Florida EOC Assessments 2011

Biology 1 End-of-Course Assessment

Test Item Specifications

FLORIDA DEPARTMENT OF EDUCATION
www.fldoe.org

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Introduction

In recent years, two realities focused attention on the need to reevaluate Florida's Sunshine State Standards. First, in 2005, outside consultants reviewed the 1996 Sunshine State Standards and suggested that the benchmark language offer greater specificity to indicate clearly what teachers should teach and what students should be able to do. Second, federal legislation through the *No Child Left Behind Act of 2001* (NCLB) holds schools and school districts accountable for how well each child is learning, which further emphasizes the need to hone expectations for all students.

In January 2006, the Florida Department of Education (DOE) committed to a six-year cycle of review and revision of the K–12 content standards. The science standards were rewritten, and the Next Generation Sunshine State Standards (NGSSS) for science were adopted by the Florida State Board of Education in February 2008 (available online at: http://www.floridastandards.org/Standards/FLStandardSearch.aspx).

For Grades 9–12, the NGSSS are divided into benchmarks that identify what a student should know and be able to do. This document, *Biology 1 End-of-Course Assessment Test Item Specifications* (*Specifications*), provides information about the benchmarks, the stimulus types, and the test items designed to assess the standards of the Biology 1 course description.

The Florida Comprehensive Assessment Test® 2.0 (FCAT 2.0) measures achievement of Florida students in writing, reading, mathematics, and science. End-of-course (EOC) assessments measure achievement of Florida students who have completed coursework in Algebra 1, Geometry, and U.S. History. The Biology 1 EOC Assessment measures achievement of Florida students enrolled in Biology 1, or an equivalent course, by assessing student progress on benchmarks from the NGSSS that are assigned to the Biology 1 course description. The course description for Biology 1 is available online at: http://www.floridastandards.org/Courses/CourseDescriptionSearch.aspx

Origin and Purpose of the *Specifications*

The Florida Department of Education and committees of experienced Florida educators developed and approved the *Specifications*. The *Specifications* is a resource that defines the content and format of the test and test items for item writers and reviewers. The *Specifications* indicates the alignment of test items with the NGSSS. It also serves to provide all stakeholders with information about the scope and function of the end-of-course assessments.

Scope of this Document

The *Specifications* for the Biology 1 EOC Assessment provides general guidelines for the development of all test items used in the Biology 1 EOC Assessment. Two additional *Specifications* documents provide similar information for FCAT 2.0 Science Grade 5 and FCAT 2.0 Science Grade 8.

The Overall Considerations section in this Introduction provides an explanation of the science concepts and elements assessed by the test. The Criteria for Biology 1 End-of-Course Assessment Test Items section addresses cognitive complexity levels as well as the review processes used to ensure the quality of the stimuli and test items. The same section explains the general guidelines for selection and development of multiple-choice items. The Individual Benchmark Specifications section contains specific information about each benchmark. This section provides benchmark clarification statements, content limits, stimulus attributes, response attributes, and a sample item for each benchmark grouping.

Overall Considerations

This section of the *Specifications* describes the guidelines that apply to all test items developed for the Biology 1 EOC Assessment.

Overall considerations are broad item-development issues that should be addressed during the development of test items. Sections of Criteria for Biology 1 End-of-Course Assessment Test Items relate more specifically to one aspect of the development (e.g., content limits, stimulus attributes).

1. Each test item should be written to measure primarily one benchmark; however, other benchmarks may also be reflected in the item context (scenario).
2. Some benchmarks are combined for assessment, and the individual specification indicates which benchmarks are combined. Test items may be written to "also assesses" benchmarks; however, the overall theme of the benchmark grouping should be evident in the items.
3. Test items should be appropriate for students in terms of course content experience and difficulty, cognitive development, and reading level. The reading level of the test items should be Grade 9, except for science terms or concepts specifically addressed in the benchmarks.
4. Test items should be written to the cognitive level of the benchmark unless otherwise noted in the individual specifications sections. For example, if the benchmark states the student will compare concepts, the test item should assess a comparison.
5. Test items should assess the application of the concept rather than the memorization of science fact, law, or theory unless otherwise noted in the Individual Benchmark Specifications.
6. Test items will not require the student to define terms.
7. Test items that include a collection of data should require the student to analyze or interpret that data (e.g., use data from a scenario to identify a trend) rather than retrieve information directly from a passage, chart, graph, or table.
8. Test items will not require the creation of a chart, graph, or table.
9. Biology 1 EOC Assessment items should not require use of a calculator.
10. Test items may require the student to apply knowledge of the science concepts described in the prior knowledge benchmarks from lower grades; however, that knowledge should NOT be assessed in isolation.
11. Each test item should be written clearly and unambiguously to elicit the desired response.
12. Test items will not require the memorization of equations or formulas unless otherwise noted in the Individual Benchmark Specifications. A reference sheet is not provided to students.
13. Test items will not require memorization of the Periodic Table. A periodic table is provided to the students and is also found in Appendix D.
14. Test 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.

Item Contexts (Scenarios)

The context in which a test item is presented is called the item context or scenario. Test items should be placed in a context.

1. The item context should be designed to interest Biology 1 students. Scenarios should be appropriate for students in terms of Biology 1 content 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 test items as concise as possible without losing cognitive flow or missing the overall idea or concept.
3. Biology 1 EOC Assessment scenarios are limited to those familiar to a Biology 1 student rather than global situations.
4. Item contexts should not refer to students using textbooks or the Internet as resources. Item contexts should focus on the students engaging in science learning rather than reading about science. Item contexts should avoid using a simple classroom scenario.
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. The item content should be timely but not likely to become dated.

Criteria for Biology 1 End-of-Course Assessment Test Items

All Biology 1 EOC Assessment items are in multiple-choice (MC) format. The general specifications on pages 4 through 15 cover the following criteria for the Biology 1 EOC Assessment:

- Use of Graphics
- Item Style and Format
- Scope of Test Items
- Guidelines for Item Writers
- Cognitive Complexity of Biology 1 EOC Assessment Test Items
- Universal Design

Use of Graphics

Graphics are used to provide both necessary and supplemental information. That is, some graphics contain information that is necessary for answering the question, while other graphics illustrate or support the context of the question. Scenarios may include diagrams, illustrations, charts, or tables, unless otherwise noted in the Individual Benchmark Specifications.

1. Test items should not begin with art. Art in test items is always preceded by text.
2. All tables, charts, and graphs should be titled. Titles should be in all caps, boldfaced, and centered.
3. Illustrations and pictures are either titled or introduced. If a title is used, the title may be placed above or below the illustration or picture.

Item Style and Format

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

General Guidelines

1. The Biology 1 EOC Assessment is a computer-based assessment. All items written for this assessment should be designed and written primarily for use with a computer-based test.
2. Test items should be clear and concise, and they should use vocabulary and sentence structure appropriate for Grade 9.
3. Whenever possible, test items should be written in active voice rather than in passive voice.
4. Scientific concepts should be appropriate to the content covered in the Biology 1 course description. Writers should refer to the Prior Knowledge information in the Individual Benchmark Specifications section, the instructional foundation for each benchmark grouping. The Grades 6–8 benchmarks are found on pages 19–35.
5. Test items should have only one correct answer. The words *most likely* or *best* should only be used when appropriate to the question.
6. The final sentence of all test item stems must be expressed as a question.
7. The International System of Units (SI) should be used unless otherwise noted. Temperature should be given in degrees Celsius.

8. Test items requiring art should be to scale whenever possible. A *not-to-scale* text box may be used when two different graphics appear to be the same size. The *not-to-scale* text box is located at the bottom left of the art.
9. Graphics in test items should be clearly labeled and contain all necessary information.
10. Test items referring to new developments or discoveries should include phrases similar to *according to current knowledge* or *based on current knowledge*.
11. Test item questions using the word *not* should emphasize the word *not* using all uppercase letters (e.g., *Which of the following is NOT an example of . . .*).
12. As appropriate, boldface type should be used to emphasize key words in the test item question (e.g., **least**, **most**, **greatest**, **percent**, **best**).
13. 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 . . .*).
14. An equal balance of male and female names should be used, including names representing current student names and different ethnic groups appropriate for Florida.
15. Test items may express values using scientific notation; however, items should not require calculations involving scientific notation.
16. Decimal numbers between $^{-}1$ and 1 should have a leading zero.
17. SI units should be expressed in a single type of unit (e.g., 1.4 kilograms instead of 1 kilogram 400 grams).
18. Decimal notation should be used for numbers with SI units (e.g., 1.5 grams instead of $1\frac{1}{2}$ grams).
19. Commas should be used in numbers greater than or equal to 1,000 unless the number has 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).
20. 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).
21. In titles of tables and charts and in labels for axes, the units of measure should be included, preferably in lowercase in parentheses, e.g., mass (kg).
22. 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).
23. In the test item stem, values needed to compute answers should be presented as numerals.

24. Test items assessing concepts that require equations should include the equation with the test item unless otherwise noted in the Individual Benchmark Specifications. Test items will not require the memorization of formulas.

Multiple-Choice (MC) Items

1. MC items should take approximately one minute per item to answer.
2. MC items are worth one point each.
3. MC items should have four answer options (A, B, C, and D).
4. The correct response should be indicated.
5. The rationale for distractors (incorrect answer options) should be indicated. The rationale should include information explaining why a student would select that distractor.
6. Distractor rationales should represent conceptual or computational errors commonly made by students who have not mastered the assessed concepts.
7. Each distractor should be a believable answer for someone who does not really know the correct answer.
8. Whenever possible, distractors should include common science misconceptions.
9. All distractors should be written in a style appropriate to the question asked. For example, a "how" question should have distractors that explain how.
10. Paired comparison structure of options should be avoided.
11. Options should have parallel structure whenever possible. Test items should not have an outlier (e.g., an answer option that is significantly longer than or different from the other options).
12. Test items should not be clued or answered by information in the stem or other options.
13. Options such as *none of the above, all of the above, not here, not enough information,* or *cannot be determined* should not be used. These responses should not be used as distractor rationales.
14. 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.
15. In most cases, answer options should be arranged vertically beneath the item stem.
16. If the answer options for an item are strictly numerical, they should be arranged in ascending or descending order, with the place values of digits aligned. 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.
17. 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 test item, by alphabetical order, or by length. Options may also be ordered in reverse alphabetical order or from longest to shortest. Options that are one word in length should be in alphabetical or reverse alphabetical order.

Context-Dependent (CD) Item Sets

1. The stimulus for the CD set may be a **short** passage describing a scientific event or investigation. The stimulus may include illustrations, graphics, tables, and/or graphs.
2. The reading level of the stimulus, excluding science terms, should be Grade 9.
3. Test items will be written so that students with benchmark mastery use scientific knowledge and the information in the passage to answer the test items in the set.
4. Test items will not be clued or answered by information in the passage or other items in the set.
5. Test items may require the student to analyze, interpret, evaluate, and/or draw inferences from the information in the stimulus.
6. As many test items as possible should be written to the stimulus. Those test items should represent an appropriate variety of benchmarks. On a test, a minimum of two different benchmarks should be assessed in a CD set.
7. CD sets may be titled; however, titles are not required.

Scope of Test Items

The scope of Biology 1 EOC Assessment test items is presented in Appendix B. Appendix B is based on the Biology 1 course description. The benchmarks serve as the objectives to which the test items are written. Additional guidelines or restrictions are located in the Individual Benchmark Specifications.

Guidelines for Item Writers

Biology 1 item writers must have a comprehensive knowledge of the assessed science curriculum and a strong understanding of the scientific concepts and cognitive abilities of the students taking the test. Item writers should know and consistently apply the guidelines established in this *Specifications* document, as well as contribute to the goal of developing test content that allows students to perform their best. Item writers are also expected to use their best judgment in writing items that measure the science benchmarks of the NGSSS without introducing extraneous elements that reflect bias for or against a group of students.

Item writers for the Biology 1 EOC Assessment must submit items in a particular format and must include the following information about each item. Because items are rated by committees of Florida educators following submission to DOE, familiarity with the directions for rating items (found in Appendix A) would prove useful to all item writers.

Format

Item writers must submit test items in the agreed-upon template. All appropriate sections of the template should be completed before the items are submitted.

Sources

Item writers are expected to provide sources for all verifiable information included in the test item. Acceptable sources include science magazines, science journals, or Internet sites maintained by reputable organizations such as government agencies, universities, or research centers.

Correct Response

Item writers must supply the correct response. Each distractor should be a believable answer for someone who does not know the correct answer. Rationales must include explanations for these errors.

Submission of Items

When submitting items, item writers must balance several factors. Item submissions should:

- include items of varying difficulty;
- include items of varying cognitive complexity;
- include items from varying content foci;
- include the content source(s) for the items;
- have a balance in location of the correct answer within benchmarks;
- have a balance of different female and different male names;
- use names representative of high school students in Florida; and
- be scientifically accurate.

Cognitive Complexity of Biology 1 End-of-Course Assessment Test Items

Educational standards and assessments can be aligned based on the category of content covered and also on the complexity of knowledge required. The Biology 1 EOC Assessment items, while assessing Florida's NGSSS, must also reflect this goal and standard. It is important to develop items that elicit student responses that demonstrate the complexity of knowledge and skills required to meet these objectives. The degree of challenge of test items is currently categorized in two ways: **item difficulty** and **cognitive complexity**.

Item Difficulty

The difficulty of test items is initially estimated by committees of educators participating in Item Content Review meetings each year. As each test item is reviewed, committee members make a prediction of difficulty based upon their knowledge of student performance at the given grade level. The classification scheme used for this prediction of item difficulty is based on the following:

Easy	More than 70 percent of the students are likely to respond correctly.
Average	Between 40 percent and 70 percent of the students are likely to respond correctly.
Challenging	Less than 40 percent of the students are likely to respond correctly.

After an item appears on a test, item difficulty refers to the actual percentage of students who chose the correct answer.

Cognitive Complexity

Cognitive complexity refers to the cognitive demand associated with an item. In the early years of the FCAT program, the Florida Department of Education (DOE) used Bloom's Taxonomy[1] to classify test items; however, Bloom's Taxonomy is difficult to use because it requires an inference about the skill, knowledge, and background of the students responding to the item. Beginning in 2004, the DOE implemented a new cognitive classification system based upon Dr. Norman L. Webb's Depth of Knowledge (DOK) levels.[2] The rationale for classifying an item by its DOK level of complexity focuses on the *expectations made of the item*, not on the *ability of the student*. When classifying an item's demands on thinking (i.e., what the item requires the student to recall, understand, analyze, and do), it is assumed that the student is familiar with the basic concepts of the task. Test items are chosen for the FCAT 2.0 and EOC assessments based on the NGSSS and on their grade-level appropriateness, but the complexity of the items remains independent of the particular curriculum a student has experienced. On any given assessment, the cognitive complexity of a multiple-choice item may be affected by the distractors. The cognitive complexity of an item depends on the grade level of the assessment; a test item that has a high level of cognitive complexity at one grade may not be as complex at a higher grade.

The categories—low complexity, moderate complexity, and high complexity—form an ordered description of the demands an item may make on a student. For example, low-complexity items may require a student to solve a one-step problem. Moderate-complexity items may require multiple steps. High-complexity items may require a student to analyze and synthesize information. The distinctions made in item complexity ensure that test items will assess the depth of student knowledge at each benchmark. The intent of the item writer weighs heavily in determining the complexity of a test item. At the end of this section, three high school biology items illustrate how a single concept may be assessed by items with increasing cognitive complexity.

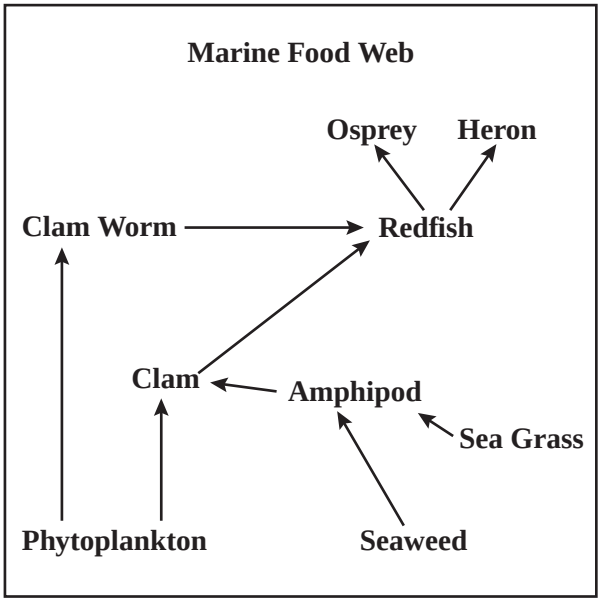
The pages that follow illustrate some of the varying demands that test items might make at each complexity level for the Biology 1 EOC Assessment. Note that test items may fit one or more descriptions. In most instances, these test items are classified in the highest level of complexity demanded by the test item. Caution must be used in referring to the table of descriptors that is provided for each cognitive complexity level. This table is provided for ease of reference, but the ultimate determination of item complexity should be made considering the overall cognitive demand placed on a student. Another table provides the breakdown of the percentage of points by cognitive complexity level.

[1] Bloom, B.S. et al. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain.* New York: McKay, 1956.
[2] Webb, Norman L. and others. "Web Alignment Tool" 24 July 2005. Wisconsin Center of Educational Research. University of Wisconsin-Madison. 2 Feb. 2006. http://www.wcer.wisc.edu/WAT/index.aspx.

Low Complexity

Science low-complexity test items rely heavily on the recall and recognition of previously learned concepts and principles. Test items typically specify what the student is to do, which often is to carry out some procedure that can be performed mechanically. It is not left to the student to come up with an original method or solution.

A marine food web is shown below.



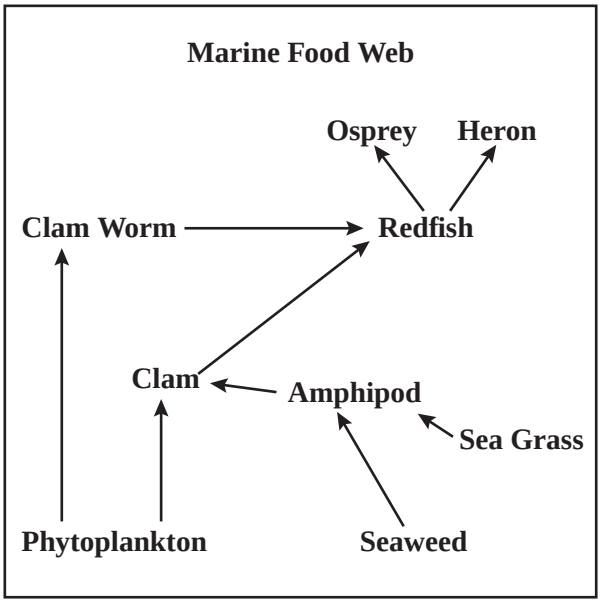
Which of the following organisms is a consumer in this food web?

A. Seaweed
B. Sea Grass
★ **C.** Clam Worm
D. Phytoplankton

Moderate Complexity

Science moderate-complexity test items involve more flexible thinking than low-complexity test items do. They require a response that goes beyond the habitual, is not specified, and ordinarily involves more than a single step or thought process. The student is expected to decide what to do—using informal methods of reasoning and problem-solving strategies—and to bring together skill and knowledge from various domains.

A marine food web is shown below.



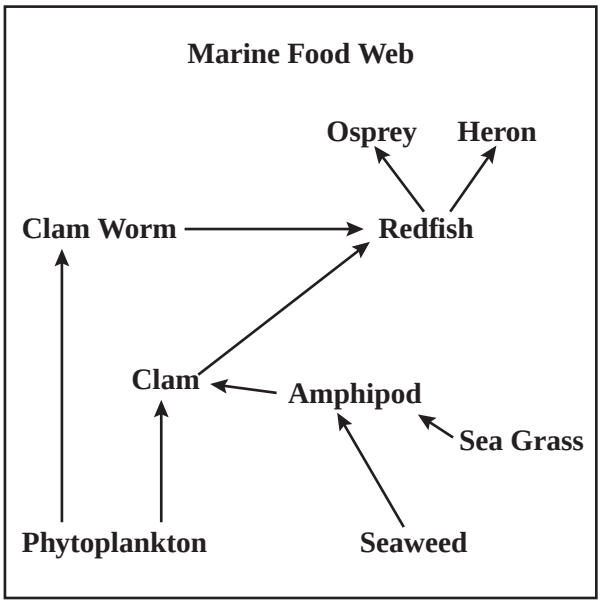
Which of the following organisms is found in the trophic level with the highest biomass that sustains the ecosystem represented by this food web?

A. Amphipod
B. Heron
C. Redfish
★ **D.** Seaweed

High Complexity

Science high-complexity test items make heavy demands on student thinking. Students must engage in abstract reasoning, planning, analysis, judgment, and creative thought. The test items require the student to think in an abstract and sophisticated way, often involving multiple steps.

A marine food web is shown below.



Which of the following is a **long-term** effect on the removal of the redfish from the ecosystem represented by this food web?

A. The osprey population will increase.
B. The amphipod population will increase.
★ **C.** The clam worm population will increase.
D. The phytoplankton population will increase.

The following table is provided for ease of reference; however, caution must be used in referring to this table of descriptors for each cognitive complexity level. The ultimate determination of an item's cognitive complexity should be made considering the intent of the overall cognitive demand placed on a student.

Examples of Science Activities across Cognitive Complexity Levels		
Low-Complexity Science	**Moderate-Complexity Science**	**High-Complexity Science**
• Identify a common example or recognize a concept. • Retrieve information from a chart, table, diagram, or graph. • Recognize a standard scientific representation of a simple phenomenon. • Calculate or complete a familiar single-step procedure or equation using a reference sheet.	• Apply or infer relationships among facts, terms, properties, or variables. • Describe examples and non-examples of scientific processes or concepts. • Predict or determine the logical next step or outcome. • Compare or contrast structures or functions of different organisms or systems. • Choose the appropriate formula or equation to solve a problem and then solve it. • Apply and use concepts from a standard scientific model or theory.	• Construct models for research. • Generalize or draw conclusions. • Design an experiment, given data and conditions. • Explain or solve a problem in more than one way. • Provide a justification for steps in a solution or process. • Analyze an experiment to identify a flaw and propose a method for correcting it. • Interpret, explain, or solve a problem involving complex spatial relationships. • Predict a long-term effect, outcome, or result of a change within a system.

The table below presents the range for the percent of raw score points by cognitive complexity on FCAT 2.0 Science, Grade 5 and Grade 8, and the Biology 1 EOC Assessment.

Percentage of Points by Cognitive Complexity Level for FCAT 2.0 Science and Biology 1 EOC Assessment

Grade	Low	Moderate	High
5	10%–20%	60%–80%	10%–20%
8	10%–20%	60%–80%	10%–20%
Biology 1	10%–20%	60%–80%	10%–20%

Universal Design

The application of universal design principles helps develop assessments that are usable to the greatest number of test takers, including students with disabilities and nonnative speakers of English. To support the goal of providing access to all students, the test maximizes readability, legibility, and compatibility with accommodations, and test development includes a review for potential bias and sensitivity issues.

The DOE trains both internal and external reviewers to revise items, allowing 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 test layout and design including, but not limited to, type size, line length, spacing, and graphics.

Review Procedures for Biology 1 End-of-Course Assessment Test Items

Prior to appearing on any Florida state assessment, all science test items must pass several levels of review as part of the FCAT 2.0 development process. Florida educators and citizens, in conjunction with the DOE and the assessment contractors, scrutinize all material related to test items prior to accepting it for placement on the tests.

Review for Potential Bias and Community Sensitivity

Science test 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.

Florida citizens associated with a variety of organizations and institutions review all test items for issues of potential concern to members of the community at large. The purpose for this review is to ensure that the primary purpose of assessing science achievement is not undermined by inadvertently including in the test any material that parents and 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. Test items are written to meet FCAT 2.0 and EOC assessment criteria and to measure the content in the NGSSS for science.

Review of Test Items

The DOE and the assessment contractor review all test items during the item development process.

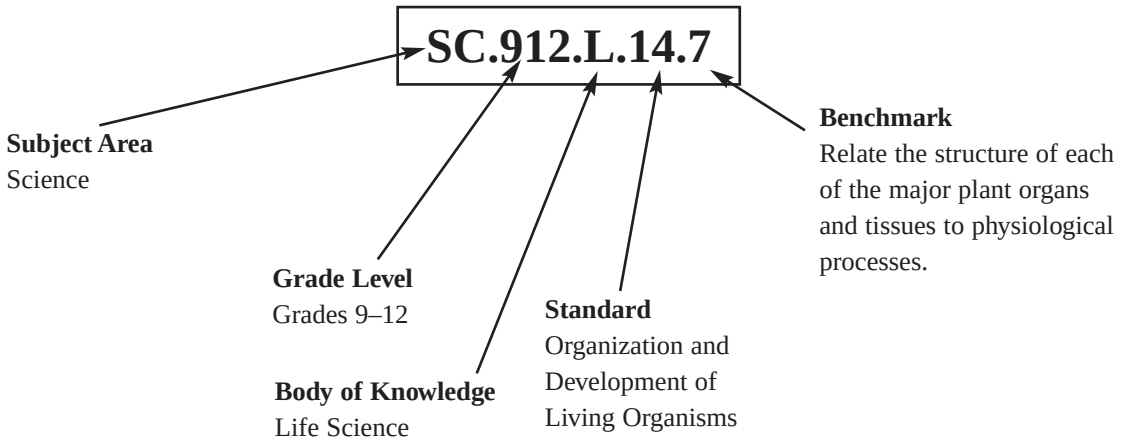
Groups of Florida science educators are subsequently convened to review the test items for content characteristics and item specifications. The content review focuses on validity, determining whether each item is a valid measure of the designated NGSSS benchmark, as defined by the *Specifications* for test items. Separate reviews for bias and sensitivity issues are also conducted as noted above.

Due to the theory-based nature of the content area, all potential science test items undergo an extra level of scrutiny. A committee of university-level science researchers, university-level faculty, and practicing scientists from the private sector reviews the test items to ensure the accuracy and currency of the science content.

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** to which the benchmark belongs.
- The letter in the *third position* represents the **Body of Knowledge** to which the benchmark belongs.
- The number in the *fourth position* represents the **Standard.**
- The number in the *last position* identifies the specific **Benchmark** under the Standard.



Grades 9–12	
Body of Knowledge	Life Science
Standard 14	Organization and Development of Living Organisms
SC.912.L.14.7	Relate the structure of each of the major plant organs and tissues to physiological processes.

Definitions of Benchmark Specifications

The *Specifications* identifies how the benchmarks in Florida's NGSSS are assessed on the Biology 1 EOC Assessment. For each benchmark assessed in science, the following information is provided in the Individual Benchmark Specifications section.

Reporting Category refers to a category of related benchmarks from the NGSSS that are used to summarize and report achievement for the Biology 1 EOC Assessment.

Standard refers to the standards statement presented in the NGSSS.

Benchmark refers to the benchmark statement presented in the NGSSS. The benchmarks are specific statements of expected student achievement. In some cases, two or more benchmarks are grouped together because of the relatedness of the concepts in those benchmarks. The related benchmarks are noted in the benchmark statement and are stated in the Also Assesses section.

Also Assesses refers to the benchmarks that are closely related to the benchmark (see description above).

Benchmark Clarification explains how the achievement of the benchmark will be demonstrated by students. Clarification statements are written for the benchmark and the Also Assesses benchmark(s). 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 test items for the benchmark.

Benchmark content limits are to be used in conjunction with the Overall Considerations, Item Contexts, and the General Guidelines of the Item Style and Format sections in the *Specifications*. The content limits defined in the Individual Benchmark Specifications section may be an expansion or further restriction of the Overall Considerations, Item Contexts, and the General Guidelines.

Stimulus Attributes define the types of stimulus materials that should be used in the test items, including the appropriate use of item context, content, or graphic materials.

Response Attributes define the characteristics of the options from which a student must choose to answer the question.

Prior Knowledge refers to benchmarks from lower grades that are the foundation for the concept(s) assessed. Test items may require the student to apply scientific knowledge described in the NGSSS from lower grades; however, test items should be written to assess the appropriate grade-level benchmark.

Sample Items are provided for each assessed benchmark grouping. The sample items are presented in a format similar to the one used in the test. The correct answer for each sample item is identified with a star. The benchmark that the sample item is written to assess is provided. The sample items provided represent a range of cognitive complexities.

Grades 6–8 FCAT 2.0 Science Benchmarks

The NGSSS for science are organized by grade level for Grades K–8. Eighteen Big Ideas thread throughout all grade levels and build in rigor and depth as students advance. The science benchmarks for Grades 6–8 serve as a foundation for the Grades 9–12 benchmarks. For that reason, the Grades 6–8 science benchmarks are included in this document. In the Individual Benchmark Specifications for Biology 1 End-of-Course Assessment section, Grades 6–8 benchmarks are cited in the Prior Knowledge sections.

Big Idea 1 The Practice of Science		
Grade 6	**Grade 7**	**Grade 8**
SC.6.N.1.1 Define a problem from the sixth grade curriculum; use appropriate reference materials to support scientific understanding; plan and carry out scientific investigations of various types, such as systematic observations or experiments; identify variables; collect and organize data; interpret data in charts, tables, and graphics; analyze information; make predictions; and defend conclusions.	**SC.7.N.1.1** Define a problem from the seventh grade curriculum; use appropriate reference materials to support scientific understanding; plan and carry out scientific investigations of various types, such as systematic observations or experiments; identify variables; collect and organize data; interpret data in charts, tables, and graphics; analyze information; make predictions; and defend conclusions.	**SC.8.N.1.1** Define a problem from the eighth grade curriculum using appropriate reference materials to support scientific understanding; plan and carry out scientific investigations of various types, such as systematic observations or experiments; identify variables; collect and organize data; interpret data in charts, tables, and graphics; analyze information; make predictions; and defend conclusions.
SC.6.N.1.2 Explain why scientific investigations should be replicable.	**SC.7.N.1.2** Differentiate replication (by others) from repetition (multiple trials).	**SC.8.N.1.2** Design and conduct a study using repeated trials and replication.
SC.6.N.1.3 Explain the difference between an experiment and other types of scientific investigation, and explain the relative benefits and limitations of each.	**SC.7.N.1.3** Distinguish between an experiment (which must involve the identification and control of variables) and other forms of scientific investigation, and explain that not all scientific knowledge is derived from experimentation.	**SC.8.N.1.3** Use phrases such as “results support” or “fail to support” in science, understanding that science does not offer conclusive ‘proof’ of a knowledge claim.
SC.6.N.1.4 Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.	**SC.7.N.1.4** Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment.	**SC.8.N.1.4** Explain how hypotheses are valuable if they lead to further investigations, even if they turn out not to be supported by the data.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 1 The Practice of Science		
Grade 6	**Grade 7**	**Grade 8**
SC.6.N.1.5 Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.	**SC.7.N.1.5** Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.	**SC.8.N.1.5** Analyze the methods used to develop a scientific explanation as seen in different fields of science.
	SC.7.N.1.6 Explain that empirical evidence is the cumulative body of observations of a natural phenomenon on which scientific explanations are based.	**SC.8.N.1.6** Understand that scientific investigations involve the collection of relevant empirical evidence; the use of logical reasoning; and the application of imagination in devising hypotheses, predictions, explanations, and models to make sense of the collected evidence.
	SC.7.N.1.7 Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community.	
Big Idea 2 The Characteristics of Scientific Knowledge		
Grade 6	**Grade 7**	**Grade 8**
SC.6.N.2.1 Distinguish science from other activities involving thought.	**SC.7.N.2.1** Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered.	**SC.8.N.2.1** Distinguish between scientific and pseudoscientific ideas.
SC.6.N.2.2 Explain that scientific knowledge is durable because it is open to change as new evidence or interpretations are encountered.		**SC.8.N.2.2** Discuss what characterizes science and its methods.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 2 The Characteristics of Scientific Knowledge		
Grade 6	**Grade 7**	**Grade 8**
SC.6.N.2.3 Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.		
Big Idea 3 The Role of Theories, Laws, Hypotheses, and Models		
Grade 6	**Grade 7**	**Grade 8**
SC.6.N.3.1 Recognize and explain that a scientific theory is a well-supported and widely accepted explanation of nature and is not simply a claim posed by an individual. Thus, the use of the term theory in science is very different than how it is used in everyday life.	**SC.7.N.3.1** Recognize and explain the difference between theories and laws and give several examples of scientific theories and the evidence that supports them.	**SC.8.N.3.1** Select models useful in relating the results of their own investigations.
SC.6.N.3.2 Recognize and explain that a scientific law is a description of a specific relationship under given conditions in the natural world. Thus, scientific laws are different from societal laws.	**SC.7.N.3.2** Identify the benefits and limitations of the use of scientific models.	**SC.8.N.3.2** Explain why theories may be modified but are rarely discarded.
SC.6.N.3.3 Give several examples of scientific laws.		
SC.6.N.3.4 Identify the role of models in the context of the sixth grade science benchmarks.		

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 4 Science and Society		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.N.4.1 Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels.
		SC.8.N.4.2 Explain how political, social, and economic concerns can affect science, and vice versa.
Big Idea 5 Earth in Space and Time		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.E.5.1 Recognize that there are enormous distances between objects in space, and apply our knowledge of light and space travel to understand this distance.
		SC.8.E.5.2 Recognize that the universe contains many billions of galaxies and that each galaxy contains many billions of stars.
		SC.8.E.5.3 Distinguish the hierarchical relationships between planets and other astronomical bodies relative to solar system, galaxy, and universe, including distance, size, and composition.
		SC.8.E.5.4 Explore the Law of Universal Gravitation by explaining the role that gravity plays in the formation of planets, stars, and solar systems and in determining their motions.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 5 Earth in Space and Time		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.E.5.5 Describe and classify specific physical properties of stars: apparent magnitude (brightness), temperature (color), size, and luminosity (absolute brightness).
		SC.8.E.5.6 Create models of solar properties including: rotation, structure of the Sun, convection, sunspots, solar flares, and prominences.
		SC.8.E.5.7 Compare and contrast the properties of objects in the Solar System including the Sun, planets, and moons to those of Earth, such as gravitational force, distance from the Sun, speed, movement, temperature, and atmospheric conditions.
		SC.8.E.5.8 Compare various historical models of the Solar System, including geocentric and heliocentric.
		SC.8.E.5.9 Explain the impact of objects in space on each other including: 1. the Sun on the Earth including seasons and gravitational attraction 2. the Moon on the Earth, including phases, tides, and eclipses, and the relative position of each body.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 5 Earth in Space and Time		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.E.5.10 Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information.
		SC.8.E.5.11 Identify and compare characteristics of the electromagnetic spectrum such as wavelength, frequency, use, and hazards, and recognize its application to an understanding of planetary images and satellite photographs.
		SC.8.E.5.12 Summarize the effects of space exploration on the economy and culture of Florida.
Big Idea 6 Earth Structures		
Grade 6	**Grade 7**	**Grade 8**
SC.6.E.6.1 Describe and give examples of ways in which Earth's surface is built up and torn down by physical and chemical weathering, erosion, and deposition.	**SC.7.E.6.1** Describe the layers of the solid Earth, including the lithosphere, the hot convecting mantle, and the dense metallic liquid and solid cores.	
SC.6.E.6.2 Recognize that there are a variety of different landforms on Earth's surface such as coastlines, dunes, rivers, mountains, glaciers, deltas, and lakes, and relate these landforms as they apply to Florida.	**SC.7.E.6.2** Identify the patterns within the rock cycle and relate them to surface events (weathering and erosion) and sub-surface events (plate tectonics and mountain building).	

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 6 Earth Structures		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.E.6.4 Explain and give examples of how physical evidence supports scientific theories that Earth has evolved over geologic time due to natural processes.	
	SC.7.E.6.5 Explore the scientific theory of plate tectonics by describing how the movement of Earth's crustal plates causes both slow and rapid changes in Earth's surface, including volcanic eruptions, earthquakes, and mountain building.	
	SC.7.E.6.6 Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.	
	SC.7.E.6.7 Recognize that heat flow and movement of material within Earth causes earthquakes and volcanic eruptions, and creates mountains and ocean basins.	
Big Idea 7 Earth Systems and Patterns		
Grade 6	**Grade 7**	**Grade 8**
SC.6.E.7.1 Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through Earth's system.		

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 7 Earth Systems and Patterns		
Grade 6	**Grade 7**	**Grade 8**
SC.6.E.7.2 Investigate and apply how the cycling of water between the atmosphere and hydrosphere has an effect on weather patterns and climate.		
SC.6.E.7.3 Describe how global patterns such as the jet stream and ocean currents influence local weather in measurable terms such as temperature, air pressure, wind direction and speed, and humidity and precipitation.		
SC.6.E.7.4 Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere.		
SC.6.E.7.5 Explain how energy provided by the sun influences global patterns of atmospheric movement and the temperature differences between air, water, and land.		
SC.6.E.7.6 Differentiate between weather and climate.		
SC.6.E.7.7 Investigate how natural disasters have affected human life in Florida.		
SC.6.E.7.8 Describe ways human beings protect themselves from hazardous weather and sun exposure.		

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 7 Earth Systems and Patterns		
Grade 6	**Grade 7**	**Grade 8**
SC.6.E.7.9 Describe how the composition and structure of the atmosphere protects life and insulates the planet.		
Big Idea 8 Properties of Matter		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.P.8.1 Explore the scientific theory of atoms (also known as atomic theory) by using models to explain the motion of particles in solids, liquids, and gases.
		SC.8.P.8.2 Differentiate between weight and mass, recognizing that weight is the amount of gravitational pull on an object and is distinct from, though proportional to, mass.
		SC.8.P.8.3 Explore and describe the densities of various materials through measurement of their masses and volumes.
		SC.8.P.8.4 Classify and compare substances on the basis of characteristic physical properties that can be demonstrated or measured: for example, density, thermal or electrical conductivity; solubility; magnetic properties; melting and boiling points, and know that these properties are independent of the amount of the sample.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 8 Properties of Matter		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.P.8.5 Recognize that there are a finite number of elements and that their atoms combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.
		SC.8.P.8.6 Recognize that elements are grouped in the periodic table according to similarities of their properties.
		SC.8.P.8.7 Explore the scientific theory of atoms (also known as atomic theory) by recognizing that atoms are the smallest unit of an element and are composed of sub-atomic particles (electrons surrounding a nucleus containing protons and neutrons).
		SC.8.P.8.8 Identify basic examples of and compare and classify the properties of compounds, including acids, bases, and salts.
		SC.8.P.8.9 Distinguish among mixtures (including solutions) and pure substances.

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 9 Changes in Matter		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.P.9.1 Explore the Law of Conservation of Mass by demonstrating and concluding that mass is conserved when substances undergo physical and chemical changes.
		SC.8.P.9.2 Differentiate between physical changes and chemical changes.
		SC.8.P.9.3 Investigate and describe how temperature influences chemical changes.
Big Idea 10 Forms of Energy		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.P.10.1 Illustrate that the sun's energy arrives as radiation with a wide range of wavelengths, including infrared, visible, and ultraviolet, and that white light is made up of a spectrum of many different colors.	
	SC.7.P.10.2 Observe and explain that light can be reflected, refracted, and/or absorbed.	
	SC.7.P.10.3 Recognize that light waves, sound waves, and other waves move at different speeds in different materials.	

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 11 Energy Transfer and Transformations		
Grade 6	**Grade 7**	**Grade 8**
SC.6.P.11.1 Explore the Law of Conservation of Energy by differentiating between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.	**SC.7.P.11.1** Recognize that adding heat to or removing heat from a system may result in a temperature change and possibly a change of state.	
	SC.7.P.11.2 Investigate and describe the transformation of energy from one form to another.	
	SC.7.P.11.3 Cite evidence to explain that energy cannot be created nor destroyed, only changed from one form to another.	
	SC.7.P.11.4 Observe and describe that heat flows in predictable ways, moving from warmer objects to cooler ones until they reach the same temperature.	
Big Idea 12 Motion of Objects		
Grade 6	**Grade 7**	**Grade 8**
SC.6.P.12.1 Measure and graph distance versus time for an object moving at a constant speed. Interpret this relationship.		
Big Idea 13 Forces and Changes in Motion		
Grade 6	**Grade 7**	**Grade 8**
SC.6.P.13.1 Investigate and describe types of forces including contact forces and forces acting at a distance, such as electrical, magnetic, and gravitational.		

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 13 Forces and Changes in Motion		
Grade 6	**Grade 7**	**Grade 8**
SC.6.P.13.2 Explore the Law of Gravity by recognizing that every object exerts gravitational force on every other object and that the force depends on how much mass the objects have and how far apart they are.		
SC.6.P.13.3 Investigate and describe that an unbalanced force acting on an object changes its speed, or direction of motion, or both.		
Big Idea 14 Organization and Development of Living Organisms		
Grade 6	**Grade 7**	**Grade 8**
SC.6.L.14.1 Describe and identify patterns in the hierarchical organization of organisms from atoms to molecules and cells to tissues to organs to organ systems to organisms.		
SC.6.L.14.2 Investigate and explain the components of the scientific theory of cells (cell theory): all organisms are composed of cells (single-celled or multi-cellular), all cells come from pre-existing cells, and cells are the basic unit of life.		
SC.6.L.14.3 Recognize and explore how cells of all organisms undergo similar processes to maintain homeostasis, including extracting energy from food, getting rid of waste, and reproducing.		

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 14 Organization and Development of Living Organisms		
Grade 6	**Grade 7**	**Grade 8**
SC.6.L.14.4 Compare and contrast the structure and function of major organelles of plant and animal cells, including cell wall, cell membrane, nucleus, cytoplasm, chloroplasts, mitochondria, and vacuoles.		
SC.6.L.14.5 Identify and investigate the general functions of the major systems of the human body (digestive, respiratory, circulatory, reproductive, excretory, immune, nervous, and musculoskeletal) and describe ways these systems interact with each other to maintain homeostasis.		
SC.6.L.14.6 Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi, and parasites.		
Big Idea 15 Diversity and Evolution of Living Organisms		
Grade 6	**Grade 7**	**Grade 8**
SC.6.L.15.1 Analyze and describe how and why organisms are classified according to shared characteristics, with emphasis on the Linnaean system combined with the concept of Domains.	**SC.7.L.15.1** Recognize that fossil evidence is consistent with the scientific theory of evolution that living things evolved from earlier species.	

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 15 Diversity and Evolution of Living Organisms		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.L.15.2 Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.	
	SC.7.L.15.3 Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.	
Big Idea 16 Heredity and Reproduction		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.L.16.1 Understand and explain that every organism requires a set of instructions that specifies its traits, that this hereditary information (DNA) contains genes located in the chromosomes of each cell, and that heredity is the passage of these instructions from one generation to another.	
	SC.7.L.16.2 Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.	
	SC.7.L.16.3 Compare and contrast the general processes of sexual reproduction requiring meiosis and asexual reproduction requiring mitosis.	

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 16 Heredity and Reproduction		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.L.16.4 Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society, and the environment.	
Big Idea 17 Interdependence		
Grade 6	**Grade 7**	**Grade 8**
	SC.7.L.17.1 Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.	
	SC.7.L.17.2 Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.	
	SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.	

Grades 6–8 FCAT 2.0 Science Benchmarks

Big Idea 18 Matter and Energy Transformations		
Grade 6	**Grade 7**	**Grade 8**
		SC.8.L.18.1 Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water, and chlorophyll; production of food; release of oxygen.
		SC.8.L.18.2 Describe and investigate how cellular respiration breaks down food to provide energy and releases carbon dioxide.
		SC.8.L.18.3 Construct a scientific model of the carbon cycle to show how matter and energy are continuously transferred within and between organisms and their physical environment.
		SC.8.L.18.4 Cite evidence that living systems follow the Laws of Conservation of Mass and Energy.

Individual Benchmark Specifications for Biology 1 End-of-Course Assessment

This section of the *Specifications* describes how the science benchmarks are assessed on the Biology 1 EOC Assessment. The benchmarks in the Biology 1 course description serve as the foundation for this assessment.

The sample test items included in the *Specifications* represent, whenever possible, a range of difficulty and cognitive complexity. Although most of the test items are of average difficulty and moderate complexity, some of the items presented will be challenging for some students and are specifically included to prompt item writers to submit test items that will measure the abilities of higher-achieving students. As a general rule, test items should be written at the cognitive level of the benchmark.

Benchmark SC.912.N.1.1

Reporting Category Items for this benchmark grouping will be placed in the appropriate reporting category based on the content of the item.

Standard **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.**

(Also assesses SC.912.N.1.4, SC.912.N.1.6, SC.912.L.14.4, LA.910.2.2.3, LA.910.4.2.2, MA.912.S.1.2, and MA.912.S.3.2.)

Also Assesses

SC.912.N.1.4 Identify sources of information and assess their reliability according to the strict standards of scientific investigation.

SC.912.N.1.6 Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

SC.912.L.14.4 Compare and contrast structure and function of various types of microscopes.

LA.910.2.2.3 The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, comparing, contrasting, or outlining).

LA.910.4.2.2 The student will record information and ideas from primary and/or secondary sources accurately and coherently, noting the validity and reliability of these sources and attributing sources of information.

MA.912.S.1.2 Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment.

MA.912.S.3.2 Collect, organize, and analyze data sets, determine the best format for the data, and present visual summaries from the following:

- bar graphs;
- line graphs;
- stem and leaf plots;
- circle graphs;
- histograms;
- box and whisker plots;
- scatter plots; and
- cumulative frequency (ogive) graphs.

Benchmark Clarifications

Students will design and/or evaluate a scientific investigation using evidence of scientific thinking and/or problem solving.

Students will interpret and analyze data to make predictions and/or defend conclusions.

Students will compare and/or contrast the structure and function of the compound microscope, dissecting microscope, scanning electron microscope, and/or the transmission electron microscope.

Students will evaluate the merits of scientific explanations produced by others.

Students will assess the reliability of sources of information according to scientific standards.

Students will describe how scientific inferences are made from observations and identify examples from biology.

Content Limits

None specified

Stimulus Attribute

Scenarios will be placed in the context of experimental design, experiment(s), scientific investigation(s), or scientific observation(s) in the field of biology.

Response Attributes

None specified

Prior Knowledge

Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.N.1.1, SC.6.N.1.2, SC.6.N.1.3, SC.6.N.1.4, SC.6.N.1.5, SC.7.N.1.1, SC.7.N.1.2, SC.7.N.1.3, SC.7.N.1.4, SC.7.N.1.5, SC.7.N.1.6, SC.7.N.1.7, SC.8.N.1.1, SC.8.N.1.2, SC.8.N.1.3, SC.8.N.1.4, SC.8.N.1.5, and SC.8.N.1.6.

Sample Item 1 SC.912.N.1.1

An osmosis investigation was conducted using chicken eggs to represent cells with semipermeable membranes. The mass of each egg was measured to determine how much water diffused into or out of the eggs. The eggs were first soaked in vinegar to dissolve the shell. Each egg was then placed in one of three different solutions for 24 hours. The table below shows the results of the investigation.

OSMOSIS IN CELLS

Solution	Average Mass of Eggs Before Soaking (grams)	Average Mass of Eggs After Soaking (grams)	Difference in Average Mass (grams)	Percent Change in Average Mass
Vinegar (95% water)	71.2	98.6	27.4	+38.5
Corn syrup (5% water)	98.6	64.5	34.1	-34.6
Distilled water (100% water)	64.5	105.3	40.8	+63.3

Based on this experiment, which of the following should be inferred about cells with semipermeable membranes?

A. Substances other than water may also cross the cell membrane.
B. Substances other than water may block pores in the cell membrane.
★ **C.** Water enters the cell when placed in environments of high water concentration.
D. Water leaves the cell when placed in environments with a low concentration of solutes.

Benchmark SC.912.L.14.1

Reporting Category	Molecular and Cellular Biology
Standard	**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. (Also assesses SC.912.N.1.3, SC.912.N.2.1, SC.912.N.3.1, and SC.912.N.3.4.)**
Also Assesses	**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. **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). **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. **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.
Benchmark Clarifications	Students will describe and/or explain the cell theory. Students will describe how continuous investigations and/or new scientific information influenced the development of the cell theory. Students will identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations). Students will identify what is science, what is not science, and what resembles but fails to meet the criteria for science. Students will explain the development of a theory. Students will recognize the differences between theories and laws.
Content Limits	Items may assess how contributions of scientists such as Van Leeuwenhoek, Hooke, Schwann, Schleiden, and/or Virchow aided in the development of the cell theory but will not assess what each scientist contributed.

Content Limits	Items assessing a scientific claim, the development of a theory, or the differences between theories and laws are limited to the cell theory.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.2, SC.8.E.5.10, SC.6.N.2.1, SC.6.N.2.2, SC.6.N.3.1, SC.6.N.3.2, SC.6.N.3.3, SC.7.N.1.7, SC.7.N.2.1, SC.7.N.3.1, SC.8.N.1.5, SC.8.N.2.1, SC.8.N.2.2, and SC.8.N.3.2.

Sample Item 2 **SC.912.L.14.1**

The cell theory was first proposed in 1838. Evidence obtained through additional scientific investigations resulted in the current cell theory. Which statement describes a component of the original cell theory that was removed because of the new scientific knowledge?

A. All living things are made of cells.
B. All cells come from other preexisting cells.
★ **C.** Cells form through spontaneous generation.
D. Cells are the basic structural and functional units of life.

Benchmark SC.912.L.14.3

Reporting Category	Molecular and Cellular Biology
Standard	**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. (Also assesses SC.912.L.14.2.)**
Also Assesses	**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).
Benchmark Clarifications	Students will compare and/or contrast the structures found in plant cells and in animal cells. Students will compare and/or contrast the structures found in prokaryotic cells and in eukaryotic cells. Students will describe how structures in cells are directly related to their function in the cell. Students will explain the role of the cell membrane during active and passive transport.
Content Limits	Items will not address protists or fungi or assess cellular structures unique to protists or fungi. Items referring to prokaryotic structures are limited to the cell wall, cell membrane (plasma membrane), cytoplasm, plasmid, ribosomes, and flagella. Items referring to eukaryotic structures are limited to the cell wall, cell membrane (plasma membrane), cytoplasm, nucleus, nuclear envelope, nucleolus, chromatin, ribosomes, endoplasmic reticulum, microtubules, microfilaments, vacuoles, mitochondria, Golgi apparatus, chloroplasts, lysosomes, cilia, and flagella. 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.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.3 and SC.6.L.14.4.

Sample Item 3 SC.912.L.14.3

There are some similarities between prokaryotic and eukaryotic cells. Which of the following structures is found in both prokaryotic and eukaryotic cells?

A. lysosome
B. mitochondrion
C. nucleus
★ **D.** ribosome

Benchmark SC.912.L.14.7

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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.**
Benchmark Clarification	Students will explain how the structures of plant tissues and organs are directly related to their roles in physiological processes.
Content Limits	Items will assess the function of plant tissues and organs in the context of physiological processes. Items assessing plant organs are limited to roots, stems, leaves, flowers, fruits, and cones. Items referring to physiological processes are limited to photosynthesis, cellular respiration, transpiration, and reproduction. Items assessing plant tissues are limited to meristematic, ground, dermal, and vascular tissues. Items referring to plant structures are limited to cambium, guard cells, phloem, seed, stomata, and xylem. Items will not address or assess mitosis or meiosis.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.1 and SC.6.L.14.4.

Sample Item 4 SC.912.L.14.7

Terrestrial plants have stomata on the surface of their leaves. A single stoma is surrounded by two guard cells that change shape in response to environmental factors and open or close the stoma. Which of the following **best** explains how the structure of the leaf is used in processes that occur in the plant?

A. Water enters the plant through the surface of the leaf for transpiration.
★ **B.** Gases for photosynthesis are exchanged through the surface of the leaf.
C. Energy for cellular reproduction is absorbed through the surface of the leaf.
D. Carbon dioxide enters the plant through the surface of the leaf for cellular respiration.

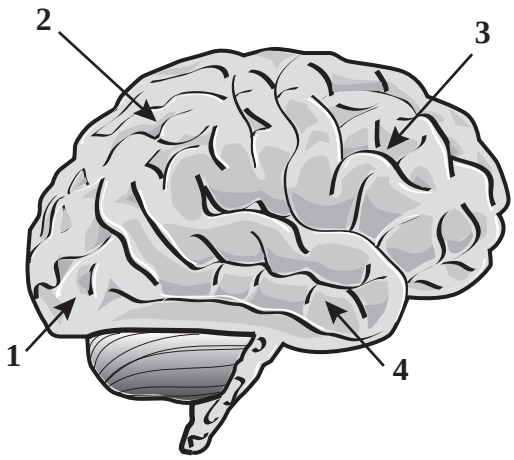
Benchmark SC.912.L.14.26

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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.**
Benchmark Clarification	Students will identify the major parts of the brain on diagrams.
Content Limits	Items are limited to the cerebrum, cerebellum, pons, medulla oblongata, brain stem, frontal lobe, parietal lobe, occipital lobe, and temporal lobe. Items will not assess the function of the major parts of the brain.
Stimulus Attribute	Items will include diagrams of the brain.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge from SC.6.L.14.5.

Sample Item 5 SC.912.L.14.26

The illustration below shows four lobes of the human brain.

Four Lobes of the Human Brain



What lobe is designated by label 2?

A. temporal
★ **B.** parietal
C. occipital
D. frontal

Benchmark SC.912.L.14.36

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**Standard 14** Organization and Development of Living Organisms
Benchmark	**SC.912.L.14.36 Describe the factors affecting blood flow through the cardiovascular system.**
Benchmark Clarification	Students will identify factors that affect blood flow and/or describe how these factors affect blood flow through the cardiovascular system.
Content Limits	Items may address factors such as blood pressure, blood volume, resistance, disease, and exercise.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge from SC.6.L.14.5.

Sample Item 6 SC.912.L.14.36

The rate at which blood flows through the human body changes in response to many factors. Which statement describes one of these factors and its effect on blood flow?

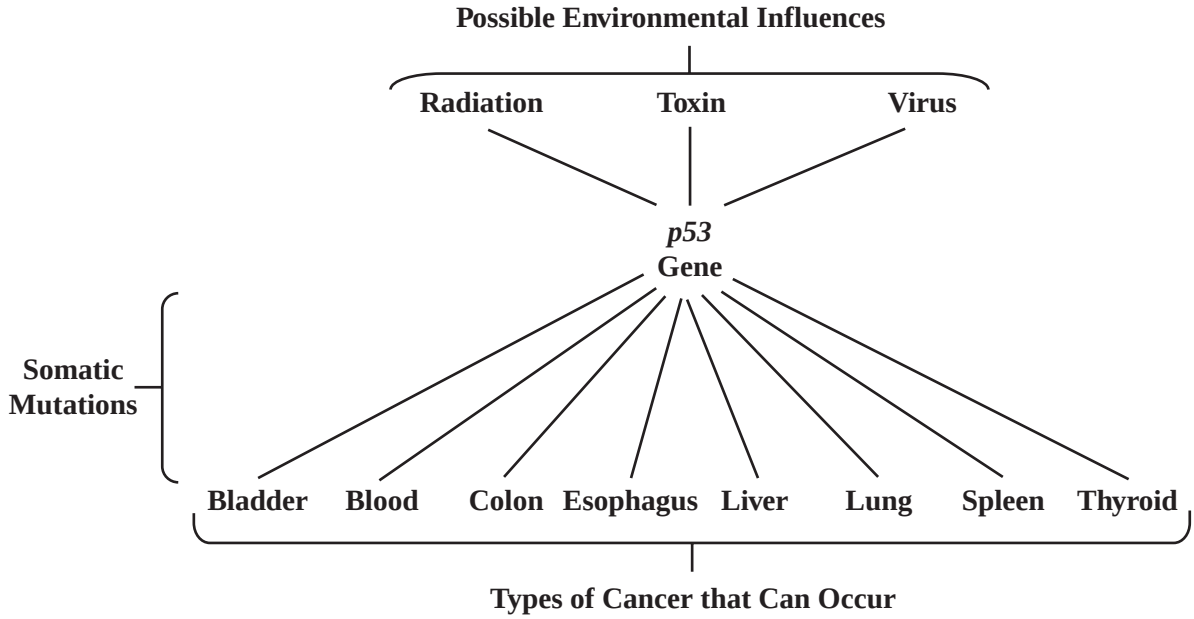
★ **A.** A high viscosity of blood causes an increased resistance in the blood vessels and leads to slow blood flow.
B. A low blood pH decreases the rate of diffusion through the blood vessels and leads to slow blood flow.
C. The changing of the shape of red blood cells to a crescent shape decreases resistance and leads to a faster blood flow.
D. The narrowing of blood vessels increases pressure and leads to a faster blood flow.

Benchmark SC.912.L.14.52

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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. (Also assesses SC.912.L.14.6, HE.912.C.1.4, and HE.912.C.1.8.)**
Also Assesses	**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. **HE.912.C.1.4** Analyze how heredity and family history can impact personal health. **HE.912.C.1.8** Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases.
Benchmark Clarifications	Students will identify and/or explain the basic functions of the human immune system, including specific and nonspecific immune responses. Students will describe how the human immune system responds to vaccines and/or antibiotics. Students will explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspective of both individual and public health.
Content Limits	Items assessing the significance of genetic factors, environmental factors, and pathogenic agents to health are limited to a conceptual understanding.
Stimulus Attribute	Scenarios are limited to those commonly included in a biology course.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.6, SC.6.E.7.8, SC.8.N.4.1, and SC.8.N.4.2.

Sample Item 7 SC.912.L.14.6

The *p53* gene codes for the p53 protein that locates DNA errors for cellular repair. The diagram below shows the relationships among possible environmental influences, the *p53* gene, and cancer.



Which of the following statements **best** describes the relationships among possible environmental influences, the *p53* gene, and cancer?

★ **A.** Environmental influences can lead to mutations in the *p53* gene, which can cause certain cancers.

B. Increased levels of p53 protein, rather than environmental influences, can cause certain cancers.

C. Mutations in the *p53* gene increase environmental influences that can cause certain cancers.

D. Genes such as *p53* are less causal than environmental influences in stimulating certain cancers.

Benchmark SC.912.L.15.1

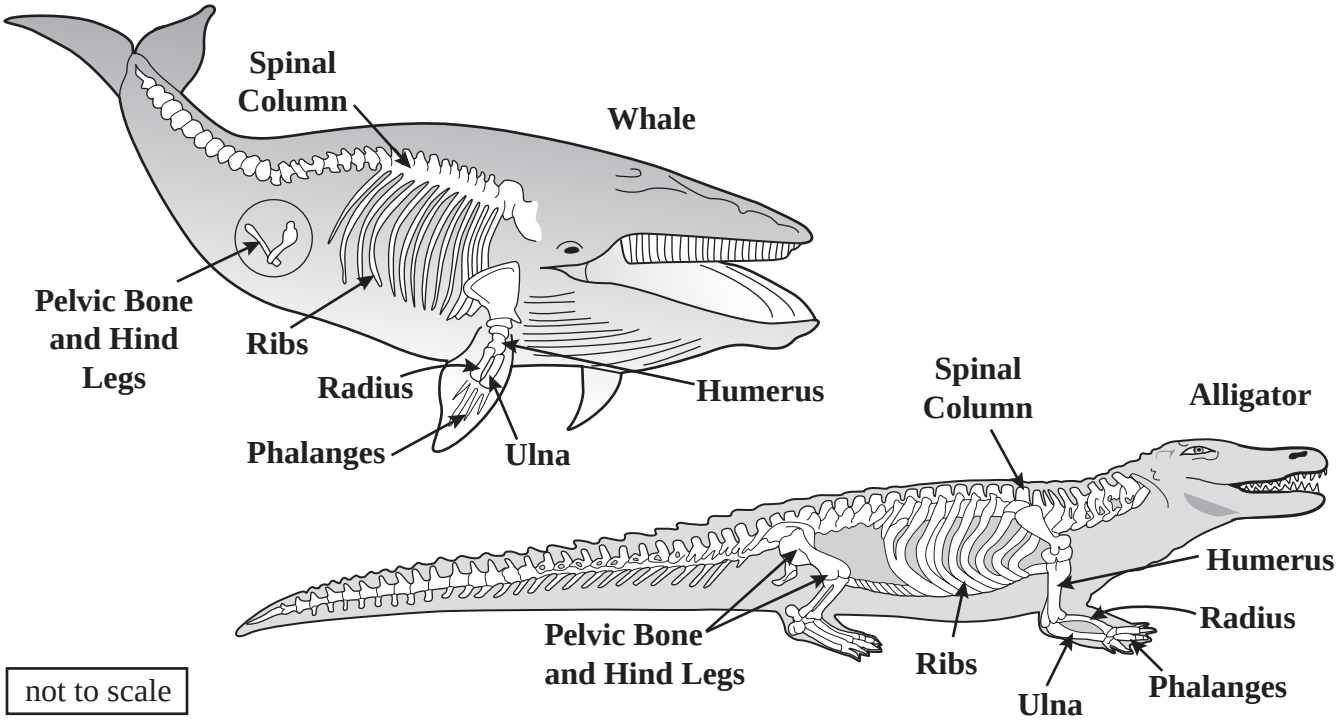
Reporting Category	Classification, Heredity, and Evolution
Standard	**Standard 15** Diversity and Evolution of Living Organisms
Benchmark	**SC.912.L.15.1 Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change. (Also assesses SC.912.L.15.10, SC.912.N.1.3, SC.912.N.1.4, SC.912.N.1.6, SC.912.N.2.1, SC.912.N.3.1, and SC.912.N.3.4.)**
Also Assesses	**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. **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. **SC.912.N.1.4** Identify sources of information and assess their reliability according to the strict standards of scientific investigation. **SC.912.N.1.6** Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied. **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). **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. **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.
Benchmark Clarifications	Students will identify evidence and/or explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observable evolutionary change. Students will identify examples of and basic trends in hominid evolution from early ancestors to modern humans.

Benchmark Clarifications	Students will identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations).
	Students will assess the reliability of sources of information according to scientific standards.
	Students will describe how scientific inferences are made from observations and identify examples from biology.
	Students will identify what is science, what is not science, and what resembles but fails to meet the criteria for science.
	Students will explain the development of a theory.
	Students will recognize the differences between theories and laws.
Content Limits	Items assessing evolution will focus on a conceptual understanding of the supporting scientific evidence.
	Items will not require memorization of the names of specific human fossils or the names of the different hominid species.
	Items assessing the fossil record must focus on the fossil rather than geologic formations in isolation.
	Items assessing the fossil record will not require understanding of the specific mechanisms used for relative dating and radioactive dating.
	Items will not require the memorization of the geologic time scale, including era, period, and/or epoch.
	Items will not assess the origin of Earth.
	Items will not assess specific knowledge of the formation of microspheres or the evolution of RNA and DNA.
	Items will not address or assess the endosymbiotic theory.
	Items referring to adaptive radiation, convergent evolution, coevolution, or punctuated equilibrium should focus on the concepts rather than on the definition of the terms.
	Items referring to the development of language or the manufacturing of tools will relate this development to changes in the skull or brain size.
	Items will not assess types of genetic mutation or how these mutations occur.
	Items referring to comparative anatomy and comparative embryology will assess anatomical similarities such as homologous structures and vestigial organs but will not require specific knowledge of embryologic stages or structures.

Content Limits	Items will not require knowledge of changes to specific species or geographic location of those species. Items will not assess genes, alleles, genetic drift, or gene flow. Items may assess how the overall contributions of scientists such as Darwin, Lamarck, Lyell, Malthus, Mendel, or Wallace aided in the development of the scientific theory of evolution. Items will not assess the differences among intelligent design, creationism, and the scientific theory of evolution. Items assessing a scientific claim, the development of a theory, or the differences between theories and laws are limited to the scientific theory of evolution.
Stimulus Attributes	Scenarios referring to specific species will include a description of the species in relation to context of the item. Scenarios addressing scientific inferences are limited to the scientific theory of evolution and trends in hominid evolution.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.15.1, SC.7.L.15.2, SC.7.L.15.3, SC.8.E.5.10, SC.6.N.2.1, SC.6.N.2.2, SC.6.N.3.1, SC.6.N.3.2, SC.6.N.3.3, SC.7.N.1.6, SC.7.N.1.7, SC.7.N.2.1, SC.7.N.3.1, SC.8.N.1.6, SC.8.N.2.1, SC.8.N.2.2, and SC.8.N.3.2.

Sample Item 8 SC.912.L.15.1

The scientific theory of evolution is supported by different types of evidence. The diagrams below show the skeletons of two different animal species.



How does comparing the skeletons of these animals provide support for the scientific theory of evolution?

A. It provides information about the organisms' habitats.
★ **B.** It shows possible common ancestry between organisms.
C. It provides information to determine the organisms' ages.
D. It shows possible chromosomal similarities between organisms.

Benchmark SC.912.L.15.6

Reporting Category	Classification, Heredity, and Evolution
Standard	**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. (Also assesses SC.912.L.15.4, SC.912.L.15.5, SC.912.N.1.3, and SC.912.N.1.6.)**
Also Assesses	**SC.912.L.15.4** Describe how and why organisms are hierarchically classified and based on evolutionary relationships. **SC.912.L.15.5** Explain the reasons for changes in how organisms are classified. **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. **SC.912.N.1.6** Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.
Benchmark Clarifications	Students will classify organisms based on the distinguishing characteristics of the domains and/or kingdoms of living organisms. Students will identify and/or describe how and/or why organisms are hierarchically classified based on evolutionary relationships. Students will identify and/or explain the reasons for changes in how organisms are classified. Students will identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations). Students will describe how scientific inferences are made from observations and identify examples from biology.
Content Limits	Items referring to distinguishing characteristics of living organisms are limited to the domains of Archea, Bacteria, and Eukarya and the kingdoms of Protista, Fungi, Plantae, and Animalia. Items will not require specific knowledge of organisms classified in any domain or kingdom; items should describe the characteristics of an organism and assess its classification.

Content Limits	Items may refer to prokaryotic, eukaryotic, unicellular and/or multicellular organisms, autotrophs, and/or heterotrophs, but they will not assess the definition of those terms. Items referring to changes in classification systems should be conceptual and will not require specific knowledge of those changes. Items may address evolutionary classification, phylogeny, and the use of cladograms, but they may not assess the definition of those terms. Items assessing a scientific claim are limited to the classification of organisms.
Stimulus Attribute	Scenarios addressing scientific inferences are limited to classification.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.15.1, SC.6.N.2.2, SC.7.N.1.6, SC.7.N.1.7, SC.7.N.2.1, and SC.8.N.1.6.

Sample Item 9 **SC.912.L.15.6**

Organisms classified as fungi have unique characteristics. Which of the following characteristics is found only in organisms classified in the kingdom Fungi?

A. single cells without a nucleus
B. multicellular with chloroplasts
★ **C.** multicellular filaments that absorb nutrients
D. colonies of single, photosynthetic cells that reproduce asexually

Benchmark SC.912.L.15.8

Reporting Category	Classification, Heredity, and Evolution
Standard	**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. (Also assesses SC.912.N.1.3, SC.912.N.1.4, and SC.912.N.2.1.)**
Also Assesses	**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. **SC.912.N.1.4** Identify sources of information and assess their reliability according to the strict standards of scientific investigation. **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).
Benchmark Clarifications	Students will describe scientific explanations of the origin of life on Earth. Students will identify situations or conditions contributing to the origin of life on Earth. Students will identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and consideration of alternative explanations). Students will assess the reliability of sources of information according to scientific standards. Students will identify what is science, what is not science, and what resembles but fails to meet the criteria for science.
Content Limits	Items may address the conditions required for the origin of life on Earth but may not require specific knowledge of the age of Earth or its eras, periods, or epochs. Items 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 but will not assess what each scientist contributed. Items assessing the origin of organic molecules, chemical evolution, and/or eukaryotic cells should be conceptual.

Content Limits	Items may refer to the endosymbiotic theory but may not assess the term in isolation. Items assessing a scientific claim are limited to the scientific explanations of the origins of life on Earth.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.8.L.18.1, SC.7.E.6.3, SC.7.E.6.4, SC.6.E.7.9, SC.6.N.2.1, SC.6.N.2.2, SC.7.N.1.7, SC.7.N.2.1, SC.8.N.2.1, and SC.8.N.2.2.

Sample Item 10 **SC.912.L.15.8**

One of the accepted scientific theories describing the origin of life on Earth is known as chemical evolution. According to this theory, which of the following events would need to occur **first** for life to evolve?

A. onset of photosynthesis
B. origin of genetic material
★ **C.** synthesis of organic molecules
D. formation of the plasma membrane

Benchmark SC.912.L.15.13

Reporting Category	Classification, Heredity, and Evolution
Standard	**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. (Also assesses SC.912.L.15.14, SC.912.L.15.15, and SC.912.N.1.3.)**
Also Assesses	**SC.912.L.15.14** Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow. **SC.912.L.15.15** Describe how mutation and genetic recombination increase genetic variation. **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.
Benchmark Clarifications	Students will explain and/or describe the conditions required for natural selection that result in differential reproductive success. Students will explain and/or describe the scientific mechanisms, such as genetic drift, gene flow, and nonrandom mating, resulting in evolutionary change. Students will explain and/or describe how mutation and genetic recombination increase genetic variation. Students will 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 will not address descent with modification or common descent. Items addressing mutation and genetic recombination in relation to increasing genetic variation must be assessed in the context of evolution. Items will not assess the Hardy-Weinberg principle or genetic equilibrium. Items may address how meiosis contributes to genetic variation but may not assess the steps or stages of meiosis. Items assessing a scientific claim are limited to the topics discussed in SC.912.L.15.13, SC.912.L.15.14, and SC.912.L.15.15.
Stimulus Attributes	None specified

Response Attributes None specified

Prior Knowledge Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.15.2, SC.7.L.15.3, SC.7.L.16.1, SC.7.L.16.3, SC.7.L.17.3, SC.7.N.1.7, SC.6.N.2.2, and SC.7.N.2.1.

Sample Item 11 **SC.912.L.15.13**

Over time, the climate of an island became drier, which resulted in changes to the populations of various island finch species. Finch populations with a certain beak shape thrived, while those not having that beak shape decreased. Which of the following describes a necessary condition for these changes in the finch populations to occur?

A. fewer mutations
★ **B.** limited food resources
C. limited beak variations
D. overproduction of offspring

BENCHMARK SC.912.L.16.1

Reporting Category	Classification, Heredity, and Evolution
Standard	**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. (Also assesses SC.912.L.16.2.)**
Also Assesses	**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.
Benchmark Clarifications	Students will use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance. Students will identify, analyze, and/or predict inheritance patterns caused by various modes of inheritance.
Content Limits	Items referring to general dominant and recessive traits may address but will not assess the P and F_1 generations. Items addressing dihybrid crosses or patterns that include codominance, incomplete dominance, multiple alleles, sex-linkage, or polygenic inheritance may assess the P and F_1 generations.
Stimulus Attributes	Inheritance outcomes may be expressed in percent, ratios, or fractions. Scenarios may refer to codominance or incomplete dominance but not both codominance and incomplete dominance. Punnett squares may be used to predict outcomes of a cross.
Response Attribute	Options may include codominance or incomplete dominance but not both.
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.16.1 and SC.7.L.16.2.

Sample Item 12 **SC.912.L.16.2**

Hemophilia is a sex-linked, recessive trait. Which of the following describes the probability of hemophilia in the offspring of a man who does not have hemophilia and a woman whose father is a hemophiliac?

A. Each of their sons will have hemophilia.
★ **B.** None of their daughters will have hemophilia.
C. Their sons have a 25% chance of having hemophilia.
D. There is a 50% chance that their daughters will have hemophilia.

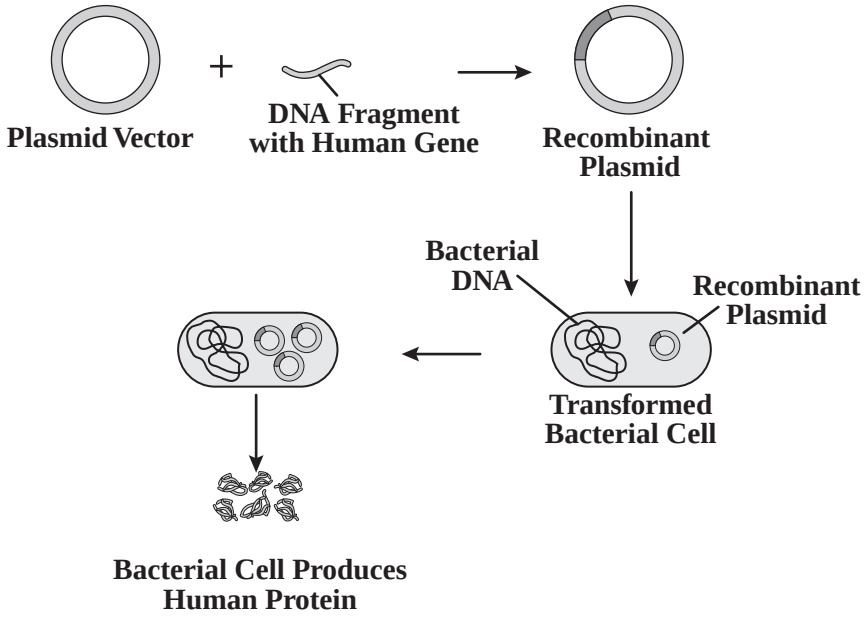
Benchmark SC.912.L.16.3

Reporting Category	Molecular and Cellular Biology
Standard	**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 the genetic information. (Also assesses SC.912.L.16.4, SC.912.L.16.5, and SC.912.L.16.9.)**
Also Assesses	**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. **SC.912.L.16.5** Explain the basic processes of transcription and translation, and how they result in the expression of genes. **SC.912.L.16.9** Explain how and why the genetic code is universal and is common to almost all organisms.
Benchmark Clarifications	Students will describe the process of DNA replication and/or its role in the transmission and conservation of genetic information. Students will describe gene and chromosomal mutations in the DNA sequence. Students will explain how gene and chromosomal mutations may or may not result in a phenotypic change. Students will explain the basic processes of transcription and/or translation, and their roles in the expression of genes. Students will explain that the basic components of DNA are universal in organisms. Students will explain how similarities in the genetic codes of organisms are due to common ancestry and the process of inheritance.
Content Limits	Items requiring the analysis of base pairs for gene mutations are limited to changes in a single gene. Items may refer to but will not assess the cell cycle, mitosis, and/or meiosis. Items will not require memorization of specific conditions resulting from chromosomal mutations. Items may refer to the process of meiosis in the context of mutations but will not assess meiosis in isolation.

Content Limits	Items addressing transcription or translation will not require specific knowledge of initiation, elongation, or termination.
Stimulus Attribute	Scenarios requiring the use of a codon table must include the codon table.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.16.1 and SC.7.L.16.4.

Sample Item 13 **SC.912.L.16.9**

Genes for medically important proteins can be cloned and inserted into bacteria, as shown in the diagram below.



Why can bacteria recognize a human gene and then produce a human protein?

A. DNA replication in bacteria and humans is the same.
B. Bacterial cells contain the same organelles as human cells.
★ **C.** The basic components of DNA are the same in humans and bacteria.
D. Bacterial cells and human cells contain the same kind of chromosomes.

Benchmark SC.912.L.16.10

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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.**
Benchmark Clarification	Students will evaluate examples and/or explain the possible impact of biotechnology on the individual, society, and/or the environment.
Content Limits	Items may assess current issues but will not require knowledge of specific biotechnologies or specific medical issues. Items assessing the possible impacts of biotechnology will not assess monetary impacts.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.16.4, SC.8.E.5.10, SC.8.N.4.1, and SC.8.N.4.2.

Sample Item 14 **SC.912.L.16.10**

While genetic engineering has positive benefits, there are also concerns associated with widespread use of genetic engineering in agriculture. If many farmers begin to plant more genetically modified crops that have an increased tolerance to insects, which of the following may result?

A. an increase in the use of pesticides
★ **B.** a decrease in genetic diversity of the crops
C. an increase in the contamination of the water supply
D. a decrease in crop productivity on these treated fields

Benchmark SC.912.L.16.13

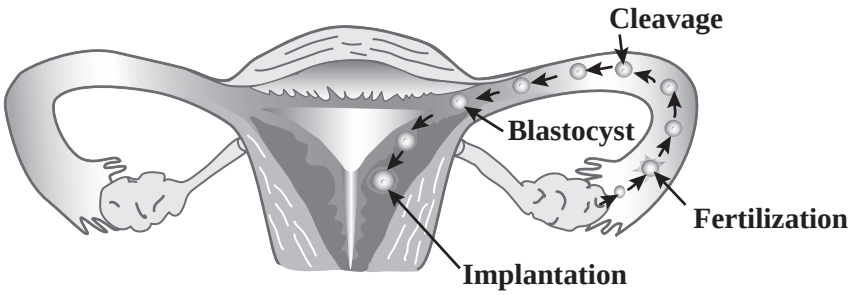
Reporting Category	Organisms, Populations, and Ecosystems
Standard	**Standard 16** Heredity and Reproduction
Benchmark	**SC.912.L.16.13 Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy.**
Benchmark Clarifications	Students will identify and/or describe the basic anatomy and physiology of the human reproductive system. Students will describe the process of human development from the zygotic stage to the end of the third trimester and birth.
Content Limits	Items referring to the male human reproductive system are limited to the seminal vesicle, prostate gland, vas deferens, urethra, epididymis, scrotum, penis, and testes. Items referring to the female human reproductive system are limited to the ovaries, oviduct (fallopian tube), uterus, cervix, and vagina. Items assessing the function of the placenta, umbilical cord, amniotic sac, and amniotic fluid are limited to how these structures relate to the development of the fetus. Items will not assess physiological or hormonal changes of the mother during pregnancy. Items assessing the production of hormones in the context of the physiology of the human reproductive system are limited to a conceptual understanding of the production of hormones. Items will not assess hormonal control during pregnancy. Items may refer to the early stages of development (implantation, morula, blastocyst, gastrulation, neurulation) but will not assess the definition of these terms. Items referring to changes in each trimester are limited to normal human development. Items will not assess specific knowledge of malformations in the human fetus, miscarriages, maternal preexisting conditions, genetic conditions, or the impact of exposure to environmental conditions. Items will not assess the utilization of technology to assist in or prevent fertilization or monitor development of the fetus. Items will not address or assess the menstrual cycle.

Stimulus Attribute	Illustrations or diagrams may be used.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.5.

Sample Item 15 **SC.912.L.16.13**

A fertilized egg undergoes several stages before it is successfully implanted. The diagram below shows these stages as the fertilized egg travels through the female human reproductive system.

Female Human Reproductive System



In which of the following structures of the female human reproductive system is the blastocyst implanted during normal human development?

A. ovary
★ **B.** uterus
C. vagina
D. amniotic sac

Benchmark SC.912.L.16.17

Reporting Category	Molecular and Cellular Biology
Standard	**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. (Also assesses SC.912.L.16.8, SC.912.L.16.14, and SC.912.L.16.16.)**
Also Assesses	**SC.912.L.16.8** Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer. **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. **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.
Benchmark Clarifications	Students will differentiate the processes of mitosis and meiosis. Students will describe the role of mitosis in asexual reproduction, and/or the role of meiosis in sexual reproduction, including how these processes may contribute to or limit genetic variation. Students will describe specific events occurring in each of the stages of the cell cycle and/or phases of mitosis. Students will explain how mitosis forms new cells and its role in maintaining chromosome number during asexual reproduction. Students will explain how cancer (uncontrolled cell growth) may result from mutations that affect the proteins that regulate the cell cycle. Students will describe the process of meiosis, including independent assortment and crossing over. Students will explain how meiosis results in the formation of haploid gametes or spores.
Content Limits	Items will focus on the relationship between mutations and uncontrolled cell growth, rather than a specific mutation that may result in uncontrolled cell growth. Items may address the presence and location of centrioles but may not require knowledge of the function of centrioles.

Content Limits	Items referring to mutation will focus on the general concepts of uncontrolled cell growth and not require specific knowledge of cancers or diseases resulting from that growth. Items will not assess the specific proteins associated with regulating the cell cycle. Items addressing mitosis or meiosis are limited to identification of phases, structures, and major events of each phase.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.16.3.

Sample Item 16 **SC.912.L.16.17**

Mitosis and meiosis are processes involved in cellular reproduction. Which of the following describes an event that results from mitosis but NOT meiosis?

A. two stages of cell division
B. replication of cellular genetic material
★ **C.** daughter cells that are identical to the parent cell
D. four daughter cells that are produced from each parent cell

Benchmark SC.912.L.17.5

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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. (Also assesses SC.912.L.17.2, SC.912.L.17.4, SC.912.L.17.8, and SC.912.N.1.4.)**
Also Assesses	**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. **SC.912.L.17.4** Describe changes in ecosystems resulting from seasonal variations, climate change, and succession. **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, non-native species. **SC.912.N.1.4** Identify sources of information and assess their reliability according to the strict standards of scientific investigation.
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. Students will explain that different types of organisms exist within aquatic systems due to chemistry, geography, light, depth, salinity, and/or temperature. Students will describe the potential changes to an ecosystem resulting from seasonal variations, climate changes, and/or succession. Students will identify positive and/or negative consequences that result from a reduction in biodiversity. Students will assess the reliability of sources of information according to scientific standards.
Content Limits	Items referring to chemical factors in aquatic systems are limited to pH, oxygen, carbon dioxide, nitrogen, phosphorous, and salinity. Items referring to geography in aquatic systems are limited to water depth, latitude, temperature, underwater topography, and proximity to land. Items will not require the identification of oceanic zones.

Content Limits	Items referring to reduction in biodiversity may include examples of catastrophic events, climate changes, human activities, and the introduction of invasive and nonnative species, but they will not assess specific knowledge of these. Items referring to reduction in biodiversity will focus on the consequence and not require knowledge of the specific event that led to the reduction. Items addressing climate change are limited to biodiversity and population dynamics contexts.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.15.2, SC.7.L.15.3, SC.7.L.17.3, SC.7.E.6.6, SC.6.E.7.7, SC.8.N.4.1, and SC.8.N.4.2.

Sample Item 17 **SC.912.L.17.5**

The number of pythons found throughout Everglades National Park has increased in recent years. These huge snakes are not native to Florida and are believed to have been released into the wild by pet owners. Wildlife biologists have initiated attempts to capture and remove these pythons. Which statement **best** explains the biologists' reason for removing these pythons from the Everglades?

A. The pythons could upset the territorial boundaries of native organisms.
B. The pythons could adapt to overcome diseases common to native snakes.
★ **C.** The pythons could prey on native organisms and cause native populations to decline.
D. The pythons could begin to interbreed with native snakes and produce a more successful species.

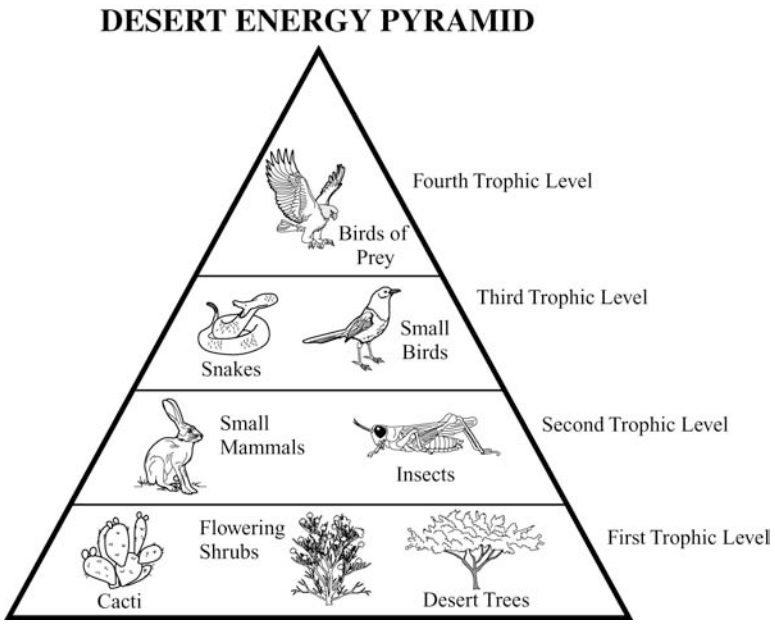
Benchmark SC.912.L.17.9

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**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. (Also assesses SC.912.E.7.1.)**
Also Assesses	**SC.912.E.7.1** Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.
Benchmark Clarifications	Students will describe the energy pathways through the different trophic levels of a food web or energy pyramid. Students will analyze the movement of matter through different biogeochemical cycles.
Content Limits	Items referring to organisms in food webs are limited to the impact of changes in matter or energy in trophic levels. Items addressing food webs will require application of the knowledge of roles of organisms in a food web to describe energy pathways rather than the identification of producers, consumers (primary, secondary, tertiary), and decomposers. Items will not require knowledge of specific organisms or their feeding habits. Items assessing biogeochemical cycles are limited to the water cycle and the carbon cycle. Items referring to the biogeochemical cycles may address but will not assess photosynthesis and cellular respiration in isolation.
Stimulus Attribute	Scenarios will express energy in joules (J).
Response Attributes	None specified

Prior Knowledge Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.17.1, SC.7.L.17.2, SC.8.L.18.3, SC.8.L.18.4, SC.6.E.7.4, SC.8.P.9.1, SC.7.P.11.2, and SC.7.P.11.3.

Sample Item 18 SC.912.L.17.9

A team of ecologists observed feeding patterns of several populations in the desert. The energy pyramid shown below depicts the feeding patterns the ecologists observed.



Which of the following **best** explains the difference in the amount of available energy in the trophic levels of the desert ecosystem?

A. There is less energy available in the producers because their tissues are less dense than those at higher trophic levels.
B. There is more energy available in the second trophic level because less energy is needed for hunting compared to the higher trophic levels.
C. There is more available energy in the birds of prey because they have greater muscle mass for storing energy than organisms in lower trophic levels have.
★ **D.** There is less available energy in the fourth trophic level because of the loss of energy through metabolism in each of the lower trophic levels.

Benchmark SC.912.L.17.20

Reporting Category	Organisms, Populations, and Ecosystems
Standard	**Standard 17** Interdependence
Benchmark	**SC.912.L.17.20 Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability. (Also assesses SC.912.L.17.11, SC.912.L.17.13, SC.912.N.1.3, and HE.912.C.1.3.)**
Also Assesses	**SC.912.L.17.11** Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests. **SC.912.L.17.13** Discuss the need for adequate monitoring of environmental parameters when making policy decisions. **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. **HE.912.C.1.3** Evaluate how environment and personal health are interrelated.
Benchmark Clarifications	Students will predict how the actions of humans may impact environmental systems and/or affect sustainability. Students will evaluate possible environmental impacts resulting from the use of renewable and/or nonrenewable resources. Students will identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and/or consideration of alternative explanations).
Content Limits	Items referring to renewable and nonrenewable resources will focus on the environmental costs and benefits of using those resources and not on identifying examples of renewable and nonrenewable resources. Items will not require knowledge of specific environmental regulations, pollution prevention technologies or devices, or other mechanisms used to prevent pollution. Items assessing a scientific claim are limited to impacts on the environment and renewable and nonrenewable resources.
Stimulus Attributes	None specified
Response Attributes	None specified

Prior Knowledge Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.7.L.17.3, SC.7.E.6.6, SC.7.N.1.7, SC.6.N.2.2, SC.7.N.2.1, SC.8.N.4.1, and SC.8.N.4.2.

Sample Item 19 SC.912.L.17.20

Salt water is an abundant resource but unusable for irrigation and drinking. As demands on freshwater sources increase, the use of desalination processes to remove salt from ocean water is increasing. A concern of desalinating water is the large amounts of recovered salts that are returned to the ocean. Which of the following describes the most likely impact of desalination on the surrounding ocean environment?

A. Methane gas would pollute the ocean environment as shoreline organisms begin to die and decay.

★ **B.** Alteration in ocean salt levels would cause loss of species and unbalanced populations in marine food webs.

C. Nonrenewable resources in the ocean environment would become depleted and upset the ecosystem's balance.

D. Increased levels of salts and minerals in the ocean would result in overpopulation of marine bivalves due to strengthened shells.

Benchmark SC.912.L.18.1

Reporting Category	Molecular and Cellular Biology
Standard	**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. (Also assesses SC.912.L.18.11.)**
Also Assesses	**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.
Benchmark Clarifications	Students will identify and/or describe the basic molecular structure of carbohydrates, lipids, proteins, and/or nucleic acids. Students will describe the primary functions of carbohydrates, lipids, proteins, and/or nucleic acids in organisms. Students will explain how enzymes speed up the rate of a biochemical reaction by lowering the reaction's activation energy. Students will identify and/or describe the effect of environmental factors on enzyme activity.
Content Limits	Items will not refer to intermolecular forces found in the four types of macromolecules. Items will not assess hydrolysis and dehydration synthesis. Items referring to the role of enzymes as catalysts will use a biological context and not require knowledge of specific enzymes. Items referring to the factors that affect enzyme activity are limited to concentration, pH, and temperature. Items will not require specific knowledge of how an enzyme reacts at a certain pH or temperature. Items will not assess the enzyme-substrate complex.
Stimulus Attributes	None specified
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.3 and SC.8.P.8.5.

Sample Item 20 SC.912.L.18.11

As food travels through the digestive system, it is exposed to a variety of pH levels. The stomach has a pH of 2 due to the presence of hydrochloric acid (HCl), and the small intestine has a pH ranging from 7 to 9. HCl converts pepsinogen into pepsin, an enzyme that digests proteins in the stomach. Which of the following **most likely** happens to pepsin as it enters the small intestine?

★ **A.** It becomes inactive.
B. It begins to replicate.
C. Its shape changes to engulf large proteins.
D. Its activity increases to digest more proteins.

Benchmark SC.912.L.18.9

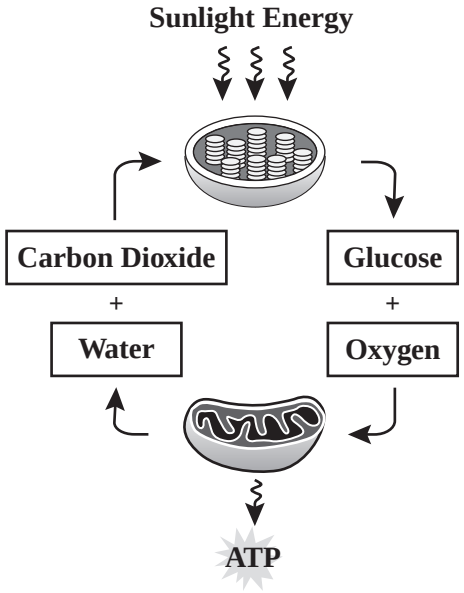
Reporting Category	Molecular and Cellular Biology
Standard	**Standard 18** Matter and Energy Transformations
Benchmark	**SC.912.L.18.9 Explain the interrelated nature of photosynthesis and cellular respiration. (Also assesses SC.912.L.18.7, SC.912.L.18.8, and SC.912.L.18.10.)**
Also Assesses	**SC.912.L.18.7** Identify the reactants, products, and basic functions of photosynthesis. **SC.912.L.18.8** Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration. **SC.912.L.18.10** Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell.
Benchmark Clarifications	Students will explain how the products of photosynthesis are used as reactants for cellular respiration and vice versa. Students will explain how photosynthesis stores energy and cellular respiration releases energy. Students will identify the reactants, products and/or the basic function of photosynthesis. Students will identify the reactants, products and/or the basic functions of aerobic and anaerobic cellular respiration. Students will connect the role of adenosine triphosphate (ATP) to energy transfers within the cell.
Content Limits	Items will not require the memorization of the stages, specific events, or intermediate molecules produced during these processes. Items will not require the balancing of equations. Items will not assess plant structures.
Stimulus Attributes	Scenarios may include chemical equations. Scenarios referring to adenosine triphosphate should use the abbreviation ATP rather than the words adenosine triphosphate.
Response Attributes	None specified

Prior Knowledge Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.L.14.4, SC.8.L.18.1, SC.8.L.18.2, SC.7.P.11.2, and SC.7.P.11.3.

Sample Item 21 SC.912.L.18.9

The diagram below shows the relationship between photosynthesis and cellular respiration and the organelles in which they occur.

Photosynthesis and Cellular Respiration



Which statement describes how photosynthesis and cellular respiration are interrelated?

A. Oxygen is produced during cellular respiration and stored during photosynthesis.
★ **B.** Carbon dioxide and water released by cellular respiration are used in photosynthesis.
C. Photosynthesis releases the energy that is stored during the process of cellular respiration.
D. Glucose is used during cellular respiration to produce food that is broken down during photosynthesis.

Benchmark SC.912.L.18.12

Reporting Category	Molecular and Cellular Biology
Standard	**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.**
Benchmark Clarifications	Students will explain the properties of water at a conceptual level. Students will explain how the properties make water essential for life on Earth.
Content Limits	Items 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. Items may address adhesion but will not assess adhesion.
Stimulus Attribute	Scenarios must have a biological context.
Response Attributes	None specified
Prior Knowledge	Items may require the student to apply scientific knowledge described in the NGSSS from lower grades. This benchmark requires prerequisite knowledge of SC.6.E.7.4 and SC.8.P.8.5.

Sample Item 22 SC.912.L.18.12

Water is essential for life. Its special properties make water the single most important molecule in plant life. Which of the following properties of water enables it to move from the roots to the leaves of plants?

A. Water expands as it freezes.
B. Water is an excellent solvent.
★ **C.** Water exhibits cohesive behavior.
D. Water is able to moderate temperatures.

Appendix A: Directions for Item Review and Biology 1 End-of-Course Assessment Item Rating Form

Directions: A series of questions is presented below. These questions are designed to assist you with your evaluation of the quality of the Biology 1 EOC Assessment items you will be reviewing. The table on the next page is an example of the one you will use to record your rating of each test item. Review each test item independently before discussing the items with other committee members. If you identify any problem with the item during independent review, you should put a crossmark (✘) in the appropriate column. Crossmarks (✘) will indicate a problem area, and blank spaces or checks (✓) will indicate that no problem is identified.

Questions for Individual Test Items—Record your answers on your rating sheet.

1. Does the test item assess the knowledge required by the benchmark?
2. Does the content of the test item adhere to the content limits described in the *Biology 1 EOC Assessment Test Item Specifications*?
3. Is the context and language of the test item appropriate for the Biology 1 course according to the course description?
4. What is the cognitive complexity of the test item for students who have mastered the benchmark? Is the item best categorized as high complexity (**H**), moderate complexity (**M**), or low complexity (**L**)?
5. Is the item clearly worded (does the item flow cognitively)? If the item has art, does it enhance the item? Is the art scientifically accurate and appropriate? Is the answer free of clang? (Is the answer clued in the context?)
6. Is the assigned content focus appropriate for this item? If not, is there a better or more appropriate content focus?
7. Is there only one correct answer? Record the letter of the correct answer on the rating sheet.
8. Are the options appropriate, plausible, and parallel (both grammatically and conceptually) to the correct response and appropriate for the question asked?
9. Is the item scientifically accurate?
10. Rate the overall quality of the item using these rating definition codes:

Overall Quality	
A (Accept)	**AR** (Accept as Revised)
RR (Revise and Resubmit)	**R** (Reject)

11. Do you have any additional comments? If so, record your comments on your rating sheet in the additional comments area.

Biology 1 EOC Item Rating Form

Signature _____ Date _____	Students in my (classroom, school, district) [circle one] are given the opportunity to learn the Biology 1 material that these items test, except as noted in my comments.

Page Number	Florida ID	Measures Benchmark	Adheres to Content Limits	Is Grade Appropriate	Appropriate Cognitive Complexity (L, M, H)	Is Clear and Free of Clang	Appropriate Content Focus	Only One Correct Answer (MC items)	Appropriate MC Options	Is Scientifically Accurate	Overall Rating A/AR/RR/R	Additional Comments

Appendix A: Directions for Context-Dependent Set Item Review and Biology 1 End-of-Course Assessment Item Rating Form

Directions: A series of questions is presented below. These questions are designed to assist you with your evaluation of the quality of the Biology 1 EOC Assessment items you will be reviewing. The table on page A–5 is an example of the one you will use to record your rating of each context-dependent-set test item. Review each test item independently before discussing the items with other committee members. If you identify any problem with the item during independent review, you should put a crossmark (✘) in the appropriate column. Crossmarks (✘) will indicate a problem area, and blank spaces or checks (✓) will indicate that no problem is identified.

Questions for Context-Dependent Item Sets—Record your answers on the rating sheet.
Review the main context of the item set.

1. Is the context appropriate in content and language for Biology 1?
2. Is the main context free of clang or does it clue test items?
3. Is the context scientifically accurate?
4. Rate the overall quality of the context using these rating definition codes:

Overall Quality	
A (Accept)	**AR** (Accept as Revised)
RR (Revise and Resubmit)	**R** (Reject)

Read each item in the set.

5. Does the test item assess the knowledge required by the benchmark?
6. Does the content of the test item adhere to the content limits described in the *Biology 1 End-of-Course Test Item Specifications*?
7. Is the item dependent on or directly related to the main context?
8. Are the context and language of the test item appropriate for Biology 1 according to the course description?
9. What is the cognitive complexity of the test item for students who have mastered the benchmark at the grade level assessed? Is the item best categorized as high complexity (**H**), moderate complexity (**M**), or low complexity (**L**)?
10. Is the answer free of clang? (Does it answer or clue other items in the set or does the main context clue an item?)
11. Is the assigned content focus appropriate for this item? If not, is there a better or more appropriate content focus?
12. Is there only one correct answer? Record the letter of the correct answer on the rating sheet.
13. Are the options appropriate, plausible, and parallel (both grammatically and conceptually) to the correct response and appropriate for the question asked?

14. Is the item scientifically accurate?
15. Rate the overall quality of the item using these rating definition codes:

Overall Quality	
A (Accept)	**AR** (Accept as Revised)
RR (Revise and Resubmit)	**R** (Reject)

16. Do you have any additional comments? If so, record your comments on your rating sheet in the additional comments area.

Biology 1 EOC Item Rating Form

Signature _____ Date _____	Students in my (classroom, school, district) [circle one] are given the opportunity to learn the Biology 1 material that these items test, except as noted in my comments.

Context-Dependent Set: Main Context

Page Number	Context Code	Is Grade Appropriate	Is Clear and Free of Clang	Is Scientifically Accurate	Overall Rating A/AR/RR/R	Additional Comments

Context-Dependent Set: Items

Page Number	Florida ID	Measures Benchmark	Adheres to Content Limits	Is Dependent or Related	Is Grade Appropriate	Appropriate Cognitive Complexity (L, M, H)	Is Clear and Free of Clang	Appropriate Content Focus	Only One Correct Answer (MC items)	Appropriate MC Options	Is Scientifically Accurate	Overall Rating A/AR/RR/R	Additional Comments

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Nature of Science
Standard 1	**The Practice of Science**

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.

Also assesses SC.912.N.1.4, SC.912.N.1.6, SC.912.L.14.4, LA.910.2.2.3, LA.910.4.2.2, MA.912.S.1.2, and MA.912.S.3.2.

AA **MC**

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.

Assessed as SC.912.L.14.1, SC.912.L.15.1, SC.912.L.15.6, SC.912.L.15.8, SC.912.L.15.13, and/or SC.912.L.17.20.

SC.912.N.1.4

Identify sources of information and assess their reliability according to the strict standards of scientific investigation.

Assessed as SC.912.N.1.1, SC.912.L.15.1, SC.912.L.15.8, and/or SC.912.L.17.5.

SC.912.N.1.6

Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

Assessed as SC.912.N.1.1, SC.912.L.15.1, and/or SC.912.L.15.6.

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Nature of Science
Standard 2	**The Characteristics of Scientific Knowledge**
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).	Assessed as SC.912.L.14.1, SC.912.L.15.1, and/or SC.912.L.15.8.
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.	Not Assessed.
Body of Knowledge	**Nature of Science**
Standard 3	**The Role of Theories, Laws, Hypotheses, and Models**
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.	Assessed as SC.912.L.14.1 and/or SC.912.L.15.1.
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.	Assessed as SC.912.L.14.1 and/or SC.912.L.15.1.
Body of Knowledge	**Earth and Space Science**
Standard 7	**Earth Systems and Patterns**
SC.912.E.7.1 Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.	Assessed as SC.912.L.17.9.

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Life Science
Standard 14	**Organization and Development of Living Organisms**
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. Also assesses SC.912.N.1.3, SC.912.N.2.1, SC.912.N.3.1, and SC.912.N.3.4. **AA** **MC**	
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). Assessed as SC.912.L.14.3.	
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. Also assesses SC.912.L.14.2. **AA** **MC**	
SC.912.L.14.4 Compare and contrast structure and function of various types of microscopes. Assessed as SC.912.N.1.1.	
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. Assessed as SC.912.L.14.52.	
SC.912.L.14.7 Relate the structure of each of the major plant organs and tissues to physiological processes. **AA** **MC**	

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	**Life Science**
Standard 14	**Organization and Development of Living Organisms**
SC.912.L.14.26 Identify the major parts of the brain on diagrams or models. **AA**	**MC**
SC.912.L.14.36 Describe the factors affecting blood flow through the cardiovascular system. **AA**	**MC**
SC.912.L.14.52 Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics. Also assesses SC.912.L.14.6, HE.912.C.1.4, and HE.912.C.1.8. **AA**	**MC**
Body of Knowledge	**Life Science**
Standard 15	**Diversity and Evolution of Living Organisms**
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. Also assesses SC.912.L.15.10, SC.912.N.1.3, SC.912.N.1.4, SC.912.N.1.6, SC.912.N.2.1, SC.912.N.3.1, and SC.912.N.3.4. **AA**	**MC**
SC.912.L.15.4 Describe how and why organisms are hierarchically classified and based on evolutionary relationships. Assessed as SC.912.L.15.6.	
SC.912.L.15.5 Explain the reasons for changes in how organisms are classified. Assessed as SC.912.L.15.6.	

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	**Life Science**
Standard 15	**Diversity and Evolution of Living Organisms**
SC.912.L.15.6 Discuss distinguishing characteristics of the domains and kingdoms of living organisms. Also Assesses SC.912.L.15.4, SC.912.L.15.5, SC.912.N.1.3, and SC.912.N.1.6. **AA** **MC**	
SC.912.L.15.8 Describe the scientific explanations of the origin of life on Earth. Also assesses SC.912.N.1.3, SC.912.N.1.4, and SC.912.N.2.1. **AA** **MC**	
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. Assessed as SC.912.L.15.1.	
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. Also assesses SC.912.L.15.14, SC.912.L.15.15, and SC.912.N.1.3. **AA** **MC**	
SC.912.L.15.14 Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow. Assessed as SC.912.L.15.13.	
SC.912.L.15.15 Describe how mutation and genetic recombination increase genetic variation. Assessed as SC.912.L.15.13.	

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MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Life Science
Standard 16	**Heredity and Reproduction**
SC.912.L.16.1 Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance. Also assesses SC.912.L.16.2. **AA** **MC**	
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. Assessed as SC.912.L.16.1.	
SC.912.L.16.3 Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information. Also assesses SC.912.L.16.4, SC.912.L.16.5, and SC.912.L.16.9. **AA** **MC**	
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. Assessed as SC.912.L.16.3.	
SC.912.L.16.5 Explain the basic processes of transcription and translation, and how they result in the expression of genes. Assessed as SC.912.L.16.3.	
SC.912.L.16.8 Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer. Assessed as SC.912.L.16.17.	

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MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Life Science
Standard 16	**Heredity and Reproduction**
SC.912.L.16.9 Explain how and why the genetic code is universal and is common to almost all organisms. Assessed as SC.912.L.16.3.	
SC.912.L.16.10 Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues. **AA**	**MC**
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. **AA**	**MC**
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. Assessed as SC.912.L.16.17.	
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. Assessed as SC.912.L.16.17.	
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. Also assesses SC.912.L.16.8, SC.912.L.16.14, and SC.912.L.16.16. **AA**	**MC**

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Life Science
Standard 17	**Interdependence**

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.

Assessed as SC.912.L.17.5.

SC.912.L.17.4
Describe changes in ecosystems resulting from seasonal variations, climate change, and succession.

Assessed as SC.912.L.17.5.

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.

Also assesses SC.912.L.17.2, SC.912.L.17.4, SC.912.L.17.8, and SC.912.N.1.4.

AA **MC**

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, non-native species.

Assessed as SC.912.L.17.5.

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.

Also assesses SC.912.E.7.1.

AA **MC**

SC.912.L.17.11
Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.

Assessed as SC.912.L.17.20.

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	**Life Science**
Standard 17	**Interdependence**
SC.912.L.17.13 Discuss the need for adequate monitoring of environmental parameters when making policy decisions. Assessed as SC.912.L.17.20.	
SC.912.L.17.20 Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability. Also assesses SC.912.L.17.11, SC.912.L.17.13, SC.912.N.1.3, and HE.912.C.1.3. **AA**	**MC**
Body of Knowledge	**Life Science**
Standard 18	**Matter and Energy Transformations**
SC.912.L.18.1 Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules. Also assesses SC.912.L.18.11. **AA**	**MC**
SC.912.L.18.7 Identify the reactants, products, and basic functions of photosynthesis. Assessed as SC.912.L.18.9.	
SC.912.L.18.8 Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration. Assessed as SC.912.L.18.9.	
SC.912.L.18.9 Explain the interrelated nature of photosynthesis and cellular respiration. Also assesses SC.912.L.18.7, SC.912.L.18.8, and SC.912.L.18.10. **AA**	**MC**

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	**Life Science**
Standard 18	**Matter and Energy Transformations**
SC.912.L.18.10 Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell. Assessed as SC.912.L.18.9.	
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. Assessed as SC.912.L.18.1.	
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. **AA** **MC**	
Strand	**Health Literacy: CONCEPTS**
Standard 1	**Comprehend concepts related to health promotion and disease prevention to enhance health**
HE.912.C.1.3 Evaluate how environment and personal health are interrelated. Assessed as SC.912.L.17.20.	
HE.912.C.1.4 Analyze how heredity and family history can impact personal health. Assessed as SC.912.L.14.52.	
HE.912.C.1.8 Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases. Assessed as SC.912.L.14.52.	

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MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Literary Analysis
Standard 2	**Nonfiction**
LA.910.2.2.3 The student will organize information to show understanding or relationships among facts, ideas, and events (e.g., representing key points within text through charting, mapping, paraphrasing, summarizing, comparing, contrasting, or outlining). Assessed as SC.912.N.1.1.	
Body of Knowledge	**Writing Applications**
Standard 2	**Informative**
LA.910.4.2.2 The student will record information and ideas from primary and/or secondary sources accurately and coherently, noting the validity and reliability of these sources and attributing sources of information. Assessed as SC.912.N.1.1.	
Body of Knowledge	**Statistics**
Standard 1	**Formulating Questions**
MA.912.S.1.2 Determine appropriate and consistent standards of measurement for the data to be collected in a survey or experiment. Assessed as SC.912.N.1.1.	

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Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix B: Science Content Assessed by Biology 1 End-of-Course Assessment

Body of Knowledge	Statistics
Standard 3	**Summarizing Data (Descriptive Statistics)**

MA.912.S.3.2

Collect, organize, and analyze data sets, determine the best format for the data, and present visual summaries from the following:

- bar graphs;
- line graphs;
- stem and leaf plots;
- circle graphs;
- histograms;
- box and whisker plots;
- scatter plots; and
- cumulative frequency (ogive) graphs.

Assessed as SC.912.N.1.1.

AA = annually assessed benchmark
MC = multiple choice

Standards marked as *Not Assessed* are more appropriately assessed through classroom instruction.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

The following glossary is a reference list provided for the item writers and is **not** intended to comprise a comprehensive vocabulary list for students. The definitions are not intended to provide a thorough scientific definition of the terms. Some definitions are limited by the extent of knowledge intended for the grade level. The terms and definitions in this glossary are specific to the Florida NGSSS in science for Grades 3 through 5 and the content assessed on FCAT 2.0 Science.

Absorb—To take up and store energy without reflecting or transmitting that energy.

Adaptation—A characteristic of an organism that increases its chances of survival in its environment.

Analyze—To examine methodically by separating into parts and studying their interrelatedness.

Asteroid—An object that is found in the solar system, orbits the Sun, and is much smaller than a planet.

Attraction—A term used to describe the magnetic force exerted by oppositely charged objects or to describe the gravitational force that pulls objects toward each other.

Balanced forces—Forces that are equal in size but opposite in direction. See also force and unbalanced forces.

Behavior—A plant or animal action, reaction, or activity that occurs in response to stimuli (e.g., gravity, light, temperature).

Carnivore—An animal that obtains nutrients from eating other animals.

Characteristic—A feature, quality, property, or trait of an object or organism.

Chemical change—Process by which substances are changed into different substances with different properties.

Classify—To arrange in a specific order or group by categories based on similarities.

Cleavage—A property used to describe how easily a mineral breaks apart along smooth surfaces.

Climate—The average pattern of weather that occurs in a certain location over many years.

Comet—An object made of rock, ice, dust, and gas that revolves around the Sun.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

Community—Populations of different species of organisms living together in the same geographic area.

Complete metamorphosis—Type of insect development characterized by the presence of a larval stage with different feeding habits.

Conclusion—A statement that tells what an investigation showed, based on observations and data.

Condensation—The process by which water is changed from a gas (water vapor) to a liquid; a stage of the water cycle.

Conduct—To transmit heat or electricity through a medium.

Consumer—An organism in a food chain that obtains nutrients from producers or other consumers; consumers may be herbivores or carnivores.

Control group—A group in a scientific experiment that serves as a reference for comparison to the experimental group; a group that is untreated by the factor being tested.

Data—Measurements or observations collected and recorded in an experiment or investigation.

Ecosystem—All the living and nonliving things that interact with each other in an environment.

Endangered species—A species whose population is so small that it is in danger of extinction.

Environment—An area that includes all living organisms and the surrounding physical features such as air, water, soil, weather, and landforms.

Erosion—The process by which rock, soil, and other weathered earth materials are moved from one place to another.

Evaporation—The process by which water is changed from a liquid to a gas (water vapor); a stage of the water cycle.

Experiment—A scientific test or procedure that is carried out under controlled conditions to answer a scientific question.

Extinct species—A species that no longer exists.

Fertilization—The process by which the female reproductive cell (egg) is united with the male reproductive cell (sperm or pollen).

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

Food chain—A diagram representing the transfer of energy from the Sun through producers and a series of consumers.

Force—A push or a pull that one object exerts on another object with or without direct contact (e.g., friction, gravity). See also balanced forces and unbalanced forces.

Friction—A force that opposes motion through direct contact.

Germination—The process by which plants begin to grow from seed to spore or from seed to bud.

Hardness—A property of a mineral that describes how easily it can be scratched.

Hemisphere—Half of Earth (i.e., Northern, Southern, Eastern, Western).

Herbivore—An animal that obtains nutrients only from plants.

Humidity—A measure of the amount of water vapor in the air.

Igneous rock—A type of rock that forms from cooled magma or lava.

Incomplete metamorphosis—Type of insect development characterized by the similar appearance of pre-adults and adults.

Inference—An explanation based on evidence that is not directly observed.

Inherited trait—A trait or characteristic that is passed from parent to offspring.

Insulator—A material used to reduce or prevent the transfer of electricity, heat, or sound.

Invertebrate—An animal that lacks a backbone.

Investigation—An organized scientific study of the natural world that may include making systematic observations, asking questions, gathering information, analyzing data, summarizing results, drawing conclusions, and/or communicating results.

Larva—An early stage in the life cycle of an organism that will undergo complete metamorphosis.

Life cycle—The stages of an organism's growth and development.

Luster—A property of a mineral that describes how it appears when it reflects light.

Mass—The amount of matter a substance or object has.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

Matter—Anything that takes up space and has mass.

Mechanical energy—A type of energy an object has due to its motion or position.

Metamorphic rock—A type of rock that is formed over time from existing rock due to extreme pressure and/or heat.

Mineral—A solid material formed in nature on or in Earth's crust with its own properties.

Moon—A natural object that orbits a planet.

Nutrient—A substance that an organism needs to survive and grow.

Nymph—A pre-adult insect undergoing incomplete metamorphosis.

Observation—Information about the natural world gathered through the senses and/or scientific instruments.

Omnivore—An organism that obtains nutrients from both plants and animals.

Organism—A living thing.

Ovary—The female reproductive organ that produces and contains egg cells.

Physical change—A type of change that involves the physical properties of a substance.

Pistil—The female reproductive structure of a flowering plant.

Pitch—The relative frequency (high or low) of a sound as perceived by a listener.

Planet—A large body in space that orbits a star and does not produce its own light.

Polar zone—A climate zone characterized by very little precipitation and extremely cold temperatures.

Pollen—The fine dustlike powder that contains the male reproductive cells of seed-bearing plants.

Pollinate—To transfer the pollen from the male reproductive structure to the female reproductive structure to fertilize flowering plants.

Population—All members of the same species living together at the same time in the same area.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

Precipitation—A form of water (e.g., hail, rain, sleet, snow) that condenses in the atmosphere and falls to Earth's surface.

Predator—An organism that obtains nutrients from other organisms.

Predict—To state what one thinks will happen under certain conditions based on data or observation.

Prey—An organism that is hunted and/or eaten by another organism (predator).

Producer—An organism that produces its own food.

Pupa—A stage in the life cycle of an insect that occurs between larva and adult.

Reflect—To bounce light, sound, or heat off of a surface.

Repel—To force away or apart.

Reproduction—The process of making more organisms of the same kind.

Revolution—The motion of one object around another object.

Rotation—The turning of an object on its axis.

Sedimentary rock—A type of rock formed from layers of sediment.

Soil—The loose top layer of Earth's surface made of weathered rock and organic matter.

Solar system—A system of planets and other bodies that orbits a star.

Species—A group of the same kind of organisms that can mate and produce offspring that can reproduce.

Speed—The distance traveled by an object in a given amount of time.

Spore—A seedlike structure that produces a new plant (e.g., ferns or mosses).

Stamen—The male reproductive structure of a flowering plant.

Star—A large object in space that is made of gas and produces its own light.

State of matter—The form matter can take (e.g., solid, liquid, gas).

Streak—The color of the powder of a mineral when it is rubbed on a streak plate.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 5

Technology—The use of scientific knowledge and processes to solve practical problems.

Temperate zone—A climate zone located between the tropics and the polar circles generally characterized by moderate temperatures rather than extremely hot or cold temperatures.

Testable (scientifically testable)—A term used to describe a question that can be answered through an experiment or observation.

Texture—A physical property of a solid used to describe its surface.

Trials—Multiple sets of measurements or observations in a scientific investigation.

Tropical zone—A climate zone near the equator characterized by warm temperatures.

Unbalanced forces—Forces that are unequal in size and may or may not be opposite in direction. See also balanced forces and force.

Valid—A term used to describe the certainty of data or results of an investigation or experiment.

Variable—An event, condition, or factor that can be changed or controlled in order to study or test a hypothesis in a scientific experiment.

Vertebrate—An animal that has a backbone.

Volume—The amount of space an object or substance occupies.

Water cycle—The continuous movement of water through the environment by evaporation, condensation, precipitation, and runoff.

Water vapor—The gas state of water.

Weather—The condition of the atmosphere at a given time and place.

Weathering—The process by which rocks and other surfaces are broken down.

Weight—A measure of the force of gravity on an object.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 8

The following glossary is a reference list provided for the item writers and is **not** intended to comprise a comprehensive vocabulary list for students. The definitions are not intended to provide a thorough scientific definition of the terms. Some definitions are limited by the extent of knowledge intended for the grade level. The terms and definitions in this glossary are specific to the Florida NGSSS in science for Grades 6 through 8 and the content assessed on FCAT 2.0 Science. Knowledge of the terms in the Glossary for Grade 5 is assumed.

Acceleration—The rate at which velocity is changing. The change may involve an increase or decrease in speed and/or a change in direction. The change may be positive or negative.

Allele—Any of two or more alternate forms of a gene that an organism may have for a particular trait.

Amplitude—The maximum absolute variation of any periodic function (e.g., a wave).

Astronomical unit—A unit used to measure distances in the solar system equal to the average distance between the Sun and Earth, approximately 150 million kilometers, and abbreviated AU.

Autotroph—An organism that can produce food from inorganic materials (e.g., carbon dioxide, sunlight, water).

Binary fission—An asexual reproductive process in which a single cell divides into two cells.

Binomial nomenclature—A system used to name organisms using two words: the genus name and the species name.

Boiling point—The temperature at which a liquid changes to a gas. The boiling point of water at sea level is 100°C (212°F).

Budding—An asexual reproductive process in which an outgrowth of a parent organism detaches and forms a new individual of the same species.

Chemical properties—Characteristics of substances that describe their composition, reactivity, and how the substance changes into different substances.

Controlled variable—A factor or condition in a scientific experiment that is purposefully kept the same.

Dominant—The form of a trait that is expressed or shown when the combination of alleles for this trait is heterozygous.

Dwarf planet—A celestial body similar to a planet but orbiting in a zone that has many other objects in it (e.g., Ceres, Pluto).

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 8

Empirical evidence—Evidence based on observations or experiments rather than theory.

Eukaryote—An organism whose cells contain a nucleus surrounded by a membrane.

Evolution (scientific theory of evolution)—A cumulative change in the characteristics of organisms or populations over time from generation to generation.

F_1 generation—The first generation of offspring from the mating of parental organisms (P generation).

Fault—A crack in Earth's crust along which movement has occurred.

Fold—A bend in a layer or several layers of rock.

Heterogeneous—A type of mixture in which different parts can be easily distinguished.

Heterotroph—An organism that cannot produce its own food.

Heterozygous—A cell or organism that has two different alleles for a particular trait.

Homeostasis—The tendency of a cell, organism, or population to maintain internal stability.

Homogeneous—A type of mixture in which the different parts are blended evenly so that the mixture is the same throughout.

Homozygous—A type of cell or organism that has identical rather than different alleles for a particular trait.

Hypothesis—A statement that can be tested scientifically through experiments and/or other scientific investigations.

Infiltration—A process in which water soaks into the soil.

Kingdom—The highest Linnaean classification into which organisms are grouped, above phylum.

Law (scientific law)—A scientific principle based on many observations of naturally occurring events that demonstrate it to be without exception under certain stated conditions. See also theory.

Light-year—The distance a ray of light travels in a vacuum in one year.

Melting point—The temperature at which a solid changes to a liquid. The melting point of ice at sea level is 0°C (32°F).

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 8

Model (scientific model)—A replica or description designed to show the workings or structure of an object or system.

Molecule—The smallest unit of matter of a substance that retains all the physical and chemical properties of that substance; consists of a single atom or a group of atoms bonded together.

Nebula—A large cloudlike mass of gas and dust in space that may lead to the formation of a star.

Net force—The sum of all the forces acting on an object. When forces are balanced, the net force is zero and the object's motion will remain the same. When forces are unbalanced, the net force is nonzero and the object's motion will change.

Niche—The unique position occupied by a particular species in terms of the area it inhabits and the function it performs within the community.

Nucleus—The center region of an atom where protons and neutrons are located; also, the cell structure that contains a cell's genetic material.

Opaque—A term used to describe a material that absorbs and/or reflects light and does not allow light to pass through.

Outcome variable (dependent variable)—A factor, usually being measured or observed, that responds to, or depends on, another factor (test variable).

P generation—The parental generation in a genetic cross.

Percolation—The movement of water through rock or soil.

pH—A measure of the acidity or alkalinity of a solution based on a scale from zero to fourteen.

Pressure—The force exerted per unit area.

Prokaryote—An organism whose cells are characterized by the lack of a defined nucleus.

Recessive—The form of a trait that will be masked unless the organism is homozygous for this trait.

Regeneration—The growth of new tissues or organs to replace those lost or damaged by injury.

Repetition—Making multiple sets of measurements or observations in a scientific investigation.

Appendix C: FCAT 2.0 Science Item Writer Glossary Grade 8

Replication—The reproduction of a scientific investigation by another person to ensure accuracy.

Saturation—A condition of a solution whereby it has reached a maximum amount of solute under the given conditions.

Solute—A substance that is being dissolved by another substance.

Solvent—A substance that dissolves another substance.

Systematic observations—Observations obtained by following a preplanned method of observation.

Temperature—A measure of how hot or cold a substance is; a measure of the average kinetic energy of the particles of a substance.

Test variable (independent variable)—The variable manipulated by the experimenter in order to study changes in the outcome variable.

Theory (scientific theory)—An explanation for some naturally occurring event developed from extensive observations, experimentation, and reasoning. See also law.

Translucent—A term used to describe a material that cannot be clearly seen through but that allows some light to pass through it.

Transparent—A term used to describe a material that can be clearly seen through because it allows light waves to pass through in straight lines.

Periodic Table of the Elements

(based on $^{12}_{6}C = 12.0000$)

Key: 14 — Atomic number; Si — Symbol; Silicon — Name; 28.086 — Average Atomic Mass

Representative Elements

Transition Metals

Period	Group 1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 H Hydrogen 1.008																	2 He Helium 4.003
2	3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
3	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.847	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
5	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.82	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.60	53 I Iodine 126.905	54 Xe Xenon 131.29
6	55 Cs Cesium 132.905	56 Ba Barium 137.327	57 La Lanthanum 138.905	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium 208.982	85 At Astatine 210	86 Rn Radon 222
7	87 Fr Francium 223	88 Ra Radium 226.025	89 Ac Actinium 227.028	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (265)	109 Mt Meitnerium (268)									

← Metals | Nonmetals →

Inner Transition Metals

Series														
Lanthanide series	58 Ce Cerium 140.12	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
Actinide series	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium 252.083	100 Fm Fermium 257.095	101 Md Mendelevium 258.099	102 No Nobelium 259.101	103 Lr Lawrencium 260.105

Appendix E: FCAT 2.0 Science and Biology 1 End-of-Course Assessment Test Design Summary

Length of Tests

This table provides an approximate range for the number of items on each test. These ranges include both the operational and field-test items.

Grade	Item Range
5	60–66
8	60–66
Biology 1	60–66

The Florida Department of Education and its test contractors currently employ strategies to protect the environment in the production and destruction of FCAT materials. The Department encourages schools and districts to recycle non-secure FCAT interpretive publications after use.