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July 2007

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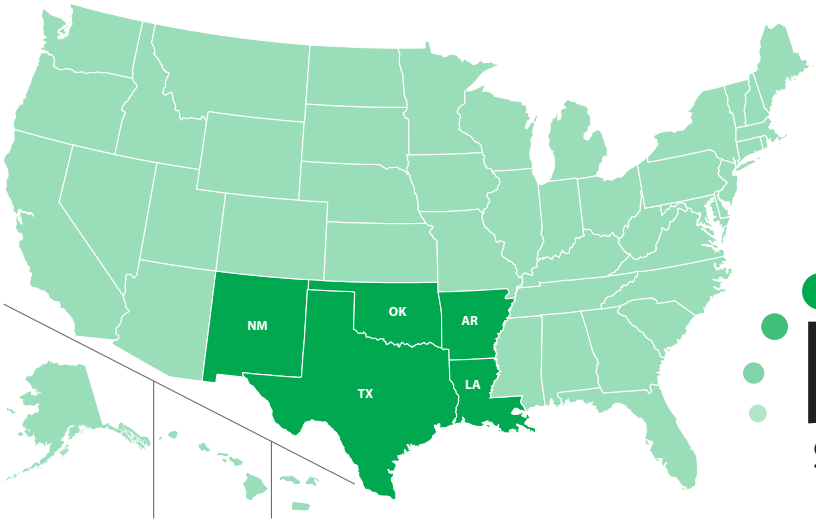

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July 2007

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Summary

Aligning science assessment standards: Texas and the 2009 National Assessment of Educational Progress (NAEP)

This policy research document is intended for policymakers to use when examining possible changes to the state assessment's alignment with the National Assessment of Educational Progress (NAEP). The 2009 NAEP test is not yet in existence, so the purpose of this report is to give policymakers a headstart in determining where they might, if they so decide, begin to make changes in their assessment standards and specifications to develop an assessment system more closely aligned to that used for the NAEP.

The alignment at each grade varied considerably. When NAEP grade 4 standards are compared with the Texas grade 5 standards in the Texas Assessment of Knowledge and Skills (TAKS) information booklet, most NAEP content items are addressed at least partially. But for grades 8 and 12 significant NAEP content areas are unaddressed by the TAKS standards. For grade 8 nearly half the NAEP content statements are unaddressed. For grade 12, TAKS includes only biology, chemistry, and integrated physics, so none of the NAEP's grade 12 Earth and space science content statements are addressed.

This report reveals current alignment issues between the state's tests and the future NAEP tests and may be especially important to those considering revising their science standards and assessments in line with No Child Left Behind requirements for state science tests in elementary, middle, and high schools. If state policymakers wish to increase the alignment between the state assessments and the NAEP, areas to consider are adding Earth and space science to the high school examination and including a wider variety of test item types beyond multiple-choice. Revising assessments requires considerable time and resources, so policymakers must carefully consider their capacity for making changes and the degree to which such changes will benefit students.

Grade 4 alignment

Most grade 4 NAEP content statements are, to some degree, addressed by Texas content statements, but the Texas statements typically are only partially aligned to the NAEP statements. TAKS also contains several content items not listed in NAEP content statements. Most of the NAEP content is implied in the Texas content, not explicit. In a few cases Texas addresses a topic at a higher grade and in more detail than the NAEP does. The overall alignment rating is 2, which indicates partial alignment. (A rating of 1 indicates no alignment, a rating of 3 full alignment.)

Grade 8 alignment

Almost half the NAEP grade 8 content statements are unaddressed by the grade 8 Texas statements. Most other Texas content statements are only partially aligned to the NAEP. But Texas also contains many content items not listed in NAEP's content statements. Most of the partially aligned NAEP statements contain more content or more detail than the corresponding Texas statements, and Texas often contains statements that imply content explicitly stated by the NAEP. The overall alignment rating is 1.6, between nonalignment and partial alignment.

Grade 12 alignment

No Earth and space science content statements in the NAEP are addressed by Texas because TAKS includes only biology, chemistry, and integrated physics. So the overall alignment between NAEP grade 12 and Texas high school TAKS tests is fairly low. But in the NAEP's physical and life science sections, Texas is most often partially aligned: Many NAEP content statements contain more content and are more detailed than Texas' corresponding content statements. In addition, Texas content statements often imply content explicitly stated by the NAEP. The overall alignment rating between only the physical and life science sections of the NAEP and Texas content statements is 1.8. The overall alignment rating including Earth and space science statements—all with ratings of 1—is 1.6.

Test specifications

Test specifications alignment reveals that the Texas assessment relies exclusively on multiple-choice items, unlike the NAEP, which also includes short and extended constructed-response items, item clusters, and predict-observe-explain items, as well as testing a subsample of students with hands-on tasks or interactive computer tasks.

Differences in testing time devoted to the NAEP science topics reflect the fact that Texas tests nature of science as a separate content strand, while the NAEP addresses science practices in conjunction with content topics. And because Earth and space science is not tested in grades 10 and 11 in Texas, the balance of testing time at grade 12 is considerably different.

Since the purpose of this report is to allow policymakers the opportunity to examine their alignment with the NAEP before the test is implemented, no further research is suggested at this time.

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Tables

This policy research document is intended for policymakers to use when examining possible changes to the state assessment's alignment with the NAEP.

The 2009 NAEP test is not yet in existence, so the purpose of this report is to give policymakers a headstart in determining where they might, if they so decide, begin to make changes in their assessment standards and specifications to develop an assessment system more closely aligned to that used for the NAEP.

BACKGROUND TO THE STUDY

This report presents the findings of an alignment study comparing the new science framework for the 2009 National Assessment of Educational Progress (NAEP) and the accompanying science assessment and item specifications with the Texas state science assessment. More details about the documents compared are in appendix A. The study was conducted for the Regional Education Laboratory Southwest, funded by the Institute of Education Sciences to provide research and support to Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. The study was undertaken in anticipation of a growing need in the region to be better informed about how state assessment standards in science compare with those tested in the NAEP.

Five factors make this study timely. First, the importance of state science assessments has been increased by the No Child Left Behind Act. Beginning in the 2007/08 school year, states are required to administer science assessments to all students in each of the elementary, middle, and high school levels, holding states and local school districts accountable for student academic achievement in science (NCLB, 2001).

Second, the NAEP is increasingly being used as a benchmark against which student achievement across the nation can be compared (Linn, 2005; Linn, Baker & Herman, 2005). The NAEP has been dubbed the "nation's report card," and when fresh NAEP results are released—as they were for science in 2006, following an administration of the test in 2005—the media report the results (Cavanagh, 2006a, 2006b). Although states are not sanctioned for failing to demonstrate NAEP student performance improvement, NAEP data do provide an external accountability benchmark and serve to verify student achievement on state assessments. In fact, the National Center for Education Statistics has a website (http://nces.ed.gov/nationsreportcard/nde/statecomp/) that allows anyone to create customized comparative reports based on the latest NAEP data. So anyone can create tables that compare states and jurisdictions based on the average scale scores for selected groups of public school students within a single assessment year, or compare the change in performance between two assessment years.

Third, NAEP data are being used more in educational research to investigate how the No Child Left Behind Act provisions have played out in different states. For example, Olson (2005) compared the percentages of students at or above

the proficient level on the 2005 state grade 8 mathematics assessments in 33 states. The study showed that, on average, 33 percent more students scored at or above the proficient level according to the state assessment than did so according to the NAEP. As yet, no similar study has been done of science, but with the release of the 2005 NAEP results it is now possible to do so.

Fourth, political attention is beginning to focus on using the NAEP as a yardstick for measuring state standards (Olson, 2007). In January 2007 two bills were introduced in Congress, one seeking to encourage states to benchmark their own standards and tests to NAEP and the other calling for states to adopt voluntary "American education content standards" in mathematics and science that would be developed by the National Assessment Governing Board, the body responsible for the NAEP. These issues will doubtless be a topic of debate in the upcoming reauthorization of the No Child Left Behind Act.

Fifth, the standards and test specifications that form the blueprint for the content the NAEP science assessment covers and the types of items it uses were revised in 2006. The 2009 NAEP framework takes account of the latest knowledge on science learning and assessment, which suggests that measuring student understanding involves much more than assessing factual knowledge. It defines the science knowledge and skills that science-literate students should possess at grades 4, 8, and 12. The assessment itself, while retaining some familiar paper-and-pencil assessment formats, will also include student performance assessments in both classroom settings and computer simulations. The 2009 NAEP framework will determine the shape of NAEP science assessments through 2017, setting the direction of science assessment across the nation.

States want to know how well their standards align with the NAEP so they can make informed decisions about possible changes to their own standards and assessment systems

These factors are working together to gradually raise the status of the NAEP to a de facto national benchmark, and states naturally want to know how well their state standards align with the NAEP so they can make informed decisions about possible changes to their own standards and assessment systems. This report describes the results of a systematic alignment study conducted for that purpose. Details of the study are in appendix B.

The intent of this report is to inform those in the Texas Education Agency responsible for shaping the state assessment in science how the current assessment standards and test specifications compare with those of the national NAEP 2009 assessment. It is hoped that this study will be of use to policymakers and others in the state who are interested in the Texas state assessments in science.

Similar reports have been completed for Arkansas, Louisiana, New Mexico, and Oklahoma, but there is no intent to compare Texas with these other states. This report shows where there is good content alignment with NAEP standards, identifies where there is partial alignment, pinpoints NAEP standards where there are no corresponding state standards, and highlights where the Texas standards go beyond the NAEP. It also deals with the assessment specifications, showing what percentages of the NAEP assessment at each grade level are devoted to different science topics and comparing that to the coverage of the topics in the Texas assessment. And it compares the proportions of types of items used to test students' science knowledge and skills. Through comprehensive comparative analysis, the report provides a way for the Texas Education Agency to gauge how well its tests are doing in covering the depth of science understanding expected on the NAEP test.

The results are presented in the summary tables and narratives in the sections that follow. Those sections provide an analysis that highlights the differences found between the NAEP assessment and the Texas state assessment. For more detail about the alignment of the Texas Assessment of Knowledge and Skills (TAKS) to the individual content statements of the NAEP, turn to the tables in appendixes C–E. They show exactly which Texas

standards align with a particular NAEP statement and, in cases of partial alignment, explain why. For a discussion of methodology, see box 1 and appendix B.

CONTENT ALIGNMENT AT GRADE 4

The NAEP grade 4 science standards were compared with the Texas Essential Knowledge and Skills statements in the TAKS Information Booklet for Science Grade 5 (Texas Education Agency, 2004a).

For grade 4 the NAEP provides 33 distinct content statements (displayed in parentheses in table 1). Four of these content statements (12 percent) are fully addressed by Texas standards in TAKS, 25 (76 percent) partially addressed, and 4 (12 percent) unaddressed (figure 1).

The average alignment rating for grade 4 is 2 (table 1). The majority of content statements were given ratings of 2, which means that state standards partially address the NAEP content statements (figure 1 and appendix C).

Areas of full alignment

Four NAEP grade 4 content statements are fully addressed by Texas grade 5 assessment standards. One of 15 physical science NAEP statements has full alignment with Texas, as do 2 of 7 life science statements and 1 of 11 Earth and space science statements.

BOX 1

Methodology

The chief research questions driving this study were these: "To what extent do current state assessment standards cover the content on which NAEP 2009 assessments will be based?" and "To what extent do current state assessment specifications align with the NAEP 2009 assessment specifications?"

The methodology used to answer the questions followed the successful pattern of a similar study conducted by WestEd in New England, which examined the alignment of math and reading standards with the NAEP. The methodology developed by WestEd for the New England study was designed to include all the most prominent alignment methodologies, discussed in appendix B. Thus far, alignment studies and methods have focused on aligning standards and tests, whereas the objective of this study was to compare one set of assessment standards and specifications with another. In this study, however, the methodology is based upon methodologies for aligning standards to tests, because similar principles are used in both types of alignments.

In this study reviewers followed the methodology of the portion of the previous study examining alignment between two sets of standards. Following the methodology of Achieve, test blueprints were examined to find correspondence between the two documents (see appendix B). Reviewers performed gap analyses to identify content included in one set of standards but not the other, identified issues of order so they could reveal differences in the grade levels at which standards appear, and examined the degree to which the standards and assessments cover content to the same depth and have similar cognitive demands (depth-of-knowledge consistency) and the degree to which assessments cover the same range of content as the corresponding standards (range-of-knowledge correspondence) to determine whether there was a match between Texas and NAEP in the level of detail, the cognitive demands, and the range of content covered. A coding scheme was used to indicate alignment issues and reviewer ratings, and a matrix-like format was created to facilitate alignment.

Reviewers attended several training sessions, conducted individual reviews, and then met in teams of two to reach consensus on ratings. This consensus method was designed to create one consensus rating per NAEP standard with the help of a moderator and was not intended to allow for disagreements. This methodology was determined to be best suited to the scope and timing of this study. The consensus methodology is designed to highlight areas for states to examine, not to gather large amounts of data, record multiple ratings, or measure inter-rater reliability (see appendix B for more on methodology).

TABLE 1

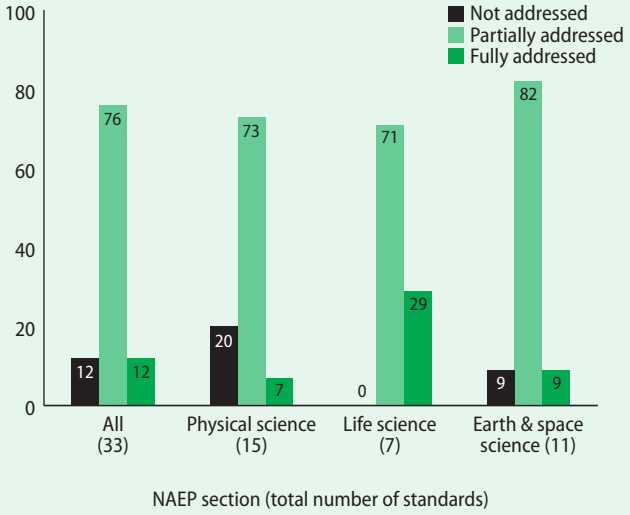
Average ratings of alignment of Texas grade 5 standards and National Assessment of Educational Progress grade 4 science content statements

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (15)	1.9
Matter (6)	2.0
Energy (5)	2.2
Motion (4)	1.3
Overall life science (7)	2.3
Structures and functions of living systems (4)	2.3
Changes in living systems (3)	2.3
Overall Earth and space science (11)	2.0
Earth and space in time (3)	2.0
Earth structures (3)	2.0
Earth systems (5)	2.0
All content (33)	2.0

Note: Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

FIGURE 1

The majority of Texas grade 5 standards partially address National Assessment of Educational Progress content statements



The four NAEP grade 4 content statements fully addressed by the Texas Essential Knowledge and Skills for Science curriculum are P4.7—forms of energy (heat, electricity, light, and sound), L4.1—needs of organisms, L4.6—plants and animals closely resemble their parents, and E4.7—the sun warms the land, air and water and helps plants grow.

Areas of partial alignment

Twenty-five NAEP grade 4 content statements (76 percent) have partial alignment, in large part because many Texas benchmarks imply content explicitly stated by the NAEP and because the NAEP content statements are often more detailed than the Texas standards.

Raters found that many Texas standards imply content that the NAEP addresses in depth. For example, Texas 5.7 (D) mentions observing and measuring characteristic properties such as boiling points and melting points, which most likely implies the content regarding measuring weight (mass) and volume in the corresponding NAEP standard (P4.1). In life science, NAEP's L4.4 states that some plants and animals survive and reproduce, die, or move to new locations when the environment changes, but the corresponding Texas statements include only comparing adaptive characteristics (5.9 A) and thriving, becoming ill, or perishing (3.8 C) but exclude moving. In Earth Science, E4.3 states that some changes on the surface of Earth are due to slow processes and others are due to rapid processes. Texas has four corresponding standards (3.6B, 5.11A, 5.5A, and 5.12A), but none delineate the slow versus the fast processes of Earth changes.

NAEP items are also addressed in higher Texas grade levels. For example, NAEP P4.10 addresses vibrating objects and producing varying pitches of sound, and while Texas 5.8 (D) states that vibrating an object can produce sound, Texas does not include how to vary the pitch of sound until grade 8. The NAEP addresses, in L4.2, the basic needs of animals and plants, including "a source of energy and building material for growth and repair." The corresponding Texas statements (3.8 and 3.8A) do not address the need for a source of energy or cellular use, but a higher grade statement in Texas

(6.10 B) covers these topics. In Earth and space science E4.2 deals with the observable shape of the moon. And although Texas 5.6 (A) includes events and changes of the lunar cycle, a higher grade statement, 7.13 B, more closely addresses the NAEP statement by including "the observed cyclical phases of the moon."

Areas of nonalignment

Three NAEP statements in physical science and one in Earth and space science are unaddressed by Texas content statements. P4.12 and P4.13 cover motion at the macroscopic level, including descriptions of position and motion, relative observation and the definition of speed. P4.15 covers the concept of gravity. E4.9 covers the use of tools for observing, recording, and predicting weather changes over days and over seasons.

Areas where Texas standards go beyond the NAEP content statements

Texas has 54 benchmarks in the TAKS Information Booklet for Science Grade 5. The NAEP does not address, in its content statements, the 10 Texas statements in nature of science, 3 of the 15 in life science, or 6 of the 17 in Earth and space sciences.

The NAEP does not address the nature of science statements because it discusses inquiry in a section separate from the content statements, called "science practices," intended to crosscut all NAEP content.

In life science the NAEP does not cover habitat or niche (5.9 B), predicting changes from adaptation (5.9 C), or learned characteristics resulting from environmental influence (5.10 B).

In Earth and space science the NAEP does not address tree rings and sedimentary rock (5.11 B), past events that led to the formation of Earth's resources (5.11 C), identifying the planets and their positions in the solar system (3.11 C), describing the sun's characteristics (3.11 D), the effects of oceans on land (4.11 B), or comparing the physical characteristics of Earth with those of the moon (5.12 C).

The NAEP addresses all Texas physical science statements. But for parts of some physical science NAEP statements (P4.2, P4.4, and P4.7), Texas contains more detailed content than the NAEP (denoted by the code "MD-TX").

Summary of grade 4 alignment

Most grade 4 NAEP content statements are, to some degree, addressed by the grade 5 Texas content statements, but the Texas statements typically are only partially aligned to the NAEP statements. The Texas Assessment of Knowledge and Skills also contains several content items not listed in NAEP content statements. Most of the NAEP content is implied in the Texas content, not explicit. In a few cases Texas addresses a topic at a higher grade and in more detail than the NAEP did. The overall alignment rating is 2, which indicates partial alignment.

Most grade 4 NAEP content statements are, to some degree, addressed by the grade 5 Texas content statements, but the Texas statements typically are only partially aligned to the NAEP statements

CONTENT ALIGNMENT AT GRADE 8

The NAEP grade 8 science standards were compared with the Texas Essential Knowledge and Skills statements found in the TAKS Information Booklet for Science Grade 8 (Texas Education Agency, 2005).

For grade 8, the NAEP provides 43 distinct content statements (displayed in parentheses in table 2). Five (12 percent) are fully addressed by Texas standards in TAKS, 17 (40 percent) partially addressed, and 21 (49 percent) unaddressed.

The average alignment rating for grade 8 is 1.6. The majority of content statements were given a rating of 1, which means that most NAEP content statements are unaddressed by grade 8 TAKS (figure 2 and appendix D).

TABLE 2

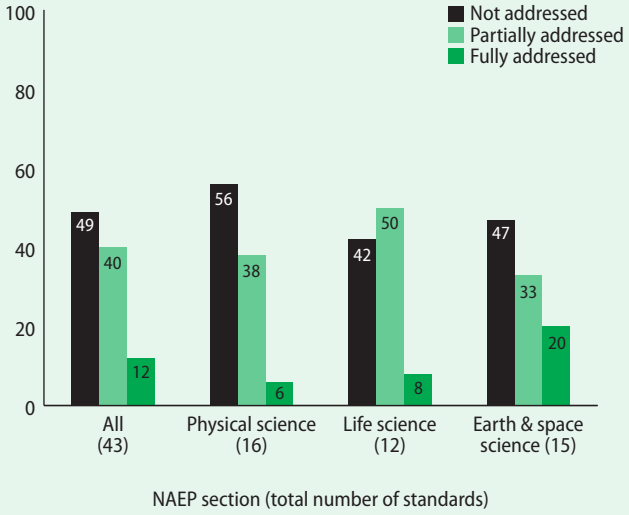
Average ratings of alignment of Texas grade 8 standards and National Assessment of Educational Progres grade 8 science content statements

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (16)	1.5
Matter (7)	1.7
Energy (6)	1.2
Motion (3)	1.7
Overall life science (12)	1.7
Structures and functions of living systems (8)	1.8
Changes in living systems (4)	1.5
Overall Earth and space science (15)	1.7
Earth and space in time (4)	1.3
Earth structures (6)	1.3
Earth systems (5)	2.6
All content (43)	1.6

Note: Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

FIGURE 2

Many Texas grade 8 standards do not address National Assessment of Educational Progress content statements



Areas of full alignment

Five NAEP grade 8 content statements are fully addressed by Texas grade 8 assessment standards. One of 16 physical science NAEP statements has full alignment with Texas, as do 1 of 12 life science statements and 3 of 15 Earth and space science statements.

The five NAEP grade 8 content statements fully addressed by the TEKS are P8.3—all substances are composed of elements in the periodic table, which organizes elements with similar properties, L8.5—consumers and decomposers have different ways of meeting energy needs, E8.11 and E8.12—the sun's observable effects, and E8.15—human-induced changes in Earth materials and systems.

Areas of partial alignment

Seventeen NAEP grade 8 content statements (40 percent) have partial alignment.

Raters found that many Texas content statements do not have as much content or detail as NAEP's statements. For example, Texas 6.7 (B) says, "classify substances by their physical and chemical properties," while NAEP gives a similar statement in P8.5 but continues to give examples and descriptions of metals and acids to further illustrate the classification of substances. In life science NAEP's L8.3 describes the functioning of cells, including growth, division, and the use of food. The corresponding Texas statement (6.10 (B)) contains the more general statement, "determine that all organisms are composed of cells that carry on functions to sustain life." In Earth and space science E8.9 in the NAEP contains content on the constant rate of movement of lithospheric plates and the resulting geological events. Texas 8.14 (A) does not contain a similar amount of detail, as it more generally asks for the prediction of land features resulting from gradual geologic changes.

Several instances of implied content were also found for Texas content statements. Texas statement 7.12 (C) states, "describe how different environments support different varieties of organisms," while NAEP L8.7 goes into more detail on the biotic and abiotic factors that support organisms.

Texas 6.8 (B) contains a statement about explaining and illustrating the water cycle, while NAEP E8.14 describes the processes in the water cycle.

Areas of nonalignment

Nine NAEP statements in physical science, five in life science, and seven in Earth and space science are unaddressed by Texas content statements.

In NAEP physical science the unaddressed content statements are P8.1—the particulate model of matter that explains properties of matter, P8.2—the arrangement of atoms and molecules that explain chemical properties, P8.6—changes of state, P8.8—kinetic energy, P8.9—potential energy, P8.11—light energy from the sun, P8.12– energy transfer and conservation of energy, P8.13—nuclear reactions in the sun and plants' usage of sunlight, and P8.15—forces acting at a distance.

In life science the following NAEP statements are unaddressed by Texas: L8.2—cell division and differentiation, L8.6—interactions and relationships of organisms, L8.8—causation of changes to organisms' environments, L8.9—reproduction, and L8.12—anatomical features of organisms and classification.

In Earth and space science the following are unaddressed: E8.1—a model of the solar system, E8.3—fossils, E8.4—Earth processes and the measurement of geologic time, E8.6—the composition of soils, E8.7—the composition of the atmosphere, and E8.10—Earth's magnetic field.

Areas where Texas standards go beyond the NAEP content statements

Texas has 53 "knowledge and skills statements" listed in the TAKS Information Booklet for Science Grade 8. The NAEP does not address, in its content statements, the 11 Texas statements in nature of science, 6 of the 13 in living systems and the environment, 3 of the 8 in structures and properties of matter, 5 of the 7 in motion, forces, and energy, or 6 of the 14 in Earth and space systems.

The NAEP does not address nature of science statements because it discusses inquiry in a section separate from the content statements, called "science practices," intended to crosscut all NAEP content.

In living systems and the environment the NAEP does not cover 6.5 (B)—describing differences between properties of a system and properties of its parts, 7.12 (D)—observing and describing ecological successions, 8.6 (A)—interactions among human systems, 8.6 (B)—feedback mechanisms for maintaining equilibrium, 8.6 (C)—interactions within ecosystems, or 8.11 (C)—predictions about outcomes of genetic combinations.

In structures and properties of matter the NAEP does not address 8.8 (A)—describing the structure and parts of an atom, 8.8 (B)—identifying the properties of an atom, or 8.10 (A)—illustrating interactions between matter and energy.

For motion, forces, and energy the NAEP does not address 6.9 (A)—identifying energy transformations, 7.8 (A)—illustrating examples of potential and kinetic energy, 7.6 (A)—demonstrating basic relationship between force and motion, 7.6 (C)—relating forces to basic processes in organisms, and 8.7 (B)—recognizing that waves are generated and can travel through different media.

In Earth and space systems the NAEP does not address 6.14 (B)—identifying relationship between groundwater and surface water in a watershed, 8.12 (A)—analyzing and predicting the sequence of events in lunar and rock cycles, 8.13 (A)—describing characteristics of the universe such as stars and galaxies, 7.14 (A)—describing and predicting the impact of different catastrophic events on Earth, 7.14 (B)—analyzing effects of regional erosional deposition and weathering, or 7.14 (C)—making inferences and drawing conclusions about effects of human activity on Earth's resources.

Almost half the NAEP grade 8 content statements are unaddressed by the grade 8 Texas statements

Summary of grade 8 alignment

Almost half the NAEP grade 8 content statements are unaddressed by the grade 8 Texas statements. Most other Texas content statements are only partially aligned to the NAEP. But Texas also contains many content items not listed in NAEP's content statements. Most of the partially aligned NAEP statements contain more content or more detail than the corresponding Texas statements, and Texas often contains statements that imply content explicitly stated by the NAEP. The overall alignment rating is 1.6, between nonalignment and partial alignment.

CONTENT ALIGNMENT AT GRADE 12

The NAEP grade 12 science standards were compared with the Texas Essential Knowledge and Skills statements in the TAKS information booklets for grades 10 and 11/exit level (Texas Education Agency, 2004b).

For grade 12 the NAEP provides 49 distinct content statements (displayed in parentheses in table 3). Four (8 percent) were fully addressed by Texas standards in TAKS, 22 (45 percent) were partially addressed, and 23 (47 percent) were unaddressed.

The average alignment rating for grade 12 is 1.6. The rating used most was 1, which means that many NAEP statements are unaddressed (figure 3 and appendix E).

Areas of full alignment

Four NAEP grade 12 content statements are fully addressed by Texas' grades 10 and 11 assessment standards. Two of 23 physical science NAEP statements have full alignment with Texas, as do 2 of 13 life science statements.

The four NAEP grade 12 content statements fully addressed by the TEKS are P12.16—total energy is conserved in a closed system, P12.20—acceleration and its relationship to force and mass, L12.9—DNA and genes, and

TABLE 3

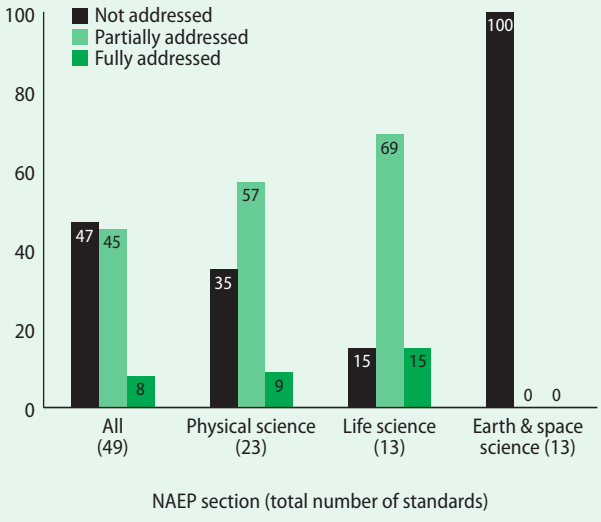
Average ratings of alignment of Texas grade 10 and 11/exit level standards and National Assessment of Educational Progress grade 12 science content statements

NAEP content area (number of NAEP standards)	Average rating
Overall physical science (23)	1.7
Matter (7)	1.7
Energy (9)	1.7
Motion (7)	1.9
Overall life science (13)	2.0
Structures and functions of living systems (7)	1.9
Changes in living systems (6)	2.2
Overall Earth and space science (13)	1.0
Earth and space in time (7)	1.0
Earth structures (1)	1.0
Earth systems (5)	1.0
All content (49)	1.6

Note: Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

FIGURE 3

Many Texas grades 10 and 11/exit level standards do not fully address National Assessment of Educational Progress content statements



L12.12—molecular and anatomical evidence for evolution.

Areas of partial alignment

Twenty-two NAEP grade 12 content statements (45 percent) have partial alignment.

Raters found that many Texas content statements do not have as much content or detail as NAEP's statements. For example, although Texas has many standards that match to NAEP's P12.1, the standards do not specify solid, liquid, and gas—and they imply content on molecular attraction that NAEP states explicitly. In P12.12, the NAEP includes content on the increase of translational, rotational, and vibrational energy of atoms during heating, while the corresponding Texas statement, IPC (6)(B), addresses the movement of heat by convection, conduction, and radiation. In L12.6 the NAEP gives many details about chemical recombination during cycles and flows of matter and energy, while Texas bio (9)(D) contains a general statement about analyzing the flow of matter and energy.

Some Texas content statements imply content stated in the NAEP. For example, P12.9 states, "Energy may be transferred from one object to another during collisions," while Texas IPC (6)(A) implies this content with its statement describing the law of conservation of energy. In addition, L12.11 has content on modern ideas about evolution that provide a scientific explanation for the history of life on Earth, implied by Texas bio (7)(B), which states, "illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction."

Areas of nonalignment

Twenty-three NAEP grade 12 statements (47 percent) are unaddressed by Texas. This is mostly due to the fact that Texas grade 10 and 11 TAKS tests contain only content from biology, chemistry, and integrated physics and do not cover Earth and space science, while NAEP's grade 12 content includes physical science, life science, and Earth and space science. So there is no alignment between Texas and the entire NAEP section for Earth and space science.

In NAEP physical science, the unaddressed content statements are P12.2—the components of an atom, P12.4—neutral atoms and isotopes, P12.11—fission and fusion, P12.13—potential energy of an object on Earth's surface, P12.14—exothermic and endothermic reactions, P12.15—the conversion of very small amounts of matter into appreciable amounts of energy through nuclear reactions, P12.22—gravitational force, and P12.23—electric force.

In life science two NAEP statements are unaddressed by Texas: L12.4—plants' transformation of energy from light to sugar molecules to amino acids and organic molecules to larger molecules with biological activity, and L12.10—large variety of possible gene combinations resulting from sorting and recombination of genes in sexual reproduction.

Many NAEP content statements contain more content and are more detailed than Texas' corresponding content statements for grade 12

In Earth and space science all NAEP statements are unaddressed by Texas. NAEP's Earth and space science section includes E12.1—the origin of the universe and the "big bang" theory, E12.2—the formation of stars and galaxies, E12.3—nuclear reactions in stars and the formation of all elements, E12.4—relative and absolute dating, E12.5—the conclusion that the solar system formed from a nebular cloud 4.6 billion years ago, E12.6—early Earth, including bacteria and the composition of the atmosphere, E12.7—the influence of sporadic and gradual events on Earth's current structure, E12.8—theory of plate tectonics, E12.9—internal and external sources of energy in Earth systems, E12.10—systems that influence climate, E12.11—the movement and forms of elements, E12.12—the movement of matter through Earth's systems, and E12.13—the processes of natural ecosystems.

Areas where Texas standards go beyond the NAEP content statements

Texas has 40 "knowledge and skills statements" in the grade 10 and 11 TAKS information booklets. The NAEP does not address 18 (45 percent) of them: the 7 Texas statements in nature of science, 3 of the 8 in organization of living systems, 2 of the 8 in interdependence of organisms, 2 of the 8 in structures and properties of matter, and 4 of the 9 in motion, forces, and energy.

The NAEP does not address the nature of science (Objective 1) statements because it discusses inquiry in a section separate from the content statements, called "science practices," intended to crosscut all NAEP content.

In organization of living systems the NAEP does not address bio (8)(C)—characteristics of kingdoms including monerans, protests, fungi, plants, and animals, bio (10)(A)—the functions of systems in organisms, or bio (10)(B)—the interrelationships of organ systems.

In interdependence of organisms the NAEP does not address bio (4)(C)—structures and functions of viruses and cells and the role of viruses in causing various diseases and conditions or bio (4)(D)—the role of bacteria in maintaining health and in causing diseases.

In structures and properties of matter the NAEP does not address IPC (7)(A)—properties of fluids including density, viscosity, and buoyancy or IPC (8)(C)—investigating and identifying the law of conservation of mass.

To improve the assessment of the range of science knowledge and skills, the last two NAEP science frameworks have expanded the range of item types on the test

In motion, forces, and energy the NAEP does not address IPC (4)(D)—the mechanical advantage and efficiency of various machines, IPC (5)(A)—demonstrating wave types and characteristics through activities, and interpreting seismic wave data, IPC (6)(D)—economic and environmental impacts of various energy sources, or IPC (6)(F)—series and parallel circuits.

Summary of NAEP grade 12 alignment

No Earth and space science content statements in the NAEP are addressed by Texas because TAKS includes only biology, chemistry, and integrated physics. So the overall alignment between NAEP grade 12 and Texas high school TAKS tests is fairly low. But in the NAEP's physical and life science sections, Texas was most often partially aligned: Many NAEP content statements contain more content and are more detailed than Texas' corresponding content statements. In addition, Texas content statements often imply content explicitly stated by the NAEP. The overall alignment rating between only the physical and life science sections of the NAEP and the Texas content statements is 1.8. The overall alignment rating including Earth and space science statements—all with ratings of 1—is 1.6.

TEST SPECIFICATIONS ALIGNMENT

The assessment specifications alignment involved two parts: examining the types of items found in NAEP and in TAKS, and comparing NAEP's and TAKS' distribution of items between the different science strands.

Science is a discipline with a strong tradition of investigation, experimentation, and application of knowledge and skills. Before the 2005 assessment, NAEP science assessments consisted primarily of short-answer, paper-and-pencil questions that were mostly multiple-choice, which can only go so far in assessing skills. To improve the assessment of the range of science knowledge and skills, the last two NAEP science frameworks have expanded the range of item types on the test. In particular, the 2009 NAEP framework takes advantage of advances in educational measurement and the development of computer-based assessments. Due to the varying ways in which differing item types assess and reveal what students know and can do, the NAEP 2009 assessment specifications require

future NAEP tests to incorporate a range of item types, allowing students to reveal their understanding in ways beyond traditional selected-response methods. Multiple-choice items, short constructed-response items, extended constructed-response items, hands-on performance tasks, and interactive computer tasks will all be used to more accurately assess student knowledge, thinking, and skills.

Each type of assessment item demands a unique response from students (selecting a response from a set of alternatives, writing an explanation or justification, performing a virtual lab experiment). Individual items may draw on different types of stimuli (verbal, graphic, manipulative) to access the knowledge and skills required and may be scored in a variety of ways (right/wrong, partial credit, human scorers, computer software). By using several types of items the 2009 NAEP science assessment will require students to draw on multiple types of knowledge and a variety of skills for using and expressing that knowledge, thereby giving a more accurate picture of the breadth and depth of their learning. In this study, the following item types from NAEP were compared with the types in use from the states.

In multiple-choice items, students reflect on the material and then select an answer from a limited number of alternatives. Well constructed multiple-choice items can probe important facts, broad concepts, and themes of science, as well as deductive reasoning skills.

Constructed-response items, in which students answer without reference to a provided list of alternatives, include short constructed-response items and extended constructed-response items. Constructed-response items can provide insights into students' levels of conceptual understanding and assess their abilities to communicate about science. They can also be used to probe student abilities to generate information related to science content statements and their interconnections (how two or more cyclic events are related). Constructed-response items may be particularly useful for probing the practices of using scientific inquiry or using technological design (interpret given data or provide a solution to a real-world problem).

In hands-on performance tasks, students manipulate selected physical objects and try to solve a scientific problem involving the objects. These exercises, if carefully designed, can probe student abilities to combine science knowledge with the investigative skills reflective of the nature of science and inquiry.

Interactive computer tasks in the 2009 NAEP science assessment may involve information search and analysis, empirical investigation, simulation, or concept mapping. The broad purpose of interactive computer tasks in this context is to tap performance expectations that are more advantageously assessed in a virtual format, such as scientific modeling of microscopic or temporal phenomena, repeated experiments, or simulations of hazardous or messy lab situations. Interactive computer tasks are intended as a complement to the hands-on performance tasks, not as a replacement.

By using several types of items the 2009 NAEP science assessment will require students to draw on multiple types of knowledge and a variety of skills for using and expressing that knowledge, thereby giving a more accurate picture of the breadth and depth of their learning

The NAEP specifications also include two other types of items, item clusters and predict-observe-explain item sets. Item clusters are groups of related items that provide more in-depth analysis of student performance than would a collection of discrete, unrelated items. They can be particularly useful in exploring student conceptions, predictions, or explanations of the natural world. The predict-observe-explain item sets (White & Gunstone, 1992) describe a situation and ask the student to predict, observe, and/or explain the outcome, sometimes with additional supporting detail. Predict-observe-explain items may involve using science principles or the cognitive demand

of "knowing why (schematic knowledge)." Because these are really ways of clustering items and are not usually included in state test specifications, they were not used for comparison in this study.

The NAEP stipulates that 50 percent of student response time should be spent on multiple-choice items and the other 50 percent on constructed-response items (including short constructed-response, extended constructed-response, and concept-mapping tasks). Within these two categories are item clusters, predict-observe-explain item sets, hands-on performance tasks, and interactive computer tasks. There will be at least one item cluster, one predict-observe-explain item set, one hands-on performance task, and one interactive computer task at each grade level, and the total number of interactive computer tasks plus hands-on performance tasks will be at least four at each grade level.

The 2009 NAEP will have 50 percent of student response time allocated to multiple-choice items and 50 percent to constructed-response items. The Texas tests contain 100 percent multiple-choice items

Table 4 shows the percentages of various item types found in the NAEP and in Texas, with the number of Texas items in parentheses. The 2009 NAEP will have 50 percent of student response time allocated to multiple-choice items and 50 percent of student response time allocated to constructed-response items (short and extended). The current Texas tests contain 100 percent multiple-choice items. The number of items used to test students in science in Texas differs across grades, increasing by ten items in grade 8 and five more items in grades 10 and 11. In grade 5 there are 40 multiple-choice items with no short constructed-response or extended constructed-response items and no hands-on performance tasks. In grade 8 there are 50 multiple-choice items with no short constructed-response or extended constructed-response items and no hands-on performance tasks. And in grades 10 and 11 there are 55 multiple-choice items with no short constructed-response or extended constructed-response items and no hands-on performance tasks.

To consider how the state test coverage of the NAEP science topics matched, table 5 shows the proportions of testing time devoted to each of the three content areas for NAEP and for the Texas test. The first column of the table lists all the science topic areas that are included on the Texas test. The first three topic areas (physical, life, and Earth and space science) are those that are covered in NAEP, and the two topics below those (science as inquiry and science and the environment) are not separately assessed on the NAEP test.

Under the column heading for elementary school, three subcolumns are shown. The first shows the proportion of testing time devoted to each topic for the three NAEP topic areas. The second shows the proportion of testing time devoted to each of the four Texas topics at grade 5. The third shows the comparison of NAEP and Texas testing times for each of the three NAEP topics, a positive number if

TABLE 4
Percentages of different item types on the Texas science assessment

	NAEP	Texas		
NAEP item types	All grades	Grade 5	Grade 8	Grades 10/11
Multiple-choice items	50 percent	100 percent (40)	100 percent (50)	100 percent (55)
Short constructed-response items	50 percent			
Extended constructed-response items				
Hands-on performance tasks[a]	(≥1)			
Interactive computer tasks[a]	(≥1)			

a. Hands-on performance tasks and interactive computer tasks are combination items and can be categorized as multiple-choice or constructed-response.

TABLE 5
Approximate testing time allocated to different science topics on the Texas science assessment (percent of time)

	Elementary school			Middle school			High school		
	NAEP Grade 4	Texas Grade 5	Difference	NAEP Grade 8	Texas Grade 8	Difference	NAEP Grade 12	Texas Grade 11	Difference
Physical science	33.3	22.5	–10.83	30.0	24.0	–6.0	37.5	40.0	2.5
Life science	33.3	22.5	–10.83	30.0	24.0	–6.0	37.5	29.0	–8.5
Earth and space science	33.3	22.5	–10.83	40.0	24.0	–16.0	25.0	0.0	–25.0
Nature of science	0.0	32.5		0.0	28.0		0.0	31.0	

TABLE 6
Comparison of the proportions of testing time allocated to the NAEP science topics (percent of time)

	Elementary school		Middle school		High school	
	NAEP Grade 4	Texas Grade 5	NAEP Grade 8	Texas Grade 8	NAEP Grade 12	Texas Grade 11
Physical science	33.3	33.3	30.0	33.3	37.5	58.0
Life science	33.3	33.3	30.0	33.3	37.5	42.0
Earth and space science	33.3	33.3	40.0	33.3	25.0	0.0

the Texas test devotes more and a negative number if the NAEP devotes more. This pattern of columns is repeated for middle and high school. For this comparison Texas grade 11 (or exit level) was used instead of grade 10, because the grade 11 TAKS is the test given at the grade closest to the NAEP's grade 12 high school assessment.

At the elementary school level the proportion of Texas testing time is approximately 11 percentage points less in all three NAEP strands. However, the Texas test devotes 32.5 percent of testing time to the nature of science, which in the NAEP is tested as part of each of the three topic areas, not separately. For Texas at grade 8 testing time is 16 percentage points less for Earth and space science and 6 percentage points less in both physical and life sciences than in the NAEP. Nature of science accounts for 28 percent of Texas grade 8 testing time. At grade 11 the distribution of testing time in Texas exceeds that in the NAEP by 2.5 percentage points in physical science but is 8.5 percentage points lower in life science, and Earth and space science is not tested at all. Nature of science accounts for 31 percent of testing time at grade 11.

Table 6 ignores the testing time devoted to nature of science, which is not separately tested in NAEP, and shows how the testing time for the three NAEP topics compares with the time in the Texas state test. At the elementary school level there is no difference in the proportions of time. At grade 8 Texas devotes 33 percent of time equally to all three topics, whereas NAEP emphasizes Earth and space science by allocating it 40 percent of testing time compared to 30 percent for the other two topics. At grade 11 the Texas test does not address Earth and space science, which is covered in the NAEP with 25 percent of testing time. Physical science receives 58 percent of the time in Texas, and life science 42 percent.

APPENDIX A
THE DOCUMENTS COMPARED

This alignment study used the science framework of the 2009 National Assessment of Educational Progress and the accompanying Science Assessment and Item Specifications as its baseline for comparison (National Assessment Governing Board, 2006). The two NAEP documents were developed by a steering and a planning committee made up of leaders in science, science education, general education, assessment, and various public constituencies. The documents went through public and committee review processes before finally being adopted and published in 2006 by the National Assessment Governing Board. The 2009 framework will guide the test development until approximately 2017.

NAEP assessments in science are administered across all states in the nation according to a statistical sampling plan and to some selected urban areas, two of them in Texas (Austin and Houston). The NAEP tests students at grades 4, 8, and 12 every four to five years and is intended to provide a snapshot of what students in those grades know and can do in science. In addition, the resulting data on student knowledge and performance have been accompanied by background information that allows analyses of student demographic and instructional factors related to achievement. The assessments have been designed to allow comparisons of student performance over time and among subgroups of students according to region, parental education, gender, and race/ethnicity.

The NAEP 2009 science assessment will include two separately timed, 25-minute sections of science items and extra 30-minute sections for hands-on performance tasks and interactive computer tasks, which will be given only to a subset of the students sampled. There will be multiple test booklet forms, and a matrix sampling design will be used so that students do not all receive the same items. Instead of detailing the number of test items that will fall in various categories, the NAEP outlines its distribution of items by "student response time" and stipulates that 50 percent of student response time will be used in answering selected-response items and the other 50 percent in constructed-response items. Constructed-response items will include short constructed-response, extended constructed-response, and concept-mapping tasks. In addition, at least one of each of the following item types must be used at each grade level: item clusters, predict-observe-explain item sets, hands-on performance tasks, and interactive computer tasks. Table A1 shows the stipulated distribution of items for NAEP 2009 as a percent of student response time:

The NAEP science content used in this study is shown in detail in Chapter Two: Science Content, which is extracted from the Science Assessment and Item Specifications for the 2009 NAEP document.

The Texas documents used in this review were the Texas Assessment of Knowledge and Skills (TAKS) Information Booklet for Science Grade 5 (Texas Education Agency, 2004a), the TAKS Information Booklet for Science Grade 8 (Texas Education Agency, 2005), and the TAKS Information

TABLE A1
National Assessment of Educational Progress distribution of items and standards by content area and grade

	Grade 4		Grade 8		Grade 12	
	Share of response time (percent)	Number of content standards	Share of response time (percent)	Number of content standards	Share of response time (percent)	Number of content standards
Physical	33.3	15	30.0	16	37.5	23
Life	33.3	7	30.0	12	37.5	13
Earth and space	33.3	11	40.0	15	25.0	13

Booklets for Science Grades 10 and 11 (Texas Education Agency, 2004b). The TAKS is based on the state-mandated science curriculum, the Texas Essential Knowledge and Skills (TEKS) for Science (Texas Education Agency, 1997). All four science assessments were developed using selected knowledge and skills statements and student expectations from the science TEKS. The elementary science test was based on eligible science TEKS from grades 2–5. The middle school science test will be based on selected science TEKS from grades 6–8. The grade 10 and the exit level (or 11th grade) TAKS tests are based on selected TEKS for biology, chemistry (IPC), and integrated physics.

The TAKS program was created through a three-year test-development process that began in 1999 and included several iterations of identifying the content to be assessed, conducting surveys and incorporating feedback from experts, committees, and the public. The TAKS tests are administered across the state and the resulting data can be analyzed by region, district, campus, and demographic group. TAKS was designed expressly to "reflect good instructional practice and more accurately measure student learning" (Texas Education Agency, 2002). The TAKS tests are untimed, allowing students as much time as needed to respond to all questions. Nearly all the items on TAKS are multiple-choice. Some of these items are cluster items. A few TAKS items require students to mark their responses on grids similar to those on math tests, allowing students to record a numerical answer to a problem and fill in the corresponding numerical bubbles (see page 7 of the TAKS Information Booklet for Science Grade 5). Tables A2–A4 show the distribution of items and standards in each "Objective" category.

There were differences between the grades at which NAEP assessments are given and the grades at which TAKS is administered. At the elementary school level NAEP tests are administered at grade 4, but in Texas the assessment is given at grade 5. It seemed reasonable to compare the state standards with the NAEP as the grade 5 standards are based on eligible science TEKS from grades 2 through 5. At the middle school level, both the NAEP and the TAKS are administered at grade 8. At the high school level,

TABLE A2

Texas Assessment of Knowledge and Skills distribution of items and standards by objective, grade 5

	Number of test items	Number of content standards
Nature of science	13	10
Life science	9	15
Physical science	9	12
Earth and space science	9	17
Total	40	54

TABLE A3

Texas Assessment of Knowledge and Skills distribution of items and standards by objective, grade 8

	Number of test items	Number of content standards
Nature of science	14	11
Living systems and the environment	12	13
Structures and properties of matter	6	8
Motion, forces, and energy	6	7
Earth and space systems	12	14
Total	50	53

TABLE A4

Texas Assessment of Knowledge and Skills distribution of items and standards by objective, grade 10 and exit level

	Grade 10 Number of test items	Exit level Number of test items	Grade 10 and exit level Number of content standards
Nature of science	17	17	7
Organization of living systems	11	8	8
Interdependence of organisms	11	8	8
Structures and properties of matter	8	11	8
Motion, forces, and energy	8	11	9
Total	55	55	40

the NAEP is given at grade 12 to test all science knowledge and skills acquired in high school. It addresses life science, physical science, and Earth and space science. The TAKS, however, is given at grade 10 and exit level (that is, 11th grade) and is limited to testing biology, chemistry, and integrated physics at the high school level, not addressing Earth and space science. In general, if a TAKS standard at one grade addressed an NAEP content statement at an earlier or later grade, that was noted in the alignment tables in appendixes C–E.

APPENDIX B
HOW THE STUDY WAS CONDUCTED

The chief research questions driving this study were these: "To what extent do current state assessment standards cover the content on which NAEP 2009 assessments will be based?" and "To what extent do current state assessment specifications align with the NAEP 2009 assessment specifications?"

The methodology used to answer the questions followed the successful pattern of a similar study conducted by WestEd in New England, which examined the alignment of math and reading standards with the NAEP. The methodology developed by WestEd for use in the New England study was designed to be inclusive of all the most prominent alignment methodologies, discussed below. Thus far, alignment studies and methods focus on aligning standards and tests, whereas the objective of this study was to compare one set of assessment standards and specifications with another set of assessment standards and specifications. In this study, however, the methodology is based upon methodologies for aligning standards to tests, because similar principles are used in both types of alignments.

Eight independent alignment methodologies are examined in *Imperfect Matches: The Alignment of Standards and Tests* (Rothman, 2003), which describes methodologies by Norman L. Webb, Karen K. Wixson, Andrew C. Porter, Achieve, the Buros Center for Testing, the American Association for the Advancement of Science's Project 2061, CRESST, and SRI International.

- Webb's method involves evaluating the degree to which consistent content categories or content strands are found between the standards and assessments (categorical concurrence), the degree to which the standards and assessments cover content to the same depth and have similar cognitive demands (depth-of-knowledge consistency), the degree to which assessments cover the same range of content as the corresponding standards (range-of-knowledge correspondence), and the degree to which the distribution of assessment items match the distribution of content standards (balance of representation) (Webb, 1997, 1999).

- Wixson's method (Wixson et al., 2002) is a modified version of Webb's and includes range-of-knowledge correspondence, balance of representation, whether or not each objective was covered by at least one assessment item (coverage), depth-of-knowledge consistency, and the extent to which the philosophy underlying the assessment matched the philosophy of the standards (structure of knowledge comparability).

- Porter's method (Porter, 2002) involves a matrix with rows representing topics and columns representing categories of cognitive demand, in which reviewers record values to represent the level of alignment.

- Achieve's method (Achieve, 2003) involves examining test blueprints to see whether they adequately reflected the map of test items to standards. It also involves examining the quality of the match between an assessment item and its corresponding standard (content centrality), the degree to which an item appropriately assesses the "performance" or cognitive demand presented by a standard (performance centrality), the degree to which the assessment's difficulty matches the difficulty presented by the standard (challenge), the degree to which the assessment's emphasis on content matches the standard's emphasis on content (balance) and the degree to which the assessment's breadth of content matches the standard's breadth of content (range).

- The Buros Center's methodology uses teachers to record four levels of alignment of items to standards (Impara, 2001).

- The Project 2061 methodology, developed by the American Association for the

Advancement of Science, includes independently rating materials and then meeting in two-person teams to reach a consensus that would be reconciled by Project 2061 staff (Stern & Ahlgren, 2002).

- The CRESST methodology includes identifying corresponding content topics, rating the centrality of the item to the topic, and rating the depth-of-knowledge level (Herman, Webb, & Zuniga, 2003).

- SRI International created codes for various portions of standards that were used to perform the alignment and to determine the degree of matching (Kreikemeier, Quellmalz, & Haydel, 2004).

The WestEd New England methodology was designed to include the major alignment methodologies. The developed methodology involved a "quality review" of grade level expectations within grades and across grades. Within grades a methodology was employed to account for depth of knowledge, breadth of knowledge, clarity, consistency, reasonableness, and assessability. Across grades, the study examined categorical concurrence, consistency, and assessability.

The study also involved an "alignment review" in which a methodology of examining gaps, order, depth and breadth was employed in order to compare the under-review grade level expectations with external referents. More specifically, the first step in the alignment review was to perform "gap analyses." Reviewers were to identify content in the grade level expectations that was absent in the external referent and content in the external referent absent in the grade level expectations. Reviewers then examined "order" to determine whether grade level expectations were included at the same grade level as matching content in the external referent. Last, reviewers examined "depth and breadth" to determine whether the content of the grade level expectations reflected the intended depth and breadth of the external referent. Because the alignment study in this report, which compares Texas and NAEP, focuses only on examining alignment between Texas assessment standards and specifications and NAEP 2009 assessment standards and specifications, only part of WestEd's New England study methodology was used.

In this study, reviewers followed the methodology of the portion of the previous study examining alignment between two sets of standards. Test blueprints were examined to find correspondence between the two documents, which follows the methodology of Achieve. Reviewers performed gap analyses to identify content included in one set of standards but not the other, identified issues of order so as to reveal differences in grade levels at which standards appear, and examined depth-of-knowledge and range-of-knowledge correspondence (following Webb's and Wixson's criteria) to determine whether or not there was a match between Texas and NAEP in terms of the level of detail, the cognitive demands and the range of content covered. A coding scheme (similar to that of the Buros Center) was used to indicate alignment issues and reviewer ratings, and a matrix-like format (similar to Porter's method) was created to facilitate alignment. Reviewers attended several training sessions and then met in teams of two to reach consensus on ratings (similar to the Project 2061 method). This consensus method was designed to create one consensus rating per NAEP standard with the help of a moderator and was not intended to allow for disagreements. This methodology was determined to be best suited to the scope and timing of this study, as the consensus methodology is simply designed to highlight areas for states to examine, not to gather large amounts of data, record multiple ratings, or measure inter-rater reliability.

The content reviews

State standards detail what students are expected to know and do, and as such they are a crucial area for examination. Assessment standards form the basis from which test items are conceived and developed, and they ultimately determine the

content that appears on tests. Therefore, this study compared state assessment standards to NAEP content statements through the completion of content reviews.

The content reviews were conducted by a team of six science educators under the leadership of a senior reviewer. The team was directed by Dr. Timms, who is a senior assessment researcher in the mathematics, science and technology program at WestEd and managing director of the Center for Assessment and Evaluation of Student Learning. The senior reviewer is a retired biology and AP biology teacher with 37 years of classroom experience, is a recipient of the Outstanding Biology Teacher Award for the state of California, and has worked in various teacher professional development capacities, including work with the Teacher Assessment Project and the National Board for Professional Teaching Standards.

The six science educators were chosen based on recommendations by the senior reviewer. The team was composed of individuals with science education experience ranging from serving on the National Board for Professional Teaching Standards' Science Committee and co-chairing the California Science Teachers Association Conference to being a technology instructor at a local university to developing widely used science curricula. All six reviewers are current, credentialed middle and high school science teachers. The reviewers have science teaching experience covering the full range of science content areas. Currently, four of the reviewers teach integrated science, one teaches Earth science, three teach biology, one teaches chemistry, and another is a middle school science teacher. The team was also supported by two research assistants.

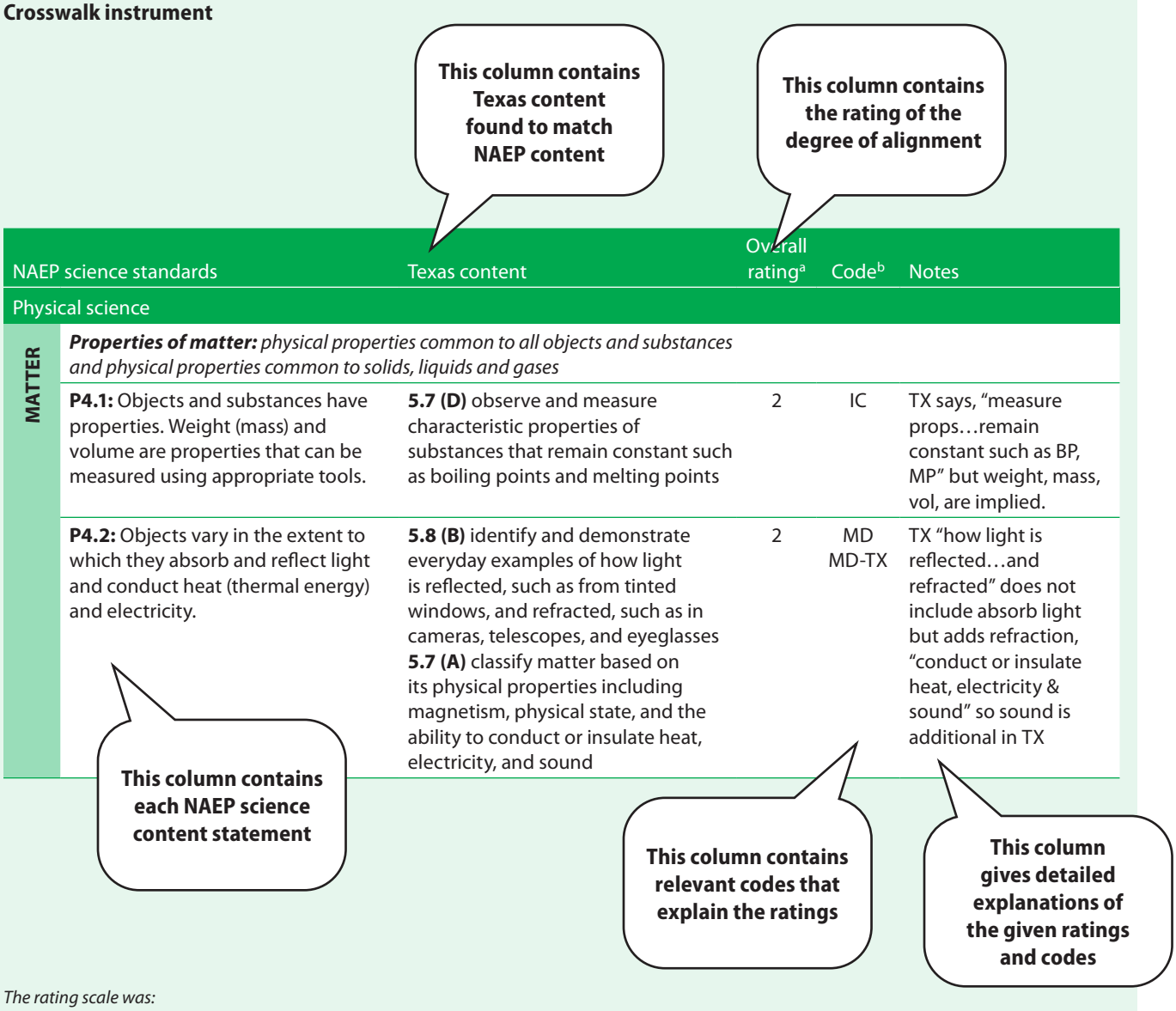
To ensure that the review was systematic, WestEd developed a crosswalk instrument that was used to evaluate the alignment of the state assessment standards to the content standards contained in the new NAEP 2009 science framework. These crosswalk instruments contained NAEP standards at the appropriate grade level in the leftmost column, blank cells in the next column for reviewers to fill in corresponding state assessment standards, another column for providing ratings, a column for assigning codes, and a final column for various notes. Completed crosswalk instruments, or "alignment tables," can be found in appendixes C–E. An extract of a completed crosswalk instrument is given, along with explanations, in figure B1.

Reviewers also added explanatory notes to the alignment ratings to indicate precisely the reason for the partial or nonalignment. There were separate instruments for grades 4, 8, and 12, and within each grade level the content was divided into Earth and space science, life science, and physical science categories. Based on a combination of their scientific and grade level experience, the six reviewers worked in teams of two reviewers per grade level.

To ensure the consistent application of the crosswalk instrument by each reviewer, the alignment team attended training sessions spread over several weeks and conducted by Dr. Timms. The training comprised four sessions. Session one included a review of a previous WestEd alignment study to allow teachers to understand the scope of the project and the methodology. The team was also given an introduction to the NAEP standards and then asked to carefully read the NAEP framework standards document before the second session. The second training session included a review and discussion of the NAEP standards and an overview of each of the REL Southwest Region's state assessment standards. Reviewers were then asked to complete an in-depth reading of one of the states' assessment standards. During the third training session, reviewers were introduced to the crosswalk instrument and asked to use it to begin performing an alignment. Reviewers then individually completed an alignment for one state on their own.

During the final training session, the teams at each grade level met to practice consensus-building and establish the criteria for assigning each rating. One

FIGURE B1
Crosswalk instrument



NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
MATTER	***Properties of matter:*** *physical properties common to all objects and substances and physical properties common to solids, liquids and gases*			
P4.1: Objects and substances have properties. Weight (mass) and volume are properties that can be measured using appropriate tools.	**5.7 (D)** observe and measure characteristic properties of substances that remain constant such as boiling points and melting points	2	IC	TX says, "measure props…remain constant such as BP, MP" but weight, mass, vol, are implied.
P4.2: Objects vary in the extent to which they absorb and reflect light and conduct heat (thermal energy) and electricity.	**5.8 (B)** identify and demonstrate everyday examples of how light is reflected, such as from tinted windows, and refracted, such as in cameras, telescopes, and eyeglasses **5.7 (A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2	MD MD-TX	TX "how light is reflected…and refracted" does not include absorb light but adds refraction, "conduct or insulate heat, electricity & sound" so sound is additional in TX

The rating scale was:

1—State standards do not address NAEP content statement

2—State standards partially address NAEP content statement

3—State standards fully address or exceed NAEP content statement by targeted grade level

When there was partial or nonalignment (ratings 2 or 1), the reviewers used a letter coding scheme to indicate the reason for the lack of alignment. The coding scheme was:

IC—Implied content	The content seems to be implied as part of the standard, but it is not explicitly stated.
LG—Content covered at a lower grade level	The NAEP standard is partially or fully covered at a lower state grade level.
HG—Content covered at a higher grade level	The NAEP standard is partially or fully covered at a higher state grade level.
MC—More content	The NAEP standard contains more content than do corresponding state standards.
MD—More detailed content	The NAEP standard contains content that is more detailed than corresponding state standards.

criterion was to compare one NAEP standard to as many state standards as possible, and to assign an overall alignment rating based upon the sum of all state standards compared to the single NAEP standard in question. Another criterion was to give a rating of 2 for alignments in which the state standard addressed only one portion (sometimes one sentence) of the NAEP statement. A third criterion was to assign ratings of 2 to alignments for which the NAEP contained more content or more detailed content than the NAEP, or for which the state appeared to imply but not explicitly state the content found in the NAEP. If a matching standard was found at a higher state grade level than the NAEP grade level, a rating of 2 was given. If a matching state standard was found at a lower grade level but did not appear to fully address the NAEP standard, a rating of 2 was also given.

As part of the stipulated methodology, the reviewers first conducted independent reviews without consulting their partners. Each began with a review of the set of state standards to get an overall impression of their content and structure. Next, the reviewer used the crosswalk instrument to do a more detailed examination starting with a NAEP content statement and then searching the state standards for those that covered all or part the same content. The reviewer continued in this way, systematically matching the state content standards to the NAEP content statements and recording the results in the crosswalk instrument table. After all the NAEP content statements had been covered, the reviewer applied the three-point rating system to determine the level of alignment for each NAEP content statement.

When both reviewers for a grade level had completed their individual reviews, they met under the guidance of the senior reviewer to compare their ratings and reach a consensus. When they disagreed on which state standard(s) matched a particular NAEP content statement or their ratings were not the same, they re-examined the content in question and discussed their differing viewpoints. The purpose was to reach a consensus so that there was a single alignment table for each grade level that represented their combined review. The senior reviewer moderated the discussion to reinforce the established rating criteria and to help reviewers achieve consensus. The alignment tables are shown in detail in appendixes C–E.

When the consensus alignment tables were complete, a WestEd researcher summarized them quantitatively by calculating the average ratings organized by each of the three major NAEP content areas of physical science, life science, and Earth and space science. These average ratings are intended to be summaries of how the state's assessment content matches the NAEP content statements and to allow the reader to quickly identify possible areas for revision. In addition, the researcher wrote a report on the results, which summarized the areas of full alignment, partial alignment, nonalignment, and areas where the state standards went beyond the NAEP content statements.

Test specifications review

In addition to examining content, this study compared the state assessment specifications with the NAEP 2009 test and item specifications. It was deemed important for this study to perform a review of assessment specifications because the way a test is structured and implemented often has implications for what the test is able to reveal about student understanding. NAEP calls for a variety of test items due to the fact that different types of items demand varying levels of cognition, knowledge, and reasoning (National Assessment Governing Board, 2006). Thus, it is important to examine the extent to which states are attempting to develop assessment items that will provide an accurate picture of what students know and can do across the range of science content and skills. In addition, it was important to examine the proportion of time that students are expected to spend on each content strand of NAEP and the TAKS. Examining the TAKS and NAEP distribution of items in these science strands creates a snapshot of the extent to which the breadth of content in Texas matches that of NAEP.

Since the final NAEP 2009 tests have not yet been developed, it is currently possible only to compare the current TAKS science assessment specifications with the stipulated specifications of the future NAEP 2009 science assessment. Accordingly, the translation of standards to actual test items and the comparison of items would also be important, but these comparisons will not be possible until the future public release of the NAEP 2009 assessments. Therefore, this report details analyses of the available information on state and NAEP test items, which includes item types and item distribution.

For the purpose of examining assessment specifications, WestEd researchers compared parts of the Science Assessment and Item Specifications for the 2009 NAEP document with the test blueprints for Texas science assessments, found in the TAKS information booklets for grades 5, 8, 10, and 11.

The NAEP Science Assessment and Item Specifications is a detailed document that covers the science content, science practices, generation and interpretation of items, types of items and administration of the assessment. For this study the review of the test specifications focused on two main things: the types of items used in the state assessment, and the proportions of time that students spend on each of the main science topic areas of the NAEP. WestEd researchers used test blueprints and assessment specifications from the state and the NAEP to compare types of items and the distribution of items in each science content strand. First, differences between the NAEP and the state were examined for the types of items required on the tests (multiple-choice, constructed-response, and so on) Next, differences in the approximate amount of student time spent on each content strand (physical, life, and Earth and space science) were examined.

APPENDIX C
CONTENT ALIGNMENT FOR GRADE 4

TABLE C1

Alignment of National Assessment of Educational Progress grade 4 science and Texas grade 5 standards

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
MATTER	***Properties of matter:*** *physical properties common to all objects and substances and physical properties common to solids, liquids and gases*			
	P4.1: Objects and substances have properties. Weight (mass) and volume are properties that can be measured using appropriate tools.	**5.7 (D)** observe and measure characteristic properties of substances that remain constant such as boiling points and melting points	2	IC	TX says, "measure props…remain constant such as BP, MP" but weight, mass, vol, are implied.
	P4.2: Objects vary in the extent to which they absorb and reflect light and conduct heat (thermal energy) and electricity.	**5.8 (B)** identify and demonstrate everyday examples of how light is reflected, such as from tinted windows, and refracted, such as in cameras, telescopes, and eyeglasses **5.7 (A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2	MD MD-TX	TX "how light is reflected…and refracted" does not include absorb light but adds refraction, "conduct or insulate heat, electricity & sound" so sound is additional in TX
	P4.3: Matter exists in several different states; the most commonly encountered are solid, liquid, and gas. Each state of matter has unique properties. For instance, gases are easily compressed while solids and liquids are not. The shape of a solid is independent of its container; liquids and gases take the shape of their containers.	**5.7 (A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2	MD	TX "classifying… including physical state" although solid, liquid & gas not specified, nor are props w/respect to container
	P4.4: Some objects are composed of a single substance; others are composed of more than one substance.	**5.7 (B)** demonstrate that some mixtures maintain the physical properties of their ingredients **5.7 (C)** identify changes that can occur in the physical properties of the ingredients of solutions such as dissolving sugar in water	2	IC MD-TX	TX "some mixtures maintain phys prop of ingred." changes in phys prop of substances in soln NAEP does not specify that student investi-gate to distinguish
	P4.5: Magnets can repel or attract other magnets. They can also attract certain nonmagnetic objects at a distance.	**5.7(A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2	IC	5.8 (C) only addresses electromagnetism, not permanent magnets, although Gr 5 TAKS p29 Highlights, say "students … experience with magnets. In objectives, magnetism as phys state

(CONTINUED)

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MATTER	***Changes in matter:*** *changes of state*				
	P4.6: One way to change matter from one state to another and back again is by heating and cooling.	**5.7 (D)** observe and measure characteristic properties of substances that remain constant such as boiling points and melting points **5.7 (A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2	IC	Measure BP & MP—change in matter states is implied
ENERGY	***Forms of energy:*** *examples of forms of energy*				
	P4.7: Heat (thermal energy), electricity, light, and sound are forms of energy.	**5.8 (A)** differentiate among forms of energy including light, heat, electrical, and solar energy; **5.8 (D)** verify that vibrating an object can produce sound.	3	MD-TX	adds solar energy vibrating object can produce sound
	P4.8: Heat (thermal energy) results when substances burn, when certain kinds of materials rub against each other, and when electricity flows though wires. Metals are good conductors of heat (thermal energy) and electricity. Increasing the temperature of any substance requires the addition of energy.	**5.8 (C)** demonstrate that electricity can flow in a circuit and can produce heat, light, sound, and magnetic effects;	2	HG	TX does not go into depth about heat except to say it is a form of energy and that it is produced by electricity. Heat is partially again addressed in 8th grade and in HS Grade 11 IPC 6 (B)
	P4.9: Light travels in straight lines. When light strikes substances and objects through which it cannot pass, shadows result. When light travels obliquely from one substance to another (air and water), it changes direction.	**5.8 (B)** identify and demonstrate everyday examples of how light is reflected, such as from tinted windows, and refracted, such as in cameras, telescopes, and eyeglasses;	2	MD	TX does not mention "straight lines" or "shadows, but studies "reflected and refracted light"
	P4.10: Vibrating objects produce sound. The pitch of sound can be varied by changing the rate of vibration.	**5.8 (D)** verify that vibrating an object can produce sound.	2	MD HG	TX does not include how to vary pitch until 8th grade
	Energy transfer and conservation: *electrical circuits*				
	P4.11: Electricity flowing through an electrical circuit produces magnetic effects in the wires. In an electrical circuit containing a battery, a bulb, and a bell, energy from the battery is transferred to the bulb and the bell, which in turn transfer the energy to their surroundings as light, sound, and heat (thermal energy).	**5.8 (C)** demonstrate that electricity can flow in a circuit and can produce heat, light, sound, and magnetic effects; **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system **5.5 (B)** describe some interactions that occur in a simple system. **5.7 (A)** classify matter based on its physical properties including magnetism, physical state, and the ability to conduct or insulate heat, electricity, and sound	2		TX obj does NOT include "transformation" or energy transfer in the objective, but in Gr 5 TAKS pg 33 test Q asks energy transfer Q and pg 31 has test Q w/ electrical circuit w/ bulb and battery, but NO bell. Energy transformation mention in Obj 3 paragraph Gr 5 p28

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
MOTION	***Motion at the macroscopic level:*** *descriptions of position and motion*			
	P4.12: An object's position can be described by locating the object relative to other objects or a background. The description of an object's motion from one observer's view may be different from that reported from a different observer's view.		1	TX does not cover relative observation
	P4.13: An object is in motion when its position is changing. The speed of an object is defined by how far it travels divided by the amount of time it took to travel that far.	**3.6 (A)** measure and record changes in the position and direction of the motion of an object to which a force such as a push or pull has been applied.	1	HG 8.7 (A)	TX does not have "speed" or "time" mentioned in obj although distance and force is…Gr 5 TAKS p40 Q21 has how ramp affects speed, but it is in the Earth Sci section (Obj 4)? Gr 5 test Q p 33 says "students must have … basic understanding of acceleration (not speed) and asks Q on most force used on mass of objects, but I do not see where force has been measured in objectives, & how are students supposed to understand acceleration when they haven't even done speed?
	Forces affecting motion: *the association of changes in motion with forces and the association of objects falling toward Earth with gravitational force*			
	P4.14: The motion of objects can be changed by pushing or pulling. The size of the change is related to the size of the force (push or pull) and the weight (mass) of the object on which the force is exerted. When an object does not move in response to a push or a pull, it is because another push or pull (friction) is being applied by the environment.	**3.6 (A)** measure and record changes in the position and direction of the motion of an object to which a force such as a push or pull has been applied.	2	HG 6.6 (B) 7.6 (A) 8.7 (A)	TX Gr 5 only covers first sentence (push/pull)

(CONTINUED)

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MOTION	**P4.15:** Earth pulls down on all objects with a force called gravity. With a few exceptions (helium filled balloons), objects fall to the ground no matter where the object is on Earth.		1	HG Gr10-IPC4B Gr11-IPC4B	TX objectives do NOT say the word 'gravity" in Gr 5, but Gr 5 TAKS pg 40 Q 21 is about ramps and speed, but commentary says students should describe gravity as a force that can cause motion, but the answer to the Q is a "force that pulls" and does not say the word 'gravity'.
Life science					
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	***Organization and development:*** *basic needs of organisms*				
	L4.1: Organisms need food, water, and air; a way to dispose of waste; and an environment in which they can live.	**3.8** The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live. **3.8 (A)** observe and describe the habitats of organisms within an ecosystem;	3		
	Matter and energy transformations: *the basic needs of organisms for growth*				
	L4.2: Organisms have basic needs. Animals require air, water, and a source of energy and building material for growth and repair. Plants also require light.	**3.8** The student knows that living organisms need food, water, light, air, a way to dispose of waste, and an environment in which to live. **3.8 (A)** observe and describe the habitats of organisms within an ecosystem;	2	HG 6.10 (B) 7.8 (B)	TX specifies "food", but doesn't elaborate it as a source of energy or the cellular uses, but 6.10 goes into this plant req light for photosynthesis explains why

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Life science				
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	***Interdependence:*** *the interdependence of organisms*			
L4.3: Organisms interact and are interdependent in various ways including providing food and shelter to one another. Organisms can survive only in environments in which their needs are met. Some interactions are beneficial; others are detrimental to the organism and other organisms.	**2.9 (B)** compare and give examples of the ways living organisms depend on each other and on their environments. **3.8 (A)** observe and describe the habitats of organisms within an ecosystem; **3.8 (C)** describe environmental changes in which some organisms would thrive, become ill, or perish; **2.9 (B)** compare and give examples of the ways living organisms depend on each other and on their environments. **3.8 (B)** observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, or space **5.5 (B)** describe some interactions that occur in a simple system.	2	IC IC IC IC	"providing food & shelter to one another " is not specified "habitat" implies organisms can only survive there "depend" could be 'eaten by' or 'provide shelter' "compete" implies detrimental
L4.4: When the environment changes, some plants and animals survive and reproduce; others die or move to new locations.	**3.8 (C)** describe environmental changes in which some organisms would thrive, become ill, or perish **5.9 (A)** compare the adaptive characteristics of species that improve their ability to survive and reproduce in an ecosystem	2	IC	TX does not specify moving as a response interactions
CHANGES IN LIVING SYSTEMS	***Heredity and reproduction:*** *life cycles*			
L4.5: Plants and animals have life cycles. Both plants and animals begin life and develop into adults, reproduce, and eventually die. The details of this life cycle are different for different organisms.	**5.6 (C)** describe and compare life cycles of plants and animals. **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system **5.10 (A)** identify traits that are inherited from parent to offspring in plants and animals)	2		NAEP second sentence describes parts of a life cycle, which TX doesn't, but to cover a life cycle you have to start with beginning to adult…some life cycles do not imply death, but perpetuity
L4.6: Plants and animals closely resemble their parents.	**5.10 (A)** identify traits that are inherited from parent to offspring in plants and animals	3		
	Evolution and diversity: *differences and adaptations of organisms*			
L4.7: Different kinds of organisms have characteristics that enable them to survive in different environments. Individuals of the same kind differ in their characteristics, and sometimes the differences give individuals an advantage in surviving and reproducing.	**2.9 (A)** identify the external characteristics of different kinds of plants and animals that allow their needs to be met **2.9 (B)** compare and give examples of the ways living organisms depend on each other and on their environments. **5.9 (A)** compare the adaptive characteristics of species that improve their ability to survive and reproduce in an ecosystem	2	HG	The variety in a population is not addressed in TX, that some individuals have different genotypes than others…

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH IN SPACE AND TIME	***Objects in the universe:*** *patterns in the sky*			
E4.1: Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon appears to move across the sky on a daily basis much like the sun.	**4.6 (A)** identify patterns of change such as in weather, metamorphosis, and objects in the sky. **5.6 (A)** identify events and describe changes that occur on a regular basis such as in daily, weekly, lunar, and seasonal cycles **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system	2	HG 7.13 (A) 7.13 (B)	TX says "identify and describe" as opposed to NAEP giving descriptions of sun and lunar movements every day 5.6 (A) should be rewritten to say, "daily, weekly, and monthly lunar cycles, and seasonal cycles related to the revolution of the Earth around the sun".
E4.2: The observable shape of the moon changes from day to day in a cycle that lasts about a month.	**5.6 (A)** identify events and describe changes that occur on a regular basis such as in daily, weekly, lunar, and seasonal cycles **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system	2	HG 7.13 (B)	
	History of Earth: *evidence of change*			
E4.3: The surface of Earth changes. Some changes are due to slow processes, such as erosion and weathering, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.	**3.6 (B)** identify that the surface of the Earth can be changed by forces such as earthquakes and glaciers. **5.11 (A)** identify and observe actions that require time for changes to be measurable, including growth, erosion, dissolving, weathering, and flow **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system **5.12 (A)** interpret how land forms are the result of a combination of constructive and destructive forces such as deposition of sediment and weathering	2	IC	"weathering" TX says "flow" Is this landslide or magma?? TX says "earthquakes & glaciers" but "such as" might imply landslides rapid vs slow change not clarified
EARTH STRUCTURES	***Properties of Earth materials:*** *natural and human-made materials*			
E4.4: Earth materials that occur in nature include rocks, minerals, soils, water, and the gases of the atmosphere.	**3.11 (A)** identify and describe the importance of earth materials including rocks, soil, water, and gases of the atmosphere in the local area and classify them as renewable, nonrenewable, or inexhaustible resources	2	IC	TX does not specify "minerals" and adds "renewable, nonrenewable or inexhaustible"
E4.5: Natural materials have different properties, which sustain plant and animal life.	**4.11 (A)** test properties of soils including texture, capacity to retain water, and ability to support life **3.8 (B)** observe and identify organisms with similar needs that compete with one another for resources such as oxygen, water, food, or space	2	IC	TX says "soils support life" TX says "resources such as O2, water" but might not include a cave as in NAEP

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science					
EARTH STRUCTURES	**E4.6:** Some Earth materials have properties that make them useful either in their present form or designed and modified to solve human problems and enhance the quality of life, as in the case of materials used for building or fuels used for heating and transportation.	**4.11 (A)** test properties of soils including texture, capacity to retain water, and ability to support life **3.11 (A)** identify and describe the importance of earth materials including rocks, soil, water, and gases of the atmosphere in the local area and classify them as renewable, nonrenewable, or inexhaustible resources	2	IC	TX does not directly cover humans modifying Earth materials in Gr 5 or how they are used
EARTH SYSTEMS	***Energy in Earth systems:*** *role of the sun*				
	E4.7: The sun warms the land, air, and water and helps plants grow.	**4.11 (C)** identify the Sun as the major source of energy for the Earth and understand its role in the growth of plants, in the creation of winds, and in the water cycle **5.5 (A)** describe some cycles, structures, and processes that are found in a simple system	3		system/process
	Climate and weather: *local weather*				
	E4.8: Weather changes from day to day and over the seasons.	**4.6 (A)** identify patterns of change such as in weather, metamorphosis, and objects in the sky.	2		TX does not specify day to day
	E4.9: Scientists use tools for observing, recording, and predicting weather changes from day to day and over the seasons.	**5.4 (A)** collect and analyze information using tools including calculators, microscopes, [cameras, sound recorders, computers,] hand lenses, rulers, thermometers, compasses, balances, [hot plates,] meter sticks, timing devices, magnets, collecting nets, and safety goggles)?	1		TX does not directly specify tools for measuring weather related phenomena, although Obj 1, 5.2 (B) has measuring, and Obj 1, 5.4 (A) using tools does not include sling psychrometer, etc
	Biogeochemical cycles: *uses of Earth resources*				
	E4.10: The supply of many Earth resources such as fuels, metals, fresh water, and farmland is limited. Humans have devised methods for extending the use of Earth resources through recycling, reuse, and renewal.	**3.11 (A)** identify and describe the importance of earth materials including rocks, soil, water, and gases of the atmosphere in the local area and classify them as renewable, nonrenewable, or inexhaustible resources **5.6 (B)** identify the significance of the water, carbon, and nitrogen cycles.	2	HG in Gr 11 IPC 6 (D) IC	nonrenewable implies limited (land/space is not necessarily implied) Gr 11 Obj 3 Bio 9 (D) Highlights—vaguely implied

(CONTINUED)

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science					
EARTH SYSTEMS	**E4.11:** Humans depend on their natural and constructed environment. Humans change environments in ways that can either be beneficial or detrimental for themselves and other organisms.	**3.8 (D)** describe how living organisms modify their physical environment to meet their needs such as beavers building a dam or humans building a home. **5.10 (B)** give examples of learned characteristics that result from the influence of the environment **5.5 (B)** describe some interactions that occur in a simple system. **5.6 (B)** identify the significance of the water, carbon, and nitrogen cycles.	2	HG 7.14 (C) 8.14 (B,D)	humans as detrimental not mentioned In Gr 8 TAKS p25 Highlights mentions human action pos and neg but it doesn't relate easily to any of the subobjectives in Obj 2

a. Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

b. Codes are IC (implied content), LG (content covered at a lower grade level), HG (content covered at a higher grade level), MC (more content), and MD (more detailed content). See appendix C for further information.

TABLE C2

Texas grade 5 assessment standards not covered by National Assessment of Educational Progress grade 4 content

Nature of science	None of the Texas standards are covered separately in NAEP
Life science	5.9 B (habitat or niche not in NAEP)
	5.9 C (predict changes from adaptation not in NAEP)
	5.10 B learned characteristics from environment not in NAEP
Physical science	All Texas objectives in NAEP
Earth and space science	5.11 B (tree rings and sedimentary rock not in NAEP)
	5.11 C past events that created resources not in NAEP
	3.11 C solar system not in NAEP
	3.11 D sun characteristics not in NAEP
	4.11 B effects of oceans on land not in NAEP
	5.12 C Earth compared with moon not in NAEP

APPENDIX D
CONTENT ALIGNMENT FOR GRADE 8

TABLE D1

Alignment of National Assessment of Educational Progress grade 8 science and Texas grade 8 standards

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MATTER	***Properties of matter:*** *chemical properties, particulate nature of matter, and the Periodic Table of Elements*				
	P8.1: Properties of solids, liquids, and gases are explained by a model of matter that is composed of tiny particles in motion.		1		
	P8.2: Chemical properties of substances are explained by the arrangement of atoms and molecules.		1		
	P8.3: All substances are composed of one or more of approximately one hundred elements. The Periodic Table organizes the elements into families of elements with similar properties.	**7.7C** recognize that compounds are composed of elements **8.9B** interpret information on the periodic table to understand that [physical] properties are used to group elements	3		Independently each would be a 2, combined = 3.
	P8.4: Elements are a class of substances composed of a single kind of atom. Compounds are composed of two or more different elements. Each element and compound has physical and chemical properties, such as boiling point, density, color, and conductivity, which are independent of the amount of the sample.	**7.7C** recognize that compounds are composed of elements	2		7.7 only covers the second sentence in the NAEP
	P8.5: Substances are classified according to their physical and chemical properties. Metals and acids are examples of such classes. Metals are a class of elements that exhibit common physical properties such as conductivity and common chemical properties such as reacting with nonmetals to produce salts. Acids are a class of compounds that exhibit common chemical properties including a sour taste, characteristic color changes with litmus and other acid/base indicators, and the tendency to react with bases to produce a salt and water.	**6.7B** classify substances by their physical and chemical properties	2	MD MC	State standard does not provide examples.

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
MATTER	***Changes in matter:*** *physical and chemical changes and conservation of mass*			
	P8.6: Changes of state are explained by a model of matter composed of tiny particles that are in motion. When substances undergo changes of state, neither atoms nor molecules themselves are changed in structure. Mass is conserved when substances undergo changes of state.	1		
	P8.7: Chemical changes can occur when two substances, elements, or compounds react and produce one or more different substances, whose physical and chemical properties are different from the reacting substances. When substances undergo chemical change, the number and kinds of atoms in the reactants are the same as the number and kinds of atoms in the products. Mass is conserved when substances undergo chemical change. The mass of the reactants is the same as the mass of the products.	**8.9A** demonstrate that substances may react chemically to form new substances **8.9C** recognize the importance of formulas and equations to express what happens in a chemical reaction	2		It is implied that in a balanced equation there is a conservation of mass.
ENERGY	***Forms of energy*****:** *kinetic energy, potential energy, and light energy from the sun*			
	P8.8: Objects and substances in motion have kinetic energy. For example, a moving baseball can break a window; water flowing down a stream moves pebbles and floating objects along with it.		1		
	P8.9: Three forms of potential energy are gravitational, elastic, and chemical. Gravitational potential energy changes in a system as the relative positions of objects are changed. Objects can have elastic potential energy due to their compression, or chemical potential energy due to the nature and arrangement of the atoms.		1		

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
ENERGY	**P8.10:** Energy is transferred from place to place. Light energy from the sun travels through space to Earth (radiation). Thermal energy travels from a flame through the metal of a cooking pan to the water in the pan (conduction). Air warmed by a fireplace moves around a room (convection). Waves—including sound and seismic waves, waves on water, and light waves—have energy and transfer energy when they interact with matter.	**8.7B** recognize that waves are generated and can travel through different media	2	MD MC IC	
	P8.11: A tiny fraction of the light energy from the sun reaches Earth. Light energy from the sun is Earth's primary source of energy, heating Earth surfaces and providing the energy that results in wind, ocean currents, and storms.		1		
	Energy transfer and conservation: *energy transfer and conservation of energy*				
	P8.12: When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. For example, as an object falls, its potential energy decreases as its speed, and consequently, its kinetic energy increases. While an object is falling, some of the object's kinetic energy is transferred to the medium through which it falls, setting the medium into motion and heating it.		1		
	P8.13: Nuclear reactions take place in the sun. In plants, light from the sun is transferred to oxygen and carbon compounds, which, in combination, have chemical potential energy (photosynthesis).		1		
MOTION	***Motion at the macroscopic level*:** *speed as a quantitative description of motion and graphical representations of speed*				
	P8.14: An object's motion can be described by its speed and the direction in which it is moving. An object's position can be measured and graphed as a function of time. An object's speed can be measured and graphed as a function of time.	**6.6B** demonstrate that changes in motion can be measured and graphically represented	2	MC MD	State standard only addresses measurement and graphing

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
MOTION	***Forces affecting motion:*** *qualitative descriptions of magnitude and direction as characteristics of forces, addition of forces, contact forces, forces that act at a distance, and net force on an object and its relationship to the object's motion*			
P8.15: Some forces between objects act when the objects are in direct contact or when they are not touching. Magnetic, electrical, and gravitational forces can act at a distance.		1		
P8.16: Forces have magnitude and direction. Forces can be added. The net force on an object is the sum of all the forces acting on the object. A nonzero net force on an object changes the object's motion; that is, the object's speed and/or direction of motion changes. A net force of zero on an object does not change the object's motion; that is, the object remains at rest or continues to move at a constant speed in a straight line.	**8.7A** demonstrate how unbalanced forces cause changes in the speed or direction of an object's motion **6.6 B** demonstrate that changes in motion can be measured and graphically represented	2	MC M IC	Motion can be measured and graphically represented, but NAEP does not address 'graphically represented'
Life science				
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	***Organization and development: basic needs of organisms:*** *the levels of organization of living systems*			
L8.1: All organisms are composed of cells, from just one cell to many cells. About two-thirds of the weight of cells is accounted for by water, which gives cells many of their properties. In multicellular organisms, specialized cells perform specialized functions. Organs and organ systems are composed of cells and function to serve the needs of cells for food, air, and waste removal. The way in which cells function is similar in all living organisms.	**6.10 B** determine that all organisms are composed of cells that carry on functions to sustain life **6.10 C** identify how structure complements function at different levels of organization including organs, organ systems, organisms, and populations	2	MD	NAEP does not refer to populations
L8.2: Following fertilization, cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo.		1		
	Matter and energy transformations: *the role of carbon compounds in growth and metabolism*			
L8.3: Cells carry out the many functions needed to sustain life. They grow and divide, thereby producing more cells. Food is used to provide energy for the work that cells do and is a source of the molecular building blocks from which needed materials are assembled.	**6.10B** determine that all organisms are composed of cells that carry on functions to sustain life	2	MC MD	State standard is general regarding function and does not address cell division.

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Life science					
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	**L8.4:** Plants are producers—they use the energy from light to make sugar molecules from the atoms of carbon dioxide and water. Plants use these sugars along with minerals from the soil to form fats, proteins, and carbohydrates. These products can be used immediately, incorporated into the plant's cells as the plant grows, or stored for later use.	**7.8B** identify that radiant energy from the Sun is transferred into chemical energy through the process of photosynthesis	2	MD IC	State only addresses energy type change. Does not get into detail.
	L8.5: All animals, including humans, are consumers that meet their energy needs by eating other organisms or their products. Consumers break down the structures of the organisms they eat to make the materials they need to grow and function. Decomposers, including bacteria and fungi, use dead organisms or their products to meet their energy needs.	**7.12B** observe and describe how organisms including producers, consumers, and decomposers live together in an environment and use existing resources; **8.6 C** describe interactions within ecosystems.	3		
	Interdependence: *specific types of interdependence*				
	L8.6: Two types of organisms may interact with one another in several ways: They may be in a producer/consumer, predator/prey, or parasite/host relationship. Or, one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.		1		
	L8.7: The number of organisms and populations an ecosystem can support depends on the biotic resources available and abiotic factors, such as quantity of light and water, range of temperatures, and soil composition.	**7.12C** describe how different environments support different varieties of organisms;	2	MD IC	State standard is general.
	L8.8: All organisms cause changes in the environment where they live. Some of these changes are detrimental to the organisms or other organisms, whereas others are beneficial.		1		

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Life science				
CHANGES IN LIVING SYSTEMS	***Heredity and reproduction:*** *reproduction and the influence of heredity and the environment on an offspring's characteristics*			
L8.9: Reproduction is a characteristic of all living systems**;** because no individual organism lives forever, reproduction is essential to the continuation of every species. Some organisms reproduce asexually. Other organisms reproduce sexually.		1		
L8.10: The characteristics of organisms are influenced by heredity and environment. For some characteristics, inheritance is more important; for other characteristics, interactions with the environment are more important.	**8.11B** distinguish between inherited traits and other characteristics that result from interactions with the environment	2	MC MD	
	Evolution and diversity: *preferential survival and relatedness of organisms*			
L8.11: Individual organisms with certain traits in particular environments are more likely than others to survive and have offspring. When an environment changes, the advantage or disadvantage of characteristics can change. Extinction of a species occurs when the environment changes and the characteristics of a species are insufficient to allow survival. Fossils indicate that many organisms that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the Earth no longer exist.	**8.11A** identify that change in environmental conditions can affect the survival of individuals and of species	2	MD MC	State standard is general.
L8.12: Similarities among organisms are found in anatomical features, which can be used to infer the degree of relatedness among organisms. In classifying organisms, biologists consider details of internal and external structures to be more important than behavior or general appearance.		1		

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH IN SPACE AND TIME	***Objects in the universe:*** *a model of the solar system*			
E8.1: In contrast to an earlier theory that Earth is the center of the universe, it is now known that the sun, an average star, is the central and largest body in the solar system. Earth is the third planet from the sun in a system that includes eight other planets and their moons, as well as smaller objects, such as asteroids and comets.		1		
E8.2: Gravity is the force that keeps most objects in the solar system in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.	**7.13B** relate the Earth's movement and the moon's orbit to the observed cyclical phases of the moon	2	MC MD	Gravity is not addressed in state standard.
EARTH STRUCTURES	***History of Earth:*** *estimating the timing and sequence of geologic events*			
E8.3: Fossils provide important evidence of how life and environmental conditions have changed in a given location.		1		
E8.4: Earth processes seen today, such as erosion and mountain building, made possible the measurement of geologic time through methods such as observing rock sequences and using fossils to correlate the sequences at various locations.		1		
	Properties of Earth materials: *soil analysis and layers of the atmosphere*			
E8.5: Rocks and rock formations bear evidence of the minerals, materials, temperature/pressure conditions, and forces that created them. Some formations show evidence that they were deposited by volcanic eruptions. Others are composed of sand and smaller particles buried and cemented by dissolved minerals to form solid rock again. Still others show evidence that they were once earlier rock types that were exposed to heat and pressure until they changed shape and in some cases melted and recrystallized.	**8.12A** analyze and predict the sequence of events in the lunar and rock cycles	2	MD IC	State standard mentions rock cycle does not address specific of rack cycle. State standard also includes lunar cycle that NAEP does not.

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH STRUCTURES				
E8.6: Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers with each having a different chemical composition and texture.		1		
E8.7: The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has a different physical and chemical composition at different elevations.		1		
Tectonics: *the basics of tectonic theory and Earth magnetism*				
E8.8: The Earth is layered with a lithosphere; hot, convecting mantle; and dense, metallic core.		1		
E8.9: Lithospheric plates on the scale of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions.	**8.14A** predict land features resulting from gradual changes such as mountain building, beach erosion, land subsidence, [and continental drift] (8.14);* *TAKS will assess students' understanding of plate tectonics. The theory of plate tectonics is the most current and accepted theory of plate movement.	2	MD	
E8.10: Earth as a whole has a magnetic field that is detectable at the surface with a compass. Earth's magnetic field is similar to the field of a natural or human-made magnet with north and south poles and lines of force. For thousands of years, people have used compasses to aid in navigation on land and sea.		1		
Energy in Earth systems: *the sun's observable effects*				
E8.11: The sun is the major source of energy for phenomena on Earth's surface. The sun provides energy for plants to *grow and **drives convection within the atmosphere and oceans, producing winds, ocean currents, and the water cycle.	****8.10B** describe interactions among solar, weather, and ocean systems ***7.8 B** identify that radiant energy from the Sun is transferred into chemical energy through the process of photosynthesis	3	MD MC	NAEP is covered only when both state standards are addressed.
E8.12: Seasons result from annual variations in the intensity of sunlight and length of day, due to the tilt of Earth's rotation axis relative to the plane of its yearly orbit around the sun.	**7.13A** identify and illustrate how the tilt of the Earth on its axis as it rotates and revolves around the Sun causes changes in seasons and the length of a day	3		

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH STRUCTURES	***Climate and Weather:*** *global weather patterns*			
	E8.13: Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate because water in the oceans holds a large amount of heat.	**8.10 B** describe interactions among solar, weather, and ocean systems	2	8.10 does not refer to global issues
EARTH SYSTEMS	***Biogeochemical cycles:*** *natural and human-induced changes in Earth materials and systems*			
	E8.14: Water, which covers the majority of Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the "water cycle." Water evaporates from Earth's surface, rises and cools as it moves to higher elevations, condenses as clouds, falls as rain or snow, and collects in lakes, oceans, soil, and underground.	**6.8B** explain and illustrate the interactions between matter and energy in the water cycle and in the decay of biomass such as in a compost bin	2	IC MD MC	Only the first part of the state standard addresses the water cycle
	E8.15: Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed Earth's land, oceans, and atmosphere. Studies of plant and animal populations have shown that such activities can reduce the number and variety of wild plants and animals and sometimes result in the extinction of species.	**8.14B** analyze how natural or human events may have contributed to the extinction of some species **8.12C** predict the results of modifying the Earth's nitrogen, water, and carbon cycles. **8.14C** describe how human activities have modified soil, water, and air quality	3		NAEP covered by addressing all three state standards.

a. Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

b. Codes are IC (implied content), LG (content covered at a lower grade level), HG (content covered at a higher grade level), MC (more content), and MD (more detailed content). See appendix C for further information.

TABLE D2

Texas grade 8 assessment standards not covered by National Assessment of Educational Progress grade 8 content

Nature of science	8.1A, 8.2A, 8.2B, 8.2C, 8.2D, 8.2E, 8.3A, 8.3B, 8.3C, 8.4A, 8.4B
Living systems and the environment	6.5B, 7.12D, 8.6A, 8.6B, 8.6C, 8.11C
Structures and properties of matter	8.8A, 8.8 B, 8.10A
Motion, forces, and energy	6.9A, 7.8A, 7.6A, 7.6C, 8.7B
Earth and space science	6.14B, 8.12A, 8.13A, 7.14A, 7.14B, 7.14C

APPENDIX E
CONTENT ALIGNMENT FOR GRADE 12

TABLE E1

Alignment of National Assessment of Educational Progress grade 12 science and Texas grades 10 and 11 standards

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MATTER	Properties of matter: characteristics of subatomic particles and atomic structure				
	P12.1: Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged and the strength of the forces of attraction between the atoms, ions, or molecules.	**IPC (8) (A)** distinguish between physical and chemical changes in matter such as oxidation, digestion, changes in states, and stages in the rock cycle; **IPC (9) (B)** relate the concentration of ions in a solution to physical and chemical properties such as pH, electrolytic behavior, and reactivity; **IPC (7)(E)** classify samples of matter from everyday life as being elements, compounds, or mixtures. **IPC (9)(D)** demonstrate how various factors influence solubility including temperature, pressure, and nature of the solute and solvent.	2	MC	**IPC (8) (A)** Texas asks students to distinguish between physical and chemical changes in matter and changes in state. NAEP goes into more detail. **IPC (9) (B)** Texas covers physical and chemical properties of ions (not molecules or atoms). TX-does not specify solid, liquid, gas Implies molecular attraction through solubility
	P12.2: Electrons, protons, and neutrons are parts of the atom and have measurable properties including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.		1		
	P12.3: In the Periodic Table, elements are arranged according to the number of protons (called the atomic number). This organization illustrates commonality and patterns of physical and chemical properties among the elements.	**IPC (7) (D)** relate the chemical behavior of an element including bonding, to its placement on the periodic table. **IPC(7)(E)** classify samples of matter from everyday life as being elements, compounds, or mixtures.	2		**IPC (7) (D)** Texas focuses on chemical properties and relationship on the periodic table, and is missing the physical properties. TX-implies number of protons through elements, compounds and mixtures

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MATTER	**P12.4:** In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.		1		
	Changes in matter: *particulate nature of matter, unique physical characteristics of water, and changes at the atomic and molecular level during chemical changes*				
	P12.5: Changes of state require a transfer of energy. Water has a very high specific heat, meaning it can absorb a large amount of energy while producing only small changes in temperature.	**IPC (9) (A)** relate the structure of water to its function [as the universal solvent];	2	IC	**IPC (9) (A)** Texas asks to relate the structure of water to its function [as the universal solvent]. But what examples are in [ ] aren't tested. So is water's specific heat covered by this Texas Standard? TX-does not specifically mention specific heat, but implies it in water as universal solvent
	P12.6: An atom's electron configuration, particularly of the outermost electrons, determines how the atom can interact with other atoms. The interactions between atoms that hold them together in molecules or between oppositely charged ions are called chemical bonds.	**IPC (7) (D)** relate the chemical behavior of an element including bonding, to its placement on the periodic table.	2	IC	**IPC (7) (D)** Texas classifies matter as elements, compounds, or mixtures. That can relate to how atoms interact in molecules and bonding.
	P12.7: A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms. In other chemical reactions, atoms interact with one another by sharing electrons to create a bond. An important example is carbon atoms, which can bond to one another in chains, rings, and branching networks to form, along with other kinds of atoms—hydrogen, oxygen, nitrogen, and sulfur—a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.	**IPC (8) (A)** distinguish between physical and chemical changes in matter such as oxidation, digestion, changes in states, and stages in the rock cycle;	2	MC	**IPC (8) (A)** Texas covers physical and chemical changes in matter such as oxidation but does not go into the reactions.

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NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science				
ENERGY	***Forms of energy:*** *nuclear energy and waves*			
P12.8: Atoms and molecules that compose matter are in constant motion (translational, rotational, or vibrational).	**IPC (6)(B)** investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation;	2	IC	TX-Does not specify vibrational, rotational or translational motion
P12.9: Energy may be transferred from one object to another during collisions.	**IPC (6) (A)** describe the law of conservation of energy;	2	IC	
P12.10: Electromagnetic waves are produced by changing the motion of charges or by changing magnetic fields. The energy of electromagnetic waves is transferred to matter in packets. The energy content of the packets is directly proportional to the frequency of the electromagnetic waves.	**IPC (5) (A)** demonstrate wave types and their characteristics through a variety of activities such as modeling with ropes and coils, activating tuning forks, and interpreting data on seismic waves. IPC (5) (B) demonstrate wave interactions including interference, polarization, reflection, refraction, and resonance within various materials.	2	IC IC	**IPC (5) (A)** Students in TX are expected to demonstrate wave types and their characteristics. Are electromagnetic waves covered? **IPC (5) (B)** Texas covers wave interactions within various materials.
P12.11: Fission and fusion are reactions involving changes in the nuclei of atoms. Fission is the splitting of a large nucleus into smaller nuclei and particles. Fusion involves joining of two relatively light nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the sun and other stars.		1		
Energy transfer and conservation: *translational, rotational, and vibrational energy of atoms and molecules, and chemical and nuclear reactions*				
P12.12: Heating increases the translational, rotational, and vibrational energy of the atoms composing elements and the molecules or ions composing compounds. As the translational energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a sample of a crystalline solid increases the vibrational energy of the atoms, molecules, or ions. When the vibrational energy becomes great enough, the crystalline structure breaks down and the solid melts.	**IPC (6) (B)** investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation;	2	MC	**IPC (6) (B)** In TX the student must investigate and demonstrate the movement of heat by convection, conduction, and radiation. TX-Does not specify vibrational, rotational or translational motion

	NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
ENERGY	**P12.13:** The potential energy of an object on Earth's surface is increased when the object's position is changed from one closer to Earth's surface to one farther from Earth's surface.		1		
	P12.14: Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).		1		
	P12.15: Nuclear reactions—fission and fusion—convert very small amounts of matter into appreciable amounts of energy.		1		
MOTION	***Motion at the macroscopic level*:** *velocity and acceleration as quantitative descriptions of motion and the representation of linear velocity and acceleration in tables and graphs*				
	P12.17: The motion of an object can be described by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.	**IPC (4) (A)** calculate speed, momentum, acceleration, work, and power in systems such as in the human body, moving toys, and machines;	2	IC	**IPC (4) (A)** Texas calculates speed and acceleration. It doesn't specify position and velocity.
	P12.18: Objects undergo different kinds of motion—translational, rotational, and vibrational.	**IPC (6)(B)** investigate and demonstrate the movement of heat through solids, liquids, and gases by convection, conduction, and radiation;	2	IC	TX-implies motion of molecules through heat
	Forces affecting motion: *quantitative descriptions of universal gravitational and electric forces, and relationships among force, mass, and acceleration*				
	P12.19: The motion of an object changes only when a net force is applied.	**IPC (4) (B)** investigate and describe [applications of] Newton's laws such as in vehicle restraints, sports activities, geological processes, and satellite orbits.	2	IC	**IPC (4) (B)** TX-Implied through Newton's Laws
	P12.20: The magnitude of acceleration of an object depends directly on the strength of the net force and inversely on the mass of the object. This relationship ($a=F_{net}/m$) is independent of the nature of the force.	**IPC (4)(A)** calculate speed, momentum, acceleration, work, and power in systems such as in the human body, moving toys, and machines; **IPC (4)(B)** investigate and describe [applications of] Newton's laws such as in vehicle restraints, sports activities, geological processes, and satellite orbits.	3	IC	**IPC (4) (A)** Texas calculates speed and acceleration. It doesn't specify force and mass. (But w/ IPC (4) (B)—it is a 3

(CONTINUED)

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Physical science					
MOTION	**P12.21:** Whenever one object exerts force on another, a force equal in magnitude and opposite in direction is exerted by the second object back on the first object. In closed systems, momentum is the quantity of motion that is conserved. Conservation of momentum can be used to help validate the relationship $a=F_{net}/m$.	**IPC (4) (A)** calculate speed, momentum, acceleration, work, and power in systems such as in the human body, moving toys, and machines;	2	MC	**IPC (4) (A)** In TX students must calculate momentum. Missing Conservation of Momentum.
	P12.22: Gravitation is a universal attractive force that each mass exerts on any other mass. The strength of the gravitational force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.		1		
	P12.23: Electric force is a universal force that exists between any two charged objects. Opposite charges attract while like charges repel. The strength of the electric force is proportional to the magnitudes of the charges and inversely proportional to the square of the distance between them. Between any two charged particles, the electric force is vastly greater than the gravitational force.		1		
Life science					
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	***Organization and Development:*** *basic needs of organisms: the chemical basis of living systems*				
	L12.1: Living systems are made of complex molecules (including carbohydrates, fats, proteins, and nucleic acids) that consist mostly of a few elements, especially carbon, hydrogen, oxygen, nitrogen, and phosphorous.	**Bio (6) (A)** describe components of deoxyribonucleic acid (DNA), and illustrate how information for specifying the traits of an organism is carried in the DNA;	2	MC	Texas has students describe the components of DNA which is a nucleic acid. But they don't cover the makeup of any of the other macromolecules.

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Life science					
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	**L12.2:** Cellular processes are carried out by many different types of molecules, mostly proteins. Protein molecules are long, usually folded chains made from combinations of amino-acid molecules. Protein molecules assemble fats and carbohydrates and carry out other cellular functions. The function of each protein molecule depends on its specific sequence of amino acids and the shape of the molecule.	**Bio (4) (B)** investigate and identify cellular processes including homeostasis, permeability, energy production, transportation of molecules, disposal of wastes, function of cellular parts, and synthesis of new molecules. **Bio (6) (B)** explain replication, transcription, and translation using models of DNA and ribonucleic acid (RNA);	2	MC MC	**Bio (4) (B)** NAEP focuses on cellular processes that involve proteins. Texas' standards include identifying cellular processes, but don't focus on proteins. **Bio (6) (B)** Texas explains how proteins are made through transcription and translation, that could explain the function of the protein molecules based on its sequence of amino acids.
	L12.3: Cellular processes are regulated both internally and externally by environments in which cells exist, including local environments that lead to cell differentiation during the development of multicellular organisms. During the development of complex multicellular organisms, cell differentiation is regulated through the expression of different genes.	**Bio (4) (B)** investigate and identify cellular processes including homeostasis, permeability, energy production, transportation of molecules, disposal of wastes, function of cellular parts, and synthesis of new molecules. **Bio (6) (A)** describe components of deoxyribonucleic acid (DNA), and illustrate how information for specifying the traits of an organism is carried in the DNA; **Bio (6) (C)** identify and illustrate how changes in DNA cause mutations [and evaluate the significance of these changes];	2	MC IC IC	**Bio (4) (B)** cell processes are discussed in Texas standards in regards to homeostasis, transportation of molecules, and function of cellular part. TX-implies, but does not mention multicellular concepts **Bio (6) (A)** Texas: info for specifying the traits of organisms is carried in DNA can cover how cell differentiation is regulated through the expression of genes. **Bio (6) (C)** Texas: evaluate the significance of changes in DNA can relate to cell differentiation through expression of genes.

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NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
STRUCTURES AND FUNCTIONS OF LIVING SYSTEMS	***Matter and energy transformations:*** *the chemical basis of matter and energy transformation in living systems*			
L12.4: Plants have the capability (through photosynthesis) to take energy from light to form higher energy sugar molecules containing carbon, hydrogen, and oxygen from lower energy molecules. These sugar molecules can be used to make amino acids and other carbon-containing (organic) molecules and assembled into larger molecules with biological activity (including proteins, DNA, carbohydrates, and fats).		1		
L12.5: The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in an ecosystem, some energy is stored in newly made structures, but much is dissipated into the environment as heat. Continual input of energy from sunlight keeps the process going.	**Bio (12) (E)** investigate and explain the interactions in an ecosystem including food chains, food webs, and food pyramids.	2	MD	NAEP goes into more detail about the energy and molecules. Texas covers interaction in an ecosystem (food chains, webs, and pyramids).
L12.6: As matter cycles and energy flows through different levels of organization of living systems—cells, organs, organisms, communities—and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.	**Bio (9) (D)** analyze the flow of matter and energy through different trophic levels and between organisms and the physical environment.	2	MD	NAEP goes into a lot more detail about matter and energy.
	Interdependence: *consequences of interdependence*			
L12.7: Although the interrelationships and interdependence of organisms may generate biological communities in ecosystems that are stable for hundreds or thousands of years, ecosystems always change when climate changes or when one or more new species appear as a result of migration or local evolution. The impact of the human species has major consequences for other species.	**Bio (12) (B)** interpret interactions among organisms exhibiting predation, parasitism, commensalism, and mutualism;	2		Interactions among organisms are in the Texas standards, but it changes in the ecosystem, climate changes, migration, local evolution, and human impact are all missing from the Texas standards.

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Life science				
CHANGES IN LIVING SYSTEMS	***Heredity and Reproduction:*** *the molecular basis of heredity*			
	L12.8: Hereditary information is contained in genes, located in the chromosomes of each cell. A human cell contains many thousands of different genes. One or many genes can determine an inherited trait of an individual, and a single gene can influence more than one trait.	**Bio (6) (A)** describe components of deoxyribonucleic acid (DNA), and illustrate how information for specifying the traits of an organism is carried in the DNA; **Bio (6) (B)** explain replication, transcription, and translation using models of DNA and ribonucleic acid (RNA); **Bio (6) (D)** compare genetic variations observed in plants and animals.	2	MD	NAEP goes into more detail than what is described in Texas Standards
	L12.9: The genetic information encoded in DNA molecules provides instructions for assembling protein molecules. Genes are segments of DNA molecules. Inserting, deleting, or substituting DNA segments can alter genes. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.	**Bio (6) (A)** describe components of deoxyribonucleic acid (DNA), and illustrate how information for specifying the traits of an organism is carried in the DNA; **Bio (6) (B)** explain replication, transcription, and translation using models of DNA and ribonucleic acid (RNA); **Bio (6) (C)** identify and illustrate how changes in DNA cause mutations [and evaluate the significance of these changes];	3		
	L12.10: Sorting and recombination of genes in sexual reproduction results in a great variety of possible gene combinations from the offspring of any two parents.		1		
	Evolution and Diversity: *the mechanisms of evolutionary change and the history of life on Earth*			
	L12.11: Modern ideas about evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as depicted in the fossil record and in the similarities evident within the diversity of existing organisms.	**Bio (7) (B)** illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction.	2	IC	Texas asks to "illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction". This should provide a scientific explanation asked for in the NAEP standards.
	L12.12: Molecular evidence substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.	**Bio (7) (A)** identify evidence of change in species using fossils, DNA sequences, anatomical similarities, physiological similarities, and embryology;	3		

(CONTINUED)

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Life science					
CHANGES IN LIVING SYSTEMS	**L12.13:** Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection from environmental pressure of those organisms better able to survive and leave offspring.	**Bio (7) (A)** identify evidence of change in species using fossils, DNA sequences, anatomical similarities, physiological similarities, and embryology; **Bio (7) (B)** illustrate the results of natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction. **Bio (12) (B)** interpret interactions among organisms exhibiting predation, parasitism, commensalism, and mutualism; **Bio (13) (A)** evaluate the significance of structural and physiological adaptations of plants to their environments.	2	MD IC	NAEP spells it out a little more, but it looks as if this is what the Texas standards are heading towards. Bio (13) (A) can cover the 4th section of this NAEP standard.
Earth and space science					
EARTH IN SPACE AND TIME	***Objects in the Universe:*** *a vision of the universe*				
	E12.1: The origin of the universe remains one of the greatest questions in science. The "big bang" theory places the origin approximately 13.7 billion years ago when the universe began in a hot, dense state. According to this theory, the universe has been expanding ever since.		1		
	E12.2: Early in the history of the universe, matter, primarily the light atoms hydrogen and helium, clumped together by gravitational attraction to form countless trillions of stars and billions of galaxies.		1		
	E12.3: Stars, like the sun, transform matter into energy in nuclear reactions. When hydrogen nuclei fuse to form helium, a small amount of matter is converted to energy. These and other processes in stars have led to the formation of all the other elements.		1		

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH IN SPACE AND TIME	***History of Earth:*** *theories about Earth's history*			
	E12.4: Early methods of determining geologic time, such as the use of index fossils and stratigraphic sequences, allowed for the relative dating of geological events. However, absolute dating was impossible until the discovery that certain radioactive isotopes in rocks have known decay rates, making it possible to determine how many years ago a given rock sample formed.	1		
	E12.5: Theories of planet formation and radioactive dating of meteorites and lunar samples have led to the conclusion that the sun, Earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.	1		
	E12.6: Early Earth was very different from today's planet. Evidence for one-celled forms of life—the bacteria—extends back more than 3.5 billion years. The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain molecular oxygen.	1		
	E12.7: Earth's current structure has been influenced by both sporadic and gradual events. Changes caused by violent earthquakes and volcanic eruptions can be observed on a human time scale, but many geological processes, such as the building of mountain chains and shifting of entire continents, take place over hundreds of millions of years.	1		

(CONTINUED)

NAEP science standards	Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science				
EARTH STRUCTURES	***Tectonics:*** *the basics of tectonic theory and Earth magnetism*			
	E12.8: Mapping of the Mid-Atlantic Ridge, evidence of sea floor spreading, and subduction provided crucial evidence in support of the theory of plate tectonics. The theory currently explains plate motion as follows: the outward transfer of Earth's internal heat propels the plates comprising Earth's surface across the face of the globe. Plates are pushed apart where magma rises to form mid-ocean ridges, and the edges of plates are pulled back down where Earth materials sink into the crust at deep trenches.	1		
EARTH SYSTEMS	***Energy in earth systems:*** *internal and external sources of energy in Earth systems*			
	E12.9: Earth systems have internal and external sources of energy, both of which create heat. The sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from Earth's original formation.	1		
	Climate and Weather: *systems that influence climate*			
	E12.10: Climate is determined by energy transfer from the sun at and near Earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover, atmospheric gases, and Earth's rotation, as well as static conditions such as the positions of mountain ranges and of oceans, seas, and lakes.	1		
	Biogeochemical cycles: *biogeochemical cycles in Earth systems*			
	E12.11: Earth is a system containing essentially a fixed amount of each stable chemical atom or element. Most elements can exist in several different chemical forms. Earth elements move within and between the lithosphere, atmosphere, hydrosphere, and biosphere as part of biogeochemical cycles.	1		

NAEP science standards		Texas content	Overall rating[a]	Code[b]	Notes
Earth and space science					
EARTH SYSTEMS	**E12.12:** Movement of matter through Earth's systems is driven by Earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in coal and other fossil fuels, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.		1		
	E12.13: Natural ecosystems provide an array of basic processes that affect humans. These processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.		1		

a. Rating is based on a scale of 1 to 3, where 1 indicates that state standards do not address NAEP content statement, 2 that state standards partially address NAEP content statement, and 3 that state standards fully address or exceed NAEP content statement by targeted grade level.

b. Codes are IC (implied content), LG (content covered at a lower grade level), HG (content covered at a higher grade level), MC (more content), and MD (more detailed content). See appendix C for further information.

TABLE E2

Texas grades 10 and 11 assessment standards not covered by National Assessment of Educational Progress grade 12 content

Nature of science (Objective 1)	Bio/IPC (1) (A)
	Bio/IPC (2) (A); Bio/IPC (2) (B); Bio/IPC (2) (C); Bio/IPC (2) (D);
	IPC (3) (A); IPC (3) (B)
Organization of living systems (Objective 2)	Bio (8) (C)
	Bio (10) (A); Bio (10) (B)
Interdependence of organisms (Objective 3)	Bio (4) (C); Bio (4) (D)
Structures and properties of matter (Objective 4)	IPC (7) (A)
	IPC (8) (C)
Motion, forces, and energy (Objective 5)	IPC (4) (D)
	IPC (5) (A)
	IPC (6) (D); IPC (6) (F)

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