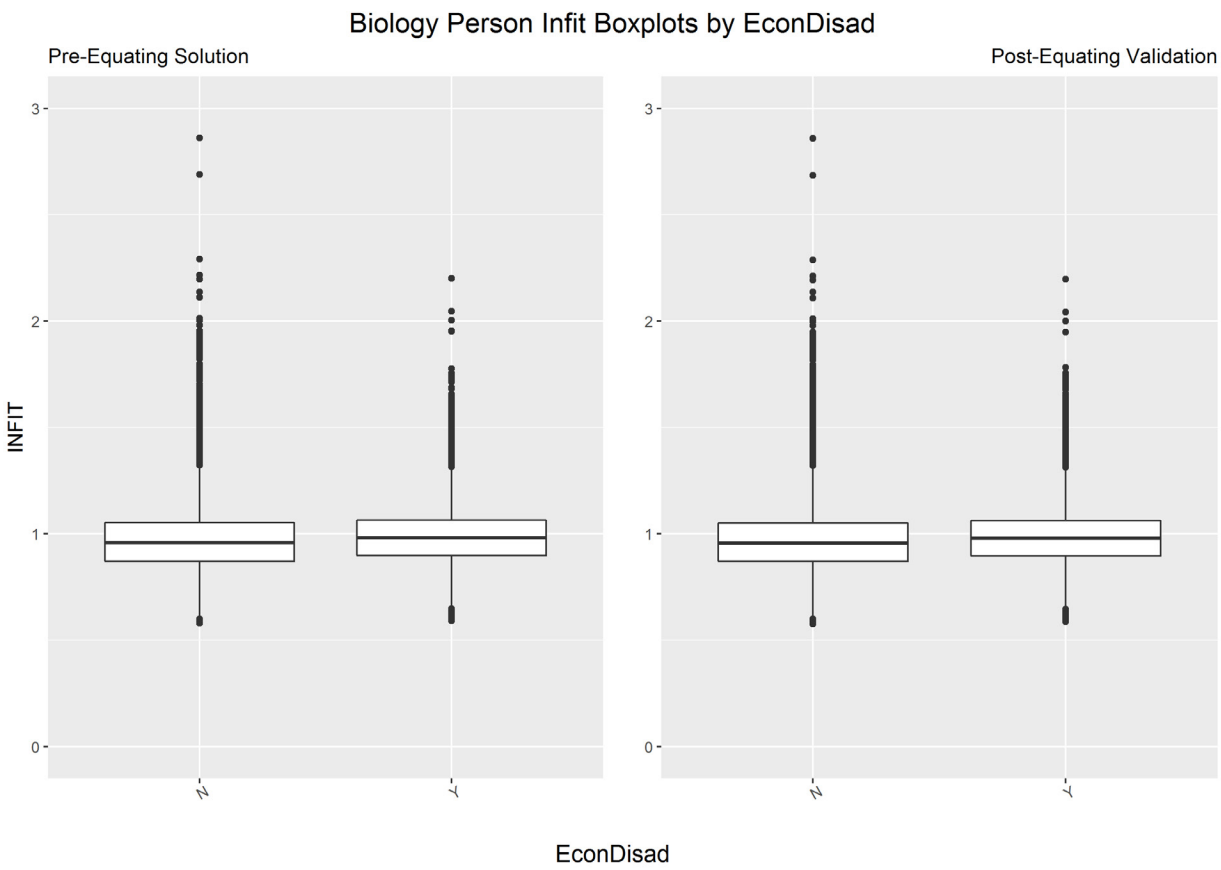
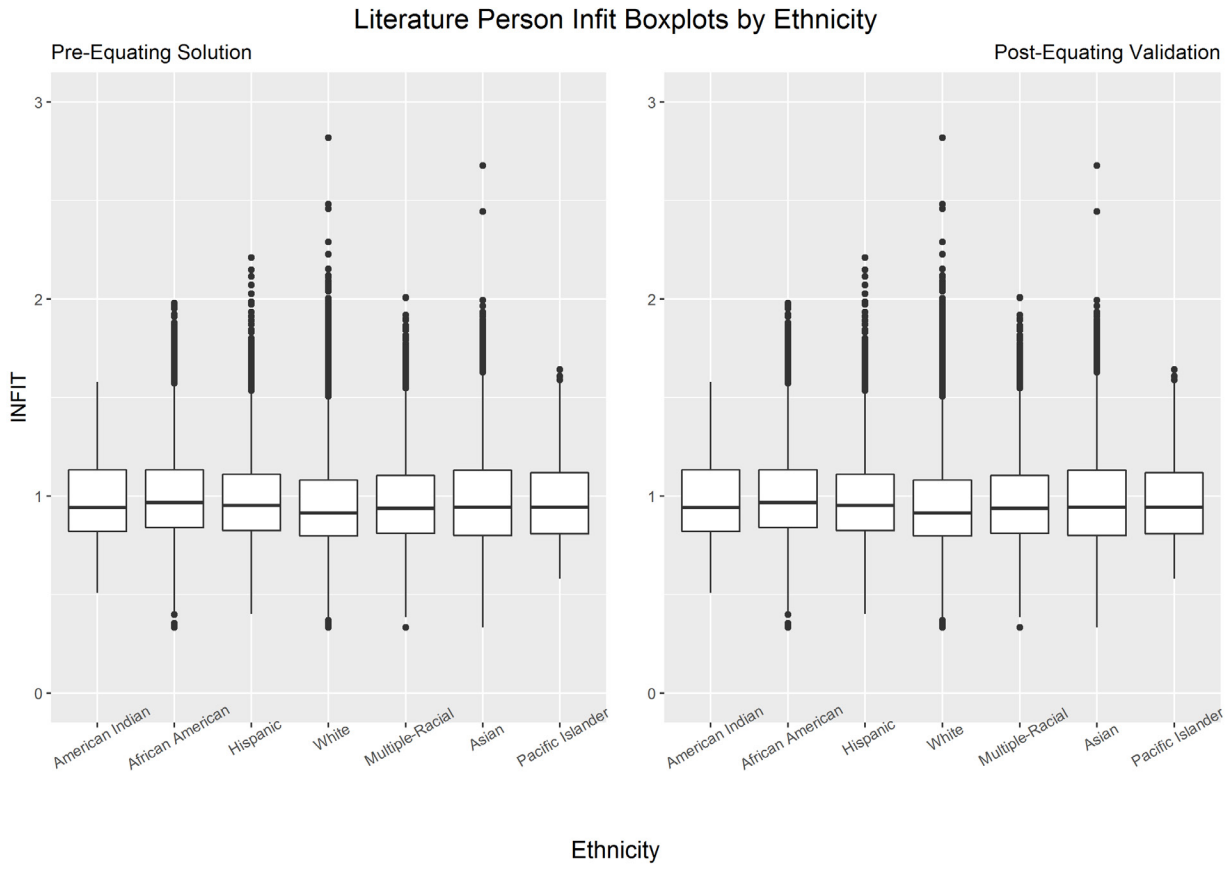


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



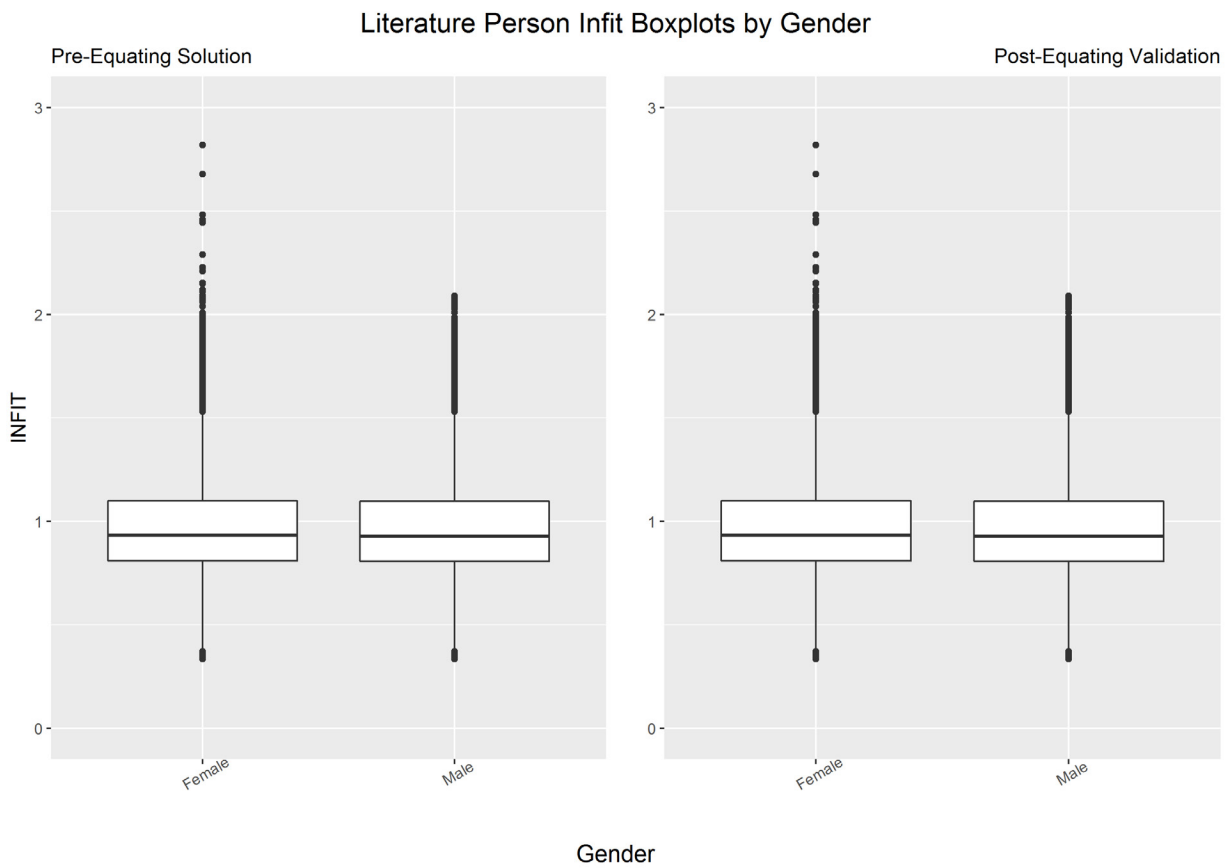
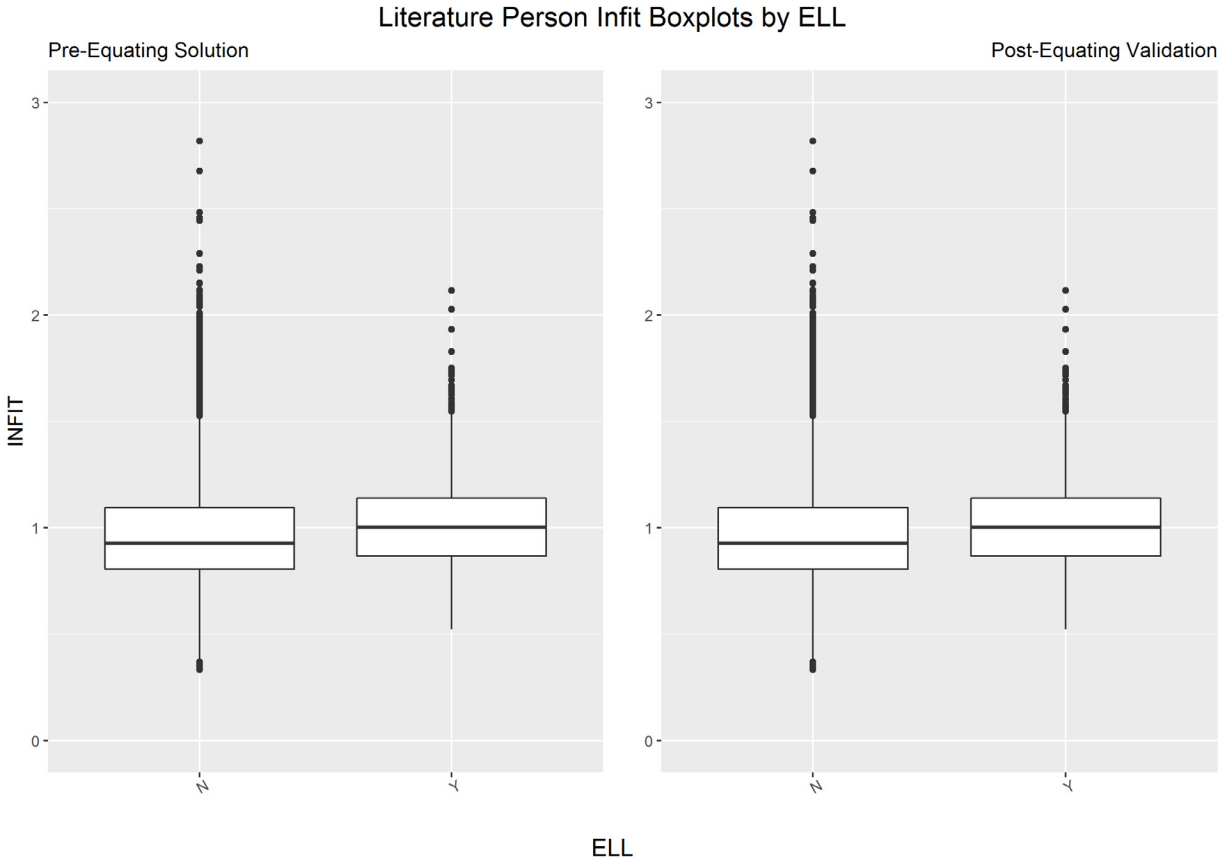


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring



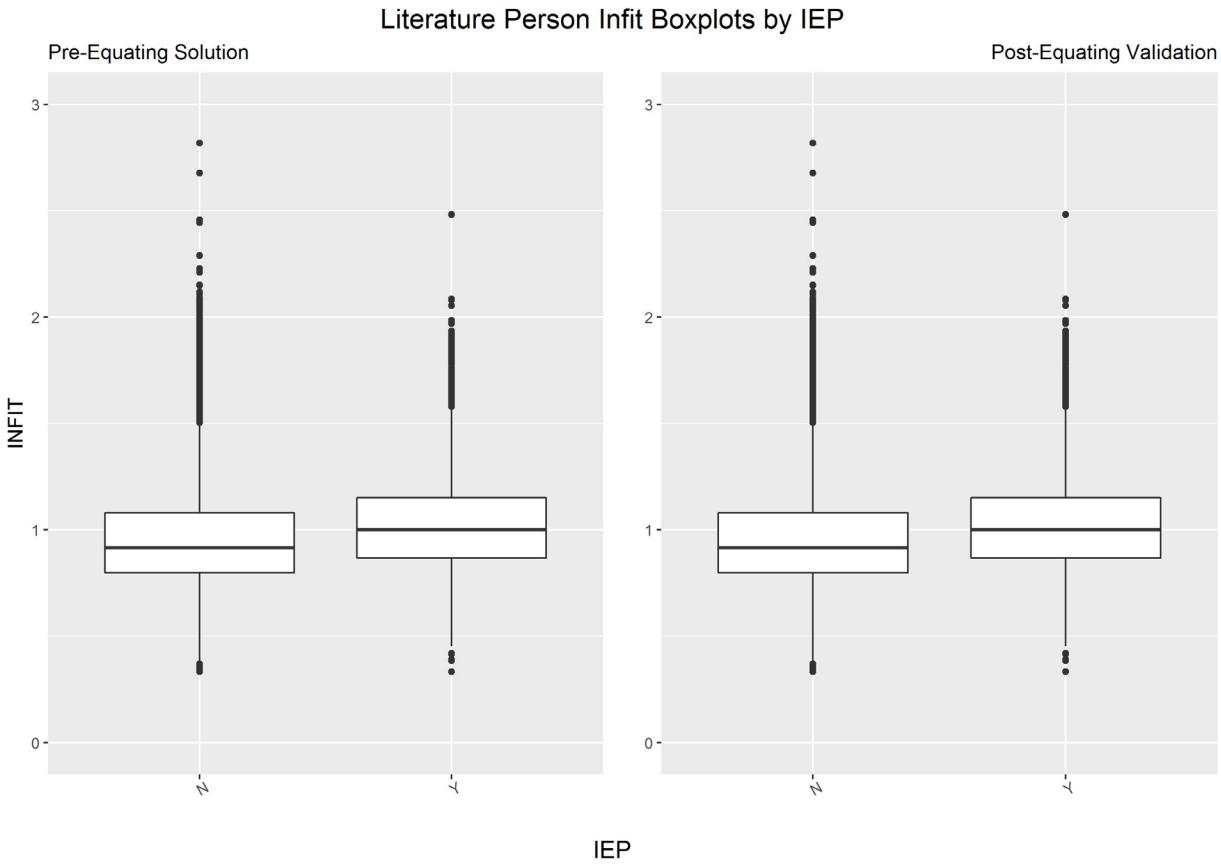


Figure L–3 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Spring

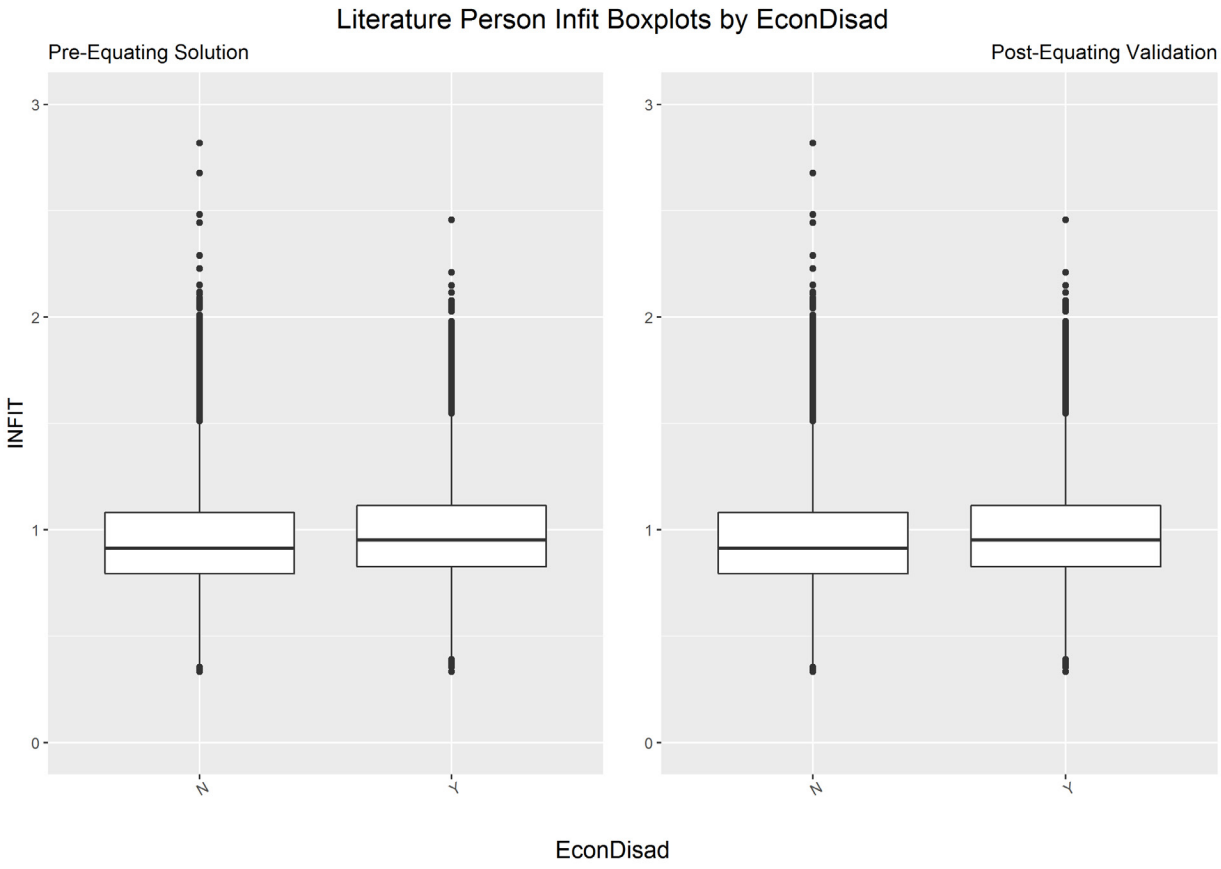
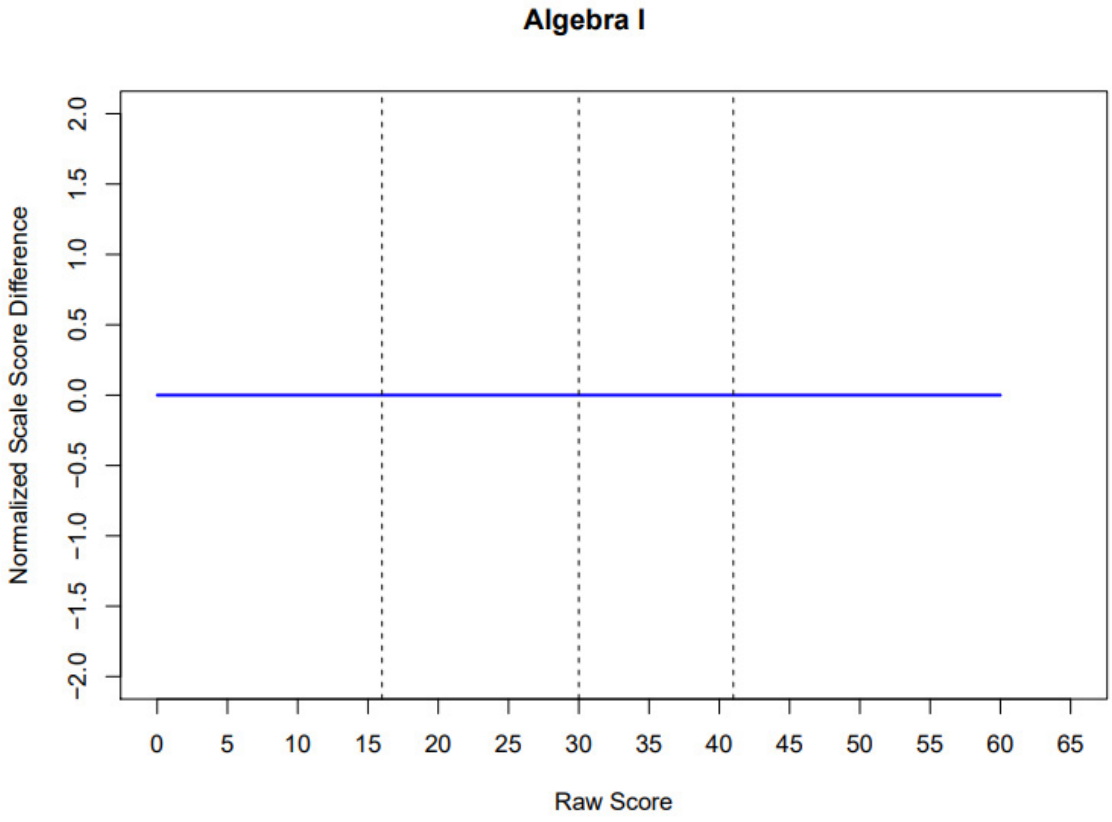


Figure L–4. Normalized Scale Score Distributions by Content Area: Spring



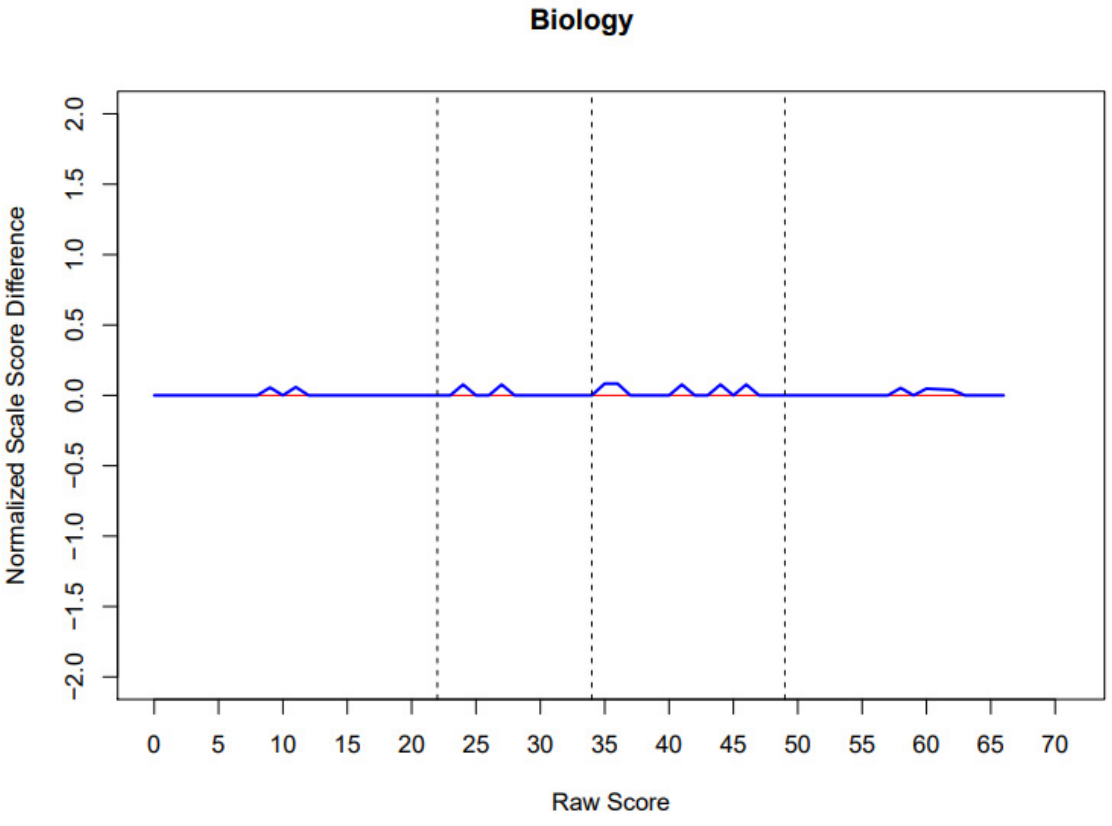


Figure L–4 (continued). Normalized Scale Score Differences by Content Area: Spring

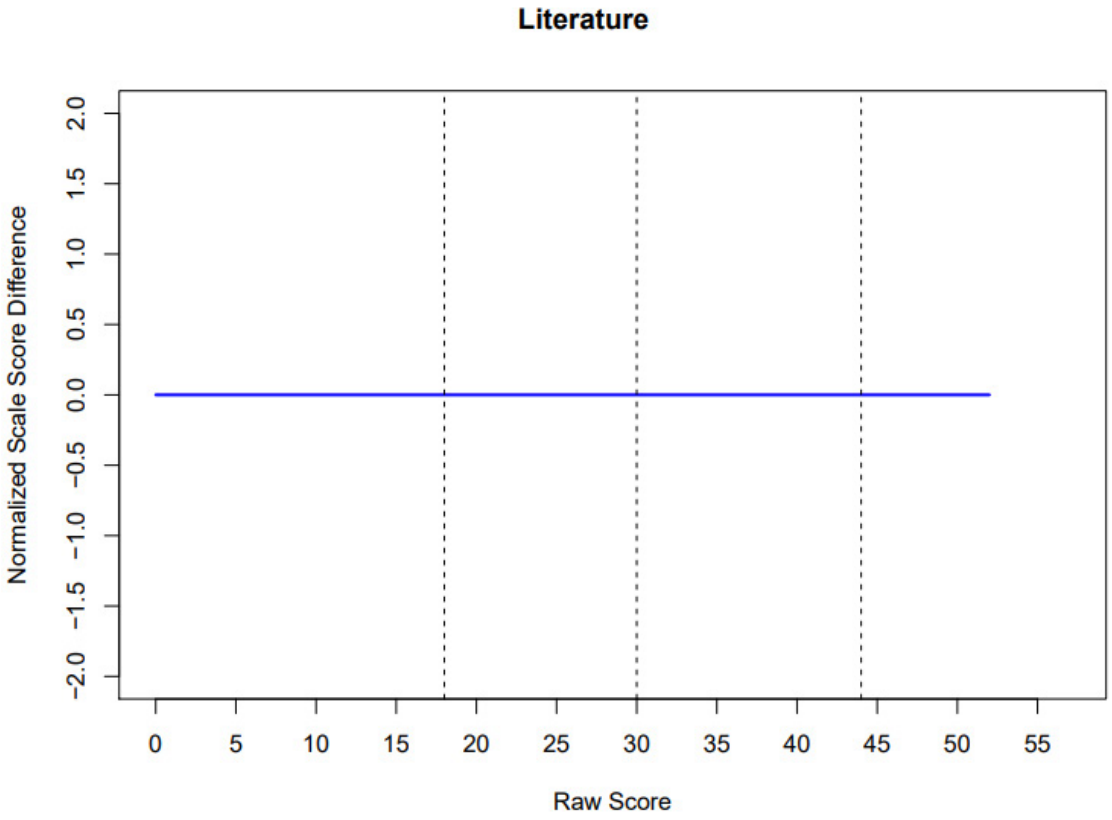


Table L–4. Spring Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1212	1212	92	92	BB	BB	0.0	TRUE
1	1273	1273	51	51	BB	BB	0.0	TRUE
2	1310	1310	37	37	BB	BB	0.0	TRUE
3	1332	1332	31	31	BB	BB	0.1	TRUE
4	1349	1349	27	27	BB	BB	0.2	TRUE
5	1362	1362	24	24	BB	BB	0.5	TRUE
6	1373	1373	23	23	BB	BB	0.9	TRUE
7	1382	1382	21	21	BB	BB	1.4	TRUE
8	1391	1391	20	20	BB	BB	2.1	TRUE
9	1399	1399	19	19	BB	BB	2.7	TRUE
10	1406	1406	19	19	BB	BB	3.3	TRUE
11	1412	1412	18	18	BB	BB	3.5	TRUE
12	1419	1419	17	17	BB	BB	3.7	TRUE
13	1424	1424	17	17	BB	BB	3.7	TRUE
14	1430	1430	16	16	BB	BB	3.7	TRUE
15	1435	1435	16	16	BB	BB	3.6	TRUE
16	1440	1440	16	16	B	B	3.4	TRUE
17	1445	1445	16	16	B	B	3.3	TRUE
18	1450	1450	15	15	B	B	3.2	TRUE
19	1455	1455	15	15	B	B	3.2	TRUE
20	1459	1459	15	15	B	B	3.0	TRUE
21	1464	1464	15	15	B	B	2.9	TRUE
22	1468	1468	15	15	B	B	3.0	TRUE
23	1472	1472	14	14	B	B	2.8	TRUE
24	1476	1476	14	14	B	B	2.7	TRUE
25	1480	1480	14	14	B	B	2.6	TRUE
26	1485	1485	14	14	B	B	2.6	TRUE
27	1489	1489	14	14	B	B	2.4	TRUE
28	1493	1493	14	14	B	B	2.4	TRUE
29	1497	1497	14	14	B	B	2.2	TRUE
30	1501	1501	14	14	P	P	2.1	TRUE
31	1505	1505	14	14	P	P	2.0	TRUE
32	1509	1509	14	14	P	P	1.9	TRUE
33	1513	1513	14	14	P	P	1.8	TRUE
34	1517	1517	14	14	P	P	1.7	TRUE
35	1521	1521	14	14	P	P	1.6	TRUE
36	1525	1525	14	14	P	P	1.7	TRUE
37	1529	1529	15	15	P	P	1.6	TRUE
38	1534	1534	15	15	P	P	1.4	TRUE
39	1538	1538	15	15	P	P	1.4	TRUE
40	1542	1542	15	15	P	P	1.3	TRUE
41	1547	1547	15	15	A	A	1.3	TRUE

Table L–4 (continued). Spring Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1552	1552	16	16	A	A	1.2	TRUE
43	1557	1557	16	16	A	A	1.2	TRUE
44	1562	1562	16	16	A	A	1.1	TRUE
45	1567	1567	16	16	A	A	1.0	TRUE
46	1573	1573	17	17	A	A	0.9	TRUE
47	1579	1579	17	17	A	A	0.9	TRUE
48	1585	1585	18	18	A	A	0.8	TRUE
49	1591	1591	19	19	A	A	0.7	TRUE
50	1599	1599	19	19	A	A	0.6	TRUE
51	1606	1606	20	20	A	A	0.6	TRUE
52	1615	1615	21	21	A	A	0.5	TRUE
53	1624	1624	22	22	A	A	0.4	TRUE
54	1635	1635	24	24	A	A	0.4	TRUE
55	1647	1647	26	26	A	A	0.3	TRUE
56	1662	1662	29	29	A	A	0.2	TRUE
57	1681	1681	32	32	A	A	0.1	TRUE
58	1705	1705	39	39	A	A	0.1	TRUE
59	1745	1745	53	53	A	A	0.0	TRUE
60	1800	1800	93	93	A	A	0.0	TRUE

Table L–5. Spring Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1224	1224	92	92	BB	BB	0.0	TRUE
1	1285	1285	50	50	BB	BB	0.0	TRUE
2	1321	1321	36	36	BB	BB	0.0	TRUE
3	1342	1342	30	30	BB	BB	0.0	TRUE
4	1357	1357	26	26	BB	BB	0.0	TRUE
5	1369	1369	23	23	BB	BB	0.1	TRUE
6	1379	1379	22	22	BB	BB	0.1	TRUE
7	1388	1388	20	20	BB	BB	0.3	TRUE
8	1396	1396	19	19	BB	BB	0.5	TRUE
9	1403	1402	18	18	BB	BB	0.8	TRUE
10	1409	1409	17	17	BB	BB	1.1	TRUE
11	1415	1414	17	17	BB	BB	1.6	TRUE
12	1420	1420	16	16	BB	BB	2.0	TRUE
13	1425	1425	16	16	BB	BB	2.4	TRUE
14	1430	1430	15	15	BB	BB	2.5	TRUE
15	1434	1434	15	15	BB	BB	2.8	TRUE
16	1439	1439	15	15	BB	BB	2.9	TRUE
17	1443	1443	14	14	BB	BB	3.0	TRUE
18	1447	1447	14	14	BB	BB	2.9	TRUE
19	1451	1451	14	14	BB	BB	2.9	TRUE
20	1454	1454	14	14	BB	BB	2.8	TRUE
21	1458	1458	13	13	BB	BB	2.8	TRUE
22	1462	1462	13	13	B	B	2.8	TRUE
23	1465	1465	13	13	B	B	2.6	TRUE
24	1469	1468	13	13	B	B	2.6	TRUE
25	1472	1472	13	13	B	B	2.5	TRUE
26	1475	1475	13	13	B	B	2.4	TRUE
27	1479	1478	13	13	B	B	2.4	TRUE
28	1482	1482	13	13	B	B	2.3	TRUE
29	1485	1485	13	13	B	B	2.2	TRUE
30	1488	1488	13	13	B	B	2.1	TRUE
31	1491	1491	12	12	B	B	2.0	TRUE
32	1494	1494	12	12	B	B	2.1	TRUE
33	1497	1497	12	12	B	B	1.9	TRUE
34	1500	1500	12	12	P	P	1.8	TRUE
35	1504	1503	12	12	P	P	1.8	TRUE
36	1507	1506	12	12	P	P	1.7	TRUE
37	1510	1510	13	12	P	P	1.7	TRUE
38	1513	1513	13	13	P	P	1.6	TRUE
39	1516	1516	13	13	P	P	1.6	TRUE
40	1519	1519	13	13	P	P	1.5	TRUE
41	1523	1522	13	13	P	P	1.5	TRUE

Table L–5 (continued). Spring Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1526	1526	13	13	P	P	1.5	TRUE
43	1529	1529	13	13	P	P	1.5	TRUE
44	1533	1532	13	13	P	P	1.4	TRUE
45	1536	1536	13	13	P	P	1.5	TRUE
46	1540	1539	13	13	P	P	1.5	TRUE
47	1543	1543	14	14	P	P	1.4	TRUE
48	1547	1547	14	14	P	P	1.4	TRUE
49	1551	1551	14	14	A	A	1.4	TRUE
50	1555	1555	14	14	A	A	1.4	TRUE
51	1559	1559	15	15	A	A	1.4	TRUE
52	1563	1563	15	15	A	A	1.4	TRUE
53	1568	1568	15	15	A	A	1.3	TRUE
54	1573	1573	16	16	A	A	1.3	TRUE
55	1578	1578	16	16	A	A	1.3	TRUE
56	1584	1584	17	17	A	A	1.2	TRUE
57	1590	1590	18	18	A	A	1.1	TRUE
58	1597	1596	19	19	A	A	1.1	TRUE
59	1604	1604	20	20	A	A	1.0	TRUE
60	1613	1612	21	21	A	A	0.9	TRUE
61	1623	1622	23	23	A	A	0.8	TRUE
62	1635	1634	26	26	A	A	0.7	TRUE
63	1650	1650	30	30	A	A	0.5	TRUE
64	1671	1671	36	36	A	A	0.3	TRUE
65	1706	1706	50	50	A	A	0.1	TRUE
66	1767	1767	92	92	A	A	0.0	TRUE

Table L–6. Spring Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

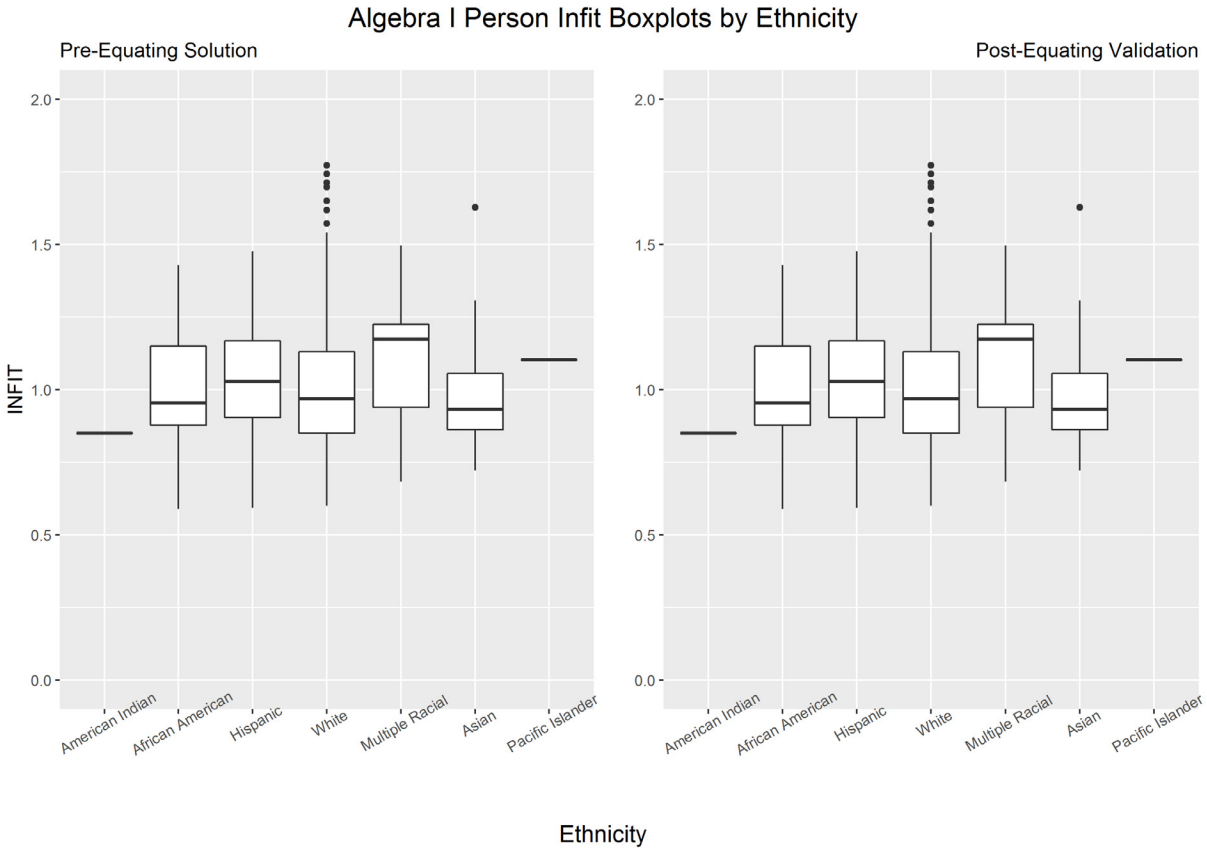
Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1207	1207	92	92	BB	BB	0.0	TRUE
1	1268	1268	51	51	BB	BB	0.0	TRUE
2	1305	1305	37	37	BB	BB	0.0	TRUE
3	1327	1327	30	30	BB	BB	0.1	TRUE
4	1343	1343	27	27	BB	BB	0.1	TRUE
5	1356	1356	24	24	BB	BB	0.2	TRUE
6	1367	1367	22	22	BB	BB	0.4	TRUE
7	1376	1376	21	21	BB	BB	0.6	TRUE
8	1384	1384	20	20	BB	BB	0.9	TRUE
9	1392	1392	19	19	BB	BB	1.0	TRUE
10	1399	1399	19	19	BB	BB	1.3	TRUE
11	1406	1406	18	18	BB	BB	1.5	TRUE
12	1412	1412	17	17	BB	BB	1.6	TRUE
13	1418	1418	17	17	BB	BB	1.5	TRUE
14	1424	1424	17	17	BB	BB	1.6	TRUE
15	1428	1426	16	16	BB	BB	B	TRUE
15	1429	1429	16	16	BB	BB	1.6	TRUE
16	1434	1434	16	16	BB	BB	1.8	TRUE
17	1440	1440	16	16	BB	BB	1.8	TRUE
18	1445	1445	16	16	B	B	1.9	TRUE
19	1449	1449	16	16	B	B	1.9	TRUE
20	1454	1454	15	15	B	B	2.0	TRUE
21	1459	1459	15	15	B	B	2.2	TRUE
22	1464	1464	15	15	B	B	2.3	TRUE
23	1468	1468	15	15	B	B	2.4	TRUE
24	1473	1473	15	15	B	B	2.5	TRUE
25	1478	1478	15	15	B	B	2.5	TRUE
26	1482	1482	15	15	B	B	2.6	TRUE
27	1487	1487	15	15	B	B	2.9	TRUE
28	1492	1492	15	15	B	B	2.9	TRUE
29	1496	1496	15	15	B	B	3.2	TRUE
30	1501	1501	16	16	P	P	3.2	TRUE
31	1506	1506	16	16	P	P	3.3	TRUE
32	1511	1511	16	16	P	P	3.5	TRUE
33	1516	1516	16	16	P	P	3.5	TRUE
34	1521	1521	16	16	P	P	3.7	TRUE
35	1527	1527	17	17	P	P	3.6	TRUE
36	1533	1533	17	17	P	P	3.7	TRUE
37	1538	1538	17	17	P	P	3.6	TRUE
37	11	1405	18	18	P	P	3.7	TRUE
38	1544	1544	18	18	P	P	3.5	TRUE
39	1551	1551	18	18	P	P	3.5	TRUE

Table L–6 (continued). Spring Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
40	1558	1558	19	19	P	P	3.3	TRUE
41	1565	1565	19	19	P	P	3.1	TRUE
42	1572	1572	20	20	P	P	2.8	TRUE
43	1580	1580	21	21	P	P	2.5	TRUE
44	1589	1589	22	22	A	A	2.2	TRUE
45	1599	1599	23	23	A	A	1.8	TRUE
46	1610	1610	24	24	A	A	1.4	TRUE
47	1623	1623	26	26	A	A	1.0	TRUE
48	1637	1637	28	28	A	A	0.7	TRUE
49	1655	1655	32	32	A	A	0.4	TRUE
50	1679	1679	38	38	A	A	0.2	TRUE
51	1717	1717	52	52	A	A	0.1	TRUE
52	1780	1780	92	92	A	A	0.0	TRUE

SUMMER

Figure L–5. Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



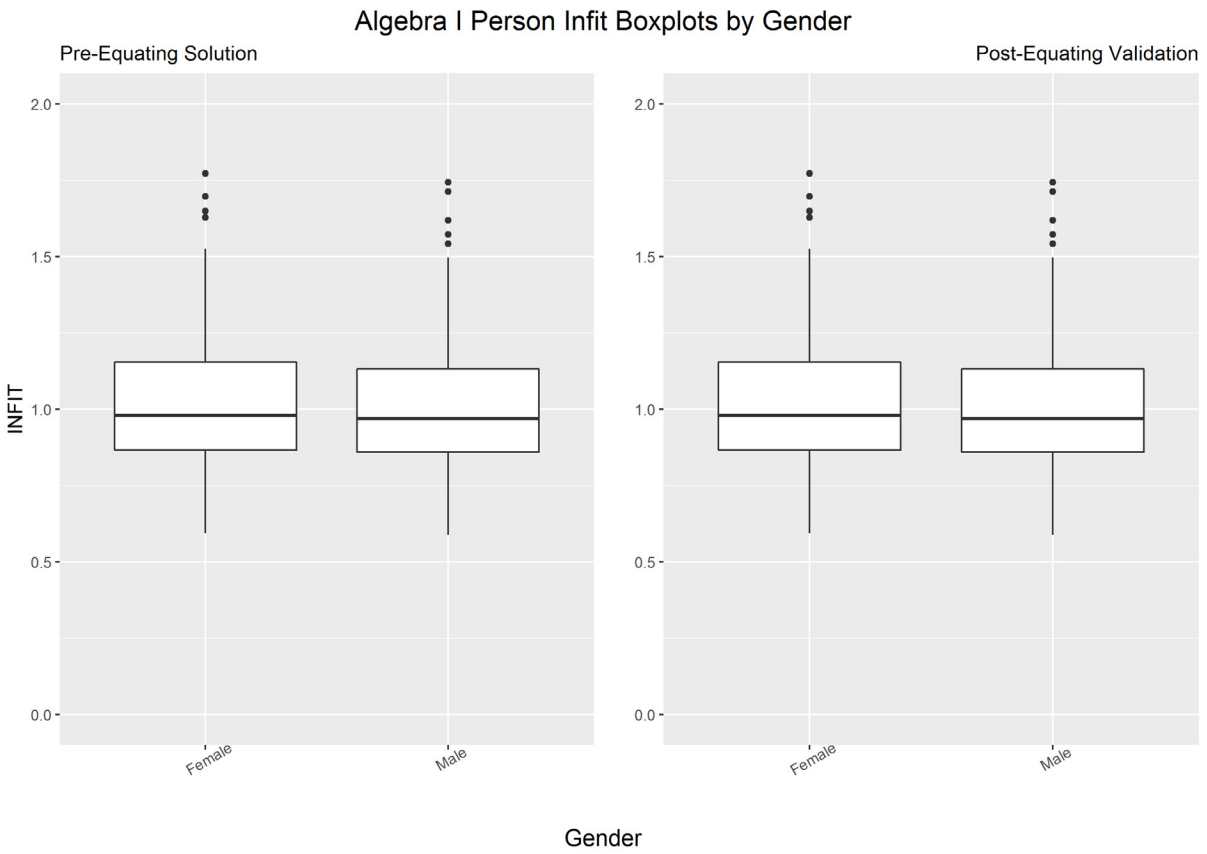
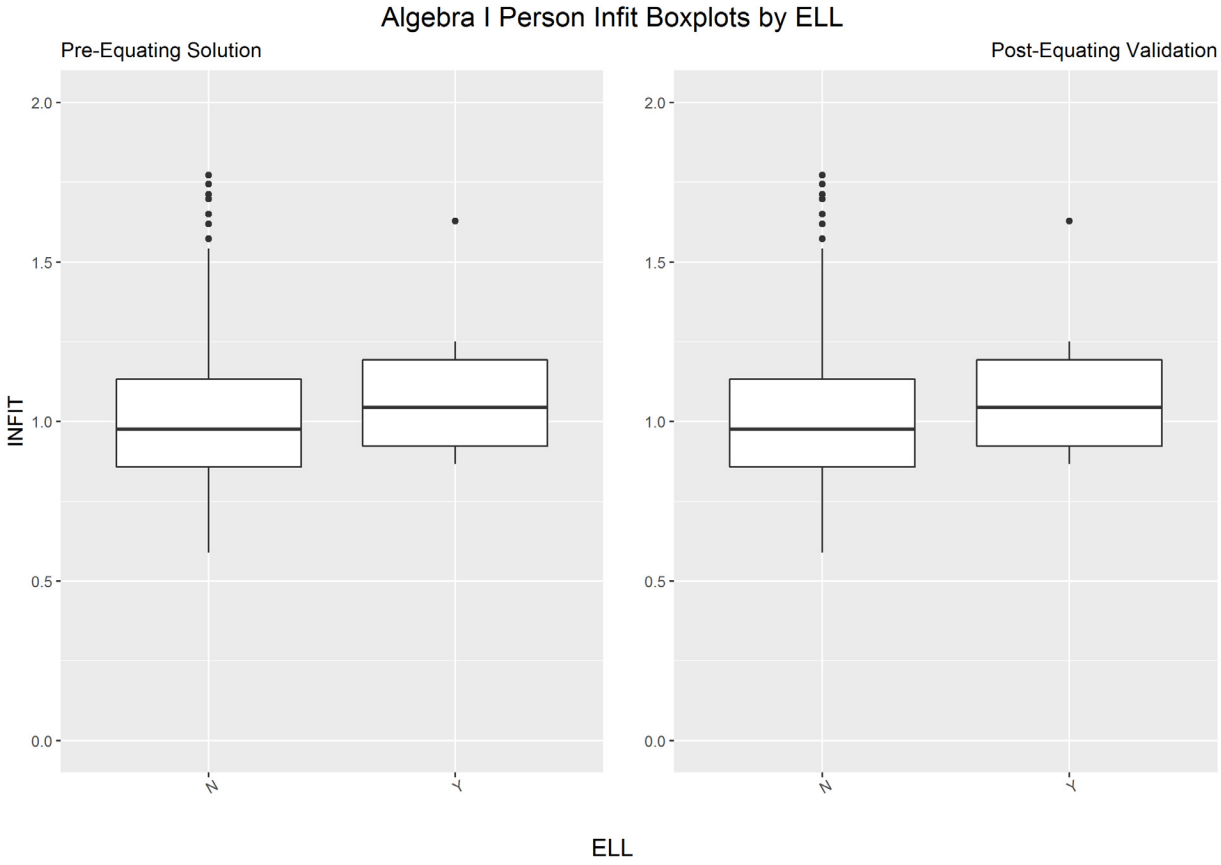


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



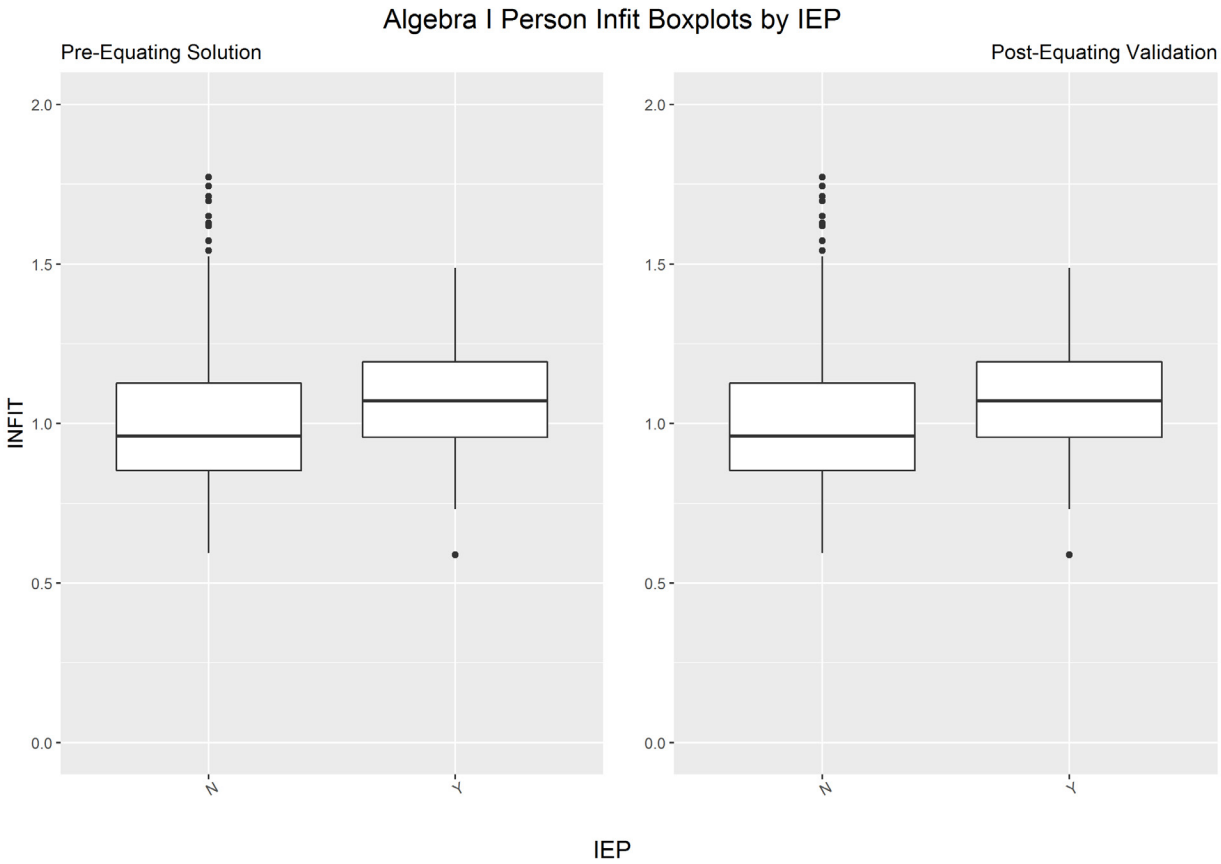
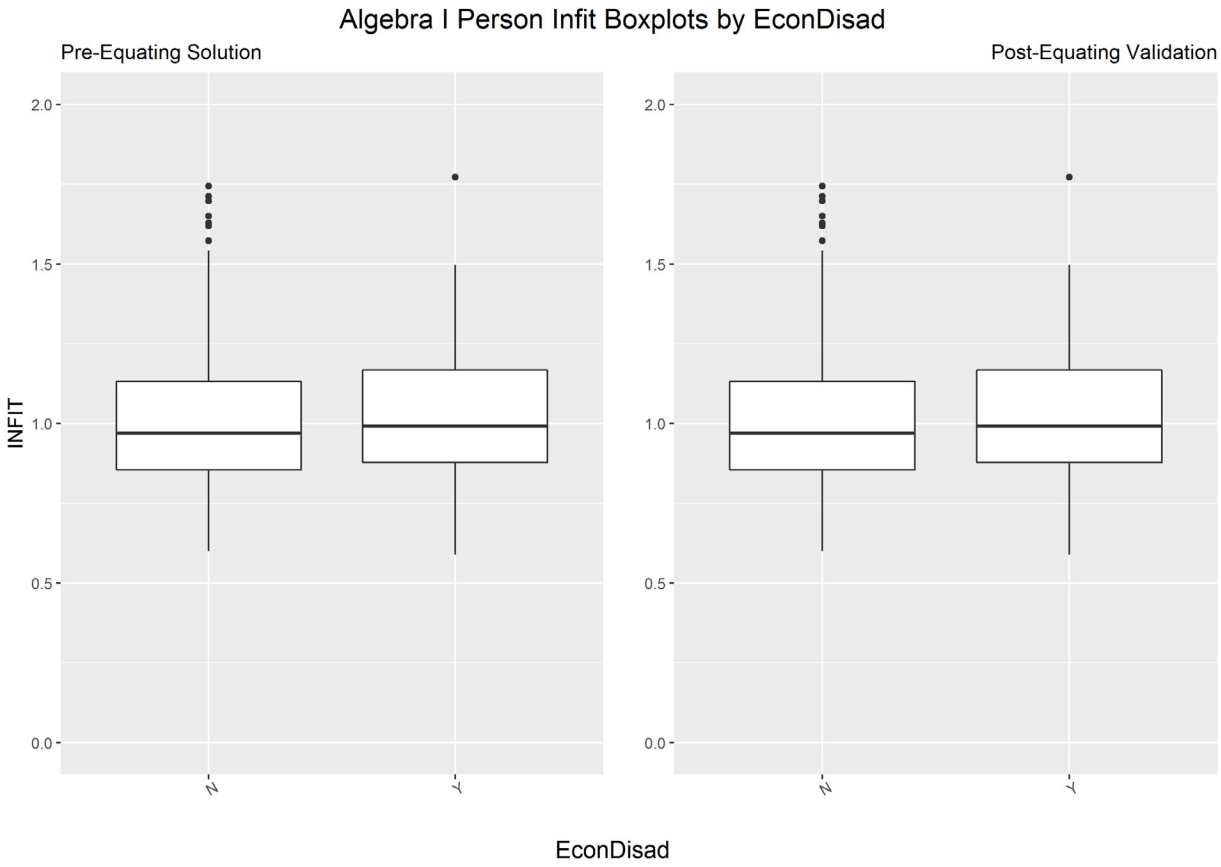


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



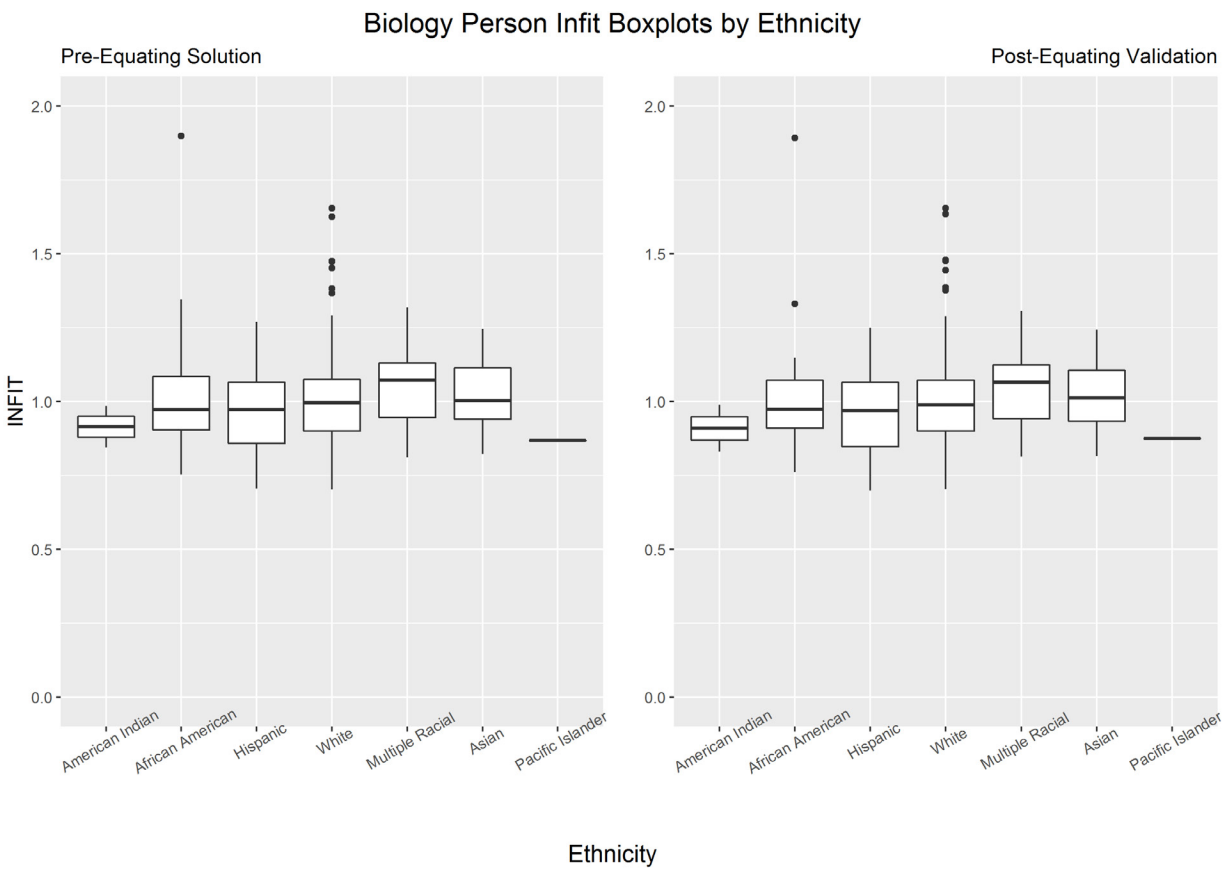
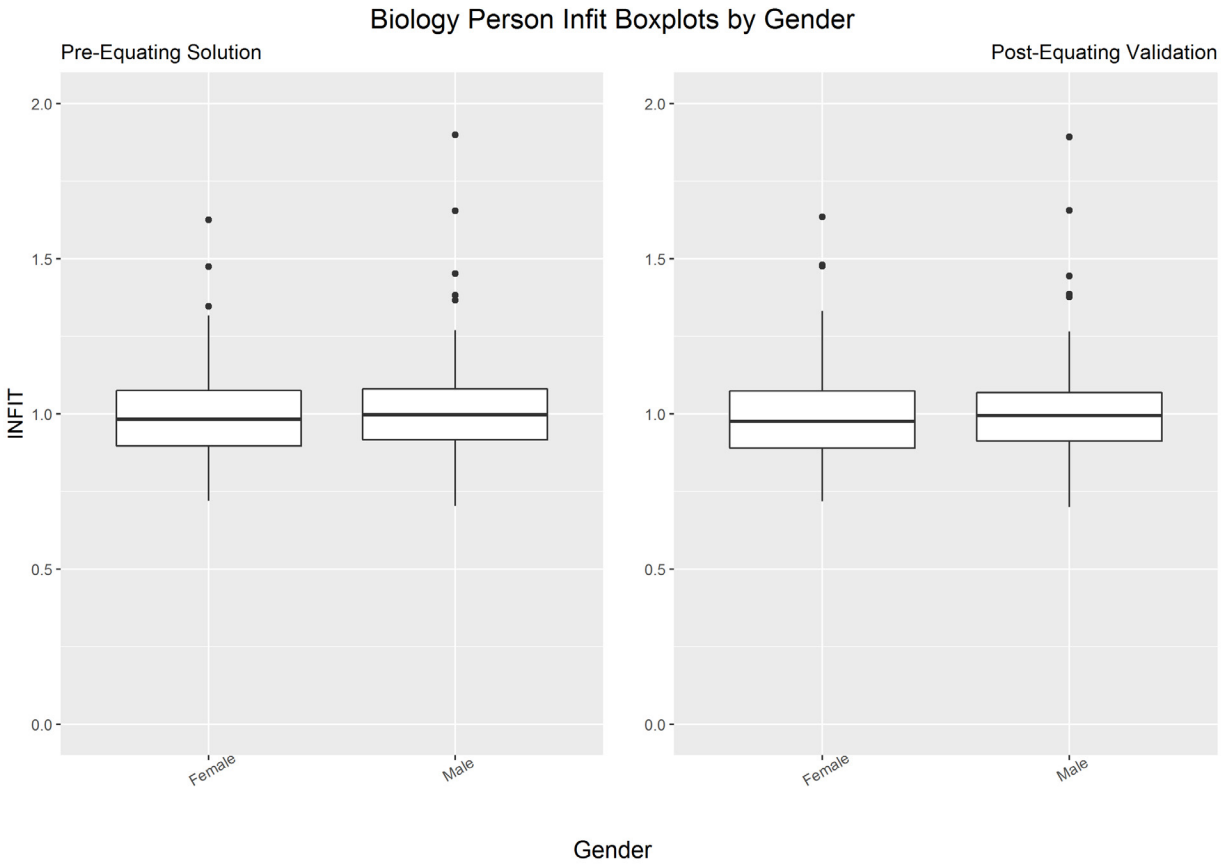


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



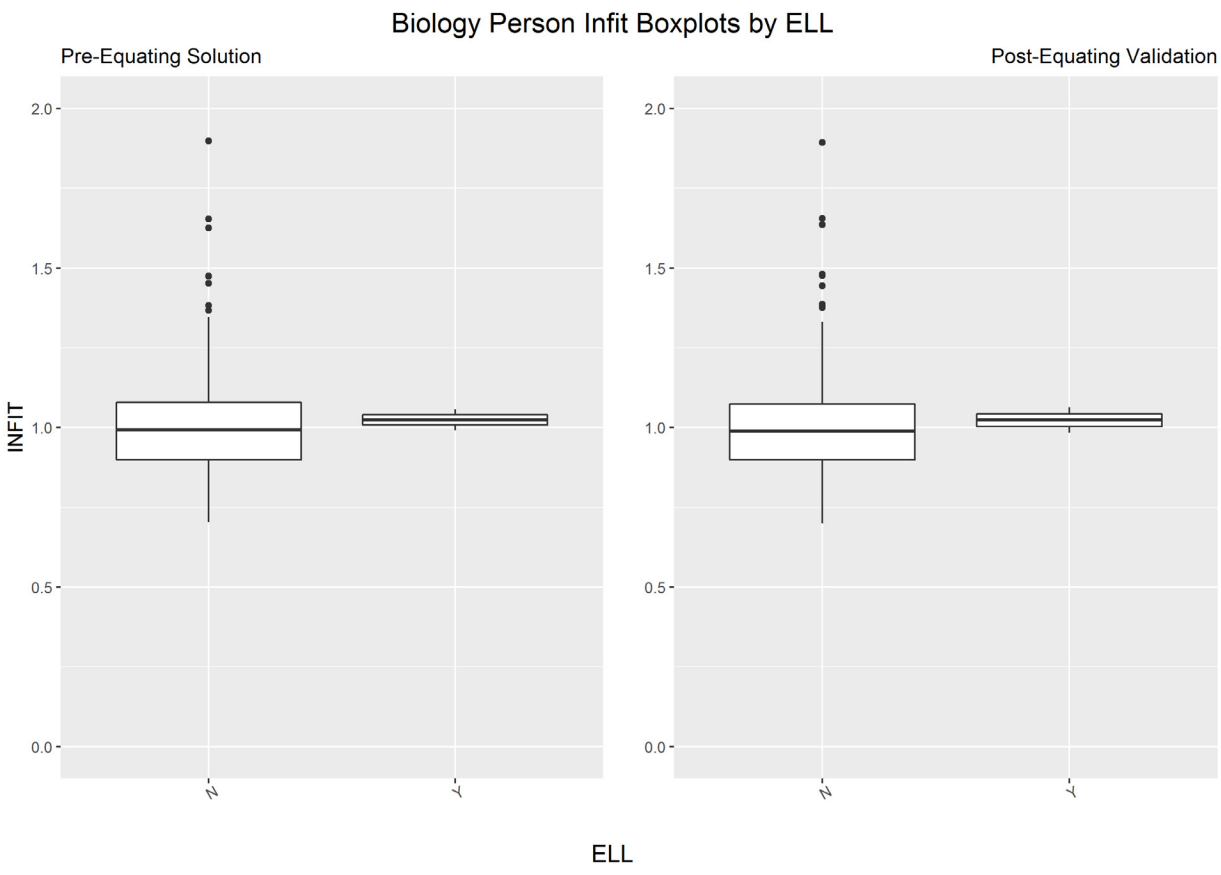
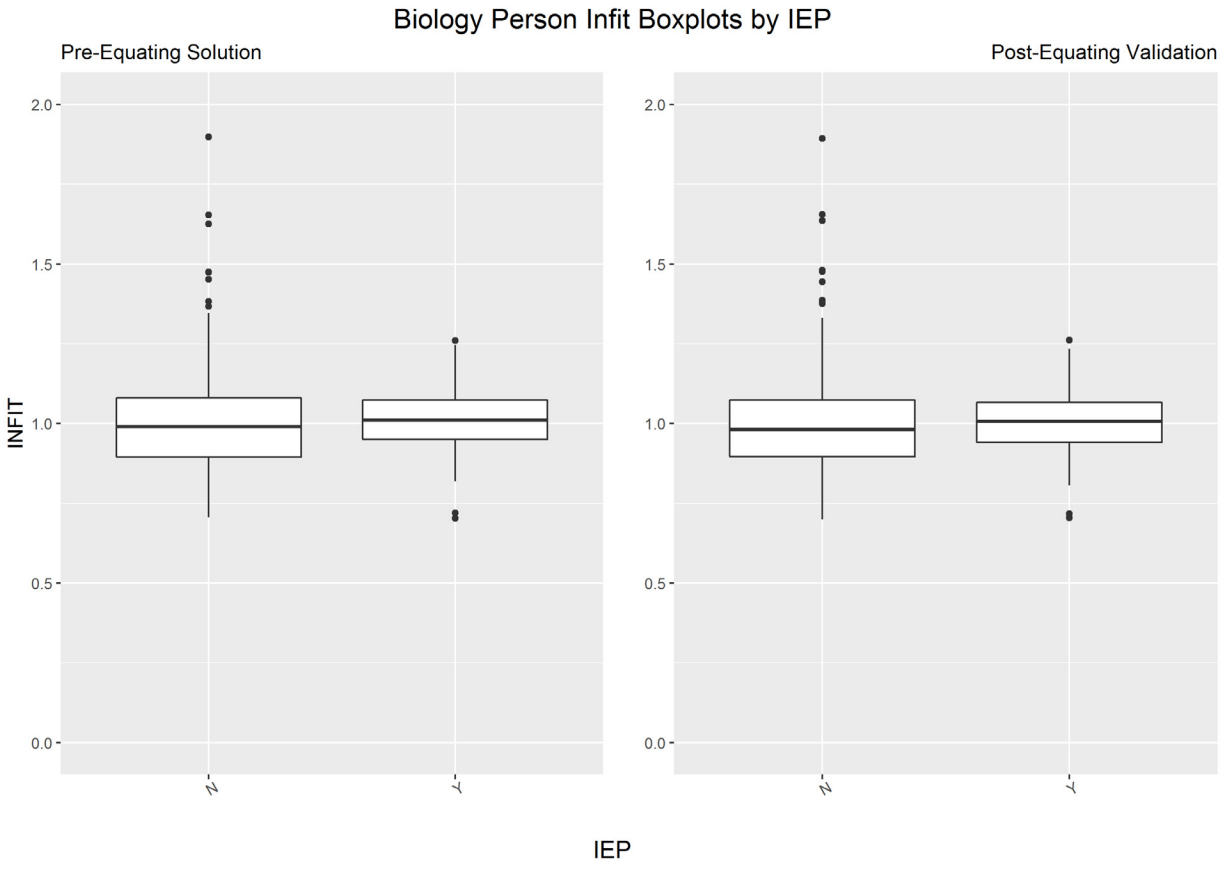


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



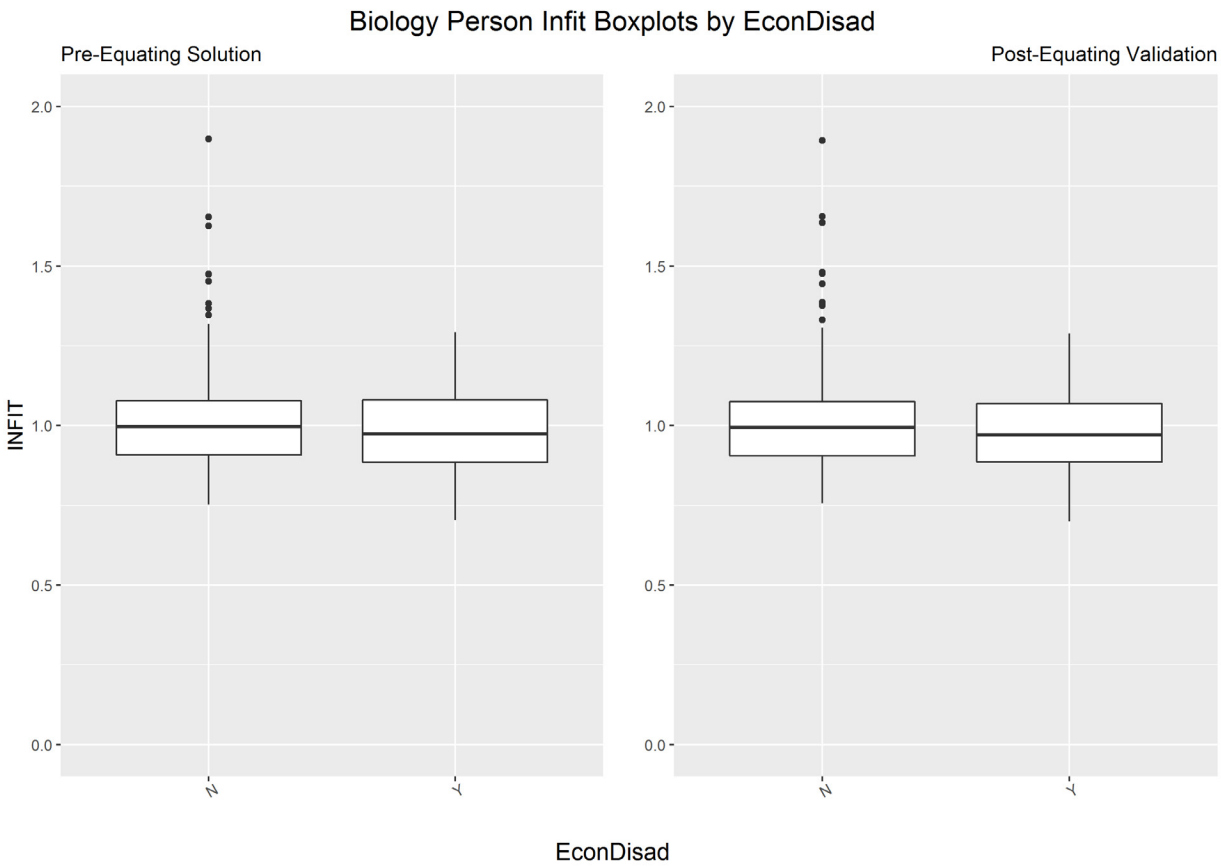
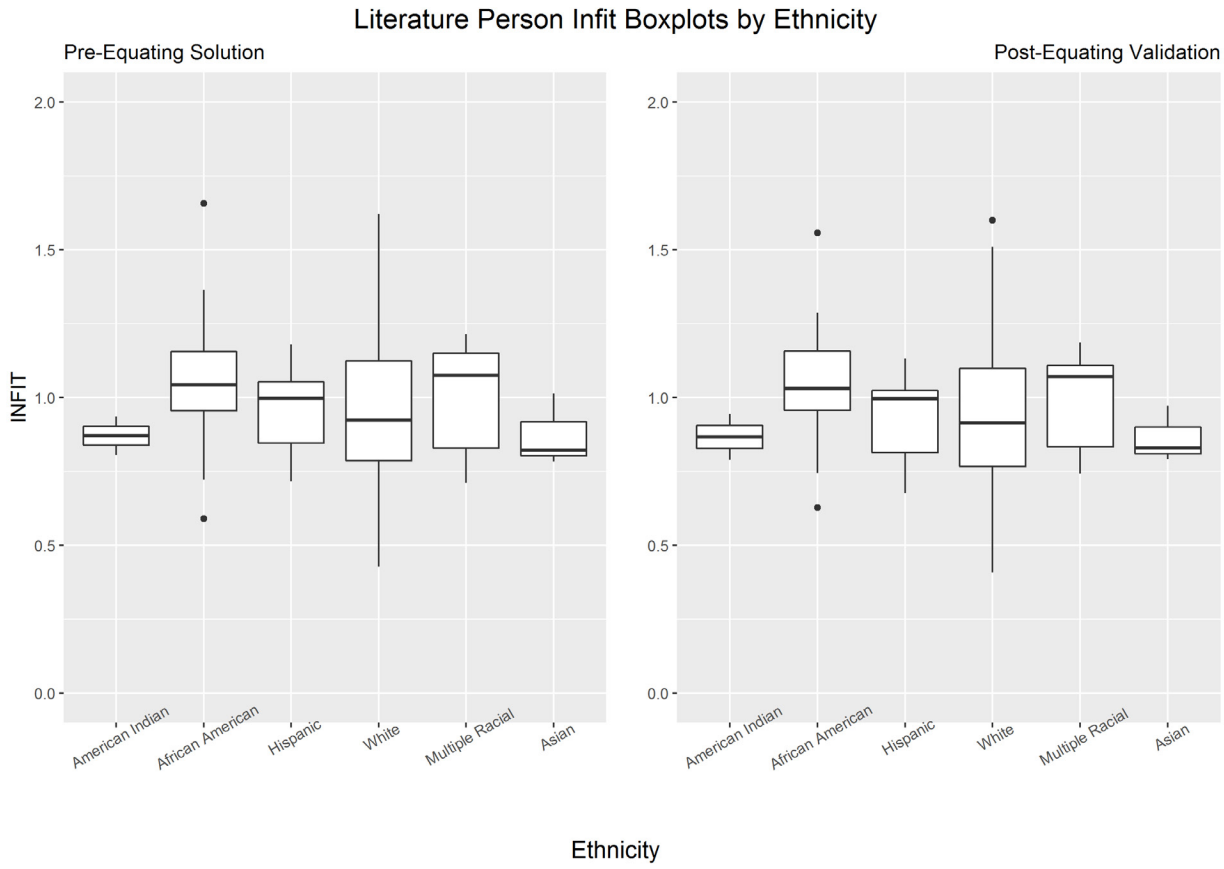


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



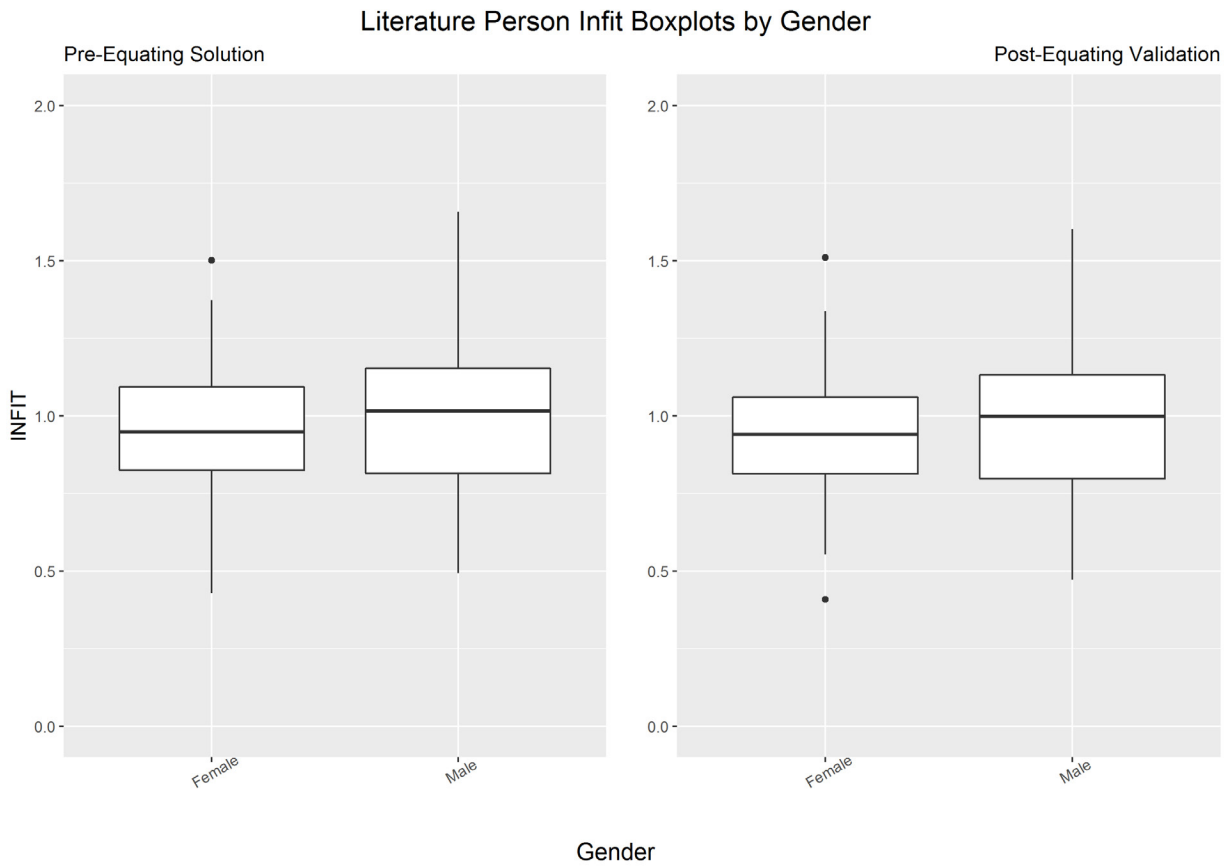
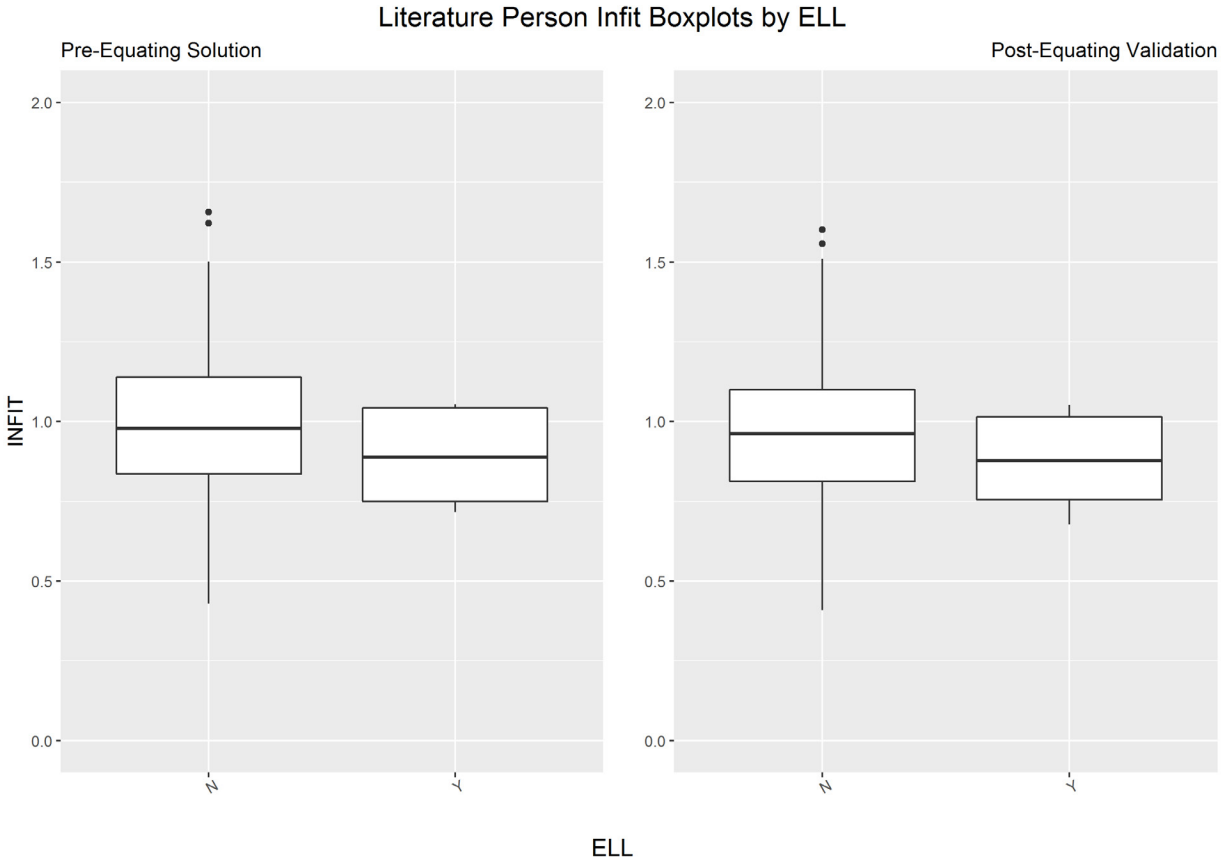


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer



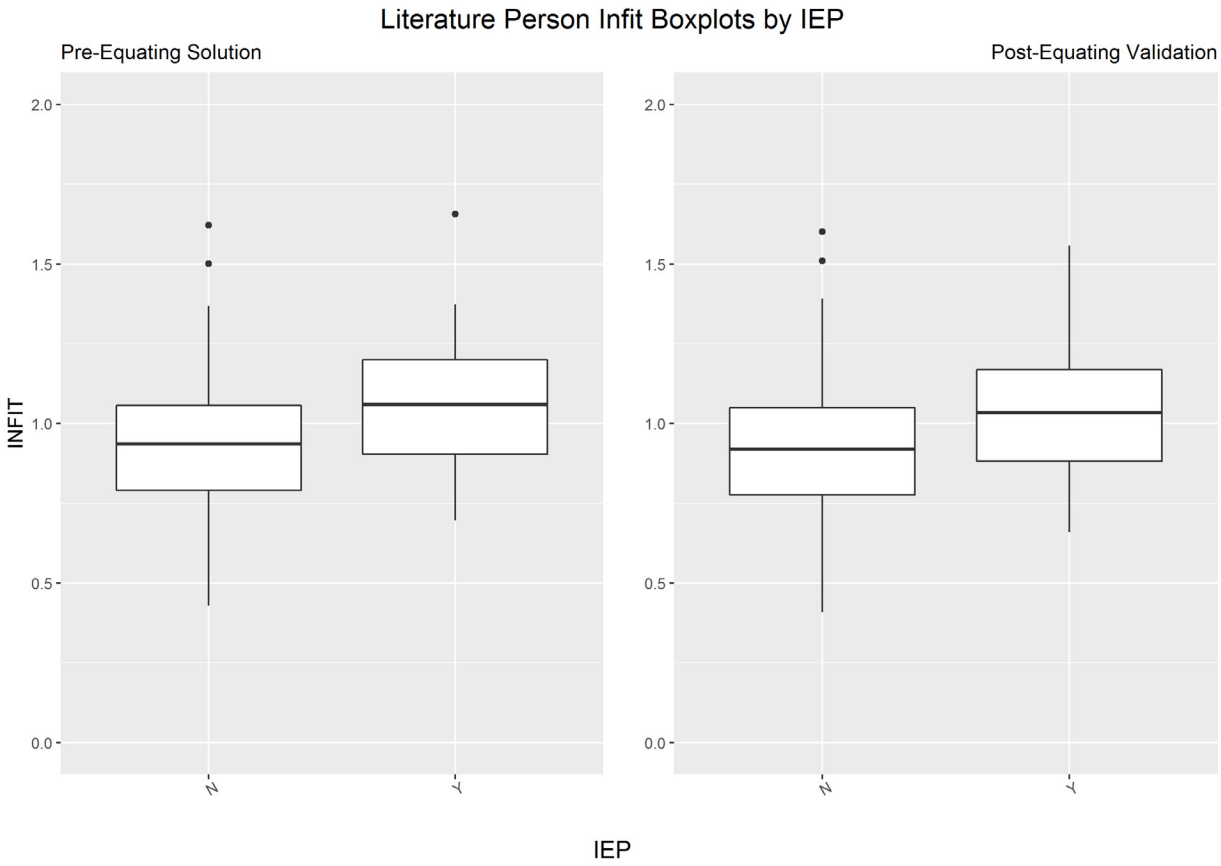


Figure L–5 (continued). Person Infit Boxplots by Content Area for Pre- and Post-Equated Solutions: Summer

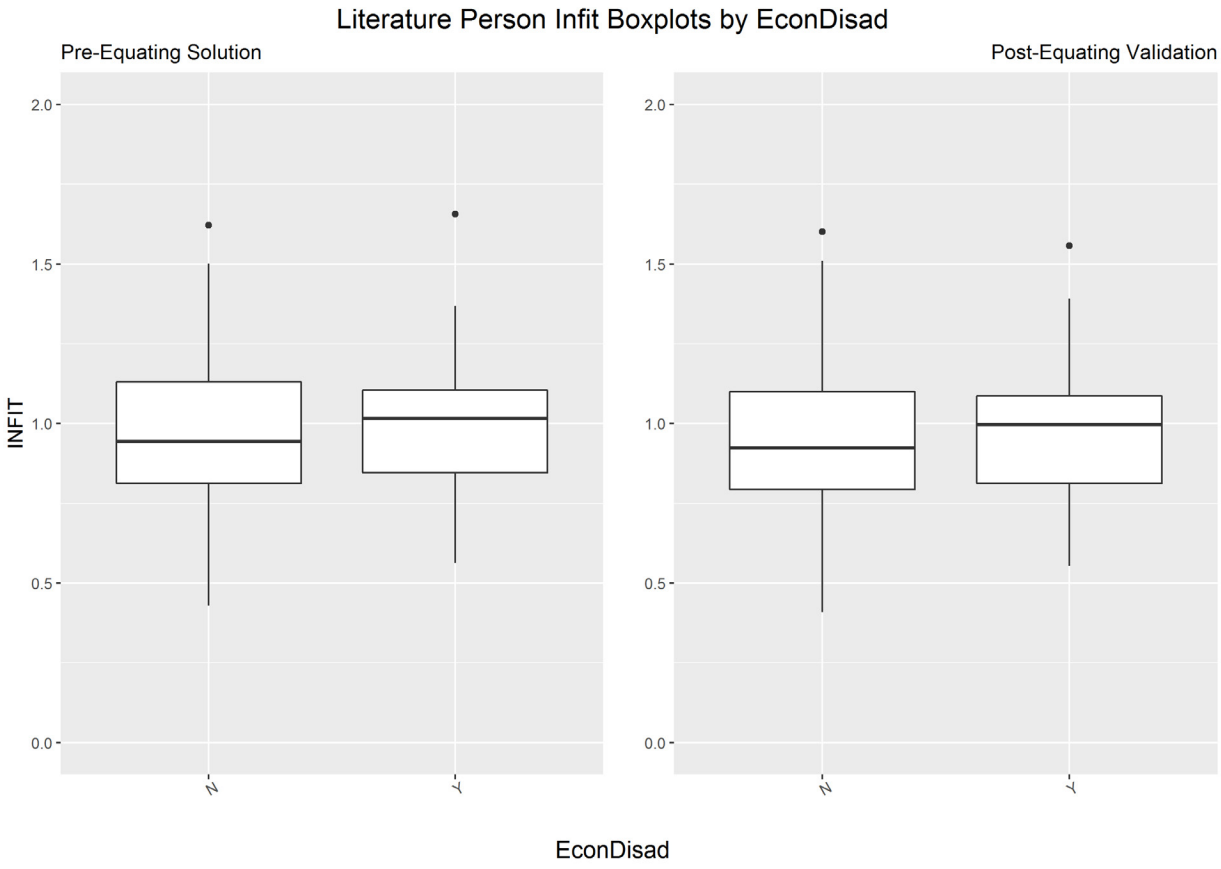
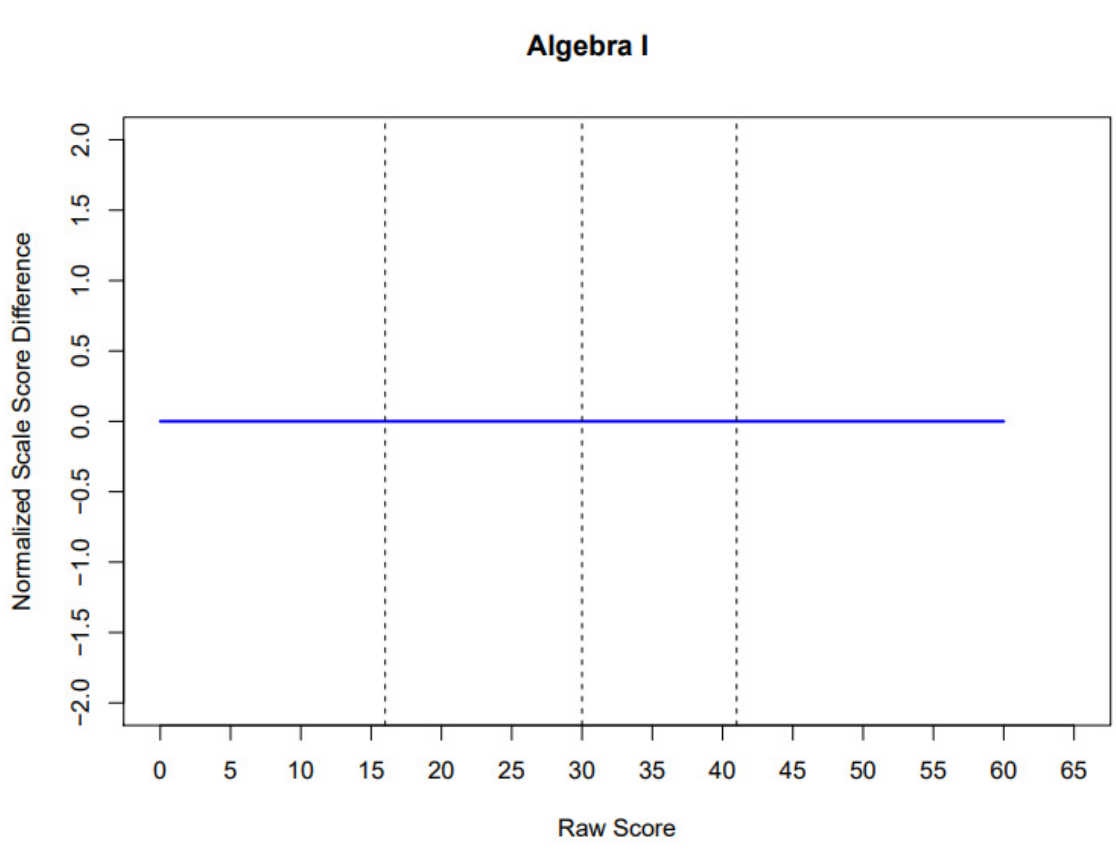


Figure L-6. Normalized Scale Score Differences by Content Area: Summer



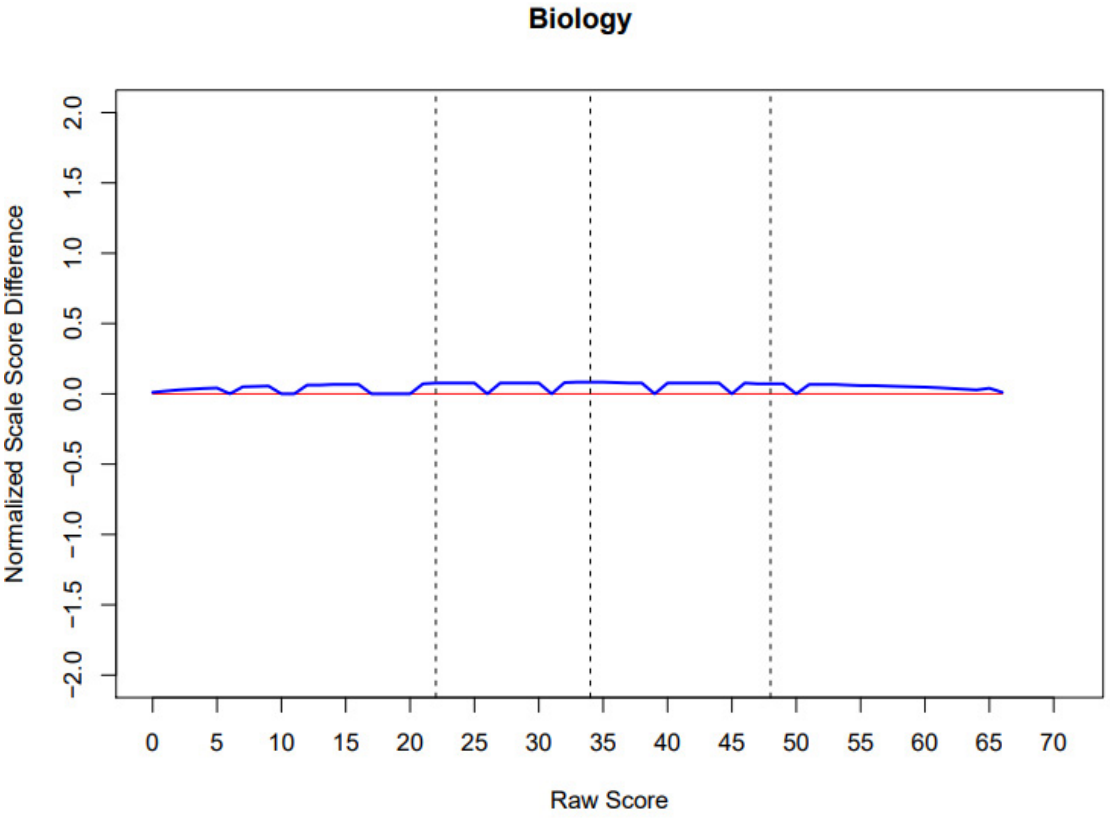


Figure L-6 (continued). Normalized Scale Score Differences by Content Area: Summer

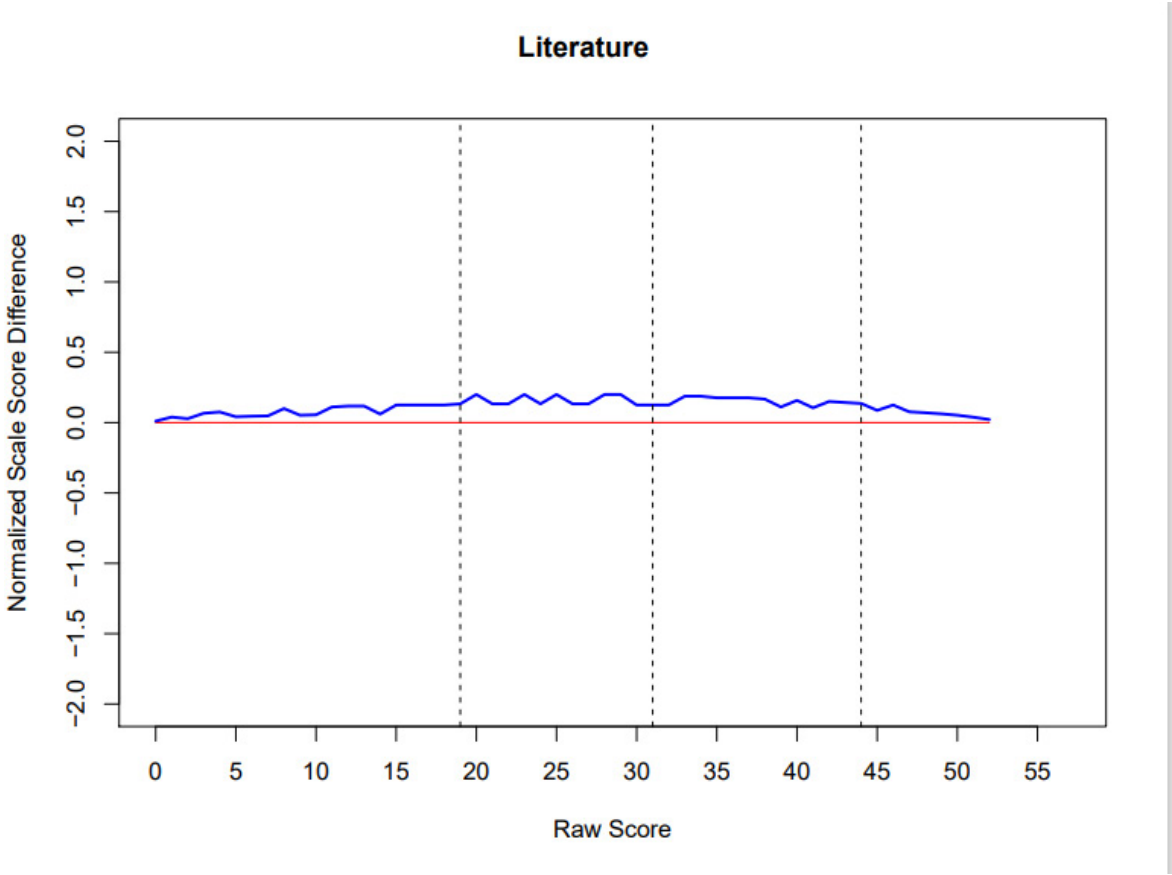


Table L-7. Summer Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1210	1210	92	92	BB	BB	0.0	TRUE
1	1272	1272	51	51	BB	BB	0.0	TRUE
2	1308	1308	37	37	BB	BB	0.0	TRUE
3	1331	1331	31	31	BB	BB	0.0	TRUE
4	1347	1347	27	27	BB	BB	0.3	TRUE
5	1361	1361	25	25	BB	BB	0.0	TRUE
6	1372	1372	23	23	BB	BB	0.9	TRUE
7	1382	1382	21	21	BB	BB	1.4	TRUE
8	1390	1390	20	20	BB	BB	1.1	TRUE
9	1398	1398	19	19	BB	BB	1.7	TRUE
10	1406	1406	19	19	BB	BB	1.4	TRUE
11	1412	1412	18	18	BB	BB	1.7	TRUE
12	1419	1419	18	18	BB	BB	1.4	TRUE
13	1425	1425	17	17	BB	BB	2.0	TRUE
14	1430	1430	17	17	BB	BB	2.3	TRUE
15	1436	1436	16	16	BB	BB	3.7	TRUE
16	1441	1441	16	16	B	B	4.8	TRUE
17	1446	1446	16	16	B	B	4.0	TRUE
18	1451	1451	15	15	B	B	3.7	TRUE
19	1456	1456	15	15	B	B	3.7	TRUE
20	1460	1460	15	15	B	B	4.8	TRUE
21	1465	1465	15	15	B	B	5.7	TRUE
22	1469	1469	15	15	B	B	4.3	TRUE
23	1473	1473	15	15	B	B	5.7	TRUE
24	1478	1478	14	14	B	B	5.1	TRUE
25	1482	1482	14	14	B	B	5.4	TRUE
26	1486	1486	14	14	B	B	5.1	TRUE
27	1490	1490	14	14	B	B	3.1	TRUE
28	1494	1494	14	14	B	B	2.3	TRUE
29	1498	1498	14	14	B	B	3.7	TRUE
30	1502	1502	14	14	P	P	2.3	TRUE
31	1506	1506	14	14	P	P	2.6	TRUE
32	1510	1510	14	14	P	P	2.3	TRUE
33	1514	1514	14	14	P	P	2.3	TRUE
34	1518	1518	14	14	P	P	1.7	TRUE
35	1522	1522	14	14	P	P	0.9	TRUE
36	1526	1526	14	14	P	P	1.4	TRUE
37	1530	1530	14	14	P	P	0.9	TRUE
38	1534	1534	15	15	P	P	0.3	TRUE
39	1539	1539	15	15	P	P	0.6	TRUE
40	1543	1543	15	15	P	P	0.3	TRUE
41	1548	1548	15	15	A	A	0.3	TRUE

Table L-7 (continued). Summer Algebra I Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1552	1552	15	15	A	A	0.6	TRUE
43	1557	1557	16	16	A	A	1.1	TRUE
44	1562	1562	16	16	A	A	1.1	TRUE
45	1567	1567	16	16	A	A	0.3	TRUE
46	1572	1572	17	17	A	A	0.0	TRUE
47	1578	1578	17	17	A	A	0.3	TRUE
48	1584	1584	18	18	A	A	0.9	TRUE
49	1590	1590	18	18	A	A	0.3	TRUE
50	1597	1597	19	19	A	A	0.0	TRUE
51	1605	1605	20	20	A	A	0.0	TRUE
52	1613	1613	21	21	A	A	0.0	TRUE
53	1622	1622	22	22	A	A	0.3	TRUE
54	1632	1632	23	23	A	A	0.0	TRUE
55	1644	1644	25	25	A	A	0.0	TRUE
56	1658	1658	28	28	A	A	0.0	TRUE
57	1676	1676	32	32	A	A	0.0	TRUE
58	1700	1700	38	38	A	A	0.3	TRUE
59	1739	1739	52	52	A	A	0.0	TRUE
60	1800	1800	93	93	A	A	0.0	TRUE

Table L-8. Summer Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1223	1222	92	92	BB	BB	0.0	TRUE
1	1284	1283	51	51	BB	BB	0.0	TRUE
2	1320	1319	36	36	BB	BB	0.0	TRUE
3	1341	1340	30	30	BB	BB	0.0	TRUE
4	1357	1356	26	26	BB	BB	0.0	TRUE
5	1369	1368	24	24	BB	BB	0.0	TRUE
6	1379	1379	22	22	BB	BB	0.0	TRUE
7	1388	1387	20	20	BB	BB	0.4	TRUE
8	1396	1395	19	19	BB	BB	0.8	TRUE
9	1403	1402	18	18	BB	BB	0.4	TRUE
10	1409	1409	18	18	BB	BB	0.4	TRUE
11	1415	1415	17	17	BB	BB	2.3	TRUE
12	1421	1420	16	16	BB	BB	1.6	TRUE
13	1426	1425	16	16	BB	BB	3.1	TRUE
14	1431	1430	15	15	BB	BB	1.6	TRUE
15	1436	1435	15	15	BB	BB	2.3	TRUE
16	1440	1439	15	15	BB	BB	2.7	TRUE
17	1444	1444	14	14	BB	BB	1.9	TRUE
18	1448	1448	14	14	BB	BB	2.3	TRUE
19	1452	1452	14	14	BB	BB	3.9	TRUE
20	1456	1456	14	14	BB	BB	4.7	TRUE
21	1460	1459	14	14	B	BB	1.9	FALSE
22	1464	1463	13	13	B	B	5.1	TRUE
23	1467	1466	13	13	B	B	3.9	TRUE
24	1471	1470	13	13	B	B	6.2	TRUE
25	1474	1473	13	13	B	B	4.7	TRUE
26	1477	1477	13	13	B	B	3.5	TRUE
27	1481	1480	13	13	B	B	3.1	TRUE
28	1484	1483	13	13	B	B	5.1	TRUE
29	1487	1486	13	13	B	B	2.7	TRUE
30	1490	1489	13	13	B	B	5.1	TRUE
31	1493	1493	13	13	B	B	3.5	TRUE
32	1497	1496	13	12	B	B	3.9	TRUE
33	1500	1499	12	12	P	B	1.6	FALSE
34	1503	1502	12	12	P	P	1.9	TRUE
35	1506	1505	12	12	P	P	1.6	TRUE
36	1509	1508	13	12	P	P	1.6	TRUE
37	1512	1511	13	13	P	P	1.9	TRUE
38	1515	1514	13	13	P	P	1.2	TRUE
39	1518	1518	13	13	P	P	1.2	TRUE
40	1522	1521	13	13	P	P	0.4	TRUE
41	1525	1524	13	13	P	P	0.4	TRUE

Table L-8 (continued). Summer Biology Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1528	1527	13	13	P	P	1.2	TRUE
43	1532	1531	13	13	P	P	0.8	TRUE
44	1535	1534	13	13	P	P	0.0	TRUE
45	1538	1538	13	13	P	P	0.0	TRUE
46	1542	1541	13	13	P	P	0.8	TRUE
47	1546	1545	14	14	P	P	0.8	TRUE
48	1550	1549	14	14	A	A	0.8	TRUE
49	1553	1552	14	14	A	A	0.0	TRUE
50	1557	1557	14	14	A	A	0.4	TRUE
51	1562	1561	15	15	A	A	1.2	TRUE
52	1566	1565	15	15	A	A	0.4	TRUE
53	1571	1570	15	15	A	A	0.4	TRUE
54	1576	1575	16	16	A	A	0.0	TRUE
55	1581	1580	17	17	A	A	0.4	TRUE
56	1587	1586	17	17	A	A	0.0	TRUE
57	1593	1592	18	18	A	A	1.2	TRUE
58	1600	1599	19	19	A	A	0.0	TRUE
59	1607	1606	20	20	A	A	0.4	TRUE
60	1616	1615	21	21	A	A	0.0	TRUE
61	1626	1625	23	23	A	A	0.8	TRUE
62	1638	1637	26	26	A	A	0.4	TRUE
63	1653	1652	30	30	A	A	0.8	TRUE
64	1674	1673	36	36	A	A	0.4	TRUE
65	1710	1708	50	50	A	A	0.4	TRUE
66	1770	1769	92	92	A	A	0.0	TRUE

Table L-9. Summer Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
0	1207	1206	92	92	BB	BB	0.0	TRUE
1	1269	1267	51	51	BB	BB	0.0	TRUE
2	1305	1304	36	36	BB	BB	0.0	TRUE
3	1327	1325	30	30	BB	BB	0.0	TRUE
4	1343	1341	27	26	BB	BB	1.2	TRUE
5	1355	1354	24	24	BB	BB	0.0	TRUE
6	1366	1365	22	22	BB	BB	1.2	TRUE
7	1375	1374	21	21	BB	BB	3.1	TRUE
8	1384	1382	20	20	BB	BB	1.2	TRUE
9	1391	1390	19	19	BB	BB	2.5	TRUE
10	1398	1397	18	18	BB	BB	3.1	TRUE
11	1405	1403	18	18	BB	BB	6.8	TRUE
12	1411	1409	17	17	BB	BB	2.5	TRUE
13	1417	1415	17	17	BB	BB	2.5	TRUE
14	1422	1421	17	16	BB	BB	3.1	TRUE
15	1428	1426	16	16	BB	BB	2.5	TRUE
16	1433	1431	16	16	BB	BB	3.7	TRUE
17	1438	1436	16	16	BB	BB	1.2	TRUE
18	1443	1441	16	16	BB	BB	3.1	TRUE
19	1448	1446	15	15	B	B	2.5	TRUE
20	1453	1450	15	15	B	B	3.1	TRUE
21	1457	1455	15	15	B	B	1.2	TRUE
22	1462	1460	15	15	B	B	1.2	TRUE
23	1467	1464	15	15	B	B	6.2	TRUE
24	1471	1469	15	15	B	B	3.7	TRUE
25	1476	1473	15	15	B	B	3.1	TRUE
26	1480	1478	15	15	B	B	3.7	TRUE
27	1485	1483	15	15	B	B	5.6	TRUE
28	1490	1487	15	15	B	B	4.3	TRUE
29	1495	1492	15	15	B	B	5.0	TRUE
30	1499	1497	16	16	B	B	3.1	TRUE
31	1504	1502	16	16	P	P	3.7	TRUE
32	1509	1507	16	16	P	P	1.2	TRUE
33	1515	1512	16	16	P	P	1.2	TRUE
34	1520	1517	16	16	P	P	1.9	TRUE
35	1525	1522	17	17	P	P	1.2	TRUE
36	1531	1528	17	17	P	P	3.1	TRUE
37	1537	1534	17	17	P	P	1.2	TRUE
38	1543	1540	18	18	P	P	1.2	TRUE
39	1549	1547	18	18	P	P	0.0	TRUE
40	1556	1553	19	19	P	P	0.6	TRUE
41	1563	1561	19	19	P	P	1.2	TRUE

Table L-9 (continued). Summer Literature Raw-to-Scaled Score Comparison for Pre-Equated and Post-Equated Solutions

Raw Score	Pre-SS	Post-SS	Pre-SEM	Post-SEM	Pre-PL	Post-PL	Proportion (%)	Same PL
42	1571	1568	20	20	P	P	0.0	TRUE
43	1580	1577	21	21	P	P	1.2	TRUE
44	1589	1586	22	22	A	A	0.6	TRUE
45	1598	1596	23	23	A	A	0.6	TRUE
46	1610	1607	24	24	A	A	0.0	TRUE
47	1622	1620	26	26	A	A	0.0	TRUE
48	1637	1635	28	29	A	A	0.0	TRUE
49	1655	1653	32	32	A	A	0.0	TRUE
50	1679	1677	38	38	A	A	0.0	TRUE
51	1718	1716	52	52	A	A	0.0	TRUE
52	1781	1779	92	92	A	A	0.0	TRUE

APPENDIX M: RELIABILITIES

Table M–1. Reliabilities

Column Heading	Definition
Level	Total test or module level
Group	Student group: all students or subgroup
Pts.	Max points possible
Len.	Test length
N	Number of students
Mean	Mean of raw score
SD	Standard deviation of raw score
r	Reliability coefficient: Cronbach's alpha
SEM	Standard error of measurement

Note. "DNR" in the tables below represents "Do Not Report," which occurs when the *N* count was too small to report.

Table M–2. Winter: Algebra I Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	60	42	36950	21.93	10.12	0.89	3.38
	Module 1	All	30	21	36950	10.94	5.26	0.80	2.34
	Module 2	All	30	21	36950	10.99	5.44	0.80	2.44
Gender	Total	Female	60	42	18015	22.17	10.09	0.89	3.40
		Male	60	42	18929	21.72	10.14	0.89	3.36
	Module 1	Female	30	21	18015	11.18	5.26	0.80	2.37
		Male	30	21	18929	10.72	5.24	0.81	2.30
	Module 2	Female	30	21	18015	10.99	5.41	0.80	2.44
		Male	30	21	18929	11.00	5.46	0.80	2.44
Ethnicity	Total	African American	60	42	4626	16.48	8.06	0.85	3.15
		American Indian	60	42	61	21.61	11.24	0.91	3.40
		Asian	60	42	1267	28.89	13.61	0.93	3.60
		Hispanic	60	42	4704	18.63	8.84	0.86	3.26
		Multi-racial	60	42	1472	21.39	10.09	0.89	3.35
		Native Hawaiian/ Pacific Islander	60	42	37	24.16	11.06	0.91	3.38
		White	60	42	24776	23.26	9.89	0.88	3.41
	Module 1	African American	30	21	4626	8.30	4.35	0.75	2.18
		American Indian	30	21	61	10.80	5.83	0.83	2.39
		Asian	30	21	1267	14.51	7.03	0.87	2.55
		Hispanic	30	21	4704	9.34	4.71	0.77	2.25
		Multi-racial	30	21	1472	10.73	5.32	0.81	2.31
		Native Hawaiian/ Pacific Islander	30	21	37	12.05	5.76	0.83	2.39
		White	30	21	24776	11.57	5.13	0.79	2.36
	Module 2	African American	30	21	4626	8.18	4.34	0.73	2.27
		American Indian	30	21	61	10.80	6.10	0.85	2.40
		Asian	30	21	1267	14.38	7.03	0.87	2.54
		Hispanic	30	21	4704	9.29	4.77	0.76	2.35
		Multi-racial	30	21	1472	10.65	5.32	0.79	2.42
		Native Hawaiian/ Pacific Islander	30	21	37	12.11	5.85	0.83	2.38
		White	30	21	24776	11.69	5.37	0.79	2.46
EL	Total	All	60	42	1429	14.33	7.11	0.82	3.06
	Module 1	All	30	21	1429	7.19	4.02	0.72	2.11
	Module 2	All	30	21	1429	7.14	3.79	0.66	2.20
IEP	Total	All	60	42	6334	15.38	7.43	0.83	3.11
	Module 1	All	30	21	6334	7.64	3.98	0.71	2.14
	Module 2	All	30	21	6334	7.74	4.12	0.70	2.25
ED	Total	All	60	42	16011	18.93	8.79	0.86	3.26
	Module 1	All	30	21	16011	9.46	4.65	0.77	2.25
	Module 2	All	30	21	16011	9.46	4.77	0.76	2.36

Table M–3. Winter: Biology Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	66	54	31027	27.90	11.26	0.88	3.83
	Module 1	All	33	27	31027	13.54	6.28	0.82	2.67
	Module 2	All	33	27	31027	14.36	5.66	0.77	2.74
Gender	Total	Female	66	54	14989	28.28	10.94	0.88	3.83
		Male	66	54	16035	27.55	11.54	0.89	3.82
	Module 1	Female	33	27	14989	13.69	6.13	0.81	2.68
		Male	33	27	16035	13.40	6.42	0.83	2.67
	Module 2	Female	33	27	14989	14.59	5.51	0.75	2.74
		Male	33	27	16035	14.16	5.78	0.78	2.73
Ethnicity	Total	African American	66	54	3881	22.73	8.97	0.83	3.74
		American Indian	66	54	52	27.21	11.04	0.88	3.84
		Asian	66	54	919	33.75	14.22	0.93	3.82
		Hispanic	66	54	4059	24.03	9.55	0.84	3.79
		Multi-racial	66	54	1147	27.23	11.68	0.89	3.82
		Native Hawaiian/ Pacific Islander	66	54	30	27.80	10.30	0.86	3.82
		White	66	54	20936	29.39	11.27	0.88	3.83
	Module 1	African American	33	27	3881	10.93	5.03	0.74	2.57
		American Indian	33	27	52	13.44	6.15	0.81	2.71
		Asian	33	27	919	16.79	7.95	0.88	2.70
		Hispanic	33	27	4059	11.52	5.33	0.76	2.62
		Multi-racial	33	27	1147	13.16	6.49	0.83	2.66
		Native Hawaiian/ Pacific Islander	33	27	30	14.07	6.34	0.83	2.65
		White	33	27	20936	14.29	6.32	0.82	2.68
	Module 2	African American	33	27	3881	11.80	4.77	0.68	2.71
		American Indian	33	27	52	13.77	5.67	0.77	2.70
		Asian	33	27	919	16.96	6.81	0.84	2.70
		Hispanic	33	27	4059	12.52	4.99	0.70	2.73
		Multi-racial	33	27	1147	14.07	5.81	0.78	2.74
		Native Hawaiian/ Pacific Islander	33	27	30	13.73	4.83	0.68	2.73
		White	33	27	20936	15.10	5.63	0.77	2.72
EL	Total	All	66	54	1175	18.67	6.44	0.69	3.59
	Module 1	All	33	27	1175	8.99	3.67	0.55	2.46
	Module 2	All	33	27	1175	9.67	3.73	0.51	2.61
IEP	Total	All	66	54	6013	21.76	8.43	0.81	3.72
	Module 1	All	33	27	6013	10.40	4.70	0.70	2.57
	Module 2	All	33	27	6013	11.36	4.56	0.65	2.69
ED	Total	All	66	54	13495	24.67	9.50	0.84	3.80
	Module 1	All	33	27	13495	11.83	5.27	0.75	2.63
	Module 2	All	33	27	13495	12.84	5.01	0.70	2.74

Table M–4. Winter: Literature Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	52	40	30416	27.26	10.35	0.91	3.13
	Module 1	All	26	20	30416	13.63	5.33	0.83	2.20
	Module 2	All	26	20	30416	13.63	5.54	0.84	2.22
Gender	Total	Female	52	40	13930	29.11	9.99	0.90	3.11
		Male	52	40	16479	25.69	10.39	0.91	3.11
	Module 1	Female	26	20	13930	14.56	5.16	0.82	2.18
		Male	26	20	16479	12.84	5.34	0.83	2.18
	Module 2	Female	26	20	13930	14.55	5.37	0.83	2.21
		Male	26	20	16479	12.86	5.57	0.84	2.21
Ethnicity	Total	African American	52	40	4034	23.02	9.43	0.89	3.17
		American Indian	52	40	51	26.31	8.76	0.87	3.19
		Asian	52	40	833	31.84	10.61	0.92	3.01
		Hispanic	52	40	4239	24.15	9.91	0.90	3.15
		Multi-racial	52	40	1118	27.05	10.19	0.91	3.14
		Native Hawaiian/ Pacific Islander	52	40	28	27.11	9.38	0.89	3.15
		White	52	40	20106	28.59	10.22	0.91	3.11
	Module 1	African American	26	20	4034	11.66	4.99	0.80	2.22
		American Indian	26	20	51	13.53	4.31	0.73	2.23
		Asian	26	20	833	15.81	5.49	0.85	2.13
		Hispanic	26	20	4239	12.04	5.19	0.82	2.21
		Multi-racial	26	20	1118	13.59	5.35	0.83	2.20
		Native Hawaiian/ Pacific Islander	26	20	28	13.54	4.96	0.80	2.22
		White	26	20	20106	14.27	5.24	0.83	2.18
	Module 2	African American	26	20	4034	11.36	5.05	0.80	2.26
		American Indian	26	20	51	12.78	5.35	0.82	2.24
		Asian	26	20	833	16.03	5.55	0.85	2.12
		Hispanic	26	20	4239	12.11	5.29	0.82	2.23
		Multi-racial	26	20	1118	13.46	5.41	0.83	2.23
		Native Hawaiian/ Pacific Islander	26	20	28	13.57	4.89	0.79	2.24
		White	26	20	20106	14.32	5.49	0.84	2.21
EL	Total	All	52	40	1107	17.55	7.22	0.82	3.10
	Module 1	All	26	20	1107	8.65	4.09	0.72	2.18
	Module 2	All	26	20	1107	8.90	3.85	0.67	2.20
IEP	Total	All	52	40	6215	19.44	8.46	0.86	3.12
	Module 1	All	26	20	6215	9.85	4.59	0.77	2.19
	Module 2	All	26	20	6215	9.59	4.53	0.76	2.21
ED	Total	All	52	40	13498	24.25	9.75	0.90	3.15
	Module 1	All	26	20	13498	12.21	5.11	0.81	2.21
	Module 2	All	26	20	13498	12.04	5.22	0.82	2.24

Table M–5. Spring: Algebra Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	60	42	158934	24.21	12.09	0.92	3.49
	Module 1	All	30	21	158934	12.21	6.49	0.85	2.50
	Module 2	All	30	21	158934	12.00	6.07	0.84	2.43
Gender	Total	Female	60	42	77703	24.32	11.96	0.91	3.49
		Male	60	42	81128	24.11	12.21	0.92	3.48
	Module 1	Female	30	21	77703	12.35	6.51	0.85	2.51
		Male	30	21	81128	12.08	6.48	0.85	2.49
	Module 2	Female	30	21	77703	11.97	5.93	0.83	2.42
		Male	30	21	8128	12.03	6.20	0.85	2.43
Ethnicity	Total	African American	60	42	24631	16.65	8.61	0.86	3.19
		American Indian	60	42	300	21.57	11.06	0.91	3.39
		Asian	60	42	6950	33.20	13.90	0.93	3.59
		Hispanic	60	42	23354	18.64	9.80	0.89	3.28
		Multi-racial	60	42	6615	23.08	11.60	0.91	3.46
		Native Hawaiian/ Pacific Islander	60	42	136	24.52	12.82	0.92	3.51
		White	60	42	96844	26.92	11.77	0.91	3.52
	Module 1	African American	30	21	24631	8.31	4.84	0.77	2.30
		American Indian	30	21	300	10.77	5.91	0.83	2.46
		Asian	30	21	6950	16.94	7.37	0.88	2.54
		Hispanic	30	21	23354	9.31	5.41	0.81	2.36
		Multi-racial	30	21	6615	11.67	6.24	0.84	2.48
		Native Hawaiian/ Pacific Islander	30	21	136	12.57	6.90	0.87	2.53
		White	30	21	96844	13.61	6.32	0.84	2.51
	Module 2	African American	30	21	24631	8.34	4.35	0.74	2.21
		American Indian	30	21	300	10.80	5.63	0.83	2.34
		Asian	30	21	6950	16.26	6.95	0.87	2.53
		Hispanic	30	21	23354	9.32	4.93	0.79	2.28
		Multi-racial	30	21	6615	11.41	5.86	0.83	2.41
		Native Hawaiian/ Pacific Islander	30	21	136	11.96	6.35	0.85	2.44
		White	30	21	96844	13.31	5.96	0.83	2.46
EL	Total	All	60	42	7789	14.63	7.82	0.85	3.05
	Module 1	All	30	21	7789	7.19	4.45	0.76	2.18
	Module 2	All	30	21	7789	7.44	3.98	0.71	2.13
IEP	Total	All	60	42	26600	15.85	8.47	0.86	3.15
	Module 1	All	30	21	26600	7.78	4.64	0.76	2.26
	Module 2	All	30	21	26600	8.06	4.40	0.75	2.20
ED	Total	All	60	42	70053	19.78	10.21	0.89	3.34
	Module 1	All	30	21	70053	9.92	5.60	0.82	2.41
	Module 2	All	30	21	70053	9.87	5.15	0.80	2.31

Table M–6. Spring: Biology Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	66	54	137405	31.51	14.64	0.93	3.77
	Module 1	All	33	27	137405	15.77	7.30	0.87	2.65
	Module 2	All	33	27	137405	15.74	7.84	0.88	2.69
Gender	Total	Female	66	54	67417	31.99	14.26	0.93	3.77
		Male	66	54	69958	31.05	14.99	0.94	3.76
	Module 1	Female	33	27	67417	15.94	7.05	0.86	2.65
		Male	33	27	69958	15.61	7.52	0.88	2.64
	Module 2	Female	33	27	67417	16.05	7.72	0.88	2.69
		Male	33	27	69958	15.44	7.94	0.89	2.68
Ethnicity	Total	African American	66	54	20156	22.80	11.01	0.89	3.69
		American Indian	66	54	228	28.86	13.28	0.92	3.80
		Asian	66	54	5864	41.13	16.04	0.95	3.63
		Hispanic	66	54	18957	24.60	12.15	0.91	3.72
		Multi-racial	66	54	5682	29.93	14.37	0.93	3.76
		Native Hawaiian/ Pacific Islander	66	54	140	34.22	15.15	0.94	3.74
		White	66	54	86347	34.52	14.32	0.93	3.76
	Module 1	African American	33	27	20156	11.62	5.60	0.79	2.59
		American Indian	33	27	228	14.48	6.44	0.83	2.69
		Asian	33	27	5864	20.56	7.99	0.90	2.54
		Hispanic	33	27	18957	12.47	6.12	0.82	2.61
		Multi-racial	33	27	5682	14.94	7.18	0.86	2.64
		Native Hawaiian/ Pacific Islander	33	27	140	17.15	7.39	0.88	2.60
		White	33	27	86347	17.20	7.15	0.86	2.65
	Module 2	African American	33	27	20156	11.19	6.05	0.81	2.62
		American Indian	33	27	228	14.38	7.31	0.86	2.69
		Asian	33	27	5864	20.57	8.45	0.91	2.60
		Hispanic	33	27	18957	12.13	6.61	0.84	2.65
		Multi-racial	33	27	5682	14.99	7.70	0.88	2.67
		Native Hawaiian/ Pacific Islander	33	27	140	17.07	8.23	0.89	2.68
		White	33	27	86347	17.31	7.68	0.88	2.67
EL	Total	All	66	54	6069	18.58	8.75	0.84	3.53
	Module 1	All	33	27	6069	9.74	4.73	0.72	2.51
	Module 2	All	33	27	6069	8.84	4.74	0.73	2.47
IEP	Total	All	66	54	24572	21.43	10.78	0.89	3.64
	Module 1	All	33	27	24572	11.00	5.52	0.79	2.56
	Module 2	All	33	27	24572	10.44	5.89	0.81	2.58
ED	Total	All	66	54	59262	25.97	12.52	0.91	3.75
	Module 1	All	33	27	59262	13.12	6.29	0.83	2.63
	Module 2	All	33	27	59262	12.86	6.81	0.85	2.67

Table M–7. Spring: Literature Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	52	40	128707	29.63	10.49	0.91	3.07
	Module 1	All	26	20	128707	15.07	5.31	0.84	2.13
	Module 2	All	26	20	128707	14.56	5.64	0.85	2.20
Gender	Total	Female	52	40	62014	31.25	10.03	0.91	3.04
		Male	52	40	66652	28.12	10.68	0.92	3.05
	Module 1	Female	26	20	62014	15.92	5.09	0.83	2.11
		Male	26	20	66652	14.29	5.39	0.85	2.12
	Module 2	Female	26	20	62014	15.33	5.42	0.84	2.19
		Male	26	20	66652	13.84	5.75	0.85	2.19
Ethnicity	Total	African American	52	40	19131	23.69	9.64	0.89	3.14
		American Indian	52	40	212	27.25	10.48	0.91	3.12
		Asian	52	40	5581	35.00	9.91	0.92	2.89
		Hispanic	52	40	16512	24.76	10.25	0.91	3.11
		Multi-racial	52	40	5166	28.94	10.39	0.91	3.08
		Native Hawaiian/ Pacific Islander	52	40	120	30.88	10.68	0.92	3.09
		White	52	40	81949	31.68	9.83	0.91	3.01
	Module 1	African American	26	20	19131	12.30	5.00	0.81	2.17
		American Indian	26	20	212	14.04	5.32	0.84	2.15
		Asian	26	20	5581	17.37	5.04	0.84	2.03
		Hispanic	26	20	16512	12.69	5.27	0.83	2.16
		Multi-racial	26	20	5166	14.81	5.27	0.84	2.13
		Native Hawaiian/ Pacific Islander	26	20	120	15.58	5.40	0.84	2.16
		White	26	20	81949	16.06	5.00	0.83	2.09
	Module 2	African American	26	20	19131	11.39	5.23	0.81	2.25
		American Indian	26	20	212	13.21	5.69	0.84	2.25
		Asian	26	20	5581	17.63	5.27	0.85	2.06
		Hispanic	26	20	16512	12.07	5.49	0.83	2.23
		Multi-racial	26	20	5166	14.13	5.62	0.84	2.22
		Native Hawaiian/ Pacific Islander	26	20	120	15.29	5.70	0.85	2.22
		White	26	20	81949	15.62	5.31	0.83	2.17
EL	Total	All	52	40	4991	17.79	7.97	0.85	3.08
	Module 1	All	26	20	4991	9.05	4.19	0.74	2.15
	Module 2	All	26	20	4991	8.73	4.39	0.75	2.20
IEP	Total	All	52	40	23847	20.51	9.12	0.89	3.09
	Module 1	All	26	20	23847	10.63	4.83	0.80	2.15
	Module 2	All	26	20	23847	9.88	4.88	0.80	2.20
ED	Total	All	52	40	54563	25.66	10.10	0.90	3.12
	Module 1	All	26	20	54563	13.19	5.20	0.83	2.16
	Module 2	All	26	20	54563	12.47	5.43	0.83	2.24

Table M–8. Summer: Algebra Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	60	42	353	23.28	8.99	0.85	3.47
	Module 1	All	30	21	353	11.87	4.69	0.72	2.47
	Module 2	All	30	21	353	11.41	5.09	0.77	2.43
Gender	Total	Female	60	42	172	24.22	9.44	0.86	3.53
		Male	60	42	181	22.40	8.48	0.84	3.41
	Module 1	Female	30	21	172	12.40	4.82	0.73	2.52
		Male	30	21	181	11.37	4.52	0.72	2.41
	Module 2	Female	30	21	172	11.82	5.42	0.80	2.45
		Male	30	21	181	11.03	4.75	0.74	2.40
Ethnicity	Total	African American	60	42	42	20.67	7.38	0.79	3.40
		American Indian	60	42	DNR	DNR	DNR	DNR	DNR
		Asian	60	42	24	29.00	8.04	0.80	3.60
		Hispanic	60	42	58	19.07	7.23	0.79	3.29
		Multi-racial	60	42	12	20.42	8.39	0.83	3.44
		Native Hawaiian/ Pacific Islander	60	42	DNR	DNR	DNR	DNR	DNR
		White	60	42	215	24.38	9.27	0.86	3.50
	Module 1	African American	30	21	42	10.60	4.25	0.69	2.36
		American Indian	30	21	DNR	DNR	DNR	DNR	DNR
		Asian	30	21	24	14.58	4.06	0.63	2.46
		Hispanic	30	21	58	10.28	4.03	0.67	2.32
		Multi-racial	30	21	12	9.92	3.70	0.58	2.41
		Native Hawaiian/ Pacific Islander	30	21	DNR	DNR	DNR	DNR	DNR
		White	30	21	215	12.30	4.83	0.73	2.51
	Module 2	African American	30	21	42	10.07	4.39	0.70	2.40
		American Indian	30	21	DNR	DNR	DNR	DNR	DNR
		Asian	30	21	24	14.42	4.88	0.71	2.61
		Hispanic	30	21	58	8.79	4.02	0.67	2.32
		Multi-racial	30	21	12	10.50	5.45	0.80	2.43
		Native Hawaiian/ Pacific Islander	30	21	DNR	DNR	DNR	DNR	DNR
		White	30	21	215	12.07	5.17	0.78	2.43
EL	Total	All	60	42	14	17.71	6.70	0.74	3.42
	Module 1	All	30	21	14	9.29	3.54	0.55	2.37
	Module 2	All	30	21	14	8.43	3.94	0.60	2.48
IEP	Total	All	60	42	51	16.22	7.44	0.81	3.22
	Module 1	All	30	21	51	8.67	4.34	0.71	2.35
	Module 2	All	30	21	51	7.55	3.86	0.68	2.18
ED	Total	All	60	42	107	20.43	7.51	0.80	3.37
	Module 1	All	30	21	107	10.63	4.28	0.69	2.37
	Module 2	All	30	21	107	9.80	4.08	0.66	2.38

Table M–9. Summer: Biology Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	66	54	257	27.47	11.68	0.89	3.84
	Module 1	All	33	27	257	13.39	6.31	0.81	2.73
	Module 2	All	33	27	257	14.09	5.98	0.80	2.70
Gender	Total	Female	66	54	128	27.81	10.32	0.86	3.86
		Male	66	54	128	27.12	12.97	0.91	3.81
	Module 1	Female	33	27	128	13.42	5.43	0.75	2.74
		Male	33	27	128	13.32	7.11	0.85	2.72
	Module 2	Female	33	27	128	14.39	5.52	0.76	2.72
		Male	33	27	128	13.80	6.44	0.83	2.66
Ethnicity	Total	African American	66	54	30	22.37	9.18	0.83	3.73
		American Indian	66	54	DNR	DNR	DNR	DNR	DNR
		Asian	66	54	12	47.08	15.61	0.95	3.56
		Hispanic	66	54	25	24.84	8.44	0.80	3.73
		Multi-racial	66	54	15	27.67	13.01	0.91	3.97
		Native Hawaiian/ Pacific Islander	66	54	DNR	DNR	DNR	DNR	DNR
		White	66	54	171	27.52	10.81	0.87	3.85
	Module 1	African American	33	27	30	10.77	5.15	0.73	2.65
		American Indian	33	27	DNR	DNR	DNR	DNR	DNR
		Asian	33	27	12	23.67	8.65	0.92	2.52
		Hispanic	33	27	25	11.92	4.78	0.69	2.66
		Multi-racial	33	27	15	13.00	7.22	0.86	2.74
		Native Hawaiian/ Pacific Islander	33	27	DNR	DNR	DNR	DNR	DNR
		White	33	27	171	13.44	5.78	0.77	2.74
	Module 2	African American	33	27	30	11.60	4.87	0.71	2.61
		American Indian	33	27	DNR	DNR	DNR	DNR	DNR
		Asian	33	27	12	23.42	7.38	0.88	2.51
		Hispanic	33	27	25	12.92	4.54	0.67	2.61
		Multi-racial	33	27	15	14.67	6.39	0.80	2.87
		Native Hawaiian/ Pacific Islander	33	27	DNR	DNR	DNR	DNR	DNR
		White	33	27	171	14.08	5.67	0.77	2.70
EL	Total	All	66	54	DNR	DNR	DNR	DNR	DNR
	Module 1	All	33	27	DNR	DNR	DNR	DNR	DNR
	Module 2	All	33	27	DNR	DNR	DNR	DNR	DNR
IEP	Total	All	66	54	45	18.76	8.43	0.83	3.50
	Module 1	All	33	27	45	8.93	4.23	0.65	2.49
	Module 2	All	33	27	45	9.82	4.87	0.75	2.46
ED	Total	All	66	54	88	24.68	7.92	0.77	3.77
	Module 1	All	33	27	88	12.02	4.32	0.61	2.70
	Module 2	All	33	27	88	12.66	4.23	0.61	2.64

Table M–10. Summer: Literature Reliabilities

	Level	Group	Pts.	Len.	*N*	Mean	SD	r	SEM
Overall	Total	All	52	40	161	22.24	9.68	0.90	3.08
	Module 1	All	26	20	161	11.45	5.14	0.81	2.23
	Module 2	All	26	20	161	10.80	5.06	0.82	2.12
Gender	Total	Female	52	40	78	24.77	9.61	0.90	3.06
		Male	52	40	83	19.87	9.18	0.89	3.06
	Module 1	Female	26	20	78	12.78	5.22	0.82	2.19
		Male	26	20	83	10.19	4.76	0.78	2.23
	Module 2	Female	26	20	78	11.99	4.83	0.81	2.13
		Male	26	20	83	9.67	5.03	0.83	2.08
Ethnicity	Total	African American	52	40	34	19.53	9.51	0.89	3.17
		American Indian	52	40	DNR	DNR	DNR	DNR	DNR
		Asian	52	40	DNR	DNR	DNR	DNR	DNR
		Hispanic	52	40	18	18.50	9.79	0.91	2.87
		Multi-racial	52	40	DNR	DNR	DNR	DNR	DNR
		Native Hawaiian/ Pacific Islander	52	40	DNR	DNR	DNR	DNR	DNR
		White	52	40	96	24.28	9.27	0.89	3.09
	Module 1	African American	26	20	34	10.29	5.24	0.81	2.31
		American Indian	26	20	DNR	DNR	DNR	DNR	DNR
		Asian	26	20	DNR	DNR	DNR	DNR	DNR
		Hispanic	26	20	18	9.11	5.00	0.83	2.07
		Multi-racial	26	20	DNR	DNR	DNR	DNR	DNR
		Native Hawaiian/ Pacific Islander	26	20	DNR	DNR	DNR	DNR	DNR
		White	26	20	96	12.54	4.95	0.80	2.22
	Module 2	African American	26	20	34	9.24	4.90	0.81	2.16
		American Indian	26	20	DNR	DNR	DNR	DNR	DNR
		Asian	26	20	DNR	DNR	DNR	DNR	DNR
		Hispanic	26	20	18	9.39	5.21	0.86	1.98
		Multi-racial	26	20	DNR	DNR	DNR	DNR	DNR
		Native Hawaiian/ Pacific Islander	26	20	DNR	DNR	DNR	DNR	DNR
		White	26	20	96	11.74	4.82	0.80	2.14
EL	Total	All	52	40	DNR	DNR	DNR	DNR	DNR
	Module 1	All	26	20	DNR	DNR	DNR	DNR	DNR
	Module 2	All	26	20	DNR	DNR	DNR	DNR	DNR
IEP	Total	All	52	40	48	18.29	8.79	0.87	3.12
	Module 1	All	26	20	48	9.44	4.88	0.78	2.27
	Module 2	All	26	20	48	8.85	4.62	0.79	2.12
ED	Total	All	52	40	64	20.23	9.27	0.89	3.06
	Module 1	All	26	20	64	10.53	4.90	0.79	2.23
	Module 2	All	26	20	64	9.70	4.86	0.81	2.10

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