Florida Interim Assessment Item Bank and Test Platform

Item Specifications

Science
Biology
Grades 9–12

FLORIDA DEPARTMENT OF EDUCATION
www.fldoe.org

Florida Department of Education
Tallahassee, Florida
32399-0400

TABLE OF CONTENTS

I. Introduction

A. Purpose of the Item Specifications 1
B. Scope 1
C. Standards Alignment 1
1. Next Generation Sunshine State Standards 1
2. Common Core State Standards 1

II. Criteria for Item Development

A. Overall Considerations for Item Development. 2
B. Item Contexts 2
C. Use of Media. 3
D. Item Style and Format 3
E. Item Types 5
1. Selected Response (SR) Items (1 point) 5
2. Gridded Response (GR) Items (1 point). 6
3. Short Response (SHR) Items (1 point) 6
4. Constructed Response (CR) Items (2 points) 6
5. Extended Response (ER) Items (4 points) 7
6. Essay Response (ESR) Items (6 points) 9
7. Performance Task (PT) Items (1–10 points) 9
F. Complex Stimuli and Reading Passages 10
G. Readability. 10
H. Cognitive Complexity 10
1. Overview 10
2. Levels of Depth of Knowledge for Science 11
I. Item Difficulty 13
J. Universal Design 13
K. Sample Items 14

III. Review Procedures for Florida Interim Assessment Item Bank Items

A. Review for Item Quality 14
B. Review for Bias and Sensitivity 14

IV. Guide to the Individual Benchmark Specifications

A. Benchmark Classification System 15
B. Common Core State Standard Classification System 15

V. Definitions of Benchmark Specifications 16

VI. Individual Benchmark Specifications

A. Grades 9–12 Biology Item Specifications 17

Appendices

Appendix A: Sample Items 68
Appendix B: Common Core State Standard Connections 78

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 Biology 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 Biology, 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 Biology courses. Assessment items for Biology should be aligned to one or more of the associated CCSS, whenever appropriate, in addition to the targeted biology 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.

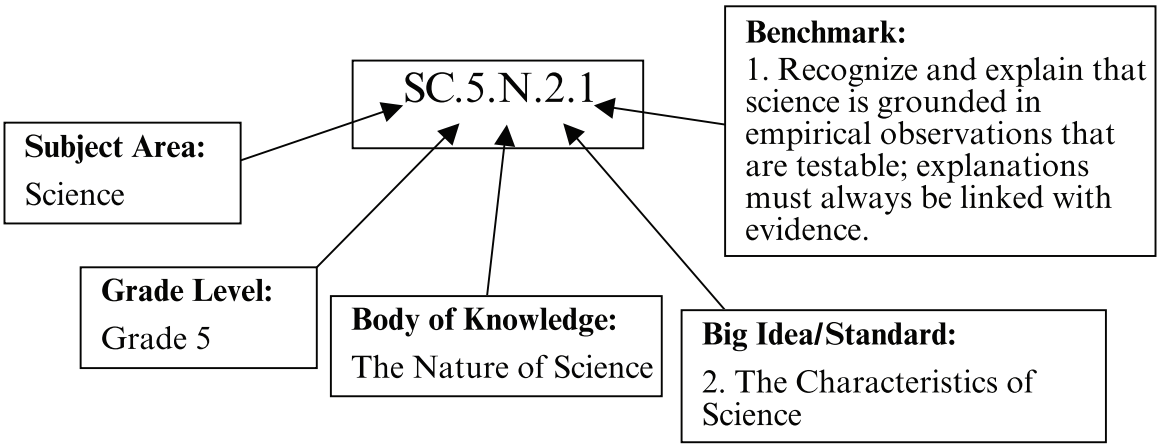
This review is to ensure that the primary purpose of assessing student achievement is not undermined by inadvertently including in the item bank any material that students, parents, or other stakeholders may deem inappropriate. Reviewers are asked to consider the variety of cultural, regional, philosophical, 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.

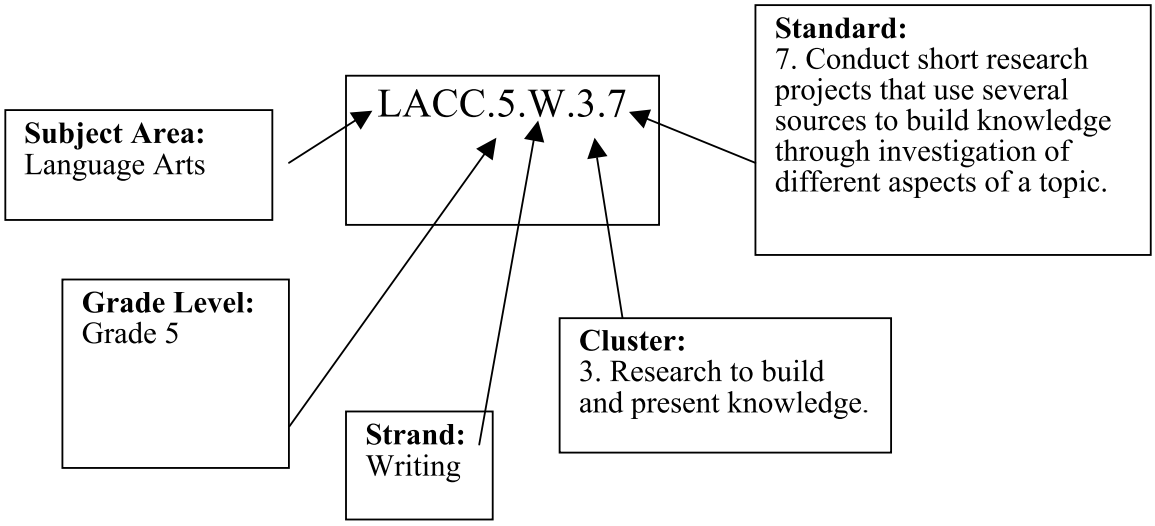
- The two letters in the *first position* of the code identify the **Subject Area**.
- The number(s) in the *second position* represent the **Grade Level**.
- The letter in the *third position* represents the **Body of Knowledge**.
- The number in the *fourth position* represents the **Big Idea/Standard**.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

Course Number: 2000310

Benchmark HE.912.C.1.3	
Body of Knowledge/Strand	**Health Education Concepts**
Standard	**1: Comprehend concepts related to health promotion and disease prevention to enhance health.**
Benchmark	**HE.912.C.1.3: Evaluate how environment and personal health are interrelated.**
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 effect of the availability of • food options within a community; • prenatal care services; • recreational activities as they relate to environmental and personal health; and • will recognize how changes in the environment can affect personal health.
Content Limits	Items for this benchmark may assess • how availability or lack of availability of healthy foods in a community can affect personal health and overall health of that community; • the need for proper prenatal care services; and • how recreational activities, or lack of activities (e.g., afterschool sports), can affect personal health and the health of a community; Items for this benchmark may not assess alternatives to birth or birth control.

Benchmark HE.912.C.1.4	
Body of Knowledge/Strand	**Health Education Concepts**
Standard	**1: Comprehend concepts related to health promotion and disease prevention to enhance health.**
Benchmark	**HE.912.C.1.4: Analyze how heredity and family history can impact personal health.**
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	Some examples may include family obesity, heart disease, mental health, and non-communicable illness or disease.
Content Limits	Items for this benchmark • may assess how knowing family histories can influence future choices (e.g., periodontal disease runs in family means individual should be extra vigilant with dental hygiene); • should use caution when referencing drug use and alcoholism.

Benchmark HE.912.C.1.8	
Body of Knowledge/Strand	**Health Education Concepts**
Standard	**1: Comprehend concepts related to health promotion and disease prevention to enhance health.**
Benchmark	**HE.912.C.1.8: Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases.**
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	Some examples may include prevention, detection, and treatment of communicable and/or chronic diseases (e.g., breast and testicular cancer, obesity, and industrial-related chronic disease).
Content Limits	Items for this benchmark • will not ask students for specific knowledge of diseases. • will not require students to know specific preventions, detections, and treatments, but could infer best practices with guidance from stem.

Benchmark SC.912.E.7.1	
Body of Knowledge/Strand	**Earth 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 flow of energy and cycling of matter (water, carbon, nitrogen, phosphorus, and oxygen) through ecosystems, relating the significance of each to maintaining the health and sustainability of an ecosystem; • analyze the flow of materials and energy using food webs and ecological pyramids; and • explain how homeostasis requires a constant energy input and is maintained in ecosystems by the cycling of matter through biotic and abiotic portions of the ecosystem.
Content Limits	Items for this benchmark addressing the recycling of carbon may refer to photosynthesis, but will not assess photosynthesis in isolation. Items for this benchmark addressing the need for homeostasis will not require students to predict environmental consequences when homeostasis is disrupted.

Benchmark SC.912.L.14.1	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.1: Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of 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 how continuous investigations and/or new scientific information influenced the development of the cell theory; and • identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations).
Content Limits	Items for this benchmark may assess how contributions of scientists such as van Leeuwenhoek, Hooke, Schwann, Schleiden, and/or Virchow aided in the development of the cell theory. Items assessing a scientific claim, the development of a theory, or the differences between theories and laws are limited to the cell theory.

Benchmark SC.912.L.14.2	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.2: Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport).**
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 processes associated with movement across the membrane; • identify cell membranes as highly selective barriers capable of both passive and active transport, and • explain how the cell membrane maintains homeostasis.
Content Limits	Items for this benchmark may assess the function and process of the organelles in addition to identifying the organelle. Items referring to the role of the cell membrane may address hypotonic, hypertonic, and/or isotonic solutions; however, the assessment should be on processes and not terminology.

Benchmark SC.912.L.14.3	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.3: Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.**
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	N/A
Content Limits	Items for this benchmark will not address protists or fungi or assess cellular structures unique to protists or fungi.

Benchmark SC.912.L.14.4	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.4: Compare and contrast structure and function of various types of microscopes.**
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 • understand that the quality of a microscope and its ability to magnify depend on its resolving power; • recognize that compound microscopes use visible light that is passed through the object and then a series of lenses to magnify the object; • calculate the total magnifying power of a typical light microscope when given the magnification of the objectives; • recognize that electron microscopes use electrons rather than light to pass over or through an object in a vacuum; • associate the electron microscope with having greater resolution because it uses a beam of electrons that have a much shorter wavelength than that of light; • understand that because electron microscopes require specimens to be in a vacuum, only dead cells or organisms can be viewed; and • identify different types of electron microscopes such as the transmission electron microscope (TEM), scanning electron microscope (SEM), and scanning tunneling microscope (STM).
Content Limits	Items for this benchmark will not • require students to recall names of scientists involved in the development of the microscope; • assess the definitions of prokaryotic, eukaryotic, unicellular, and/or multicellular organisms, but items may refer to those terms.

Benchmark SC.912.L.14.6	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.6: Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health.**
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 • differentiate between genetic factors, environmental factors, and pathogens as the causative agents of health issues; and • compare and contrast individual versus public health concerns.
Content Limits	Items for this benchmark assessing the significance of genetic factors, environmental factors, and pathogenic agents to health are limited to a conceptual understanding. Items for this benchmark asking students to differentiate between genetic factors, environmental factors, and pathogens will not require specific knowledge of human infectious diseases, their causative agents, affected body systems, or modes of transmission.

Benchmark SC.912.L.14.7	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.7: Relate the structure of each of the major plant organs and tissues to physiological processes.**
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	N/A
Content Limits	Items for this benchmark • assessing plant organs are limited to roots, stems, leaves, flowers, fruits, and cones; • referring to physiological processes are limited to photosynthesis, cellular respiration, transpiration, and reproduction; • assessing plant tissues are limited to meristematic, ground, dermal, and vascular tissues; • referring to plant structures are limited to guard cells, phloem, seed, stomata, and xylem; • may not ask about the process of mitosis or meiosis, but may assess how mitosis and meiosis affect the plant.

Benchmark SC.912.L.14.26	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.26: Identify the major parts of the brain on diagrams or models.**
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	N/A
Content Limits	Items for this benchmark • are limited to the cerebrum, cerebellum, pons, medulla oblongata, brain stem, frontal lobe, parietal lobe, occipital lobe, and temporal lobe. • should include a diagram or model of the brain. • will not assess the function of the major parts of the brain.

Benchmark SC.912.L.14.36	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.36: Describe the factors affecting blood flow through the cardiovascular system.**
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	N/A
Content Limits	Items for this benchmark addressing blood volume should be limited to • factors that can increase or decrease volume; • ways differentiation in blood volume can affect blood flow. Items for this benchmark addressing resistance should be limited to factors that can affect resistance (diameter of the blood vessels, blood viscosity, and blood vessel length). Items for this benchmark may not assess • autonomic or chemical regulations of heart rate; • the pathway of blood through the heart or body; or • calculation of blood pressure.

Benchmark SC.912.L.14.52	
Body of Knowledge/Strand	**Life Science**
Standard	**14: Organization and Development of Living Organisms**
Benchmark	**SC.912.L.14.52: Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.**
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 that the body uses both nonspecific and specific defense mechanisms to detect and destroy pathogens; • classify the body's surface defenses, mucous membranes, inflammatory response, temperature response, white blood cell production (macrophages, natural killer cells), and protein production (such as complement system/interferon) as being nonspecific immune responses that do not target specific pathogens; • classify the production of cytotoxic T cells, B cells, and helper T cells as being specific immune responses to specific invading pathogens; • describe how vaccines provide long-lasting immunity against a pathogen by providing the body with antibodies; and • recall that antibiotics are a way to help the body fight infections by killing or inhibiting the growth of microorganisms; however, they do not combat viruses such as HIV.
Content Limits	Items for this benchmark will not require specific knowledge of • names or mechanisms of action of any antibiotics; • normal/elevated blood values of any white blood cell; or • human infectious diseases, their causative agents, affected body systems, or modes of transmission when assessing how pathogens cause disease.

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 • identify ways in which a scientific claim regarding evolution is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations); • assess the reliability of sources of information according to scientific standards; and • describe how scientific inferences regarding evolution are made from observations and identify examples from biology.
Content Limits	Items for this benchmark • will not require memorization of the names of specific human fossils, the names of the different hominid species, or geologic time scale (including era, period, and/or epoch); • assessing the fossil record will not require understanding of the specific mechanisms used for relative dating and radioactive dating; • that refer to adaptive radiation, convergent evolution, coevolution, or punctuated equilibrium should focus on the concepts rather than on the definitions of the terms; and • that refer to comparative anatomy and comparative embryology will assess anatomical similarities such as homologous and analogous structures and vestigial organs but will not require specific knowledge of embryologic stages or structures.

Benchmark SC.912.L.15.4	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.4: Describe how and why organisms are hierarchically classified and based on evolutionary relationships.**
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 hierarchical levels and systems of classification used to distinguish groups of organisms; • understand that organisms are classified based on physiological characteristics and evolutionary relationships, rather than other variables such as size, location, diet, etc.; and • discuss the benefits, limitations, and need for hierarchical systems of classification.
Content Limits	Items for this benchmark will not require students to explain the difference between the Aristotle and Linnaeus designs of classification.

Benchmark SC.912.L.15.5	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.5: Explain the reasons for changes in how organisms are classified.**
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 • understand that it is the nature of science to change as new evidence is provided; • explain the historical development and changing nature of classification systems; • describe how genetics provides more evidence of how closely organisms are related, causing groupings to have to be adjusted; and • explain how the development of the microscope provided for the study of microscopic structures, allowing scientists to find differences between fungi and plants to form another phylum.
Content Limits	Items for this benchmark assessing • the contribution of the microscope to the evolution of taxonomy will not require students to identify specific parts of the microscope; • the historical development of classification systems will not require specific knowledge of dates.

Benchmark SC.912.L.15.6	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.6: Discuss distinguishing characteristics of the domains and kingdoms of living organisms.**
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 distinguishing characteristics required for an organism to be classified within a domain or kingdom; • compare and contrast the characteristics of different taxonomic groups, including archaea, bacteria, protists, fungi, plants, and animals; and • describe the characteristics of an organism and assess its classification based on similarities and differences such as shape, size, and body structure;
Content Limits	Items for this benchmark addressing distinguishing characteristics of living organisms are limited to the domains of Archaea, Bacteria, and Eukarya and the kingdoms of Protista, Fungi, Plantae, and Animalia. Items for this benchmark will not require specific knowledge of organisms classified in any domain or kingdom. Items for this benchmark may refer to characteristics such as prokaryotic, eukaryotic, unicellular, and/or multicellular organisms, autotrophs and/or heterotrophs.

Benchmark SC.912.L.15.8	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and 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 for this benchmark • 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; and • may assess how contributions of scientists such as Pasteur, Oparin, Miller and Urey, Margulis, or Fox aided in the development of the scientific explanation of the origin of life. Items for this benchmark that assess the origin of organic molecules, chemical evolution, and/or eukaryotic cells should be conceptual.

Benchmark SC.912.L.15.10	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.10: Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools.**
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 and evaluate how evidence of common ancestry, including anatomical and developmental evidence, is provided by the fossil record; • explain how fossil, biochemical, and anatomical evidence support the theory of evolution; • identify examples of and basic trends in hominid evolution from early ancestors to modern humans such as cranial expansion and enlargement of teeth and jaws; and • associate the discovery of burial grounds, cave paintings, detailed stone and bone artifacts, and human figurines with the development of religious views and communication through spoken language.
Content Limits	Items for this benchmark will not require specific knowledge of the genus and species of specific types of hominids.

Benchmark SC.912.L.15.13	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.13: Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success.**
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 and/or describe the scientific mechanisms, such as genetic drift, gene flow, and nonrandom mating, resulting in evolutionary change; and • explain and/or describe how mutation and genetic recombination increase genetic variation.
Content Limits	Items for this benchmark that address mutation and genetic recombination in relation to increasing genetic variation must be assessed in the context of evolution; Items for this benchmark may address how meiosis contributes to genetic variation, but may not assess the steps or stages of meiosis. Items for this benchmark will not assess • descent with modification or common descent; or • the Hardy-Weinberg principle or genetic equilibrium.

Benchmark SC.912.L.15.14	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.14: Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow.**
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 genetic drift as a cause of change to genetic equilibrium that involves chance processes; and • identify gene flow as the transfer of genes from one population to another.
Content Limits	Items for this benchmark will not require • students to provide specific examples of alleles that appear in populations due to gene flow or genetic drift; or • specific knowledge of population dynamics such as predation, effects of competition, crowding, and stress.

Benchmark SC.912.L.15.15	
Body of Knowledge/Strand	**Life Science**
Standard	**15: Diversity and Evolution of Living Organisms**
Benchmark	**SC.912.L.15.15: Describe how mutation and genetic recombination increase genetic variation.**
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 • provide examples of reasons for genetic diversity and why it can be an advantage for populations such as the ability to resist lethal pathogens; and • use the mRNA codon chart to determine the effects of different types of mutations on amino acid sequence and protein structure (e.g., sickle cell anemia resulting from base substitution mutation).
Content Limits	Items for this benchmark • will not require students to recall specific codons for amino acids; or • require students to recall the specific codon for the initiation or termination of translation but may require students to be able to recognize them from the mRNA codon chart.

Benchmark SC.912.L.16.1	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.1: Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.**
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, analyze, and/or predict inheritance patterns caused by various modes of inheritance.
Content Limits	Items for this benchmark addressing dihybrid crosses or patterns that include codominance, incomplete dominance, multiple alleles, sex linkage, or polygenic inheritance may assess the P and F1 generations.

Benchmark SC.912.L.16.2	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.2: Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.**
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 sex-linked traits as traits dependent on genes that follow the inheritance patterns of the X chromosome; and • predict inheritance patterns using Punnett squares and pedigree diagrams.
Content Limits	Items for this benchmark • assessing inheritance patterns using pedigrees are limited to basic symbols to identify males and females, affected and unaffected individuals, matings, and other relationships; • using Punnett squares may assess the F_1 and F_2 generations.

Benchmark SC.912.L.16.3	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.3: Describe the basic process of DNA replication and how it relates to the transmission and conservation of genetic information.**
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 gene and chromosomal mutations in the DNA sequence; • explain how gene and chromosomal mutations may or may not result in a phenotypic change; • explain that the basic components of DNA are universal in organisms; and • explain how similarities in the genetic codes of organisms are due to common ancestry and the process of inheritance.
Content Limits	Items for this benchmark • requiring the analysis of base pairs for gene mutations are limited to changes in a single gene; • may refer to but will not assess the cell cycle, mitosis, and/or meiosis; and • may refer to the process of meiosis in the context of mutations, but will not assess meiosis in isolation.

Benchmark SC.912.L.16.4	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.4: Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring.**
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 that a large portion of an organism's total genome is noncoding DNA; • infer that changes to DNA sequence in noncoding DNA do not affect protein production and, therefore, do not result in phenotypic changes; and • explain that changes in sex cells, or gametes, can be passed on to offspring and, therefore, may result in phenotypic changes.
Content Limits	Items for this benchmark • requiring the analysis of base pairs for gene mutations are limited to changes in a single gene; and • may refer to the processes of mitosis and meiosis in the context of mutations but will not assess them in isolation.

Benchmark SC.912.L.16.5	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.5: Explain the basic processes of transcription and translation and how they result in the expression of genes.**
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 DNA and RNA code for proteins and determine traits; • explain the purpose and process of transcription and translation using models of DNA and RNA; and • recognize that gene expression is a regulated process.
Content Limits	Items for this benchmark • addressing transcription or translation will not require specific knowledge of initiation, elongation, or termination; • assessing amino acids may ask students to refer to the mRNA codon chart but will not require specific knowledge of the names of amino acids in isolation.

Benchmark SC.912.L.16.8	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.8: Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer.**
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 illustrate changes in DNA and evaluate the significance of these changes; • explain how mutations in DNA that result from interactions with the environment (e.g., radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype; • explain the importance of the cell cycle to the growth of organisms; and • recognize that mutations in genes that control the cell cycle lead to uncontrolled cell growth and potentially result in cancer.
Content Limits	Items for this benchmark will not assess the specific proteins associated with regulating the cell cycle. Items for this benchmark may assess cancer in terms of resulting from uncontrolled cell growth but will not require knowledge of specific cancers.

Benchmark SC.912.L.16.9	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.9: Explain how and why the genetic code is universal and is common to almost all organisms.**
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 relationships among DNA, proteins, and amino acids in carrying out the work of cells and how this is similar in all organisms.
Content Limits	Items for this benchmark may require students to compare percent similarities of genomes between organisms but will not require specific knowledge of the size of genomes.

Benchmark SC.912.L.16.10	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.10: Evaluate the impact of biotechnology on the individual, society, and the environment, including medical and ethical 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 • evaluate ethical issues surrounding the use of DNA technology (including cloning, genetically modified organisms, stem cell research, and the Human Genome Project); • discuss and evaluate the significance of human interference with major ecosystems (e.g., the loss of genetic diversity in cloned crops or animals); and • describe the uses, limitations, and potential for misuse of genetic information.
Content Limits	Items for this benchmark may assess current issues but will not require knowledge of specific biotechnologies or specific medical issues.

Benchmark SC.912.L.16.13	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.13: Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy.**
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 process of human development from the zygotic stage to the end of the third trimester and birth.
Content Limits	Items for this benchmark referring to • changes in each trimester are limited to normal human development. Items for this benchmark will not assess • hormonal control during pregnancy; • specific knowledge of malformations in the human fetus, miscarriages, maternal preexisting conditions, genetic conditions, or the impact of exposure to environmental conditions; • the utilization of technology to assist in or prevent fertilization or monitor development of the fetus; or • the menstrual cycle.

Benchmark SC.912.L.16.14	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.14: Describe the cell cycle, including the process of mitosis. Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction.**
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 stages of the cell cycle, including deoxyribonucleic acid (DNA) replication and mitosis; • explain the importance of the cell cycle to the growth of organisms, and the replacement of damaged cells; and • explain the significance of mitosis to asexual reproduction.
Content Limits	Items for this benchmark will not • require the knowledge of specific types of cellular damage; or • assess the specific proteins associated with regulating the cell cycle. Items for this benchmark referring to the stages of mitosis may use diagrams but are limited to identification of phases, structures, and major events of each phase.

Benchmark SC.912.L.16.16	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.16: Describe the process of meiosis, including independent assortment and crossing over. Explain how reduction division results in the formation of haploid gametes or spores.**
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 • create and/or use a diagram to model the stages of meiosis and explain the processes occurring at each stage; • explain how independent assortment, along with crossing over, increases genetic diversity by producing novel genetic combinations; and • explain how the process of reductive division in meiosis results in the formation of haploid gametes or spores.
Content Limits	Items for this benchmark will not require • specific knowledge of the chromosome number of organisms; or • calculations of the number of different kinds of eggs or sperm an organism can produce. Items for this benchmark addressing meiosis with diagrams are limited to the identification of phases, structures, and major events of each phase.

Benchmark SC.912.L.16.17	
Body of Knowledge/Strand	**Life Science**
Standard	**16: Heredity and Reproduction**
Benchmark	**SC.912.L.16.17: Compare and contrast mitosis and meiosis and relate to the processes of sexual and asexual reproduction and their consequences for genetic variation.**
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 mitosis forms new cells and its role in maintaining chromosome number during asexual reproduction; • describe the process of meiosis, including independent assortment and crossing over; and • explain how meiosis results in the formation of haploid gametes or spores, and mitosis results in the formation of identical diploid cells.
Content Limits	Items for this benchmark • may address the presence and location of centrioles; • using diagrams/models addressing mitosis or meiosis are limited to identification of phases, structures, and major events of each phase. Items for this benchmark will not assess the specific proteins associated with regulating the cell cycle.

Benchmark SC.912.L.17.2	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.2: Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature.**
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 quantitative data, including pH, salinity, temperature, mineral content, nitrogen compounds, and turbidity from an aquatic environment.
Content Limits	Items for this benchmark • assessing the physical properties of seawater will not require specific knowledge of seawater temperature, salinity, and dissolved nutrients; • referring to chemical factors in aquatic systems are limited to pH, oxygen, carbon dioxide, nitrogen, phosphorous, salinity; • referring to geography in aquatic systems are limited to water depth, latitude, temperature, underwater topography, and proximity to land. Items for this benchmark will not require the identification of oceanic zones or ocean currents.

Benchmark SC.912.L.17.4	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.4: Describe changes in ecosystems resulting from seasonal variations, climate change, and succession.**
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 the impact of environmental pressures such as seasonal variations and climate change on populations and ecosystems; and • explain the process of ecological succession and describe the different communities that result.
Content Limits	Items for this benchmark referring to • changes in biodiversity may include examples of catastrophic events, climate changes, human activities, and the introduction of invasive and nonnative species, but will not assess specific knowledge of these; • reduction in biodiversity will focus on the consequence, but not require knowledge of the specific event that led to the reduction. Items for this benchmark addressing climate change are limited to biodiversity and population dynamics contexts.

Benchmark SC.912.L.17.5	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.5: Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.**
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 data and information about population dynamics, abiotic factors, and/or biotic factors to explain and/or analyze a change in carrying capacity and its effect on population size in an ecosystem; • predict environmental factors on population and on population growth; and • identify patterns of population growth such as rapid and slow life-history patterns.
Content Limits	Items for this benchmark will not require specific knowledge of • growth curves but may assess the initial slow growth phase, a period of exponential growth, and a plateau; or • birth rates and death rates of countries around the world.

Benchmark SC.912.L.17.8	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.8: Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, nonnative species.**
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 and predict how invasive, nonnative species would impact the biodiversity of an ecosystem; and • discuss and evaluate the significance of human interference with major ecosystems (e.g., the loss of genetic diversity in cloned crops or animals).
Content Limits	Items for this benchmark will not • address specific catastrophic events; • require specific knowledge of which species are native to certain ecological systems; or • require specific knowledge of which species are designated as extinct or endangered.

Benchmark SC.912.L.17.9	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.9: Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.**
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	N/A
Content Limits	Items for this benchmark • referring to organisms in food webs are limited to the impact of changes in matter or energy in trophic levels; • addressing food webs will require application of the knowledge of roles of organisms in a food web to describe energy pathways, in addition to the identification of producers, consumers (primary, secondary, tertiary), and decomposers; and • will not require knowledge of specific organisms or their feeding habits.

Benchmark SC.912.L.17.11	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.11: Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.**
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 • infer how human activities (including population growth, pollution, burning of fossil fuels, habitat destruction, and introduction of nonnative species) may impact the environment; and • explain how the use, protection, and conservation of natural resources by humans impacts the environment from one generation to the next.
Content Limits	Items for this benchmark referring to the costs of renewable and nonrenewable resources will not require specific knowledge of the actual numerical costs of using these resources. Items for this benchmark will not require specific knowledge of which resources are imported or produced domestically.

Benchmark SC.912.L.17.13	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.13: Discuss the need for adequate monitoring of environmental parameters when making policy decisions.**
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 the use, protection, and conservation of natural resources by humans impacts the environment from one generation to the next; • recognize that the long-term survival of a species is dependent on changing resource bases that are limited; and • investigate and analyze how organisms, populations, and communities respond to external factors such as acid rain and various forms of pollution.
Content Limits	Items for this benchmark will not require knowledge of specific environmental regulations or legislative policies regarding the control of pollution.

Benchmark SC.912.L.17.20	
Body of Knowledge/Strand	**Life Science**
Standard	**17: Interdependence**
Benchmark	**SC.912.L.17.20: Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.**
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 possible environmental impacts resulting from the use of renewable and/or nonrenewable resources; and • identify ways in which a scientific claim about human lifestyles is evaluated (e.g., through scientific argumentation, critical and logical thinking, and/or consideration of alternative explanations) and the effects on resources, etc.
Content Limits	Items for this benchmark will not require knowledge of specific environmental regulations, pollution-prevention technologies or devices, or other mechanisms used to prevent pollution.

Benchmark SC.912.L.18.1	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.1: Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.**
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/or describe the basic molecular structure of carbohydrates, lipids, proteins, and nucleic acids; • describe the primary functions of carbohydrates, lipids, proteins, and nucleic acids in organisms; and • identify common examples of carbohydrates, lipids, proteins, and nucleic acids.
Content Limits	Items for this benchmark will not • refer to intermolecular forces found in the four types of macromolecules; or • assess hydrolysis and dehydration synthesis.

Benchmark SC.912.L.18.7	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.7: Identify the reactants, products, and basic functions of photosynthesis.**
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 general equation for photosynthesis and identify the reactants and products; • identify water, carbon dioxide, and light energy as the reactants needed for photosynthesis to occur; • identify oxygen and simple sugars, such as glucose, as the products of photosynthesis; • identify the light-dependent reactions as the electron transport chain and the light-independent reactions as the Calvin Cycle reactions of photosynthesis; • explain the basic functions of photosynthesis; • explain how photosynthetic organisms use the processes of photosynthesis and respiration; and • explain how photosynthesis stores energy.
Content Limits	Items for this benchmark will not require the balancing of equations.

Benchmark SC.912.L.18.8	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.8: Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.**
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 • recall that the process of releasing the stored energy in food molecules is referred to as respiration; • recall that respiration may (aerobic) or may not (anaerobic) require oxygen to take place; • identify the cellular sites of, and follow through the major pathways of, anaerobic and aerobic respiration; • compare reactants and products for each process; • explain how cellular respiration releases energy; and • account for how aerobic respiration produces more ATP per monosaccharide.
Content Limits	Items for this benchmark will not require • balancing equations; or • knowledge of the location of where these reactions take place other than that they occur in specific organelles/organisms.

Benchmark SC.912.L.18.9	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.9: Explain the interrelated nature of photosynthesis and cellular respiration.**
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 the products of photosynthesis are used as reactants for cellular respiration; • explain how the products of cellular respiration are used as reactants for photosynthesis; • explain how photosynthesis stores energy and cellular respiration releases energy; • identify the reactants, products, and/or the basic function of photosynthesis; • identify the reactants, products, and/or the basic functions of aerobic and anaerobic cellular respiration; and • connect the role of adenosine triphosphate (ATP) to energy transfers within the cell.
Content Limits	Items for this benchmark will not assess plant structures.

Benchmark SC.912.L.18.10	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.10: Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.**
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 cellular respiration in terms of how energy is stored, released, and transferred within and between these systems; • explain the significance of various molecules involved in metabolic processes and energy conversions that occur in living organisms; • connect the role of adenosine triphosphate (ATP) to energy transfers within a cell; • explain how cells store energy temporarily as ATP; and • describe ATP as the main link between energy-releasing and energy-using reactions.
Content Limits	Items for this benchmark will not require students to know the structure of ATP.

Benchmark SC.912.L.18.11	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.11: Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity.**
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 enzymes and explain their role in acting as catalysts to control the rate of metabolic reactions; • describe the function of enzymes, including how enzyme-substrate specificity works, in biochemical reactions; and • predict the effect of factors such as pH and temperature on an enzyme's activity.
Content Limits	Items for this benchmark referring to: • the role of enzymes as catalysts will use a biological context and not require knowledge of specific enzymes; • the factors that affect enzyme activity are limited to concentration, pH, and temperature. Items for this benchmark will not require specific knowledge of how an enzyme reacts at a certain pH or temperature.

Benchmark SC.912.L.18.12	
Body of Knowledge/Strand	**Life Science**
Standard	**18: Matter and Energy Transformations**
Benchmark	**SC.912.L.18.12: Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.**
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 water's polarity to its ability to dissolve substances and to the formation of acids and bases; and • explain how the properties of water, such as high surface tension, high heat of evaporation, and resistance to changes in temperature, make water essential for life on Earth.
Content Limits	Items for this benchmark • referring to the properties of water are limited to hydrogen bonding, polarity, cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent; • may address adhesion but will not assess adhesion; and • referring to water's ability to form acidic and basic solutions will not assess acids and bases in isolation.

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	N/A
Content Limits	Items for this benchmark will assess biology-related scenarios/content only.

Benchmark SC.912.N.1.3	
Body of Knowledge/Strand	**Nature of Science**
Standard	**1: The Practice of Science**
Benchmark	**SC.912.N.1.3: Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented.**
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	N/A
Content Limits	Items for this benchmark will assess biology-related scenarios/content 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 scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials; and • use scientific reasoning and valid logic to recognize unsubstantiated inferences and conclusions.
Content Limits	Items for this benchmark will assess biology-related scenarios/content only. Items for this benchmark will not require knowledge of specific names of journals or other sources.

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 • 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 for this benchmark will assess biology-related scenarios/content only. Students will • draw inferences when given data; and • identify types of observations made to gather given types of data.

Benchmark SC.912.N.2.1	
Body of Knowledge/Strand	**Nature of Science**
Standard	**2: The Characteristics of Scientific Knowledge**
Benchmark	**SC.912.N.2.1: Identify what is science, what clearly is not science, and what superficially resembles science (but fails to meet the criteria for 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 • detect potential bias in scientific investigations; and • recognize that valid scientific investigations must be evaluated by other members of the scientific community. Students will define science as • the systematic collection and organization of information; • based on empirical evidence and data; • appropriate to connecting events in the natural world; • objective; and • open to change based on new evidence/data from technologies/discoveries.
Content Limits	Items for this benchmark will assess biology-related scenarios/content only. Items for this benchmark will not • address the scientific method by name, but may use the process; or • require students to calculate experimental error.

Benchmark SC.912.N.2.2	
Body of Knowledge/Strand	**Nature of Science**
Standard	**2: The Characteristics of Scientific Knowledge**
Benchmark	**SC.912.N.2.2: Identify which questions can be answered through science and which questions are outside the boundaries of scientific investigation, such as questions addressed by other ways of knowing, such as art, philosophy, and religion.**
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	N/A
Content Limits	Items for this benchmark will assess biology-related scenarios/content only. Items for this benchmark will not require knowledge of specific religions, works of art, philosophies, etc. Items for this benchmark will identify valid questions that can be answered by scientific investigations (e.g., Not valid: Which flowers produce the prettiest blooms? Valid: Which flower blooms attract the most bees?).

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 • explain scientific theories as well-established and highly reliable explanations that are capable of being tested by multiple independent researchers; • identify biological theories and describe what makes them theories instead of laws; and • identify the process of theory formation (e.g., pose questions, create hypothesis, perform experiment, collect and analyze data, repeat by other scientists).
Content Limits	Items for this benchmark • may assess the process of theory formation; • may assess the formation of biological theories (e.g., Cell Theory, Germ Theory); • may ask students to pose questions, form hypotheses that could have contributed to the formation of biological theories; and • may assess biological hypotheses and models. Items for this benchmark will not assess hypotheses or theories outside of biological concepts.

Benchmark SC.912.N.3.4	
Body of Knowledge/Strand	**Nature of Science**
Standard	**3: The Role of Theories, Laws, Hypotheses, and Models**
Benchmark	**SC.912.N.3.4: Recognize that theories do not become laws, nor do laws become theories; theories are well-supported explanations and laws are well-supported descriptions.**
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 theories as explanations that have been verified multiple times by independent researchers and proved to be true; • recognize theories are subject to change as new areas of science and technologies are developed; • recognize laws as statements that are simple, true, universal, and absolute; and • differentiate laws from theories.
Content Limits	Items for this benchmark may assess biological laws (e.g., Laws of Inheritance). Items for this benchmark will not assess laws outside of biology (e.g., Law of Gravity).

Appendix A: Sample Items

Sample Item 1

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
912/Biology	SR	2	SC.912.L.14.3: Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells.	N/A	1

There are some similarities between prokaryotic and eukaryotic cells. Which structure is found in **both** prokaryotic and eukaryotic cells?

A. lysosome

B. mitochondrion

C. nucleus

D. ribosome*

Correct Answer: D

Rationales:

A	Incorrect. Some students may simply think that lysosomes are present in both prokaryotic and eukaryotic cells, or they may confuse the term lysosome with ribosome. A lysosome is a membrane-bound organelle that releases enzymes that dissolve material within the cell. It is present in eukaryotic cells only.
B	Incorrect. Some students may think that mitochondria are present in all cells because they are relatively large and play an essential role in aerobic respiration in the cell. However, mitochondria are present in eukaryotic cells only.
C	Incorrect. Some students may think that nuclei are present in all cells because they are the largest and most distinguishable organelles inside of eukaryotic cells. Nuclei contain the genetic material DNA in eukaryotic cells. Prokaryotic cells do not have distinct nuclei.
D	Correct.

Sample Item 2

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
912/Biology	SHR	2	SC912.L.16.2: Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.	N/A	1

Face dimples are caused by an autosomal dominant allele.

Calculate the probability that offspring will have dimples if one parent is heterozygous for face dimples and the other parent does not have face dimples.

Correct answer: 50% OR 0.5 OR 1/2 OR 2/4

Correct Answer	The student calculated the probability using a Punnett square correctly. The student understands that one parent would be *Dd*, and the other would be *dd*, yielding the probability of 50% that each offspring would have dimples.

Sample Item 3

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
912/Biology	CR	2	SC.912.L.18.12: Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent.	LACC.910. WHST.1.2: Write informative/ explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.	2

Water in soil is absorbed by the roots of plants through osmosis. Explain how water is able to move against gravity from the roots of a plant to the leaves.

Scoring Rubric and Exemplar

Rubric	
2	A score of two indicates that the student has demonstrated a thorough understanding of the concepts embodied in the task. 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 lack sufficient information to determine the student's understanding, contain clear misunderstandings of the underlying scientific concepts and/or procedures, or may be incorrect.

Exemplar	
2	A correct student response should indicate that water molecules are able to form hydrogen bonds that help them adhere to other substances. In addition, the response should indicate that this process of cohesion allows water to move up a plant due to the attraction to other substances in the plant tissue.

Sample Item 4

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
912/Biology	ER	2	SC.912.L.15.15: Describe how mutation and genetic recombination increase genetic variation.	N/A	4

Changes to an organism's genome may be harmful or beneficial.

Part 1: Describe how an organism's genome can be changed.

Part 2: Describe how those changes could be beneficial to the organism. Provide an example with your answer.

Scoring Rubric and Exemplar

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 misunderstanding of the underlying scientific concepts and/or procedures, or may be incorrect.

Exemplar	
4	**A correct student response should indicate:** • **how mutations and recombination result in changes to an organism's genome; and** • **how genetic changes may be beneficial to an organism by giving them some potential advantage over other individuals in a population. (Note: A response must include a reasonable example for full credit.)** **For example:** Changes to an organism's genome can be brought about through mutation and/or recombination. Recombination occurs during the process of meiosis through crossing over and independent assortment of chromosomes, while mutation can occur randomly. Genetic changes can be beneficial to an organism by giving it an advantage over the other individuals in its environment, such as a mutation for white fur for rabbits that live in snowy habitats.

Sample Item 5

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
912/Biology	ESR	3	SC.912.L.16.8: Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer.	N/A	6

The cell cycle in eukaryotes is controlled by many genes, such as a tumor suppressor gene. Tumor suppressor genes control the cell cycle by inhibiting DNA replication for limited periods and detecting damage to genes.

Explain how a mutation to tumor suppressor genes could result in cancer.

Scoring Rubric and Exemplar

	Rubric
6	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 non-detracting 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 (same as "6"). Appropriate scientific terminology is used correctly (same as "6"). 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 (same as "6"). There are minor errors in the use of scientific terminology. There are minor conceptual errors or omissions. The response demonstrates understanding, though it may be somewhat flawed. The response may attempt connections between the scientific concept and the 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. 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	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 misunderstanding of the underlying scientific concepts and/or procedures, or may be incorrect.

Exemplar	
6	**A full-credit student response will be similar to the following:** Tumor suppressor genes are examples of sets of genes that contain necessary information to make the proteins that regulate cell growth and division. A mutation in a tumor suppressor gene would cause a cell to lose control of the cell cycle. Tumor suppressor genes prevent cell division from occurring too often by inhibiting DNA replication. Loss of this inhibition would result in the uncontrolled cell division characteristic of cancer. Tumor suppressor genes also have the capacity to detect gene damage. In most cancers, this error detection has been disabled.

Sample Item 6

Performance Task 2–6 points

Teacher Instructions:

This performance task consists of three items, and incorporates knowledge and understanding of genetics.

PT Item 1: The first part of this activity requires students to follow directions to locate information about the symbols that are used to construct a typical pedigree showing how a trait is inherited.

PT Item 2: The short response item requires students to analyze a data table of the number of children in a large family who have inherited a particular trait and draw a typical pedigree showing the trait in each generation.

PT Item 3: The constructed response item requires students to analyze their pedigrees and explain the genotypes of the parents and offspring.

Student Instructions:

In this performance task you will use technology to locate information about the symbols that are used to construct a typical pedigree showing how a trait is inherited. You will begin by following step-by-step directions to find information about how males and females, both affected and unaffected, are represented in a typical pedigree. You will use the information to draw a typical pedigree that is based on a given set of data. Finally, explain how the trait may be inherited.

PT Item 1

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9/Biology	PT	2	SC.912.L.16.1: Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.	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.	2

For this task, you will need to understand the symbols that are used to create a typical pedigree using a computer with Internet access. Open a web browser and follow these steps:

1. Go to the National Center for Biotechnology Information website at *http://www.ncbi.nlm.nih.gov*.
2. In the drop-down arrow box, select "Books" and type "Symbols Used In Pedigree Analysis" in the "Search" bar, and then click "Search."
3. On the next page, choose the first image under "Images search in Bookshelf."
4. Using the information shown in Figure 4-17 on the website, write a few sentences to describe how an unaffected male and an affected female are presented in a typical pedigree.

Exemplar	
2	**Any student response that correctly and fully explains:** A circle represents a female; a square represents a male. Unshaded circles and squares designate individuals that are unaffected. Shaded circles and squares designate individuals that are affected.

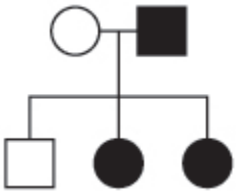
PT Item 2

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9/Biology	SHR	2	SC.912.L.16.1: Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.	N/A	2

Use data analysis to construct a typical pedigree showing how a trait in each generation is inherited. Use symbols that geneticists also use to create the pedigree.

Person	Sex/Phenotype
Parent 1	Male/Affected
Parent 2	Female/Unaffected
Child 1	Male/Unaffected
Child 2	Female/Affected
Child 3	Female/Affected

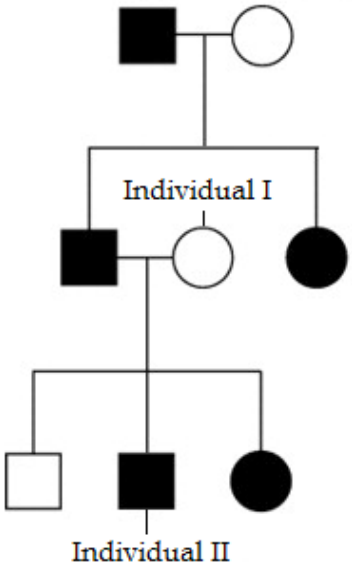
Based on the data table above, draw a typical pedigree showing how the trait was inherited by the children. Include both parents and all offspring in your drawing.

Exemplar	
2	A score of two is indicated by a student response showing a sketched diagram similar to the following showing the pedigree of the individuals in the data table: 

PT Item 3

Grade/Course	Item Type	DOK	NGSSS Benchmark	CCSS Benchmark	Point Value
9/Biology	CR	2	SC.912.L.16.2: Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles.	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).	2

The pedigree chart below shows the pattern of inheritance for an autosomal dominant trait (T).



Based on the pedigree shown above, use all of the following terms to predict and describe the genotypes of Individual I and Individual II: homozygous, heterozygous, dominant, and recessive.

Exemplar	
2	A full-credit student response would correctly use all four terms (homozygous, heterozygous, dominant, and recessive) to predict the genotypes of individual I and II. Individual I is homozygous recessive for the trait (*tt*). Individual II is heterozygous dominant for the trait (*Tt*).

Appendix B: Common Core State Standard Connections

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

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—Biology

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—Biology

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. Graph linear and quadratic functions and show intercepts, maxima, and minima. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.