Final Report for NAGB Subtask 4.3

NAEP in Relation to the ACT College Readiness Standards and Benchmarks in Reading and Mathematics

Presented by ACT, Inc.
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Redacted by the Governing Board to protect the confidentiality of study participants and NAEP assessment items.

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1. INTRODUCTION

This report describes two studies that compared the frameworks for the Grade 12 National Assessment of Educational Progress (NAEP) in Reading and Mathematics with the domain definitions and test specifications for the ACT Reading Test and the ACT Mathematics Test and with ACT's College Readiness Standards®. Both studies were conducted by ACT on July 13–19, 2009, under contract to the National Assessment Governing Board (NAGB) under Subtask 4.3 of contract ED-06-CO-0098.

The ACT (ACT, 2007a) is a battery of tests measuring an examinee's academic readiness for postsecondary education. It is composed of multiple-choice tests in English, mathematics, reading, and science, and an optional test in writing. The College Readiness Standards are interpretive statements describing the knowledge and skills an examinee is likely to have based on his or her ACT scores. The overarching purpose of Subtask 4.3 was to provide NAGB with information about the alignment of the NAEP and the ACT to inform NAGB's investigation of whether NAEP scores should be used to make inferences about Grade 12 students' academic preparedness for college.

Subtask 4.3 comprised two studies. The first, hereafter called the Alignment Study, was a detailed comparison of the NAEP frameworks with the ACT content and cognitive domains, test specifications, and the ACT College Readiness Standards in Reading and Mathematics. The second, called the Item Classification Study, attempted to categorize each item in the 2009 NAEP assessments in Reading and Mathematics according to the ACT College Readiness Standards score ranges. The data for both studies was collected through the work of panels of subject matter experts. For each subject area, ACT convened a seven-member panel of educators, some at the high school level and some at the postsecondary level, some with prior experience with the NAEP and some with experience with the ACT. ACT staff developed the procedures for the studies, trained the panel members, and facilitated the panel meeting.

This document is the final report of Subtask 4.3. Section 2 describes the processes used to select and recruit panelists. Section 3 describes the procedures and results of the Alignment Study. Section 4 describes the procedures and results of the Item Classification Study. Section 5 offers some comments on what these studies imply about the relationship between the NAEP and the ACT.

2. SELECTION AND RECRUITMENT OF PANELISTS

Selection Criteria

ACT recruited seven subject matter experts in each subject area to collect the data for the Alignment and Item Classification Studies. In selecting and recruiting individuals to serve as panelists, ACT had the following goals: (1) three or four panelists in each subject area would be individuals who have worked closely with the ACT tests (i.e., who have served as external consultants to ACT, reviewing ACT test materials for content accuracy, educational relevance, and age appropriateness), and the remaining panelists would be individuals who have similar experience working with the NAEP frameworks; (2) to avoid conflicts of interest, no panelist would be a current employee of either NAGB or ACT; (3) a majority of each panel would be individuals from two-year or four-year postsecondary institutions who have expertise in the reading or mathematics knowledge and skills 12th-grade students must have to be placed into standard, entry-level, credit-bearing courses (as appropriate, in mathematics or in subjects that require college-level reading, such as history or psychology) or into remedial/developmental programs in reading or mathematics; and (4) each panel, respectively, and the two panels taken together, would reflect geographic, institutional, and demographic diversity to the greatest extent possible.

The ACT Project Manager identified for review by the Contract Officer's Representative (COR) a number of individuals in both reading and mathematics who have had extensive experience with the ACT tests and who ACT determined were well qualified to be panelists for these studies. When the COR had approved those names, and had provided ACT with a similar list of potential panelists with NAEP experience, the Project Manager contacted individuals from both lists and invited them to participate in the studies.

Recruitment Procedure

The initial contacts were made via e-mail. The invitational e-mails briefly described the dates, location, purpose, and scope of both the Alignment Study and the Item Classification Study, and also described how the invitee would be compensated for his or her participation (e.g., honorarium, travel arrangements, hotel accommodations, and meals). If the invitee agreed to participate in the study, the Project Manager sent via e-mail a formal Letter of Agreement (Appendix A) and a NAEP Confidentiality Agreement (Appendix B), both of which the panelist was asked to sign and return to ACT. The initial e-mail contacts were roughly evenly divided between the names in the COR's list and those on ACT's list, as well as between high school, two-year, and four-year faculty.

In Reading, three individuals with experience with the NAEP Reading assessment, and four with prior experience with the ACT Reading Test, agreed to take part in the studies. For Mathematics, the numbers of NAEP-knowledgeable and ACT-knowledgeable panelists were four and three, respectively. Three of the Reading panelists were current high school teachers with experience teaching 12th grade. The rest were faculty members from two- or four-year postsecondary institutions. The numbers of high school and postsecondary Mathematics panelists were two and five, respectively. Combined, the panels included individuals from the West Coast, the South, the Midwest, and the East Coast. The names and affiliations of the panelists are listed in Table 2.1.

The two panels met concurrently at ACT's national headquarters in Iowa City, Iowa, for three and one-half days. The time was split approximately equally between the two studies. The panels were facilitated by ACT's Senior Test Development Associates in Reading (Nina Metzner) and Mathematics (Ken Mullen), who moderated group discussions and recorded the outcomes of the Alignment and Item Classification Studies. All panelists and ACT staff who had access to NAEP items signed the NAEP Confidentiality Agreement (as per Appendix B).

Table 2.1
Panelists for the Alignment and Item Classification Studies

Name	Affiliation
Reading	
NAEP-knowledgeable	
REDACTED	
ACT-knowledgeable	
REDACTED	
Mathematics	
NAEP-knowledgeable	
REDACTED	
ACT-knowledgeable	
REDACTED	

3. THE ALIGNMENT STUDY

The purpose of the Alignment Study was to determine and document the content and skills alignment between the Grade 12 NAEP in Reading and Mathematics and the ACT Reading Test and Mathematics Test, respectively. The study consisted of a detailed comparison of the content and cognitive specifications and format of each assessment to that of the other. The comparison was of domain and test specifications to domain and test specifications, not test form to test form. The comparison was bidirectional, meaning that panelists first considered each element of the NAEP frameworks and identified, where possible, a similar element in the ACT domain and test specifications, then considered each element of the ACT domain and test specifications (including the College Readiness Standards) and identified, where possible, a comparable feature of the NAEP. By performing separate comparisons in each direction, it is possible not only to document the areas of content overlap between the assessments, but also to pinpoint areas of dissimilarity, features that are unique to each assessment.

Prior to the meeting at ACT headquarters, panelists received a pre-mailing of materials related to both assessments, which they were asked to read. The meeting opened with the panelists receiving a brief orientation to both assessments. After that, the Alignment Study began. The following sections describe the pre-mailing; the orientation session; the method used to conduct the Alignment Study; the results, first for Reading, then for Mathematics; a discussion of the results; and a summary of the responses to an evaluation questionnaire the panelists completed just after the Alignment Study.

Pre-Mailing of Materials for the Alignment Study

Panelists in each subject area determined the content alignment of the NAEP and the ACT by comparing documents describing the content domains, test specifications, and item specifications of both assessments. For the NAEP, these were:

- the *Reading* (or *Mathematics*) *Framework for the 2009 National Assessment of Educational Progress* (NAGB, 2008a, 2008b); and either
- the *Reading Assessment and Item Specifications for the 2009 National Assessment of Educational Progress* (NAGB, 2007a), or
- the *Assessment and Item Specifications for the NAEP 2009 Mathematics Assessment* (NAGB, 2007b).

For the ACT, the comparable documents were:

- Chapters 1–3 of the *ACT Technical Manual* (ACT, 2007a);
- the *Domain Definition for the ACT Reading* (or *Mathematics*) *Test* (ACT, 2008a, 2008b);
- *The Complexity of the Reading Test Passages on the ACT: Sample Passages and Annotations* (ACT, 2008c; Reading panelists only);
- the *Item Writer's Guide for the ACT Reading* (or *Mathematics*) *Test* (ACT, 2007b, 2007c);
- the College Readiness Standards in Reading or Mathematics (ACT, 2008d); and
- *Preparing for the ACT 2009–2010* (ACT, 2009).

Each panelist was sent the ACT documents and the NAEP framework in his/her subject area approximately one week prior to the meeting and was asked to review them, as those documents would form the basis of the work the panel would be doing. Panelists received the NAEP test and item specifications in their subject areas at the start of the meeting.

Orientation

The opening session on the first day of the meeting was a general session for all 14 panelists by the ACT Project Manager. This included a description of the Alignment and Item Classification studies, and a discussion of how they fit into NAGB's overall preparedness research agenda. The overview also included an introduction to both the NAEP and the ACT, including a discussion of the purpose and philosophy of each assessment, how each assessment was developed, and the types of score information that each assessment reported. After this overview, the panelists broke into their subject area panels, reconvened in separate meeting rooms, and began the Alignment Study.

Method

Each panelist was given a worksheet for his/her subject area (Appendix E or F) on which to record his/her judgments about the feature(s) of the ACT compatible with each feature of the NAEP. The left-hand column of this worksheet lists the major elements of the NAEP in that subject area, as taken from the frameworks (NAGB, 2008a, 2008b) and the test and item specifications (NAGB, 2007a, 2007b). For Reading, these include the types of texts found on the NAEP; the characteristics of the texts selected for inclusion on the NAEP, including text length; the cognitive targets around which NAEP items are written; and the types of items (i.e., multiple-choice and constructed-response). For Mathematics, these included the mathematical content areas assessed, the mathematical complexity of test items, and item types. The right-hand column was for indicating which features(s) of the ACT, including the College Readiness Standards, were comparable to each NAEP feature. Each panel completed their worksheets in small groups of two or three. Each group included at least one ACT-knowledgeable panelist and one NAEP-knowledgeable panelist; this was done so that experience with both assessments was represented in each group. When the members of each small group had completed their worksheets, the entire panel was reconvened to compare findings and to come to consensus on the ACT element(s) mapping to each NAEP element.

After that discussion was finished, each panelist was given another worksheet (Appendix G or H), the left-hand column of which listed the major elements of the ACT (including the College Readiness Standards) in that subject area, as taken from ACT (2007a, 2007b, 2007c; 2008a, 2008b, 2008c, 2008d), and the right-hand column of which was for indicating the feature(s) of the NAEP comparable to each ACT feature. Panelists completed these worksheets in their small groups, after which each panel was reconvened and the findings discussed.

Results—The NAEP Reading Framework Compared to the ACT Reading Test Domain, Test Specifications, and College Readiness Standards

Table 3.1 presents the results of the comparison of the NAEP Reading framework to the ACT Reading Test domain, test specifications, and College Readiness Standards. The items listed in the

right-hand column are those features, if any, of the ACT that the Reading panel identified as being similar to each element of the NAEP. All of the similarities identified by the panel are included in Table 3.1.

Types of texts

With regard to the types of texts featured on the NAEP, the panelists found commonalities with the ACT, as well as elements in NAEP that do not appear on the ACT. NAEP distinguishes between two broad categories of texts: literary texts and informational texts. Literary texts include fiction, literary nonfiction (personal essays, autobiographies/biographies, sketches, etc.), and poetry, and comprise approximately 30% of the texts in the NAEP pool. Both the NAEP and the ACT include works of fiction—one of the four passages on each ACT Reading Test is a work of Prose Fiction—although the judgment of the panelists was that the NAEP framework emphasizes genres of fiction (e.g., adventure, historical fiction, parody, etc.) more than does the ACT; the ACT Reading Test domain does not specify particular genres of fiction to include. Panelists did not see a clear counterpart to literary nonfiction in the ACT Reading domain, although they agreed that some of the ACT's Humanities passages, which may include excerpts or adaptations from memoirs and personal essays, would fit this description. (Humanities passages may also include nonfiction essays on literature, philosophy, or the arts; the panel did not think these fit the NAEP idea of literary nonfiction.) The panel concluded that one form of literary nonfiction—the classical essay—was not featured in the ACT Reading Test domain, and that the focus of the ACT was on 20th- and 21st-century texts exclusively. A clear distinction between the two assessments is in the use of poetry; the NAEP framework calls for works of poetry to be included in the Reading pool, whereas poetry is excluded from the ACT Reading Test domain.

The NAEP Reading framework specifies that informational texts comprise 70% of the assessment pool and encompass exposition (essays or literary analyses), argumentation or persuasive texts (e.g., journals, speeches, historical accounts, persuasive essays, editorials, advertisements), and procedural texts and documents (e.g., manuals, contracts, applications). The panel believed that two of the four content areas featured in the ACT Reading Test domain—Social Sciences and Natural Sciences—could best be described as works of exposition, and that many Humanities passages would also fall into this category. The panel did not see persuasive text as a feature of the ACT—the panel concluded that ACT Reading passages convey information rather than attempt to influence opinion or action—but they agreed that a Social Science or Natural Science passage with an historical focus may employ some the elements of argumentative text. For example, a passage outlining the historical evidence for some scientific theory may be organized in the manner of a scientific argument, with each element of the theory presented in a carefully chosen order. (A common feature of argumentative or persuasive text—the use of graphics—is not a feature of the ACT Reading Test domain.) Finally, the panel noted that procedural texts and documents were not included on the ACT Reading Test domain.

The NAEP Reading assessment also makes use of mixed texts and paired texts. Mixed texts combine elements of two or more of the passage types described above—for example, an essay on economics that includes biographical details of a famous economist. The panel thought that there may be passages in the ACT Reading Test pool that incorporate multiple types of text, but these are not a specific feature of the ACT. Paired texts on the NAEP are presented to the examinee together,

and the accompanying assessment items ask the examinee to compare and contrast the texts in some manner. The panel agreed that paired texts were not a feature of the ACT Reading Test.

Characteristics of texts

In addition to specifying the types of texts featured on the NAEP, the Reading framework describes several characteristics of the texts to be included on the NAEP. Texts must be authentic, high-quality, coherent, grade-appropriate, drawn from a variety of contexts, engaging, and must reflect the nation's literary heritage. Based on the samples provided in ACT (2008c), the panel identified essentially all of these as characteristics of ACT Reading Test passages, as well. They saw the ACT Reading Test passages as authentic, being adapted or excerpted from published works, not created specifically for the test. They also agreed that, though typically adapted from longer works, ACT passages were coherent, engaging, and of high quality.

With regard to grade-level appropriateness the panel concluded that, because ACT passages are intended to reflect the types of reading encountered in introductory postsecondary coursework, they are appropriate for 12th-grade students. With regard to the variety of contexts reflected in ACT passages and the degree to which they reflect the nation's literary heritage, the panel felt that, while ACT passages are primarily by contemporary writers, the gender, ethnic, and regional diversity in the passages reflects a variety of contexts and a variety of literary heritages. The panel agreed that "classical" authors, the so-called reading "canon," and works from varied historical periods were unlikely to be found on the ACT Reading Test, but that ACT Reading Test passages nonetheless had considerable variety.

Passage length

The NAEP framework calls for Reading passages between 500 and 1,500 words in length. Less variability is allowed in ACT Reading Test passages; the test specifications indicate that each ACT passage is required to be approximately 750 words.

Cognitive targets

NAEP Reading items are intended to measure three broad categories of cognitive targets. NAEP calls these *Locate/Recall*, which involves identifying explicit information from text or making simple inferences within or across texts; *Integrate/Interpret*, which involves making complex inferences within and across texts; and *Critique/Evaluate*, which involves the critical analysis of text. Within each category, some targets are specific to literary texts, some are specific to informational texts, and some are applicable to both. Appendix I lists all of the NAEP cognitive targets; this table is Exhibit 8 on page 39 of the Reading framework (NAGB, 2008a). The columns of this table denote the three categories, and the rows denote the broad types of texts. Within each of the nine cells are the cognitive targets within that category that are applicable to that text type. All of these cognitive targets appear in the left-hand column of Table 3.1.

In comparing the cognitive targets to the cognitive skills measured on the ACT Reading Test, the panel focused primarily on the articulation of those skills found in the College Readiness Standards (Appendix C). The standards are statements of what examinees are likely to be able to do, based upon their ACT scores. As such, the standards cover most of the ACT Reading cognitive skills domain. The columns (strands) of the standards table denote particular text features (*Main Ideas and Author's Approach*; *Supporting Details*; and *Sequential, Comparative, and Cause-Effect*

Relationships) or cognitive outputs of reading (*Meaning of Words*; *Generalizations and Conclusions*), while the rows represent levels of achievement, as reflected in ranges of ACT Reading Test scores. The statements within each cell—the standards—are articulations of what students with Reading Test scores in that range are likely able to do. Each standard describes a cognitive skill measured by ACT test items that students in that range have a high probability of success with, but that students at the lower ranges have less success with. The standards are numbered within strand, and the numbers reflect the score ranges; standards in the 13–15 range all have numbers in the 200s; standards in the 16–19 range have numbers in the 300s, etc. The entries in the right-hand column of Table 3.1 are direct references to the College Readiness Standards; each capitalized abbreviation (MID, etc.) refers to a strand (Main Ideas, etc.), and the 3-digit number indicates the standard within that strand.

The right-hand column of Table 3.1 shows that the panel did not see a simple, one-to-one relationship between the NAEP cognitive targets and the College Readiness Standards. Most of the targets were matched to several standards, usually spanning multiple score ranges, and often spanning multiple strands. This points out an issue that was a source of challenge to the Reading panel (and to the Mathematics panel, as will be shown) throughout the Alignment Study—the fact that the NAEP framework and the ACT documents and College Readiness Standards organize their information in different ways and with differing degrees of granularity. The NAEP cognitive targets are organized, first, by the three broad categories above, and then by text features or ways in which the categories may be demonstrated. Levels of proficiency with the cognitive targets are not a part of this organization. And, while the NAEP cognitive targets distinguish between literary and informational texts, the ACT College Readiness Standards attend, not only to passage type, but also to passage complexity. (ACT passage complexity is described in the results of the ACT-to-NAEP comparison, below). Often, what distinguishes the College Readiness Standards in one score range from those in others is the complexity of the passage to which the cognitive skills are applied. From these differences, the panel drew the inference that, in many cases, a particular NAEP cognitive target might potentially be represented by a number of ACT College Readiness Standards, depending on the particular context in which the target is being assessed, and that deciding which standard is the best "fit" in a given situation (i.e., for a given test item and text) may depend upon how the target is evoked (i.e., how the item and text are written). By the same token, a given ACT College Readiness Standard might conceivably fit a number of NAEP cognitive targets.

That having been said, one can see from Table 3.1 that the panel was able to identify applicable ACT College Readiness Standards for many of the NAEP cognitive targets. All of the *Locate/Recall* targets were matched up with standards in ways that seem logical when one looks at Appendix C. The targets regarding definitions and language were mapped to standards in the *Meanings of Words* strand. Those dealing with topic sentences and author's purpose were matched to standards in the *Main Ideas* strand (although topic sentences are not specifically mentioned in this strand). Those regarding facts, details, and setting were matched to standards in the *Supporting Details* strand. Those dealing with sequences of events and causal relations were matched to standards in the *Relationships* strand. Finally, the target dealing with character traits was found to have similarities to standards from across three strands: *Supporting Details*, *Relationships*, and *Generalizations and Conclusions*. Overall, it appears that the *Locate/Recall* cognitive targets are all reflected in the College Readiness Standards.

The panel also determined that most of the *Integrate/Interpret* targets were reflected in the College Readiness Standards. Some, like "Compare or connect ideas, problems, or situations," "Summarize major ideas," and "Draw conclusions and provide supporting information," are sufficiently broad that entire strands of the standards (REL, MID, and GEN, respectively) are applicable. For a given item measuring one of those targets, which standard might apply would depend on how the item was written, as well as on the complexity of the accompanying text. The panel matched most of the remaining targets to individual standards, typically from across two or more strands. A few *Integrate/Interpret* targets were matched weakly or not at all. "Describe how an author uses literary devices and text features" was a weak match to two upper-level standards, due to the use of the verb "describe" in the target; the panel didn't see this as fitting well with the ACT's multiple-choice format. "Determine the importance of information within and across texts" was matched to several standards solely on the basis of the word "within," since the ACT Reading Test does not use paired texts. Finally, the target regarding poetry did not have a match in the College Readiness Standards.

Of the three broad categories of cognitive targets, the panel concluded that the College Readiness Standards matched the *Critique/Evaluate* the least. The targets dealing with author's craft, technique, and point of view (within but not across texts) were seen to be compatible with standards in the MID strand, but most of the other targets—those involving analysis or evaluation—were at best weakly matched by standards at the highest score levels. The panel had difficulty reconciling these targets with the ACT's multiple-choice format. The two other evaluative targets—"Determine the quality of counterarguments within and across texts," and "Judge the coherence, logic, or credibility of an argument"—were not reflected in any College Readiness Standards.

In summary, the panel found applicable ACT College Readiness Standards for many of the NAEP Reading cognitive targets. Essentially all of those under the heading of *Locate/Recall* were reflected in the College Readiness Standards, most of the *Integrate/Interpret* targets could be found in the standards, and few of the *Critique/Evaluate* targets could be found there. With regard to the cognitive demands of the two assessments, it was the sense of the panel that the ACT Reading Test compares adequately with the NAEP in all areas except higher-level analysis and evaluation.

Item types

The last feature of the NAEP Reading assessment to be compared with the ACT Reading Test involved the types of test items each assessment employs. The NAEP uses three item formats: multiple-choice, short constructed-response items (each scored using a two- or three-point scoring rubric), and extended constructed-response items (each scored using a four-point rubric). Multiple-choice and short constructed-response items comprise the majority of the NAEP item pool, and in approximately equal proportions (40% and 45%, respectively); extended constructed-response items are used in smaller numbers (15%). The ACT uses only multiple-choice items.

Results—The ACT Reading Test Domain, Test Specifications, and College Readiness Standards Compared to the NAEP Reading Framework

Table 3.2 presents the Reading panel's findings in the comparison of the ACT Reading Test domain, test specifications, and College Readiness Standards to the NAEP Reading framework. The items listed in the right-hand column are those features, if any, of the NAEP that the panelists

identified as being similar to each element of the ACT. All of the similarities identified by the Reading panel are included in Table 3.2.

Passage content

ACT Reading Test passages are classified by content area. On each form of the Reading Test, one passage is from Prose Fiction (usually an excerpt from a short story or a novel), one is from the Humanities (e.g., memoirs, personal essays, nonfiction essays on the arts), one is from the Social Sciences (e.g., anthropology, archaeology, business, economics, geography), and one is from the Natural Sciences (e.g., anatomy, astronomy, biology, chemistry, ecology). As we have seen, NAEP texts are categorized quite differently, but the panel concluded that all four of the ACT content areas could be reflected in NAEP texts. Fiction is certainly a feature of the NAEP Reading assessment; those texts comprise about 20% of the NAEP pool. NAEP fiction texts, however, encompass many more genres (such as adventure, historical fiction, realistic fiction, myths, and parody) than ACT Prose Fiction passages do. The NAEP category of literary nonfiction may apply to some of the ACT Humanities passages, particularly personal essays, memoirs, and biographical sketches. The NAEP category of informational texts may apply to ACT Humanities, Social Sciences, and Natural Sciences passages, although the NAEP frameworks do not specify that texts must be from any of those disciplines. In short, it was the panel's opinion that the way in which ACT Reading passages are classified by content is compatible with elements of the NAEP classification scheme.

Complexity of passages

A characteristic of passages that the ACT Reading domain definition and College Readiness Standards explicitly refer to is their complexity. Besides their content classifications, passages for the ACT Reading Test are characterized as *uncomplicated*, *more challenging*, or *complex*, using the criteria described in ACT (2008c). The distinction is made between uncomplicated, more challenging, and complex *literary narratives* and *informational passages*. In a number of cases, the distinction between two College Readiness Standards may be based on the complexity of the passage within which an examinee demonstrates a cognitive skill. The panel determined that the NAEP Reading framework does not explicitly define the complexity of a text. The NAEP framework describes how the texts for the 4th-, 8th-, and 12th-grade NAEP should become longer and be "increasingly complex" as the grade level increases, and the cognitive targets are said to become "increasingly complex" from one grade to the next, but the panel's opinion was that these were, at best, indirect references to text complexity, and that the ACT Reading Test domain operationalizes complexity in a much more systematic way. In short, the concept of passage complexity is a feature of the ACT Reading Test domain which the NAEP Reading framework does not describe.

Passage length

As noted above, ACT Reading passages have a target length of 750 words. NAEP texts run 500 to 1,500 words.

Cognitive skills

ACT Reading Test items measure two broad categories of skills (ACT, 2008a, 2007b). *Referring* items ask about material explicitly stated in a passage—main ideas, relationships, and

significant details—and are designed to measure literal reading comprehension. *Reasoning* items are items about meaning implicit in a passage, items that require critical understanding about a passage, and items dealing with context-dependent vocabulary. Items of either type may appear in conjunction with any of the four types of ACT passages described above. The left-hand column of Table 3.2 lists the skills measured by Referring and Reasoning items. For each of these, the panel determined the NAEP cognitive target(s) that best fits (or fit) that skill. They did so by identifying which of the nine cells in Appendix I contained cognitive targets consistent with each ACT skill (e.g., the *Locate/Recall* targets specific to literary texts, the *Integrate/Interpret* targets specific to informational texts). The left-hand column of Table 3.2 gives the panel's findings.

The first thing to note from these results is that the panel was able to identify cognitive targets comparable to each ACT Reading skill. The next is that, for many of the skills, the panel identified targets applicable to either kind of NAEP texts. By and large, the panel thought the ACT Referring skills were best fit by NAEP Locate/Recall targets. Identifying the main ideas of a passage, paragraph, or paragraphs was seen as comparable to the Locate/Recall targets pertaining to facts (applicable to both literary and informational texts) and to topic sentences and main ideas (applicable to informational texts). The skill of recognizing sequences was seen as comparable to Locate/Recall and Integrate/Interpret targets pertaining to either type of text. The skills pertaining to causal relationships were judged to fit with Integrate/Interpret targets for both types of texts. The skills pertaining to comparative relationships were seen to fit with Locate/Recall targets specific to informational texts, and to Integrate/Interpret targets applicable to both types of texts. Finally, the skill of recognizing significant details within a passage was seen to match Locate/Recall cognitive targets pertaining only to informational texts, as well as to targets applicable to both types of text.

While NAEP Locate/Recall targets were seen as most compatible with the ACT Referring skills, the panel felt that the ACT Reasoning skills were best addressed by Integrate/Interpret and Critique/Evaluate targets. All of the skills pertaining to the inference of main ideas, and to inferring the roles of supporting details, sequences, and causal relationships, were seen to have counterparts in Integrate/Interpret targets pertaining to both types of texts. The skill of drawing conclusions from information was found among the Integrate/Interpret targets for informational texts. The skills of making comparisons, contrasts, and generalizations were found among the Integrate/Interpret targets for both types of texts. The panel determined that some of the higher-level reasoning skills—those of understanding points of view and recognizing logical fallacies or logical flaws—were best reflected in Critique/Evaluate targets applicable to texts of both types, while others—recognizing stereotypes and distinguishing between fact and opinion—were best reflected in Critique/Evaluate targets pertaining specifically to informational texts. Finally, with regard to the Reasoning skill of determining the meanings of words or phrases in context, the panel indicated that, while this skill is not represented among the NAEP cognitive targets, it was assessed by the NAEP (see, for example, NAGB, 2008a, p. 32). In short, the panel's opinion was that all of the ACT Reading Test cognitive skills—the skills around which ACT items are written—were reflected in the NAEP Reading domain.

Item types

As mentioned above, the ACT Reading Test uses only multiple-choice items, while the NAEP Reading assessment employs these as well as short and extended constructed-response items.

College Readiness Standards

In the final stage of the ACT-to-NAEP comparison, the panelists examined each of the College Readiness Standards in Reading (ACT, 2008d; Appendix C) and attempted to find one or more NAEP cognitive targets addressing the same skill. Recall that the College Readiness Standards are interpretive statements of what students are likely to know and be able to do based on their ACT scores. As mentioned above, the standards for Reading are organized by text features or cognitive outputs (the strands), and then by levels of achievement (the score ranges). The left-hand column of Table 3.2 lists the standards first by strand, then by score range, as implied by the number of the standard (201, 301, etc.). The right-hand column shows the cognitive target(s) the panel thought applicable to each standard. As they did for the ACT Reading cognitive skills, the panel indicated the cognitive target(s) that best reflected each College Readiness Standard by referencing one of the nine cells in Appendix I.

As one scans down the right-hand column one first notices that, for four of the five strands, the panel was able to find elements in at least one set of cognitive targets that touched on each College Readiness Standard. The panel identified no targets reflecting the standards in the Meanings of Words strand. These standards all involve the use of context to determine the meanings of words or phrases; recall that context-dependent vocabulary is assessed on the NAEP—see, for example, pages 32–35 of NAGB (2008a)—but is not represented in the cognitive targets. The panel agreed that, while not reflected in the cognitive targets, the skills described in the Meaning of Words strand are nevertheless assessed on the NAEP.

For the remaining strands, most of the standards were seen as reflected in *Locate/Recall* and *Integrate/Interpret* families of cognitive targets; only eight standards were seen as reflected in *Critique/Evaluate* targets. This is consistent with the finding above that few ACT cognitive skills are reflected in *Critique/Evaluate* targets. To a large extent, the standards in the Main Ideas, Supporting Details, Relationships, and Generalizations and Conclusions strands were matched to the family of cognitive targets consistent with the language of the standards. Standards using verbs like "locate," "identify," "recall," and "recognize" are more likely to be reflected in *Locate/Recall* targets, while those using verbs like "infer," "interpret," "understand," and "use" are more likely to be reflected in *Integrate/Interpret* targets. Note finally that *all* of the standards in the Generalizations and Conclusions strand were reflected in *Integrate/Interpret* or *Critique/Evaluate* targets.

In summary, the panel concluded that all of the skills represented in the College Readiness Standards are measured on the NAEP Reading assessment. Most are reflected in the NAEP cognitive targets; those dealing with vocabulary are reflected elsewhere in the NAEP framework.

Results—The NAEP Mathematics Framework Compared to the ACT Mathematics Test Domain, Test Specifications, and College Readiness Standards

Table 3.3 presents the results of the comparison of the NAEP Mathematics framework to the ACT Mathematics Test domain, test specifications, and College Readiness Standards. The items listed in the right-hand column are those features, if any, of the ACT that the Mathematics panel identified as being similar to each element of the NAEP. All of the similarities identified by the panel are included in Table 3.3.

Mathematical content areas

The content domain of the NAEP Mathematics assessment is divided into five subcategories: *Number Properties and Operations*; *Measurement*; *Geometry*; *Data Analysis, Statistics, and Probability*; and *Algebra*. The framework (NAGB, 2008b) lists several specific objectives that are suitable for assessment under each subcategory. The left-hand column of Table 3.3 lists these, using the numbering system provided in the framework. In looking for similarities with the ACT, the panel examined the domain definition (ACT, 2008b) and the *Item Writer's Guide for the ACT Mathematics Test* (ACT, 2007c), as well as the College Readiness Standards in Mathematics (Appendix D). The first two of these documents list the major content areas assessed on the Mathematics Test. Each is accompanied by a list of topics that are representative of the content area; these are listed in the left-hand column of Table 3.3. These topics are not exhaustive of the content area, but they give the reader a good sense of its scope. The College Readiness Standards also cover most of the ACT Mathematics domain. As with Reading, the Mathematics standards are organized by strand and by ACT score range. The eight strands are general areas of mathematical content: *Basic Operations and Applications; Probability, Statistics, and Data Analysis; Numbers: Concepts and Properties; Expressions, Equations, and Inequalities; Graphical Representations; Properties of Plane Figures; Measurement;* and *Functions*. The standards within those strands are statements of what examinees are likely to know and be able to do in Mathematics, as implied in their ACT Mathematics scores. The standards, therefore, are a representation of the ACT Mathematics domain.

In documenting the evidence for each NAEP Mathematics objective in the ACT Mathematics domain, panelists noted the College Readiness Standard(s) that reflected each objective. The letters and numbers in the right-hand columns of Table 3.3 refer to the numbering in Appendix D. In some cases, no College Readiness Standards could be found that reflected a particular NAEP objective. If an examination of the domain definition or *Item Writer's Guide* revealed that the objective was part of the ACT domain nonetheless, this was noted in Table 3.3.

Scanning down the right-hand column of Table 3.3, one first notices that many of the NAEP content topics were reflected in one or more College Readiness Standards. In many of these cases, the matches were to standards within a single strand, but spanning multiple score ranges. This speaks to the issues of organization and granularity discussed in the Reading results above. The NAEP frameworks, ACT domain definition and *Item Writer's Guide*, and College Readiness Standards are all written for different purposes, and so are organized differently and are written to differing degrees of specificity. As was the case with the Reading panel, the Mathematics panel found this a challenge when trying to determine the degree of similarity between the two assessments. The Reading panel often found NAEP cognitive targets to be reflected in ACT College Readiness Standards from across multiple strands and multiple score ranges. The Mathematics panel less frequently assigned a NAEP content topic to standards in multiple strands, but very often assigned a topic to multiple score ranges within a strand.

NAEP items assessing Number Properties and Operations comprise about 10% of the NAEP item pool. The panel determined that these objectives are most similar to content in the ACT Pre-Algebra subdomain; Pre-Algebra items comprise approximately 23% of each ACT Mathematics Test form. With regard to the College Readiness Standards, the panel found that these objectives were best reflected in standards in the Basic Operations and Applications (BOA) and the Numbers: Concepts and Properties (NCP) strands. Objectives explicitly involving operations on numbers were reflected in BOA standards, while the rest were addressed by NCP standards. Two objectives

dealing with mathematical reasoning were matched to NCP standards, but the panel thought these matches were weak. Two objectives pertaining to estimation, accuracy, and divisibility were not seen in any College Readiness Standards, but the panel agreed that these topics fell within the ACT Pre-Algebra subdomain nevertheless.

The panel felt that NAEP objectives under the heading of Measurement encompass content from a variety of ACT subdomains. Objectives pertaining to the measurement of physical attributes had counterparts in standards in the Measurement (MEA), Properties of Plane Figures (PPF), Graphical Representations (GRE), and BOA strands. Systems of measurement objectives were reflected in standards in the BOA, NCP, and MEA strands. (It was unclear to the panel whether an objective dealing with approximation and variation in measurement was part of the ACT domain.) Objectives dealing with measurement in triangles (including objectives related to trigonometry) were reflected in standards in the Functions strand (FUN).

The NAEP objectives listed under Geometry comprise, along with Measurement, 35% of the NAEP item pool. Panelists saw many of these objectives reflected in the ACT Coordinate Geometry and Plane Geometry subdomains, which together comprise about 38% of each Mathematics Test form, and were able to find College Readiness Standards (primarily PPF and GRE) that were comparable to many of them. For many objectives, however, it was unclear to the panel whether they were part of the ACT domain. Panelists had to infer the connections in a number of cases, and in some cases those connections were uncertain. For example, the NAEP objectives dealing with transformations may be assessed on the ACT, the panel concluded. Similarly, the panel judged as "unclear" similarities between the ACT domain and objectives pertaining to vectors, ellipses and hyperbolas, polar coordinates, and mathematical reasoning. The panel did not feel they had solid evidence indicating their inclusion in the ACT domain, but neither had they clear evidence that they were not included. Only one objective—involving drawing geometric figures from written descriptions—was seen by the panel as clearly *not* reflected in the ACT domain, due to the multiple-choice format of the Mathematics Test.

The panel was similarly uncertain about a number of the NAEP objectives for Data Analysis, Probability, and Statistics. Many were reflected in College Readiness Standards in the Probability, Statistics, and Data Analysis strand (PSD). For others—those pertaining to experiments and samples, the binomial theorem, and mathematical and statistical modeling—the connections were less clear. (In the ACT Mathematics domain, probability, statistics, and data analysis topics are part of the Pre-Algebra subdomain and comprise a small subset of the Pre-Algebra items on each test form.) The panel was more decided about the NAEP Algebra objectives, however. Most of those were reflected in College Readiness Standards in the Expressions, Equations, and Inequalities strand (XEI); the objectives dealing with mathematical reasoning in Algebra were the most unclear for the panel.

Mathematical complexity of items

The next aspect of the NAEP Mathematics framework considered by the panel was the way in which the frameworks categorize items by their complexity. NAEP uses three levels of complexity: low, moderate, and high (NAGB, 2007b). Low-complexity items require students to recall concepts or procedures, and typically specify what the examinee is to do. Moderate-complexity items require the examinee to decide what needs to be done to solve a problem and how to do it, and to bring together concepts from more than one domain. High-complexity items require

the examinee to use reasoning, planning, analysis, judgment, and creative thought, perhaps justifying mathematical statements or making a mathematical argument. The NAEP framework call for 25% of the items in the NAEP pool to be low complexity, 50% to be moderate complexity, and 25% to be high complexity.

The domain definition for the ACT Mathematics Test describes four categories of items that require different levels of cognitive skill from the examinee. *Knowledge and Skills* (KS) items require the use of facts definitions, formulas, and procedures in "pure" mathematical problems. *Direct Application* (DA) items require those same things, but in problems cast in real-world scenarios. *Understanding Concepts* (UC) items require examinees to demonstrate the depth of their understanding, while *Integrating Conceptual Understanding* (IC) items require examinees to bring together two or more major concepts to solve more sophisticated problems. The panel's opinion was that many KS and DA items would be comparable to the NAEP low-complexity items; that most KS, DA, UC, and IC items would be of moderate complexity as defined by NAEP; and that few ACT items would be considered high complexity.

Item formats

The NAEP Mathematics item specifications (NAGB, 2008b) call for about half of an examinee's testing time to be spent on five-option multiple-choice items, with the other half divided between short constructed-response items (each scored using a two-, three-, or four-point scoring rubric) and extended constructed-response items (each scored with a five-point rubric). The ACT Mathematics Test employs only five-option multiple-choice items.

Results—The ACT Mathematics Test Domain, Test Specifications, and College Readiness Standards Compared to the NAEP Mathematics Framework

Table 3.4 presents the Mathematics panel's findings in their comparison of the ACT Mathematics Test domain, test specifications, and College Readiness Standards to the NAEP Mathematics framework. The items listed in the right-hand column are those features of the NAEP that the panelists identified as being similar to each element of the ACT. All of the similarities identified by the Mathematics panel are included in Table 3.4.

Mathematics Test domain

The content domain of the ACT Mathematics Test is composed of six broad subcategories: *Pre-Algebra*, *Elementary Algebra*, *Intermediate Algebra*, *Coordinate Geometry*, *Plane Geometry*, and *Trigonometry*. As mentioned above, the domain definition for the test (ACT, 2008b) lists for each category a representative, but not exhaustive, list of topics. These are listed in the left-hand column of Table 3.4. For each topic, the right-hand column of the table indicates the elements of the NAEP assessment domain that are best reflected by each ACT topic. The numbering scheme for these elements is the one used in the framework (NAGB, 2007b) and in the left-hand column of Table 3.3. Most of the NAEP elements listed here are from the Grade 12 content domain, but some are from the Grade 8 domain. Those are indicated in the table.

Scanning down the right-hand column of Table 3.4, one can see that the Mathematics panel was able to find elements of the NAEP domain that reflected all of the ACT Mathematics topics. On the ACT, number concepts and properties, probability, statistics, and data analysis are all part of Pre-

Algebra. Generally speaking, the panel determined that the Pre-Algebra topics listed in Table 3.4 are best represented by elements of the NAEP belonging to Number Properties and Operations (NPO) and Data Analysis, Statistics, and Probability (DASP). Some ACT topics, however, were seen as below the level of Grade 12; those pertaining to operations on numbers, fractions, decimals, and integers; comparison of fractions; conversion between fractions and decimals; absolute value; and order properties. For the ACT topics underlying Elementary and Intermediate Algebra, the panel identified comparable topics from the NAEP Algebra category (ALG), only a few of which were from the Grade 8 NAEP domain.

For the topics listed under Coordinate Geometry, the panel identified NAEP topics from NPO, ALG, and Geometry (GEO) that applied. "Graphing on a number line" was seen as an NPO topic, while NAEP topics about the slope of a line, graphing equations, and graphing the solutions to systems of equations were considered ALG topics. The rest were identified with NAEP Geometry topics. The ACT topics listed as Plane Geometry were mapped to NAEP GEO and Measurement (MEA) topics; those dealing with geometric figures were reflected in GEO topics, while those dealing with radius, diameter, circumference, area, etc., were identified with MEA topics. Finally, the ACT topics under the heading of Trigonometry were identified with NAEP ALG and MEA topics in about equal numbers. Overall, the sense of the panel was that the elements of the ACT Mathematics Test content domain were reflected well in the NAEP domain, although a number of lower-level ACT topics were seen as addressing topics from the Grade 8, not the Grade 12, NAEP.

Cognitive classes

As we have seen, the domain definition for the ACT Mathematics Test describes four categories of items that require different levels of cognitive skill from the examinee: Knowledge and Skills (KS), Direct Application (DA), Understanding Concepts (UC), and Integrating Conceptual Understanding (IC). KS items comprise about half of every ACT Mathematics Test, DA items about 28%, and UC and IC items together comprise the remaining approximately 22%. We have also seen that NAEP Mathematics items are classified by their level of complexity: low, moderate, or high.

It was the sense of the panel that most of the KS and DA items would fit the description of low-complexity items on the NAEP. The panel decided that moderate-complexity items on the NAEP would probably be divided among the DA, UC, and IC types, and that high-complexity NAEP items would probably be consistent with the descriptions of UC and IC items. Because low-complexity items comprise only about 25% of the NAEP item pool, the panelists determined that the ACT Mathematics Test contains proportionately many more low-complexity items than does the NAEP. Since high-complexity items comprise about 25% of the NAEP pool, the panel concluded that the ACT probably contains a lower proportion of high-complexity items than does the NAEP.

Item sets

On each form of the ACT Mathematics Test there are a number of items grouped into *item sets* (ACT, 2007c). These are groupings of three or more items based on a common stimulus, sometimes including, for example, drawings, graphs, tables, or charts. The items within each set span at least two of the six content areas and two of the cognitive classes. Though related by a stimulus, the items are logically independent; an examinee's success on one item in a set does not depend on his/her success on any other. Each form of the ACT Mathematics Test contains two of these item sets. The panelists determined that there is a similar feature in the NAEP Mathematics

assessment, in that an examinee may be administered a series of items that are based on a common stimulus, but that are otherwise independent. The NAEP test specifications (NAGB, 2007b) do not require the same mix of content area and complexity that the ACT does.

Use of calculators

Examinees are allowed to use calculators on the ACT Mathematics Test, but calculators are not required; every item on the ACT may be answered correctly without the use of a calculator, and no item advantages an examinee based on the type of calculator he or she uses. Examinees provide their own calculators; ACT does not provide them. ACT has restrictions on what sort of calculators examinees may use. For example, calculators with QWERTY-style keyboards or built-in algebra systems are not allowed. As Table 3.4 shows, the NAEP has similar policies regarding calculator use on the Mathematics assessment. Some blocks of NAEP Mathematics items allow the use of calculators; some do not. Examinees may provide their own calculators, but the NAEP will provide them for use on calculator blocks. If an examinee provides his or her own calculator, the NAEP has restrictions on what sort of calculator it may be, and no items unfairly advantage an examinee on the basis of the type of calculator he or she uses. In these respects, the ACT and the NAEP policies on calculator use are quite similar.

College Readiness Standards

The next section of Table 3.4 lists the College Readiness Standards for Mathematics (ACT 2008d and Appendix D) and the element(s) of the NAEP Mathematics domain that the panel identified as being reflected in each standard. The panel was able to find elements of the NAEP domain for nearly all of the standards. Most of the Basic Operations and Applications standards were seen as comparable to the NAEP Number Properties and Operations subdomain, while the BOA standards explicitly involving conversions of units, proportions, or rates were comparable to elements of the NAEP Measurement subdomain. The Probability, Statistics, and Data Analysis standards were reflected in NAEP Data Analysis, Statistics, and Probability topics, with the exception of the ACT standard pertaining to the probabilities of an event and its complement; the panel could not find a compatible topic in the NAEP framework. By and large, the panel felt that the College Readiness Standards in the Numbers: Concepts and Properties strand were reflected in NAEP Number Properties and Operations topics, and the Expressions, Equations, and Inequalities standards could be found within the NAEP Algebra subdomain.

The panel split the ACT Graphical Representations standards between NAEP Geometry and Algebra topics. Algebra topics were matched to the standards dealing with inequalities, as well as to the highest-level GRE standards pertaining to analysis and the integration of algebraic and geometric concepts. NAEP Geometry and Measurement topic areas were seen as reflecting the Properties of Plane Figures standards. The panel was able to identify NAEP Measurement topics consistent with most of the ACT Measurement standards, although a comparatively low number of different NAEP topics were listed for the standards in this strand. Finally, the College Readiness Standards listed under the Functions strand were seen as addressing NAEP topics primarily in the Measurement and Algebra subdomains.

Discussion

In either subject area, the panel found considerable overlap in what the ACT and the NAEP assess; this is clear from the comparison of the NAEP domains either to the ACT domains or to the College Readiness Standards. However, the panel also pointed out some important differences between the assessments to which attention should be paid.

In the case of Reading, both assessments employ texts that are authentic, high-quality, engaging, and drawn from a variety of contexts. The domain of text types employed by the NAEP, however, is broader than that of the ACT. Each ACT Reading Test contains one work of prose fiction, and three works of literary or informational nonfiction: one from the humanities, one from the social sciences, and one from the natural sciences. All ACT passages are chosen to be indicative of the types of prose an examinee can expect to read in first-year college English, social studies, or science coursework. NAEP texts are chosen to reflect the broader variety of text types an examinee has been exposed to by Grade 12. This means that, in addition to prose fiction and literary and informational nonfiction, NAEP also employs poetry, persuasive nonfiction designed to encourage an action, and procedural texts and documents pertaining to specific tasks, text types that do not appear on the ACT. The ACT Reading Test domain includes a detailed taxonomy to describe the complexity of each passage, while the NAEP framework addresses complexity through the choice of texts for grade-level appropriateness and length.

Many of the reading skills measured by the two assessments are similar but, again, there are some notable differences. All of the skills highlighted in the ACT domain and in the College Readiness Standards were identified within the NAEP Reading framework. In performing the comparison in the other direction—NAEP to ACT—it was the sense of the panel that the ACT measured primarily those skills that NAEP identifies as *Locate/Recall* and *Integrate/Interpret* skills, those that pertain primarily to finding explicit information in text (what the ACT would call Referring skills) and to making inferences, drawing conclusions, and making generalizations from information within text (what the ACT would call Reasoning skills). The panel saw less evidence of the higher-level analytical and evaluative *Critique/Evaluate* skills in the ACT domain, and attributed that to the multiple-choice format of the ACT. Another difference is that NAEP includes items and texts measuring how well an examinee can apply reading skills across texts, whereas the paired passage format is not a feature of the ACT. So, while the NAEP Reading framework and the ACT Reading domain, test specifications, and College Readiness Standards share similarities, important differences in what and how the assessments measure suggest caution when drawing comparisons between the assessments.

Caution should likewise be used in making any judgments about the similarity between the NAEP and ACT Mathematics assessments. The Mathematics panel found that the two assessments have much of their content domains in common. However, in the NAEP-to-ACT comparison, the difference in specificity with which the domains are articulated in the assessment documents left the panel uncertain as to whether a number of NAEP content topics—those pertaining to transformations, probability, statistics, and data analysis—are assessed by the ACT. In addition, there was some uncertainty within the panel on the degree to which higher-order analytic skills were assessed, and it was the sense of the panel that the ACT Mathematics Test contained few items involving high mathematical complexity, at least as the NAEP defines it. With regard to the ACT-to-NAEP comparison, the Mathematics panel found nearly all of the ACT Mathematics domain and College Readiness Standards reflected in the NAEP Mathematics domain, but determined that a number of the lower-level topics in the ACT Pre-Algebra subdomain were more consistent with

Grade 8 NAEP topics. All of these points suggest that while there may be substantial overlap in what the two assessments measure and how they measure it, there are areas of difference, as well.

Evaluation of the Alignment Study

After data for the Alignment Study had been collected, both panels were administered an evaluation questionnaire (Appendix J) to gather their impressions of the materials that were pre-mailed, the orientation session, and the alignment process. The evaluation included 14 forced-choice, Likert-type items pertaining to the pre-mailing, the orientation, and the small- and large-group rounds of the Alignment study.

Table 3.5 presents the panelists' responses to the forced-choice items. It includes the frequencies of their responses to each question as well as the average response from each panel. In calculating the averages, the response options were each given a value of 1 to 5. For example, a response of "Totally Agree" to Question 1 was given a value of 1, "Somewhat Agree" was given a value of 3, and so on. So, looking at the responses to Question 1, it appears that nearly every panelist thought that the pre-mailing of materials adequately prepared them for the Alignment Study. All but one panelist agreed at least somewhat with that statement, and the average responses were 1.9 and 2.3, both above the "Somewhat Agree" mark. Likewise, all panelists had a positive response to the organization of the advanced materials: average responses were 1.4 and 1.6. Every panelist felt that the right amount of time was devoted to the opening orientation session (Question 3), that the explanation of the purpose and goals of the study was at least somewhat clear (Question 4), and that the introductions to the NAEP and the ACT were at least somewhat clear (Questions 5 and 6).

Panel members also had an overall positive response to the small-group portion of the Alignment Study (Questions 7-10). All thought that the overview of the method was at least somewhat clear (the average response for either group was 2.4), and that the time allotted to the task was at least somewhat adequate (the average response for either group was 2.0). Both groups felt they were given adequate opportunities to voice their opinions (average responses for Question 9 were 1.4 and 1.9), and both panels came away from the small-group round feeling at least fairly confident in judgments they made comparing each assessment to the other (average responses for Question 10 were 2.0 and 2.4).

The opinions of the panel members changed little when asked to consider the large-group discussion round. Overall, the Reading panel thought that the time allotted for this round was more adequate than in the previous round (their average response for Question 11 was 1.6, compared to 2.0 for Question 8), while the opinion of the Math panel was essentially unchanged from the previous round. Both panels also felt that the opportunities they were given to voice their opinions (Question 12) were as adequate, or slightly more adequate, than in the previous round. The confidence level of the Mathematics panel was essentially unchanged from the first round to the second (their average response for Question 13 was 2.3, compared with 2.4 for Question 10). The confidence level of the Reading panel rose slightly; the average response for Question 13 was 1.6, compared to 2.0 for Question 10, and every Reading panelist reported feeling more than "fairly confidant" with his/her judgments after the group discussion. Finally, members of both panels were varied considerably in their opinions of whether the method used in the study captured the important elements of both assessments, with the responses of either

panel spanning four of the five points on the scale. Average responses for Question 14 were 2.3 and 2.5, however, indicating that as a group each panel agreed at least somewhat that the method used in the Alignment Study did what it was intended to do.

Table 3.1
Results of the Comparison of the NAEP Reading Framework to the
ACT Reading Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Reading Framework Feature (NAGB, 2008a; 2007a)	ACT Reading Domain Feature/Test Specification/ College Readiness Standard*
TYPES OF TEXTS	
Literary texts (30%)	
Fiction: e.g., adventure, historical fiction, realistic fiction, folktales/legends/myths/fantasy, satire, parody, allegory, monologue; intact passages or excerpts	25% Prose Fiction. Primarily excerpts from short stories, novels. There may well be a range of fiction types but they are not systematically chosen for type. No fantasy or myths.
Literary nonfiction: e.g., personal essay, autobiographical/biographical, sketches, speech, character sketch, memoir, classical essay; intact passages or excerpts	Some Humanities passages would be considered literary nonfiction. Similar essays—personal essay, memoirs, biographical sketches—although few or no classical essays. Primarily 20th- and 21st-century works. Excerpts or adaptations.
Poetry: e.g., narrative poem, free verse, lyrical poem, humorous poem, ode, song, epic, sonnet, elegy; intact poems or excerpts	No poetry.
Informational texts (70%)	As much as 75%—Humanities, Social Sciences, and Natural Sciences—although some Humanities texts might be considered literary nonfiction.
Exposition: e.g., essay, literary analysis; intact passages or excerpts	Most if not all Humanities, Social Science, and Natural Science passages are of this type.
Argumentation and persuasive text: e.g., informational trade book, journal, speech, persuasive essay, letter to the editor, argumentative essay, editorial, historical account, position paper (brochure, campaign literature, advertisement, etc.)	Few, if any. Passages are not labeled as such, but some may have elements of argument. No graphics.
Procedural text and documents	Not a feature.
Mixed texts	May be used in some passages (e.g., an economics essay with a biographical aside).
Paired texts	No paired texts.
CHARACTERISTICS OF TEXTS SELECTED FOR INCLUSION	
Authentic	Texts are adapted or excerpted from the original sources, not created for the test.
High-quality	Texts are adapted or excerpted from published works, and are of high quality.
Coherent	Texts are coherent though may be adapted/excerpted.
Grade-appropriate	Texts are at an appropriate level for college-ready students.
Drawn from a variety of contexts	Texts are primarily 20th-century pieces; the emphasis is not on "classical" authors or the canon. Passages reflect diverse (not just ethnic) literary heritages (e.g., region, gender).
Engaging	Texts are engaging.

* GEN: Generalizations and Conclusions; MID: Main Ideas and Author's Approach; MOW: Meanings of Words; REL: Sequential, Comparative, and Cause-Effect Relationships; SUP: Supporting Details

Table 3.1 (continued)
Results of the Comparison of the NAEP Reading Framework to the
ACT Reading Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Reading Framework Feature (NAGB, 2008a; 2007a)	ACT Reading Domain Feature/Test Specification/ College Readiness Standard*
Reflecting our literary heritage, including works from varied historical periods	Texts are primarily 20th-century pieces; the emphasis is not on "classical" authors or the canon. Passages reflect diverse (not just ethnic) literary heritages (e.g., region, gender). The contemporary frame of reference reflects diverse literary heritages.
PASSAGE LENGTH	
Approximately 500-1,500 words	Approximately 750 words
COGNITIVE TARGETS	
Locate/recall (20%): identify textually explicit information and make simple inferences with and across texts, such as:	Referring items; no specific %.
Definitions	Contextual meaning: MOW 201, 401-701
Facts	SUP 201
Supporting details	SUP 201-702
Character traits	SUP 201, 501; REL 301, 402, 502, 503, 602; GEN 201
Sequence of events or actions	REL 201, 401, 501, 601, 701
Setting	SUP 201-702
Figurative language	MOW 301
Topic sentence or main idea	MID 201-701, but topic sentences not mentioned explicitly
Author's purpose	MID 201, 301
Causal relations	REL 201-202, 302, 403, 505, 603, 701, 703
Specific information in texts or graphics	SUP all, in texts, not graphics
Integrate/Interpret (45%): make complex inferences within and across texts to:	Reasoning items; no specific %.
Compare or connect ideas, problems, or situations	SUP 602; REL all
Determine unstated assumptions in an argument	MID 603; GEN all
Describe how an author uses literary devices and text features	Perhaps not measured as explicitly as in NAEP due to constrictions of the multiple-choice format; MID 603; SUP 702
Infer mood or tone	MID 603, 700 level; MOW 401, 502
Integrate ideas to determine theme	SUP 702; REL 702; GEN 701
Identify or interpret a character's motivations or decisions	SUP 601, 701; REL 503, 601, 602, 702, 703
Examine relations between theme and setting or characters	MID 601; SUP 702; REL 402, 602, 702, 703; GEN 701
Explain how rhythm, rhyme, or form in poetry contribute to meaning	Not applicable
Summarize major ideas	MID all
Draw conclusions and provide supporting information	GEN all
Find evidence in support of an argument	MID 603; SUP 503, 602; GEN 402, 601
Distinguish facts from opinions	SUP 201, 402; GEN 301, 401
Determine the importance of information within and across texts	SUP 401, 501, 601, 602; GEN 601; within texts, not across

* GEN: Generalizations and Conclusions; MID: Main Ideas and Author's Approach; MOW: Meanings of Words; REL: Sequential, Comparative, and Cause-Effect Relationships; SUP: Supporting Details

Table 3.1 (continued)
Results of the Comparison of the NAEP Reading Framework to the
ACT Reading Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Reading Framework Feature (NAGB, 2008a; 2007a)	ACT Reading Domain Feature/Test Specification/ College Readiness Standard*
Critique/Evaluate (35%): consider text(s) critically to:	Some items but at a much lower percentage than on NAEP.
Judge author's craft and technique	MID 402, 504, 603; GEN 702
Evaluate the author's perspective or point of view within or across texts	MID 402, 504, 603, GEN 702; within but not across texts
Take different perspectives in relation to a text	GEN 701
Evaluate the role of literary devices in conveying meaning	MID 603, SUP 702; perhaps not measured as explicitly as in NAEP due to constrictions of the multiple-choice format
Evaluate a character's motivations and decisions	Fewer evaluative items; REL 502, 602, 702; GEN 401, 501, 601, 701
Analyze the point of view used by the author	MID 402, 504, 603, if "understand" taken to mean "analyze"
Analyze the representation of information	GEN 701 may cover this but "evaluate" is problematic given the MC format
Evaluate the way the author selects language to influence readers	Perhaps GEN 701, 702, but "evaluate" is problematic given the MC format
Evaluate the strength and quality of evidence use by the author to support his./her position	GEN may cover this but "evaluate" is problematic given the MC format
Determine the quality of counterarguments within and across texts	No
Judge the coherence, logic, or credibility of an argument	No
ITEM TYPES	
Multiple-choice (40%)	100% multiple choice
Four answer options: one correct, three incorrect	Same
Assumed time to complete: approx. 1 minute	Approximately: 40 items in 35 minutes
Short constructed response (45%)	None
Extended constructed-response (15%)	None

* GEN: Generalizations and Conclusions; MID: Main Ideas and Author's Approach; MOW: Meanings of Words; REL: Sequential, Comparative, and Cause-Effect Relationships; SUP: Supporting Details

Table 3.2
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
PASSAGE CONTENT (ACT, 2008a)	
Prose Fiction (25%): passages from short stories or novels	Fiction: 20%, but a greater variety of genres is included in NAEP.
Humanities (25%): passages from memoirs, personal essays, and nonfiction essays on architecture, art, dance, ethics, film, language, literary criticism, music, philosophy, radio, religion, television, and theater	Literary nonfiction and informational texts might be included here. A greater variety of genres are included in the descriptions of literary nonfiction and some information.
Social Science (25%): nonfiction passages on anthropology, archaeology, biography, business, economics, education, geography, history, political science, psychology, and sociology	Informational texts (70%) may be from the social sciences, but texts are not specified by genre.
Natural Science.(25%): nonfiction passages on anatomy, astronomy, biology, botany, chemistry, ecology, geology, medicine, meteorology, microbiology, natural history, physiology, physics, technology, and zoology	Informational texts may be from the natural sciences, but texts are not specified by genre.

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
COMPLEXITY OF PASSAGES (ACT, 2008c)	
Uncomplicated literary narratives: • use simple language and structure; • have a clear purpose, familiar style; • present straightforward interactions between characters; • employ a limited number of literary devices.	Passage complexity is addressed indirectly through the characteristics of grade appropriateness and length of passage. As grade level increases, NAEP framework calls for "increasingly complex" passages.
More challenging literary narratives: • make moderate use of figurative language; • have a more intricate structure; • have messages conveyed with some subtlety; • may feature somewhat complex interactions between characters.	
Complex literary narratives: • make generous use of ambiguous language and literary devices; • feature complex and subtle interactions between characters; • contain challenging context-dependent vocabulary; • contain messages and/or meanings that are not explicit but are embedded in the passage.	
Uncomplicated informational passages: • contain a limited amount of data; • address basic concepts using familiar language; • use conventional organizational patterns; • have a clear purpose' • are written to be accessible.	
More challenging informational passages: • present concepts that are not always stated explicitly; • accompany concepts with more—and more detailed—supporting data; • include difficult context-dependent words; • are written in a more demanding and less accessible style.	
Complex informational passages: • include a sizable amount of data; • present difficult concepts that are embedded (not explicit) in the text; • use demanding words and phrases whose meaning must be determined from context; • are likely to include intricate explanations of processes or events.	
PASSAGE LENGTH (ACT, 2008a)	
Approximately 750 words	500–1500 words

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
COGNITIVE SKILLS (ACT, 2008a, 2007b)	(Note: The phrases below refer to the Cognitive Targets provided on page 46 of the *NAEP Assessment and Item Specifications*.)
Referring – Main Ideas	
Recognizing the main idea of a passage	Locate/Recall – Specific to Informational Text
Recognizing the main idea of a paragraph or paragraphs	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Informational Text
Referring – Relationships	
Recognizing sequences	Locate/Recall – Specific to Literary Text Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
Recognizing cause-effect relationships	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text
Recognizing comparative relationships (comparisons and contrasts)	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text
Referring – Significant Details	
Recognizing the information in a passage that answers the questions who, what, where, when, why, and how	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Informational Text
Reasoning – Inferences from the Text	
Inferring the main idea or purpose of a passage	Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
Inferring the main idea or purpose of a paragraph or paragraphs	Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
Showing how details are related to main ideas (e.g., how they support the main idea)	Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
Inferring sequences	Locate/Recall – Specific to Literary Text Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text
Inferring cause-effect relationships	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text
Reasoning – Critical Understanding of the Text	
Drawing conclusions from information given in the passage	Integrate/Interpret – Specific to Informational Text
Making comparisons and contrasts using stated information	Integrate/Interpret – Both Literary and Informational Text
Making appropriate generalizations	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text (though "generalizations" are not explicitly mentioned)
Understanding point of view	Critique/Evaluate – Both Literary and Informational Text Critique/Evaluate – Specific to Literary Text Critique/Evaluate – Specific to Informational Text

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
Recognizing logical fallacies, rhetorical flaws, or limitations in passages	Integrate/Interpret – Both Literary and Informational Text Critique/Evaluate – Specific to Literary Text Critique/Evaluate – Specific to Informational Text
Recognizing stereotypes	Critique/Evaluate – Specific to Informational Text
Distinguishing between fact and opinion	Integrate/Interpret – Specific to Informational Text Critique/Evaluate – Specific to Informational Text
Reasoning – Context-Dependent Vocabulary	
Determining the meaning in context of multiple-meaning words or short phrases	Vocabulary in context is assessed on NAEP (NAGB, 2008a, p.32), though not listed among cognitive targets.
ITEM TYPES (ACT, 2008a)	
Multiple-choice (100%)	40% MC; 45% short constructed response (2 or 3 score points) 15% extended constructed response (4 score points). Percentages are across the entire item pool; each examinee is not necessarily administered items in those same percentages.
Four answer options: one correct, three incorrect	Same.
COLLEGE READINESS STANDARDS (ACT, 2008d)	
Main Ideas and Author's Approach (MID)	
201. Recognize a clear intent of an author or narrator in uncomplicated literary narratives	Locate/Recall – Specific to Informational Text
301. Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	Locate/Recall – Specific to Informational Text
401. Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Informational Text
402. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text Critique/Evaluate – Both Literary and Informational Text Critique/Evaluate – Specific to Literary Text
501. Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages	Locate/Recall – Specific to Informational Text
502. Infer the main idea or purpose of straightforward paragraphs in more challenging passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Informational Text
503. Summarize basic events and ideas in more challenging passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Informational Text
504. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text
601. Infer the main idea or purpose of more challenging passages or their paragraphs	Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Informational Text
602. Summarize events and ideas in virtually any passage	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Literary Text Integrate/Interpret – Specific to Informational Text

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
603. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text Critique/Evaluate – Both Literary and Informational Text Critique/Evaluate – Specific to Informational Text
701. Identify clear main ideas or purposes of complex passages or their paragraphs	Locate/Recall – Specific to Informational Text
Supporting Details (SUP)	
201. Locate basic facts (e.g., names, dates, events) clearly stated in a passage	Locate/Recall – Both Literary and Informational Text
301. Locate simple details at the sentence and paragraph level in uncomplicated passages\	Locate/Recall – Both Literary and Informational Text
302. Recognize a clear function of a part of an uncomplicated passage	Locate/Recall – Specific to Literary Text Integrate/Interpret – Specific to Literary Text
401. Locate important details in uncomplicated passages	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Literary Text
402. Make simple inferences about how details are used in passages	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Literary Text
501. Locate important details in more challenging passages	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Informational Text
502. Locate and interpret minor or subtly stated details in uncomplicated passages	Locate/Recall – Both Literary and Informational Text Locate/Recall – Specific to Literary Text
503. Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Specific to Informational Text
601. Locate and interpret minor or subtly stated details in more challenging passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
602. Use details from different sections of some complex informational passages to support a specific point or argument	Integrate/Interpret – Specific to Informational Text
701. Locate and interpret details in complex passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text Critique/Evaluate – Specific to Informational Text
702. Understand the function of a part of a passage when the function is subtle or complex	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text Critique/Evaluate – Specific to Literary Text
Sequential, Comparative, and Cause-Effect Relationships (REL)	
201. Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages	Locate/Recall – Specific to Literary Text
202. Recognize clear cause-effect relationships described within a single sentence in a passage	Locate/Recall – Specific to Literary Text Locate/Recall – Specific to Informational Text
301. Identify relationships between main characters in uncomplicated literary narratives	Integrate/Interpret – Specific to Literary Text
302. Recognize clear cause-effect relationships within a single paragraph in uncomplicated literary narratives	Locate/Recall – Specific to Informational Text

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
401. Order simple sequences of events in uncomplicated literary narratives	Locate/Recall – Specific to Literary Text
402. Identify clear relationships between people, ideas, and so on in uncomplicated passages	Integrate/Interpret – Specific to Literary Text
403. Identify clear cause-effect relationships in uncomplicated passages	Locate/Recall – Specific to Informational Text
501. Order sequences of events in uncomplicated passages	Locate/Recall – Specific to Literary Text
502. Understand relationships between people, ideas, and so on in uncomplicated passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text
503. Identify clear relationships between characters, ideas, and so on in more challenging literary narratives	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text
504. Understand implied or subtly stated cause-effect relationships in uncomplicated passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text
505. Identify clear cause-effect relationships in more challenging passages	Locate/Recall – Specific to Informational Text Integrate/Interpret – Both Literary and Informational Text
601. Order sequences of events in more challenging passages	Locate/Recall – Specific to Literary Text Integrate/Interpret – Both Literary and Informational Text
602. Understand the dynamics between people, ideas, and so on in more challenging passages	Integrate/Interpret – Specific to Literary Text
603. Understand implied or subtly stated cause-effect relationships in more challenging passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text
701. Order sequences of events in complex passages	Locate/Recall – Specific to Literary Text Integrate/Interpret – Both Literary and Informational Text
702. Understand the subtleties in relationships between people, ideas, and so on in virtually any passage	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text
703. Understand implied, subtle, or complex cause-effect relationships in virtually any passage	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Informational Text
Meanings of Words (MOW)	
201. Understand the implication of a familiar word or phrase and of simple descriptive language	Vocabulary in context is measured on the NAEP.
301. Use context to understand basic figurative language	Vocabulary in context is measured on the NAEP.
401. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages	Vocabulary in context is measured on the NAEP.
501. Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages	Vocabulary in context is measured on the NAEP.
502. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages	Vocabulary in context is measured on the NAEP.

Table 3.2 (continued)
Results of the Comparison of the ACT Reading Domain, Test Specifications, and College Readiness Standards Test to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
601. Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts	Vocabulary in context is measured on the NAEP.
701. Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage	Vocabulary in context is measured on the NAEP.
Generalizations and Conclusions (GEN)	
201. Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
301. Draw simple generalizations and conclusions about people, ideas, and so on in uncomplicated passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
401. Draw generalizations and conclusions about people, ideas, and so on in uncomplicated passages	Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
402. Draw simple generalizations and conclusions using details that support the main points of more challenging passages	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
501. Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives	Integrate/Interpret – Both Literary and Informational Text Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
502. Draw generalizations and conclusions about people, ideas, and so on in more challenging passages	Integrate/Interpret – Specific to Literary Text Integrate/Interpret – Specific to Informational Text
601. Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so on	Integrate/Interpret – Specific to Informational Text Critique/Evaluate – Specific to Informational Text
701. Draw complex or subtle generalizations and conclusions about people, ideas, and so on, often by synthesizing information from different portions of the passage	Integrate/Interpret – Specific to Informational Text Critique/Evaluate – Specific to Informational Text
702. Understand and generalize about portions of a complex literary narrative	Critique/Evaluate – Specific to Informational Text

Table 3.3
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	**ACT Mathematics Domain Feature/Test Specification/College Readiness Standard***
MATHEMATICAL CONTENT AREAS	
Number Properties and Operations (NPO; 10% of items)	Pre-Algebra (approx. 23% of each test form)
1. Number sense	
d) Represent, interpret or compare expressions for real numbers, including expressions utilizing exponents and logarithms.	NCP 201, 301, 401, 506, 602, 604, 701, 702, 703; XEI 201
f) Represent or interpret expressions involving very large or very small numbers in scientific notation.	NCP 503, 504
g) Represent, interpret or compare expressions or problem situations involving absolute values.	NCP 401; XEI 604, 703
i) Order or compare real numbers, including very large and very small real numbers.	NCP 201, 301, 302, 401, 501, 502, 504, 701
2. Estimation	
b) Identify situations where estimation is appropriate, determine the needed degree of accuracy, and analyze the effect of the estimation method on the accuracy of results.	Estimation and accuracy assessed, but not reflected in CRS
c) Verify solutions or determine the reasonableness of results in a variety of situations.	Estimation and accuracy assessed, but not reflected in CRS
d) Estimate square or cube roots of numbers less than 1,000 between two whole numbers.	NCP 505, 507
3. Number operations	
a) Find integral or simple fractional powers of real numbers.	NCP 201, 501, 502, 503, 504, 505, 506, 507, 601, 604
b) Perform arithmetic operations with real numbers, including common irrational numbers.	BOA 201, 202, 203, 301, 302, 401, 501, 701
c) Perform arithmetic operations with expressions involving absolute value.	NCP 401 (if one assumes "Exhibit Knowledge" includes performing arithmetic operations; very weak)
d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a real number by: • Zero, • A number less than zero, • A number between zero and one, • One, or • A number greater than one.	NCP 201, 301, 302, 401, 501, 502, 503, 504, 508, 701
f) Solve application problems involving numbers, including rational and common irrationals.	BOA 301, 302, 401, 501, 601, 701; NCP 505, 506, 507
4. Ratios and proportional reasoning	
c) Use proportions to solve problems (including rates of change).	BOA 203, 401, 501, 601, 701

* BOA: Basic Operations and Applications; FUN: Functions; GRE: Graphical Representations; MEA: Measurement; NCP: Numbers: Concepts and Properties; PPF: Properties of Plane Figures; PSD: Probability, Statistics, and Data Analysis; XEI: Expressions, Equations, and Inequalities

Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
d) Solve multi-step problems involving percentages, including compound percentages.	BOA 401, 501, 601, 701
5. Properties of number and operations	
c) Solve problems using factors, multiples, or prime factorization.	NCP 401, 503, 601, 602 601 602
d) Use divisibility or remainders in problem settings.	Assessed, but not reflected in CRS
e) Apply basic properties of operations, including conventions about the order of operations.	BOA 201, 202, 203, 301, 302, 401, 501, 601; FUN 701
f) Recognize properties of the number system—whole numbers, integers, rational numbers, real numbers, and complex numbers—recognize how they are related to each other, and identify examples of each type of number.	NCP 201-509, 601-605, 701, 703
6. Mathematical Reasoning using Number	
a) Give a mathematical argument to establish the validity of a simple numerical property or relationship.	NCP 401, 701 (not explicit)
b) Analyze or interpret a proof by mathematical induction of a simple numerical relationship.	NCP 401, 602, 603 (not explicit)
Measurement (MEA; 35% of items, with Geometry)	
1. Measuring physical attributes	
b) Determine the effect of proportions and scaling on length, areas and volume.	MEA 201, 301, 302, 401, 501-503, 601, 602, 701, 702
c) Estimate or compare perimeters or areas of two-dimensional geometric figures.	MEA 201, 301, 302, 401, 402, 501, 503, 503, 601
d) Solve problems of angle measure, including those involving triangles or other polygons or parallel lines cut by a transversal.	PPF 301, 401, 402, 501, 503, 701, 702, 703
f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.	MEA 201, 301, 302, 401, 402, 501, 502, 503, 601, 702
h) Solve problems by determining, estimating, or comparing volumes or surface areas of three-dimensional figures.	3-D figures part of ACT domain, but weak in CRS (MEA 601 mentions "volume")
i) Solve problems involving rates such as speed, density, population density, or flow rates.	BOA 601, 701; GRE 502, 503, 504, 605, 704
2. Systems of measurement	
a) Recognize that geometric measurements (length, area, perimeter, and volume) depend on the choice of a unit, and apply such units in expressions, equations, and problem solutions.	BOA 203, 401, 501, 601, 701, 702; MEA 201-701

* BOA: Basic Operations and Applications; FUN: Functions; GRE: Graphical Representations; MEA: Measurement; NCP: Numbers: Concepts and Properties; PPF: Properties of Plane Figures; PSD: Probability, Statistics, and Data Analysis; XEI: Expressions, Equations, and Inequalities

Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
b) Solve problems involving conversions within or between measurement systems, given the relationship between the units.	BOA 203, 501, 601
d) Understand that numerical values associated with measurements of physical quantities are approximate, are subject to variation, and must be assigned units of measurement.	Unclear whether this is assessed. Not explicit.
e) Determine appropriate accuracy of measurement in problem situations (e.g., the accuracy of measurement of the dimensions to obtain a specified accuracy of area) and find the measure to that degree of accuracy.	NCP 302, 401
f) Construct or solve problems-involving scale drawings.	MEA 701, 702 (solve problems, not construct)
3. Measurement in Triangles	
a) Solve problems involving indirect measurement.	PPF 602, 701, 702; FUN 602, 702
b) Solve problems using the fact that trigonometric ratios (sine, cosine, and tangent) stay constant in similar triangles.	FUN 502, 602, 702, 703
c) Use the definitions of sine, cosine, and tangent as ratios of sides in a right triangle to solve problems about length of sides and measure of angles.	FUN 502, 601, 602, 702, 703
d) Interpret and use the identity $\sin^2 q + \cos^2 q = 1$ for angles q between 0° and 90°; recognize this identity as a special representation of the Pythagorean theorem.	FUN 502, 602, 702, 703
e) Determine the radian measure of an angle and explain how radian measurement is related to a circle of radius 1.	FUN 703
f) Use trigonometric formulas such as addition and double angle formulas.	FUN 702
g) Use the law of cosines and the law of sines to find unknown sides and angles of a triangle.	FUN 702
Geometry (GEO; 35% of items, with Measurement)	Coordinate Geometry (approx. 15%), Plane Geometry (approx. 23%)
1. Dimension and shape	
c) Give precise mathematical descriptions or definitions of geometric shapes in the plane and in three-dimensional space.	3-D figures part of the ACT Geometry domain, but not clear if this is tested
d) Draw or sketch from a written description plane figures and planar images of three-dimensional figures.	Not in the multiple-choice format

* BOA: Basic Operations and Applications; FUN: Functions; GRE: Graphical Representations; MEA: Measurement; NCP: Numbers: Concepts and Properties; PPF: Properties of Plane Figures; PSD: Probability, Statistics, and Data Analysis; XEI: Expressions, Equations, and Inequalities

Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
e) Use two-dimensional representations of three-dimensional objects to visualize and solve problems.	PPF 701, 702, 703
f) Analyze properties of three-dimensional figures including spheres and hemispheres.	3-D figures part of ACT Geometry domain, but weak in CRS (MEA 601 mentions "volume")
2. Transformation of shapes and preservation of properties	
a) Recognize or identify types of symmetries (e.g., point, line, rotational, self-congruence) of two- and three-dimensional figures.	Unclear if this is tested on the ACT.
b) Give or recognize the precise mathematical relationship (e.g., congruence, similarity, orientation) between a figure and its image under a transformation.	Unclear if this is tested on the ACT.
c) Perform or describe the effect of a single transformation on two- and three-dimensional geometric shapes (reflections across lines of symmetry, rotations, translations, and dilations).	Unclear if this is assessed.
e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.	MEA 601, 701; PPF 601
g) Perform or describe the effects of successive transformations.	Maybe FUN 701 but weak
3. Relationships between geometric figures	
b) Apply geometric properties and relationships to solve problems in two and three dimensions.	PPF 701, 702, 703; MEA 501, 503, 601
c) Represent problem situations with geometric models to solve mathematical or real-world problems.	PPF 701, 702, 703
d) Use the Pythagorean theorem to solve problems in two- or three-dimensional situations.	PPF 502, 602
e) Recall and interpret definitions and basic properties of congruent and similar triangles, circles, quadrilaterals, polygons, parallel, perpendicular and intersecting lines, and associated angle relationships.	PPF 301, 402, 502, 701, 702, 703
f) Analyze properties or relationships of triangles, quadrilaterals, and other polygonal plane figures.	PPF 301, 501, 601, 701, 702, 703 (all involve using properties, not "analyzing" them); seems to be assessed in Plane Geometry.
g) Analyze properties and relationships of parallel, perpendicular, or intersecting lines, including the angle relationships that arise in these cases.	GRE 604; PPF 301-703 (all involve using properties, not "analyzing" them); seems to be assessed in Plane Geometry.

* BOA: Basic Operations and Applications; FUN: Functions; GRE: Graphical Representations; MEA: Measurement; NCP: Numbers: Concepts and Properties; PPF: Properties of Plane Figures; PSD: Probability, Statistics, and Data Analysis; XEI: Expressions, Equations, and Inequalities

Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
h) Analyze properties of circles and the intersection of circles and lines (inscribed angles, central angles, tangents, secants, and chords).	GRE 605; PPF 703; MEA 502 (all involve using properties, not "analyzing" them); seems to be assessed in Plane Geometry.
4. Position, direction, and coordinate geometry	
a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines..	GRE 402, 403, 502, 504, 603, 604
b) Describe the intersections of lines in the plane and in space, intersections of a line and a plane, or of two planes in space.	GRE 604, 702, 703, 704
c) Describe or identify conic sections and other cross sections of solids.	GRE 605, 702, 703; seems to be assessed in Coordinate Geometry.
d) Represent two-dimensional figures algebraically using coordinates and/or equations.	GRE 601, 605, 702, 704
e) Use vectors to represent velocity and direction; multiply a vector by a scalar and add vectors both algebraically and graphically.	Seems to be assessed be aspects of Intermediate Algebra and Trigonometry, but not explicit in CRS.
f) Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.	GRE 604, 605
g) Graph ellipses and hyperbolas whose axes are parallel to the coordinate axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.	May be assessed in aspects of Coordinate Geometry, but not explicit in CRS.
h) Represent situations and solve problems involving polar coordinates.	May be assessed in aspects of Trigonometry, but not explicit in CRS.
5. Mathematical Reasoning in Geometry	
a) Make, test, and validate geometric conjectures using a variety of methods including deductive reasoning and counterexamples.	May be assessed by aspects of Geometry, but not clear.
b) Determine the role of hypotheses, logical implications, and conclusion, in proofs of geometric theorems.	May be assessed by aspects of Geometry, but not clear.
c) Analyze or explain a geometric argument by contradiction.	May be assessed by aspects of Geometry, but not clear.
d) Analyze or explain a geometric proof of the Pythagorean theorem.	May be assessed by aspects of Geometry, but not clear.
e) Prove basic theorems about congruent and similar triangles and circles.	May be assessed by aspects of Geometry, but not clear. Maybe PPF 701.

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Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
Data Analysis, Statistics, and Probability (DASP; 25%)	Probability and Statistics (part of Pre-Algebra)
1. Data representation	
a) Read or interpret graphical or tabular representations of data.	PSD 202, 303, 402, 602, 702
b) For a given set of data, complete a graph and solve a problem using the data in the graph (histograms, scatterplots, line graphs).	PSD 202, 301, 302, 304, 401, 402, 501, 502, 601, 702
c) Solve problems involving univariate or bivariate data.	PSD 202, 301, 302, 304, 401, 501, 502, 601, 702
d) Given a graphical or tabular representation of a set of data, determine whether information is represented effectively and appropriately.	Maybe PSD 402, 502, 602, 702
e) Compare and contrast different graphical representations of univariate and bivariate data.	PSD 303, 402, 602, 702
f) Organize and display data in a spreadsheet in order to recognize patterns and solve problems.	Creating a spreadsheet not covered, but using data is covered in PSD 502, 602, 702.
2. Characteristics of data sets	
a) Calculate, interpret, or use summary statistics for distributions of data including measures of typical value (mean, median), position (quartiles, percentiles), and spread (range, interquartile range, variance, standard deviation).	PSD 201, 202, 301, 302, 304, 401, 501, 502, 503, 601, 701, 702
b) Recognize how linear transformations of one-variable data affect mean, median, mode, range, interquartile range, and standard deviation.	Not clear if this is assessed. Maybe PSD 602, 702 apply.
c) Determine the effect of outliers on mean, median, mode, range, interquartile range, or standard deviation.	Not clear if this is assessed. Maybe PSD 602, 702 apply.
d) Compare data sets using summary statistics (mean, median, mode, range, interquartile range, or standard deviation) describing the same characteristic for two different populations or subsets of the same population.	Unclear; maybe PSD 602, 701, 702
e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make a prediction.	Maybe PSD 602, 702.

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Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
f) Recognize that the correlation coefficient is a number from –1 to +1 that measures the strength of the linear relationship between two variables; visually estimate the correlation coefficient (e.g., positive or negative, closer to 0, .5, or 1.0) of a scatterplot.	Seems to be assessed in Probability and Statistics; maybe PSD 602, 702.
g) Know and interpret the key characteristics of a normal distribution such as shape, center (mean), and spread (standard deviation).	Seems to be assessed in Probability and Statistics; not in CRS.
3. Experiments and samples	
a) Identify possible sources of bias in sample surveys, and describe how such bias can be controlled and reduced.	Not clear if this is assessed.
b) Recognize and describe a method to select a simple random sample.	Not clear if this is assessed.
c) Draw inferences from samples, such as estimates of proportions in a population, estimates of population means, or decisions about differences in means for two "treatments".	PSD 702
d) Identify or evaluate the characteristics of a good survey or of a well-designed experiment.	Not clear if this is assessed.
e) Recognize the differences in design and in conclusions between randomized experiments and observational studies.	Not clear if this is assessed.
4. Probability	
a) Recognize whether two events are independent or dependent.	PSD 602, 702, 703 may apply.
b) Determine the theoretical probability of simple and compound events in familiar or unfamiliar contexts.	PSD 403, 404, 503, 603, 604, 703
c) Given the results of an experiment or simulation, estimate the probability of simple or compound events in familiar or unfamiliar contexts.	PSD 604, 703
d) Use theoretical probability to evaluate or predict experimental outcomes.	PSD 403
e) Determine the number of ways an event can occur using tree diagrams, formulas for combinations and permutations, or other counting techniques.	Maybe PSD 603.
h) Determine the probability of independent and dependent events.	Not clear; maybe PSD 703.
i) Determine conditional probability using two-way tables.	PSD 703

* BOA: Basic Operations and Applications; FUN: Functions; GRE: Graphical Representations; MEA: Measurement; NCP: Numbers: Concepts and Properties; PPF: Properties of Plane Figures; PSD: Probability, Statistics, and Data Analysis; XEI: Expressions, Equations, and Inequalities

Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
j) Interpret and apply probability concepts to practical situations.	PSD 503, 603, 604, 702, 703
k) Use the binomial theorem to solve problems.	Not clear if this is assessed.
5. Mathematical Reasoning with Data	
a) Identify misleading uses of data in real-world settings and critique different ways of presenting and using information.	Maybe PSD 502, 602, 702
b) Distinguish relevant from irrelevant information, identify missing information, and either find what is needed or make appropriate approximations.	Maybe PSD 602 702
c) Recognize, use, and distinguish between the processes of mathematical (deterministic) and statistical modeling.	Not clear if this is assessed.
d) Recognize when arguments based on data confuse correlation with causation.	Not clear if this is assessed. Maybe PSD 602, 702 apply.
e) Recognize and explain the potential errors caused by extrapolating from data.	Not clear if this is assessed. Maybe PSD 602, 702 apply.
Algebra (ALG; 35%)	Elementary Algebra (approx. 17%), Intermediate Algebra (approx. 15%)
1. Patterns, relations, and functions	
a) Recognize, describe, or extend numerical patterns, including arithmetic and geometric progressions.	NCP 401, 702
b) Express linear and exponential functions in recursive and explicit form given a table, verbal description, or some terms of a sequence.	XEI 701, 702; FUN 401
e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or trigonometric functions from tables, graphs, or equations.	GRE 503, 605, 702, 704; FUN 401
g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.	Not clear if this is assessed. Maybe GRE 702, 704.
h) Recognize and analyze the general forms of linear, quadratic, rational, exponential, or trigonometric functions.	GRE 503, 601, 605, 701, 702, 704; FUN401, 501, 704
i) Determine the domain and range of functions given in various forms and contexts.	Assessed in Intermediate Algebra. Maybe GRE 704.
j) Given a function, determine its inverse if it exists, and explain the contextual meaning of the inverse for a given situation.	Assessed in Intermediate Algebra. Maybe GRE 701, 704.

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Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
2. Algebraic expressions	
a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.	XEI 404, 502, 602, 702; GRE 701, 704
b) Analyze or interpret relationships expressed in symbols, graphs, tables, diagrams (including Venn diagrams), or written descriptions and evaluate the relative advantages or disadvantages of different representations to answer specific questions.	PSD 504, 702; GRE 704; FUN 601, 701, 704,
d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and trigonometric functions.	May be assessed, but unclear. Maybe FUN 601, 701, 704.
e) Make inferences or predictions using an algebraic model of a situation.	XEI 701, 702; GRE 703, 704; FUN 602
f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or trigonometric function fits the situation.	GRE 702, 703, 704; FUN 702
g) Solve problems involving exponential growth and decay.	Assessed in Intermediate Algebra. XEI 701 702.
h) Analyze properties of exponential, logarithmic, and rational functions.	GRE 704
3. Variables, expressions, and operations	
b) Write algebraic expressions, equations, or inequalities to represent a situation.	XEI 502, 602, 701, 702
c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.	XEI 201, 302, 303, 402, 405, 504, 505, 601
d) Write equivalent forms of algebraic expressions, equations, or inequalities to represent and explain mathematical relationships.	XEI 602, 701, 702
e) Evaluate algebraic expressions, including polynomials and rational expressions.	XEI 201, 301, 401, 601
f) Use function notation to evaluate a function at a specified point in its domain and combine functions by addition, subtraction, multiplication, division, and composition.	XEI 301, 402, 405, 504, 505, 601; FUN 401, 501, 601, 701
g) Determine the sum of finite and infinite arithmetic and geometric series.	NCP 702
h) Use basic properties of exponents and logarithms to solve problems.	NCP 604, 702

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Table 3.3 (continued)
Results of the Comparison of the NAEP Mathematics Framework
to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b; 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard*
4. Equations and inequalities	
a) Solve linear, rational or quadratic equations or inequalities, including those involving absolute value.	XEI 202, 302, 403, 501, 503, 505, 506, 603, 604, 605, 606, 703
c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.	XEI 202, 302, 403, 501, 502, 503, 506, 602, 603, 604, 605, 606, 701, 703
d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.	XEI 606; GRE 704
e) Solve problems involving special formulas such as: $A = P(I + r)^t$, $A = Pe^{rt}$].	Assessed in Intermediate Algebra. Maybe XEI 601.
f) Solve an equation or formula involving several variables for one variable in terms of the others.	XEI 501, 502, 601, 702
g) Solve quadratic equations with complex roots.	NCP 509, 703; XEI 503, 505, 605
5. Mathematical Reasoning in Algebra	
a) Use algebraic properties to develop a valid mathematical argument.	Not clear if this is assessed.
b) Determine the role of hypotheses, logical implications, and conclusions in algebraic argument.	Not clear if this is assessed.
c) Explain the use of relational conjunctions (and, or) in algebraic arguments.	Not clear if this is assessed.
MATHEMATICAL COMPLEXITY OF ITEMS	
Low Complexity (25%)	Many Knowledge and Skills and Direct Applications items would fall into this category.
Moderate Complexity (50%)	Most Knowledge and Skills, Direct Applications, Understanding Concepts and Integrating Conceptual Understanding items would fall into this category.
High Complexity (25%)	There seem to be few ACT items in this category, based on "heavy demands on students, who are expected to use reasoning, planning, analysis, judgment and creative thought."
ITEM FORMATS	
Multiple-choice (50% of testing time)	100%
Four or five answer options: one correct, three or four incorrect	Five answer options; one correct answer
Short constructed response (50%, with Extended CR)	None
Extended constructed-response (50%, with Short CR)	None

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Table 3.4
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
TEST DOMAIN (ACT, 2008b, 2007c)	**Note: All NAEP domain topics are for Grade 12 unless noted.**
Pre-Algebra (23% of questions)	
Addition, subtraction, multiplication, division of whole numbers, decimals, fractions, integers	NPO 3a, b (Gr..4, 8)
Positive integer exponents	NPO 3a
Prime factorization	NPO 5c
Comparison of fractions	Gr. 8 NPO 1h
Ratio and proportion	NPO 4c; also Gr. 8 NPO 4a, 4b, 4c, 4d
Conversion between fractions and decimals	Gr. 8 NPO 1e
Absolute value	NPO 1g, NPO 3c; also Gr. 8 NPO 1g
Solution of simple linear equations in one variable	ALG 4a (both Gr. 8 and 12)
Percent	NPO 4d
Scientific notation	NPO 1f (both Gr. 8 and 12)
Square roots	NPO 2d, 3a
Operations with real numbers (field axioms)	NPO 3b, 3f, 5e, 5f
Order properties for real numbers	NPO 1f ; also Gr. 8 NPO 5e
Common factors and common multiples	NPO 5c
Counting and counting techniques	DASP 4e, 4k; also Gr. 8 DASP 4f
The concept of probability	DASP 4a, 4b, 4c, 4d, 4h, 4i, 4j
Data collection and representation	DASP 3a, 3b, 3c, 3d, 3e, 5°, 5b, 5c, 5d, 5e
Reading and interpreting graphs, charts, and other representations of data	DASP 1a, 1b, 1c, 1d, 1e, 1f
Using the mean, median, mode, and range	DASP 2a, 2b, 2c, 2d, 2g
Elementary Algebra (17%), e.g.,	
Evaluation of algebraic expressions by substitution	ALG 3e, 3f
Simplification of algebraic expressions	ALG 3c, 3d
Addition, subtraction, and multiplication of polynomials	ALG 3c
Factorization of polynomials	ALG 3c; also Gr. 8 ALG 3c
Solution of quadratic equations by factoring	ALG 4a, 4g
Formula manipulation and field properties of algebraic expressions	ALG 1b, 3c, 3d, 4e, 4f
Intermediate Algebra (15%); e.g.,	
Solution of linear inequalities in one variable	ALG 4a, 4c
Operations with integer exponents	NPO 1d; ALG 2d, 3h
Operations with rational expressions	ALG 3c
Slope-intercept form of a linear equation	ALG 1b, 1e, 1h; also Gr. 8 ALG 4d
Operations with radical expressions	ALG 3c, 3h
Quadratic formula	ALG 4a, 4g
Zeros of polynomials	ALG 4a, 4c, 4g
Rational exponents	NPO 3a

* ALG: Algebra; DASP: Data Analysis, Statistics, and Probability; GEO: Geometry; MEA: Measurement; NPO: Number Properties and Operations

Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
Solution of systems of two linear equations in two variables	ALG 4d
Simple absolute value equations and inequalities	NPO 1g; ALG 4a
Counting techniques and probability using factorials, combinations, and permutations	DASP 4b, 4e
Coordinate Geometry (15%); e.g.,	
Graphing on the number line	NPO 1d; also Gr. 8 NPO 1b
Identification and location of points in the coordinate plane	GEO 4a; also Gr. 8 GEO 4a
Determination of graphs of functions and relations in the plane by plotting points	GEO 4a, 4b, 4c, 4d, 4f, 4g, 4h
Graphs of linear equations in two variables	ALG 2a, both Gr. 12 and Gr. 8
Slope of a line	GEO 4a; ALG 3b; also Gr. 8 ALG 4a
Distance formula for points in the plane	GEO 4a
Equations of parallel and perpendicular lines	GEO 3g, 4a
Graphical solutions to systems of equations and inequalities	ALG 4a, 4d
Graphs of parabolas, circles, ellipses, and hyperbolas	GEO 4c, 4d, 4g
Rotation, reflection, and other transformations	GEO 2a, 2b, 2c, 2d
Plane Geometry (23%); e.g.,	
Identification of plane geometric figures	GEO 1c, 1d; also Gr. 8 GEO 1b, 1c, 1d
Basic properties of a circle: radius, diameter, and circumference	GEO 3h, 4f; MEA 1f
Measurement and construction of right, acute, and obtuse angles	GEO 3e; MEA 1d
Parallel lines and transversals	GEO 3e, 3g; MEA 1d
Congruent and similar triangles	GEO 2b, 2e, 3e
Areas of circles, triangles, rectangles, parallelograms, trapezoids, and, with formulas, other figures	MEA 1f (both Gr. 8 and Gr. 12)
Pythagorean theorem	GEO 3d, 5d; also Gr. 8 GEO 3d
Lines, segments, and rays	GEO 1c
Perpendicular lines	GEO 3e, 3g, 4
Properties of triangles	MEA 3a-3g; GEO 3d, 3e, 3f; also Gr. 8 GEO 3f
Ratio of sides in 45°-45°-90° triangles and 30°-60°-90° triangles	GEO 3b, 3d, 3f; MEA 3a, 3b; also Gr. 4 and Gr. 8 MEA 1b
Circumference and arc length	GEO 3e; MEA 1f, 3a; also Gr. 8 MEA 1f
Trigonometry (7%); e.g.,	
Right triangle trigonometry	MEA 3a, 3b, 3c, 3d
Trigonometric functions	MEA 3a, 3b, 3c, 3d, 3e, 3f, 3g; ALG 2a, 2d, 2f
Graphs of trigonometric functions, including amplitude, period, and phase shift	ALG 2a, 2d

* ALG: Algebra; DASP: Data Analysis, Statistics, and Probability; GEO: Geometry; MEA: Measurement; NPO: Number Properties and Operations

Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
Trigonometric identities	MEA 3d, 3f, 3g
Simple trigonometric equations	MEA 3d, 3f; ALG 2f
COGNITIVE SKILLS (ACT, 2008b, 2007c)	
Knowledge and Skills (50% of questions): require the student to use one or more facts, definitions, formulas, or procedures to solve problems that are presented in purely mathematical terms.	Most of NAEP low-complexity problems would fall in this category. Contains some moderate- and few high-complexity problems.
Direct Application (28%): require the student to use one or more facts, definitions, formulas, or procedures to solve straightforward problems set in real-world situations.	NAEP Real World or Application problems (low- and moderate-complexity) would fall into this category.
Understanding Concepts (22%, with Integrating): test the student's depth of understanding of major concepts by requiring reasoning from a concept to reach an inference or a conclusion.	NAEP's moderate- & high-complexity questions would fall into this category.
Integrating Conceptual Understanding (22%, with Understanding): test the student's ability to achieve an integrated understanding of 2 or more major concepts so as to solve nonroutine problems.	NAEP moderate- & high-complexity questions would fall into this category. Also high-complexity questions without creative thought or mathematical argument.
ITEM SETS (ACT, 2007c)	
At least 3 questions related to a stimulus, representing at least 2 content areas, and at least 2 cognitive classes.	Item sets are used on NAEP. Note: restrictions are not the same (i.e., 2 content areas and 2 cognitive classes etc.); could be multiple-choice or open-ended.
2 item sets per test form.	
USE OF CALCULATORS (ACT, 2008b, 2007c)	
Allowed on the Mathematics Test, but not required; students without calculators should be able to answer every question.	Some within (blocks), some without.
Calculators are student-supplied.	Supplied by NAEP or by examinee.
A student should not be advantaged or disadvantaged by the type of calculator he/she chooses to use.	Same.
Prohibited types: pocket organizers; handheld or laptop computers; electronic writing pads or pen-input devices, calculators built into cellular phones or other wireless communication devices, calculators with QWERTY (typewriter) keyboards, and calculators with built-in computer algebra systems.	Similar restrictions on the NAEP and the ACT.

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Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
COLLEGE READINESS STANDARDS (ACT, 2008d)	**Note: All NAEP domain topics are for Grade 12 unless noted.**
Basic Operations & Applications (BOA)	
201. Perform one-operation computation with whole numbers and decimals	NPO 3b, 5e
202. Solve problems in one or two steps using whole numbers	NPO 3b, 5e
203. Perform common conversions (e.g., inches to feet or hours to minutes)	NPO 5e ; MEA 2b
301. Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent	NPO 5e
302. Solve some routine two-step arithmetic problems	NPO 3b, 5e
401. Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average	NPO 3b, 3f, 4c, 4d, 5e
501. Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)	NPO 3b, 3f, 4d; MEA 2a, 2b, 3e, 5e
601. Solve word problems containing several rates, proportions, or percentages	NPO 3f, 4c, 4d, 5e; MEA 1i
701. Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)	NPO 3b, 3d, 4c, 4d, 5e; MEA 1i; ALG 4e
Probability, Statistics, & Data Analysis (PSD)	
201. Calculate the average of a list of positive whole numbers	DASP 2a, 2d
202. Perform a single computation using information from a table or chart	DASP1b, 1c, 2a
301. Calculate the average of a list of numbers	DASP1b, 1c, 2a
302. Calculate the average, given the number of data values and the sum of the data values	DASP1b, 1c, 2a
303. Read tables and graphs	DASP 1a, 1b, 1c
304. Perform computations on data from tables and graphs	DASP 1b, 1c
305. Use the relationship between the probability of an event and the probability of its complement	Nothing
401. Calculate the missing data value, given the average and all data values but one	DASP 2a

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Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
402. Translate from one representation of data to another (e.g., a bar graph to a circle graph)	DASP 1b, 1e
403. Determine the probability of a simple event	DASP 4b, 4d
404. Exhibit knowledge of simple counting techniques	DASP 4e
501. Calculate the average, given the frequency counts of all the data values	DASP 1b, 1c, 2a
502. Manipulate data from tables and graphs	DASP 1d, 1f
503. Compute straightforward probabilities for common situations	DASP 4b, 4j
504. Use Venn diagrams in counting	ALG 2b
601. Calculate or use a weighted average	DASP 2a
602. Interpret and use information from figures, tables, and graphs	DASP 1d, 1f, 2b, 2c, 2d, 2e, 4a, 5a, 5b, 5d, 5e; ALG 1b
603. Apply counting techniques	DASP 4e, 4j
604. Compute a probability when the event and/or sample space are not given or obvious	DASP 4b, 4c, 4j
701. Distinguish between mean, median, and mode for a list of numbers	DASP 2a, 2c, 2d
702. Analyze and draw conclusions based on information from figures, tables, and graphs	DASP 1d, 1e, 2b, 2c, 2d, 2e, 3a, 3c, 3d, 3e, 4a, 4j, 5a, 5b, 5d, 5e
703. Exhibit knowledge of conditional and joint probability	DASP 4b, 4c, 4h, 4i, 4j
Numbers: Concepts & Properties (NCP)	
201. Recognize equivalent fractions and fractions in lowest terms	NPO 1d, 5f
301. Recognize one-digit factors of a number	NPO 1i, 5c
302. Identify a digit's place value	NPO 5f, 1i
401. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor	NPO 1g, 2b, 2c, 3c, 5c, 5d; MEA 2c, ALG 1a, 1b
501. Find and use the least common multiple	NPO 5c
502. Order fractions	NPO 1d, 1i
503. Work with numerical factors	NPO 5c
504. Work with scientific notation	NPO 1f
505. Work with squares and square roots of numbers	NPO 2d, 3a, 3f
506. Work problems involving positive integer exponents	NPO 1d, 3a
507. Work with cubes and cube roots of numbers	NPO 2d, 3a, 3f
508. Determine when an expression is undefined	NPO 3d
509. Exhibit some knowledge of the complex numbers	NPO 5f ; ALG 4g

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Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
601. Apply number properties involving prime factorization	NPO 5c
602. Apply number properties involving even/odd numbers and factors/multiples	NPO 5c
603. Apply number properties involving positive/negative numbers	NPO 3d, 5c, 5f, 6b
604. Apply rules of exponents	NPO 1d, 3a
605. Multiply two complex numbers	NPO 5f
701. Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers	NPO 1d, 3d, 5d, 5f
702. Exhibit knowledge of logarithms and geometric sequences	NPO 1d; ALG 1e, 3g, 3h
703. Apply properties of complex numbers	NPO 5f ; ALG 4g
Expressions, Equations, & Inequalities (XEI)	
201. Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$)	ALG 3c, 3e
202. Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals	ALG 4a
301. Substitute whole numbers for unknown quantities to evaluate expressions	ALG 3e
302. Solve one-step equations having integer or decimal answers	ALG 4a
303. Combine like terms (e.g., $2x + 5x$)	ALG 3c
401. Evaluate algebraic expressions by substituting integers for unknown quantities	ALG 3c, 3e
402. Add and subtract simple algebraic expressions	ALG 3c
403. Solve routine first-degree equations	ALG 4a
404. Perform straightforward word-to-symbol translations	ALG 2a, 3c, 3e, 4c
405. Multiply two binomials	ALG 3c, 3f
501. Solve real-world problems using first-degree equations	ALG 3c, 3e, 4c
502. Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)	ALG 2a, 3b, 4f
503. Identify solutions to simple quadratic equations	ALG 4a, 4c, 4g
504. Add, subtract, and multiply polynomials	ALG 3c, 3f
505. Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)	NPO 5d; ALG 3c, 3f, 4a, 4g
506. Solve first-degree inequalities that do not require reversing the inequality sign	ALG 4a
601. Manipulate expressions and equations	NPO 3b; ALG 3c, 3d, 3e, 3f, 4f

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Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
602. Write expressions, equations, and inequalities for common algebra settings	ALG 2a, 3b, 3d, 4a
603. Solve linear inequalities that require reversing the inequality sign	ALG 4a
604. Solve absolute value equations	NPO 1g, 3c; ALG 4a
605. Solve quadratic equations	ALG 4a, 4g
606. Find solutions to systems of linear equations	GEO 4b; ALG 4a, 4c, 4d
701. Write expressions that require planning and/or manipulating to accurately model a situation	ALG 2a, 2e, 2g, 3b, 3d, 4c
702. Write equations and inequalities that require planning, manipulating, and/or solving	ALG 1b, 2a, 2e, 2g, 3b, 3d, 4c
703. Solve simple absolute value inequalities	NPO 1g, 3c; ALG 4a
Graphical Representations (GRE)	
201. Identify the location of a point with a positive coordinate on the number line	NPO 1b (Gr. 8)
301. Locate points on the number line and in the first quadrant	GEO 4a
401. Locate points in the coordinate plane	GEO 4a (Gr. 8)
402. Comprehend the concept of length on the number line	GEO 4a
403. Exhibit knowledge of slope	GEO 4a
501. Identify the graph of a linear inequality on the number line	ALG 2a
502. Determine the slope of a line from points or equations	GEO 4a, 4b
503. Match linear graphs with their equations	ALG 1e, 1h, 2a
504. Find the midpoint of a line segment	GEO 4a
601. Interpret and use information from graphs in the coordinate plane	GEO 2c, 4a, 4d
602. Match number line graphs with solution sets of linear inequalities	ALG 4a, 4c
603. Use the distance formula	GEO 4a
604. Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point	GEO 3e, 3g, 4a
605. Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)	GEO 4c, 4d, 4f
701. Match number line graphs with solution sets of simple quadratic inequalities	ALG 2a
702. Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$	GEO 4c, 4d; ALG 1e, 1g, 1h, 2a, 2f

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Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
703. Solve problems integrating multiple algebraic and/or geometric concepts	GEO 2a, 3c, 4b, 4c; ALG 2a, 2e, 2f
704. Analyze and draw conclusions based on information from graphs in the coordinate plane	GEO 2c, 4b, 4d, 5a, 5b; ALG 1e, 1g, 1h, 1i, 1j, 2a, 2b, 2e, 2f, 2h, 4d
Properties of Plane Figures (PPF)	
301. Exhibit some knowledge of the angles associated with parallel lines	MEA 1d; GEO 3e, 3f, 3g
401. Find the measure of an angle using properties of parallel lines	MEA 1d; GEO 3e, 3g
402. Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)	MEA 1d; GEO 3e
501. Use several angle properties to find an unknown angle measure	GEO 3f, 3g, 3h; MEA 1d
502. Recognize Pythagorean triples	GEO 3d
503. Use properties of isosceles triangles	GEO 3f, 3g; MEA 1d
601. Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles	NPO 4c; GEO 2e, 3b, 3f
602. Use the Pythagorean theorem	GEO 3d, 5d
701. Draw conclusions based on a set of conditions	GEO 3b, 3c, 3e, 3f, 3g, 5e; MEA 1d
702. Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas	GEO 2e, 3b, 3c, 3e, 3f, 3g, 5a, 5e; ALG 2f; MEA 1d, 3a
703. Use relationships among angles, arcs, and distances in a circle	GEO 3b, 3c, 3e, 3f, 3g, 3h, 5e; MEA 1d
Measurement (MEA)	
201. Estimate or calculate the length of a line segment based on other lengths given on a geometric figure	MEA 1c, 1f, 2a
301. Compute the perimeter of polygons when all side lengths are given	MEA 1c, 1f
302. Compute the area of rectangles when whole number dimensions are given	MEA 1c, 1f
401. Compute the area and perimeter of triangles and rectangles in simple problems	MEA 1c, 1f
402. Use geometric formulas when all necessary information is given	MEA 1f, 2a
501. Compute the area of triangles and rectangles when one or more additional simple steps are required	MEA 1f
502. Compute the area and circumference of circles after identifying necessary information	MEA 1f

* ALG: Algebra; DASP: Data Analysis, Statistics, and Probability; GEO: Geometry; MEA: Measurement; NPO: Number Properties and Operations

Table 3.4 (continued)
Results of the Comparison of the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/ Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature*
503. Compute the perimeter of simple composite geometric figures with unknown side lengths	MEA 1c, 1f
601. Use relationships involving area, perimeter, and volume of geometric figures to compute another measure	MEA 1b, 1c, 1f, 1h; GEO 1f
701. Use scale factors to determine the magnitude of a size change	NPO 4c; MEA 1b, 1c, 2f; GEO 2b, 2e
702. Compute the area of composite geometric figures when planning or visualization is required	MEA 1b, 1c, 1f, 2a, 2f; GEO 1e, 3c
Functions (FUN)	
401. Evaluate quadratic functions, expressed in function notation, at integer values	ALG 3e, 3f
501. Evaluate polynomial functions, expressed in function notation, at integer values	ALG 3e, 3f
502. Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths	MEA 3b, 3c
601. Evaluate composite functions at integer values	ALG 3f
602. Apply basic trigonometric ratios to solve right-triangle problems	MEA 3a, 3b, 3c
701. Write an expression for the composite of two simple functions	GEO 2g; ALG 2b, 3f
702. Use trigonometric concepts and basic identities to solve problems	MEA 3a, 3b, 3d, 3f, 3g
703. Exhibit knowledge of unit circle trigonometry	MEA 3b, 3d, 3e
704. Match graphs of basic trigonometric functions with their equations	ALG 1e, 1h, 2a, 2b, 2d

* ALG: Algebra; DASP: Data Analysis, Statistics, and Probability; GEO: Geometry; MEA: Measurement; NPO: Number Properties and Operations

Table 3.5

Frequencies of Responses and Average Responses to Questions 1–14 of Evaluation Questionnaire No. 1

Question	Reading					Average[a]	Mathematics					Average[a]
I. Advance Materials												
1. The advance materials I received were adequate to prepare me to fulfill my role in this meeting.	Totally Agree 1	6	Somewhat Agree		Totally Disagree	1.9	Totally Agree 2	3	Somewhat Agree 1		Totally Disagree 1	2.3
2. The organization of the advance materials I received for this meeting was:	Very Good 5	1	Acceptable 1		Very Poor	1.4	Very Good 4	2	Acceptable 1		Very Poor	1.6
II. Introduction to the Study, the NAEP, and the ACT												
3. The amount of time allocated for the introduction to the study, the NAEP, and the ACT was:	Far Too Long		About Right 7		Far Too Short	3.0	Far Too Long		About Right 7		Far Too Short	3.0
4. The explanation of the purpose and goals of the study was:	Absolutely Clear 2	4	Somewhat Clear 1		Not at All Clear	1.9	Absolutely Clear 1	5	Somewhat Clear 1		Not at All Clear	2.0
5. The introduction to the NAEP was:	Absolutely Clear 1	5	Somewhat Clear 1		Not at All Clear	2.0	Absolutely Clear 1	3	Somewhat Clear 3		Not at All Clear	2.3
6. The introduction to the ACT was:	Absolutely Clear 3	4	Somewhat Clear		Not at All Clear	1.6	Absolutely Clear 3	3	Somewhat Clear 1		Not at All Clear	1.7

[a] Averages result from assigning numeric values of 1-5 to the response options, in the order shown here. For example, "Totally Agree" in Question 1 was assigned a value of 1, "Somewhat Agree" a value of 3, and so on.

Table 3.5 (continued)

Frequencies of Responses and Average Responses to Questions 1–14 of Evaluation Questionnaire No. 1

Question	Reading					Average[a]	Mathematics					Average[a]
III. Comparison of NAEP to ACT and ACT to NAEP – Small Group Sessions												
7. The overview of the method employed in these portions of the comparison task was:	Absolutely Clear 1	2	Somewhat Clear 4		Not at All Clear	2.4	Absolutely Clear 1	2	Somewhat Clear 4		Not at All Clear	2.4
8. The amount of time allocated for these portions of the comparison task was:	Totally Adequate 3	1	Somewhat Adequate 3		Totally Inadequate	2.0	Totally Adequate 2	3	Somewhat Adequate 2		Totally Inadequate	2.0
9. I feel that the opportunities I was given to express my opinions/views during these portions of the comparison task were:	Totally Adequate 4	3	Somewhat Adequate		Totally Inadequate	1.4	Totally Adequate 5	2	Somewhat Adequate		Totally Inadequate	1.3
10. Overall, I feel ____ about the judgments my group made during these portions of the comparison task.	Very Confidant 2	3	Fairly Confidant 2		Not Confidant	2.0	Very Confidant	4	Fairly Confidant 3		Not Confidant	2.4
IV. Comparison of NAEP to ACT and ACT to NAEP – Large Group Discussion												
11. The amount of time allocated for these portions of the task was:	Totally Adequate 5	1	Somewhat Adequate	1	Totally Inadequate	1.6	Totally Adequate 2	2	Somewhat Adequate 2		Totally Inadequate	2.0
12. I feel that the opportunities I was given to express my opinions/views during these portions of the task were:	Totally Adequate 6	1	Somewhat Adequate		Totally Inadequate	1.1	Totally Adequate 4	2	Somewhat Adequate		Totally Inadequate	1.3
13. Overall, I feel ____ about the judgments the large group made during these portions of the comparison task.	Very Confidant 3	4	Fairly Confidant		Not Confidant	1.6	Very Confidant	4	Fairly Confidant 2		Not Confidant	2.3
14. Overall, I feel that the method we used to compare the NAEP to the ACT and the ACT to the NAEP captured the important similarities and differences between the two assessments.	Totally Agree 2	2	Somewhat Agree 2	1	Totally Disagree	2.3	Totally Agree 1	2	Somewhat Agree 2	1	Totally Disagree	2.5

[a] Averages result from assigning numeric values of 1-5 to the response options, in the order shown here. For example, "Totally Agree" in Question 1 was assigned a value of 1, "Somewhat Agree" a value of 3, and so on.

4. THE ITEM CLASSIFICATION STUDY

The purpose of the Item Classification Study was to classify the 2009 NAEP Grade 12 operational assessment items in Reading and Mathematics to the ACT College Readiness Standards (CRS) Reading and Mathematics score ranges, respectively. The CRS for each subject and each score range describe the knowledge and skills a student with an ACT subject test score in that range is likely to know and be able to do. For each NAEP multiple-choice item, and for each creditable score category of each NAEP constructed-response item (i.e., any category above level "1" on the scoring rubric), each panelist in this study determined the score range (13–15, 16–19, 20–23, 24–27, 28–32, or 33–36) for which the CRS for that subject were the most consistent with the skills and knowledge measured by the NAEP item or score category.

The study began with each panelist reviewing the College Readiness Standards table in his/her subject area (Appendix C or D). For each CRS score range, panelists read the knowledge and skills listed across that row of the table. These are the knowledge and skills that a student with an ACT test score in that range is likely to know and be able to do, where *likely* refers to the fact that students in this score range have a high probability of success (at least 80%) on ACT items that measure these skills, whereas students in the lower score ranges have lower success rates with these items.

Round 1–Independent Classification

In Round 1 of this study each panelist worked independently, recording his/her decisions on an Individual Classification Form (see Appendix K for a sample). Each form represents one block of NAEP items; a separate form was used for each block. Each white row on the form represents a multiple-choice item in the block. A group of adjacent, similarly colored rows represents the creditable score categories for a constructed-response item in the block.

Round 1 began with panelists receiving a copy of the first NAEP block (Block F23R1 in Reading and F3M1 in Mathematics) and being asked to briefly skim the items in the block to get an understanding for what the block was assessing. Reading panelists were also asked to read the text(s) on which the items in the block were based. After reviewing the entire block, each panelist carried out the following steps for each item:

(Steps 1–3 below were for **multiple-choice** items only.)

1. The panelist began by reading the item and its supporting documentation (Cognitive Target and Achievement Level for Reading; Topic, Objective, Complexity, and Achievement Level for Mathematics) and determining the knowledge and/or skills a student would need to correctly respond to the item.
2. Starting with the lowest CRS score range (13–15), the panelist applied the following "80% criterion" to the item. The panelist asked him/herself: *Would students having the knowledge and skills described in this ACT score range have at least an 80% chance of responding to this NAEP item correctly?* Alternatively, the panelist could ask: *Would at least 80 out of 100 students having the knowledge and skills described in this ACT score range respond to this*

NAEP item correctly? If the answer to either of these was "No," the panelist proceeded to the next higher CRS score range and repeated this process.

3. When the panelist had determined the *lowest* score range for which the answer to either of the questions above was "Yes," the panelist checked the appropriate box on the Individual Classification Form. (If the panelist believed that students scoring *below* the 13–15 range on the ACT would have an 80% chance of answering the item correctly, then he/she checked the "1–12" box on form.) The panelist was also asked to check the box corresponding to how sure he/she felt about his/her decision: *Very Sure*, *Fairly Sure*, or *Not Sure*. Space was also provided for the panelist to write any relevant notes, comments, or concerns he/she had with the item.

(Steps 1–4 below were for **constructed response** items only.)

1. The panelist read the item and its supporting documentation, including the scoring rubric for the item, and determined the knowledge and/or skills a student would need to achieve the highest score on the rubric (i.e., respond to the item correctly and completely). Also, the panelist identified the degree of knowledge and/or skill that distinguished the highest score category on the rubric from the lower creditable categories.
2. Starting with the lowest CRS score range, each panelist asked him/herself: *Would students having the knowledge and skills described in this ACT score range have at least an 80% chance of receiving the highest score indicated on the rubric for this NAEP item?* Alternatively, the panelist could ask: *Would at least 80 out of 100 students having the knowledge and skills described in this ACT score range receive the highest score for this NAEP item?* If the answer to either of these was "No," the panelist proceeded to the next higher CRS score range and repeated this process.
3. When the panelist had determined the *lowest* score range for which the answer to either of the questions above was "Yes," the panelist checked the appropriate box on the Individual Classification Form. (If the panelist believed that students scoring *below* the 13–15 range on the ACT would have an 80% chance of answering the item completely and correctly, he/she checked the "1–12" box on form.) The panelist was also asked to check the box corresponding to how sure he/she felt about his/her decision: *Very Sure*, *Fairly Sure*, or *Not Sure*. Space was also provided for the panelist to write any relevant notes, comments, or concerns he/she had with the item.
4. The panelist then repeated Steps 2 and 3 for each of the remaining creditable score categories on the scoring rubric. For each category, the panelist asked him/herself: *Would students having the knowledge and skills described in this ACT score range have at least an 80% chance of receiving this score, as indicated by the rubric?* Alternatively, the panelist could ask: *Would at least 80 out of 100 students having the knowledge and skills described in this ACT score range receive this score?* When the panelist determined the *lowest* CRS score range corresponding to the NAEP score category, he/she checked the appropriate box on the Individual Classification Form. The panelist was also asked to indicate how sure he/she felt about his/her decision, and to write any relevant notes, comments, or concerns in the space provided on the form.

Each panelist completed the steps above for every item in the first NAEP block. The group Facilitator then conducted Round 2 for this block.

Round 2–Group Classification

In Round 2, panelists shared and discussed their classifications for the items and score categories in the first block. The purpose of this round was to help panelists clarify their thinking about each item, but agreement was not required. During this round each panelist completed a Group Classification Form, similar to the Individual Form. If the group agreed on a final classification for an item or score category, each panelist marked that classification on the Group Classification Form. If the group did not agree on a final classification, each panelist recorded the classification he/she felt was most appropriate.

Rounds 1 and 2 were conducted for every 2009 NAEP block. The Mathematics panel conducted the entire study as described above. Shortly after beginning Round 1, however, the Reading panelists voiced frustration to the panel Facilitator about the process. Recall that text complexity is an explicit feature of the College Readiness Standards in Reading, and that what often distinguishes the skills described in one score range of the standards from those in another is the complexity of the passage to which the skills are being applied. Every ACT Reading Test passage is classified according to its place on the ACT complexity rubric (Appendix C). NAEP texts, in contrast, are not explicitly classified by any complexity rubric; NAEP deals with text complexity more indirectly. The panelists determined that, in order to map a block of NAEP Reading items onto the College Readiness Standards score ranges using the steps listed above, it was first necessary to "score" the NAEP text according its complexity as ACT defines it. This caused disagreements, confusion, and frustration among the panelists. It was decided from that point forward that the Reading panel would perform the entire task as one group, first reading and categorizing the text according to its complexity, then classifying each item using the agreed-upon complexity of the text to guide their decisions. Each panelist was still free to disagree with the group's opinion of each item or score category, and could still mark the Group Classification Form with a dissenting opinion, if he/she felt it appropriate.

Results of the Item Classification Study

A total of 152 Reading items (comprising 17 blocks) were classified in this study. Of these, 97 were multiple-choice (MC). Nine were dichotomously-scored ("incorrect" or "correct") short constructed-response (DSCR) items. Thirty-three were polytomously-scored short constructed-response (PSCR) items, each scored using a three-point scoring rubric. Thirteen were extended constructed-response (ECR) items, each scored using a four-point rubric. Each DSCR had one creditable score category, each PSCR had two, and each ECR had three. Each Reading panelist, therefore, assigned a total of 211 classifications to the NAEP Reading items.

A total of 177 Mathematics items (comprising 12 blocks) were classified in this study. Of these, 108 were MC, 30 were DSCR, 35 were PSCR, and 5 were ECR. Each DSCR had one creditable score category. Thirty-four of the PSCR items had two creditable score categories

each; the remaining item had three. Each ECR had four creditable score categories. Therefore, each Mathematics panelist assigned a total of 229 classifications to the NAEP Mathematics items.

For a number of the Mathematics constructed-response items, the scoring rubrics distinguish between multiple, but equivalent, responses at a given score category. For example, the rubric for PSCR Item 3 of Block F3M1 distinguishes between "2A" responses and "2B" responses. Both are "2"-level responses, but they differ in their details. For these items, panelists were asked to classify only the overall level of correctness or completeness—the "2" in this example—rather than to attempt to classify each level.

Tables 4.1 and 4.2 present the data collected in this study. The final classifications (those recorded on the Group Classification Forms) for all items as provided by all seven panelists are listed. These data are ordered by block, item sequence number (Seq.) within block and, in the case of the constructed-response items, creditable score category (Score Cat.). Also included in these tables are the NAEP accession numbers for the items (Acc. Num.), and the column *Item Type*, which indicates whether each item is MC, DSCR, PSCR, or ECR. The columns *Panelist 1* through *Panelist 7* present the final classifications assigned by each panelist. ("NC" indicates that a panelist thought the item could not be classified to any CRS score range.) The *Majority* column indicates the classification chosen by the majority (at least four) of the panelists, if there was one. The column *Majority Type* indicates whether the majority was a simple majority (four panelists) or a supermajority of five or more panelists. Finally, the column *Agreement* indicates the degree of panelist agreement underlying each majority classification: U if the agreement was unanimous; A if the disagreements were all adjacent (i.e., no panelist gave a classification that was more than one score range away from the majority); or N if one or more of the disagreements was nonadjacent (more than one score range away from the majority). (Disagreements in which one of the classifications was "NC" are considered nonadjacent.)

Table 4.3 presents the number of Reading majority classifications, by item type and score range. This table shows that there was a high degree of consensus with regard to the Reading items; of the 211 items or score categories classified, a majority of the panelists were able to agree on final classifications for 210 of them. Table 4.3 also shows that 65 of the majority classifications were to the 20–23 score range, the range that contains the Reading College Readiness Benchmark Score (21). Thus a majority of panelists thought that slightly less than one-third of the NAEP Reading items or score categories map to the ACT Reading Benchmark Score range. Likewise, a majority thought that 36 items or score categories (17%) map to the range directly above the Benchmark range, 24–27; that 14 (about 7%) map to the range directly below the Benchmark range, 16–19; and that 10 (about 5%) map to the next range below that, 13–15. Only 12 items or score categories (about 6%) were thought to map to the highest CRS score ranges, 28–32 and 33–36. No items or score categories were thought to map to the lowest CRS score range, 1-12. Finally, a majority of panelists thought that 73—slightly more than one third—of the NAEP items and score categories were not classifiable to any CRS score range. It should be noted (and will be discussed below) that, in most cases where a constructed-response item received a majority opinion of "NC," that opinion applied to every score category; in only a few cases, for example, was a "partial credit" category classified to a score range while the corresponding "full credit" category was not. As will be shown below, most of the "NC" opinions in Reading were given on the basis of the texts accompanying those items.

Table 4.4 breaks down the Reading majority classifications by majority type. We see from this that the majority classifications were overwhelmingly supermajority decisions. Only 6 (about 3%) of the final classifications were by simple majority. Table 4.5 breaks down the majority decisions by agreement type, and shows that the seven panelists were unanimous on 181 of the 210 majority decisions (about 86%). Only 14 of the majority decisions (about 7%) involved only adjacent disagreements, and only 15 (7%) involved nonadjacent disagreements.

Tables 4.3, 4.4, and 4.5 suggest that there was a high degree of agreement among the Reading panelists with regard to the final classifications of the 2009 NAEP Reading items. As further evidence of this, Fleiss's generalized kappa coefficient (Fleiss, 1981) was computed for the seven panelists and eight classification categories. Its value was approximately 0.92 (statistically significantly different from zero; $p < 0.001$), indicating a very high degree of interrater agreement. Given the decision that was made to perform the entire study as one group, this is not surprising. However, the fact that there were a number of less-than-unanimous decisions on the part of the panel suggests that the panelists felt comfortable disagreeing with the group when they felt it was warranted.

Table 4.6 shows the number of Mathematics majority classifications, by item type and score range. This table shows that there was a lower degree of consensus among the Mathematics panelists than there was among the Reading panelists. Of the 229 Mathematics items or score categories classified, a majority of the panelists were able to agree on final classifications for 190 (83%) of them; a majority did not agree on 39 items or score categories. Table 4.6 also shows that, by and large, the NAEP Mathematics items were mapped to higher CRS score ranges than were the Reading items. Just 32 of the 190 majority classifications (14% of all the items and score categories) were to the 20–23 score range, the one covering the Mathematics College Readiness Benchmark Score (22). More items were mapped to each of the higher score ranges: 50 (about 22%) map to 24–27; 61 (about 27%) map to 28–32; and 37 (16%) map to 33–36. Only 10 items (4%) were mapped to either of the two score ranges below the Mathematics Benchmark range. In no case did the majority of Mathematics panelists map an item or score category to the 1-12 range, nor was any item or score category thought to be unclassifiable (NC).

Table 4.7 shows the Mathematics majority classifications by majority type. We can see that simple majority decisions comprised a much larger share of the Mathematics group classifications than they did for the Reading classifications. Of the 190 majority classifications, 75 (39%) were by simple majority. Table 4.8 shows that, in Mathematics as compared with Reading, unanimous decisions comprised a much smaller share of the majority decisions (24 or about 13%) and that adjacent disagreements were involved in a much larger share (142 or 74%). Nonadjacent disagreements were involved in 24 (about 13%) of the majority decisions.

Tables 4.6, 4.7, and 4.8 all suggest that the Mathematics panelists were more varied in their final classifications of the 2009 NAEP Mathematics items than the Reading panelists had been in their classifications of the Reading items. This is borne out by Fleiss's generalized kappa coefficient for the Mathematics classifications, which was approximately 0.36. While this value was, statistically, significantly different from zero ($p < 0.001$), its magnitude suggests a much lower degree of interrater agreement among the Mathematics panelists.

Discussion

The purpose of the Item Classification Study was to attempt to classify each 2009 NAEP Reading and Mathematics assessment item and score category to one of the College Readiness Standards score ranges. The evidence suggests that this was a difficult task for either panel. The seven Reading panelists were, as a group, able to form an opinion on every multiple-choice item, and on all creditable constructed-response score categories but one. In all, majority opinions were delivered on 210 of the 211 NAEP Reading items or score categories. Even so, the differences between the two assessments on the subject of text complexity made this task a very frustrating one for them, and they modified the process in order to cope with the frustration and provide final judgments with some level of confidence. The Mathematics panel, by contrast, carried out the process to the letter but in less agreement about how best to classify the Mathematics items on the College Readiness Standards scale. In all, majority opinions were delivered on 190 of the 229 NAEP Mathematics items or score categories, but barely one eighth of those opinions were unanimous, and interrater agreement was also quite low. In this study, the task of classifying items from a *different* assessment using the descriptors in the College Readiness Standards proved a challenge in either subject area.

It is interesting to note the degree to which the two panels differed in classifying items as "NC," or not classifiable to any score range. As shown in Tables 4.3 and 4.6, 73 of the majority opinions in Reading declared items or score categories as not classifiable, while no Mathematics item or score category was given that classification. In fact, of the 1,610 separate classifications assigned by the seven Mathematics panelists to the 229 items or score categories, panelists used the "NC" category only *9* times. While the Mathematics panel may have been harder-pressed to reach agreement than the Reading panel, clearly each Mathematics panelist felt that nearly every Mathematics item could be classified to *some* score range.

Table 4.9 lists the 73 Reading items or score categories classified as "NC" by a majority of the Reading panel. Sixteen are MC items and one is a DSCR item. The rest are score categories spanning 15 PSCR and 10 ECR items. The column "Reason" summarizes the reasons expressed for not finding a place for each of these items or score categories on the College Readiness Standards scale. Nearly half (36) of the items or score categories not classified—including the complete blocks F3R12 and F3R13—are associated with passage types that are not found in the ACT Reading domain: poems, a job posting, and a rental agreement. The panel felt that items in the context of these passage types could not be classified according to the College Readiness Standards, and that doing so would misrepresent the ACT Reading domain. The panel felt the same with regard to one MC item and nine score categories (spanning three items) that require the examinee to compare or contrast elements of paired texts. Twelve of the items or score categories in Table 4.9 measure cognitive targets from the NAEP *Critique/Evaluate* category. The Alignment Study showed that these targets are reflected in the ACT Reading Test and College Readiness Standards to a much lesser degree that targets from the other categories. The panelists felt that each of these items and score categories all require a degree of analysis that is outside the domain of ACT cognitive skills. The panel felt the same about three score categories from two *Integrate/Interpret* items: F3R7, Item 7, score levels 3 and 4, and F3R8, Item 10, score level 3. The panel felt that the level of analysis required to be successful on these score categories was beyond the scope of the Reading Test domain.

In short, while the panels were able to place most of the 2009 NAEP Reading and Mathematics items into the College Readiness Standards score ranges, the process and the results reflect some of the differences between the two assessments that were revealed by the Alignment Study. In interpreting and using the results of the Item Classification Study in either subject area, one should keep in mind the commonalities between the two assessments and the areas in which the assessments are not alike.

Evaluation of the Item Classification Study

After data for the Item Classification Study had been collected, both panels were administered a second evaluation questionnaire (Appendix L). Questions 1 through 8 (forced-choice, Likert-type questions), and 9 and 10 (free-response questions) were intended to gather the panelists' impressions of and reactions to the study. The following discusses the panelists' responses to these questions.

Table 4.10 presents the panelists' responses to forced-choice Questions 1 through 8. The panelists' opinions of Round 1 of the study (Questions 1 through 4) show some interesting comparisons to their opinions about the small-group discussion of the Alignment Study (as revealed in Questions 7 through 10 of the first evaluation questionnaire). With regard to the clarity of the method used in the Item Classification Study, the Reading panels reported that the method used in this study was about as clear as the method employed in the Alignment Study; the average response to Question 1 was 2.3, while the average response to Question 7 of the first evaluation questionnaire was 2.4. The Mathematics panel thought the method used in the Item Classification Study was considerably clearer than that used in the Alignment Study; the average response to Question 1 was 1.6, compared with 2.4 for Question 7 of the previous questionnaire. With regard to the amount of time allowed for the classification task, most panelists reported that the time was at least "somewhat adequate;" average responses to Question 2 were 2.1 and 2.3, which compare favorably to the average responses for Question 8 of the previous questionnaire. However, three panelists reported that it the time was less than somewhat adequate; no one said this about the Alignment Study. Both panels reported very positively about the opportunities they had to express their opinions; average responses were 1.0 and 1.6. With regard to the level of confidence the panelists had in the judgments they made during the first rounds. Nine of the panelists reported feeling only "fairly confident" about the item classifications they assigned during Round 1; only two expressed confidence this low after the first round of the Alignment Study.

The panelists' opinions (Questions 5 through 7) of Round 2 of the study—the group discussion—also show some differences with their opinions of the similar round in the Alignment Study. As a group, the Reading panelists felt that the time allotted to Round 2 and the opportunities they had to express their views were very adequate; average responses to Questions 5 and 6 were 1.7 and 1.1, respectively, which were consistent with their average responses to Questions 11 and 12 of the previous questionnaire. However, the Reading panelists felt less confident about their final decisions in the Item Classification Study than they did about their final alignment decisions; the average response to Question 7 was 2.7, in contrast to the average of 1.6 on Question 13 of the previous questionnaire. As a group, the Mathematics panelists reported that the time allotted to Round 2 of the Item Classification Study and the opportunities

they had to express their opinions during this round were less adequate than in group round of the Alignment Study; average responses to Questions 5 and 6 were 2.6 and 2.0, respectively, in contrast to the averages of 2.0 and 1.3, respectively, for Questions 11 and 12 of the previous questionnaire. As a group, their level of confidence in their decisions after Round 2 of the Item Classification Study, 2.3, was similar to their level of confidence at the conclusion of the Alignment Study. Finally, both panels indicated that the classification task was a difficult one; average responses to Question 8 were 4.0 and 3.4, respectively, between "somewhat easy" and "very difficult." Only two of the fourteen panelists rated the task between "very easy" and somewhat easy."

Table 4.11 lists the panelists' responses to Question 9. When asked to elaborate on the clarity of the instructions, the adequacy of the time allotted, their level of confidence with the process, or any other issues regarding the study, the Reading panelists expressed the frustration they felt at the outset of the Item Classification Study, frustration that, for most, eased as the task proceeded. One panelist remarked that part of the frustration came from trying to use the College Readiness Standards as a scoring rubric, which is not the main purpose of the standards. Several also reported that if more time had been spent at the outset reviewing the NAEP passages and items and the ACT materials, it might have mitigated some of the initial frustration that was felt. The Mathematics panelists had less to say in response to Question 9. Several remarked that the instructions were clear. Two commented that time was an issue. Several stated that the process overall was challenging.

Table 4.12 lists the challenges panelists perceived in carrying out the item classification task. There are a couple of recurring themes in these responses. First, most remarked that trying to classify constructed-response items to the College Readiness Standards was a major source of frustration for them. Several stated that they felt the College Readiness Standards were not adequate for the task the panelists were asked to undertake. One Reading panelist remarked on the limited scope of the standards, based as they are on only those ACT test items that have a success rate of 80% in a score range. Another reiterated a previously discussed concern: that the inclusion of passage complexity into the language of the standards made them difficult to apply to the NAEP Reading items. For two Mathematics panelists, the specific language used in the College Readiness Standards made it difficult to classify NAEP items.

The response to Questions 4 and 8 to the evaluation questionnaire suggest that both panels felt between "very sure" and "fairly" sure overall about the decisions they made during the Item Classification Study. The Classification Forms filled out by the panelists (Appendix K) asked them to indicate how sure they felt about each classification decision. Table 4.13 presents the average confidence ratings of the panelists' final classification decisions. These results are broken out by panelist and by item type. The background of each panelist—whether he or she was ACT-knowledgeable or NAEP-knowledgeable—is also indicated in this table. The confidence scale used on the Classification Form had three levels: Very Sure, Fairly Sure, and Not Sure. In Table 4.13, these levels were coded 1, 2, and 3, respectively. Thus, lower averages indicate higher levels of confidence.

Consistent with the results of Question 7 of the evaluation questionnaire, most Reading panelists felt somewhere between "very sure" and "fairly sure" about their final classification decisions; average ratings ranged from 1.1 to 2.0 for six of the panelists, and only one panelist had an average rating greater than 2. ACT-knowledgeable panelists tended to be more confident

than NAEP-knowledgeable panelists: average ratings for the ACT panelists ranged from 1.1 to 1.4, while those of the NAEP panelists ranged from 1.4 to 2.0. Across all panelists, there was little difference in the confidence with which decisions were made about the different item types; these averages ranged from 1.1 to 1.4. Within the panel, there was some variability with respect to item type, with some panelists expressing comparatively greater confidence in their decisions about the MC items, and others expressing comparatively more confidence when it came to classifying the constructed response score categories. Generally speaking, the Reading panel expressed the highest level of confidence in their decisions about ECR score categories, due perhaps to the high degree of "NC" decisions the panel made about these items.

Most of the Mathematics panelists also felt either "very sure" or "fairly sure" about their classification decisions; only two of the seven panelists had average confidence ratings greater than 2 across all item types. Unlike Reading, there was not a clear relationship between average confidence ratings and panelist background. Of the two most confident panelists (Panelists 2 and 3), one was NAEP-knowledgeable and the other was ACT-knowledgeable. The same was true for the two least confident panelists, Panelists 4 and 6. Across item types, average confidence ratings ranged only from 1.5 to 1.7, indicating that, as a group, the Mathematics panel did not find one item type easier to classify than another. Within the panel, there was some variability with respect to item type, although less overall than among the Reading panelists. Overall, the results indicate that the Mathematics panelists felt only slightly less confident in their final classification decisions than did the Reading panel.

Overall, both panels felt the task of classifying NAEP assessment items to the College Readiness Standards score ranges was challenging. Some panelists traced this difficulty to the amount of time allotted to the task, others to the mismatch in item types between the two assessments, and others to the wording of the standards. Nearly all the panelists, however, expressed at least a fair degree of confidence in their final classification decisions.

Table 4.1
Final Item Classifications for Reading

Redacted

Table 4-2
Final Item Classifications for Mathematics

Redacted

Table 4.3
Number of Reading Group Majority Classifications, by Item Type and Score Range

	Majority classification							No	
Item Type	13–15	16–19	20–23	24–27	28–32	33–36	NC	majority	Total
MC	9	10	43	18		1	16		97
DSCR	1		5	1	1		1		9
PSCR		2	14	14	7		28	1	66
ECR		2	3	3	3		28		39
Total	10	14	65	36	11	1	73	1	211

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, two for each PSCR item, and three for each ECR item.

Table 4.4
Number of Reading Group Majority Classifications, by Item Type, Score Range, and Majority Type

	13–15		16–19		20–23		24–27		28–32		33–36		NC		
Item Type	simple	super	simple	super	simple	super	simple	super	simple	super	simple	super	simple	super	Total
MC		9		10	3	40		18				1		16	97
DSCR		1				5		1		1				1	9
PSCR				2	2	12	1	13		7				28	65
ECR				2		3		3		3				28	39
Total	0	10	0	14	5	60	1	35	0	11	0	1	0	73	210

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, two for each PSCR item, and three for each ECR item.

Table 4.5
Number of Reading Group Majority Classifications, by Agreement

	Agreement			
Item Type	U	A	N	Total
MC	85	7	5	97
DSCR	7	2		9
PSCR	55	5	5	65
ECR	34		5	39
Total	181	14	15	210

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, two for each PSCR item, and three for each ECR item.

Table 4.6
Number of Mathematics Group Majority Classifications, by Item Type and Score Range

	Majority classification							No	
Item Type	13–15	16–19	20–23	24–27	28–32	33–36	NC	majority	Total
MC	2	5	19	27	26	12		17	108
DSCR	1	1	8	7	3	4		6	30
PSCR		1	4	13	24	13		16	71
ECR			1	3	8	8			20
Total	3	7	32	50	61	37	0	39	229

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, two or three for each PSCR item, and four for each ECR item.

Table 4.7
Number of Mathematics Group Majority Classifications, by Item Type, Score Range, and Majority Type

	13–15		16–19		20–23		24–27		28–32		33–36		
Item Type	simple	super	simple	super	simple	super	simple	super	simple	super	simple	super	Total
MC		2	3	2	7	12	13	14	11	15	5	7	91
DSCR		1	1		3	5	3	4	3		2	2	24
PSCR			1		3	1	4	9	7	17	2	11	55
ECR					1		3		1	7	2	6	20
Total	0	3	5	2	14	18	23	27	22	39	11	26	190

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, two or three for each PSCR item, and four for each ECR item.

Table 4.8
Number of Mathematics Group Majority Classifications, by Agreement

	Agreement			
Item Type	U	A	N	Total
MC	15	63	13	91
DSCR		20	4	24
PSCR	7	44	4	55
ECR	2	15	3	20
Total	24	142	24	190

Note: For MC items, the numbers shown here are numbers of distinct items. For DSCR, PSCR, and ECR items, they are the numbers of creditable score categories: one for each DSCR item, 2 or 3 for each PSCR item, and 4 for each ECR item.

Table 4.9
NAEP Reading Items Classified “NC” by a Majority of Panelists

Redacted

Table 4.10

Frequencies of Responses and Average Responses to Questions 1–8 of Evaluation Questionnaire No. 2

Question	Reading					Average[a]	Mathematics					Average[a]
V. Classification of NAEP items using the College Readiness Standards Score Ranges—Individual or Small Group Sessions												
1. The overview of the method employed in this portion of the classification task was:	Absolutely Clear	5	Somewhat Clear	2	Not at All Clear	2.3	Absolutely Clear	4	Somewhat Clear	2	1	Not at All Clear	1.6
2. The amount of time allocated for this portion of the classification task was:	Totally Adequate 3	2	Somewhat Adequate	2	Totally Inadequate	2.1	Totally Adequate 2	2	Somewhat Adequate 2	1		Totally Inadequate	2.3
3. I feel that the opportunities I was given to express my opinions/views during this portion of the classification task were:	Totally Adequate 7		Somewhat Adequate		Totally Inadequate	1.0	Totally Adequate 4	2	Somewhat Adequate 1			Totally Inadequate	1.6
4. Overall, I felt ____ about the classification decisions I made during this portion of the classification task.	Very Sure	2	Fairly Sure	5	Not Sure	2.7	Very Sure	3	Fairly Sure 4			Not Sure	2.6
VI. Classification of NAEP items using the College Readiness Standards Score Ranges – Large Group Discussions													
5. The amount of time allocated for this portion of the task was:	Totally Adequate 3	3	Somewhat Adequate	1	Totally Inadequate	1.7	Totally Adequate 1	2	Somewhat Adequate 3	1		Totally Inadequate	2.6
6. I feel that the opportunities I was given to express my opinions/views during this portion of the task were:	Totally Adequate 6	1	Somewhat Adequate		Totally Inadequate	1.1	Totally Adequate 1	5	Somewhat Adequate 1			Totally Inadequate	2.0
7. Overall, I feel ____ about my classification decisions after this portion of the classification task.	Very Sure	2	Fairly Sure	5	Not Sure	2.7	Very Sure 1	3	Fairly Sure 3			Not Sure	2.3
8. Overall, I found the task of classifying NAEP items to the College Readiness Standards score ranges to be:	Very Easy		Somewhat Easy	1	Very Difficult 1	4.0	Very Easy	2	Somewhat Easy	5		Very Difficult	3.4

[a] Averages result from assigning numeric values of 1-5 to the response options, in the order shown here. For example, "Absolutely Clear "in Question 1 was assigned a value of 1, "Somewhat Clear" a value of 3, and so on.

Table 4.11
Panelists' Responses to Question 9 of Evaluation Questionnaire No. 2

9. Please use the space below to provide additional comments concerning the clarity and completeness of the instructions you received, the adequacy of the time available, your level of understanding and confidence, or any other aspects of the procedure for classifying NAEP items to the ACT College Readiness Standards score ranges.

Reading

"What would have been required of me to feel that my classifications or judgments were fairly reliable and valid for all categorization tasks was specific training to models that have already been well classified by experts. As it was we were performing two disparate tasks. First, we were developing a scoring scheme to a large extent and then applying that scheme to unfamiliar passages and items. Further, the College Readiness Standard document was not created as a scoring template—but as a public document to capture performance levels by item type. This added to the ambiguity and complexity of our tasks."

"Clarity on both sides was weak at first but became strengthened once we jumped in to the task. Tension among the NAEP folks was higher as they anticipated/found the unknown, and I think there was some filibustering going on before we jumped in, too! I would have preferred to have tried out/piloted the task long before one hour-plus of discussions that preceded it. The tension/discussions at the outset, I think, stalled the work or slowed it and we might've accomplished more and sooner otherwise." (from a NAEP-knowledgeable panelist)

"I'm confident that were I to start this process with what I now know and understand, it would be much easier, smoother. BUT I'm not sure there was any way to preclude that initial period of frustration and uncertainty. Ideally, we would have started with more holistic knowledge of the differing purposes, goals, assumptions, and definitions driving NAEP and ACT, BUT that might have so shaped the alignment process as to make it pure self-fulfilling prophecy. I don't see a clear way to avoid this dilemma but it might be worth thinking about possible approaches that might not point to outcomes and conclusions."

"I think it would have helped if the process started with everyone reading several sets of passages and items from the 2 assessments and talking about observed similarities and differences before engaging in distinct rating tasks."

"I feel that if we could have spent some time at the outset examining ACT samples and the rest of the materials sent to us prior to starting the classification process, that the classifying would have been a little smoother. Other than that, however, I believe the session was expertly facilitated, questions were answered promptly and with all the information available, that time was monitored efficiently, and procedures were adapted as we went along to help us be more efficient. All the ACT staff were efficient, knowledgeable, and gracious."

"To me, time seemed to be an issue, but it didn't actually play out as a concern, because with time, my ability to understand the procedure so improved that now I feel as though I stumbled along in the right direction. That has to have been a function of the instructions given to me."

"In the beginning of the individual/small group task the instructions were not entirely clear. By the end of the discussion it was more clear. There was not enough time to do both small group and large group discussions. It was much harder to come to any sort of agreement. Had we continued with small group discussion we would not have finished on time."

Table 4.11 (continued)
Panelists' Responses to Question 9 of Evaluation Questionnaire No. 2

9. Please use the space below to provide additional comments concerning the clarity and completeness of the instructions you received, the adequacy of the time available, your level of understanding and confidence, or any other aspects of the procedure for classifying NAEP items to the ACT College Readiness Standards score ranges.

Mathematics

"The task was very clear and fairly straightforward. No problems."

"Fine for individual. Time pressure for group discussion. Task was challenging and required us to look for precision in descriptions. As a teacher of these levels of students I had a 'sense' of who would know which ideas. "

"This task was a little challenging. The taxonomy really helped me with this process."

"The biggest difficulty was in trying to be confident of the classifications of NAEP test items in terms of the ACT CRS. NAEP items requiring constructed response with 'justification' or 'proof' may map to 'draw conclusions' statements in the CRS, but it's not so clear how. This had an impact on the certainty which I could attribute to my answers. The instructions to proceed generally acknowledged this challenge. The overall instructions were complete and helpful."

"Instructions and organization was good. Time was inadequate so that procedure was atomized and mechanical. No time to consolidate information into coherent analysis of the overall comparison task."

"I felt concern regarding the validity of the process. Perhaps training on procedure would have helped."

Table 4.12
Panelists' Responses to Question 10 of Evaluation Questionnaire No. 2

10. Please comment on any particular challenges you experienced in performing the classification of the NAEP items (multiple-choice and/or constructed response) to the College Readiness Standards score ranges. Do you have suggestions that would improve these situations?

Reading

"There were simply types of items (constructed responses) and certain passages/text genres (poetry, myths, documents) that are characteristic of NAEP but beyond the realm of ACT multiple-choice/passage typifications. It would be valuable for ACT to consider expanding the number of critical/analytic/evaluative item types that they incorporate—especially given the predictive mission of the test. On the side of NAEP, it might prove useful to give greater consideration to the explicit content of the domain-specific informational passages that are identified and used" (from a NAEP-knowledgeable panelist).

"I highlighted a lot of these on the grid/the clean copy we were given on Wednesday. Here's a summary:

- Inconsistent/apparently inconsistent weights given to skills—if we perceive it (albeit accidentally), others must.
- Verbs like 'understand'/'determine'/'identify' v. 'locate' are muddy and though useful for end users, not useful for alignment.
- Classification of text need not integrated [*sic*] into the grid at all and it would still be very useful"

"Way too many terms were understood one way in NAEP and another way in ACT or terms were crucial in NAEP and not so important in ACT. As we've pretty well documented, the College Readiness Standards chart is not robust enough, rigorous enough, or systematic enough to make it an effective instrument for the purpose it was meant to serve in this process."

"It was challenging to rate NAEP items according to CRS in part at least because the CRS only represented the ACT items that 'anchored' at different proficiency levels—and not the full range of ACT items. It would have been much easier to compare the NAEP items to the item types described in the ACT *Item Writer's Guide*."

"It was often impossible to match the constructed response to the standards because the NAEP item skills were not reflected in the Standards."

"Ahh—I think I could finally do it, but I have yet to really wrap my head around why it needed to be done."

"Because ACT Readiness Standards do not cover constructed responses, this seemed to be the item that caused the most problems. Some uncomplicated passages would have items that contained a higher skill set that could not be scored because it fell under the more challenging range. The ranges sort of 'boxed' us in to scoring and I'm not entirely sure that the ranges are completely accurate."

Table 4.12 (continued)
Panelists' Responses to Question 10 of Evaluation Questionnaire No. 2

11. Please comment on any particular challenges you experienced in performing the classification of the NAEP items (multiple-choice and/or constructed response) to the College Readiness Standards score ranges. Do you have suggestions that would improve these situations?

Mathematics

"Only challenges popped up when specific verbiage was missing in the College Readiness Standards and we then had to use our own personal observation and best judgment about what band to categorize the students."

"Some concepts exist in NAEP framework but not in CRS."

"This task was a lot smoother than one mentioned above. Only challenge was categorizing the taxonomy that I relied on prior. This was a really good learning experience to 'NAEP-world'."

"Perhaps having more ACT tests to examine w/ NAEP tests would have been useful in this regard."

"NAEP framework and ACT College Readiness Frameworks have different goals. New NAEP framework is more focused on critical thinking, ACT on measuring acquired skills. Most ACT items map to a partial subset of NAEP framework items."

"Some of the constructed responses were difficult to score because the topics were not explicitly covered on the College Readiness document. This also true with some of the multiple choice problems. The topics that were challenging were standard deviation and proof (including mathematical induction)."

"Mostly difficult due to level of specificity differences."

Table 4.13
Average Confidence Ratings[a] for Panelists' Item Classification Decisions, by Panelist and Item Type

Reading	Panelist[b]							
Item Type	1 (N)	2 (N)	3 (A)	4 (N)	5 (A)	6 (A)	7 (A)	Average
MC	2.1	1.3	1.1	3.0	1.2	1.4	1.6	1.3
DSCR	2.0	1.8	1.1	N/A[c]	1.1	1.3	2.0	1.4
PSCR	2.7	1.7	1.1	2.5	1.2	N/A	1.0	1.3
ECR	1.0	1.0	1.1	N/A	1.1	N/A	1.0	1.1
Average	2.0	1.4	1.1	2.8	1.2	1.4	1.4	1.3
Math								
Item Type	1 (N)	2 (N)	3 (A)	4 (A)	5 (N)	6 (N)	7 (A)	Average
MC	1.9	1.0	1.2	2.1	1.6	2.2	1.5	1.6
DSCR	1.9	1.1	1.3	2.3	1.7	2.2	1.7	1.7
PSCR	1.9	1.3	1.3	2.2	1.6	2.2	1.7	1.7
ECR	1.8	1.0	1.2	2.1	1.4	2.2	1.3	1.5
Average	1.9	1.1	1.2	2.2	1.6	2.2	1.6	1.6

[a] The rating scale was: 1 (Very Sure), 2 (Fairly Sure), and 3 (Not Sure).
[b] "A" indicates an ACT-knowledgeable panelist. "N" indicates a NAEP-knowledgeable panelist.
[c] "N/A" indicates that the panelist did not provide confidence ratings for his/her decisions about items of that type.

5. CONCLUSION

This report described two studies—an Alignment Study and an Item Classification Study—conducted by ACT under contract to the National Assessment Governing Board. Both studies compared the National Assessment in Educational Progress in Reading and Mathematics to the ACT Reading and Mathematics Tests. To conduct the study, ACT convened panels of Reading and Mathematics subject matter experts: high school and postsecondary instructors, each with extensive experience in one of the assessments. The panels met for three and one-half days, collecting the data for the studies. The purpose of the Alignment Study was to determine and document the similarities and differences in the content and cognitive skills measured by the two assessments through an examination of the NAEP frameworks and comparable documents for the ACT, including the College Readiness Standards. Each panel made judgments about the areas of similarity and dissimilarity between the domains of the assessments based on these documents. The purpose of the Item Classification Study was to classify the operational Reading and Mathematics items from the 2009 NAEP to score ranges for the ACT Reading Test and Mathematics Test, using the College Readiness Standards in those subject areas as articulations of the knowledge and skills associated with those score ranges. Each panel made a judgment as to the College Readiness Standards score range it felt was most consistent with the knowledge or skill measured by each multiple-choice item, and by each creditable score category (each score category above "1") for each constructed-response item.

The results of the Alignment Study showed that the two assessments have a good deal of their content and cognitive domains in common, but that notable differences exist. The Reading panel concluded that both Reading assessments employ authentic, high-quality, and engaging texts. Both assessments measure reading skills within the contexts of fiction, literary nonfiction, and expository texts. It was the opinion of the panel, however, that NAEP texts encompass more genres of fiction and a broader range of topics than the ACT's humanities, social sciences, and natural sciences passages do. The NAEP also employs a number of text types (poems, persuasive text, procedural texts, documents, and paired texts) that do not appear in the ACT domain. The two Reading assessments cover much the same domain of reading skills. The sense of the Reading panel, though, was that the NAEP assessed analytical, critical, and evaluative skills to a greater degree than the ACT does, typically through the constructed-response format. The Reading panel concluded, however, that essentially all of the ACT College Readiness Standards in Reading are reflected in elements of the NAEP Reading domain.

Both the NAEP and the ACT Mathematics assessments measure knowledge and skills from the same general areas of mathematics, but differences exist here, as well. The Mathematics panel determined that the NAEP Mathematics domain emphasizes a number of topics—probability, statistics, data analysis, and transformations—to a greater extent than does the ACT Mathematics domain. Higher-order analytic and evaluative skills are also assessed to a greater degree, primarily through the use of constructed-response. The panel also concluded that the content domain of the ACT Mathematics Test includes a few topics (in the Pre-Algebra subdomain) that are reflected in elements of the Grade 8 NAEP domain. Like the Reading panel, the Mathematics panel was able to find elements in the NAEP content domain that were

consistent with all of the ACT College Readiness Standards in their discipline. As did the Reading panel, the Mathematics panel expressed uncertainty in their determinations due to differences in the organization and granularity of the NAEP and ACT documents.

The results of the Item Classification Study echo the issues described above. Overall, the results were mixed. Both panels were able to agree on final classifications for most of the 2009 NAEP items; majority opinions were reached on 210 of the 211 Reading items and score categories, and on 190 of the 229 Mathematics items and score categories. About one third (65) of the Reading items and score categories were classified to the ACT Reading Benchmark Score range (20–23), but more items and score categories (73) were deemed not classifiable to any score range, either because they pertain to text types not found in the ACT domain or because the level of analysis or evaluation required by the items was deemed outside the scope the ACT's cognitive skills domain. Most of the Reading majority opinions were unanimous, and the final classifications of the panel members showed a high degree of interrater reliability, but only after much struggling with aspects of the ACT College Readiness Standards in Reading (particularly, text complexity) that are not dealt with as explicitly in the NAEP frameworks. In Mathematics, 32 of the 190 final classifications were to the Mathematics Benchmark Score range (20–23), while 148 were to score ranges above that. The difficulty of the classification task for the Mathematics panel is borne out by the small numbers of unanimous opinions, the large proportion of simple majority opinions, and the low interrater reliability of the panelists' final classifications.

The evidence collected in these studies supports the position that the NAEP Reading assessment and the ACT Reading Test measure similar skills in somewhat similar ways. The same may be said for the NAEP Mathematics assessment and the ACT Mathematics Test. Both assessments measure large sets of important knowledge and skills acquired by students by Grade 12. The ACT Reading and Mathematics domains are reflected in the knowledge and skills measured by the NAEP, but some of what is found on the NAEP is not found in the ACT. When making judgments about the degree to which NAEP information may be used to make statements about college readiness (as defined by the ACT), educators should take care to keep both these similarities and these differences in mind.

Appendix A

ACT Letter of Agreement

Month date, year

Name
Address
City, State Zip

Dear Name:

This letter confirms the understanding between you and ACT, Inc. (ACT), whereby you agree to perform the following services for ACT:

Participate in a meeting at ACT national headquarters in Iowa City, Iowa on July 13-16, 2009, the goals of which are (1) to determine and document the alignment of the ACT (Reading or Mathematics) Test and ACT's College Readiness Standards™ with the Grade 12 National Assessment of Educational Progress (NAEP) in (Reading or Mathematics), and (2) to classify NAEP assessment items according to ACT's College Readiness Standards.

In consideration for the above, ACT agrees to pay you a fee in the amount of $2,800, provide air transportation to and from Iowa City, provide hotel accommodations for the nights of July 12-15, provide breakfast and lunch for all four days of the meeting, and provide dinner for one evening.

ACT has been asked to disclose certain confidential and proprietary information to you in connection with your participation in this meeting. Prior to disclosing such information to you, ACT requires you to sign this Letter of Agreement (the "Agreement").

In agreeing to the above, you further agree to the following:

1. The term "Confidential Information" shall include, without limitation, any stimulus, test items, test forms, or any other examination materials, guides or materials provided to you by ACT.

2. With respect to the Confidential Information, you agree to:

    a. use the Confidential Information strictly as necessary to participate in the meeting;

    b. not disclose or in any way convey the Confidential Information to anyone outside of ACT;

    c. keep all Confidential Information strictly confidential and secure and not take any Confidential Information outside of the ACT monitored meeting site;

    d. not record, in any manner, any information that paraphrases or captures the essence of a test form, item, passage, or stimulus;

    e. not discuss specific test form designations and content with anyone, as to do so will be considered a breach in security;

    f. immediately notify ACT in writing in the event of any unauthorized use or disclosure of the Confidential Information and assist in remedying such unauthorized use or disclosure, as requested by ACT (which shall not limit other remedies of ACT as provided herein or by applicable law); and

    g. immediately return all Confidential Information to ACT at the conclusion of the meeting and/or at any time upon the request of ACT.

3. You represent that you are not currently involved with either test preparation workshops or the development of test preparation materials for the ACT Test. You further agree not to engage in any such activities for a minimum of one year following the completion of the services provided by you under this Agreement.

4. This Agreement shall be governed by the laws of the State of Iowa without giving effect to conflict of law principles.

5. ACT may assign its interest in this Agreement. You may not assign your interest in, or any of your responsibilities under this Agreement.

If the foregoing is acceptable, please sign, date, and return the original of this Agreement. You may retain the enclosed copy for your files.

ACT, Inc.	Agreed to and Accepted by:
By: _____	By: _____
Jay Happel Senior Program Development Associate Elementary and Secondary School Programs ACT, Inc.	Signature, Print: _____
Date: _____	Date: _____

Appendix B

NAEP Confidentiality Agreement

UNITED STATES DEPARTMENT OF EDUCATION
INSTITUTE OF EDUCATION SCIENCES

NATIONAL CENTER FOR EDUCATION STATISTICS

CONFIDENTIALITY AGREEMENT:
Test Materials and Data Security Requirements for the National Assessment of Educational Progress (NAEP)

Under this agreement, you will have access to secure and confidential National Assessment of Educational Progress (NAEP) test materials and data belonging to the National Center for Education Statistics (NCES) in the United States Department of Education. These materials and data are confidential and may not be shared or discussed with any person who has not signed a NAEP confidentiality agreement.

These data or materials may not be copied, published, announced, or in any other way made public. "Any unauthorized person who knowingly discloses, publishes, or uses [NAEP] assessment questions, or complete and current assessment instruments of any [NAEP] assessment…may be fined as specified in section 3571 of title 18, United States Code or charged with a class E felony" (H. Res. 1, 2001).

By signing this agreement, you acknowledge that the NAEP test materials and data constitute proprietary and confidential materials of the United States Department of Education. You further understand that any disclosure, unauthorized use, or reproduction of these materials would damage the confidentiality of NAEP, is illegal, and can result in a felony charge. You agree to keep the test materials and data secure and confidential.

ACCEPTED AND AGREED TO:

Signature_____ Date_____

Full name (please print)_____

Title_____

Address_____

_____

Appendix C

College Readiness Standards in Reading

	Main Ideas and Author's Approach (MID)	Supporting Details (SUP)	Sequential, Comparative, and Cause-Effect Relationships (REL)
13–15	**201.** Recognize a clear intent of an author or narrator in uncomplicated literary narratives	**201.** Locate basic facts (e.g., names, dates, events) clearly stated in a passage	**201.** Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages **202.** Recognize clear cause-effect relationships described within a single sentence in a passage
16–19	**301.** Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	**301.** Locate simple details at the sentence and paragraph level in uncomplicated passages **302.** Recognize a clear function of a part of an uncomplicated passage	**301.** Identify relationships between main characters in uncomplicated literary narratives **302.** Recognize clear cause-effect relationships within a single paragraph in uncomplicated literary narratives
20–23	**401.** Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives **402.** Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages	**401.** Locate important details in uncomplicated passages **402.** Make simple inferences about how details are used in passages	**401.** Order simple sequences of events in uncomplicated literary narratives **402.** Identify clear relationships between people, ideas, and so on in uncomplicated passages **403.** Identify clear cause-effect relationships in uncomplicated passages
24–27	**501.** Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages **502.** Infer the main idea or purpose of straightforward paragraphs in more challenging passages **503.** Summarize basic events and ideas in more challenging passages **504.** Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages	**501.** Locate important details in more challenging passages **502.** Locate and interpret minor or subtly stated details in uncomplicated passages **503.** Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages	**501.** Order sequences of events in uncomplicated passages **502.** Understand relationships between people, ideas, and so on in uncomplicated passages **503.** Identify clear relationships between characters, ideas, and so on in more challenging literary narratives **504.** Understand implied or subtly stated cause-effect relationships in uncomplicated passages **505.** Identify clear cause-effect relationships in more challenging passages
28–32*	**601.** Infer the main idea or purpose of more challenging passages or their paragraphs **602.** Summarize events and ideas in virtually any passage **603.** Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage	**601.** Locate and interpret minor or subtly stated details in more challenging passages **602.** Use details from different sections of some complex informational passages to support a specific point or argument	**601.** Order sequences of events in more challenging passages **602.** Understand the dynamics between people, ideas, and so on in more challenging passages **603.** Understand implied or subtly stated cause-effect relationships in more challenging passages
33–36†	**701.** Identify clear main ideas or purposes of complex passages or their paragraphs	**701.** Locate and interpret details in complex passages **702.** Understand the function of a part of a passage when the function is subtle or complex	**701.** Order sequences of events in complex passages **702.** Understand the subtleties in relationships between people, ideas, and so on in virtually any passage **703.** Understand implied, subtle, or complex cause-effect relationships in virtually any passage

Descriptions of the EPAS (EXPLORE, PLAN, and ACT) Reading Passages

olicated Literary Narratives refers to excerpts ays, short stories, and novels that tend to use anguage and structure, have a clear purpose and r style, present straightforward interactions characters, and employ only a limited number of levices such as metaphor, simile, or hyperbole.

allenging Literary Narratives refers to from essays, short stories, and novels that nake moderate use of figurative language, nore intricate structure and messages d with some subtlety, and may feature at complex interactions between characters.

x Literary Narratives refers to excerpts from short stories, and novels that tend to make s use of ambiguous language and literary feature complex and subtle interactions characters, often contain challenging context-nt vocabulary, and typically contain messages eanings that are not explicit but are ed in the passage.

***** Statements apply to PLAN & ACT only
† Statements apply to ACT only

	Meanings of Words (MOW)	Generalizations and Conclusions (GEN)
13–15	**201.** Understand the implication of a familiar word or phrase and of simple descriptive language	**201.** Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives
16–19	**301.** Use context to understand basic figurative language	**301.** Draw simple generalizations and conclusions about people, ideas, and so on in uncomplicated passages
20–23	**401.** Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages	**401.** Draw generalizations and conclusions about people, ideas, and so on in uncomplicated passages **402.** Draw simple generalizations and conclusions using details that support the main points of more challenging passages
24–27	**501.** Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages **502.** Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages	**501.** Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives **502.** Draw generalizations and conclusions about people, ideas, and so on in more challenging passages
28–32*	**601.** Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts	**601.** Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so on
33–36†	**701.** Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage	**701.** Draw complex or subtle generalizations and conclusions about people, ideas, and so on, often by synthesizing information from different portions of the passage **702.** Understand and generalize about portions of a complex literary narrative

Descriptions of the EPAS (EXPLORE, PLAN, and ACT) Reading Passages

Uncomplicated Informational Passages refers to materials that tend to contain a limited amount of data, address basic concepts using familiar language and conventional organizational patterns, have a clear purpose, and are written to be accessible.

More Challenging Informational Passages refers to materials that tend to present concepts that are not always stated explicitly and that are accompanied or illustrated by more—and more detailed—supporting data, include some difficult context-dependent words, and are written in a somewhat more demanding and less accessible style.

Complex Informational Passages refers to materials that tend to include a sizable amount of data, present difficult concepts that are embedded (not explicit) in the text, use demanding words and phrases whose meaning must be determined from context, and are likely to include intricate explanations of processes or events.

***** Statements apply to PLAN & ACT only
† Statements apply to ACT only

Appendix D

College Readiness Standards in Mathematics

	Basic Operations & Applications (BOA)	Probability, Statistics, & Data Analysis (PSD)	Numbers: Concepts & Properties (NCP)	Expressions, Equations, & Inequalities (XEI)
13–15	**201.** Perform one-operation computation with whole numbers and decimals **202.** Solve problems in one or two steps using whole numbers **203.** Perform common conversions (e.g., inches to feet or hours to minutes)	**201.** Calculate the average of a list of positive whole numbers **202.** Perform a single computation using information from a table or chart	**201.** Recognize equivalent fractions and fractions in lowest terms	**201.** Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$) **202.** Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals
16–19	**301.** Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent **302.** Solve some routine two-step arithmetic problems	**301.** Calculate the average of a list of numbers **302.** Calculate the average, given the number of data values and the sum of the data values **303.** Read tables and graphs **304.** Perform computations on data from tables and graphs **305.** Use the relationship between the probability of an event and the probability of its complement	**301.** Recognize one-digit factors of a number **302.** Identify a digit's place value	**301.** Substitute whole numbers for unknown quantities to evaluate expressions **302.** Solve one-step equations having integer or decimal answers **303.** Combine like terms (e.g., $2x + 5x$)
20–23	**401.** Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average	**401.** Calculate the missing data value, given the average and all data values but one **402.** Translate from one representation of data to another (e.g., a bar graph to a circle graph) **403.** Determine the probability of a simple event **404.** Exhibit knowledge of simple counting techniques*	**401.** Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor	**401.** Evaluate algebraic expressions by substituting integers for unknown quantities **402.** Add and subtract simple algebraic expressions **403.** Solve routine first-degree equations **404.** Perform straightforward word-to-symbol translations **405.** Multiply two binomials*
24–27	**501.** Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)	**501.** Calculate the average, given the frequency counts of all the data values **502.** Manipulate data from tables and graphs **503.** Compute straightforward probabilities for common situations **504.** Use Venn diagrams in counting*	**501.** Find and use the least common multiple **502.** Order fractions **503.** Work with numerical factors **504.** Work with scientific notation **505.** Work with squares and square roots of numbers **506.** Work problems involving positive integer exponents* **507.** Work with cubes and cube roots of numbers* **508.** Determine when an expression is undefined* **509.** Exhibit some knowledge of the complex numbers†	**501.** Solve real-world problems using first-degree equations **502.** Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions) **503.** Identify solutions to simple quadratic equations **504.** Add, subtract, and multiply polynomials* **505.** Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)* **506.** Solve first-degree inequalities that do not require reversing the inequality sign*
28–32*	**601.** Solve word problems containing several rates, proportions, or percentages	**601.** Calculate or use a weighted average **602.** Interpret and use information from figures, tables, and graphs **603.** Apply counting techniques **604.** Compute a probability when the event and/or sample space are not given or obvious	**601.** Apply number properties involving prime factorization **602.** Apply number properties involving even/odd numbers and factors/multiples **603.** Apply number properties involving positive/negative numbers **604.** Apply rules of exponents **605.** Multiply two complex numbers†	**601.** Manipulate expressions and equations **602.** Write expressions, equations, and inequalities for common algebra settings **603.** Solve linear inequalities that require reversing the inequality sign **604.** Solve absolute value equations **605.** Solve quadratic equations **606.** Find solutions to systems of linear equations
33–36†	**701.** Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)	**701.** Distinguish between mean, median, and mode for a list of numbers **702.** Analyze and draw conclusions based on information from figures, tables, and graphs **703.** Exhibit knowledge of conditional and joint probability	**701.** Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers **702.** Exhibit knowledge of logarithms and geometric sequences **703.** Apply properties of complex numbers	**701.** Write expressions that require planning and/or manipulating to accurately model a situation **702.** Write equations and inequalities that require planning, manipulating, and/or solving **703.** Solve simple absolute value inequalities

***** Statements apply to PLAN & ACT only
† Statements apply to ACT only

	Graphical Representations (GRE)	Properties of Plane Figures (PPF)	Measurement (MEA)	Functions† (FUN)
13–15	**201.** Identify the location of a point with a positive coordinate on the number line		**201.** Estimate or calculate the length of a line segment based on other lengths given on a geometric figure	
16–19	**301.** Locate points on the number line and in the first quadrant	**301.** Exhibit some knowledge of the angles associated with parallel lines	**301.** Compute the perimeter of polygons when all side lengths are given **302.** Compute the area of rectangles when whole number dimensions are given	
20–23	**401.** Locate points in the coordinate plane **402.** Comprehend the concept of length on the number line* **403.** Exhibit knowledge of slope*	**401.** Find the measure of an angle using properties of parallel lines **402.** Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)	**401.** Compute the area and perimeter of triangles and rectangles in simple problems **402.** Use geometric formulas when all necessary information is given	**401.** Evaluate quadratic functions, expressed in function notation, at integer values
24–27	**501.** Identify the graph of a linear inequality on the number line* **502.** Determine the slope of a line from points or equations* **503.** Match linear graphs with their equations* **504.** Find the midpoint of a line segment*	**501.** Use several angle properties to find an unknown angle measure **502.** Recognize Pythagorean triples* **503.** Use properties of isosceles triangles*	**501.** Compute the area of triangles and rectangles when one or more additional simple steps are required **502.** Compute the area and circumference of circles after identifying necessary information **503.** Compute the perimeter of simple composite geometric figures with unknown side lengths*	**501.** Evaluate polynomial functions, expressed in function notation, at integer values **502.** Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths
28–32*	**601.** Interpret and use information from graphs in the coordinate plane **602.** Match number line graphs with solution sets of linear inequalities **603.** Use the distance formula **604.** Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point **605.** Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)†	**601.** Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles **602.** Use the Pythagorean theorem	**601.** Use relationships involving area, perimeter, and volume of geometric figures to compute another measure	**601.** Evaluate composite functions at integer values **602.** Apply basic trigonometric ratios to solve right-triangle problems
33–36†	**701.** Match number line graphs with solution sets of simple quadratic inequalities **702.** Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$ **703.** Solve problems integrating multiple algebraic and/or geometric concepts **704.** Analyze and draw conclusions based on information from graphs in the coordinate plane	**701.** Draw conclusions based on a set of conditions **702.** Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas **703.** Use relationships among angles, arcs, and distances in a circle	**701.** Use scale factors to determine the magnitude of a size change **702.** Compute the area of composite geometric figures when planning or visualization is required	**701.** Write an expression for the composite of two simple functions **702.** Use trigonometric concepts and basic identities to solve problems **703.** Exhibit knowledge of unit circle trigonometry **704.** Match graphs of basic trigonometric functions with their equations

* Statements apply to PLAN & ACT only
† Statements apply to ACT only

Appendix E

Worksheet for Comparing the NAEP Reading Framework to the ACT Reading Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Reading Framework Feature (NAGB, 2008a, 2007a)	ACT Reading Domain Feature/Test Specification/ College Readiness Standard
TYPES OF TEXTS	
Literary texts (30%)	
Fiction: e.g., adventure, historical fiction, realistic fiction, folktales/legends/myths/fantasy, satire, parody, allegory, monologue; intact passages or excerpts	
Literary nonfiction: e.g., personal essay, autobiographical/biographical, sketches, speech, character sketch, memoir, classical essay; intact passages or excerpts	
Poetry: e.g., narrative poem, free verse, lyrical poem, humorous poem, ode, song, epic, sonnet, elegy; intact poems or excerpts	
Informational texts (70%)	
Exposition: e.g., essay, literary analysis; intact passages or excerpts	
Argumentation and persuasive text: e.g., informational trade book, journal, speech, persuasive essay, letter to the editor, argumentative essay, editorial, historical account, position paper (brochure, campaign literature, advertisement, etc.)	
Procedural text and documents	
Mixed texts	
Paired texts	
CHARACTERISTICS OF TEXTS SELECTED FOR INCLUSION	
Authentic	
High-quality	
Coherent	
Grade-appropriate	
Drawn from a variety of contexts	
Engaging	
Reflecting our literary heritage, including works from varied historical periods	
PASSAGE LENGTH	
Approximately 500-1,500 words	
COGNITIVE TARGETS	
Locate/recall (20%): identify textually explicit information and make simple inferences with and across texts, such as:	
Definitions	
Facts	
Supporting details	
Character traits	
Sequence of events or actions	
Setting	
Figurative language	
Topic sentence or main idea	
Author's purpose	
Causal relations	
Specific information in texts or graphics	

NAEP Grade 12 Reading Framework Feature (NAGB, 2008a, 2007a)	ACT Reading Domain Feature/Test Specification/ College Readiness Standard
Integrate/Interpret (45%): make complex inferences within and across texts to:	
Compare or connect ideas, problems, or situations	
Determine unstated assumptions in an argument	
Describe how an author uses literary devices and text features	
Infer mood or tone	
Integrate ideas to determine theme	
Identify or interpret a character's motivations or decisions	
Examine relations between theme and setting or characters	
Explain how rhythm, rhyme, or form in poetry contribute to meaning	
Summarize major ideas	
Draw conclusions and provide supporting information	
Find evidence in support of an argument	
Distinguish facts from opinions	
Determine the importance of information within and across texts	
Critique/Evaluate (35%): consider text(s) critically to:	
Judge author's craft and technique	
Evaluate the author's perspective or point of view within or across texts	
Take different perspectives in relation to a text	
Evaluate the role of literary devices in conveying meaning	
Evaluate a character's motivations and decisions	
Analyze the point of view used by the author	
Analyze the representation of information	
Evaluate the way the author selects language to influence readers	
Evaluate the strength and quality of evidence use by the author to support his./her position	
Determine the quality of counterarguments within and across texts	
Judge the coherence, logic, or credibility of an argument	
ITEM TYPES	
Multiple-choice (40%)	
Four answer options: one correct, three incorrect	
Assumed time to complete: approx. 1 minute	
Short constructed response (45%)	
Extended constructed-response (15%)	

Appendix F

Worksheet for Comparing the NAEP Mathematics Framework to the ACT Mathematics Domain, Test Specifications, and College Readiness Standards

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
MATHEMATICAL CONTENT AREAS	
Number Properties and Operations (NPO; 10% of items)	
1. Number sense	
d) Represent, interpret or compare expressions for real numbers, including expressions utilizing exponents and logarithms.	
f) Represent or interpret expressions involving very large or very small numbers in scientific notation.	
g) Represent, interpret or compare expressions or problem situations involving absolute values.	
i) Order or compare real numbers, including very large and very small real numbers.	
2. Estimation	
b) Identify situations where estimation is appropriate, determine the needed degree of accuracy, and analyze the effect of the estimation method on the accuracy of results.	
c) Verify solutions or determine the reasonableness of results in a variety of situations.	
d) Estimate square or cube roots of numbers less than 1,000 between two whole numbers.	
3. Number operations	
a) Find integral or simple fractional powers of real numbers.	
b) Perform arithmetic operations with real numbers, including common irrational numbers.	
c) Perform arithmetic operations with expressions involving absolute value.	
d) Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a real number by: • Zero, • A number less than zero, • A number between zero and one, • One, or • A number greater than one.	
f) Solve application problems involving numbers, including rational and common irrationals.	
4. Ratios and proportional reasoning	
c) Use proportions to solve problems (including rates of change).	
d) Solve multi-step problems involving percentages, including compound percentages.	
5. Properties of number and operations	
c) Solve problems using factors, multiples, or prime factorization.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
d) Use divisibility or remainders in problem settings.	
e) Apply basic properties of operations, including conventions about the order of operations.	
f) Recognize properties of the number system—whole numbers, integers, rational numbers, real numbers, and complex numbers—recognize how they are related to each other, and identify examples of each type of number.	
6. Mathematical Reasoning using Number	
a) Give a mathematical argument to establish the validity of a simple numerical property or relationship.	
b) Analyze or interpret a proof by mathematical induction of a simple numerical relationship.	
Measurement (MEA; 35% of items, with Geometry)	
1. Measuring physical attributes	
b) Determine the effect of proportions and scaling on length, areas and volume.	
c) Estimate or compare perimeters or areas of two-dimensional geometric figures.	
d) Solve problems of angle measure, including those involving triangles or other polygons or parallel lines cut by a transversal.	
f) Solve problems involving perimeter or area of plane figures such as polygons, circles, or composite figures.	
h) Solve problems by determining, estimating, or comparing volumes or surface areas of three-dimensional figures.	
i) Solve problems involving rates such as speed, density, population density, or flow rates.	
2. Systems of measurement	
a) Recognize that geometric measurements (length, area, perimeter, and volume) depend on the choice of a unit, and apply such units in expressions, equations, and problem solutions.	
b) Solve problems involving conversions within or between measurement systems, given the relationship between the units.	
d) Understand that numerical values associated with measurements of physical quantities are approximate, are subject to variation, and must be assigned units of measurement.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
e) Determine appropriate accuracy of measurement in problem situations (e.g., the accuracy of measurement of the dimensions to obtain a specified accuracy of area) and find the measure to that degree of accuracy.	
f) Construct or solve problems-involving scale drawings.	
3. Measurement in Triangles	
a) Solve problems involving indirect measurement.	
b) Solve problems using the fact that trigonometric ratios (sine, cosine, and tangent) stay constant in similar triangles.	
c) Use the definitions of sine, cosine, and tangent as ratios of sides in a right triangle to solve problems about length of sides and measure of angles.	
d) Interpret and use the identity $\sin^2 q + \cos^2 q = 1$ for angles q between 0° and 90°; recognize this identity as a special representation of the Pythagorean theorem.	
e) Determine the radian measure of an angle and explain how radian measurement is related to a circle of radius 1.	
f) Use trigonometric formulas such as addition and double angle formulas.	
g) Use the law of cosines and the law of sines to find unknown sides and angles of a triangle.	
Geometry (GEO; 35% of items, with Measurement)	
1. Dimension and shape	
c) Give precise mathematical descriptions or definitions of geometric shapes in the plane and in three-dimensional space.	
d) Draw or sketch from a written description plane figures and planar images of three-dimensional figures.	
e) Use two-dimensional representations of three-dimensional objects to visualize and solve problems.	
f) Analyze properties of three-dimensional figures including spheres and hemispheres.	
2. Transformation of shapes and preservation of properties	
a) Recognize or identify types of symmetries (e.g., point, line, rotational, self-congruence) of two- and three-dimensional figures.	
b) Give or recognize the precise mathematical relationship (e.g., congruence, similarity, orientation) between a figure and its image under a transformation.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
c) Perform or describe the effect of a single transformation on two- and three-dimensional geometric shapes (reflections across lines of symmetry, rotations, translations, and dilations).	
e) Justify relationships of congruence and similarity, and apply these relationships using scaling and proportional reasoning.	
g) Perform or describe the effects of successive transformations.	
3. Relationships between geometric figures	
b) Apply geometric properties and relationships to solve problems in two and three dimensions.	
c) Represent problem situations with geometric models to solve mathematical or real-world problems.	
d) Use the Pythagorean theorem to solve problems in two- or three-dimensional situations.	
e) Recall and interpret definitions and basic properties of congruent and similar triangles, circles, quadrilaterals, polygons, parallel, perpendicular and intersecting lines, and associated angle relationships.	
f) Analyze properties or relationships of triangles, quadrilaterals, and other polygonal plane figures.	
g) Analyze properties and relationships of parallel, perpendicular, or intersecting lines, including the angle relationships that arise in these cases.	
h) Analyze properties of circles and the intersection of circles and lines (inscribed angles, central angles, tangents, secants, and chords).	
4. Position, direction, and coordinate geometry	
a) Solve problems involving the coordinate plane such as the distance between two points, the midpoint of a segment, or slopes of perpendicular or parallel lines.	
b) Describe the intersections of lines in the plane and in space, intersections of a line and a plane, or of two planes in space.	
c) Describe or identify conic sections and other cross sections of solids.	
d) Represent two-dimensional figures algebraically using coordinates and/or equations.	
e) Use vectors to represent velocity and direction; multiply a vector by a scalar and add vectors both algebraically and graphically.	
f) Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius..	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
g) Graph ellipses and hyperbolas whose axes are parallel to the coordinate axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.	
h) Represent situations and solve problems involving polar coordinates.	
5. Mathematical Reasoning in Geometry	
a) Make, test, and validate geometric conjectures using a variety of methods including deductive reasoning and counterexamples.	
b) Determine the role of hypotheses, logical implications, and conclusion, in proofs of geometric theorems.	
c) Analyze or explain a geometric argument by contradiction.	
d) Analyze or explain a geometric proof of the Pythagorean theorem.	
e) Prove basic theorems about congruent and similar triangles and circles.	
Data Analysis, Statistics, and Probability (DASP; 25%)	
1. Data representation	
a) Read or interpret graphical or tabular representations of data.	
b) For a given set of data, complete a graph and solve a problem using the data in the graph (histograms, scatterplots, line graphs).	
c) Solve problems involving univariate or bivariate data.	
d) Given a graphical or tabular representation of a set of data, determine whether information is represented effectively and appropriately.	
e) Compare and contrast different graphical representations of univariate and bivariate data.	
f) Organize and display data in a spreadsheet in order to recognize patterns and solve problems.	
2. Characteristics of data sets	
a) Calculate, interpret, or use summary statistics for distributions of data including measures of typical value (mean, median), position (quartiles, percentiles), and spread (range, interquartile range, variance, standard deviation).	
b) Recognize how linear transformations of one-variable data affect mean, median, mode, range, interquartile range, and standard deviation.	
c) Determine the effect of outliers on mean, median, mode, range, interquartile range, or standard deviation.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
d) Compare data sets using summary statistics (mean, median, mode, range, interquartile range, or standard deviation) describing the same characteristic for two different populations or subsets of the same population.	
e) Approximate a trend line if a linear pattern is apparent in a scatterplot or use a graphing calculator to determine a least-squares regression line, and use the line or equation to make a prediction.	
f) Recognize that the correlation coefficient is a number from –1 to +1 that measures the strength of the linear relationship between two variables; visually estimate the correlation coefficient (e.g., positive or negative, closer to 0, .5, or 1.0) of a scatterplot.	
g) Know and interpret the key characteristics of a normal distribution such as shape, center (mean), and spread (standard deviation).	
3. Experiments and samples	
a) Identify possible sources of bias in sample surveys, and describe how such bias can be controlled and reduced.	
b) Recognize and describe a method to select a simple random sample.	
c) Draw inferences from samples, such as estimates of proportions in a population, estimates of population means, or decisions about differences in means for two "treatments".	
d) Identify or evaluate the characteristics of a good survey or of a well-designed experiment.	
e) Recognize the differences in design and in conclusions between randomized experiments and observational studies.	
4. Probability	
a) Recognize whether two events are independent or dependent.	
b) Determine the theoretical probability of simple and compound events in familiar or unfamiliar contexts.	
c) Given the results of an experiment or simulation, estimate the probability of simple or compound events in familiar or unfamiliar contexts.	
d) Use theoretical probability to evaluate or predict experimental outcomes.	
e) Determine the number of ways an event can occur using tree diagrams, formulas for combinations and permutations, or other counting techniques.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
h) Determine the probability of independent and dependent events.	
i) Determine conditional probability using two-way tables.	
j) Interpret and apply probability concepts to practical situations.	
k) Use the binomial theorem to solve problems.	
5. Mathematical Reasoning with Data	
a) Identify misleading uses of data in real-world settings and critique different ways of presenting and using information.	
b) Distinguish relevant from irrelevant information, identify missing information, and either find what is needed or make appropriate approximations.	
c) Recognize, use, and distinguish between the processes of mathematical (deterministic) and statistical modeling.	
d) Recognize when arguments based on data confuse correlation with causation.	
e) Recognize and explain the potential errors caused by extrapolating from data.	
Algebra (ALG; 35%)	
1. Patterns, relations, and functions	
a) Recognize, describe, or extend numerical patterns, including arithmetic and geometric progressions.	
b) Express linear and exponential functions in recursive and explicit form given a table, verbal description, or some terms of a sequence.	
e) Identify or analyze distinguishing properties of linear, quadratic, rational, exponential, or trigonometric functions from tables, graphs, or equations.	
g) Determine whether a relation, given in verbal, symbolic, tabular, or graphical form, is a function.	
h) Recognize and analyze the general forms of linear, quadratic, rational, exponential, or trigonometric functions.	
i) Determine the domain and range of functions given in various forms and contexts.	
j) Given a function, determine its inverse if it exists, and explain the contextual meaning of the inverse for a given situation.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
2. Algebraic expressions	
a) Create and translate between different representations of algebraic expressions, equations, and inequalities (e.g., linear, quadratic, exponential, or trigonometric) using symbols, graphs, tables, diagrams, or written descriptions.	
b) Analyze or interpret relationships expressed in symbols, graphs, tables, diagrams (including Venn diagrams), or written descriptions and evaluate the relative advantages or disadvantages of different representations to answer specific questions.	
d) Perform or interpret transformations on the graphs of linear, quadratic, exponential, and trigonometric functions.	
e) Make inferences or predictions using an algebraic model of a situation.	
f) Given a real-world situation, determine if a linear, quadratic, rational, exponential, logarithmic, or trigonometric function fits the situation.	
g) Solve problems involving exponential growth and decay.	
h) Analyze properties of exponential, logarithmic, and rational functions.	
3. Variables, expressions, and operations	
b) Write algebraic expressions, equations, or inequalities to represent a situation.	
c) Perform basic operations, using appropriate tools, on algebraic expressions including polynomial and rational expressions.	
d) Write equivalent forms of algebraic expressions, equations, or inequalities to represent and explain mathematical relationships.	
e) Evaluate algebraic expressions, including polynomials and rational expressions.	
f) Use function notation to evaluate a function at a specified point in its domain and combine functions by addition, subtraction, multiplication, division, and composition.	
g) Determine the sum of finite and infinite arithmetic and geometric series.	
h) Use basic properties of exponents and *logarithms to solve problems.	
4. Equations and inequalities	
a) Solve linear, rational or quadratic equations or inequalities, including those involving absolute value.	

NAEP Grade 12 Mathematics Framework Feature (NAGB, 2008b 2007b)	ACT Mathematics Domain Feature/Test Specification/College Readiness Standard
c) Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.	
d) Solve (symbolically or graphically) a system of equations or inequalities and recognize the relationship between the analytical solution and graphical solution.	
e) Solve problems involving special formulas such as: $A = P(I + r)^t$, $A = Pe^{rt}$].	
f) Solve an equation or formula involving several variables for one variable in terms of the others.	
g) Solve quadratic equations with complex roots.	
5. Mathematical Reasoning in Algebra	
a) Use algebraic properties to develop a valid mathematical argument.	
b) Determine the role of hypotheses, logical implications, and conclusions in algebraic argument.	
c) Explain the use of relational conjunctions (and, or) in algebraic arguments.	
MATHEMATICAL COMPLEXITY OF ITEMS	
Low Complexity (25%)	
Moderate Complexity (50%)	
High Complexity (25%)	
ITEM FORMATS	
Multiple-choice (50% of testing time)	
Four or five answer options: one correct, three or four incorrect	
Short constructed response (50%, with Extended CR)	
Extended constructed-response (50%, with Short CR)	

Appendix G

Worksheet for Comparing the ACT Reading Domain, Test Specifications, and College Readiness Standards to the NAEP Reading Framework

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
PASSAGE CONTENT (ACT, 2008a)	
Prose Fiction (25%): passages from short stories or novels	
Humanities (25%): passages from memoirs, personal essays, and nonfiction essays on architecture, art, dance, ethics, film, language, literary criticism, music, philosophy, radio, religion, television, and theater	
Social Science (25%): nonfiction passages on anthropology, archaeology, biography, business, economics, education, geography, history, political science, psychology, and sociology	
Natural Science.(25%): nonfiction passages on anatomy, astronomy, biology, botany, chemistry, ecology, geology, medicine, meteorology, microbiology, natural history, physiology, physics, technology, and zoology	

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
COMPLEXITY OF PASSAGES (ACT, 2008c)	
Uncomplicated literary narratives: • use simple language and structure; • have a clear purpose, familiar style; • present straightforward interactions between characters; • employ a limited number of literary devices.	
More challenging literary narratives: • make moderate use of figurative language; • have a more intricate structure; • have messages conveyed with some subtlety; • may feature somewhat complex interactions between characters.	
Complex literary narratives: • make generous use of ambiguous language and literary devices; • feature complex and subtle interactions between characters; • contain challenging context-dependent vocabulary; • contain messages and/or meanings that are not explicit but are embedded in the passage.	
Uncomplicated informational passages: • contain a limited amount of data; • address basic concepts using familiar language; • use conventional organizational patterns; • have a clear purpose' • are written to be accessible.	
More challenging informational passages: • present concepts that are not always stated explicitly; • accompany concepts with more—and more detailed—supporting data; • include difficult context-dependent words; • are written in a more demanding and less accessible style.	
Complex informational passages: • include a sizable amount of data; • present difficult concepts that are embedded (not explicit) in the text; • use demanding words and phrases whose meaning must be determined from context; • are likely to include intricate explanations of processes or events.	
PASSAGE LENGTH (ACT, 2008a)	
Approximately 750 words	
COGNITIVE SKILLS (ACT, 2008a)	
Referring – Main Ideas	
Recognizing the main idea of a passage	
Recognizing the main idea of a paragraph or paragraphs	

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
Referring – Relationships	
Recognizing sequences	
Recognizing cause-effect relationships	
Recognizing comparative relationships (comparisons and contrasts)	
Referring – Significant Details	
Recognizing the information in a passage that answers the questions who, what, where, when, why, and how	
Reasoning – Inferences from the Text	
Inferring the main idea or purpose of a passage	
Inferring the main idea or purpose of a paragraph or paragraphs	
Showing how details are related to main ideas (e.g., how they support the main idea)	
Inferring sequences	
Inferring cause-effect relationships	
Reasoning – Critical Understanding of the Text	
Drawing conclusions from information given in the passage	
Making comparisons and contrasts using stated information	
Making appropriate generalizations	
Understanding point of view	
Recognizing logical fallacies, rhetorical flaws, or limitations in passages	
Recognizing stereotypes	
Distinguishing between fact and opinion	
Reasoning – Context-Dependent Vocabulary	
Determining the meaning in context of multiple-meaning words or short phrases	
ITEM TYPES (ACT, 2008a)	
Multiple-choice (100%)	
Four answer options: one correct, three incorrect	
COLLEGE READINESS STANDARDS (ACT, 2008d)	
Main Ideas and Author's Approach (MID)	
201. Recognize a clear intent of an author or narrator in uncomplicated literary narratives	
301. Identify a clear main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	
401. Infer the main idea or purpose of straightforward paragraphs in uncomplicated literary narratives	
402. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in uncomplicated passages	
501. Identify a clear main idea or purpose of any paragraph or paragraphs in uncomplicated passages	

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
502. Infer the main idea or purpose of straightforward paragraphs in more challenging passages	
503. Summarize basic events and ideas in more challenging passages	
504. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in more challenging passages	
601. Infer the main idea or purpose of more challenging passages or their paragraphs	
602. Summarize events and ideas in virtually any passage	
603. Understand the overall approach taken by an author or narrator (e.g., point of view, kinds of evidence used) in virtually any passage	
701. Identify clear main ideas or purposes of complex passages or their paragraphs	
Supporting Details (SUP)	
201. Locate basic facts (e.g., names, dates, events) clearly stated in a passage	
301. Locate simple details at the sentence and paragraph level in uncomplicated passages\	
302. Recognize a clear function of a part of an uncomplicated passage	
401. Locate important details in uncomplicated passages	
402. Make simple inferences about how details are used in passages	
501. Locate important details in more challenging passages	
502. Locate and interpret minor or subtly stated details in uncomplicated passages	
503. Discern which details, though they may appear in different sections throughout a passage, support important points in more challenging passages	
601. Locate and interpret minor or subtly stated details in more challenging passages	
602. Use details from different sections of some complex informational passages to support a specific point or argument	
701. Locate and interpret details in complex passages	
702. Understand the function of a part of a passage when the function is subtle or complex	
Sequential, Comparative, and Cause-Effect Relationships (REL)	
201. Determine when (e.g., first, last, before, after) or if an event occurred in uncomplicated passages	
202. Recognize clear cause-effect relationships described within a single sentence in a passage	
301. Identify relationships between main characters in uncomplicated literary narratives	

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
302. Recognize clear cause-effect relationships within a single paragraph in uncomplicated literary narratives	
401. Order simple sequences of events in uncomplicated literary narratives	
402. Identify clear relationships between people, ideas, and so on in uncomplicated passages	
403. Identify clear cause-effect relationships in uncomplicated passages	
501. Order sequences of events in uncomplicated passages	
502. Understand relationships between people, ideas, and so on in uncomplicated passages	
503. Identify clear relationships between characters, ideas, and so on in more challenging literary narratives	
504. Understand implied or subtly stated cause-effect relationships in uncomplicated passages	
505. Identify clear cause-effect relationships in more challenging passages	
601. Order sequences of events in more challenging passages	
602. Understand the dynamics between people, ideas, and so on in more challenging passages	
603. Understand implied or subtly stated cause-effect relationships in more challenging passages	
701. Order sequences of events in complex passages	
702. Understand the subtleties in relationships between people, ideas, and so on in virtually any passage	
703. Understand implied, subtle, or complex cause-effect relationships in virtually any passage	
Meanings of Words (MOW)	
201. Understand the implication of a familiar word or phrase and of simple descriptive language	
301. Use context to understand basic figurative language	
401. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in uncomplicated passages	
501. Use context to determine the appropriate meaning of virtually any word, phrase, or statement in uncomplicated passages	
502. Use context to determine the appropriate meaning of some figurative and nonfigurative words, phrases, and statements in more challenging passages	
601. Determine the appropriate meaning of words, phrases, or statements from figurative or somewhat technical contexts	

ACT Reading Domain Feature/Test Specification/ College Readiness Standard	NAEP Grade 12 Reading Framework Feature
701. Determine, even when the language is richly figurative and the vocabulary is difficult, the appropriate meaning of context-dependent words, phrases, or statements in virtually any passage	
Generalizations and Conclusions (GEN)	
201. Draw simple generalizations and conclusions about the main characters in uncomplicated literary narratives	
301. Draw simple generalizations and conclusions about people, ideas, and so on in uncomplicated passages	
401. Draw generalizations and conclusions about people, ideas, and so on in uncomplicated passages	
402. Draw simple generalizations and conclusions using details that support the main points of more challenging passages	
501. Draw subtle generalizations and conclusions about characters, ideas, and so on in uncomplicated literary narratives	
502. Draw generalizations and conclusions about people, ideas, and so on in more challenging passages	
601. Use information from one or more sections of a more challenging passage to draw generalizations and conclusions about people, ideas, and so on	
701. Draw complex or subtle generalizations and conclusions about people, ideas, and so on, often by synthesizing information from different portions of the passage	
702. Understand and generalize about portions of a complex literary narrative	

Appendix H

Worksheet for Comparing the ACT Mathematics Domain, Test Specifications, and College Readiness Standards to the NAEP Mathematics Framework

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
TEST DOMAIN (ACT, 2008b, 2007c)	
Pre-Algebra (23% of questions)	
Addition, subtraction, multiplication, division of whole numbers, decimals, fractions, integers	
Positive integer exponents	
Prime factorization	
Comparison of fractions	
Ratio and proportion	
Conversion between fractions and decimals	
Absolute value	
Solution of simple linear equations in one variable	
Percent	
Scientific notation	
Square roots	
Operations with real numbers (field axioms)	
Order properties for real numbers	
Common factors and common multiples	
Counting and counting techniques	
The concept of probability	
Data collection and representation	
Reading and interpreting graphs, charts, and other representations of data	
Using the mean, median, mode, and range	
Elementary Algebra (17%), e.g.,	
Evaluation of algebraic expressions by substitution	
Simplification of algebraic expressions	
Addition, subtraction, and multiplication of polynomials	
Factorization of polynomials	
Solution of quadratic equations by factoring	
Formula manipulation and field properties of algebraic expressions	
Intermediate Algebra (15%); e.g.,	
Solution of linear inequalities in one variable	
Operations with integer exponents	
Operations with rational expressions	
Slope-intercept form of a linear equation	
Operations with radical expressions	
Quadratic formula	
Zeros of polynomials	
Rational exponents	
Solution of systems of two linear equations in two variables	
Simple absolute value equations and inequalities	
Counting techniques and probability using factorials, combinations, and permutations	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
Coordinate Geometry (15%); e.g.,	
Graphing on the number line	
Identification and location of points in the coordinate plane	
Determination of graphs of functions and relations in the plane by plotting points	
Graphs of linear equations in two variables	
Slope of a line	
Distance formula for points in the plane	
Equations of parallel and perpendicular lines	
Graphical solutions to systems of equations and inequalities	
Graphs of parabolas, circles, ellipses, and hyperbolas	
Rotation, reflection, and other transformations	
Plane Geometry (23%); e.g.,	
Identification of plane geometric figures	
Basic properties of a circle: radius, diameter, and circumference	
Measurement and construction of right, acute, and obtuse angles	
Parallel lines and transversals	
Congruent and similar triangles	
Areas of circles, triangles, rectangles, parallelograms, trapezoids, and, with formulas, other figures	
Pythagorean theorem	
Lines, segments, and rays	
Perpendicular lines	
Properties of triangles	
Ratio of sides in 45°-45°-90° triangles and 30°-60°-90° triangles	
Circumference and arc length	
Trigonometry (7%); e.g.,	
Right triangle trigonometry	
Trigonometric functions	
Graphs of trigonometric functions, including amplitude, period, and phase shift	
Trigonometric identities	
Simple trigonometric equations	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
COGNITIVE SKILLS (ACT, 2008b, 2007c)	
Knowledge and Skills (50% of questions): require the student to use one or more facts, definitions, formulas, or procedures to solve problems that are presented in purely mathematical terms.	
Direct Application (28%): require the student to use one or more facts, definitions, formulas, or procedures to solve straightforward problems set in real-world situations.	
Understanding Concepts (22%, with Integrating): test the student's depth of understanding of major concepts by requiring reasoning from a concept to reach an inference or a conclusion.	
Integrating Conceptual Understanding (22%, with Understanding): test the student's ability to achieve an integrated understanding of 2 or more major concepts so as to solve nonroutine problems.	
ITEM SETS (ACT, 2007c)	
At least 3 questions related to a stimulus, representing at least 2 content areas, and at least 2 cognitive classes.	
2 item sets per test form.	
USE OF CALCULATORS (ACT, 2008b, 2007c)	
Allowed on the Mathematics Test, but not required; students without calculators should be able to answer every question.	
Calculators are student-supplied.	
A student should not be advantaged or disadvantaged by the type of calculator he/she chooses to use.	
Prohibited types: pocket organizers; handheld or laptop computers; electronic writing pads or pen-input devices, calculators built into cellular phones or other wireless communication devices, calculators with QWERTY (typewriter) keyboards, and calculators with built-in computer algebra systems.	
COLLEGE READINESS STANDARDS (ACT, 2008d)	
Basic Operations & Applications (BOA)	
201. Perform one-operation computation with whole numbers and decimals	
202. Solve problems in one or two steps using whole numbers	
203. Perform common conversions (e.g., inches to feet or hours to minutes)	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
301. Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent	
302. Solve some routine two-step arithmetic problems	
401. Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average	
501. Solve multistep arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour)	
601. Solve word problems containing several rates, proportions, or percentages	
701. Solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings)	
Probability, Statistics, & Data Analysis (PSD)	
201. Calculate the average of a list of positive whole numbers	
202. Perform a single computation using information from a table or chart	
301. Calculate the average of a list of numbers	
302. Calculate the average, given the number of data values and the sum of the data values	
303. Read tables and graphs	
304. Perform computations on data from tables and graphs	
305. Use the relationship between the probability of an event and the probability of its complement	
401. Calculate the missing data value, given the average and all data values but one	
402. Translate from one representation of data to another (e.g., a bar graph to a circle graph)	
403. Determine the probability of a simple event	
404. Exhibit knowledge of simple counting techniques	
501. Calculate the average, given the frequency counts of all the data values	
502. Manipulate data from tables and graphs	
503. Compute straightforward probabilities for common situations	
504. Use Venn diagrams in counting	
601. Calculate or use a weighted average	
602. Interpret and use information from figures, tables, and graphs	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
603. Apply counting techniques	
604. Compute a probability when the event and/or sample space are not given or obvious	
701. Distinguish between mean, median, and mode for a list of numbers	
702. Analyze and draw conclusions based on information from figures, tables, and graphs	
703. Exhibit knowledge of conditional and joint probability	
Numbers: Concepts & Properties (NCP)	
201. Recognize equivalent fractions and fractions in lowest terms	
301. Recognize one-digit factors of a number	
302. Identify a digit's place value	
401. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor	
501. Find and use the least common multiple	
502. Order fractions	
503. Work with numerical factors	
504. Work with scientific notation	
505. Work with squares and square roots of numbers	
506. Work problems involving positive integer exponents	
507. Work with cubes and cube roots of numbers	
508. Determine when an expression is undefined	
509. Exhibit some knowledge of the complex numbers	
601. Apply number properties involving prime factorization	
602. Apply number properties involving even/odd numbers and factors/multiples	
603. Apply number properties involving positive/negative numbers	
604. Apply rules of exponents	
605. Multiply two complex numbers	
701. Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers	
702. Exhibit knowledge of logarithms and geometric sequences	
703. Apply properties of complex numbers	
Expressions, Equations, & Inequalities (XEI)	
201. Exhibit knowledge of basic expressions (e.g., identify an expression for a total as $b + g$)	
202. Solve equations in the form $x + a = b$, where a and b are whole numbers or decimals	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
301. Substitute whole numbers for unknown quantities to evaluate expressions	
302. Solve one-step equations having integer or decimal answers	
303. Combine like terms (e.g., $2x + 5x$)	
401. Evaluate algebraic expressions by substituting integers for unknown quantities	
402. Add and subtract simple algebraic expressions	
403. Solve routine first-degree equations	
404. Perform straightforward word-to-symbol translations	
405. Multiply two binomials	
501. Solve real-world problems using first-degree equations	
502. Write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)	
503. Identify solutions to simple quadratic equations	
504. Add, subtract, and multiply polynomials	
505. Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)	
506. Solve first-degree inequalities that do not require reversing the inequality sign	
601. Manipulate expressions and equations	
602. Write expressions, equations, and inequalities for common algebra settings	
603. Solve linear inequalities that require reversing the inequality sign	
604. Solve absolute value equations	
605. Solve quadratic equations	
606. Find solutions to systems of linear equations	
701. Write expressions that require planning and/or manipulating to accurately model a situation	
702. Write equations and inequalities that require planning, manipulating, and/or solving	
703. Solve simple absolute value inequalities	
Graphical Representations (GRE)	
201. Identify the location of a point with a positive coordinate on the number line	
301. Locate points on the number line and in the first quadrant	
401. Locate points in the coordinate plane	
402. Comprehend the concept of length on the number line	
403. Exhibit knowledge of slope	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
501. Identify the graph of a linear inequality on the number line	
502. Determine the slope of a line from points or equations	
503. Match linear graphs with their equations	
504. Find the midpoint of a line segment	
601. Interpret and use information from graphs in the coordinate plane	
602. Match number line graphs with solution sets of linear inequalities	
603. Use the distance formula	
604. Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point	
605. Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)	
701. Match number line graphs with solution sets of simple quadratic inequalities	
702. Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$	
703. Solve problems integrating multiple algebraic and/or geometric concepts	
704. Analyze and draw conclusions based on information from graphs in the coordinate plane	
Properties of Plane Figures (PPF)	
301. Exhibit some knowledge of the angles associated with parallel lines	
401. Find the measure of an angle using properties of parallel lines	
402. Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)	
501. Use several angle properties to find an unknown angle measure	
502. Recognize Pythagorean triples	
503. Use properties of isosceles triangles	
601. Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles	
602. Use the Pythagorean theorem	
701. Draw conclusions based on a set of conditions	
702. Solve multistep geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas	
703. Use relationships among angles, arcs, and distances in a circle	

ACT Mathematics Domain Feature/Test Specification/College Readiness Standard	NAEP Grade 12 Mathematics Framework Feature
Measurement (MEA)	
201. Estimate or calculate the length of a line segment based on other lengths given on a geometric figure	
301. Compute the perimeter of polygons when all side lengths are given	
302. Compute the area of rectangles when whole number dimensions are given	
401. Compute the area and perimeter of triangles and rectangles in simple problems	
402. Use geometric formulas when all necessary information is given	
501. Compute the area of triangles and rectangles when one or more additional simple steps are required	
502. Compute the area and circumference of circles after identifying necessary information	
503. Compute the perimeter of simple composite geometric figures with unknown side lengths	
601. Use relationships involving area, perimeter, and volume of geometric figures to compute another measure	
701. Use scale factors to determine the magnitude of a size change	
702. Compute the area of composite geometric figures when planning or visualization is required	
Functions (FUN)	
401. Evaluate quadratic functions, expressed in function notation, at integer values	
501. Evaluate polynomial functions, expressed in function notation, at integer values	
502. Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths	
601. Evaluate composite functions at integer values	
602. Apply basic trigonometric ratios to solve right-triangle problems	
701. Write an expression for the composite of two simple functions	
702. Use trigonometric concepts and basic identities to solve problems	
703. Exhibit knowledge of unit circle trigonometry	
704. Match graphs of basic trigonometric functions with their equations	

Appendix I

Cognitive Targets for Literary and Informational Texts

(Taken from the *Reading Assessment and Item Specifications for the 2009 National Assessment of Educational Progress,* p. 46)

	Locate/Recall	Integrate/Interpret	Critique/Evaluate
Both Literary and Informational Text	Identify textually explicit information and make simple inferences within and across texts, such as: • Definitions • Facts • Supporting details	Make complex inferences within and across texts to: • Describe problem and solution, cause and effect • Compare or connect ideas, problems, or situations s • Determine unstated assumptions in an argument • Describe how an author uses literary devices and text features	Consider text(s) critically to: • Judge author's craft and technique • Evaluate the author's perspective or point of view within or across texts • Take different perspectives in relation to a text
Specific to Literary Text	Identify textually explicit information within and across texts, such as: • Character traits • Sequence of events or actions • Setting Identify figurative language	Make complex inferences within and across texts to: • Infer mood or tone • Integrate ideas to determine theme • Identify or interpret a character's motivations and decisions • Examine relations between theme and setting or characters Explain how rhythm, rhyme, or form in poetry contribute to meaning	Consider text(s) critically to: • Evaluate the role of literary devices in conveying meaning • Determine the degree to which literary devices enhance a literary work • Evaluate a character's motivations and decisions • Analyze the point of view used by the author
Specific to Informational Text	Identify textually explicit information within and across texts, such as: • Topic sentence or main idea • Author's purpose • Causal relations Locate specific information in text or graphics	Make complex inferences within and across texts to: • Summarize major ideas • Draw conclusions and provide supporting information • Find evidence in support of an argument • Distinguish facts from opinions • Determine the importance of the information within and across texts	Consider text(s) critically to: • Analyze the presentation of information • Evaluate the way the author selects language to influence readers • Evaluate the strength and quality of evidence used by the author to support his or her position • Determine the quality of counterarguments within and across texts • Judge the coherence, logic, or credibility of an argument

Appendix J

Panelist Evaluation Questionnaire No. 1

NAEP/ACT Alignment Study

July 13-16, 2009

Evaluation Questionnaire No. 1

Please take a few minutes to complete this Evaluation Questionnaire so that the procedures used in the first part of this study can be evaluated. Your evaluation will be a key element in the overall evaluation of this study. Your responses to this questionnaire will be held in strict confidence and will be analyzed only in conjunction with those of other panelists who participated in this meeting.

I. Advance Materials

If you did not receive any advance materials prior to this meeting, check here ☐ and skip to Section II of this questionnaire.

1. The advance materials I received were adequate to prepare me to fulfill my role in this meeting:	Totally Agree ☐	☐	Somewhat Agree ☐	☐	Totally Disagree ☐
2. The organization of the advance materials I received for this meeting was:	Very Good ☐	☐	Acceptable ☐	☐	Very Poor ☐

II. Introduction to the Study, the NAEP, and the ACT

3. The amount of time allocated for the introduction to the study, the NAEP, and the ACT was:	Far Too Long ☐	☐	About Right ☐	☐	Far Too Short ☐
4. The explanation of the purpose and goals of the study was:	Absolutely Clear ☐	☐	Somewhat Clear ☐	☐	Not at All Clear ☐
5. The introduction to the NAEP was:	Absolutely Clear ☐	☐	Somewhat Clear ☐	☐	Not at All Clear ☐
6. The introduction to the ACT was:	Absolutely Clear ☐	☐	Somewhat Clear ☐	☐	Not at All Clear ☐

III. Comparison of NAEP to ACT and ACT to NAEP – Small Group Sessions					
7. The overview of the method employed in these portions of the comparison task was:	Absolutely Clear ☐	☐	Somewhat Clear ☐	☐	Not at All Clear ☐
8. The amount of time allocated for these portions of the comparison task was:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
9. I feel that the opportunities I was given to express my opinions/views during these portions of the comparison task were:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
10. Overall, I feel ____ about the judgments my group made during these portions of the comparison task.	Very Confident ☐	☐	Fairly Confident ☐	☐	Not Confident ☐

IV. Comparison of NAEP to ACT and ACT to NAEP – Large Group Discussion					
11. The amount of time allocated for these portions of the task was:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
12. I feel that the opportunities I was given to express my opinions/views during these portions of the task were:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
13. Overall, I feel ____ about the judgments the large group made during these portions of the comparison task.	Very Confident ☐	☐	Fairly Confident ☐	☐	Not Confident ☐
14. Overall, I feel that the method we used to compare the NAEP to the ACT and the ACT to the NAEP captured the important similarities and differences between the two assessments.	Totally Agree ☐	☐	Somewhat Agree ☐	☐	Totally Disagree ☐

15. Please use the space below to provide additional comments concerning the clarity and completeness of the instructions you received, the adequacy of the time available, your level of understanding and confidence, or any other aspects of the comparison of the NAEP to the ACT and the ACT to the NAEP. Please use the back of this page if necessary.

16. Please comment on any particular difficulties you experienced in performing the comparison of the NAEP to the ACT, or the ACT to the NAEP. Do you have suggestions that would improve these situations? Please use the back of this page if necessary.

17. Please provide any additional comments or suggestions concerning this portion of the study. Please use the back of this page if necessary.

Thank You! Your responses will help NAGB and ACT evaluate this portion of the study.

Appendix K

Sample Individual Classification Form

Item Classification Study

Block F23R1

Individual Classification Form

Block	Seq.	Acc. Num.	Cat.	1-12	13-15	16-19	20-23	24-27	28-32	33-36	Very Sure	Fairly Sure	Not Sure	Notes/Comments
F23R1	1	VC101308		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	2	VC101310		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	3	VC101312		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	4	VC101314	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	5	VC101326	4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	5	VC101326	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	5	VC101326	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	6	VC101317	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	6	VC101317	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	7	VC101319	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	7	VC101319	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	8	VC101321		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	9	VC101323		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	10	VC101316	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	
F23R1	10	VC101316	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

Appendix L

Panelist Evaluation Questionnaire No. 2

NAEP/ACT Alignment Study

July 13-16, 2009

Evaluation Questionnaire No. 2

Please take a few minutes to complete this Evaluation Questionnaire so that the procedures used in the second part of this study can be evaluated. Your evaluation will be a key element in the overall evaluation of this study. Your responses to this questionnaire will be held in strict confidence and will be analyzed only in conjunction with those of other panelists who participated in this meeting.

V. Classification of NAEP items using the College Readiness Standards Score Ranges—Individual or Small Group Sessions

1. The overview of the method employed in this portion of the classification task was:	Absolutely Clear ☐	☐	Somewhat Clear ☐	☐	Not at All Clear ☐
2. The amount of time allocated for this portion of the classification task was:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
3. I feel that the opportunities I was given to express my opinions/views during this portion of the classification task were:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
4. Overall, I felt ____ about the classification decisions I made during this portion of the classification task.	Very Sure ☐	☐	Fairly Sure ☐	☐	Not Sure ☐

VI. Classification of NAEP items using the College Readiness Standards Score Ranges – Large Group Discussions

5. The amount of time allocated for this portion of the task was:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
6. I feel that the opportunities I was given to express my opinions/views during this portion of the task were:	Totally Adequate ☐	☐	Somewhat Adequate ☐	☐	Totally Inadequate ☐
7. Overall, I feel ____ about my classification decisions after this portion of the classification task.	Very Sure ☐	☐	Fairly Sure ☐	☐	Not Sure ☐
8. Overall, I found the task of classifying NAEP items to the College Readiness Standards score ranges to be:	Very Easy ☐	☐	Somewhat Easy ☐	☐	Very Difficult ☐

9. Please use the space below to provide additional comments concerning the clarity and completeness of the instructions you received, the adequacy of the time available, your level of understanding and confidence, or any other aspects of the procedure for classifying NAEP items to the ACT College Readiness Standards score ranges. Please use the back of this page if necessary.

10. Please comment on any particular challenges you experienced in performing the classification of the NAEP items (multiple-choice and/or constructed response) to the College Readiness Standards score ranges. Do you have suggestions that would improve these situations? Please use the back of this page if necessary.

11. The goal of this week has been to determine the comparability of the content assessed by the NAEP with that assessed by the ACT, including what is described in the ACT College Readiness Standards, as part of a much larger research agenda that will inform NAGB about the validity of using NAEP data to make statements about students' college preparedness. Please think about the tasks you have performed and the experiences you have had this week. How comparable is the content assessed on the two tests? Please use the back of this page if necessary.

If you have any additional thoughts or comments you would like to share about this study, please e-mail them to Jay at jay.happel@act.org.
Just like your responses to this evaluation, your e-mails will be kept in strict confidence.
Thank You!

REFERENCES

ACT. (2007a). *ACT technical manual.* Iowa City, IA: Author.

ACT. (2007b). *Item writer's guide for the ACT Reading Test.* Iowa City, IA: Author.

ACT. (2007c). *Item writer's guide for the ACT Mathematics Test.* Iowa City, IA: Author.

ACT. (2008a). *Domain definition for the ACT Reading Test.* Iowa City, IA: Author.

ACT. (2008b). *Domain definition for the ACT Mathematics Test.* Iowa City, IA: Author.

ACT. (2008c). *The complexity of Reading Test passages on the ACT: Sample passages and annotations.* Iowa City, IA: Author.

ACT. (2008d). *College Readiness Standards for EXPLORE, PLAN, and the ACT*. Iowa City, IA: Author.

ACT. (2009). *Preparing for the ACT 2009–2010*. Iowa City, IA: Author.

Fleiss, J. L. (1981). *Statistical methods for rates and proportions* (2nd ed.). New York: John Wiley & Sons, Inc.

National Assessment Governing Board. (2007a). *Reading assessment and item specifications for the 2009 National Assessment of Educational Progress.* Washington, DC: Author.

National Assessment Governing Board. (2007b). *Assessment and item specifications for the NAEP 2009 Mathematics Assessment.* Washington, DC: Author.

National Assessment Governing Board. (2008a). *Reading Framework for the 2009 National Assessment of Educational Progress.* Washington, DC: Author.

National Assessment Governing Board. (2008b). *Mathematics Framework for the 2009 National Assessment of Educational Progress.* Washington, DC: Author.