Florida Interim Assessment Item Bank and Test Platform

Item Specifications

Science
Earth and Space Science
Grades 9–12

FLORIDA DEPARTMENT OF EDUCATION
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I. Introduction

The U.S. Department of Education awarded a Race to the Top grant to Florida in August 2010. An important component of this grant focused on the development of high-quality assessment items and balanced assessments for use by districts, schools, and teachers. The assessment items will be stored in the Florida Interim Assessment Item Bank and Test Platform (IBTP), a statewide secure system which allows Florida educators to search the item bank, export test items, and generate customized high-quality assessments for computer-based delivery or paper-and-pencil delivery. The IBTP allows Florida educators to determine what students know and are able to do relative to instruction on Florida's Next Generation Sunshine State Standards and the Common Core State Standards (CCSS).

A. Purpose of the Item Specifications

The *Item Specifications* define the expectations for content, standards alignment, and format of assessment items for the Item Bank and Test Platform. The *Item Specifications* are intended for use by item writers and reviewers in the development of high-quality assessment items.

B. Scope

The *Item Specifications* provide general and grade-specific guidelines for the development of all Grades 9–12 Earth and Space Science assessment items available in the Florida Interim Assessment Item Bank.

C. Standards Alignment

Items developed for the Florida Interim Assessment Item Bank and Test Platform will align to the Next Generation Sunshine State Standards for Science and, where appropriate and applicable, the Common Core State Standards for Mathematics and Literacy in Science and Technical Subjects.

1. Next Generation Sunshine State Standards

Florida's Next Generation Sunshine State Standards (NGSSS) for Science provide the basis for science teaching and learning in Florida's public schools. For Grades 9–12 Earth and Space Science, the NGSSS are divided into benchmarks that identify what a student should know and be able to do in each course. The NGSSS are available at *http://www.floridastandards.org/homepage/index.aspx*.

2. Common Core State Standards

Selected standards from the Common Core State Standards for Mathematics and Literacy in Science and Technical Subjects have been embedded in Florida's course descriptions for Grades 6–12 science courses to provide support for science literacy and mathematics skills. Appendix B of this document provides a list of the CCSS Mathematics and Literacy Standards associated with the Grades 9–12 Earth and Space Science courses. Assessment items for Earth and Space Science should be aligned to one or more of the associated CCSS, whenever appropriate, in addition to the targeted earth and space science benchmark.

II. Criteria for Item Development

Science item writers for the Florida Interim Assessment Item Bank must have a comprehensive knowledge of science curriculum based on the Next Generation Sunshine State Standards and an understanding of the range of cognitive abilities of the target student population. Item writers should understand and consistently apply the guidelines established in this document. Item writers are expected to use their best judgment in writing items that measure the science benchmarks of the NGSSS and the CCSS, where appropriate, without introducing extraneous elements that reflect bias for or against a group of students.

A. Overall Considerations for Item Development

These guidelines are provided to ensure the development of high-quality assessment items for the Florida Interim Assessment Item Bank.

1. Each item should be written to measure primarily one NGSSS benchmark; however, other benchmarks may also be addressed for some item types.
2. Whenever possible, each item will also be aligned to a secondary CCSS Mathematics and/or Literacy standard applicable to a particular grade.
3. Items should be appropriate for students in terms of grade-level instruction, experience and difficulty, cognitive development, and reading level. The reading level of the test items should be on grade level. (Refer to the glossaries in CPALMS for each course.)
4. Of the assessment items associated with a given benchmark, 50% or more should meet or exceed the cognitive level (DOK) of the benchmark.
5. Each item should be written clearly and unambiguously to elicit the desired response.
6. Items should not disadvantage or exhibit disrespect to anyone in regard to age, gender, race, ethnicity, language, religion, socioeconomic status, disability, occupation, or geographic region.

B. Item Contexts

The context in which an item is presented is called the item context or scenario. These guidelines are provided to assist item writers with development of items within an appropriate context.

1. The item context should be designed to interest students at the targeted level. Scenarios should be appropriate for students in terms of grade-level experience and difficulty, cognitive development, and reading level.
2. The context should be directly related to the question asked. The context should lead the student cognitively to the question. Every effort should be made to keep items as concise as possible without losing cognitive flow or missing the overall idea or concept.
3. Information and/or data in items must be accurate and verifiable using reliable sources. Source documentation should accompany items as needed.

4. All item scenarios, graphics, diagrams, and illustrations must be age-, grade-, and experience-appropriate.
5. Item contexts and illustrations depicting individuals conducting laboratory investigations should include proper safety equipment and model safe laboratory procedures.
6. Scenarios describing scientific investigations should model current science methodology and adhere to the Intel International Science and Engineering Fair Rules and Guidelines unless otherwise noted in the benchmark clarification statements. These rules and guidelines can be found using the Document Library link at: *http://www.societyforscience.org/ISEF*.
7. Items or illustrations may include, but are not limited to, the following common laboratory tools: dissection equipment, electronic balance, flask, hot plate, meter stick, petri dish, pH sensor, pipette, probe, prism, pulley, test strips, triple-beam balance, battery, beaker, compass, eyedropper, flashlight, graduated cylinder, light bulb, magnet, metric measuring tape, metric ruler, microscope, microscope slide, model, safety goggles, spring scales, stopwatch, telescope, test tube, thermometer, and topographic map.
8. The item content should be timely but not likely to become dated.

C. Use of Media

Media can be used to provide either necessary or supplemental information—that is, some media contain information that is necessary for answering the question, while other media support the context of the question. Items may include diagrams, illustrations, charts, tables, audio files, or video files unless otherwise noted in the Individual Benchmark Specifications.

1. Items should not begin with media. Media in items is always preceded by text.
2. All visual media (tables, charts, graphs, photographs, etc.) should be titled. Titles should be in all caps, boldfaced, and centered, and may be placed above or below the visual media.

D. Item Style and Format

This section presents stylistic guidelines and formatting directions that should be followed while developing items.

1. Items should be clear and concise and should use vocabulary and sentence structure appropriate for the assessed grade level. Writers should refer to the resources provided during item writer training and to the glossaries in CPALMS.
2. The words *most likely* or *best* should be used only when appropriate to the question.
3. At Grades 9–12, temperatures should be given in degrees Celsius unless otherwise noted in the Individual Benchmark Specifications.

4. Metric units of measure should be used in scenarios addressing mass, length, weight, and/or volume. International System of Units (SI) should be used unless otherwise noted in the Individual Benchmark Specifications.
5. The first occurrence of units of measure should be written out in the item stem, e.g., kilograms (kg). In graphics, an abbreviation may be used (e.g., g or cm). To avoid confusion between the preposition *in* and the abbreviation for inches, only units of measure in graphics should be presented, e.g., height (cm) NOT height (in cm).
6. In titles of tables and charts and in labels for axes, the unit of measure should be included, preferably in lowercase and in parentheses, e.g., height (m).
7. Items requiring art should be to scale whenever possible. If not possible, a not-to-scale text box should be included at the bottom left of the art.
8. Graphics in items should be clearly labeled and contain all necessary information.
9. Items referring to new developments or discoveries should include phrases similar to *according to current knowledge* or *based on current knowledge*.
10. Items using the word *not* should emphasize the word *not* using all uppercase letters (e.g., Which of the following is NOT an example of . . .). The word *not* should be used sparingly.
11. As appropriate, boldface type should be used to emphasize key words in the item (e.g., **least**, **most**, **greatest**, **percent**, **best**).
12. Masculine pronouns should NOT be used to refer to both sexes. Name(s) should be used whenever possible to avoid gender-specific pronouns (e.g., instead of "The student will make changes so that he . . .", use "John and Maria will make changes so that they . . .").
13. Grades 9–12 items may express values using scientific notation
14. Decimal numbers between –1 and 1 should have a leading zero.
15. SI units should be expressed in a single type of unit when possible (e.g., 1.4 kilograms instead of 1 kilogram 400 grams).
16. Commas should be used in numbers greater than or equal to 1,000 except for numbers having an SI unit. In this case, numbers with four digits should be presented without a comma or a space (e.g., 9960 meters). Numbers with more than four digits should be presented with a thin space inserted in place of a comma (e.g., 10 123 kilograms).
17. In most cases, scenarios involving elements, chemical formulas, or chemical symbols and/or equations should be written out followed by the abbreviation, e.g., carbon dioxide (CO_2).
18. In the item stem, values needed to compute answers should be presented as numerals.

E. Item Types

This section presents guidelines for development of the following types of items:

- Selected Response (SR)—1 point
- Gridded Response (GR)—1 point
- Short Response (SHR)—1 point
- Constructed Response (CR)—2 points
- Extended Response (ER)—4 points
- Essay Response (ESR)—6 points
- Performance Task (PT)—1–10 points

1. Selected Response (SR) Items (1 point)

Selected response items require students to choose an answer from the choices given. Each item consists of a stem and either three or four answer options, depending on the grade level (see #3 below). One of the answer options is the correct answer, and the remaining options are called distractors. Selected response items may also include a stimulus and/or passage.

1. SR items should take approximately one minute per item to answer.
2. SR items are worth one point each.
3. SR items for grades K, 1, and 2 should have three answer options (A, B, and C). SR items for all other grades and courses should have four answer options (A, B, C, and D).
4. SR items must have only one correct answer option.
5. During item development and review, the correct response should be indicated.
6. During item development and review, the rationale for distractors (incorrect answer choices) should be indicated. The rationale should include information explaining why a student would select that distractor.
7. Distractor rationales should represent computational or conceptual errors or misconceptions commonly made by students who have not mastered the assessed concepts.
8. Each distractor should be a believable answer (i.e., plausible, but incorrect).
9. All answer options should be written in a style appropriate to the question asked. For example, a “how” question should have answer options that explain how.
10. Options should have parallel structure whenever possible. Test item options should not have an outlier (e.g., an answer option that is significantly longer than or different from the other options).
11. Items should not be clued or answered by information in the stem or other options.

12. Options such as *none of the above*, *all of the above*, *not here*, *not enough information*, or *cannot be determined* should not be used as answer options.
13. If an option is a single word or a phrase, the option should start with a lowercase letter. If an option is a sentence, the sentence should be conventionally capitalized and punctuated. Options that are imperatives should be treated as sentences.
14. Answer options that are single words should be arranged in alphabetical or reverse alphabetical order.
15. Answer options that are phrases or sentences should be arranged from shortest to longest or longest to shortest.
16. Numerical answer options should be arranged in ascending or descending order.
17. Numerical answer options that represent relative magnitude or size should be arranged as they are shown in the stem or in some other logical order.
18. When the item requires the identification of a choice from the item stem, table, chart, or illustration, the options should be arranged as they are presented in the item stem, table, chart, or illustration.
19. If the answer options for an item are neither strictly numerical nor denominate numbers, the options should be arranged by the logic presented in the item, by alphabetical order, or by length.

2. **Gridded Response (GR) Items (1 point)**

   Gridded response questions are worth 1 point each. The questions require students to solve problems and mark their answers by filling in the appropriate bubbles for the numbers on answer grids. Students must accurately complete the grid to receive credit for their answers.

3. **Short Response (SHR) Items (1 point)**

   Short response items usually include a scenario and instructions on how to respond. The recommended time allotment for a student to respond is 3 minutes. A complete answer is worth 1 point. There are no partial points for this item type.

4. **Constructed Response (CR) Items (2 points)**

   Constructed response items usually include a scenario and instructions on how to respond. The recommended time allotment for a student to respond is 5 minutes. A complete answer is worth 2 points and a partial answer is worth

1 point. The constructed response holistic rubric and exemplar specific to each item are used for scoring as follows:

SCORING RUBRIC	
2	A score of two indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, in a scientifically sound manner. When required, student explanations and/or interpretations are clear and complete. The response may contain minor flaws that do not detract from the demonstration of a thorough understanding.
1	A score of one indicates that the student has provided a response that is only partially correct. For example, the student may arrive at an acceptable conclusion or provide an adequate interpretation, but may demonstrate some misunderstanding of the underlying scientific concepts and/or procedures. Conversely, a student may arrive at an unacceptable conclusion or provide a faulty interpretation, but could have applied appropriate and scientifically sound concepts and/or procedures.
0	A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, contain clear misunderstandings of the underlying scientific concepts and/or procedures, or may be incorrect.

Exemplars: A specific exemplar should be developed for each constructed response item. Exemplars will be used as scoring guides and should be specific to the item, but not so specific as to discount multiple correct answers. Exemplars should include a clear and defensible description of the top score point, and contain straightforward language that is accurate, complete, and easy to interpret.

5. **Extended Response (ER) Items (4 points)**

Extended response items include a scenario and instructions on how to respond and are worth 4 score points. However, ER items are usually more complex than SHR items and 2-point CR items. The recommended time allotment for a student to respond is 10–15 minutes. The extended response holistic rubric and exemplar specific to each item are used for scoring as follows:

SCORING RUBRIC	
4	A score of four indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, used scientifically sound procedures, and provided clear and complete explanations and interpretations. The response may contain minor flaws that do not detract from a demonstration of a thorough understanding.
3	A score of three indicates that the student has demonstrated an understanding of the scientific concepts and/or procedures embodied in the task. The student's response to the task is essentially correct, but the scientific procedures, explanations, and/or interpretations provided are not thorough. The response may contain minor flaws that reflect inattentiveness or indicate some misunderstanding of the underlying scientific concepts and/or procedures.
2	A score of two indicates that the student has demonstrated only a partial understanding of the scientific concepts and/or procedures embodied in the task. Although the student may have arrived at an acceptable conclusion or provided an adequate interpretation of the task, the student's work lacks an essential understanding of the underlying scientific concepts and/or procedures. The response may contain errors related to misunderstanding important aspects of the task, misuse of scientific procedures/processes, or faulty interpretations of results.
1	A score of one indicates that the student has demonstrated a very limited understanding of the scientific concepts and/or procedures embodied in the task. The student's response is incomplete and exhibits many flaws. Although the student's response has addressed some of the conditions of the task, the student has reached an inadequate conclusion and/or provided reasoning that is faulty or incomplete. The response exhibits many flaws or may be incomplete.
0	A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, contain clear misunderstandings of the underlying scientific concepts and/or procedures, or may be incorrect.

Exemplars: A specific exemplar should be developed for each extended response item. Exemplars will be used as scoring guides and should be specific to the item, but not so specific as to discount multiple correct answers. Exemplars should include a clear and defensible description of the top score point, and contain straightforward language that is accurate, complete, and easy to interpret.

6. **Essay Response (ESR) Items (6 points)**

   Essay response items consist of asking a general question or providing a stimulus (such as an article or research paper on a relevant topic), and asking the students to express their thoughts or provide facts about the topic using logic and reason. Essay response items encompass a higher level of thinking and a broader range of skills that includes CCSS literacy standards, both of which are critical to future success in higher education and the workforce.

   In most cases, essay responses will go beyond a single paragraph in length, with a distinct introduction, body, and conclusion. An essay response will be worth a total of 6 points, with a rubric structure similar to that of the 4-point extended response. Students should be given about 20 to 30 minutes to complete each item.

   Exemplars: A specific exemplar should be developed for each essay response item. Exemplars will be used as scoring guides and should be specific to the item, but not so specific as to discount multiple correct answers. Exemplars should include a clear and defensible description of the top score point, and contain straightforward language that is accurate, complete, and easy to interpret.

7. **Performance Task (PT) Items (1–10 points)**

   Performance tasks are used to measure students' ability to *demonstrate* knowledge and skills from one or more benchmarks of the NGSSS and the CCSS. Specifically, performance tasks may require students to create a product, demonstrate a process, or perform an activity that demonstrates proficiency in science. They are evaluated using customized scoring rubrics, and each task may be worth 1–10 points. Performance tasks may have the following characteristics:

   1. Performance tasks may cover a short time period or may cover an extended period of time.
   2. Performance tasks must contain clear and explicit directions for understanding and completing the required component tasks and producing the objective output.
   3. All tasks, skills, and/or behaviors required by the performance tasks must be objective, observable, and measurable.
   4. All necessary equipment, materials, and resources should be referenced within the text of the performance task.
   5. Performance tasks should elicit a range of score points.
   6. Performance tasks generally require students to organize, apply, analyze, synthesize, and/or evaluate concepts.

7. Performance tasks may measure performance in authentic situations and outside the classroom, where appropriate and practical.
8. Typical response formats include demonstrations, laboratory performance, oral presentations, exhibits, or other products.
9. Every performance task requires a companion rubric to be used for scoring purposes. Rubrics should meet the following criteria:
   a. The rubrics and performance tasks should be developed in tandem to ensure compatibility.
   b. Rubrics must be specific to the individual requirements of each performance task; generic rubrics are not acceptable.
   c. The rubric must allow for efficient and consistent scoring.
   d. The customized rubric will also serve as an exemplar and should include a clear and defensible description of the top score point, and contain straightforward language that is accurate, complete, and easy to interpret.
   e. The highest score descriptor should allow for all foreseeable methods of correctly and thoroughly completing all requirements of the performance task.

A performance task may address one or more benchmarks or standards and may be composed of multiple items. The expectation is the performance tasks will include a demonstration of the student's mastery of the benchmark or standard. Items are expected to have rubrics.

F. Complex Stimuli and Reading Passages

The cross-curricular focus on aligning Florida IBTP items with the Common Core State Standards for mathematics and literacy make complex reading passages important components of the item bank. A passage is a segment of written work, followed by a series of questions that assess the student's comprehension of reading and the content presented. Some science items will be associated with a reading passage, while others will be standalone items.

G. Readability

Items must be written with readability in mind. In addition, vocabulary must be appropriate for the grade level being tested. The following sources provide information about the reading level of individual words:

Taylor, Stanford E. *EDL Core Vocabularies: Reading, Mathematics, Science, and Social Studies*. Austin, TX: Steck-Vaughn-EDL, 1989.

Mogilner, Alijandra. *Children's Writer's Word Book*. Cincinnati, OH: Writer's Digest Books, 1992.

H. Cognitive Complexity

1. Overview

Florida's adoption of the Common Core State Standards (CCSS) for Mathematics and English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects presents Florida with an opportunity to revise its current Depth of Knowledge (DOK) Model of Cognitive Complexity. More information about Florida's Depth of Knowledge levels is available online at http://www.cpalms.org/cpalms/dok.aspx.

2. **Levels of Depth of Knowledge for Science**

Interpreting and assigning Depth of Knowledge levels to objectives within science standards and assessment items is an essential requirement of alignment analysis. Please note that, in science, "knowledge" can refer to content knowledge, knowledge of science processes, and nature of science.

Level 1 (Recall) is the recall of information such as a fact, definition, or term, as well as performing a simple science process or procedure. Level 1 only requires students to demonstrate a rote response; use a well-known formula; follow a set, well-defined procedure (like a recipe); or perform a clearly defined series of steps. Standards that lend themselves to simple word problems that can be directly translated into and solved by a formula are considered Level 1. Some examples that represent but do not constitute all of Level 1 performance are:

- Recall or recognize a fact, term, or property.
- Represent in words or diagrams a scientific concept or relationship.
- Provide or recognize a standard scientific representation for simple phenomena.
- Perform a routine procedure, such as measuring length.
- Identify familiar forces (e.g., pushes, pulls, gravitation, friction, etc.)
- Identify objects and materials as solids, liquids, or gases.

Level 2 (Basic Application of Concepts & Skills) includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is more complex than in Level 1. Level 2 requires that students make some decisions as to how to approach the question or problem. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and representing and displaying data in tables, graphs, and charts.

Some action verbs, such as "explain," "describe," or "interpret," may be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, which requires reading information from the graph, is at Level 2. An activity that requires interpretation from a complex graph, such as making decisions regarding features of the graph that should be considered and how information from the graph can be aggregated, is at Level 3. Some examples that represent but do not constitute all of Level 2 performance are:

- Specify and explain the relationships among facts, terms, properties, and variables.
- Identify variables, including controls, in simple experiments.
- Distinguish between experiments and systematic observations.

- Describe and explain examples and non-examples of science concepts.
- Select a procedure according to specified criteria and perform it.
- Formulate a routine problem given data and conditions.
- Organize and represent data.

Level 3 (Strategic Thinking & Complex Reasoning) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are complex and abstract. The complexity results not only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but also because the multi-step task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be at Level 3.

Experimental designs in Level 3 typically involve more than one dependent variable. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve non-routine problems. Some examples that represent but do not constitute all of Level 3 performance are:

- Identify research questions and design investigations for a scientific problem.
- Design and execute an experiment or systematic observation to test a hypothesis or research question.
- Develop a scientific model for a complex situation.
- Form conclusions from experimental data.
- Cite evidence that living systems follow the laws of conservation of mass and energy.
- Explain how political, social, and economic concerns can affect science, and vice versa.
- Create a conceptual or mathematical model to explain the key elements of a scientific theory or concept.
- Explain the physical properties of the Sun and its dynamic nature and connect them to conditions and events on Earth.
- Analyze past, present, and potential future consequences to the environment resulting from various energy production technologies.

Level 4 (Extended Thinking & Complex Reasoning) standards and assessment items have the same high cognitive demands as Level 3 with the additional requirement that students work over an extended period of time or with extended effort. Students are required to make several connections—relating ideas within the content area or among content areas—and have to select or devise one approach among many alternatives for how the situation or problem can be solved. Standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be at Level 4.

Level 4 requires complex reasoning and an extended period of time either for a science investigation relevant to a standard or for carrying out the complex analysis and synthesis required of an assessment item. For example, a standard or performance task that calls for the student to use evidence from multiple fields of scientific inquiry in supporting a scientific claim might be classified at Level 4, depending upon the complexity of the analysis. In any event, an activity or performance task associated with a Level 4 standard will require an extended period of time for a student to accomplish.

It is important to reiterate that the extended time period is not a distinguishing factor if the required work is only repetitive and does not require the application of significant conceptual understanding and higher-order thinking. For example, an activity that calls upon a student to measure the water temperature from a river each day for a month before constructing a graph would be classified as at Level 2. On the other hand, an activity that calls upon a student to conduct a complex river study that requires taking into consideration a number of variables would be at Level 4. Some examples that represent but do not constitute all of a Level 4 performance are:

- Based on provided data from a complex experiment that is novel to the student, deduce the fundamental relationships among several variables.
- Conduct an investigation, from specifying a problem to designing and carrying out an experiment and analyzing data and forming conclusions.
- Explain how a particular scientific theory (e.g., evolution, plate tectonics, atomic theory, etc.) is supported by evidence from multiple lines of inquiry.
- Produce a detailed report of a scientific experiment or systematic observation, and infer conclusions based upon evidence obtained.
- Write a detailed history of the development of an important scientific concept (e.g., atomic theory, gravitation) and explain how current conceptions developed from prior ones.

I. Item Difficulty

Item writers will not be expected to make a prediction of difficulty for each item created. However, item writers should develop items that reflect a range of difficulty levels.

J. Universal Design

The application of universal design principles helps develop assessments that are usable to the greatest number of students, including students with disabilities and nonnative speakers of English. To support the goal of providing access to all students, the items in the Florida Interim Assessment Item Bank maximize readability, legibility, and compatibility with accommodations, and item development includes a review for potential bias and sensitivity issues.

Items must allow for the widest possible range of student participation. Item writers must attend to the best practices suggested by universal design, including, but not limited to,

- reduction in wordiness;
- avoidance of ambiguity;
- selection of reader-friendly construction and terminology; and
- consistently applied concept names and graphic conventions.

Universal design principles also inform decisions about item layout and design, including, but not limited to, type size, line length, spacing, and graphics.

K. Sample Items

Appendix A of this document contains a selection of sample items. The sample items represent a range of cognitive complexities and item types.

III. Review Procedures for Florida Interim Assessment Item Bank Items

Prior to being included in the Florida Interim Assessment Item Bank, items must pass several levels of review as part of the item development process.

A. Review for Item Quality

Assessment items developed for the Florida Interim Assessment Item Bank are reviewed by Florida educators, the FDOE, and the Item Bank contractors to ensure the quality of the items, including grade-level appropriateness, standards alignment, accuracy, and other criteria for overall item quality.

B. Review for Bias and Sensitivity

Items are reviewed by groups of Florida educators generally representative of Florida's geographic regions and culturally diverse population. Items are reviewed for the following kinds of bias: gender, racial, ethnic, linguistic, religious, geographic, and socioeconomic. Item reviews also include consideration of issues related to individuals with disabilities.

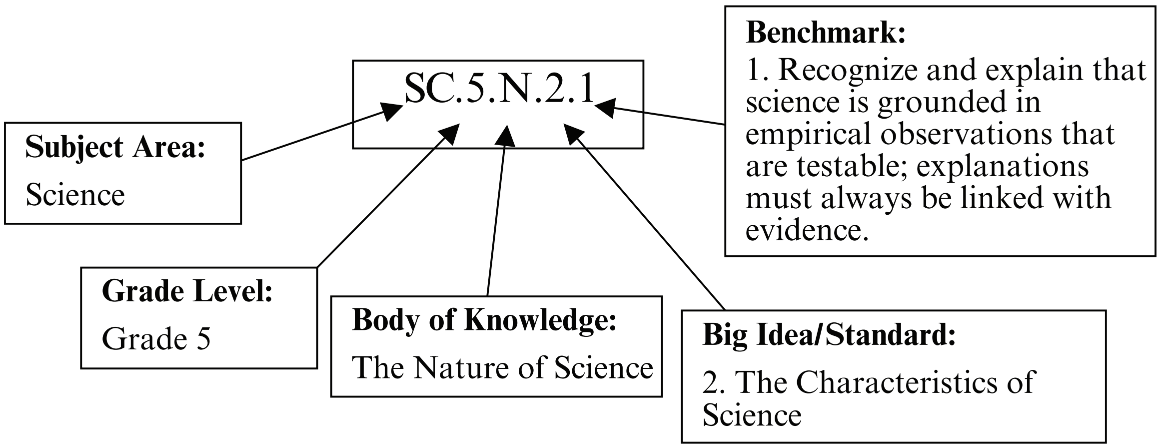
This review is to ensure that the primary purpose of assessing student achievement is not undermined by inadvertently including in the item bank any material that students, parents, or other stakeholders may deem inappropriate. Reviewers are asked to consider the variety of cultural, regional, philosophical, political, and religious backgrounds throughout Florida and to determine whether the subject matter will be acceptable to Florida students, their parents, and other members of Florida communities.

IV. Guide to the Individual Benchmark Specifications

A. Benchmark Classification System

Each benchmark in the NGSSS is labeled with a system of numbers and letters.

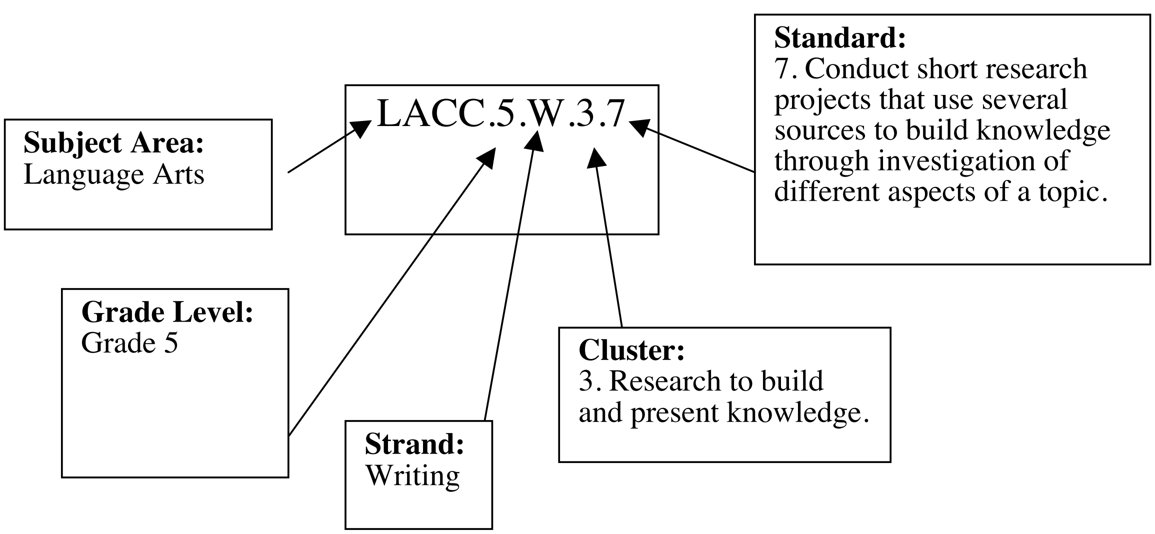
- The two letters in the *first position* of the code identify the **Subject Area**.
- The number(s) in the *second position* represent the **Grade Level**.
- The letter in the *third position* represents the **Body of Knowledge**.
- The number in the *fourth position* represents the **Big Idea/Standard**.
- The number in the *last position* identifies the specific **Benchmark**.



B. Common Core State Standard Classification System

Each standard in the CCSS is also labeled with a system of numbers and letters.

- The four letters in the *first position* of the code identify the **Subject Area**.
- The number(s) in the *second position* represent the **Grade Level**.
- The letter in the *third position* represents the **Strand**.
- The number in the *fourth position* represents the **Cluster**.
- The number in the *last position* identifies the specific **Standard**.



V. Definitions of Benchmark Specifications

The *Item Specifications* identify how the benchmarks in Florida's NGSSS and the CCSS are assessed by items in the Florida Interim Assessment Item Bank. For each assessed benchmark, the following information is provided in the Individual Benchmark Specifications section.

Body of Knowledge/ Strand	refers to the general category of science knowledge (Earth/Space Science, Life Science, Physical Science, and Nature of Science).
Standard/Big Idea	refers to a main idea or description statement of general expectations regarding knowledge and skill development.
Benchmark	refers to specific statements of expected student achievement.
Common Core State Standard Connections	refers to the Common Core Literacy and Mathematics Standards that are closely related to the benchmark. (See Appendix B for a list of CCSS standards associated with this course/grade band.)
Benchmark Clarifications	explain how achievement of the benchmark will be demonstrated by students. The clarification statements explain what students are expected to do when responding to the question.
Content Limits	define the range of content knowledge and degree of difficulty that should be assessed in the items for the benchmark. Content limits may be used to identify content beyond the scope of the targeted benchmark if the content is more appropriately assessed by another benchmark. These statements help to provide validity by ensuring the test items are clearly aligned to the targeted benchmark.

VI. Individual Benchmark Specifications

This section of the *Item Specifications* provides benchmark-specific guidance for assessment item development based on the NGSSS science benchmarks for grades 9–12.

A. Grades 9–12 Earth and Space Science Item Specifications

Course Number: 2001310

Benchmark SC.912.E.5.1	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.1: Cite evidence used to develop and verify the scientific theory of the big bang (also known as the big bang theory) of the origin of the universe.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • identify evidence that supports the big bang theory of the origin of the universe; • list instruments used to gather data that led to the development of the big bang theory; and • explain how the big bang theory is verified by evidence such as the Doppler shift and cosmic background radiation.
Content Limits	Items will not address or assess theories of the origin of the universe other than the big bang theory. Line spectra in the visible range may be used in items that illustrate the Doppler effect if the red and blue ends of the spectra are clearly labeled as “red” and “blue.”

Benchmark SC.912.E.5.2	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.2: Identify patterns in the organization and distribution of matter in the universe and the forces that determine them.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • identify patterns in the organization of matter in the universe; • classify and distinguish between types of celestial bodies; and • describe the forces that affect the organization and distribution of matter in the universe.
Content Limits	Assessment will be limited to the distribution of normal matter, and items will not assess dark matter or dark energy. Items will not • require the use of the formula for the law of universal gravitation or the gravitational constant; or • require memorization of quantitative astronomical data. Items may include • images of galaxies with shapes easily identified as spiral, elliptical, or irregular; and • a chart listing the properties of one or more celestial bodies.

Benchmark SC.912.E.5.3	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.3: Describe and predict how the initial mass of a star determines its evolution.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the evolution of stars with a mass similar to the Sun; • describe the evolution of stars with a mass much greater than the Sun; and • predict the effect of mass on a star's evolution.
Content Limits	Items will not • require memorization of quantitative astronomical data; or • assess equations for nuclear fusion. Items may contain • a Hertzsprung-Russell diagram; and • a diagram showing stages in the evolution of a star.

Benchmark SC.912.E.5.4	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.4: Explain the physical properties of the Sun and its dynamic nature and connect the properties to conditions and events on Earth.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the physical properties of the Sun; • explain the dynamic nature of the Sun; and • explain how the properties of the Sun affect conditions and events on Earth.
Content Limits	Items will not require knowledge of the number of nucleons involved in nuclear fusion. Items may assess the names, relative temperature, and relative thickness of the layers of the Sun, and the processes that take place within them, but not their absolute temperature or thickness. Items may include a clearly labeled diagram of the layers or the surface of the Sun.

Benchmark SC.912.E.5.5	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.5: Explain the formation of planetary systems based on our knowledge of our Solar System and apply this knowledge to newly discovered planetary systems.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • locate and identify information about the formation of our Solar System; • explain the formation of our Solar System; • apply their knowledge of the formation of our Solar System to explain how planetary systems are generally formed; and • examine a newly discovered planetary system and explain how it formed.
Content Limits	Items will assess only the characteristics of our Solar System that are related to the formation of planetary systems. Items will not • require quantitative calculations; or • require memorization of quantitative astronomical data. Items may include • labeled illustrations; • labeled photographs of planetary features and/or objects in the solar system; • flowcharts displaying the process of forming our Solar System; and • descriptions of newly discovered solar systems.

Benchmark SC.912.E.5.6	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.6: Develop logical connections through physical principles, including Kepler's and Newton's laws about the relationships and the effects of Earth, Moon, and Sun on each other.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • explain the relative positions and motion of the Earth, Moon, and Sun using physical principles, including Kepler's and Newton's laws; • describe the physical principles that can be applied to the relationships between the Earth, Moon, and Sun, including Kepler's and Newton's laws; and • use the relative positions and motion of the Earth, Moon, and Sun to explain their effects on each other, such as the phases of the Moon, tides, seasons, and eclipses.
Content Limits	Items will not • require the use of the formula for the law of universal gravitation or the gravitational constant; • require use of mathematical formulae for Kepler's laws of motion; • address celestial bodies other than the Earth, Moon, and Sun; or • assess the characteristics of the Moon, Sun, or Earth in isolation. Items may include diagrams of the relative position and motion of the Earth, Moon, and/or Sun. Items may be in the form of labeled illustrations.

Benchmark SC.912.E.5.9	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.9: Analyze the broad effects of space exploration on the economy and culture of Florida.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • examine how Florida's economy has changed since the implementation of the space program; • evaluate the role space exploration has played in shaping Florida's culture; and • describe specific areas of Florida's economy and culture that are most affected by space exploration today.
Content Limits	Items may • mention specific space exploration missions or programs, but should not require specific prior knowledge about them; • include charts indicating Florida's economic situation before and after the introduction of the space program; and • include primary sources describing people's reaction to and opinion of the space program, both now and throughout its history.

Benchmark SC.912.E.5.11	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**5: Earth in Space and Time**
Benchmark	**SC.912.E.5.11: Distinguish the various methods of measuring astronomical distances and apply each in appropriate situations.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe methods of measuring astronomical distances; • compare and contrast various methods of measuring astronomical distances; and • judge which method of measuring astronomical distance is appropriate in a given scenario.
Content Limits	Distances will be given in astronomical units (AU) or light-years. Items will not require the memorization of quantitative astronomical data. Items may include • diagrams depicting the distances between astronomical objects; and • written scenarios describing situations in which astronomical measurements are necessary.

Benchmark SC.912.E.6.1	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**6: Earth Structures**
Benchmark	**SC.912.E.6.1: Describe and differentiate the layers of Earth and the interactions among them.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the layers of the Earth; • compare and contrast each of the layers of the Earth; and • describe the interactions between the layers of the Earth.
Content Limits	Items may • assess the relative thickness, density, temperature, and physical state of the layers of the Earth but not their absolute thickness, density, or temperature; • include a diagram depicting layers of the Earth and/or the interactions between them; and • include a chart containing information about the layers of the Earth.

Benchmark SC.912.E.6.2	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**6: Earth Structures**
Benchmark	**SC.912.E.6.2: Connect surface features to surface processes that are responsible for their formation.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe surface features of the Earth, such as river valleys and canyons; • describe processes that take place on the surface of the Earth, such as erosion and weathering; • relate the features on the surface of the Earth to the processes that formed them; and • evaluate how a particular surface feature may have been formed.
Content Limits	Items will not require memorization of quantitative data or features of specific landforms. Items may include • labeled diagrams of surface features and/or processes; and • photographs of surface features for students to evaluate.

Benchmark SC.912.E.6.3	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**6: Earth Structures**
Benchmark	**SC.912.E.6.3: Analyze the scientific theory of plate tectonics and identify related major processes and features as a result of moving plates.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • explain the scientific theory of plate tectonics; • define the major processes of plate tectonics; and • match the features that result from moving tectonic plates to the major processes of plate tectonics.
Content Limits	Items will not assess or refer to theories other than the theory of plate tectonics. Items may include • labeled diagrams of features resulting from the movement of tectonic plates; and • labeled diagrams of processes of plate tectonics.

Benchmark SC.912.E.6.4	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**6: Earth Structures**
Benchmark	**SC.912.E.6.4: Analyze how specific geologic processes and features are expressed in Florida and elsewhere.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • determine which specific geologic processes have occurred in Florida; • analyze specific geologic features that are found in Florida to determine which processes produced them; and • compare the geologic processes taking place in Florida with those occurring elsewhere, as well as the geologic features that result from them.
Content Limits	Items will not require memorization of quantitative data. If the specific geological feature being assessed is not familiar to all students, items must provide sufficient information to allow the students to analyze the feature. Items may include diagrams, images, or maps of specific geologic processes or features.

Benchmark SC.912.E.6.5	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**6: Earth Structures**
Benchmark	**SC.912.E.6.5: Describe the geologic development of the present day oceans and identify commonly found features.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe how the present-day oceans were formed; • evaluate the processes that resulted in the present day oceans forming from older oceans; • identify common characteristics of seawater; and • identify common features of the ocean floor.
Content Limits	Items will not require memorization of quantitative data. Items may include • labeled diagrams of ocean features; • charts or graphs of seawater characteristics; and • both historical and modern maps of the oceans.

Benchmark SC.912.E.7.1	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.1: Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • analyze the movement of matter and energy through the carbon cycle, including the sources and sinks of carbon dioxide in the atmosphere; • analyze the movement of matter and energy through the water cycle, including the processes of evaporation, transpiration, condensation, and precipitation; and • analyze the movement of various forms of energy involved in the Earth's energy budget.
Content Limits	Items may mention, but not require detailed knowledge of, cycles of substances other than water and carbon. Items may assess the starting materials and products of photosynthesis but will not require detailed knowledge of the process of photosynthesis. Items may include labeled diagrams of biogeochemical cycles.

Benchmark SC.912.E.7.3	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.3: Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe and compare and contrast Earth systems, including the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere; and • describe the interactions among Earth systems, including the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.
Content Limits	Items may assess knowledge of the cryosphere (places on Earth where water is in solid form), but the term *cryosphere* is not in general use in most textbooks. Items may include labeled diagrams of Earth systems.

Benchmark SC.912.E.7.4	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.4: Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • summarize the conditions that affect climate in general, such as latitude, elevation, proximity to lakes and oceans, ocean currents, topography, prevailing winds, and vegetation; • summarize the conditions that contribute to the climate of a specific geographic area, such as the relationship to nearby lakes and oceans; and • explain how conditions such as latitude and elevation contribute to the climate of a geographic area.
Content Limits	Items may include maps and charts of climatic data.

Benchmark SC.912.E.7.5	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.5: Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • predict future weather conditions based on present observations, such as temperature, wind direction, and barometric pressure; • use conceptual models, such as cold fronts and low pressure systems, to predict future weather conditions; and • recognize the limitations and uncertainties of weather predictions.
Content Limits	Items will not assess past weather conditions. Items may • include weather maps; and • include labeled diagrams of atmospheric conditions.

Benchmark SC.912.E.7.6	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.6: Relate the formation of severe weather to the various physical factors.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will relate the formation of • thunderstorms, lightning, and thunder to various physical factors, such as a frontal boundary; • tornadoes to various physical factors, such as differing directions of upper and lower winds; and • hurricanes to various physical factors, including the presence of warm ocean water and the Coriolis effect.
Content Limits	Items may • mention historical instances of severe weather but will not require memorization of information specific to those instances, such as time and place; • include labeled diagrams; and • include weather maps.

Benchmark SC.912.E.7.7	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.7: Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • identify and analyze the internal (Earth system) conditions that contribute to global climate change; • identify and analyze the external (astronomical) conditions that contribute to global climate change; and • relate the internal (Earth system) conditions that contribute to global climate change to the external (astronomical) conditions that contribute to global climate change.
Content Limits	Items will not involve political opinions on climate change. Items may include charts and graphs of climatic data.

Benchmark SC.912.E.7.8	
Body of Knowledge/Strand	**Earth and Space Science**
Standard	**7: Earth Systems and Patterns**
Benchmark	**SC.912.E.7.8: Explain how various atmospheric, oceanic, and hydrologic conditions in Florida have influenced and can influence human behavior, both individually and collectively.**
Common Core State Standard Connections	Indicate appropriate alignments to the CCSS Literacy or Math Standards for Science and Technical Subjects whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will explain • how atmospheric conditions in Florida, such as high humidity and tropical storms, influence individual and collective human behavior; • how oceanic conditions in Florida, such as rip currents and the presence of the Gulf Stream, influence individual and collective human behavior; and • how hydrologic conditions in Florida, such as the abundance of wetlands, influence individual and collective human behavior.
Content Limits	Items will focus on the relationship between conditions and human behavior and will not assess atmospheric conditions or human behavior independently.

Benchmark SC.912.L.15.1	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.1: Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the theory of evolution that all living things evolved from earlier species; • understand how the principle of superposition and radioactive dating are used to analyze fossil evidence; • explain how fossil evidence is consistent with the theory of evolution; • recognize the historical debate regarding the theory of evolution; and • identify examples of and basic trends in hominid evolution from early ancestors to modern humans.
Content Limits	Items may • assess the theory of evolution directly; • use the concepts of superposition and radioactive dating to assess the fossil record but will not assess these concepts directly; and • use the concepts of natural selection, survival of the fittest, adaptation, mutation, and genetics to assess the theory of evolution and the fossil record but may not assess these concepts directly. Items assessing the fossil record must focus on the fossil rather than geologic formations in isolation. Items will not require the memorization of the geologic time scale, including era, period, and/or epoch.

Benchmark SC.912.L.15.8	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and the Evolution of Living Organisms**
Benchmark	**SC.912.L.15.8: Describe the scientific explanations of the origin of life on Earth.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will identify situations or conditions contributing to the origin of life on Earth.
Content Limits	Items may • address the conditions required for the origin of life on Earth but may not require specific knowledge of the age of Earth or its eras, periods, or epochs; • include descriptions and explanations of pioneering scientists on the origin of life of Earth (e.g. Charles Darwin, A.R. Wallace, Steven J. Gould); and • refer to the endosymbiotic theory but may not assess the term in isolation. Items assessing • the origin of organic molecules, chemical evolution, and/or eukaryotic cells should be conceptual; • a scientific claim will be limited to the scientific explanations of the origins of life on Earth.

Benchmark SC.912.N.1.1	
Body of Knowledge/Strand	Nature of Science
Standard	**1: The Practice of Science**
Benchmark	**SC.912.N.1.1 Define a problem based on a specific body of knowledge, for example, biology, chemistry, physics, and earth/space science, and do the following:** **1. pose questions about the natural world,** **2. conduct systematic observations,** **3. examine books and other sources of information to see what is already known,** **4. review what is known in light of empirical evidence,** **5. plan investigations,** **6. use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems and also the generation and interpretation of graphical representations of data, including data tables and graphs),** **7. pose answers, explanations, or descriptions of events,** **8. generate explanations that explicate or describe natural phenomena (inferences),** **9. use appropriate evidence and reasoning to justify these explanations to others,** **10. communicate results of scientific investigations, and** **11. evaluate the merits of the explanations produced by others.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • evaluate or define a scientific investigation using evidence of scientific thinking and/or problem solving; • identify or define test variables (independent variables) and/or outcome variables (dependent variables) in a given scientific investigation; • interpret and/or analyze data to make predictions and/or defend conclusions; • distinguish between an experiment and other types of scientific investigations where variables cannot be controlled; and • explain how hypotheses are valuable.
Content Limits	Items will address earth and space science only.

Benchmark SC.912.N.1.4	
Body of Knowledge/Strand	**Nature of Science**
Standard	**1: The Practice of Science**
Benchmark	**SC.912.N.1.4: Identify sources of information and assess their reliability according to the strict standards of scientific investigation.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will identify sources of information from the Internet, textbooks, and scientific/experimental publications. Students will assess the reliability of sources of scientific information based on strict scientific standards, which may include assessment of the following: the scientific/experimental methods used, the reproducibility of the experiment, valid citations, peer review, bias, and reputation of the publication.
Content Limits	Items will address earth and space science only.

Benchmark SC.912.N.1.5	
Body of Knowledge/Strand	**Nature of Science**
Standard	**1: The Practice of Science**
Benchmark	**SC.912.N.1.5: Describe and provide examples of how similar investigations conducted in many parts of the world result in the same outcome.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will describe or explain how scientific investigations ultimately follow the laws of the universe resulting in the same outcome regardless of the location of an investigation. Students will recognize that scientific investigations are repeatable.
Content Limits	Items must be focused on earth and space science only. Items may not ask students to define a particular scientific law or theory. Items may reference familiar scientific laws on a conceptual level only (e.g., geophysical, thermodynamics, electromagnetic, gravitational).

Benchmark SC.912.N.1.6	
Body of Knowledge/Strand	**Nature of Science**
Standard	**1: The Practice of Science**
Benchmark	**SC.912.N.1.6: Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • recognize the distinction between direct and indirect evidence when drawing a conclusion/inference (e.g., ice cores and tree rings can be used to identify indirect evidence of climate change, while historic harvest records may provide more direct evidence of climate change); • understand that observation is the process of gathering data and that inference is the conclusion drawn about the gathered data; and • make inferences based on qualitative and quantitative observations.
Content Limits	Items will address content related to earth and space science only. Items may include natural records (e.g., ice core evidence) and human-derived evidence (e.g., harvest records).

Benchmark SC.912.N.2.4	
Body of Knowledge/Strand	**Nature of Science**
Standard	**2: The Characteristics of Scientific Knowledge**
Benchmark	**SC.912.N.2.4: Explain that scientific knowledge is both durable and robust and open to change. Scientific knowledge can change because it is often examined and re-examined by new investigations and scientific argumentation. Because of these frequent examinations, scientific knowledge becomes stronger, leading to its durability.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will explain how human biases and values can influence observations and interpretations. Students will construct, explain, describe, and/or compare different scientific scenarios using evidence and how thinking can change over time based on evidence (e.g., work of three evolutionary scientists—Paley, Lamarck, and Darwin).
Content Limits	Items will address earth and space science only.

Benchmark SC.912.N.2.5	
Body of Knowledge/Strand	**Nature of Science**
Standard	**2: The Characteristics of Scientific Knowledge**
Benchmark	**SC.912.N.2.5: Describe instances in which scientists' varied backgrounds, talents, interests, and goals influence the inferences and thus the explanations that they make about observations of natural phenomena and describe that competing interpretations (explanations) of scientists are a strength of science as they are a source of new, testable ideas that have the potential to add new evidence to support one or another of the explanations.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • discuss and provide examples of how methods are cross-curricular in the various science fields (e.g., geology and paleontology in exploring prehistoric evidence, biology and chemistry in discovering treatments for disease); • explain how competing interpretations from scientists create new, testable ideas and possibly new evidence supporting other scientists' explanations; and • describe that competing scientific explanations expand the knowledge of science concepts across the various fields of science.
Content Limits	Items will address earth and space science only.

Benchmark SC.912.N.3.1	
Body of Knowledge/Strand	**Nature of Science**
Standard	**3: The Role of Theories, Laws, Hypotheses, and Models**
Benchmark	**SC.912.N.3.1: Explain that a scientific theory is the culmination of many scientific investigations drawing together all the current evidence concerning a substantial range of phenomena thus, a scientific theory represents the most powerful explanation scientists have to offer.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe/explain what defines a scientific theory; • explain different examples of major scientific theories in terms of evidence gathered from scientific investigations (e.g., big bang theory, gaia theory, plate tectonic theory, continental drift theory); and • recognize that a theory is built on many pieces of evidence and never on a single piece of evidence.
Content Limits	Items will focus on content related to theories in earth and space science. Items will not expect the memorization of the names of scientists or specific scientific experiments associated with theories.

Benchmark SC.912.N.3.5	
Body of Knowledge/Strand	**Nature of Science**
Standard	**3: The Role of Theories, Laws, Hypotheses, and Models**
Benchmark	**SC.912.N.3.5: Describe the function of models in science, and identify the wide range of models used in science.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe models as important tools to help scientists explore and test a hypothesis, and explain their ideas; • recognize that there are many different types of models including physical, mathematical, illustrative, statistical, computer, theoretical, etc.; and • recognize that drawings and prototypes are other examples of models.
Content Limits	Item content should assess content related to earth and space science at this benchmark. Items will not ask students to construct, solve, or recall mathematical or statistical equations.

Benchmark SC.912.N.4.1	
Body of Knowledge/Strand	**Nature of Science**
Standard	**4: Science and Society**
Benchmark	**SC.912.N.4.1: Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • explain how/why scientific knowledge and reasoning can be used to inform decision-making at the community, state, national, and international levels (e.g, knowledge of dominant weather patterns during different times of the year in Florida helps communities be better prepared for the potential consequences of natural disasters, such as wind and water damage from hurricanes); and • describe ways information from a specific scientific research project could be used to inform decision-making at the community, state, national, or international levels (e.g., seismic monitoring by the USGS and universities helps scientists gather information on the potential for earthquakes, NOAA/NASA hurricane-hunting aircraft provide scientists with information to better predict the behavior of major storms). Given a particular decision that needs to be made, students will describe scientific research that could be done to help the decision-making process at the community, state, national, or international levels.
Content Limits	Items will not address controversial or complex issues.

Benchmark SC.912.P.10.4	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.4: Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to changes in temperature or states of matter.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe heat as a transfer of energy; • differentiate between heat and temperature; • define and differentiate between convection, conduction, and radiation; and • explore the relation between heat and changes in temperature or states of matter.
Content Limits	Phases of matter will be limited to solids, liquids, and gases. Items will not • require memorization of thermal properties (e.g., phase transition temperatures); • assess connection between temperature and average molecular kinetic energy; • assess chemical or nuclear changes; • assess changes in entropy; or • assess unit conversion. Scenarios should be limited to a single phase transition.

Benchmark SC.912.P.10.10	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.10: Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear).**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • identify scenarios in which each of the four forces is prevalent; • qualitatively compare the magnitudes of the four fundamental forces; and • qualitatively compare the range of the four fundamental forces.
Content Limits	Items will not • require use of the formula for the law of universal gravitation; • require use of the formula for the Lorentz law of electromagnetic force; • require memorization of physical constants; • assess grand unified theories; or • assess force mediators (e.g., photons, gluons). Number lines can be used to show relative positions of the four forces (in terms of either magnitude or range). Students can be asked to rank magnitudes or ranges.

Benchmark SC.912.P.10.11	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.11: Explain and compare nuclear reactions (radioactive decay, fission, and fusion), the energy changes associated with them, and their associated safety issues.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the structure of the atomic nucleus (e.g., neutrons, protons); • describe and compare nuclear reactions (e.g., radioactive decay, fission, and fusion); • qualitatively and quantitatively describe the half-life of radioactive isotopes; • use the mass-energy relation to calculate energy in fission and fusion reactions; and • qualitatively describe the safety issues associated with nuclear reactions.
Content Limits	Items will not • require memorization of atomic properties; • assess radiometric dating; • assess nuclear reactor design; or • assess nuclear reaction equations or rates.

Benchmark SC.912.P.10.16	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.16: Explain the relationship between moving charges and magnetic fields, as well as changing magnetic fields and electric fields and their application to modern technologies.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the motion of an electric charge in a magnetic field; • describe the force felt by a current-carrying wire in a magnetic field; • describe the magnetic field produced by an electric current; • describe the EMF induced in a wire coil by changing the magnetic flux; and • explain how principles of electromagnetic induction are used in motors, generators, and transformers.
Content Limits	Items will not • assess ferromagnetic materials; • assess magnetic energy density; • assess inductance; or • require memorization of formulas or physical constants; Items requiring calculation may provide the relevant formulas and physical constants. Items may reference • diagrams of current, magnetic field, and forces; and • simple circuit schematics. Options may be in the form of arrows (vectors) describing possible forces or currents.

Benchmark SC.912.P.10.18	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.18: Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • compare and contrast different regions of the electromagnetic spectrum; • quantitatively explore the relationships among wavelength, frequency, and energy; and • relate different regions of the spectrum to technological applications and natural phenomena.
Content Limits	Items will not require memorization of wavelength, frequency, or energy limits of spectrum regions. Items may assess relative order of spectrum regions in terms of wavelength, frequency, or energy. Items may reference a labeled drawing of the electromagnetic spectrum. Items requiring calculation may provide the relevant formulas and physical constants. Options may be in the form of ordered lists (e.g., listing spectrum regions in decreasing order of energy).

Benchmark SC.912.P.10.19	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.19: Explain that all objects emit and absorb electromagnetic radiation, and distinguish between objects that are blackbody radiators and those that are not.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • explain that all objects emit and absorb electromagnetic radiation; • compare and contrast the blackbody curve for objects at different temperatures; • describe the blackbody peak in terms of temperature (Wien's displacement law); and • distinguish between objects that are blackbody radiators and those that are not.
Content Limits	Items will not • assess topics from quantum mechanics (e.g., photons, atomic oscillators); • require the use of Planck's formula for blackbody intensity; or • require memorization of Wien's displacement law or Planck's constant. Items may ask students to calculate the wavelength of peak intensity from temperature (or vice-versa) but should otherwise be qualitative. Items may reference multiple blackbody curves of different temperatures on the same graph.

Benchmark SC.912.P.10.20	
Body of Knowledge/Strand	**Physical Science**
Standard	**10: Energy**
Benchmark	**SC.912.P.10.20: Describe the measurable properties of waves, explain the relationships among them, and explain how these properties change when the wave moves from one medium to another.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • describe the measurable properties of waves (e.g., amplitude, frequency, wavelength); • explore the relationship between wave velocity, frequency, and wavelength; • describe how the speed of a wave depends on the medium in which it travels; and • use Snell's law to explore how wave direction changes upon entering a new medium.
Content Limits	Items may refer to • sound waves but will not assess the underlying physics; • the electromagnetic spectrum but will not assess the electromagnetic spectrum; and • labeled wave drawings. Items will not assess mathematical wave descriptions (e.g., sines, cosines, complex exponentials). Items will not assess Doppler shifts.

Benchmark SC.912.P.12.2	
Body of Knowledge/Strand	**Physical Science**
Standard	**12: Motion**
Benchmark	**SC.912.P.12.2: Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • use kinematic equations to calculate an object's position, velocity, and acceleration at a given time; • qualitatively and quantitatively explore the relationships among position, velocity, and acceleration; • use graphs to describe an object's position, velocity, and acceleration as a function of time; and • interpret diagrams of projectile motion in terms of the *x* and *y* components of position, velocity, and acceleration.
Content Limits	Items will be limited to scenarios with constant acceleration. Items may reference • labeled diagrams (e.g., an object undergoing projectile motion); and • graphs of position, velocity, or acceleration versus time. Items will not require memorization of kinematic equations or physical constants. Scenarios will not assess friction or air resistance. Scenarios involving calculation will provide the kinematic equations and the acceleration due to gravity.

Benchmark SC.912.P.12.4	
Body of Knowledge/Strand	**Physical Science**
Standard	**12: Motion**
Benchmark	**SC.912.P.12.4: Describe how the gravitational force between two objects depends on their masses and the distance between them.**
Common Core State Standard Connections	Indicate appropriate alignments to the Grades 9–12 CCSS Mathematics and/or Literacy Standards for Science whenever applicable. (See Appendix B.)
Benchmark Clarifications	Students will • use the law of universal gravitation to calculate the gravitational force between two objects; • describe how mass and distance affect the gravitational force between two objects; and • distinguish between weight and mass.
Content Limits	Items will not require memorization of the formula for universal gravitation or the gravitational constant, *G*. Items may provide the universal gravitation formula and gravitational constant when needed. Items may ask students to compare relative forces at different distances or masses (e.g., how much stronger will the force be if the distance is halved?).

Appendix A: Sample Items

Sample Item 1

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	SR	2	SC.912.E.7.3: Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.	N/A	1

Various Earth systems often interact. Which Earth system interaction is represented by the ocean washing away sand from a beach?

A. geosphere and cryosphere

B. atmosphere and biosphere

C. biosphere and hydrosphere

D. hydrosphere and geosphere*

Correct Answer: D

Rationales:

A	Incorrect. Some students may confuse the different Earth systems. The geosphere is represented by the solid inner parts (mainly rock) of Earth and the cryosphere is represented by solid water (ice) found on Earth.
B	Incorrect. Some students may confuse the different Earth systems. The atmosphere contains the planet's air, while the biosphere is represented by living organisms.
C	Incorrect. Some students may confuse the different Earth systems. The biosphere is represented by living organisms.
D	Correct.

Sample Item 2

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	SHR	1	SC.912.E.6.2: Connect surface features to surface processes that are responsible for their formation.	N/A	1

The picture below shows the Grand Canyon.

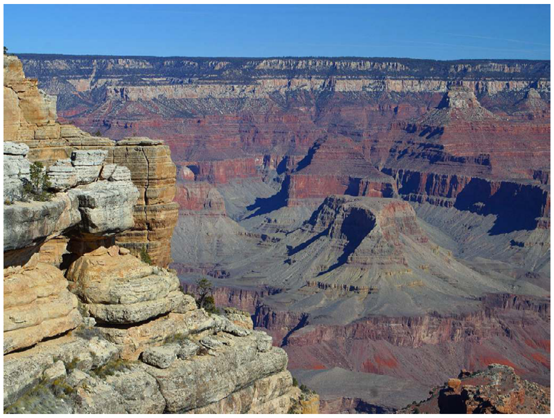


Image Source: www.public-domain-photos.com **(public domain image)**

What type of surface process is responsible for the land features shown in the picture?

Correct answer: Erosion

Correct Answer	The Colorado River has eroded away the sedimentary rocks forming the Grand Canyon.

Sample Item 3

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	CR	2	SC.912.E.5.6: Develop logical connections through physical principles, including Kepler's and Newton's laws about the relationships and the effects of Earth, Moon, and Sun on each other.	LACC.910. WHST.1.2: Write informative/ explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	2

Tides on Earth are strongest during a new moon. Explain why ocean tides are strongest during the new moon phase.

Scoring Rubric and Exemplar

Rubric	
2	A score of two indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, in a scientifically sound manner. When required, student explanations and/or interpretations are clear and complete. The response may contain minor flaws that do not detract from the demonstration of a thorough understanding.
1	A score of one indicates that the student has provided a response that is only partially correct. For example, the student may arrive at an acceptable conclusion or provide an adequate interpretation but may demonstrate some misunderstanding of the underlying scientific concepts and/or procedures. Conversely, a student may arrive at an unacceptable conclusion or provide a faulty interpretation but could have applied appropriate and scientifically sound concepts and/or procedures.
0	A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, or contain clear misunderstandings of the underlying scientific concepts and/or procedures, or it may be incorrect.

Exemplar	
2	A complete student response should correctly explain that the tide at new moon is strongest because of the combined gravitational pull of the Sun and Moon on Earth/ocean. During a new moon, the Sun, Earth, and Moon are aligned. When this happens, the gravitational force of the Sun and Moon combine with one another and create higher tides on Earth.

Sample Item 4

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	ER	2	SC.912.E.7.5: Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions.	LACC.1112. WHST.1.2: Write informative/ explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	4

A group of students observed weather data and patterns at school. The students have created a weather forecast for the following week to place in the school's newspaper. Study the weather predictions in the forecast.

	Monday	Tuesday	Wednesday	Thursday	Friday
Temperature	78˚F	85˚F	73˚F	80˚F	87˚F
Air Pressure	rising	steady	falling	falling	rising
Humidity	48%	72%	97%	100%	50%
Wind Speed	4 mph	10 mph	12 mph	3 mph	2 mph
Weather Description	Warm, sunny, gentle breeze	Hot, cloudy, windy	Warm, rainy, windy	Warm, rainy	Hot, sunny

A. What relationship between humidity and precipitation have the students identified?

B. According to the students' prediction, what is the relationship between air pressure and the weather conditions?

Rubric	
4	A score of four indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, used scientifically sound procedures, and provided clear and complete explanations and interpretations. The response may contain minor flaws that do not detract from a demonstration of a thorough understanding.

3	A score of three indicates that the student has demonstrated an understanding of the scientific concepts and/or procedures embodied in the task. The student's response to the task is essentially correct, but the scientific procedures, explanations, and/or interpretations provided are not thorough. The response may contain minor flaws that reflect inattentiveness or indicate some misunderstanding of the underlying scientific concepts and/or procedures.
2	A score of two indicates that the student has demonstrated only a partial understanding of the scientific concepts and/or procedures embodied in the task. Although the student may have arrived at an acceptable conclusion or provided an adequate interpretation of the task, the student's work lacks an essential understanding of the underlying scientific concepts and/or procedures. The response may contain errors related to misunderstanding important aspects of the task, misuse of scientific procedures/processes, or faulty interpretations of results.
1	A score of one indicates that the student has demonstrated a very limited understanding of the scientific concepts and/or procedures embodied in the task. The student's response is incomplete and exhibits many flaws. Although the student's response has addressed some of the conditions of the task, the student has reached an inadequate conclusion and/or provided reasoning that is faulty or incomplete. The response exhibits many flaws or may be incomplete.
0	A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, or contain clear misunderstandings of the underlying scientific concepts and/or procedures, or it may be incorrect.

Exemplar	
4	**Part A:** A complete student response should correctly explain the relationship between humidity and precipitation based on the data in the table. When the humidity percentage is closer to 100%, precipitation is in the forecast. When the humidity is lower, the forecast calls for sunny weather. When the humidity is high but not as close to 100%, the forecast is cloudy weather. **Part B:** A complete student response should correctly explain the relationship between air pressure and general weather conditions based on the data in the table. When the pressure is rising, the weather is clear and sunny. When the pressure is falling, the weather is cloudy or rainy. Low pressure means worse weather, and higher pressure means better weather.

Sample Item 5

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	ESR	2	SC.912.E.7.1: Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.	LACC.1112. WHST.1.2: Write informative/ explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	6

Water is the most abundant compound on Earth and allows Earth to support life. It is present in three forms on Earth: liquid, solid, and gas. Water is derived from many sources. Liquid water sources include oceans, lakes, rivers, streams, and groundwater; solid sources include icecaps and glaciers; and gaseous water (or water vapor) comes from the atmosphere.

Fueled by energy from the Sun, water is constantly moving from Earth to the atmosphere and back to Earth again in a process called the water cycle. Without the water cycle, there would be no rain, making conditions too harsh to support life. In a short essay, explain the steps of the water cycle including the following terms: evaporation, condensation, and precipitation.

Scoring Rubric and Exemplar

Rubric	
6	Complete and correct response is made to all parts of the prompt. Appropriate scientific terminology is used. There are no major conceptual errors, though there may be nondetracting minor errors. In-depth understanding of the scientific concepts applicable to the prompt is demonstrated. Thorough understanding of the connection between the scientific concepts and the real-life application is demonstrated.
5	Complete and correct response is made to all parts of the prompt. Appropriate scientific terminology is used correctly. There are no major conceptual errors, though there may be minor conceptual errors. Understanding of the scientific concepts applicable to the prompt is demonstrated. Connections are made between the scientific concepts and real-life application.

4	Complete and correct response is made to all parts of the prompt. There are minor errors in the use of scientific terminology. There are minor conceptual errors or omissions. The response may attempt connections between the scientific concepts and real-life application.
3	Response to two or more parts of the prompt is attempted. There is limited use of scientific terminology. Response contains some major conceptual errors or omissions. Response shows limited understanding.
2	Response to one or more parts of the prompt is attempted. The use of scientific terminology may be missing. Response contains many major conceptual errors and omissions. Response shows minimal understanding.
1	Little attempt to answer the prompt is evident. Scientific terminology is missing. Response contains many major conceptual errors and omissions. Explanation shows no understanding.
0	Response addresses an entirely different prompt or is completely unintelligible.

Exemplar	
6	**A full-credit student response should contain similar points of information that are presented in a similar logical flow of ideas as shown:** The water cycle is important for all life on Earth. Water constantly moves from Earth to the atmosphere and back again. In the first step of the water cycle, energy from the Sun evaporates water from liquid water sources on Earth (such as oceans and lakes) up into the atmosphere as water vapor. In the second step of the water cycle, the water vapor in the atmosphere cools and condenses into liquid through a process called condensation. The condensing water forms clouds, which are made up of millions of tiny water droplets. Condensation and the formation of clouds lead to the third step in the water cycle. Tiny water droplets in the clouds collide to form larger drops. When the water drops get too large to be held in the clouds, they fall to Earth as precipitation. After water falls to Earth, the water cycle starts over again.

Sample Item 6

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9–12/Earth and Space Science	PT	2	SC.912.E.7.8: Explain how various atmospheric, oceanic, and hydrologic conditions in Florida have influenced and can influence human behavior, both individually and collectively.	LACC.910. WHST.1.2: Write informative/ explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	9

Each year from June through November, Florida is at an increased risk for tropical storms and hurricanes. Florida's unique geography, subtropical climate, and proximity to warm ocean water make it an attractive place to live but also make it vulnerable to dangerous weather. It is important that all people who visit or move to Florida from other places understand the danger of tropical storms and learn how to be prepared.

Student Instructions:

The first step in creating an informative brochure is to identify the main information that must be shared with the audience. Visit a library or conduct research online to find out what actions people should take before, during, and after a tropical storm in order to stay safe and be well prepared. Gather information on hazards, important supplies, and storm preparedness plan implementation.

In the classroom, create an effective storm preparedness brochure with a checklist that highlights what to do for before the storm season arrives, during a storm watch or warning, and after a storm strikes. List a minimum of three key actions in each of the three categories.

Teacher Instructions:

The following task will ask students to create a tropical storm preparedness brochure for people who are new to Florida. It should cover information about what to do before, during, and after a storm event for people who have never experienced a tropical storm. Students may use the NOAA website as a resource: *http://www.nhc.noaa.gov/prepare/*

Scoring Rubric and Exemplar:	
9	**A full-credit student response would correctly provide at least nine key points of information (three preparedness actions before, during, and after a storm) to be included in a storm preparedness brochure.** **Before the storm season:** Any three of (but not limited to) the following: • Determine safe evacuation routes away from coast. • Learn locations of official shelters. • Check emergency equipment to make sure it works (e.g., flashlights, generators, cell phones, weather radio). • Store non-perishable food items (e.g. canned food). • Store drinking water. • Have plywood or other material to protect your home (e.g. shutter/cover windows and doors). • Have a first-aid kit/medication on hand. • Trim hazardous branches near the home. • Make sure home drains and gutters are clear. • Review storm damage insurance plans and laws. **During a storm watch or warning:** Any three of (but not limited to) the following: • Evacuate and stay with friends or relatives away from the storm's path. • Evacuate immediately if you live near the coast, flood zone or in a mobile home. • Follow instructions issued by local officials (e.g., evacuate, turn off utilities). • Track storm progress on TV, Internet, and radio. • Turn off/unplug appliances. • Stay away from doors and windows. • Move under a sturdy object (e.g., kitchen table, mattress). • Move to a small interior room, closet, or hallway. • Fill bathtub with water for washing and flushing. • Fuel and service family vehicles. • Have extra cash on hand. • Cover/shutter all windows and doors. • Double-check and restock food and drinking water supplies if necessary. • Move all lawn equipment and furniture indoors. • Move to a public shelter. • Bring your pets with you. **After the storm:** Any three of (but not limited to) the following: • Wait until local officials declare an area safe before entering. • Do not try to pass through blocked or washed out roads and bridges. • Do not enter flooded areas, even if the water appears shallow. • Watch for and avoid downed power lines to prevent electrocution. • Wear proper clothing and footwear to prevent injury from storm debris. • Check gas, water, and electrical systems and appliances for damage. • Use a flashlight instead of candles indoors to reduce fire hazard. • Do not drink or use tap water in food preparation until local officials say it is safe.

Appendix B: Common Core State Standard Connections

A. Reading Standards for Literacy in Science and Technical Subjects—Earth and Space Science

LACC.910.RST.1.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
LACC.1112.RST.1.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
LACC.910.RST.1.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LACC.1112.RST.1.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
LACC.910.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
LACC.1112.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
LACC.910.RST.2.5	Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LACC.910.RST.3.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LACC.1112.RST.3.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
LACC.910.RST.4.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.
LACC.1112.RST.4.10	By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

B. Writing Standards for Literacy in Science and Technical Subjects—Earth and Space Science

LACC.910.WHST.1.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

LACC.1112.WHST.1.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
LACC.910.WHST.3.9	Draw evidence from informational texts to support analysis, reflection, and research.
LACC.1112.WHST.3.9	Draw evidence from informational texts to support analysis, reflection, and research.

C. Mathematics Standards in Science and Technical Subjects—Earth and Space Science

MACC.912.N-Q.1.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MACC.912.N-Q.1.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MACC.912.F-IF.3.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.